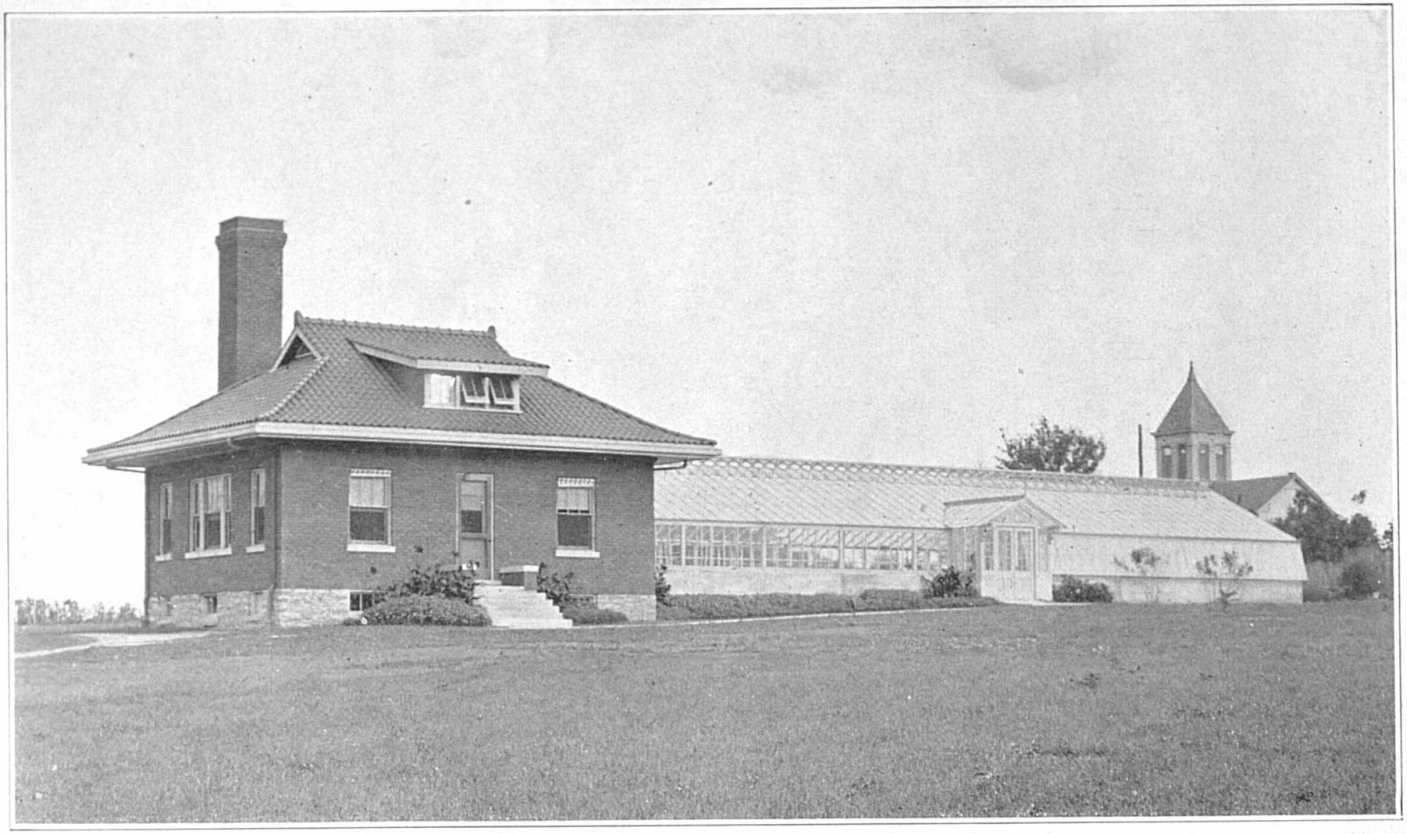


PLATE 1. CONSERVATORY—EXPERIMENT STATION FARM.

TWENTY-SEVENTH ANNUAL REPORT

OF THE

Kentucky Agricultural Experiment Station

OF THE

STATE UNIVERSITY

LEXINGTON, KY.

FOR THE YEAR 1914

STATE UNIVERSITY PRESS
LEXINGTON, KY.

619287

VAULT NO. 3
639.2
K3786eb
1914

TWENTY-SEVENTH ANNUAL REPORT

OF THE

Kentucky Agricultural Experiment Station

FOR THE YEAR 1914.

PART I.

Report of Director and Heads of Departments.
Water Analyses and Meteorological Observations.

Letter of Transmittal.

To His Excellency,

HON. JAMES B. MCCREARY,

Governor of Kentucky.

SIR:—

Under the authority of the Board of Control of the Kentucky Agricultural Experiment Station, and in accordance with an act of Congress, approved March 2, 1887, and entitled "An Act to establish Agricultural Experiment Stations in connection with the Agricultural Colleges established in the several States under the provision of an act approved July 2, 1862, and under the acts supplementary thereto," and of the act of the Legislature of the State of Kentucky, approved February 20, 1888, and entitled "An Act to accept the provisions of an Act passed by the Congress of the United States, approved March 2, 1887, for the establishment and maintenance of Agricultural Experiment Stations in connection with Agricultural Colleges established by the several States and Territories under an Act of Congress, approved July 2, 1862," I herewith submit the Twenty-seventh Annual Report of the Kentucky Agricultural Experiment Station.

Very respectfully,

JOSEPH H. KASTLE, *Director.*

February 1, 1915.

State University

LEXINGTON, KY.

BOARD OF TRUSTEES.

His Excellency, Governor James B. McCreary, *ex-officio* Chairman.

President Henry S. Barker, Member *ex-officio*.

Hon. Barksdale Hamlett, Supt. Public Instruction, Member *ex-officio*.

APPOINTED BY THE GOVERNOR.

Hon. James Breathitt, Hopkinsville, Christian County.
Thomas Lewis Edelen, Frankfort, Franklin County.
Charles B. Nichols, R. F. D., Lexington, Fayette County.
Dr. James K. Patterson, Lexington, Fayette County.
James W. Turner, Paintsville, Johnson County.
Robert W. Brown, Louisville, Jefferson County.
Hon. Tibbis Carpenter, Scottsville, Allen County.
Hon. William H. Cox, Maysville, Mason County.
Denny P. Smith, Cadiz, Trigg County.
Hon. Claude B. Terrell, Bedford, Trimble County.
Hon. Johnson N. Camden, Versailles, Woodford County.
Richard C. Stoll, Lexington, Fayette County.
Lewis L. Walker, Lancaster, Garrard County.
Richard N. Wathen, Lebanon, Marion County.
Dr. A. Gatliff, Williamsburg, Whitley County.

ELECTED BY THE ALUMNI.

Dr. Samuel Blackburn Marks, Lexington, Fayette County.
John Wesley Woods, Ashland, Boyd County.
George Green Brock, London, Laurel County.
John Edwin Brown, Shelbyville, Shelby County.
Philip Preston Johnston, Jr., Lexington, Fayette County.

KENTUCKY AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

RICHARD C. STOLL, Chairman, Lexington, Ky.
CHARLES B. NICHOLS, Lexington, Ky.
LEWIS L. WALKER, Lancaster, Ky.
HENRY S. BARKER, President of the University.
THE DIRECTOR, Secretary, ex-officio.

JOSEPH H. KASTLE, Director.

STATION COUNCIL

THE DIRECTOR

A. M. PETER
H. E. CURTIS
H. GARMAN
C. W. MATHEWS
R. M. ALLEN
J. D. TURNER
E. S. GOOD
GEORGE ROBERTS
J. J. HOOPER

DEPARTMENTAL ORGANIZATION

ADMINISTRATION

THE DIRECTOR, Head.
H. E. CURTIS, Bursar.
HYWEL DAVIES, Purchasing Agent.
O. L. GINOCHIO, Secretary to Director.
ADDIE LEE DEAN, Librarian.
ANNA WALLIS, Clerk.
CORNELIA C. PAGE, Clerk.

AGRICULTURAL EXTENSION

F. MUTCHLER, Superintendent.
T. R. BRYANT, Asst. Superintendent.
J. H. CARMODY, Horticulture.
H. B. HENDRICK, Agronomy.
C. D. BOHANNAN. Rural Economics.
W. D. NICHOLLS, Dairying.
H. W. RICKEY, Poultry. (In cooperation with U. S. Dept. of Agriculture.)
T. E. STOKES, Animal Husbandry. (In cooperation with U. S. Dept. of Agriculture.)
MARY E. SWEENY. Home Economics.
AUBYN CHINN, Cookery and Dietetics.
RUBY M. BUCKMAN, Sewing and Household Arts.
ANNA BERRY JONES, Clerk.
MARGARET RYAN, Clerk.

AGRONOMY

GEORGE ROBERTS, Agronomist, Head.
E. J. KINNEY, Assistant Agronomist.
P. E. KARRAKER, Soil Survey.
A. E. EWAN, Supt. Experiment Fields.
D. S. MYER, Assistant in Crops.
JESSIE F. CASWALL, Clerk.

ANIMAL HUSBANDRY.

(Beef Cattle, Sheep and Swine.)

E. S. GOOD, Head.
ROBERT GRAHAM, Veterinary Science, in Charge Hog Cholera Serum Production.
O. S. CRISLER, Hog Cholera Serum.
R. L. PONTIUS, Hog Cholera Serum.
W. V. SMITH, Asst. in Animal Husbandry.
M. J. SMITH, Asst. in Animal Husbandry.
M. G. GINOCHIO, Clerk.
E. J. GOTT, Hog Cholera Serum.
A. L. BRUECKNER, Hog Cholera Serum.
LUCY K. HUTCHCRAFT, Clerk.

ANIMAL HUSBANDRY

(Horses, Dairy Cattle and Poultry.)

J. J. HOOPER, Head.
W. S. ANDERSON, Asst. Horse Husbandry.
J. W. NUTTER, Supt. Dairy Farm.
W. D. NICHOLLS, Asst. in Dairying.
D. D. SLADE, Supt. Poultry Farm.
P. E. BACON, Elmendorf Milk Records.
ED HUSTON, Asst. in Dairying.
F. WALLACE UTTERBACK, Clerk.

CHEMISTRY

A. M. PETER, Chief Chemist, Head.
S D. AVERITT, Chemist.
J. S. McHARGUE, Asst. Chemist.
R. PFANSTIEL, Asst. Chemist.
ETHEL V. T. CASWALL, Clerk.

ENTOMOLOGY AND BOTANY

H. GARMAN, Entomologist and Botanist, Head.
MARY L. DIDLAKE, Laboratory Asst.
E. C. VAUGHN, Asst. in Seed Inspection and Plant Breeding.
H. H. JEWETT, Research Asst. Entom.
H. R. NISWONGER, Asst. in Field Work and Nursery Inspection.
LOUISE BEWLAY, Clerk.

FEED

J. D. TURNER, Head.
H. D. SPEARS, Chemist.
E. H. NOLLAU, Asst. Chemist.
ELMER INGRAM, Chief Inspector.
ROGER W. JONES, Inspector.
FANNY C. ROGERS, Clerk.

FERTILIZER

H. E. CURTIS, Chemist, Head.
WM. RODES, Assistant Chemist.
ELMER INGRAM, Inspector.
R. W. JONES, Inspector.
ANNA WALLIS, Clerk.

FOOD AND DRUGS

R. M. ALLEN, Head.
J. O. LABACH, Chief Chemist.
L. A. BROWN, Chemist, Drugs.
J. W McFARLIN, Chief Food Inspector.
W. R. PINNELL, Bacteriologist.
C. S. PORTER, Inspector, Drugs.
WALTER SCHEPPELMAN, Inspector, Bakery Sanitation.
E. F. WORTHINGTON, Inspector, Dairy Sanitation.
W. G. TERRELL, Inspector, Foods.
LILLIE LISTON, Chief Clerk.
LENA LISTON Clerk.

HORTICULTURE

CLARENCE W. MATHEWS, Head.
F. W. HOFMANN, Asst. in Horticulture.
G. B. WURTZ, Consulting Meteorologist.
MURIEL CASWALL, Clerk.

RESEARCH

THE DIRECTOR, Head.
H. GARMAN, Entomologist and Botanist.
D. J. HEALY, Bacteriologist.
E. S. GOOD, Animal Husbandry.
O. M. SHEDD, Chemist.
MARY L. DIDLAKE, Asst. Entomologist and Botanist.
G. D. BUCKNER, Chemist.
H. H. JEWETT, Research Asst. in Entom.

Address
KENTUCKY AGRICULTURAL EXPERIMENT STATION,
LEXINGTON, KENTUCKY.

THE KENTUCKY AGRICULTURAL EXPERIMENT STATION

In account with the United States Appropriations, 1913-14:

	Hatch Fund.	Adams Fund.
Receipts from the Treasurer of the United States, as per appropriations for fiscal year ended June 30, 1914, under Acts of Congress, approved March 2, 1887 (Hatch Fund) and March 16, 1906 (Adams Fund)	$15,000.00	$15,000.00
EXPENDITURES.		
By Salaries	$8,620.86	$12,187.91
Labor	1,246.42	458.25
Publications	485.70	
Postage and Stationery	671.85	37.60
Freight and Express	70.60	30.01
Heat, Light, Water, Power	511.47	106.39
Chemicals and Laborat'y Sup.	400.32	805.01
Seeds, Plants and Sundry Sup.	195.70	151.12
Fertilizers		
Feeding Stuffs		265.48
Library	648.17	315.37
Tools, Machinery and Appli.	393.71	61.70
Furniture and Fixtures	881.90	54.80
Scientific Appar. and Specimens	80.77	147.75
Live Stock		197.60
Traveling Expenses	145.95	166.11
Contingent Expenses	20.00	4.00
Buildings and Land	626.58	10.90
Total	$15,000.00	$15,000.00

We, the undersigned, duly appointed Auditors of the Corporation, do hereby certify that we have examined the books and accounts of the Kentucky Agricultural Experiment

Station for the fiscal year ended June 30, 1914; that we have found the same well kept and classified as above; that the balance brought forward from the preceding year was nothing on the Hatch Fund, and nothing on the Adams Fund; that the receipts for the year from the Treasurer of the United States were $15,000.00 under the Act of Congress of March 2, 1887, and $15,000.00 under the Act of Congress of March 16, 1906, and the corresponding disbursements $15,000.00 and $15,000.00; for all of which proper vouchers are on file and have been by us examined and found correct, leaving balances of nothing and nothing.

And we further certify that the expenditures have been solely for the purposes set forth in the Acts of Congress approved March 2, 1887, and March 16, 1906, and in accordance with the terms of said acts, respectively.

(Signed) RICHARD C. STOLL,
(Seal) H. S. BARKER,
Auditors.

Attest: EZRA L. GILLIS, Custodian.

5855
135

ANNUAL REPORT

OF THE

Kentucky Agricultural Experiment Station

FOR THE YEAR 1914.

REPORT OF THE DIRECTOR.

ORGANIZATION. As organized at present, the Kentucky Agricultural Experiment Station includes twelve departments of work, viz:

Department of Administration—Joseph H. Kastle, H. E. Curtis and Hywel Davies.
Department of Agricultural Extension—Fred Mutchler, Superintendent.
Department of Agronomy—George Roberts, Head.
Department of Animal Husbandry—(Beef Cattle, Sheep and Swine)—E. S. Good, Head.
Department of Animal Husbandry—(Dairy Cattle, Horses and Poultry)—J. J. Hooper, Head.
Department of Chemistry—A. M. Peter, Head.
Department of Entomology and Botany—H. Garman, Head.
Department of Feed Control—J. D. Turner, Head.
Department of Fertilizer Control—H. E. Curtis, Head.
Department of Food and Drug Control—R. M. Allen, Head.
Department of Horticulture—C. W. Mathews, Head.
Department of Research—Joseph H. Kastle, Head.

The passage of the Smith-Lever Act within the period included in this report and the acceptance of its provisions for the State of Kentucky by the Governor of the Commonwealth has contributed additional funds to the support of the

work of agricultural extension within the State, and has necessitated the reorganization of the work of this department in a spirit of cooperation with the United States Department of Agriculture as provided for in the Smith-Lever Act. In the reorganization of the work of this Department, Dr. Fred Mutchler, State Leader of the Farmers' Cooperative Demonstration Work in Kentucky, has been appointed Superintendent of Agricultural Extension and within the period covered by this report, the extension activities of the Experiment Station and the College of Agriculture have greatly increased. Among these various activities may be mentioned the following:

Demonstrations in the cultivation of ordinary field crops, experimental orcharding, including demonstrations in pruning, spraying, the reclamation of old orchards, etc., truck gardening and the growing of small fruits, the care of lawns, dairying, demonstrations in the feeding of beef cattle, the raising of sheep, hogs and poultry, the care and use of manure, the erection of silos, drainage demonstrations, the removal of stumps, animal diseases, improved agricultural implements, fertilizers, boys' corn clubs, cooperative marketing, roads, agricultural meetings, including agricultural chautauquas, movable schools in agriculture, agricultural trains. Hundreds of persons witnessed the pruning and spraying demonstrations conducted during the year, and a large number of orchards were inspected.

Among new lines of work, may be mentioned that of rural or agricultural economics, the purpose of which is threefold —to give instruction to students in this subject, to study problems in the production and marketing of various agricultural products, and to conduct social surveys of various

agricultural communities, with the view ultimately of improving the conditions of rural life.

Within the past year, the work in veterinary science has been greatly strengthened and enlarged, partly by the equipment of a new bacteriological and pathological laboratory for the study of animal diseases, and partly by additions to the staff of a number of trained veterinarians. Among the various helpful activities of the veterinary department may be mentioned a newly organized veterinary clinic for the study and treatment of obscure animal diseases, at actual cost to owners of live stock for feed and medicines for afflicted animals during the time of treatment. Such a free, animal clinic should grow in usefulness to the live stock interests of the State year by year.

The present Staff of the Experiment Station, including the Board of Control, is given on page vii of this report.

APPOINTMENTS. Within the period covered by this report, the following appointments have been made to the Staff of the Experiment Station:

R. L. Pontius appointed to succeed L. W. McElyea, resigned, February 6, 1914.

R. Pfanstiel of the State University, Lexington, Kentucky, appointed Assistant Chemist, Department of Chemistry, July 1, 1914.

E. H. Nollau of the State University, Lexington, Kentucky, appointed Assistant Chemist, Feed Department, July 1, 1914.

Fred Mutchler appointed Superintendent of Agricultural Extension, July 17, 1914.

C. D. Bohannan appointed Associate Professor of Agricultural Economics, August, 1914.

A. L. Brueckner of the State University, Lexington, Kentucky, appointed Assistant in Hog Cholera Serum

Administration to succeed C. B. Wilson, September, 1914.

P. E. Karraker of the University of Illinois appointed Assistant in Soils, Department of Agronomy, to succeed S. C. Jones, November, 1914.

RESIGNATIONS. Within the same period, the following resignations from the Staff of the Experiment Station have been accepted:

James E. Mastin, Assistant Food Chemist, Department of Food and Drugs. Resigned January 1, 1914, to take charge of the food laboratory at the Mississippi Experiment Station, Agricultural College, Miss.

L. W. McElyea, Assistant in Hog Cholera Serum Administration. Resigned February 1, 1914, to take charge of a commercial serum laboratory at Mason City, Iowa.

G. C. Routt, Assistant in the Department of Animal Husbandry (Beef Cattle, Sheep and Swine). Resigned April 1, 1914, to take up work in tobacco for the British Government at Ottawa, Canada.

B. F. Scherffius, Tobacco Expert. Resigned May 1, 1914, to take up work in tobacco for the British Government in Ceylon.

C. B. Wilson, Assistant in Hog Cholera Serum Laboratory. Resigned September, 1914, to pursue post-graduate work in the College of Agriculture, University of Iowa, Ames, Iowa.

B. D. Wilson, Assistant Chemist, Fertilizer Department. Resigned September, 1914, to pursue post-graduate work in Cornell University, Ithaca, N. Y.

S. C. Jones, Soil Survey, Department of Agronomy. Resigned November 15, 1914, to accept a position in the Agronomy Department of Purdue University, Lafayette, Indiana.

E. W. Mumma, Assistant in Charge of Hog Cholera Serum Production. Deceased, December 4, 1914.

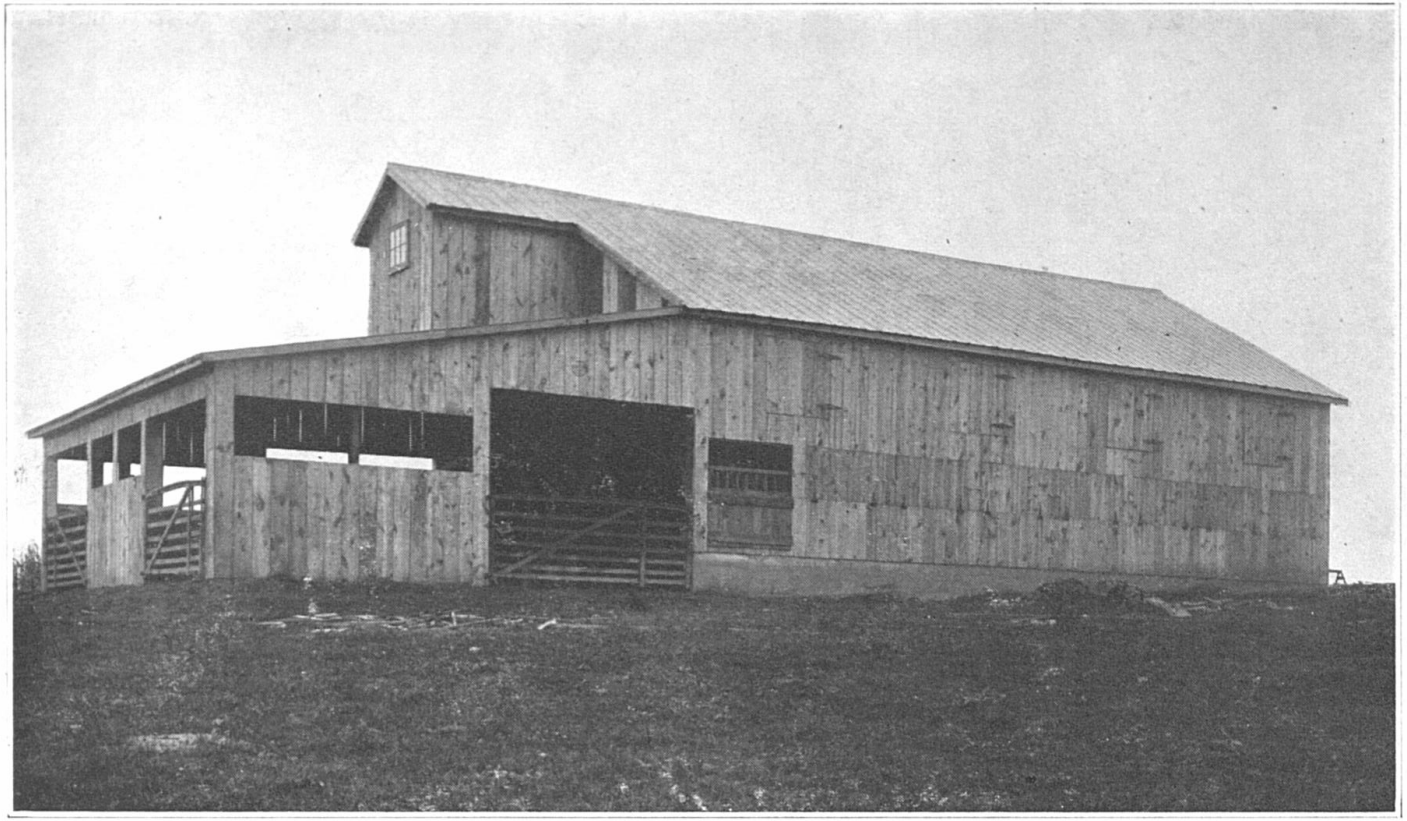


PLATE 2. NEW BEEF CATTLE BARN—EXPERIMENT STATION FARM.

This barn will accommodate two carloads of feeders, and has the advantage that the manure from same is conserved under cover until the end of the feeding period.

NEW BUILDINGS AND EQUIPMENT. Within the period included in this report, two new buildings have been erected on the Experiment Station farm—a conservatory for horticultural investigations and a small beef cattle barn, and an addition to the barn on the horticultural grounds.

The conservatory, a cut of which is shown in Plate 1 includes attractive offices, a general work room, photographic room on the first floor, store room and a sleeping room for the attendant on the second floor, and a hot water heating system in the basement. The greenhouse proper is 30 by 85 feet and has been used during the past season for purposes of propagation and for experiments in forcing vegetables.

The new beef cattle barn was built primarily to illustrate the methods employed in western Kentucky in the feeding and housing of beef cattle and to serve as an inexpensive model of a barn of this type to farmers in Central Kentucky. This barn, a photograph and plans of which are shown in Plates 2, 3, 4 and 5, was constructed of rough lumber and cost complete, $1015.70. It has the advantage of good ventilation, adequate protection of the cattle during the winter months, and complete preservation of all of the manure until such a time as it may prove convenient and desirable to apply it to the land. Most excellent results have been accomplished in the feeding of beef cattle in barns of this general type in western Kentucky in the neighborhood of Bowling Green. Complete plans and specifications of this barn will be furnished to farmers of the State free of cost. We had planned to utilize this barn in actual feeding experiments during the autumn and winter of 1914-15, but were prevented from so doing owing to dangers arising from the widespread prevalence of foot-and-mouth disease throughout the State.

Among the additions to our equipment made within the period covered by this report, may be mentioned the complete equipment of a new bacteriological and pathological laboratory for the veterinary department. This new laboratory is located on the second floor of the hog cholera serum laboratory and has already served a most useful purpose for the diagnosis and treatment of animal diseases.

EXPERIMENTAL AND COOPERATIVE FIELDS. The work of our experimental and cooperative fields, nine of which are now being operated in various localities in the State, has attracted great attention during the past year. The experimental fields at Lone Oak, Russellville, and Greenville have been visited at intervals during the past year by large and enthusiastic delegations of farmers from counties contiguous to these fields. Our agricultural population is awakening to the realization that it is only through such studies as are now being carried on on these experimental fields that we can arrive at an intelligent conception of the needs and requirements of the various types of soil represented on these several fields and that systems of agriculture can be devised that will restore these soils, many of which are badly worn and depleted, to a permanent condition of fertility. It is proposed to establish and maintain experimental fields on the ten great soil areas of the State, as soon as the funds of the Experiment Station will permit.

INVESTIGATIONS UNDER THE ADAMS FUND AND THE STATE APPROPRIATION. As is well known, the principal object of Experiment Stations is to carry on such investigations as will likely benefit the agricultural interests of the state and nation. Under the Adams Fund, approved March 16, 1906, the sum of fifteen thousand dollars is appropriated annually by the Federal government for the support of agricultural

research in the Agricultural Experiment Stations of the several states and territories. The Kentucky Agricultural Experiment Station is a beneficiary under this act, and during the past year, the following investigations have been provided for out of the Adams Fund:

1. (a. b. c.)
   a. The continuation of the study of the nodule organism of alfalfa and its relation to the nitrifying organisms of sweet clover and red clover.
   b. The completion of our work on the life history of the corn-ear worm, etc.
   c. The locust borer.

   Messrs. Garman, Jewett, Niswonger and Miss Didlake.
2. Contagious abortion in horses and cattle and immunization against these diseases. Prof. Good and assistants.
3. The rendering available of the potassium of insoluble silicates by the action of soil bacteria and yeasts. Dr. A. M. Peter and his assistants and Dr. Healy.
4. The occurrence of sulphur in plants and soils and the significance of this element to permanent soil fertility, and the determination experimentally of the best and most economical sulphur compound to employ in correcting a deficiency of sulphur in any soil. Mr. O. M. Shedd.
5. The translocation of mineral matter of plants. Dr. G. D. Buckner.
6. The occurrence and distribution of barium in the vegetable kingdom and the part (if any) played by barium in the growth of plants, and the possible effect of this element in stimulating the production of nitrifying nodules on leguminous plants. Mr. J. S. McHargue.
7. The occurrence and distribution of manganese in plants, especially in the harder epidermal tissues of various parts of plants and the possible significance of manganese in the production of such tissues. Mr. J. S. McHargue.

8. The study of clover bloat or tympany of the rumen in cattle and its cure by means of formaldehyde, urotropin or hexamethylene-tetramine. Dr. Healy.

A number of these investigations have been completed during the past year and note-worthy progress has been made in all of them.

The State appropriation of fifty thousand dollars per annum, for the benefit of the Kentucky Agricultural Experiment Station, approved March 11, 1912, also provides for the carrying on of various lines of experimental work in agriculture. Among the subjects of investigation specifically mentioned in the act are the following: Field experiments to determine the character of the various soil types represented in Kentucky and the best methods of cultivation of the same; experiments in orcharding and in the cultivation and marketing of fruits and vegetables, remedies for insect pests, studies in plant breeding and variety tests; such investigations as are calculated to develop the beef, pork and mutton interests of the State, including the economical feeding of meat-producing animals and their preparation for the market; studies looking to the development of the dairy and poultry interests of the State; the rearing of calves and the experimental study and investigation of various animal diseases; studies looking to the development of the horse interests of the State, and lastly the production and distribution of hog cholera serum, in the attempt to control and eradicate hog cholera. In conformity with the purposes of this act, field experiments have been carried on on a number of soil types throughout the State; soil surveys have been completed in two counties of the State and numerous analyses of soils have been made in the chemical laboratories of the Experiment Station. As already pointed out, studies have been

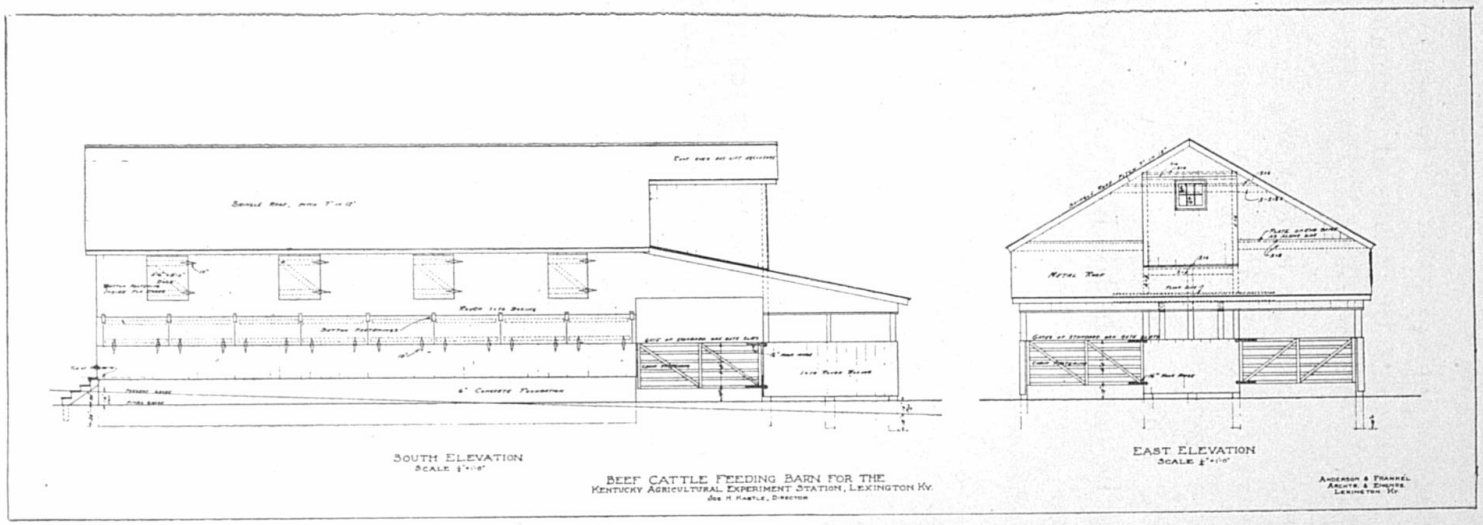


PLATE 3. PLAN OF NEW BEEF CATTLE BARN—EAST ELEVATION.

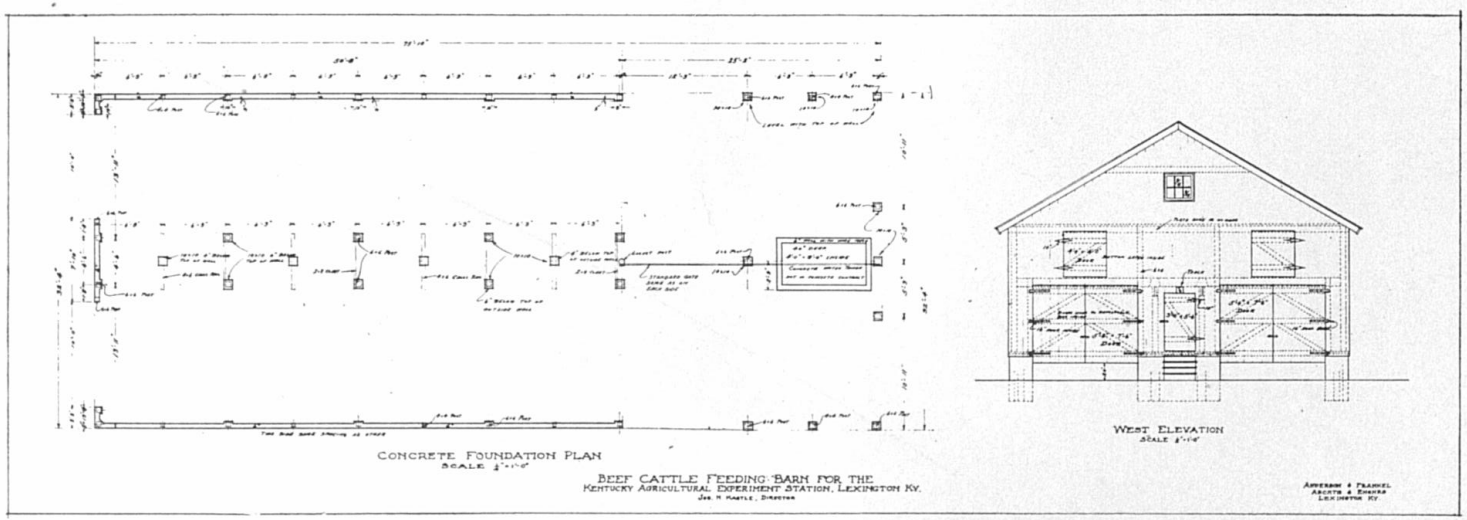


PLATE 4. PLAN OF NEW BEEF CATTLE BARN—WEST ELEVATION.

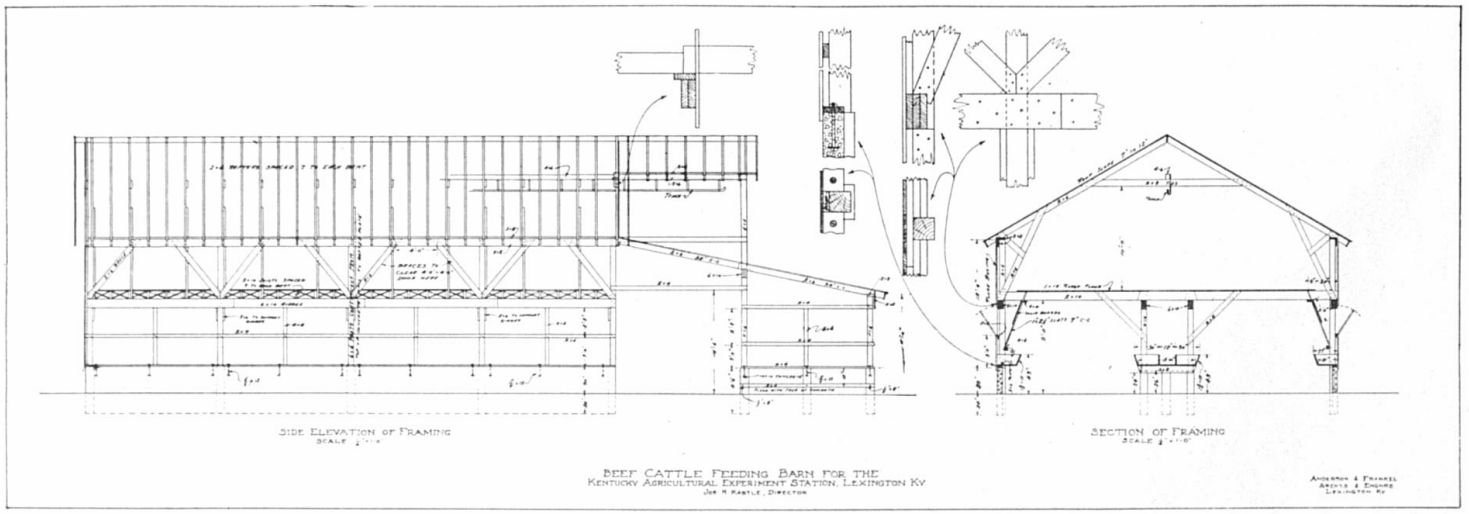


PLATE 5. PLAN CF NEW BEEF CATTLE BARN—SIDE ELEVATION AND SECTION OF FRAMING.

made in orcharding and in the reclamation of old orchards. Successful demonstrations in pruning and spraying have been made in a number of localities throughout the State, and on the Experiment Station farm and in the conservatory, experimental studies have been made on the cultivation of fruits and vegetables including variety tests and improved methods of cultivation. Our studies in plant breeding have already resulted in the discovery of a variety of wheat (Jersey Fultz) that seems admirably adapted to the soil and climatic conditions prevailing in central and western Kentucky, and in the propagation for seed purposes of a variety of winter oats that seems able to withstand the rigors of the winter climate in central Kentucky and which promises good returns to the farmer. For a number of years, the Experiment Station has distributed among tobacco growers, free of cost, small amounts of the seed of pure bred varieties of burley tobacco and has recleaned and graded samples of tobacco seed brought in by farmers. Experiments in beef cattle feeding and in hog feeding have been carried on on the Experiment Station farm during the past two years with considerable success. In fact, Professor Good's swine feeding experiments have attracted considerable attention among hog raisers throughout the State. The experimental work carried out on the Experiment Station farm during the past year has also included studies in the economic feeding of dairy cattle and the rearing of calves. Valuable experimental work has also been done on hog cholera, forage poisoning, blackleg and other diseases of live stock. The Experiment Station has actively cooperated with the Bureau of Animal Industry, United States Department of Agriculture, and with the Kentucky State Live Stock Sanitary Board in the work of hog cholera eradication in Henderson County

and in the control and eradication of foot-and-mouth disease. Our studies affecting the horse interests of the State include a study of the inheritance of coat colors in horses and the study of lack of virility in thoroughbred stallions and an investigation of infectious abortion in mares and of infectious arthritis in colts. During the past year, the poultry plant on the Experiment Station farm has been completed and brought into successful operation. Inexpensive colony houses have been erected embodying the best and most economical principles of poultry house construction. Our studies with poultry have included a comparison of a number of pure bred varieties for egg production and general utility purposes, the feeding and care of young chicks and turkeys, etc. More attention than ever before has been given to bringing the results of Experiment Station work directly home to the farmer. This has been accomplished through the medium of our bulletins and other publications, by correspondence, and through the medium of agricultural chautauquas, farmers' meetings, movable schools in agriculture and the various other agencies employed in agricultural extension. Within the past year, we produced 3,238,835 cubic centimeters of hog cholera serum in our serum laboratory and inoculated 57,297 hogs in 83 counties of the State, with a saving of 91.49 per cent.

PUBLICATIONS. The following publications have been made by the Experiment Station during the year 1914:

Bulletins.

No.

178. Alfalfa and Sweet Clover. Geo. Roberts, E. J. Kinney, H. B. Hendrick. March, 1914.

179. Construction and Equipment of Dairy Barns. W. D. Nicholls. June, 1914.

180. The Inheritance of Coat Colors in Horses. W. S. Anderson. July, 1914.
181. 1. Suggestions Relative to the Prevention of Hog Cholera. 2. List of Publications of the Kentucky Agricultural Experiment Station. J. H. Kastle and Robert Graham. August, 1914.
182. Hog Cholera and Its Control, with Foreword by Joseph H. Kastle, Director of the Kentucky Agricultural Experiment Station. Robert Graham and E. W. Mumma. August, 1914.
183. Some Kentucky Weeds and Poisonous Plants. H. Garman. August, 1914.
184. Six Different Species of Nodule Bacteria. H. Garman and M. L. Didlake. August, 1914.
185. Concentrated Commercial Feeding Stuffs. J. D. Turner and H. D. Spears. September, 1914.
186. Experiments with the Sharples Mechanical Milker. J. J. Hooper and J. W. Nutter. December, 1914.
187. The Corn-ear Worm in Kentucky. H. Garman. December, 1914.
188. The Relation of Sulphur to Soil Fertility. O. M. Shedd. December, 1914.
189. Commercial Fertilizers. H. E. Curtis. December, 1914.

Circulars.

No.

16. The Agricultural Needs of Kentucky. J. N. Camden, H. Weissinger and H. M. Froman. February, 1914.
17. Economic Value and Future of the Thoroughbred Horse. J. N. Camden. February, 1914.
18. Silo Building. W. D. Nicholls. May, 1914.
19. Community Improvement Clubs for the Rural and Village Communities of Kentucky. C. D. Bohannan. May, 1914.
20. Malignant Catarrhal Fever of Cattle. Robert Graham, E. W. Mumma and R. L. Pontius. May, 1914.

21. Blackleg and Its Prevention by Means of Protective Vaccination. Robert Graham and E. W. Mumma. May, 1914.
22. The Meaning and Value of Soil Analysis. George Roberts. May, 1914.
23. Immune Hogs and Distillery By-Products. Robert Graham and E. S. Good. May, 1914.
24. Orchard Spray Calendar. J. H. Carmody. July, 1914.
25. Poultry Raising in Kentucky. J. J. Hooper and D. D. Slade. July, 1914.
26. Varieties of Fruits for Kentucky. C. W. Mathews and J. H. Carmody. July, 1914.
27. What is Home Economics? Mary E. Sweeny. September, 1914.
28. Foot-and-Mouth Disease. Robert Graham. November, 1914.

Circular to Commission Merchants, Retail Grocers, Produce Dealers and Producers. Kentucky Egg Supply. R. M. Allen. March, 1914.

Circular to Druggists, "Variations in Elixir Iron, Quinine and Strychnine Phosphates, etc." L. A. Brown. March, 1914.

Circular to Kentucky Pharmacists, "U. S. Pharmacopoeia, 8th Revision; Weights and Measures; Manufacturing; Storage of Drugs." L. A. Brown and C. S. Porter. May, 1914.

Circular to Kentucky Millers; Submit Samples of Flour for Free Baking Test. R. M. Allen. May 25, 1914.

Circular to Kentucky Bakers; Submit Samples of Flour for Free Baking Test. R. M. Allen. May 25, 1914.

Circular to Health Officers of Kentucky: Cooperation with County and City Health Officers under Kentucky Food and Drugs Act. R. M. Allen. July 28, 1914.

Circular to Women's Clubs of Kentucky: For Formulating Mailing List. R. M. Allen. September 4, 1914.

Regulation 9. Exposure of Bread and Other Bakery Pro-

ducts to Contamination. R. M. Allen. November 15, 1914.

Press Bulletins.

No.

73. The Place of Agriculture in Kentucky Schools. T. R. Bryant.
74. Paint for the Farm. J. A. Farra.
75. Pruning Grape Vines. J. H. Carmody.
76. Forage Poisoning Threatens to Cause Heavy Losses in Outbreaks Among Horses and Mules. E. W. Mumma.
77. Pruning Fruit Trees. J. H. Carmody.
78. The Treatment of Hog Cholera. R. L. Pontius.
79. Protection against "Wormy" Fruit. J. H. Carmody.
80. A New Live Stock Exchange. T. R. Bryant.
81. Treatment for Cutworms and Flea Beetles in Tobacco Beds. H. Garman.
82. How to Avoid Potato Scab and Dry Rot. H. Garman.
83. Fire Blight or Pear Blight. J. H. Carmody.
84. Lime for Agricultural Purposes. George Roberts.
85. The Elm Trees about Kentucky in Danger from the Imported Leaf Beetle. H. Garman.
86. Hog Cholera Prevalent in Kentucky. Robert Graham.
87. Needs of the Kentucky Live Stock Exchange. T. R. Bryant.
88. Some Facts in Regard to Crimson Clover. E. J. Kinney.
89. Winter Barley Supplements a Failing Corn Crop. E. J. Kinney.
90. Important September Farm Notes. T. R. Bryant.
91. Enzootic Ophthalmia—Widespread in Cattle over the State—Precautionary Measures Necessary to Prevent its Spread. Robert Graham.
92. Farmers Urged to Continue Efforts in Combating Hog Cholera—United Effort Essential. Robert Graham.
93. Distillery Slop for Swine. A. L. Brueckner.
94. Frozen Rye and Barley Fatal to Sheep and Hogs. Robert Graham.

95. Pig Clubs in Kentucky. T. E. Stokes.
96. San Jose Scale: A Serious Orchard Trouble. J. H. Carmody.
97. Buy Grass and Clover Seed Early. E. J. Kinney.
98. The Place of Sheep in Kentucky Agriculture. M. J. Smith.

Scientific Papers.

The Effect of Ferments and Other Substances on the Growth of Burley Tobacco. J. Du P. Oosthuizen and O. M. Shedd. (Journal of Biological Chemistry, Vol. XVI, No. 4, January, 1914).

The Occurrence of Manganese in Kentucky Soils and Its Possible Significance. O. M. Shedd. (Journ. Indus. & Eng. Chemistry, Vol. 6, No. 8, August, 1914).

A New Method for the Determination of Zinc in Treated Wood. Hume Bedford and R. Pfansteil. (Journ. Indus. & Eng. Chemistry, Vol. 6, No. 10, October, 1914).

The Bacillus Abortivus Equinus as an Etiological Factor in Infectious Arthritis of Colts. E. S. Good and W. V. Smith. (Journ. Infectious Diseases, Vol. 15, No. 2, September, 1914).

Note on Black Band Iron Ore from the Stearns Company's Coal Mines and on the Calcium-Magnesium Ratio in Kentucky Carbonate Ores. Alfred M. Peter. (Journ. Indus. & Eng. Chemistry, Vol. 6, No. 6, June, 1914).

The Occurrence and Significance of Manganese in the Seed Coat of Various Seeds. J. S. McHargue. (Journ. Am. Chem. Society, Vol. XXXVI, No. 12, December, 1914).

GIFTS TO THE EXPERIMENT STATION. In this connection, it is a pleasure to acknowledge the gift by Mrs. M. A. Scovell, of a bronze memorial tablet commemorating the distinguished services to the Experiment Station and to the

cause of agriculture to the State and Nation by the first Director of the Kentucky Agricultural Experiment Station, Dr. Melville Amasa Scovell. This tablet has been placed in the vestibule to the left of the main entrance of Scovell Hall.

The work of the Experiment Station has grown to such an extent within the past few years that beginning with this, the Twenty-seventh Annual Report, the annual reports of the Experiment Station will contain brief reports by the heads of departments. These reports for the year 1914 are given in the following pages.

AGRICULTURAL EXTENSION.

By Fred Mutchler.

THE WORK OF COUNTY AGENTS.

This report includes the work of those agents who have been long enough in their counties to do some definite things. There are twenty such agents. We have eleven other agents at work, but they have only recently started. There will probably be six or seven men to take up work between this and July 1st, 1915.

The following is the list of counties having County Agents in 1914:

Henderson,
Daviess,
Metcalfe,
Mason,
Whitley,
Woodford,
Muhlenberg,
Mercer,
Lawrence,
McCracken,
Jefferson,
Warren,
Christian,
Logan,
Barren,
Madison,
Hopkins,
Pulaski,
Todd.

Total 19.

Demonstration of Work.

Total number of Demonstrators	1130
" Demonstrations	1935
" Cooperators	838
" Demonstrations by Cooperators	740
Total number of Farms visited	6,718
" Interviewed and visited	5,322
" of Visits	16,043
" Persons met	35,439
" Letters written	12,070

REMARKS: It has been difficult from the reports handed in to get all the work that has been done. The distribution of the work is under-stated rather than over-stated; and the agents have found it hard work to differentiate cooperators, and I know much cooperative work is not reported because of this difficulty. This will explain why our list of cooperators is very small; also in counties where agents have been for more than one year, a large majority of the farmers become cooperators.

Demonstrations in Field Crops.

Number of	Corn Demonstrations	495
"	Tobacco Demonstrations	5
"	Alfalfa "	206
"	Crimson Clover Demonstrations	165
"	Hairy Vetch "	26
"	Sweet Clover "	52
"	Barley "	22
"	Orchard "	105
"	Truck and Small Fruit Demonstrations	146
"	Pure Bred Live Stock	185
"	Dairy Demonstrations	28
"	Beef Cattle	43
"	Sheep	7
"	Hogs	63
"	Poultry	51
"	Farmers influenced to take better care of Farm Manures	857
"	Silos built due to Demonstration Work	207
"	Acres drained due to Demonstration Work	3,895
"	Acres from which stumps were removed	152
"	Hogs inoculated for cholera directly due Demonstration Work	17,554
"	Cattle vaccinated for Blackleg	1,509
"	Hogs treated for Diseases other than cholera	600
"	Horses treated for Various Diseases	50
"	Improved implements bought due to Demonstration Work	2,549
"	Corn Demonstrations	495
Total Acres in Demonstrations		4,360¼
Average yield per acre		43.5

REMARKS: Our corn yields in demonstrations have not been as high as we anticipated. This may be explained on account of another very severe drought. For the first time in a number of years late corn has produced a better yield than early. Most of our demonstrations in corn were all early planting.

Number of Fall Plowing or Cover Crops for 1914 Corn Crop	219
" Fall Plowing or Cover Crops for 1915 Corn Crop	219
Number selecting Seed for 1914 Corn Crops	35
Number selecting Seed for 1915 Corn Crops	117

REMARKS: Cover crops for corn will not be so common next year, because the chief one used is rye. On account of the dry weather at planting time, it was very difficult to get the ground into proper condition. I think crimson clover will supplant rye on this account. It will be a very great thing for us if it does. The selection of seed corn is just beginning to be appreciated in Kentucky. I think it significant that we have 117 demonstrators who have selected their seed corn for next year's work.

Number of Acres of Corn worked by Demonstration Methods	30,888

REMARKS: A large acreage was worked by demonstration methods. It has given us a good opportunity to compare deep and shallow methods of cultivation. On poor land lacking in humus, the shallow cultivation has shown good results. On land where the seed bed has been properly prepared with a normal humus and plant food supply, cultivation not to exceed three inches has shown as good results as the very shallow cultivation. We are emphasizing the properly prepared seed bed, increase in soil fertility, and cultivation not more than three inches about four times.

Number of Acres Hogged or cut for Silage	11,381

REMARKS: More and more attention is given to growing corn for the silo and for hogging down. There will be five acres handled in this way the coming year over one this year. Our people are beginning to understand that it is an economic way of harvesting the corn crop and a splendid method of soil improvement.

No Kaffir Corn, Milo or Cotton Demonstrations in Kentucky.

Tobacco.

Number of Agents reporting growing Demonstrations	3
Number of Acres	32
Average yield per Acre	1270 lbs

REMARKS: A number of agents held fall meetings for the purpose of demonstrating the value of arsenate of lead to control tobacco worms. Universally results have proven satisfactory. Paris green was shown to be less effective than arsenate of lead.

Alfalfa.

Number of Acres cut 1914	103
Average yield per Acre	2¾ tons
Number of Demonstrators seeding 1914	206
" Acres in Demonstrations	1,054
" Acres due to Demonstration Work	5,000 (estimated)

REMARKS: Hardly any failures in alfalfa demonstrations have been reported. Wherever lime and phosphorus were used in abundance, and the seed inoculated and sown previous to September 10th, we have fine stands, and so far the winter has not injured it. Some Turkestan seed was used by mistake, and it is a failure. We are doing all we can to keep people from using this seed.

Crimson Clover.

Very little sown before fall of 1914.

Number of Demonstrators	165
" Acres	1260¾
" Acres due to Demonstration Work	6930

REMARKS: We think the greatest work for soil improvement is accomplished with crimson clover. Until two years ago it was practically unknown in Kentucky. It has proven very successful in most localities; grows well with lime or inoculation, and if we can get seed at a reasonable price there will be very large areas seeded next year.

Number of Demonstrators	26
" Acres	64½

REMARKS: Vetch is doing fairly well where tried. Seems to be a little slow to make growth enough to turn under in the spring. It must be inoculated in Kentucky, and will not be as valuable as crimson clover because the latter is so much more easily grown.

Sweet Clover.

Number of Demonstrators	52
" Acres	600

REMARKS: We have had many failures in sweet clover, due to the fact that lime and inoculation have been lacking. Furthermore our people believe that it is not much more easily grown than alfalfa, and they prefer alfalfa.

Red Clover.

All sown with nurse crop	failures
All sown alone in fall	successful

REMARKS: Red clover during the past two years has been almost a total failure. If we can get our people to sow it alone in the fall of the year, I think we can handle the crop. However, it is so important in a rotation with corn and small grains, that we were hoping to be able to grow it with a nurse crop by using large amounts of limestone. This, however, has not been as satisfactory as we would like. It may be that growing barley in place of wheat will help us solve the problem. Experimental work in the state does not give us much consolation, so far as the effectiveness of lime is concerned, in growing red clover.

Cowpeas and Soy-Beans.

Number of Demonstrations	126
" Acres	1,376¾
" Acres harvested for hay	646
Average yield per acre	1½ tons
Number of Acres harvested for seed	349
Yield per Acre { Soy-Beans	16 bu.
Yield per Acre { Cowpeas	9 bu.
Acres grazed by Hogs	260
Acres turned under	60
Total number of Acres due to Demonstration Work	2,636

REMARKS: In most counties these crops are so well understood that few demonstrations are necessary.

Barley.

REMARKS: Barley is just beginning to be considered at its true value in the State, and a vast amount of it will be sown in the future. Mr. Morgan gives the following reasons for growing barley:

1. It will be fed to stock when wheat would be sold.
2. It out-yields wheat.
3. It affords more grazing than wheat.
4. It is available at the time of year when other feeds are scarce.
5. It helps the farmer to fatten his hogs for September market when hogs are high.
6. Mules will do more work in summer on barley than on corn.
7. It leaves the ground in better condition than wheat.
8. It is easier to catch a stand of grass with barley than with any other small grain.
9. It gives a better distribution of labor as compared with all wheat.
10. It is possible to get a crop of ensilage corn, cowpeas, late potatoes, etc., after the barley is cut.

Christian County grows more barley than any other place in the state, due to the demonstration work. It produces from 50 to 100 per cent more than wheat per acre. In 1912 this county had 20 acres; in 1913, fifteen demonstrators had 250 acres; in 1914, 3600 acres were seeded. This county made an average yield of about 35 bushels to the acre. Seven other demonstrators put in 22 acres this fall.

Orchards.

Number of Agents reporting work on Orchards	13
" Demonstrators	105
" Orchards inspected	641
" " pruned	224
" " sprayed	192
" " supervised	90

Number of Orchards planted under Demonstration Supervision	75
" Trees planted in above Orchards	13,483
Total number of Trees inspected, pruned and sprayed	56,193
Number of Orchards cared for due to the influence of Demonstration Work	738

The Following Diseases Were Reported.

San Jose Scale,	Smut Fungus,	Slugs,
Oyster Shell Scale,	Shot Hole Fungus,	Green Aphis,
Maple Scale,	Frog Eye Fungus,	Woolly Aphis,
Black Rot,	Fly Speck Fungus,	Canker,
Brown Rot,	Trunk Blight,	Crown Gall,
Bitter Rot,	Fire Blight,	Trunk Borers,
Codling Moth,	New York Blight,	Shot Hole Bore,
Apple Worm,	Cedar Rust,	Gummosis,
Apple Scab,	Tent Caterpillar,	Rabbits,
		Mice.

REMARKS: One important point stands out prominently in the orchard work in Kentucky, and this is that especial attention was paid to old orchards. We have got to prove to the farmers of Kentucky that an orchard properly pruned and sprayed will produce fruit that is superior to any grown in other states. If we prove that, new orchards will be planted without any special effort on our part.

We are proud of the showing made in orchard work, as, after all, this is merely an incident in connection with demonstration work.

A great deal of this splendid work was made possible by the hearty cooperation of Professor Carmody of the Extension Department who assisted the county agents in every way possible. His valuable work deserves special mention.

Individual Items of Interest:

One agent helped his farmers to market their domonstration apples in their home town and they sold for the same price as western grown apples.

Another agent reports—No lime-sulphur solution sold in 1913: Six barrels lime-sulphur solution sold in 1914.

Another agent reports—Fifty-eight spraying outfits sold in his county in 1914.

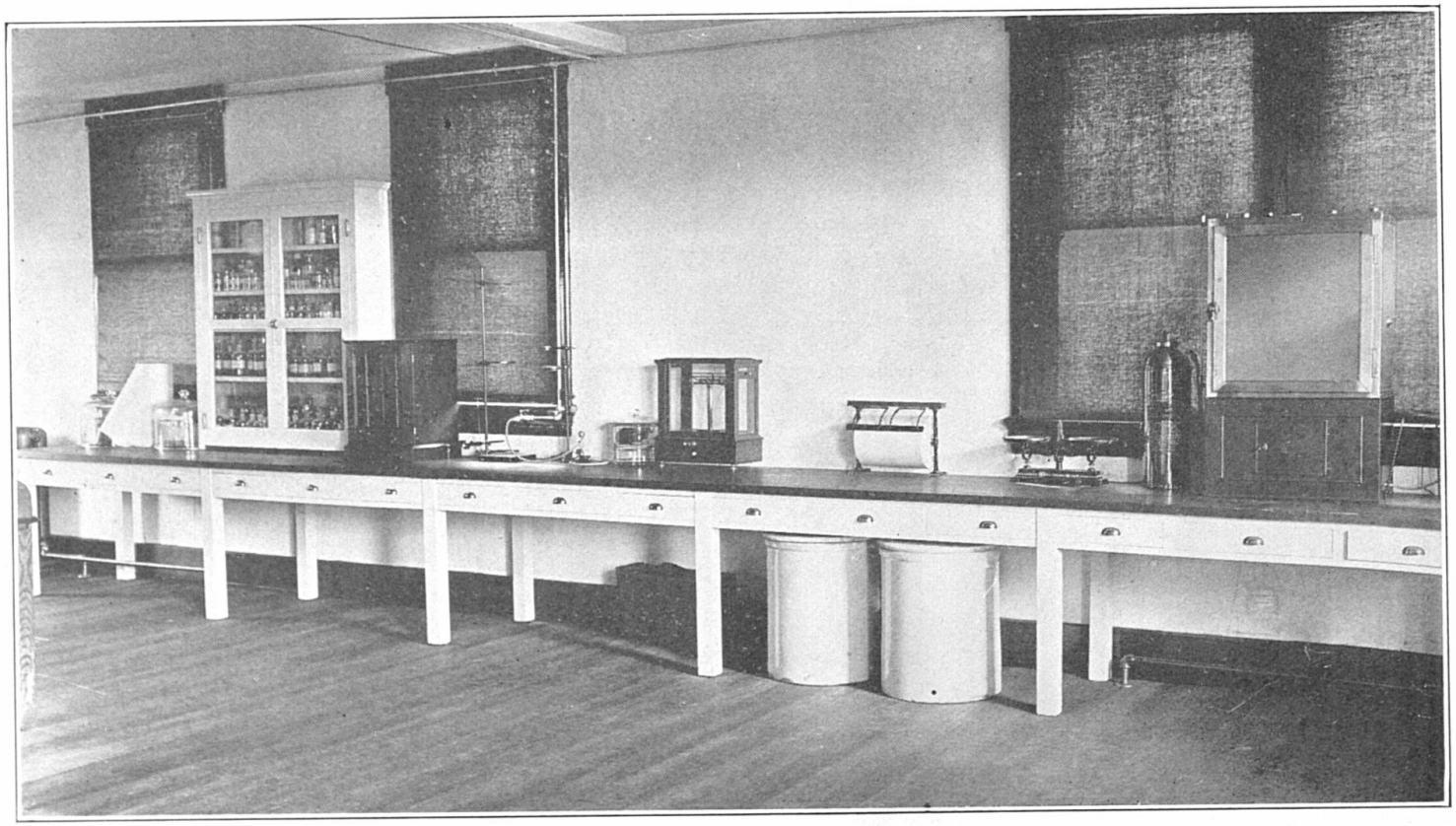


PLATE 6. BACTERIOLOGICAL AND PATHOLOGICAL LABORATORY.

Another agent reports—number of barrels of lime-sulphur sold in 1912, 7; in 1913, 25; in 1914, 68; also 33 spray pumps. Number of carloads of peaches sold in 1913, 3; in 1914, 22.

Truck and Small Fruit.

Number of	Agents reporting work	12
"	Demonstrators	146
"	Acres	289

Demonstrations divided as follows: Home Gardens, 35; Strawberries, 63; Sweet Potatoes, 30; Irish Potatoes, 14; Raspberries, 2; Cucumbers, 1; Cantaloupes, 1.

REMARKS: Truck demonstrations have not been encouraged in this State.

Special Mention: $300 worth of cantaloupes sold from one acre. A yield of 240 bushels per acre on a fifty-acre field of Irish potatoes.

Lawns: Number of lawns started or improved 23

Pure Blood Live Stock Purchased: Bulls, 32; Cows, 64; Stallions, 5; Mares, 1; Boars, 23; Sows, 7; Sheep, 53. Total, 185.

Work Stock: Number of horses and mules fed according to Demonstration Work, 485.

Dairying.

Number of	Agents reporting work	6
"	Demonstrators	28
"	Cows fed according to Demonstration Methods	720
"	Cows tested for Butter Fat	315
"	Creameries started	1
"	Patrons	59
"	Cows supplying Creameries	600
"	Cream Separators sold	74

REMARKS: More attention will be given to the development of the dairy cow in the future, not only for the commercial dairy, but on the farm far away from markets.

Beef Cattle.

Number of	Agents reporting work with beef cattle	6
"	Demonstrators	43
"	Beef Herds started	17
"	Feeding Cattle bought due to Demonstration Work	1835
"	Fattened according to Demonstration Work	330

Sheep.

Number of	Agents reporting work with Sheep	3
"	Demonstrators	7
"	Sheep in Demonstrations	262

Hogs.

Number of	Agents reporting work with Hogs	9
"	Demonstrators	63
"	Hogs in Demonstrations	2842
"	Hog pastures started	72
"	Acres in pastures	1525

Poultry.

Number of	Agents reporting work with Poultry	5
"	Demonstrators	51
"	Model Poultry Houses built	20

REMARKS: In one county 8,000 guinea eggs were given to the farmers by a firm of poultry dealers. 2,000 guineas were raised from these eggs and they will be kept on the farms for breeding purposes.

Manure.

Number of	Agents reporting work	7
"	Farmers influenced to take better care of manure	857

Silos.

Number of	Agents reporting work with Silos	12
"	Silos built in 1914 due to Demonstration Work	207
"	Silos reported either of tile or concrete	44

Drainage.

Number of	Agents reporting work on Drainage	8
"	Acres drained due to Demonstration Work	3,895

Stumps.

Number of	Agents reporting work with Stumps	3
"	Demonstrators	11
"	Acres from which Stumps were removed	152

Diseases.

Number of	Agents reporting	15
"	Hogs Inoculated and Vaccinated due to Demonstration Work	17,554

Number of Cattle Vaccinated for Blackleg	1,519
" Hogs treated for Diseases other than Cholera	600
" Horses treated for various Diseases	50
" Cows treated for Milk Fever	1

Improved Implements.

Number of Agents reporting	10
Implements brought into County through influence of Demonstration Work—	
Binders	21
Grain Drills	16
Manure Spreaders	80
Corn Drills	26
Disc Harrows	94
Mowers	18
Shredders	1
Ensilage Cutters	3
Threshers	2
Heavy Plows	55
Implements for shallow cultivation	1654
Sub-soil Plows	230
Cream Separators	73
Corn Binders	1
Tobacco Setters	6
Spray Pumps	60
Feed Grinders	1
Alfalfa Seed Drills	183
Hay Forks	3
Lime Spreaders	9
Limestone Pulverizers	18
Total	2,554

Fertilizers.

Practically no attention has been given to home mixing. We have an abundance of potash in nearly all of our soils. We lay vigorous stress on the growth of legumes, and emphasize the use of phosphates in acid or rock form as being the only mineral element to supply. Increasingly larger amounts of phosphates are being used, replacing high priced mixed goods.

Boys' Corn Clubs (Incomplete.)

Number of Agents reporting	14
" Boys enrolled	598
" Boys reporting	94
Average yield of those reporting	60⅔ bushels
Number of prizes offered	105
Value of prize money	$1240.00

Sources of Prize Money: Farmers; Merchants; Bankers; Boards of Education; Fiscal Courts.

Other Clubs, Agricultural, Education, Etc.

Number of Agents reporting	11
" Clubs formed	83
Total membership of Clubs	2,551

Cooperative Buying.

Number of Agents reporting	14
" Instances of buying Cooperatively due to the influence of Demonstration Work	27

The following articles were bought cooperatively:

Fertilizers	3030 tons
Phosphate Rock	63 "
Limestone Rock	725 "
Cotton Seed Meal	15 "
Clover and Grass Seed	956 bushels
Seed Oats	175 "
Cowpeas	85 "
Salt	60 "
Coal	2 car-loads
Silo Material	7 "
Ensilage Cutters	1
Total number of dollars saved through this cooperative buying	$8628.00

Material bought through the Farmers Union and grange not included in the above.

Roads.

Number of Agents reporting	———
" Drags in use due to Demonstration Work	128
" Miles being dragged	407

Meetings.

Number of Agents reporting	16
" Public or General Meetings held	916

Total number of persons in attendance at above meetings	42,839
Number of Schools visited	191
Number of teachers, pupils and parents in the Schools the days they were visited	6,217
Grand total number of people reached in Club Work Meetings and School Visits	50,024

Travel.

Number of Agents reporting	16
Total number of miles traveled by rail	10,814
Total number of miles traveled by team	55,624
Grand total number of miles traveled	66,438

AGRICULTURAL ECONOMICS.

The following is a brief summary of the work in Agricultural Economics for the year 1914.

The work was begun in August, 1914 under the direction of Professor Chas. D. Bohannan.

The work in Agricultural Economics is based on the idea that the successful farmer must needs have not only a knowledge of the physical and biological forces concerned in the production of plants and animals but that he must also have an understanding of economic forces and their influences in the shaping of the business side of his activities. Agricultural Economics presents two great problems or sets of problems, namely, those having to do with economy of production, and those having to do with the marketing of the produce. A little reflection will serve to show that each of these divisions of the field of Agricultural Economics offers an opportunity for a considerable amount of investigation and research on problems which are of vital interest to both the individual farmer and to the State at large and includes such general subjects as rural credits and farm finance, cooperative enterprises, marketing, tenancy, the relation between production and consumption, etc. In addition to these strictly economic problems Agricultural Economics must concern itself with the general social conditions of rural life since our agricultural prosperity depends in the long run

on maintaining on our farms a highly efficient type of rural citizenry. To do this we must in some way counteract the effect of the advantages, real or reputed, of the cities and towns which annually entice from our farms many of our most capable and successful young men and women. This will require a careful study of the existing social conditions with a view to pointing out their apparent advantages as well as determining specific deficiencies where such occur and the offering of suggestions for the remedy of such deficiencies. Confronted with this mass of economic and social problems, each and every one of vital importance to agricultural life, it has been found necessary to select for immediate investigation those projects which seemed to be of the most pressing nature and which at the same time would lend themselves most readily to investigation. Believing that the marketing of farm produce is the greatest of present day farm economic problems, it was decided to begin work in this general field. The first market study inaugurated was a study of the method of milk marketing in Lexington. This was taken up with a view to ascertaining the cost of the present delivery system and of pointing out if possible a more efficient as well as economical method of distribution. While the study has not progressed far enough to warrant the publication of the results obtained it has already demonstrated that under the present system of delivery there is a tremendous waste of time and effort and an accompanying needless expenditure of money. It is proposed to follow this study by a rather detailed investigation of instances of farmers' cooperative enterprises. The purpose back of this is twofold, first, to collect and publish information regarding successful cooperative ventures in order to arouse interest in cooperation and secondly, to analyze those factors which have made for success on the one hand or failure on the other. The results of this analysis should be of considerable value to farmers who are contemplating cooperative enterprises. Two other lines of investigation which it is proposed to take up in the near future are a study of existing rural credit needs and facilities, with a view to securing a definite basis for remedial

measures, and a study of the relation between production and consumption on Kentucky farms.

The method of study now being used in the social investigation is the social survey. With a view to getting a more complete and intelligent understanding of actual social conditions in the rural districts of the State a number of surveys have been begun. It is the purpose of these surveys to collect such data as will serve as an index to rural social conditions in the State and at the same time form a scientifically correct basis for social legislation and community activity. These surveys include a study of the hygienic, economic, social, religious, and educational conditions prevailing in the territory covered. It is the aim to make at least one such survey in each of the typical sections of the State. So far surveys have been begun in a blue-grass county, a river county, and a mountain county. Another county is about to make, under our direction, a rather intensive study with particular reference to school conditions. The rural school occupies a unique position as a social institution and it is believed that many of the ideas for rural community development can best be worked out through this agency. Therefore, great stress will be laid on improved and more efficient rural schools. County school superintendents and rural school teachers have manifested much interest in this work and have cooperated most heartily in these investigations. Two county superintendents in particular have taken an active part in furthering this work, Supt. Jessie O. Yancey, of Mason County, and Supt. James R. McDanell, of Gallatin County. Miss Yancey is starting under our direction the educational survey above referred to. Mr. McDanell has had some of his teachers making surveys of their districts and next year each eighth grade graduate of Gallatin County will be required to make a map of his home district and write an account setting forth the main geographical, historical, economic and social facts thereof.

Considerable time and effort have been given to the introduction of agricultural instruction into rural schools and high schools, and an ever increasing interest in agricultural in-

struction is becoming manifest on the part of both teachers and patrons. In several places work in agriculture is being carried on under our direction. The only publication so far is Extension Circular 19, which outlines a form of organization and methods of work for rural community improvement clubs. No active campaign of organization has been conducted since it is felt that a community organization to be effective must be an outgrowth of needs in the community felt by community members. A number of such clubs have been organized either under our immediate direction or as a result of the publication of the circular. Gallatin and Boone Counties have especially strong clubs organized on this plan.

In addition to the various lines of investigation indicated above there is an ever increasing demand for lectures and conferences on various phases of rural life. These calls come from rural schools, rural churches and bible schools, community organizations and from individual community members who are desirous of interesting the whole community. The topics discussed at these meetings cover a variety of subjects, rural sanitation and hygiene, rural education, the teaching of agriculture, the rural church, etc. This work seems to be quite effective and in practically every instance it has led to the adoption of a definite program for community or institution betterment as the case might be. There is no doubt that this is one of the most important phases of the work in that it puts the Experiment Station in direct contact with the rural community leaders and it is through these leaders that the results of Experiment Station investigations, not only rural and economic, but on the production side as well, must be brought to the community at large. This work has already increased to the point of encroaching on the investigational work and it is but a matter of a few months' time until one person can be kept busy his full time meeting these engagements.

HORTICULTURE.

A very important branch of our extension work is the extension work in horticulture conducted by John H. Carmody. The following is a brief outline of some of the things accomplished in the field of horticultural extension during the year 1914:

Pruning and Spraying Demonstrations.

County.	Town.	Attendance.	Size of Orchard.
Jefferson	Louisville	125	15 acres
Jefferson	Fern Creek	75	10 acres
Franklin	Frankfort	10	25 acres
Christian	Hopkinsville	50	50 acres
McCracken	Paducah	100	75 acres
Daviess	Whitesville	80	20 acres
Owen	Wheatley	40	5 acres
Fayette	Lexington	10	3 acres
Lawrence	Louisa	250	6 acres
Mason	Maysville	10	20 acres
Jessamine	Nicholasville	25	3 acres
Woodford	Versailles	10	6 acres
Christian	Edgeton	20	5 acres
Anderson	Lawrenceburg	20	2 acres
Scott	Georgetown	5	2 acres
Mercer	Harrodsburg	20	10 acres
Fayette	Lexington	5	1 acre

Fairs and Expositions With Exhibits.

Farmers' Week	Lexington
National Corn Show	Dallas, Texas
Conference for Education in the South	Louisville
State Fair	Louisville
Blue Grass Fair	Lexington
Pennyroyal Fair	Hopkinsville
Paducah Fair	Paducah
Shepherdsville Fair	Shepherdsville
Irvington Fair	Irvington

Orchard Inspection.

County	Town	Date	Size of Orchard
Daviess	Owensboro	Jan 30	5 acres
Rockcastle	Mt. Vernon	Mar. 11	80 acres
Fleming	Flemingsburg	Mar. 12	75 acres

County	Town	Date	Size of Orchard
Lawrence	Louisa	Mar. 14	6 acres
Franklin	Frankfort	Mar. 21	25 acres
Christian	Hopkinsville	Mar. 23–24	50 acres
McCracken	Paducah	Mar. 25	75 acres
Jessamine	Nicholasville	Apr. 6	3 acres
Scott	Georgetown	June 8	2 acres
Woodford	Versailles	May 19, June 2	6 acres
Hardin	Stithton	April 16	40 acres
Carter	Olive Hill	April 21	10 acres
Jefferson	Prospect	May 14–15–16	4 acres
Meade	Brandenburg	April 28–29	5 acres
Christian	Hopkinsville	April 28–29	5 acres
Hardin	Elizabethtown	May 12–13	40 acres
Henderson	Henderson	May 26–27	250 acres
Warren	Bowling Green	May 28–29	Strawberry inspection
Mason	Maysville	June 12	20 acres
Woodford	Pisgah	June 19	25 acres
Bullitt	Shepherdsville	July 11	7000 peach trees

Farm Schools, Chautauquas and Farmers Meetings.

Town	Nature of Meeting	Attendance
Hardinsburg	Farm School	70
Henderson	Farm School	300
Madisonville	Meeting	100
Louisville	Crop Improvement Committee	60
Louisville	Garden Club	225
Corydon	Farmers Club	20
Fern Creek	Chautauqua	150
Dawson Springs	Chautauqua	400
Olmstead	Chautauqua	400
Bowling Green	Chautauqua	150
Auburndale	Chautauqua	300
Germantown	Chautauqua	100

The chautauquas lasted for a period of four days in each case. They are unquestionably one of the best means that we have of presenting horticultural information direct to the farmer.

Movable Schools of Agriculture.

Town	County	Attendance
Barlow	Ballard	175
Bardwell	Carlisle	50
Milburn	Carlisle	200
Clinton	Hickman	50
Fulton	Fulton	30
Wingo	Graves	100
Mayfield	Graves	40
Lone Oak	McCracken	30
Hazel	Calloway	75
Murray	Calloway	60
Benton	Marshall	25
Hawesville	Hancock	75
Beaver Dam	Ohio	150
Calhoun	McLean	30
Livermore	McLean	40
Greenville	Muhlenberg	75
Sebree	Webster	125
Kuttawa	Lyon	80
Eddyville	Logan	20
Cadiz	Trigg	150
Hopkinsville	Christian	25
Trenton	Christian	125
Elkton	Todd	100
Lewisburg	Logan	200
Adairville	Logan	50
Franklin	Simpson	250

Demonstration Orchards.

June 5-6.

The Middlesboro Town Lands Company proposes to plant several demonstration orchards in order to show what can be done along the lines of fruit production. Arrangements were completed and a demonstration orchard of five acres was started this fall. The company owns 3,000 acres of land and the object at the present time is to divide this into small farms and plant four or five acre orchards on each one.

March 13.

Inspection of property owned by Ohio Valley Pulley

Works with the idea of establishing a demonstration orchard. The company owns 2,000 acres of land.

March 14—Louisa, Lawrence County.

Looked over proposed sites for demonstration orchard. The site for this orchard was finally selected in November and a five acre orchard will be planted this spring under the direction of the Department of Extension.

Horticultural and Poultry Special.

July 15-24.

This train was conducted over the L. & N. and L. & E. lines in Eastern Kentucky. An average of about five stops a day was made, and it is safe to say that 4,000 people were informed of the work of the Experiment Station.

Potato Club Work.

October 26—November 3.

A tuber unit system of seed selection was undertaken in cooperation with County Agent Merriman of Jefferson County. The results were very gratifying and they will be announced later on. This work is very important in this locality because it is one of the most important second crop potato producing sections in the country.

San Jose Scale Campaign.

A week was spent during the month of December working in cooperation with County Agent Faulkner combating San Jose Scale. This is one of the most satisfactory lines of work attempted in horticulture, and it is planned to carry on several weeks work during the coming year with other agents.

Correspondence.

In addition to the above over 600 inquiries covering various phases of orchard practice were answered. Two circulars were printed and distributed—Orchard Spray Calendar and Varieties of Fruit for Kentucky. Several press bulletins were prepared for newspaper circulation.

AGRONOMY

BY GEORGE ROBERTS.

The following is the report of the work of the Department of Agronomy for the year 1914:

Experiments With Crops.

Corn. The experimental work with corn consists of variety tests, breeding for increased yield and cultivation experiments. The results of four years of cultivation experiments indicate that cultivation beyond what is necessary to keep down weeds is not profitable or necessary to conserve moisture. These statements are applicable to soils of good physical condition.

Wheat. A continuation of variety tests. The poorer varieties are being eliminated and varieties adapted to Kentucky conditions are being propagated and distributed in the State. About 100,000 bushels of Jersey Fultz, one of the best varieties tried, were available for seed this year. Attempts are being made to improve the best varieties by selection.

Oats. Continuation of tests of a large number of strains of spring oats. All but a few of the best have been eliminated. A test of winter oats gives strong promise of a strain that will withstand the severest of Kentucky winters. This strain is being tried in six different places in the State with the idea of introducing it in the State.

Barley. Similar work is being done with barley. Two of the best varieties have been kept for propagation and introduction in the State.

Soy-Beans. Experiments in cultivation and variety tests. Cultivation tests show that just as large yields of hay and better yields of seed are obtained by planting in rows and cultivating, as compared with drilling broadcast. Out of a

very large number of varieties we are now able to recommend the best varieties for hay and grain.

Alfalfa. A continuation of experiments with liming shows that lime is essential to the successful growing of alfalfa. Experiments on different methods of subsoiling show very little gain from any of them as compared with ordinary plowing.

Tobacco. Variety tests and fertilizer tests. Fertilizer tests on the type of soil represented by the Experiment Station farm tend to show that mineral fertilizers are not necessary for the growing of this crop.

Soil Fertility Experiments.

Soil fertility experiment fields are now being conducted at Burnside, Pulaski County; Lincoln, Laurel County; Berea and Richmond, Madison County; at Lexington, Fayette County; Lincoln Ridge, Shelby County; Greenville, Muhlenberg County; Russellville, Logan County; Lone Oak, McCracken County, and Mayfield, Graves County.

Each of these fields represents a different type of soil. On these fields experiments are being conducted to determine the best fertilizer treatment for increasing and maintaining fertility, the crops best adapted to the soil, and rotations adapted to the region.

A brief summary of some of the results obtained will indicate the value of the work.

The Burnside field is the oldest and has been in operation six years. The following comparison of untreated soil and soil treated with acid phosphate shows the progress made in reclaiming this unproductive soil.

	Untreated Land.	Treated Land.
1909 Corn, bus.	7.0	17.7
1910 Oats, bus.	9.0	13.6
1911 Clover Hay, lbs.	668	2,328
1912 Corn, bus.	9.5	43.5
1913 Soy Bean Hay, lbs.	628	2,112
1914 Wheat, bus.	2.5	18.1
Value of Above Crops	$23.52	$85.09
Cost of Fertilizers	------	$9.60
Net Value of Increase	------	$51.97

It was shown by the experiments that potash is not necessary on these soils, but that without phosphates no headway can be made in restoring such soils to a productive state. The chief requirements of these soils are phosphorus, organic matter and nitrogen.

A similar experiment at London, Laurel County, on the very thin soil typical of the base of the coal measures, has given some very encouraging results. The untreated soil and soil treated with acid phosphate and limestone have given the following results:

	Untreated Land.	Treated Land.
Average of 4 Corn Crops	17.1 bus.	40.7 bus.
Average of 3 Wheat Crops	3.2 "	10.1 "
Average of 3 Cowpea Crops	1,197 lbs.	3,213 lbs.
One Clover Crop	290 "	3,300 "
Value of Above Crops	$72.99	$202.74
Cost of Fertilizers	------	$35.20
Net Value of Increase	------	$94 55

The largest yield of corn on this field was 64 bushels per acre.

The requirements for restoring this land are the use of phosphate, limestone and organic matter, although much can be accomplished without the use of limestone.

At Greenville, Muhlenberg County, some remarkable yields of tobacco have been secured this year on unproductive land. Phosphorus and nitrogen gave a yield of 1,625 lbs. per acre, while the untreated land gave a yield of 575 lbs. per acre. The season was a dry one, and only 80 per cent of a stand was secured. The net profit on the increased yield, on the basis of last year's prices, was $82.57 per acre.

The results are very different on the Lexington soil experiment field. Neither phosphorus, potassium or lime, or their combinations, gave any appreciable increase in the crops used in the rotation. The experiments extend through four years and include four corn crops, three wheat crops, three soy bean crops and one clover crop. However, lime was found to give very large increases on alfalfa and sweet clover on the same farm. If organic matter and nitrogen are maintained in typical blue-grass soils through the use of legumes and the return of manure either in feeding or pasturing, fertilizers do not seem to be necessary. Limestone may prove highly beneficial on soils deficient in humus.

DEPARTMENT OF ANIMAL HUSBANDRY

(BEEF CATTLE, SHEEP AND SWINE)

BY E. S. GOOD.

The work of this Department during the year 1914 was carried out along five different lines, namely: (1) A continuation of investigations pertaining to the discovery of a prevention or cure for infectious abortion in cows. (2) A continuation of investigations pertaining to the discovery of a prevention or cure for infectious abortion in mares and jennets. (3) Investigations relative to the etiology of infectious arthritis of colts. (4) A continuation of investigations relative to the economy of pork production in the dry lot and on forage crops. (5) Steer feeding experiments.

Our work in protecting cows from abortion in a large herd, where the disease existed to a considerable extent the previous year, has been very satisfactory. It is too early yet, however, to give a complete report of this work. Chemical and biological products were used in this experiment. The work of diagnosing the disease in herds and of advising as to procedure in infected herds has been continued during the year.

We have arrived at no conclusive results relative to immunizing mares against infectious abortion. In our investigations relative to infectious arthritis (rheumatism) in colts, we were able to isolate the same germ that causes infectious abortion in mares, showing that this organism is capable of producing the disease, as are other germs which have been noted by other investigators. Infectious arthritis is usually found associated with colts that come alive in a stud affected with infectious abortion.

One series of experiments with swine was to determine the value of distillers' dried grains as a feed, alone and in

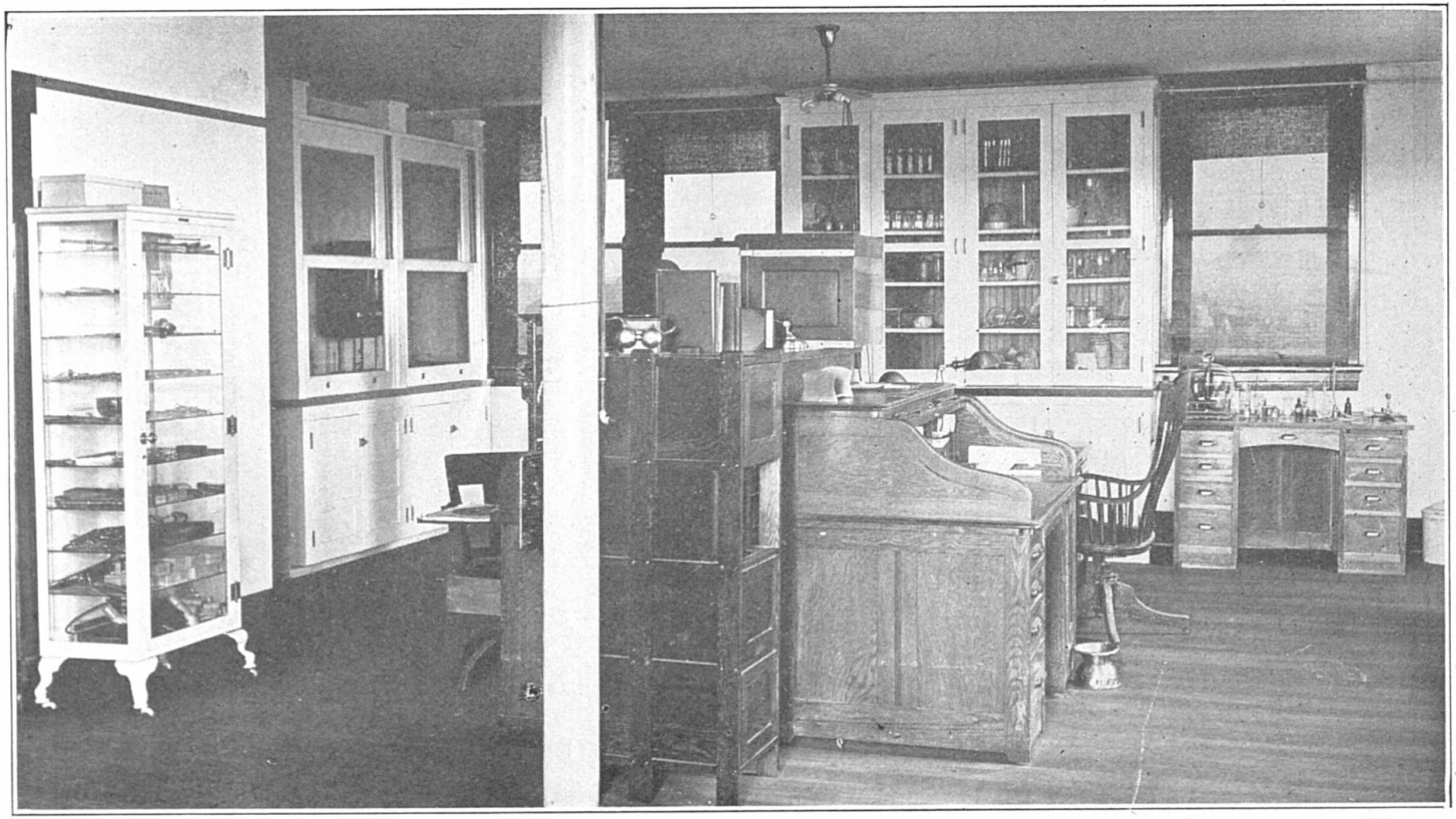


PLATE 7. BACTERIOLOGICAL AND PATHOLOGICAL LABORATORY

combination with other feeds, for hogs on pasture. One lot of hogs was fed in the dry lot for comparative purposes. The plan of the experiment was as follows: Fifty-four shotes, averaging 68.6 pounds, were divided into four lots and fed as follows: Lot 1, consisting of 15 pigs, was allowed the run of a pasture of rape and oats, and it was fed all the distillers' dried grains it would eat without waste; Lot 2, consisting of 14 pigs, was allowed the same kind of pasture and given from two and one-half to three per cent of its weight in corn meal per day; Lot 3, consisting of 15 pigs, was given a similar pasture and allowed two and one-half to three per cent of its weight per day of a mixture of corn meal five parts and distillers' dried grains one part. For comparative purposes, the fourth lot of 10 pigs was confined in a dry lot and given a full feed of corn meal five parts and distillers' dried grains one part. Professor D. W. May, formerly of this Station, determined while here that no greater proportion of distillers' dried grains to corn than is represented by one to five produced good results for pigs fed in the dry lot. The pigs in our experiment were fed seventy-three days. The average daily gain per pig in the different lots was as follows: Lot 1, .456 pound; Lot 2, .931 pound; Lot 3, 1.027 pounds; and Lot 4, .883 pound. The number of pounds of grain for a hundred pounds of gain in the different lots was as follows: Lot 1, 368; Lot 2, 344; Lot 3, 300; and Lot 4, 444. The cost of a hundred pounds of gain in the different lots, not considering the cost of the pasture, was $4.97 for Lot 1; $4.95 for Lot 2; $4.27 for Lot 3; and $6.32 for Lot 4. The above figures were based on corn at 75 cents per bushel, plus $2.00 per ton for grinding; distillers' dried grains, $25.00 per ton, plus freight, $2.00 per ton. This experiment showed Lot 1, receiving distillers' dried grains alone on pasture, did not make the gain that was made by any of the other three lots; in fact, the average gains of Lots 2 and 3 were more than double that of Lot 1, and, at the same time, a hundred pounds of gain were made on 68 pounds less feed in Lot 3, and 24 pounds less feed in Lot 2, than in Lot 1. The gains

of Lot 2 were satisfactory, but they were not as good as the gains of Lot 3, where corn meal was supplemented with distillers' dried grains. The results of this experiment show that distillers' dried grains is not well relished by the hog, and that it is not as satisfactory a feed for hogs on pasture as is corn alone, or a mixture of corn meal five parts and distillers' dried grains one part. Distillers' dried grains make a very good supplement to corn, in the proportion mentioned, in the feeding of hogs in the dry lot.

As there were many farmers who sold their wheat last fall as low as 75 cents a bushel, this department conducted an experiment to determine the value of wheat as a feed for pigs, as well as to determine the best form in which it may be fed. Lot 1, consisting of ten pigs, was fed whole wheat soaked for twenty-four hours; Lot 2, consisting of nine pigs, was fed ground wheat dry; Lot 3, consisting of ten pigs, was fed ground wheat soaked for twelve hours; and Lot 4, consisting of ten pigs, was fed ground wheat fourteen parts, and digester tankage one part, soaked for twelve hours. These pigs averaged 105 pounds, and were fed in the dry lot for a period of seventy days. The whole wheat was purchased at 80 cents a bushel, and the ground wheat at 86 cents a bushel. All the pigs in this experiment were sold in Lexington at $8.50 per hundredweight. The pigs receiving whole wheat soaked for twenty-four hours made an average daily gain of 1.5 pounds, requiring 425.8 pounds of wheat for each hundred pounds of gain; estimating pork at $8.50 per hundredweight, each bushel of wheat fed this lot realized $1.19. The lot of hogs receiving ground wheat dry made an average daily gain of 1.72 pounds, producing 16.02 pounds of pork for each bushel of wheat eaten. The wheat fed the pigs in this lot realized $1.36 a bushel. The lot receiving ground wheat soaked for twelve hours made an average daily gain of 1.68 pounds, producing 15.65 pounds of pork for each bushel of wheat eaten. Wheat fed these pigs realized $1.33 a bushel. The lot receiving ground wheat fourteen parts and digester tankage one part, soaked for twelve hours, made an average daily gain of 1.78 pounds, producing 16.69 pounds of pork

for each sixty pounds of the mixture eaten. The amount realized in this instance was $1.41 for each sixty pounds eaten, while the cost of the same was 91 cents. Even figuring pork at $7.00 per hundredweight, the following amounts per bushel of wheat fed would have been realized in the respective lots mentioned: 98 cents, $1.12, $1.09, $1.16.

Four lots of two-year-old steers were fed during the year to throw some light on the economy and rapidity of gains on a ration composed of broken-ear corn, cottonseed meal, cottonseed hulls, and a limited amount of clover hay, as compared with a ration of the same feeds with the exception of silage. Two lots were finished in the dry lot and two on pasture. In the dry lot test, the cost of a hundred pounds of gain made by the lot of cattle receiving silage was $1.66 less than the cost of a hundred pounds of gain made by the cattle which did not receive silage in the ration. Both of these lots were given a full feed. The following prices of feeds were used: Ear corn, 75 cents per bushel; cottonseed meal, $31.20 per ton; corn silage, $3.00 per ton; cottonseed hulls, $9.85 per ton; clover hay, $16.00 per ton. The two other lots of steers were given a three-fourths' full feed of the rations mentioned above during the winter and early spring, and they were finished on grass without grain to determine the functional ability of cattle to graze after having had silage the previous winter, as compared with steers receiving dry feeds, i.e., the same feeds with the exception of silage. The lot which received silage during the winter did not make as large gains on pasture as the lot receiving the same feeds with the exception of silage during the winter, the difference being 23 pounds per steer. The steers were on pasture from May 14th to July 16th. On the basis of the prices of feedstuffs as given above, and pasture at $2.50 per steer per month, and crediting the pork produced by the hogs following the steers during the winter months, the lot of steers which received silage during the winter netted a profit of $5.88 per steer, while the non-silage fed lot made a profit of $1.31 per steer. As far as could be determined, there was no difference in the finish of the steers

in the two lots when sold. They were purchased as feeders at $7.00 per hundred-weight, and sold as finished steers at $8.16 per hundredweight.

Under this department of animal husbandry there is herewith submitted the report of the Veterinary Department, including the work of the hog cholera serum laboratory for the year 1914, Robert Graham, in charge.

To stop the spread of hog cholera and reduce the losses from this disease by the injection of serum is one of the most important problems which the Experiment Station is attempting to solve. In order to make this work effective, experts from the Experiment Station go to the various hog raising counties and give demonstrations in the proper method of administering the serum and outline the essentials in sanitation. Veterinarians and farmers by this method acquaint themselves with the proper use of serum in the control of this disease. The serum is manufactured at the Experiment Station and sold to the swine breeders at the cost of production. No charge is made for the services of the experts.

The increased demand for serum and expert service in this work indicates its almost universal adoption in the State. Farmers in eighty-three counties, out of a possible one hundred and twenty, have employed serum in the protection of their herds. Farmers are urged not to delay this treatment, as in sick herds the results are not encouraging.

During the year 1914, 3,238,835 cubic centimeters of hog cholera serum were produced on the Experiment Station farm. Eight hundred and forty-six immune hogs were hyperimmunized, and virus was drawn from 826 shotes suffering from hog cholera and which had been previously inoculated for the production of this product. The receipts from serum and virus during the year amounted to $39,824.53.

Record of Hogs Inoculated During 1914.

Total number herds treated	1,478
Total number hogs treated	57,297
Total number hogs suspicious	12,414
Total number hogs reported	52,265

Total number hogs not reported	5,032	
Total number herds reported	1,339	
Total number herds not reported	139	
Total number hogs lived	47,815	91.49%
Total number hogs died	4,450	8.51%

Serum Depots.

In order that swine breeders may have serum available on short notice, serum depots have been established in the following counties:

Hopkinsville, Christian County	G. C. Richardson, in charge
Henderson, Henderson County	P. D. Brown, in charge
Versailles, Woodford County	O. F. Floyd, in charge
Harrodsburg, Mercer County	J. C. Gentry, in charge
Richmond, Madison County	T. H. Collins, in charge
Franklin, Simpson County	H. K. Gayle, in charge
Clinton, Hickman County	Ellison Nall, in charge
Bandana, Ballard County	T. C. Ogden, in charge
Smithland, Livingston County	L. C. Menard, in charge
Louisville, Jefferson County	F. E. Merriman, in charge

At these serum depots considerable amounts of hog cholera serum are kept in cold storage ready for immediate use by farmers and hog raisers in their respective localities.

These various depots provide immediate service to the swine breeders, and in emergency cases permit the serum to be had at a moment's notice. The results of this expansion have been very effective, and serum depots will be established in every hog raising county as the situation warrants it.

Sanitation.

In connection with our hog cholera eradication work, it has been noted that the lack of shelter and sanitary conditions under which the hog is kept, in some instances, are deplorable. We have issued circulars pertaining to this subject, given lectures, prepared popular newspaper articles, et cetera, in bringing this to the farmers' attention.

Cooperative Work in Henderson County.

The United States Department of Agriculture selected Henderson County, Kentucky, as a demonstration county in which to control hog cholera. The Experiment Station furnishes the services of an expert to assist in the education and organization of the farmers in the county. The United States Government is in charge of this work and furnishes serum and expert service free to the hog raisers of Henderson County. Information regarding the progress of this work can be obtained on application to the United States Department of Agriculture, Washington, D. C.

Bacterial Examination of Anti-Hog Cholera Serum.

The various lots of serum produced at the Experiment Station have been examined bacteriologically by Dr. D. J. Healy and Mr. E. J. Gott to determine the extent of bacterial contamination. It will be noted from the following tabulation of results that the different lots of serum ranged from none to 65,000 bacteria, per cubic centimeter. In this connection it can be said that no relation between bacteriological content and potency could be noted. Serum that showed the presence of secondary bacteria proved just as potent as the serum which was sterile. However, the bacterial content of serum is important, as no doubt serum which contains large numbers of bacteria might produce pyaemia or septic infection. The determination of secondary bacteria in serum should be adopted as a requirement in the routine of production. The samples for bacteriological examination were taken from the mixing tank at the time the samples for potency were drawn. The potency sample is drawn subsequent to stirring and mixing.

The average bacterial count per cubic centimeter in the twenty-nine samples given below was 4,224. The average number of molds per cubic centimeter was 3.4.

Tabulation of Results of Bacteriological Examination of Sera Produced at the Serum Laboratory.

Serum No.	Date	Total No. Bacteria per c. c.	Total No. Molds per c. c.
108	June 8, 1914	0	
109	May 23	13,600	0
110	May 13	17,000	0
111	May 20	600	0
113	July 2	400	0
114	July 10	0	0
115	July 17	9,500	0
116	July 23	100	100
117	July 28	65,000	0
118	July 30	100	0
119	August 5	0	0
120	August 8	0	0
121	August 18	0	0
Marked	"Suspicious"	6,300	0
122	August 26	100	0
123	August 19	0	0
124	August 26	1,300	0
125	September 5	0	0
126	September 29	0	0
127	October 6	2,600	0
128	November 30	4,700	0
129	February 15, 1915	Less than 100	0
130	" "	" " 100	0
131	" "	" " 100	0
132	" "	200	0
133	" "	Less than 100	0
134	" "	" " 100	0
135	" "	200	0
136	" "	300	0

Activities of Veterinary Department.

Abscesses Following Inoculation.

Following the use of anti-hog cholera serum under farm conditions, it is not uncommon to observe abscess development at the point of inoculation. An extended observation, under farm conditions, indicates that secondary infection following injection of serum and virus may occur at the point of injection of either product, and that the pus-producing

organisms are not necessarily carried in with the serum or virus but that they may gain entrance on the needle from the epidermis or subsequently through the needle wound. Animals that have been inoculated by a careful and competent person very seldom suffer unless they are allowed access to dirty, dusty quarters after the operation. It is advisable not to inject more than twenty cubic centimeters of serum in one place.

Effect of Vaccination on the Offspring.

Immune dams do not produce permanently immune offspring. The pigs while young (up to three weeks of age) are quite resistant to hog cholera infection when naturally or artificially exposed. Following this age, the resistance is gradually depleted and they may succumb to the disease. Pigs from immune dams on infected premises should receive the double treatment at about the age of three or four weeks, and again about ten days after weaning time to establish permanent immunity.

Two pregnant sows were fed fifty cubic centimeters of virus each for twenty days before parturition and thirty days after the pigs were born. No ill effect could be noticed on the offspring during this time but when exposed to cholera at weaning time (ten weeks old) 91 per cent of the pigs contracted hog cholera and died.

Effect of Vaccination on Breeding.

Following the administration of serum alone pregnant sows, in herds that were in good condition and under proper surroundings, gave birth to strong healthy pigs. The results following the simultaneous treatment of pregnant sows were just as satisfactory in some herds, yet we have observed abortions in some animals with the result that breeders consider it dangerous. Careful handling of pregnant sows is important, and our observations indicate that proper handling of pregnant animals is necessary in order to avoid abortions following the use of either the simultaneous or serum alone treatment. Abortions have been observed more frequently

in diseased herds following treatment than in healthy herds. It must be remembered in this connection that abortion is often a sequel of hog cholera. The Experiment Station herd, as well as many others, is kept permanently immune without any deterioration noted in the breeding power, and the idea that the serum simultaneous method produces sterility does not seem to be well founded. Other causes, such as improper feed or mismanagement, may result in barrenness.

Immune Bodies in Anti-Hog Cholera Serum.

The part of the hyperimmune blood which incorporates the immune bodies in anti-hog cholera serum has been fairly well established by testing the clear serum, the fibrin and the red blood corpuscles. Our experiments indicate that fibrin and red blood corpuscles do not incorporate the protective substance, but that the clear serum and whole serum (hyperimmune blood minus fibrin) will protect in inoculations under conditions wherein the fibrin and red blood corpuscles will not protect. The whole serum contained red blood corpuscles in addition to clear serum. The red blood corpuscles fail to protect and it seems safe to conclude that the immune bodies are united with some element in the clear serum. What constituent of the clear serum incorporates the immune substance will be the object of further experiments.

Virus in Cholera Blood.

Similar experiments have been undertaken with blood from a cholera hog to determine what part of the blood incorporates the specific cause of the disease. The red blood corpuscles, carefully washed, reproduced the disease of the same type on inoculation, as did the virulent clear serum. This indicates that the virus is not washed from the red blood corpuscles, even if it is not incorporated therein.

Testing of Hog Cholera Remedies.

There are numerous remedies advertised extensively in farm papers for the prevention and cure of hog cholera, which have been brought to the attention of the Experiment

Station by requests for accurate information regarding same. Several of these remedies have been tested, with negative results. On application this information will be gladly submitted. There is no known cure for hog cholera.

Cerebro-Spinal Meningitis in Horses and Mules.

This disease has caused considerable loss in some counties in Kentucky, and our experts have visited the farms where the disease appeared. The type of the disease was similar to the outbreak of two years ago in Kentucky. Moldy feed is, in all probability, the exciting cause. No reliable remedy has been found for this affection, and therefore it must be controlled by preventive measures, i. e. by avoiding damaged feedstuffs.

Examination of Animal Tissues.

During the year approximately fifty samples of animal tissues have been received at this laboratory. The tissues examined consisted principally of hog cholera, tuberculosis, blackleg, mycotic stomatitis, parasitic infections, pneumonia, and tissues containing pus-producing organisms such as are found in garget, thrush, poll-evil, quittor.

Blackleg Vaccine.

Blackleg has been observed in many counties of the State during the spring and fall months. Vaccine from the United States Department of Agriculture has been distributed gratis in ample quantities to supply all requests. The use of this vaccine is well established, and results are entirely satisfactory. From July first to December thirty-first, 1914, 4,060 cattle were vaccinated, with a saving of approximately 99.5 per cent.

Foot-and-Mouth Disease.

Following the appearance of this disease in Kentucky, two of the veterinarians of the Experiment Station were detailed to assist in the control and eradication of this disease, working with the State Veterinarian and Federal authorities. Foot-and-mouth disease threatened to completely demoralize

the cattle industry of the State, and the Veterinary Department endorses the severe steps taken by the Federal Government in stamping out this disease. If hog cholera had been controlled by this method on its first appearance in the United States, the farmers of Kentucky would in all probability not be confronted with this fatal hog disease which has proven so costly through its losses. Too much stress cannot be laid on the protection of our live stock industry and anything which will add to our knowledge of animal diseases will be rewarded by better means and methods of guarding this important branch of the State's wealth.

Publications.

The following bulletins, circulars, and newspaper bulletins have been issued from this department during the year 1914:

Bulletin 181. Suggestions Relative to the Prevention of Hog Cholera.
Bulletin 182. Hog Cholera and Its Control.
Circular 20. Malignant Catarrhal Fever of Cattle.
Circular 21. Blackleg and Its Prevention by Means of Protective Vaccination.
Circular 23. Immune Hogs and Distillery By-Products.
Circular 28. Foot-and-Mouth Disease.

Newspaper Bulletins:

76. Forage Poisoning Threatens to Cause Heavy Losses in Outbreaks Among Horses and Mules.
78. The Treatment of Hog Cholera.
86. Hog Cholera Prevalent in Kentucky.
91. Enzootic Ophthalmia.
92. Farmers Urged to Continue Efforts in Combating Hog Cholera.
94. Frozen Rye and Barley Fatal to Sheep and Hogs.

ANIMAL HUSBANDRY

(HORSES, DAIRY CATTLE AND POULTRY)

BY J. J. HOOPER.

The following is a report of the work of the Department of Animal Husbandry (Horses, Dairy Cattle and Poultry) for the year 1914.

HORSES: The following lines of work on horses have been carried on during the year 1914.

I. A study is being made of the rations supplied to 40 head of horses and mules owned and worked by two firms in Lexington. In this study an effort is being made to decrease the cost of the rations employed and to find the relative efficiency of horses and mules for city work.

II. A horse at the Experiment Station is being fed on silage. It is commonly understood that this is a dangerous feed, particularly if it is moldy. Silage at the Experiment Station farm, however, is free from mould and up to the present time has caused no ill effects.

III. In February, 1914, arrangements were made with Judge I. H. Thurman, Springfield, Kentucky, to secure two excellently bred saddle brood mares and a weanling colt. The Experiment Station hereafter is to own a half interest in the colts from the mares and in the weanling colt. This will give the Experiment Station an opportunity to make many valuable studies relating to the breeding and rearing of saddle horses.

IV. Professor Anderson of this department reported in Bulletin 180 from this Experiment Station, his work relating to the tabulation of coat colors in horses. His purpose was to determine the laws underlying the inheritance of coat colors. This work includes studies relating to the matings of 11,739 horses, and may be summed up as follows:

Chestnut seems to be the recessive color to all others; black is dominant to chestnut and recessive to all other colors. Bay is dominant to chestnut and black and recessive to roan, dun and grey. The last named color seems to be the most dominant of all coat colors.

V. An interesting line of investigation is that relating to a study of the infertility of animals. Several post-mortems have been held on infertile animals and bacteriological cultures have been taken from the vagina of mares that are irregular breeders. Through the generous cooperation of the veterinary department of the Experiment Station this work has already led to results of value.

VI. Mr. W. E. D. Stokes, proprietor of the Patchen Wilkes Farm, has become very much interested in the work that is being carried out in this Department. He has made it possible for us to secure all the data regarding the breeding of several hundred mares at that farm. In fact the mating of the different stallions with the various mares is being arranged upon the advice of this Department. This work was carried on during 1914 and is being continued during the present year.

VII. Additional data were collected during the past year relating to the measurements and history of jack stock. Bulletin 176 which was published by this Station relating to the rearing of jack stock and mules, is the only one published on this subject by any Experiment Station in this country, and the requests for this publication have been so extensive that the present edition is practically exhausted. The additional data secured during 1914 were collected with the view of including the same in another bulletin to be published at some future date. Up to the present time approximately 100 jacks and jennets have been measured and their measurements recorded and tabulated.

VIII. Speakers from this Department have attended ten meetings during the year, and in Fleming County organized the Fleming County Horse and Jack Breeders' Association, which at the time of its organization included fourteen

619287

active members. Also the workers of this department of the Experiment Station organized in January, 1914, the Kentucky State Horse, Jack and Mule Breeders' Association, which organization started with about fifty members. It is planned to organize many of these associations in an effort to bring about a cooperative and intelligent interest in the upbuilding of the horse industry of Kentucky.

DAIRYING AND DAIRY CATTLE. I. One phase of the dairy work at the Experiment Station is to show the dairymen of the State how to produce clean milk that will contain very few bacteria. Fifty dairies supply milk to Lexington and during the past three years the local Health Board has published a diagram each month showing the relative positions attained by the different dairies relative to the cleanliness of the milk produced. Usually the Experiment Station dairy heads this list. This is the more remarkable because of the fact that our equipment is such as can be employed by any dairyman of moderate means. For about 18 months Mr. J. W. Nutter has been spending the afternoons at the Elmendorf dairy. His work there has brought about very gratifying results in the operation of this great dairy.

The following tabulation of the bacteria contained in the milk from the Experiment Station during the calendar year of 1914, together with a statement of the rank of the Experiment Station dairy among the fifty dairies supplying the city of Lexington is of interest. These records were secured from the Health Board of the city.

Bacterial Count for Year 1914.

	Bacteria per cc.	Rank.
January	450	1st
February	80	1st
March	520	3rd
April	140	2nd
May	3000	10th
June	1000	1st
July	1100	2nd
August	6300	4th
September	200	2nd

	Bacteria per cc.	Rank.
October	30	1st
November	20	1st
December	950	10th
Total	13790 bacteria for 12 months	
Average for month	1149 bacteria	

Experiment Station Dairy ranked 1st, five months.
" " " " 2nd, three months.
" " " " 3rd, one month.
" " " " 4th, one month.
" " " " 10th, two months.

II. In May, 1914, six acres of rye were cut for silage. We found that the rye furnished a heavy crop of green material which made good silage. This rye was fed in quantities of from 30 to 40 pounds to each cow per day during July and August, last summer. Another field of four acres of rye was cut early in June and made a palatable hay that has been utilized in feeding the dairy cattle during the past winter. Circular 31 contains a full account of the methods employed in handling the rye and its value as a feed for dairy cows

III. In an experiment in feeding all the cows first on ground wheat and then on wheat bran, it was found that one of these feeds might easily be substituted for another. The cows were fed in this experiment during August, September, October and November, and the feed was so alternated that they were fed during one month on wheat and the next month on bran. For every pound of bran that was supplied in the grain mixture the cows produced 3.23 pounds of milk and for every pound of ground wheat they produced 3.01 pounds of milk. In other words they produced 7.3 per cent more milk from bran than from wheat. This information is extremely important as an economic proposition during such a season as last summer when wheat was worth less than bran. For a time wheat was selling at 77 cents per bushel (1.3 cents per pound) or $26 per ton; and bran at that time was costing the Experiment Station $30 per ton. In other

words the bran cost 13.4 per cent more than the wheat, at that time.

IV. Several pure bred and grade Holstein cows were added to the dairy herd during 1914. The grade Holstein cows have been crossed with a Jersey bull in order that we might study the heredity of characters in the cross and particularly the milk and butter production resulting from the cross.

V. The late Director M. A. Scovell had an idea that if a cow came in heat the period of oestrum would make a considerable fluctuation in her milk and butter fat yield. For the past three years accurate records have been made when cows came in heat during the time their milk and fat tests were being made. We have found that with some cows this does cause a considerable variation, while with others it seems to have very little effect.

VI. During the summer of 1914, observations were made with 203 cows to determine whether there is any relation between the shape and size of the escutcheon and milk and butter fat production. The cows included in this study are owned in Shelby and Fayette Counties. After tabulating our records we can find no correlation between the escutcheon and dairy production. Also after carefully tabulating data regarding the amount and color of body secretions, we can find no relation between the secretions and amount of milk and fat production. Professor C. H. Eckles, of Missouri, has found, however, that the yellowness of the secretions indicates the color of the milk.

In this work we have followed the work of Guenon, of France, who classified the escutcheons into many forms and who states that each form is correlated with milk and butter production. Our records do not verify his conclusions. However, when two hundred and three records are separated into ten classes and each class into six or more orders (some of which are rare) the numbers become so small that one is not safe in drawing radical conclusions. During the present summer we hope to secure several hundred additional records.

VII. During the past year 125 cows have been officially tested for the Advanced Registry Associations representing

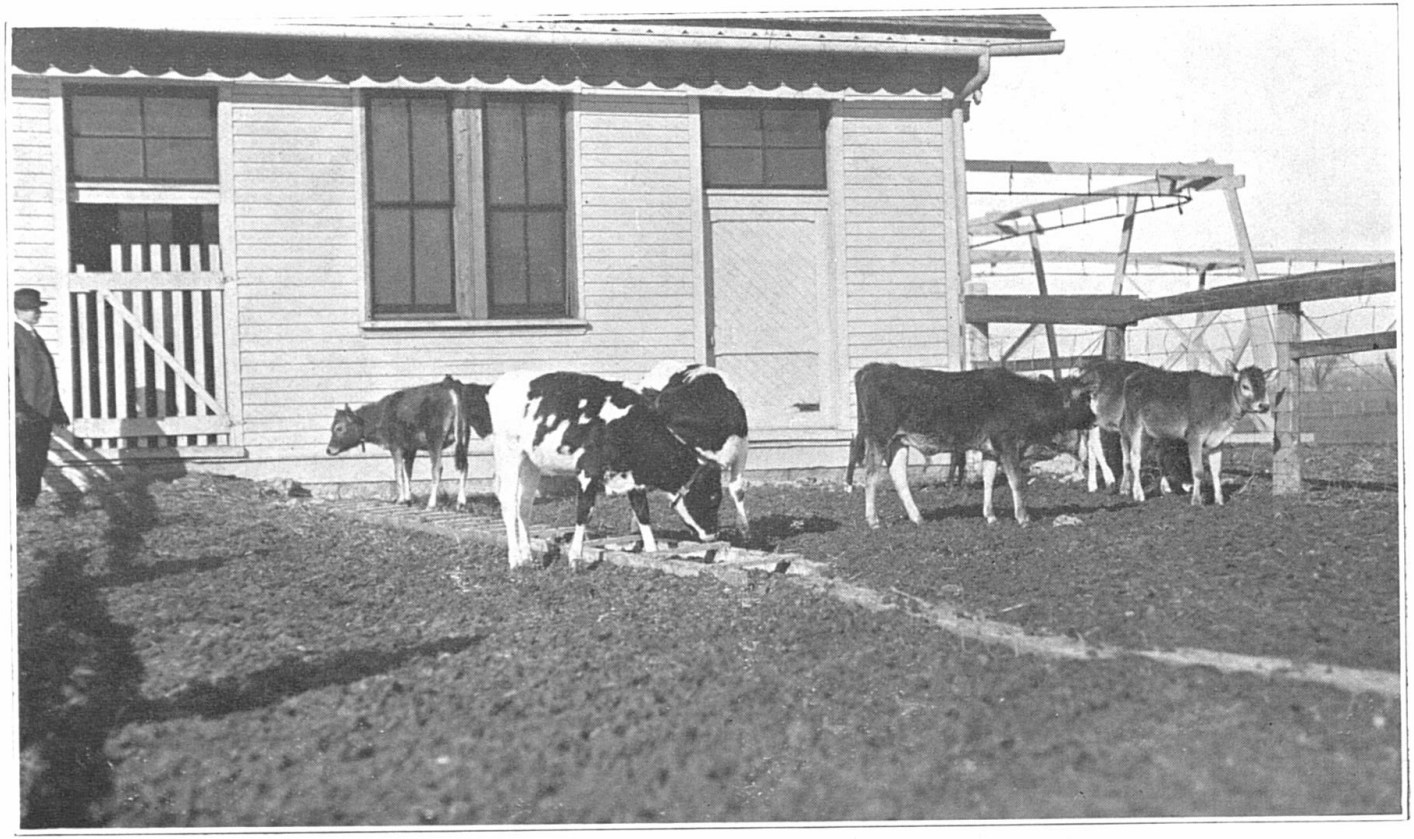


PLATE 8. HOLSTEIN AND JERSEY CALVES—EXPERIMENT STATION FARM.

the Jersey, Holstein and Ayrshire breeds. The tendency in this work is toward yearly rather than short time tests. These authenticated records of dairy performance have in the past proven of great value to the pure bred interests of our State and have aided greatly in establishing and enhancing the reputation of our dairy herds.

VIII. The department has cooperated in dairy extension work at various fairs. The dairy division of the Blue Grass Fair is entrusted to the officers of this Experiment Station, and cooperation is also extended in the management of the dairy cattle department of the State Fair. The Experiment Station operated a model dairy at the State Fair and had charge of the students' stock judging contests and the dairy products exhibits.

IX. The officials of the department also cooperate with the State Dairy Association in holding the annual dairy meeting and dairy show during Farmers' Week. In January, 1914, twenty-five samples of butter and ten exhibits of milk and cream were sent to this show. The various firms dealing in dairy appliances throughout the United States offered several hundred dollars in premiums at the local dairy show.

X. Mr. W. D. Nicholls, of this department devotes a considerable part of his time to extension work in dairying. The Experiment Station owns six forms which are used in the construction of concrete silos. These have been loaned to dairymen and farmers during the past year and with the aid of these forms thirteen concrete silos were constructed during the summer of 1914. Mr. Nicholls assisted in the construction of four wooden silos and one tile silo. He also sent to various farmers 27 sets of directions and bills of material for silos. In tabulating the work of the past summer it is found that the farmers who erected concrete silos under the supervision of the Experiment Station, built them at a cost of $7.25 per foot of height. Commmercial firms charge $13 for the same work. Circular No. 18 which was published by the Experiment Station in May, 1914, and which contains 24 pages, deals with the construction of silos. Mr. Nicholls also prepared 13 sets of blue-

print plans for the remodeling of dairy barns, at the request of farmers. Seven of these barns were actually reconstructed, according to the plans furnished. He also attended twenty-one meetings and consulted with approximately one hundred dairymen in regard to the operation of their dairy farms. Mr. Nicholls also assists in the work at the State Fair, etc. This is in addition of course, to his regular duties in the Agricultural College.

Bulletin 179 which contains 82 pages was prepared by Mr. Nicholls in June, 1914, and is entitled the " Construction and Equipment of Dairy Barns." It contains various plans for different kinds of dairy barns. I believe that this is one of the most complete publications of this kind that has ever been prepared by any Experiment Station.

XI. In December, 1914, the Experiment Station published Bulletin 186 entitled "Experiments with the Sharples Mechanical Milker." This bulletin embraces 35 pages and gives full data in regard to the tests made with the machine at the Experiment Station dairy. The tests reveal the fact that the machine has no detrimental effect on milk and butter production and that if it is used by a careful man, clean milk can be produced with it.

THE POULTRY DEPARTMENT was established in 1913 on three acres of ground and includes fourteen different types of poultry houses and 450 birds of ten varieties. This has given an opportunity during 1914 to draw some conclusions in regard to the best type of house and the best varieties of chickens adapted to conditions obtaining in Kentucky.

The experiments under way at the poultry yards are as follows:

I. Records and observations in regard to the length of time required for different hens to complete their period of broodiness and number of times that they become broody. Some investigators believe that the most productive hens cast almost all their feathers and continue broody several days longer than unproductive hens. Our records will probably verify this.

II. Daily temperature records are made in each poultry house.

III. An experiment to determine the heredity of the rumpless or tailless character.

IV. During 1914 considerable quantities of sour milk were used in rearing young chicks, with good results.

V. Records of 1914 show that most of the turkey eggs were laid by hen turkeys rather than by pullets. The turkey pullets did not lay many eggs.

VI. Three young turkeys raised in confinement during 1914 made very slow growth and finally died. Turkeys allowed to range over the farm grew much more satisfactorily.

VII. Records with various types of trap nests were made during the past year.

VIII. An experiment that is almost completed, is to show the gain and cost of gain made by six cockerels and six capons. The capons are making much more growth on the same feed than the cockerels.

IX. The yards surrounding the different poultry houses are of different sizes and this affords an opportunity to study the number of square yards of grass that must be supplied each hen in order that the sod may not be killed.

X. The poultry yards contain various varieties of apple, peach, plum and mulberry trees. This will determine the best kind of trees to use in poultry yards.

XI. An experiment has been begun to see whether ground rock phosphate can replace oyster shell with laying hens.

XII. To see if broken limestone can replace both grit and oyster shell with laying hens.

XIII. An experiment to determine if laying hens can do without oyster shell or other forms of inorganic lime when supplied with grit, dry mash and grain. The grit contains almost no lime.

XIV. In July, 1914, this Department issued Circular No. 25 which contains 32 pages and 27 half-tones. The circular gives information in regard to the feeding and rearing of chicks and contains photographs and bills of material illustrating

the cost of construction of the various types of poultry houses, now in use on the Experiment Station farm.

XV. Mr. D. D. Slade and the Head of the Department have on several occasions made trips to farmers' institutes, and last summer the department had charge of the poultry show at the Blue Grass Fair and assisted with the poultry show at the State Fair.

XVI. During the summer of 1914, the L. & N. Railroad supplied a train of two coaches and an engine which was operated for the purpose of increasing interest in fruit and poultry raising in the mountainous districts traversed by that railway. The train was on the road for over a week and this department supplied eight varieties of chickens and a speaker in the person of Mr. D. D. Slade.

XVII. During Farmers' Week in 1914, the Experiment Station held a most successful poultry show. The Experiment Station and the State Fair in cooperation purchased $1,800 worth of beautiful wire coops which are used annually at the Kentucky State Poultry Show, held at the Experiment Station each January and at the State Fair, each September. The first show was held at the University in January, 1913, and exhibited 450 birds and caused considerable interest throughout the State. The poultry and agricultural press mentioned the show in laudatory terms, and last September the Kentucky Poultry Association showed its appreciation by donating $25 in money for premiums at this show. This is the only poultry show that is so favored by that Association.

CHEMISTRY

By A. M. Peter.

The following is a brief report of the work of the Chemical Department for the calendar year 1914.

Soils. Chemical analyses have been made of 69 samples of soil from Graves County in connection with the soil survey of that county by the Experiment Station. For the soil survey of Franklin County, in cooperation with the Kentucky Geological Survey, 56 samples have been analyzed. All these analyses have been incorporated in the reports by Mr. S. C. Jones on these two counties, the manuscripts of which reports are ready for publication in bulletin form. The report on Franklin County will also be published in the reports of the Kentucky Geological Survey. Chemical analyses have been made, also, of 20 samples from the Experiment fields of the Experiment Station and of 36 samples from 15 counties, sent in by farmers, making a total of 181 quantitative chemical analyses of soils. Besides these, 116 samples of soil, from 61 counties, have been tested qualitatively for acidity, calcium carbonate and phosphorus as an aid in giving advice on the use of ground limestone and phosphate. The manuscript for a bulletin on the chemistry of the soils of the principal soil areas in the State is now in preparation and is nearly ready for publication.

Limestones. Partial analyses of 240 samples of limestone from 58 counties have been made for farmers and county agents for the purpose of advising the owners and users as to their fitness for agricultural purposes. In this connection much attention has been given to devising a short method for the analysis of agricultural limestones, including a rapid

method for the determination of both calcium and magnesium. This work has led us to adopt, tentatively, a modification of the method worked out by Behrman last year, ("A Rapid Method for the Analysis of Limestone for Agricultural Purposes," by A. S. Behrman, Thesis for the degree of B. S. in Industrial Chemistry, State University, Lexington, Ky., June, 1914). In this method, the neutralizing power of the limestone is first determined by dissolving a weighed portion of the finely ground sample in a known measure of standard hydrochloric acid and titrating the excess with standard alkali and phenolphthalein, after boiling off the CO_2 and peroxidizing any ferrous compound with a little H_2O_2, substantially as described by Behrman. Where the limestone is only slightly magnesian, this determination is all that is required to give a good estimate of its agricultural value. But if it is desired to actually determine the amount of calcium present as is the case with magnesian limestones, we make the same solution up to volume, without filtering, pipette out an aliquot, add a suitable quantity of ammonium chlorid, heat to boiling and precipitate with ammonium oxalate. The precipitate, containing the calcium as oxalate, is filtered, washed and the oxalate determined by titration with standard $KMnO_4$ solution in the usual way. From the neutralizing power and the amount of calcium thus found, the amount of magnesium present may be easily calculated. The results are accurate enough for practical purposes. The manuscript for a bulletin containing more than 1000 analyses of Kentucky limestones has been prepared and is ready for publication.

MINERAL AND POTABLE WATERS. More or less quantitative work has been done upon 129 samples of mineral and potable waters from 43 counties. Such of these analyses as are believed to be of permanent value have been compiled and are submitted herewith for publication, (See pages 85-118 of this report).

PLANT FOOD IN SOLUTION IN THE WATERS OF SPRINGS AND STREAMS. Analyses of 32 samples of waters of springs and streams of the state have been made to determine the

amount of mineral plant food which they carry in solution. This investigation is nearly finished and the results will be ready for publication in 1915. They show that the waters of the Bluegrass Region of Central Kentucky carry in solution a much larger proportion of phosphorus than those coming from areas based upon geological formations above the Cincinnatian.

OCCURRENCE OF MANGANESE IN PLANTS. Many determinations of manganese have been made in parts of seeds and fruits and the leaves of plants and some of the results have been published in a paper on "The Occurrence and Significance of Manganese in the Seed Coats of Different Seeds," by J. S. McHargue, Journal of the American Chemical Society, December, 1914, p. 2532. This study is being continued.

BARIUM IN PLANTS. The study of the presence of barium in plants and its effect upon plant growth is being prosecuted. A series of 12 pot experiments has been carried out during the past year and analyses have been made of the plants grown therein.

OSAGE ORANGE. Material has been collected and prepared for some work on the composition of the fruit of the osage orange.

THE LIBERATION OF POTASSIUM FROM INSOLUBLE SILICATES. This study has been continued, both in the field experiment with tobacco and in the action of yeasts and bacteria, in collaboration with Dr. Healy.

METHODS OF ANALYSIS. A short method for the determination of manganese in soils, much superior to the official method both in accuracy and speed, has been developed. The results are very satisfactory. A description of this method was read by Mr. McHargue before the Lexington Section, American Chemical Society, February 11th, 1914.

An indirect method for the determination of strontium in the presence of calcium and one for lithium in the presence of sodium, in the analysis of mineral waters, have been studied with very satisfactory results in the case of stron-

tium. A report of this work was read by Mr. Averitt before the Lexington Section, American Chemical Society, February 11th, 1914.

The rapid method for analysis of agricultural limestones has been referred to already under "Limestones."

Some cooperative work was done in the study of methods of analysis of soils and insecticides for the Referees upon these subjects of the Association of Official Agricultural Chemists.

GEOLOGICAL SURVEY. Analyses of 77 samples of limestones, coals, iron ores, mineral waters, etc., have been made for the Kentucky Geological Survey under a cooperative arrangement with the State Geologist.

MISCELLANEOUS ANALYSES. About a hundred samples of miscellaneous substances have been analyzed for farmers and others, including work done for other departments of the Experiment Station. Besides this, many specimens of minerals, rocks, ores and other materials have been identified and reported upon without actual analysis, for persons in all parts of the State.

CORRESPONDENCE. Some two thousand letters have been written, most of them in connection with reports of analyses or in answer to questions as to the fertilizer requirements of soils in different parts of the State, or questions of a more or less chemical bearing.

COMMERCIAL FEEDING STUFFS.

By J. D. Turner.

The following is a brief statement of the work carried on by the Department of Feed Control during the year ending December 31st, 1914:

The work of the department has been directed along the same lines as heretofore, namely: Inspection and analysis of the various brands of commercial feeding stuffs found on the market; the education of consumers, manufacturers and dealers and the economical and moral development of the business generally. As in previous years, inspectors have been continuously in the field, giving information to those interested as to the requirements and purpose of the law; inspecting and weighing shipments; watching for infractions and securing samples from materials on the market to be sent to the laboratory for microscopical and chemical examination.

On account of the general use of commercial feeding stuffs throughout the State, practically every section has to be visited by our inspectors. Special attention has been given to misrepresentation and unwarranted claims made by unscrupulous manufacturers, and a number of materials of no merit have been refused sale within the State.

So far as we may judge from requests for inspection and examination of shipments the law is continually growing in favor with the consumer of feeding stuffs in the State, and it is very rare indeed for any considerable amount of feed of bad character to be purchased without a request for examination. This is especially true of compounded feeds, cotton seed meals, etc., such requests coming from both dealers and consumers.

The department has made a number of examinations of feeding stuffs suspected of being the cause of death of live stock with the result that a considerable number of feeding stuffs were found to contain poisonous weed seeds, fungi and badly damaged grains.

During the year, 1543 different brands of feed were registered, representing 457 firms. Analyses have been made of 598 inspectors' samples, 46 consumers', 238 dealers' and 36 miscellaneous samples, making a total of 918 samples. Besides this number, 129 untagged samples have been examined microscopically.

During this period about three million labels have been issued, representing a tonnage trade of about one hundred and fifty thousand tons, or a business of over four million dollars.

The results of the year's work have been very gratifying. Notwithstanding the extreme scarcity of feeding materials, and the great demand for same, the manner in which the feed business has been conducted has never been better in the history of the trade in the State. In fact, we have found comparatively few instances where the law seems to have been violated intentionally, and the manufacturers and dealers have acted promptly in correcting the few irregularities that we have found

A more detailed report is given in Experiment Station Bulletin No. 185.

COMMERCIAL FERTILIZERS

By H. E. Curtis.

The following is a brief report of the work of the Fertilizer Department for the year 1914.

There were registered during the year 746 brands of fertilizer by 51 firms doing business in this State. These brands included complete fertilizers, nitrogenous superphosphates, bones, acid phosphates, acid phosphates and potash salts, potash salts and nitrate of soda.

During the year our inspectors collected samples at various places in the State and samples were sent in by farmers, the total number of these samples so collected and sent in being 471. The results of all of this work will be published in Bulletin 189.

We issued during the year 1914, 2,530,996 tags and 1,329,378 stamps of denominations of 100, 125, 167 and 200 pounds. The total value of these tags and stamps was $42,832.50.

By comparing the business of 1914 with that of the previous year it will be noticed that the total sales of tags and stamps was about $4500.00 more this year than last, and considering that the business in 1913 was something like $5000.00 more than any previous year, it can readily be seen that the fertilizer business in the State is growing rapidly.

ENTOMOLOGY AND BOTANY

BY H. GARMAN.

The following is the report of the Department of Entomology and Botany for the calendar year 1914.

The work of this department has been of the same general character as that done in previous years, consisting in part of research, in part of inspection, partly of seed testing for farmers and seedsmen, together with some demonstrations and a good deal of correspondence and routine office and laboratory business.

RESEARCH. As a new subject of research we have been making a study of the locust borer (*Cyllene robiniae*), an insect of special interest at present because of its depredations on black locust plantings made for the production of fence posts. The injuries by the beetle are the chief obstacle to the successful growing of this useful tree. The life-history of the insect has been followed continuously since last July, and we have now to complete it by following its growth and changes up to the time of year when we began the study. Observations on the habits and some tentative experiments on remedies lead me to believe we shall find a means of lessening the injuries. We have carried forward with this study another investigation on the white fly of hothouses (*Aleurodes vaporariorium*) from which we have accumulated material for a bulletin, and are now testing remedies for its injuries.

In continuing our study of the different nodule bacteria, seven hundred and fifty (750) different growths of leguminous plants have been made, involving the testing of three hundred and seventy (370) cultures of bacteria on plants, with the same number of controls.

While not pursued under the Adams Act, other research work was done during the season which will later contribute to results of more concentrated and prolonged studies. Of this work may be mentioned the distribution to Kentucky farmers during the summer and fall, of nodule cultures for use on leguminous forage seeds. The department furnished for this purpose eight hundred and thirty (830) cultures to be used on alsike, crimson and red clovers, alfalfa, sweet clover, vetch, soy-bean and cowpea. I felt willing to undertake this free distribution because of the possibility of obtaining by means of it data concerning the effect of inoculation on the different soils of Kentucky. We have already received some reports of results, part of them very favorable to the use of cultures, some uncertain, others indicating no benefit. The reports from too large a number of applicants show a disposition to apply for cultures because they are furnished free, with no serious purpose of using them and reporting fully. To correct this tendency, it may be desirable later to charge each applicant the cost of producing the cultures which are supplied to him. In my correspondence concerning this work, it has sometimes seemed to me that certain applications indicated a disposition to secure from us as large a number of cultures as possible with a view to peddling them to others. The object we have in view is to supply actual farmers, and no one else, and to furnish only enough to give cultures a thorough trial on the land of each applicant. When Kentucky farmers are satisfied as to the benefit derived from the use of cultures, it will be time for the Experiment Station to give up the distribution of them. In the meantime, it is hoped we shall have acquired data that will be of service to us in prosecuting the scientific studies of nodule organisms with which we are now engaged in this department.

Our work with the corn-ear worm is being continued as a minor subject of study and with the purpose of gathering up some odds and ends of information acquired in the course of the work already done.

INSPECTION. A tendency of the times seems to be to call for more and more inspection each year, to protect us from the inroads of disease and from the encroachments of dishonest and careless traders of one sort or another. The work required of this department in this field, is the inspection of seeds, provided for by the State, the inspection of orchards and home-grown nursery stock, also provided for by a State law, and the inspection of imported nursery and florists' stock, required by a federal law somewhat recently enacted. As with inspections of other sorts those we have in charge are increasing, and promise to tax our resources, under present arrangements, none of the laws providing any funds beyond those required for expenses, and one, the seed law, not even furnishing these. I am stating the facts, and not making a complaint, when I say that our work in this field has been somewhat handicapped from the beginning as compared with other inspection work carried on by the Experiment Station, involving as it does the necessity of turning the time and energies of our regular assistants upon inspection work, when they should be employed with other duties. Inspections will not wait. Stock must be examined, perhaps treated, before it can be certificated, and the owner in the meantime may be left in uncertainty in the face of an approaching shipping season. In the case of imported stock, again, it has often been en route for a long time and may need watering to save it. The consignee is anxious to get it unpacked and in the ground as soon as it arrives. Sometimes several different applications from several places reach us at one time. With only one assistant available for the task it will be seen that we are not in a position to handle properly a great deal of this work. Thus far we have managed to examine everything required of us, but I am beginning to think that we may find it necessary some time to have local agents in such cities as Louisville, Covington, Paducah and perhaps one or two other places, who when notified by us of importations of stock coming from abroad will examine them immediately and while the plants are being unpacked. The expenses for inspecting this stock,

excepting the salaries of inspectors, are now paid by the State Department of Agriculture under an arrangement having the sanction of the Governor and the present Commissioner of Agriculture, but it is only a temporary arrangement, and is open to some criticism as a permanent provision for this important work. We should have both the inspections of nurseries and orchards, and those of imported stock, under one law, fixing responsibility for the work and making a sufficient provision in funds to carry it out properly. In other States this provision is already made, in some cases an independent state official being provided for, who devotes his whole time, and often that of a staff of assistants, to the work. Kentucky is not as extensively engaged in growing and importing nursery stock as are some other states, and with some needed amendments of our law the work can be very well taken care of here at the Experiment Station, like the work of food, feed and fertilizer inspection.

A word should be added as to the condition of stock inspected. The San Jose scale has for many years been spreading in the orchards of the eastern states. Kentucky escaped serious visitation longer than most of the states about us. It was prevalent in Ohio, Indiana and Tennessee, when giving but little concern in this State, but it now occupies practically all of the fruit-growing territory in the United States, and has for some years past been giving our nurserymen a good deal of trouble, to get rid of it when it appears in their nurseries, to keep it out, at all times. Of the forty-eight nurseries inspected by us this year seventeen were found infested, and all of these were required to fumigate with hydrocyanic acid gas. Notwithstanding this spread of the scale the stock in our nurseries is now in better condition than ever before. Nurserymen have found it worth while to take better care of their nurseries than they did formerly. The plants are better planted and better tilled, and more carefully handled every way, owing to an improvement in our knowledge and an increased experience in dealing with pests. There is room for improvement yet, of course, both in the matter of propagating and in inspecting.

We can claim, however, to have handled our stock with as little expense to the State as any other inspectors in the country.

During the calendar year 1914 we inspected approximately 3,279,900 home-grown plants. Of foreign-grown stock we inpected 107 shipments, consisting of 360 cases, containing 179,925 plants.

SEED WORK. During the past five years there has been a rapid increase in the amount of seed work demanded of the department. Seedsmen especially are waking up to the importance of knowing the exact facts about the purity and viability of stock they are buying or selling. Farmers, too, wish to know whether or not they will sow noxious weed seeds with seeds they think of buying. A good stand may depend absolutely on the germinating quality of the seed sown. Loss from sowing poor seeds does not stop with failure to get one's money's worth in seeds, but results in loss of time as well. The matter of good seeds has thus an important relation to successful farming. As showing how this work is increasing there is given below some figures relative to it for the past five years. It will be seen that the tests made have more than doubled during this period and that the number examined in 1914 represents an increase of 52 per cent over the five years' average.

Year.	Samples Received.	Purity.	Germination.	Total.
1910	489	449	359	808
1911	614	468	410	878
1912	577	485	547	1032
1913	868	767	797	1564
1914	954	829	824	1653
Average for 5 years	700	599	487	1087

PLOT WORK. The experiments being carried out in our experimental plots on the Experiment Station farm are also in the nature of research, though not conducted under the Adams Act. We have had a total of three hundred and twelve plots occupied during the past year.

Our rotation experiments numbered 56, representing nine-

teen different systems. These have been conducted for a good many years in cooperation with the United States Department of Agriculture.

Other plots were occupied with 50 varieties of soy-beans, which are being tested and improved for our conditions, by selection; 17 varieties of cowpeas; 6 varieties of wheat; and 1 variety of hemp. Still others were occupied with strains of timothy, clover, alfalfa and bluegrass, which are being improved; while some were given up to eighteen species of grasses and to eight grass mixtures.

In addition to this more strictly botanical work, tests have been made in the plots of insecticides against the corn-ear worm, the tobacco worm, and other insects brought to our attention during the season, special plantings being required in some cases to accommodate these experiments.

DEMONSTRATIONS. It has been thought well to continue some of the demonstrations with which we have been occupied for many years, with a view to showing the value of different procedures in checking pests, and we have during 1914 used our power sprayer in showing how the elm leaf-beetle may be controlled and trees kept in good condition by spraying them with arsenate of lead. We have also treated an orchard in the vicinity of Lexington for several years with a view to showing what may be done toward checking the insect and fungus pests of apples. The work has done good, we are sure, in calling the attention of farmers to the possibilities in fruit growing even in Bluegrass Kentucky, where land is costly and other lines of agriculture are now occupying most of the attention of land owners. If by spraying and other treatment we can raise fruit profitably here, we can surely produce it at a profit on the cheap lands in the State which are better suited to fruit growing and are not well adapted to stock raising.

Of course we can not spray for every one who applies. Our purpose is to encourage people to spray for themselves, and to avoid as far as possible favoring individuals.

OFFICE WORK. The correspondence of the department has

been about the same as during previous years. It is increasing steadily, and consists in replies to requests for information about the injuries suffered by crops from insects and fungi; in giving information about weeds, forage plants, seeds, nursery stock, shade and forest trees, and in short about plants and plant products of all sorts. Over three thousand letters have been written during the year, together with numerous circular letters.

BULLETINS. Some of the results of our work have appeared from time to time in bulletins issued by the Experiment Station, which will speak for themselves better than anything I can say as to the nature and extent of the work we are doing. Some other articles by the Entomologist and Botanist on similar subjects have appeared from time to time in daily and agricultural papers. The publications of which the titles are given below consist of 194 pages of text, 3 colored plates, 61 half-tones and 5 zinc etchings.

Titles of publications issued by the Department of Entomology and Botany for the year 1914:

1. Treatment for Cutworms and Flea Beetles in Tobacco Beds.
2. How to Avoid Potato Scab and Dry Rot.
3. The San Jose Scale and its Treatment.
4. Some Kentucky Weeds and Poisonous Plants.
5. Six Different Species of Nodule Bacteria.
6. The Life-history and Habits of the Corn-ear Worm, (*Chloridea obsoleta*).

HORTICULTURE

By C. W. Mathews.

The following is the report of the Department of Horticulture, for the calendar year 1914.

The horticultural work on the Experiment Station farm was re-established in 1913, after it had been permitted to lapse for a period of several years, during which period, the time of the writer was given exclusively to the work of the University.

A tract of about sixteen acres of land was assigned to this department, for experiment purposes. As a basis for our future work, there has been planted upon this area, during the past two seasons, about eight acres of orchard fruits, containing nearly four hundred varieties of apples, peaches, plums, etc. Another tract has been set with over one hundred varieties of grapes and one hundred varieties of other small fruits, making a total of over six hundred varieties of fruits of the different classes, now growing upon our grounds. These plantings are designed to afford a basis for future work in the study of the behavior of varieties under our conditions, and also as an aid to the identification of the numerous varieties which are sent to us for name; as a source of material for experiments in propagation, breeding of fruits, etc., and finally, as a source of valuable illustrative material for the training of our students, and for the information of the horticultural public.

A considerable number of varieties of vegetables has also been grown during the past year, in furtherance of experiments with this class of crops, although less time and space have been devoted to vegetable gardening than to fruit crops.

During the summer, the Skinner irrigation system was

established over about two acres of ground, too late to arrange for experiments upon this subject during the past season, but not too late to be of great value in developing the crops already growing upon the ground. It is proposed, during the coming year, to undertake specific experiments in the comparative results upon irrigated and non-irrigated tracts, with a variety of vegetables and fruits.

During the year, a valuable greenhouse plant has been erected, consisting of an attractive brick service building, with a greenhouse proper, about 30 x 85 ft. in size. The service building contains, in the basement, the heating system for the plant; upon the first floor, an office, workroom, photographic laboratory, and on the second floor, a sleeping room for attendant. The greenhouse is now in use for purposes of propagation, for experiments in forcing vegetable crops, etc.

An addition, 30 x 48 ft. in size, to the barn, jointly occupied by the Department of Animal Husbandry and this department, was erected during the season, and affords a greatly needed space for wagons, farm implements, etc.

The work upon grapes during the past three seasons is now being embodied in a bulletin in preparation. A beginning has been made, also, in the growing of a considerable number of ornamental trees, shrubs, and herbaceous perennial plants, both for use upon the Experiment Station and University grounds, and also for various lines of experimental work.

Arrangements are also in progress for cooperative orcharding in Lawrence County and in Shelby County, tracts of land having been selected for the planting of orchards in these places, with the expectation of setting the trees during the coming spring.

PURE FOOD AND DRUGS.

BY R. M. ALLEN.

The following is the report of the Department of Pure Food and Drugs for the year 1914.

Food Laboratory.

Professor LaBach reports from the Food Laboratory samples analyzed as follows:

Total number of samples received and analyzed by food laboratory, April 1, 1914,–April 1, 1915, inclusive:

Official samples	2,401
Unofficial samples, including milks; creams; ice creams; breast milks (15); beers; whiskies, etc., (29); oysters for ammonia, amino acids, etc., (39); suspected-poison cases, (7); tobacco; flour, meat products; fruits and fruit juices; pops, etc.; honey; molasses, etc.; vinegars; baking powders, etc.; egg powders; coffee; starch; artificial colors, etc.	563
Total	2,964

Statement of the number of adulterated samples still depends upon further consideration of the data at hand, and will be given in the report for the biennial period. This laboratory has been taking up the chemistry of food deterioration and spoilage, and it is necessary to consider these data in connection with the bacteriological data. Further, although a chemical examination may report a sample of milk as not found adulterated, the bacteriological examination may find the product to be highly contaminated.

Drug Laboratory.

Dr. Brown reports from the drug laboratory as follows: During the period above mentioned, this laboratory has

analyzed a total of 495 drug samples of which 421 were official samples and 74 miscellaneous samples.

Of the 421 official samples, 122 were classed as adulterated or misbranded, representing 29 per cent of the official samples. This is the lowest per cent of adulteration that we have obtained for any year since the establishment of the drug control work in Kentucky. Last year, it was 58.4 per cent, and the year previous, 45.5 per cent.

The class of samples investigated during the past year represents a decided advance over that usually undertaken by state laboratories, and, as you are already aware from the correspondence relative to the samples reported by the various manufacturing drug houses, shows that it has served to call their attention to many instances where either their formula, label, or manufacturing process was at fault.

About 74 miscellaneous samples were analyzed during the year, consisting of the following *class* of drugs: Ensilage, for poison and coffee, for poison—found strychnine; prescrip tion, for poison and composition; abortion medicine; poison case; lambs' tails, for poison—found strychnine; stomachs, for poison (4); tablets and salve, for poison; fodder, for poison; stock feed, for poison; water, for arsenic; beer, per cent alcohol; linseed oil, for adulterants (5 samples); rubber cement; chicken feed, for poison; epilepsy remedy, for composition; heroin tablets, for assay; aspirin tablets, for assay (2 samples); solution magnesium citrate, for assay; elixir lactated pepsin, for assay; white powder, for poison; horse stomach, for poison; whiskey, for poison; peroxide cream, for assay; lead arsenate, for assay; turpentine, for assay; Fowler's solution, for assay; Pepsinaid, for assay; Peptenzyme tablets, for assay; Elbon, Lipoiodin, Digifolin, Phytin, white powder, salt, tablets, suspected of being "dope;" chocolate drops, for added caffeine; seventeen standard samples, manufactured and assayed for standards.

Bacteriological Laboratory.

Dr. Pinnell reports from the bacteriological laboratory examination of samples as follows:

Milk and cream	944
Water	57
Oysters, 124 samples, 10 separate examinations of each sample for research	1,240
Ice cream	33
Exposed fruit, vegetables, bread, etc.	20
Miscellaneous	7
Total	2,301

Unofficial samples.

Milk and cream	111
Water	154
Ice cream	6
Total	271
Total number examined	2,572

This laboratory has co-operated with the Department of Dairy Husbandry in the examination of samples submitted in connection with the milking machine and other tests. A co-operative oyster survey to determine the extent of contamination and its control is in progress with the Division of Bacteriology of the United States Bureau of Chemistry. Further work on the influence of carbon dioxide gas on the growth of bacteria has been carried out, and the laboratory has undertaken to determine the extent and character of contamination from the exposure of foods in the retail markets.

Inspections by Mr. McFarlin.

During the year, the regular work of inspection of groceries, fish and meat markets, slaughter-houses, hotels, restaurants, lunch rooms, outdoor markets, milk depots, ice cream factories, bottling works, candy shops, bakeries, and bread wagons has been continued. The cooperative milk work with Cincinnati, Covington, Newport, Louisville and Lexington was also continued during the year. All milks from Kentucky going into Cincinnati were examined by sample analysis from each can. The milk supply of the other cities was examined in a similar way.

During the year, 1,144 samples have been collected, including milks, groceries, soft drinks, bakery products, waters,

etc. The best portion of the work accomplished by the department in company with the Louisville Health Department was the detection, capture and conviction of those connected with the sale of horse meat as beef, and killed in extremely unsanitary conditions in the City of Louisville. The cooperative work of this kind during the year has been very satisfactory both to the city and State departments. Many dairies and slaughter-houses outside of the State have been inspected and warned of their condition and instructed that they must come to the Kentucky requirements if they expect to sell their products within this State. We found that some slaughter-houses in Indiana, claiming to hold permits from the Federal Government, were supplying Louisville, and the sanitary condition of these houses was bad.

During the year, I have attended court in Hopkinsville, slaughter-house cases; Owensboro, slaughter-house cases; Bowling Green, slaughter-house cases; Louisville, horse meat, slaughter-house, grocery, confectionery, and other cases; Paducah, slaughter-house cases.

I have inspected cities and towns practically all over the State during this year, and by such inspection I have found that it is necessary to continue the work on sanitation in grocery stores, fish and meat markets, slaughter-houses, hotels, restaurants, and, in fact, all places where foods are manufactured, kept, stored, or offered for sale.

Mr. Porter reports as follows:

Number of towns visited, 24; drug stores inspected, 253; physicians visited, 5; drug samples collected, 370; grocery stores inspected, 11; sanitary inspections, including slaughter-houses and meat markets, 16; scales and balances tested, 322; weights (sets) tested, 393; graduates tested, 1,758.

Mr. Terrell reports as follows:

My records show that I have traveled 10,145 miles, visited 140 stores and inspected grocery stores, meat markets, slaughter-houses, cold storage plants, ice cream factories, bakeries, fish and oyster places, hotels, restaurants, lunch stands, and many other places where food products are sold.

I have collected and delivered 451 food samples for examination, also about 200 samples in company with others.

It is gratifying to note the increasing interest being taken in the sanitary work throughout the State, as many substantial citizens have expressed their desire to assist in this great work.

In company with Dr. T. B. Poté, federal meat inspector, a survey has been made of the meat situation in Lexington, Owensboro, Henderson, Paducah, Hopkinsville, Bowling Green, Elizabethtown, Covington, Newport, and Maysville. Many places were found where meat was prepared for human consumption which were wholly unfit for that purpose. All of such places were reported for prosecution.

Special attention has been devoted to sanitary conditions in various places in the State, for example, Ashland and Catlettsburg, which show striking improvement by way of clean grocery stores and meat markets; also unsanitary slaughterhouses have been replaced by new and sanitary ones.

Experimental Bakery.

Mr. Scheppelman reports as follows:

One hundred samples of flour, bread, and cake have been received and examined. In some instances the color of the loaf shows that the flour may have been bleached, on account of its dead-white appearance; again, where it shows a dirty-white color, it may be due to poor milling process, the wheat not being thoroughly cleansed before milling, or the mill is of old construction and lacks the modern milling methods and system. The tests of these flours show that their baking qualities are of sufficient merit to recommend them for bread making, and especially to blend with spring patent flour.

During the summer, I personally collected quite a few flour samples from millers in the state, who were very much interested. But, from what I have experienced during the past year, it seems that, while the miller and the baker may be deeply interested in laboratory experiments, too much of

their time is devoted to their business in a way that is absolutely wasted. They could, if they but would, utilize some of that time in coming into the laboratory to study and work out some of their trying problems, and thus profit thereby.

Several trips were made by me during the year throughout the state. In Owensboro, I went before the grand jury and that body heard my case against an Owensboro baker and others. In Louisville, I made inspections into bakeries, and, as a result, six were reported for prosecution. Five of these cases were won and one was dismissed.

My experience with bakers and the trade, after five years of inspection work, convinces me that it is necessary and essential to continue inspections of bakeries regularly, and I further feel that inspection is the best way in which to keep in close touch with the baker, his problems, and the sanitary condition of his shop.

The following experiments with various materials are being carried on in the laboratory; cottonseed, gluten, whole wheat flours, and powdered milks. These results, together with the work on Kentucky flours will be of interest to Kentucky bakers, millers, and consumers alike.

Administration.

Hearings and other office consideration have been given to 2,500 cases; 233 cases have been reported to the courts of the State, and 34 to the Federal Government. A total of 6,139 samples have been examined in the chemical and bacteriological laboratories, representing more than 30,000 determinations, over 20,000 of which were quantitative. The lowest number of determinations made on any given sample was 3, and the highest number 56. In addition, the samples found to be adulterated or misbranded are frequently checked in duplicate, which analyses and determinations are not included.



PLATE 9. HOLSTEIN COWS—EXPERIMENT STATION FARM.

Meat Inspection.

After over six years of constant effort in Louisville, we have, with all who cooperated in the work—the local Board of Health, the Commercial Club, various civic organizations, a committee from the association of butchers, the retail grocers' association, the State Board of Health, and other organizations—to report the passage of one of the best meat inspection ordinances yet enacted in any city of the United States. The ordinance was passed substantially in form, and the plan followed, as recommended by the Food and Drug Department. The city has organized an efficient inspection under the ordinance and we have been giving further aid in readjustment of plants allowed permits under the city's new control.

It may be stated also, that meat inspection for Lexington, in a model central plant, seems assured. We are close to results in many other parts of the State. It has been a long siege of agitation, prosecution, conference, persuasion and patience with the many difficulties which seem to follow, one after the other, before results are accomplished.

The Bureau of Animal Industry of the United States Department of Agriculture contributed the services of Dr. T. B. Pote for a systematic re-inspection of local slaughter-houses in Kentucky, and he has returned to give testimony in the courts. His reports were thorough and effective. There was nothing new, but we wanted the support of outside expert investigation. Dr. Pote accompanied Mr. McFarlin, Mr. Terrell, and the writer on tours of inspection.

Grocery Stores and Food Exposure.

An average bunch of bananas costs the retailer $1.50. The average loss may be given at 10 cents per bunch, or 6⅔ per cent. There is frequently a loss of 10 cents on a box of oranges. There are also losses in canned goods, meats, bulk foods. The original sales are on the basis of sound goods. Some one must pay for these losses. To devise means of mitigating these losses in the handling and sale of perish-

able food-stuffs is one of the most important problems now engaging the attention of this department.

Another important problem now engaging the attention of this department is the sanitary condition of grocery stores. Before us is the tabulated sanitary condition of grocery stores throughout the State.

The average grocery store has no hot water for cleaning utensils, no sanitary system, and the dealer little or no knowledge that he is losing profits through preventable spoilage or deterioration in quality. Once, in Vancouver, B. C., the writer saw a line of people going in and out of a grocery and meat retail store. On one side the beef and sheep carcasses hung in refrigeration over a clean floor, behind double plate glass. In a separate compartment, still behind glass, a workman in white and in plain view was grinding "hamburger." There were similar arrangements for handling poultry, fish, vegetables, fruits and other foods.

Many grocers in cities large and small have adopted sanitary methods, but the average grocery, supplying the masses of the population, is still far away from the sanitary methods necessary to protect food against deterioration and contamination. The methods of sanitary control in the food factory, cold storage house and inspected packing plant must pass on into all of the places where foods are sold and served, before the consuming public will reap the full benefit from the costs of sanitary inspections. It is a problem of temperatures, containers, over-buying and protection from outside contamination. The necessity for display must be met with facilities to protect food while keeping it before the purchasing public. The cost of food packaging must ultimately conform to sanitary needs rather than to trade fancy.

Sanitary regulations will ultimately require proper facilities for handling perishable foods before permits are allowed. The establishment of municipal markets with proper refrigeration, arrangement and equipment, and renting space only to those who are capable of sanitary care is worth considering for districts in which the proper protection of food now seems to be impossible. The necessary protection of foods

in the retail market is a potent reason for more efficient and sanitary methods in municipal street cleaning.

OYSTER STUDIES. The fact that in many instances, oysters in the retail market are greatly contaminated led us to investigate all causes that might possibly affect the contamination of raw oysters. Through Dr. Alsberg, Chief of the Bureau of Chemistry, United States Department of Agriculture, Dr. Bates undertook the bacteriological and chemical examination of oysters at the beds and during the processes of shucking and packing prior to shipment. This department has undertaken the bacteriological and chemical examination of samples taken on their arrival in Lexington and upon keeping at different temperatures in the laboratory and in the retail market. The facts already accumulated in this field will serve to convince the trade of the necessity of a more careful handling of oysters and will aid in establishing protective regulations during the next season. Already a number of interesting results affecting the deterioration of oysters during shipment and particularly preservation in the retail markets have been obtained. These results we hope ultimately to publish in the form of a bulletin.

DEPARTMENT OF CHEMISTRY

ANALYSES OF MINERAL AND POTABLE WATERS

BY

A. M. PETER, S. D. AVERITT AND J. S. MCHARGUE.

BOURBON COUNTY.

LABORATORY NO. 43805—Mineral water sent by P. J. Millett, Paris, August 23, 1914, from a drilled well, 155 ft. deep.

ANALYSIS—One gallon contains 126.3 grains of solid matter (2.166 grams per liter) composed mainly of sodium chlorid (common salt) and sodium carbonate. There are small amounts of calcium carbonate and magnesium carbonate, also traces of iron, silica, potassium sulfate, lithium, strontium and sodium iodid. It is alkaline, due to the sodium carbonate present.

It would probably have some medicinal value as a diuretic and in some forms of stomach trouble.

BOYD COUNTY.

Three samples of water sent by C. E. Layman, Ashland, on March 10th, 1914.

LABORATORY NO. 43495—Marked "Well No. 1, 95 ft. deep." Bored 4 months ago. The water is clear and colorless with a very slight sediment.

ANALYSIS—Sample contains 9.5 grains of solid matter per gallon (.162 gram per liter) composed of small amounts of calcium carbonate, magnesium carbonate, calcium sulfate and sodium chlorid, with traces of iron, silica and potassium sulfate.

It would not be classed as a mineral water.

LABORATORY NO. 43496—Marked "Well No. 2, 115 ft. deep." Bored 8 months ago. Water turbid.

ANALYSIS—Sample contains 13.3 grams of solid matter per gallon (.228 gram per liter) composed of sodium carbonate and very small amounts of calcium sulfate, calcium carbonate, magnesium carbonate and sodium chlorid. There is a small amount of iron present and traces of silica and potassium sulfate.

This water is alkaline in reaction due to the sodium carbonate present. The turbidity is due to iron. It should be a good water for drinking.

LABORATORY NO. 43497—Marked "Spring No. 3, Geo. Dickson." Water clear and colorless. Very slight sediment.

ANALYSIS—Sample contains 6.5 grains of solid matter per gallon (.112 gram per liter) composed of small amounts of calcium carbonate, magnesium carbonate, iron and silica.

It would not be classed as a mineral water.

BREATHITT COUNTY.

LABORATORY NO. 43430—Water from a dug well at Jackson, brought by M. Seargeant, Feb. 9, 1914, for sanitary examination. Nearly clear, colorless water with some white flocculent sediment.

ANALYSIS—

Total solid matter	36.6	grains per gal.
Ignited solid matter	29.0	" " "
Organic and volatile	7.6	" " "

Sanitary tests: Chlorids, considerable; nitrite nitrogen, large; nitrate nitrogen, 25 parts per million; free ammonia, a trace. The large nitrite and nitrate nitrogen indicate contamination.

BRECKENRIDGE COUNTY.

LABORATORY NO. 43759—Spring water sent by M. D. Stephens, Union Star, July 27, 1914.

ANALYSIS—One gallon contains 40.6 grains of solid matter (.696 gram per liter) composed of calcium carbonate, magnesium carbonate, some calcium sulfate and a little sodium chlorid. There are also traces of iron and silica.

It is a weak chalybeate water.

BULLITT COUNTY.

LABORATORY NO. 43970—Mineral water, sent by Herman Blatz, 319 S. Shelby St., Louisville, from a spring on his farm in Bullitt County. Received December 7, 1914. Clear, colorless water with only a trace of sediment.

ANALYSIS—One gallon contains 316.5 grains of mineral matter (5.426 grams per liter) composed of calcium sulfate and magnesium sulfate, mainly, with small amounts of calcium carbonate, magnesium carbonate and sodium chlorid. There are traces of iron, silica, potassium sulfate, lithium and strontium salts.

It is a magnesium water and would have a laxative effect.

CALDWELL COUNTY.

Two well waters sent by J. F. Canada, Fredonia, January 21, 1914. Both samples contained some light reddish, ferruginous sediment. The wells are about 100 yards apart.

LABORATORY NO. 43397—Marked No. 1, Canada's well.

ANALYSIS—One gallon contains 67.1 grains of solid matter (1.15 grams per liter) composed of calcium sulfate, sodium chlorid, calcium carbonate, magnesium carbonate and magnesium sulfate. There is a small quantity of iron present, also traces of iodids and bromids, potassium and lithium salts and silica.

It is a weak magnesian water containing some iron and would have some medicinal value.

LABORATORY NO. 43398—Marked No. 2, Church well.

ANALYSIS—One gallon contains 39.8 grains of solid matter and is similar to No. 43397 in composition.

LABORATORY NO. 43463—Water sent February 19, 1914, by W. P. Black, Crider, from a well about 80 ft. deep, bored in the summer of 1913 on his farm two miles east of Crider, on the Crider and Farmersville road and about one mile east of the water divide between Cumberland and Tradewater Rivers The boring passed through 6 ft. of soil, 30 ft. of limestone, 20 to 25 ft. of sandstone, a thin stratum of lead or zinc and about 20 ft. into limestone, where the water was found, apparently in a large stream flowing in a cavity in the limestone. The supply appears to be inexhaustible. Sample when received showed a slight milky turbidity and a very slight, whitish, flocculent precipitate.

ANALYSIS—	Parts per Million.	Grains per Gallon.
Total solids, dried at 100° C.	375.	21.86
Ignited solids	330.	19.24
Alkalinity, stated as calcium carbonate	225.	13.12
Chlorin	12.	.66
Equivalent to sodium chlorid	20.	1.17
Nitrite	A faint trace.	

The mineral matter is mainly calcium carbonate, with a little calcium sulfate, magnesium sulfate, potassium sulfate, sodium chlorid, and traces of iron, manganese, lithium and strontium compounds.

It is rather too hard a water for domestic use, but does not contain enough mineral matter to be classed as a mineral water, though it should be wholesome for drinking.

LABORATORY NO. 43464—Mineral water sent by W. D. Pruett, Princeton, received March 4, 1914, from a well 175 feet deep, on his farm one-fourth mile north of Princeton, bored by Mr. Haines six years ago and known as the "Haines Mineral Wells." (See analysis No. 14889, 18th Annual Report, Kentucky Agricultural Experiment Station.) Colorless water with a little sediment.

ANALYSIS—One gallon contains 163.3 grains of solid mat-

ter (2.800 grams per liter) composed of calcium carbonate, magnesium carbonate, sodium carbonate, sodium sulfate, a little potassium sulfate and sodium chlorid and traces of iron, silica, bromid, iodid and lithium.

It is an alkaline saline water containing a considerable quantity of sodium sulfate. It should have medicinal value.

CASEY COUNTY.

LABORATORY NO. 43673—Well water sent by M. D. Wilcher, Chilton, June 23, 1914.

ANALYSIS—One gallon contains 120.8 grains of solid matter (2.072 grams per liter) composed mainly of sodium chlorid and calcium sulfate with small amounts of calcium and magnesium carbonate, also traces of iron and silica.

It is a weak saline water and may have some medicinal value.

LABORATORY NO. 43691—Sulfur water brought by W. O. Hulett, Yosemite, July 17, 1914, from well on the property of Mrs. Martha Roy, near that place. A slightly turbid sulfur water.

ANALYSIS—One gallon contains 120.4 grains of solid matter (2.064 grams per liter) composed mainly of sodium chlorid and calcium carbonate, with some magnesium carbonate and calcium sulfate. There are traces of sodium sulfid, iodids and bromids, potassium sulfate, strontium sulfate, silica, iron and hydrogen sulfid.

It is a weak sulfur water.

CHRISTIAN COUNTY.

LABORATORY NO. 43383—Salt-sulfur water received from C. L. Dade, Hopkinsville, January 7, 1914. The water gave a strong test for metallic sulfid.

ANALYSIS—One gallon contains 857.7 grains of mineral matter (14.714 grams per liter) composed mainly of sodium chlorid, calcium sulfate, magnesium sulfate and sodium sulfid. There are small amounts of calcium carbonate and

magnesium carbonate present and traces of sodium iodid, sodium bromid, iron, silica, potassium, lithium and strontium salts.

It is a strong salt-sulfur water, very common in deep wells in this county. It is not a good stock water, though stock would probably not drink enough of it to be injurious.

LABORATORY NO. 43429—Water from a bored well 34 ft. deep on the property of Mrs. Annie M. Dority, one mile northwest of Pembroke, received from Guy H. Dority, Pembroke, February 4, 1914. The water was slightly cloudy.

ANALYSIS—One gallon contains 17.7 grains of solid matter (.304 gram per liter) composed of calcium sulfate, calcium carbonate, magnesium carbonate, sodium chlorid, with traces of iron, silica, potassium sulfate and lithium carbonate.

The analysis indicates that it is an ordinary well water. It should be very good for drinking though it is quite a hard water.

LABORATORY NO. 43891—Sulfur water sent by Ed. Wilkins, Fairview, October 12, 1914. Water slightly yellow with a small amount of dark colored sediment.

ANALYSIS—One gallon contains 75.9 grains of solid matter (1.303 gram per liter) composed mainly of sodium chlorid, sodium carbonate and sodium sulfate, with small amounts of calcium carbonate, magnesium carbonate and sodium sulfid. There are traces of iodids, bromids, borates, iron, silica, potassium sulfate, lithium and strontium salts. Hydrogen sulfid, free and combined, is present to the extent of 5.4 grains per gallon (.0926 gram per liter)

It is an alkaline saline sulfur water and should have some medicinal value.

LABORATORY NO. 43897—Mineral water received from Martin & Boyd, Hopkinsville, October 24, 1914, from farm of Webber Woodburn. Clear, colorless water with very slight sediment.

ANALYSIS—One gallon contains 640.4 grains of mineral matter (10.98 grams per liter) composed mainly of magnesium sulfate, calcium sulfate and sodium sulfate, with moderate quantities of sodium chlorid, calcium carbonate and magnesium carbonate and traces of iron, silica, potassium sulfate, lithium and strontium.

It is an alkaline, magnesian water and would have the medicinal properties of that class of water. It is alkaline from the magnesium carbonate present.

CRITTENDEN COUNTY.

LABORATORY NO. 43607—Mineral water sent by W. I. Tabor, Mexico, May 2, 1914, from a well 22 feet deep, dug about 1902, in the town of Mexico. The water is said to have cured rheumatism and other complaints. It has a slight brownish flocculent precipitate.

ANALYSIS—One gallon contains 147.6 grains of solid matter (2.53 grams per liter) composed of calcium sulfate, magnesium sulfate, sodium chlorid, calcium carbonate, magnesium carbonate and traces of iron, silica, potassium sulfate and lithium carbonate.

It is a weak magnesian water and should have some medicinal value.

FAYETTE COUNTY.

Two well waters brought by Dr. M. E. Johnston, Lexington, May 6, 1914, from near Montrose Station on the L. & E. Railway, 5 miles from Lexington.

LABORATORY NO. 43583—No. 1—Well 36 ft. deep, bored about 8 months ago. Slightly turbid water with a small amount of whitish sediment.

ANALYSIS—One gallon contains 25.2 grains of solid matter (.432 gram per liter) composed of calcium carbonate and small amounts of calcium sulfate, magnesium carbonate, sodium chlorid and traces of iron, silica, potassium and lithium salts.

The sanitary tests show a faint trace of nitrite, 8.2 parts of nitrate nitrogen per million, and a trace of free ammonia.

LABORATORY NO. 43584—No. 2.—Well 96 ft. deep, bored about same time as the above. Sample clear, colorless water with a very slight sediment.

ANALYSIS—One gallon contains 19.4 grains of solid matter (.334 gram per liter) composed of calcium carbonate, sodium carbonate, sodium chlorid, magnesium carbonate and traces of iron, silica, potassium and lithium salts It is an alkaline water due to a small amount of sodium carbonate present.

Sanitary tests show a distinct trace of nitrite, no nitrate and a rather strong test for free ammonia.

LABORATORY NO. 43674—Well water brought by James M. Pierson, Lexington, in June 1914, from a well located 4 miles from Lexington on the Georgetown Pike. It was dug about two years ago and is 15 feet deep. Water slightly turbid.

ANALYSIS—One gallon contains 22.8 grains of solid matter (.392 gram per liter) composed of calcium sulfate, calcium carbonate, magnesium carbonate, sodium chlorid, and traces of iron, silica, potassium sulfate and lithium carbonate. There is only a small amount of chlorid present, no nitrite and only a trace of free ammonia.

It is an ordinary well water and should be all right for domestic purposes.

LABORATORY NO. 43806—Well water received August 28, 1914, through Dr. Pinnell, from Thos. M. Neff, Lexington. Colorless water with slight sediment.

ANALYSIS—One gallon contains 41.4 grains of solid matter (.718 gram per liter) composed mainly of sodium chlorid with small quantities of calcium carbonate, magnesium carbonate and traces of iron, silica, potassium sulfate, lithium and strontium salts.

It is a very weak saline water.

LABORATORY NO. 43968—Sulfur water from a well 138 feet deep recently bored on the farm of J. W. Smith, Georgetown. The well is located in Fayette County, 12 miles from Lexington on the north side of the Carrick Pike, one-fourth mile west of the Russell Cave Pike. Somewhat turbid water. Sample received November 28, 1914.

ANALYSIS—One gallon contains 166.0 grains of solid matter (2.846 grams per liter) composed mainly of sodium chlorid and small quantities of calcium sulfate, calcium carbonate and magnesium carbonate and traces of iron, silica, zinc, iodids and bromids, potassium sulfate and lithium carbonate. There is .2 grain of hydrogen sulfid per gallon present.

It is a weak sulfur water containing a considerable amount of sodium chlorid.

FLEMING COUNTY.

Three waters sent by T. D. Hise, Wallingford, marked Nos. 1, 2 and 3, received September 14, 1914. All clear, colorless waters.

LABORATORY NO. 43848—marked No. 1.

ANALYSIS—One gallon contains 19.0 grains of solid matter (.326 gram per liter) composed of sodium carbonate, sodium chlorid and small quantities of calcium carbonate, magnesium carbonate and traces of iron, silica and lithium carbonate.

LABORATORY NO. 43849—marked No. 2.

ANALYSIS—One gallon contains 32.8 grains of solid matter (.562 gram per liter) and is similar to No. 1 in composition.

These are alkaline, carbonated waters and should have some value as a diuretic and for some forms of stomach trouble.

LABORATORY NO. 43850—marked No. 3.

ANALYSIS—One gallon contains 23.7 grains of solid matter (.406 gram per liter) composed of calcium carbonate, calcium sulfate, magnesium carbonate, sodium chlorid, a distinct trace of iron and trace of silica.

This seems to be an ordinary spring or shallow well water.

FRANKLIN COUNTY.

LABORATORY NO. 43608—Sulfur water sent by H. D. Dunstall, Secretary of State, Frankfort, from the Murray well, 1 mile north of Frankfort. Clear water, slightly yellowish in color. Received May 18, 1914.

ANALYSIS—One gallon contains 86.2 grains of solid matter (1.479 gram per liter) composed mainly of sodium chlorid with some sodium sulfate, sodium carbonate, calcium carbonate, magnesium carbonate and traces of sodium sulfid, iron, silica, iodid, bromid and borates, potassium sulfate and lithium carbonate.

There are 6 grains per gallon (.0102 gram per liter) of free and combined hydrogen sulfid.

It is a weak salt sulfur water.

GARRARD COUNTY.

LABORATORY NO. 43804—Spring water brought August 28, 1914, by Lon Moore, Lexington, from a strong flowing spring on his place in Garrard County, on the east side of Dix River and about 3 miles above its mouth. Slightly turbid water with some white flocculent sediment.

ANALYSIS—One gallon contains 16.2 grains of solid matter (.278 gram per liter) composed of calcium carbonate and magnesium carbonate with traces of sodium chlorid, potassium sulfate, iron, silica and lithium carbonate.

The analysis indicates an ordinary spring water.

HOPKINS COUNTY.

LABORATORY NO. 43554—Mineral water sent by E. P. Doom, Dawson Springs, from a well at that place, April 8, 1914. Clear, colorless water with very little sediment.

ANALYSIS—One gallon contains 315.6 grains of mineral matter (5.41 grams per liter) composed mainly of magnesium sulfate, sodium chlorid, calcium sulfate, some calcium car-

bonate and magnesium carbonate and traces of iron, silica, potassium sulfate and lithium carbonate.

It is a magnesian water and doubtless has the usual medicinal properties of that class of waters

LABORATORY No. S 108—Concentrated water sent by E. P. Doom, Dawson Springs, May 28, 1914, prepared from the water of well No. 2.

ANALYSIS—	Grams per liter.	Grains per gallon.
Calcium carbonate, $CaCO_3$	0.94	55.
Calcium sulfate, anhydrous, $CaSO_4$	.36	21.
Magnesium sulfate, anhydrous, $MgSO_4$	131.34	7657.
Potassium sulfate, K_2SO_4	2.50	146.
Sodium sulfate, anhydrous, Na_2SO_4	18.57	1082.
Sodium chlorid, NaCl	6.78	395.
Lithium sulfate, Li_2SO_4	.02	1.
Silica, SiO_2	.08	5.
Total	160.59	9362.
Total solids, ignited,	159.67	9309.
Specific gravity at 60° F	1.144 equal to 18¼° Baume.	

The water contains large proportions of magnesium sulfate and sodium sulfate. It is very similar to the concentrated Crab Orchard waters.

Analysis by Mr. H. D. Spears.

LABORATORY No. S 109—Mineral water sent June 24, 1914, by H. W. Russell, Dawson Springs.

ANALYSIS—	Grams per liter.	Grains per gallon.
Ferrous carbonate, $FeCO_3$	.0029	0.17
Calcium carbonate, $CaCO_3$	.2688	15.67
Magnesium carbonate, $MgCO_3$	.0107	.62
Calcium sulfate, anhydrous, $CaSO_4$	.2832	16.51
Magnesium sulfate, anhydrous, $MgSO_4$	.4431	25.83
Potassium sulfate, K_2SO_4	.0018	.11
Sodium sulfate, anhydrous, Na_2SO_4	.1117	6.51

Analysis—	Grams per liter.	Grains per gallon.
Sodium chlorid, NaCl	.0924	5.39
Silica, SiO_2	.0180	1.05
Total	1.2326	71.86
Total solids @ 100° C.	1.3850	80.75
Ignited solids	1.1450	66.76

It is a good magnesian water of moderate strength.

Analysis by Mr. H. D. Spears.

Four samples of water sent by E. H. Staninger, Dawson Springs, June 21, 1914.

	Analyses			
Samples marked	No. 1	No. 2	No. 3	No. 4
Laboratory Numbers	S110-1	S110-2	S110-3	S110-4
Total solids in grams per liter, dried at 100° C.	0.29	3.25	0.44	3.54
Equivalent grains per gal.	19.6	189.5	25.6	206.4
Sulfate	Small	Rather large	Very small	Large
Chlorid	Very small	Rather large	Small	Large
Calcium	Small	Rather large	Rather large	Large
Magnesium	Very small	Large	Small	Rather large
Sodium	Small	Moderate	Small	Moderate
Potassium	Trace	Small	Trace	Small
Alkalinity	Slight	Decided	Decided	Strong

These are alkaline magnesian waters, very much alike in their mineral constituents but differing in strength. The most important constituent is magnesium sulfate. They contain, also, some calcium sulfate, sodium sulfate, sodium chlorid, calcium carbonate, etc. Nos. 2 and 4 are the strongest and therefore the best, No. 4 being slightly the stronger of these two.

Analyses by Mr. H. D. Spears.

LABORATORY NO. 43738—Epsom water from one of the wells of Mr. E. H. Stanninger, Dawson Springs, sent by him July 11, 1914.

ANALYSIS—	Grams per liter.	Grains per gallon.
Ferrous carbonate, $FeCO_3$	0.0249	1.45
Calcium carbonate, $CaCO_3$	0.5900	34.40
Calcium sulfate, anhydrous, $CaSO_4$	0.6388	37.24
Magnesium sulfate, anhydrous, $MgSO_4$	1.8182	94.34
Sodium sulfate, anhydrous, Na_2SO_4	2.2386	13.91
Potassium sulfate, K_2SO_4	0.0209	1.22
Lithium sulfate, Li_2SO_4	0.0036	0.21
Sodium chlorid, NaCl	0.1129	6.58
Silica, SiO_2	0.0112	0.65
Total	3.2591	190.00
Total solids dried at 100° C.	3.7856	220.70
Total solids ignited	3.2216	187.82

It is a good magnesian water, the principal constituent being magnesium sulfate.

LABORATORY NO. 43800—Water sent by Mrs. E. W. Hendrix, Dawson Springs, August 26, 1914. Water contained only a slight brown flocculent sediment.

ANALYSIS—One gallon contains 21.2 grains of mineral matter (.376 gram to the liter) composed mainly of calcium sulfate and magnesium sulfate with a little sodium chlorid, potassium sulfate and a trace of iron and lithium.

LABORATORY NO. S 135—Mineral water sent October 3, 1914, by H. E. Redden, Dawson Springs.

ANALYSIS—	Grams per liter.	Grains per gallon.
Ferrous carbonate, $FeCO_3$	.0081	0.47
Calcium carbonate, $CaCO_3$	.2189	12.76
Magnesium carbonate, $MgCO_3$	.0061	.36
Calcium sulfate, anhydrous, $CaSO_4$	1.0026	58.43
Magnesium sulfate, anhydrous, $MgSO_4$	2.4720	144.10
Potassium sulfate, K_2SO_4	.0483	2.82

Analysis—	Grams per liter.	Grains per gallon.
Sodium sulfate, anhydrous, Na_2SO_4	.8873	51.73
Lithium sulfate	A trace	Trace.
Sodium chlorid, NaCl	.0935	5.45
Silica, SiO_2	.0260	1.52
Total	4.7628	277.64
Total solid matter at 100°C	5.17	301.4
Ignited solids	4.52	263.5

It is a good laxative water.

Analysis by Mr. H. D. Spears.

LABORATORY No. S 137—Mineral water sent December 1, 1914, by W. N. Gardner, Dawson Springs.

Analysis—	Grams per liter.	Grains per gallon.
Ferrous carbonate, $FeCO_3$	0.0050	0.29
Calcium carbonate, $CaCO_3$	.5907	34.48
Magnesium carbonate, $MgCO_3$	.0339	1.98
Calcium sulfate, anhydrous, $CaSO_4$	.5073	29.56
Magnesium sulfate, anhydrous, $MgSO_4$	4.9556	288.91
Potassium sulfate, K_2SO_4	.0780	4.55
Sodium sulfate, anhydrous, Na_2SO_4	.2977	17.34
Lithium sulfate	A trace.	A trace.
Sodium chlorid, NaCl	.2135	12.45
Silica, SiO_2	.0690	4.02
Total	6.7507	393.58
Total solids at 100° C.	7.66	446.55
Ignited solids	6.51	437.82

It is a good magnesium sulfate water, decidedly alkaline from the presence of calcium and magnesium carbonates.

Analysis by Mr. H. D. Spears.

JEFFERSON COUNTY.

LABORATORY No. 43641—Mineral water sent about June 1, 1914, by J. T. Foster, South Park, from a spring known as the Charley Zenor spring. Water clear and colorless.

ANALYSIS—One gallon contains 397.0 grains of mineral matter (6.806 grams per liter) composed of sodium chlorid, magnesium sulfate, calcium sulfate, calcium carbonate and magnesium carbonate with traces of iron, silica, potassium sulfate and lithium carbonate.

It is a magnesian water and would be classed as a saline sulfated water. Should have medicinal value.

LABORATORY NO. 43785—Water sent by Mrs. Louisa F. Hardin, R. F. D. No. 17, Anchorage.

ANALYSIS—One gallon contains 19.9 grains of solid matter (.342 gram per liter) composed mainly of calcium carbonate, magnesium carbonate and sodium chlorid, with traces of iron and silica.

In composition it is like an ordinary spring or shallow well water.

LABORATORY NO. 43938—Water from a well at Beuchel, about 28 ft. deep, bored 10 years ago, sent by Busath's Candy Shop, Louisville, to find whether it will corrode pipes as it is to be used for household supply. Water clear and colorless with very little sediment.

ANALYSIS—One gallon contains 25.4 grains of solid matter (.436 gram per liter) composed of sodium chlorid and calcium carbonate with small amounts of calcium carbonate and magnesium carbonate. There are also traces of iron and silica.

In composition it is about like the average shallow well water.

JESSAMINE COUNTY.

LABORATORY NO. 43526 a—Sulfur water brought April 2, 1914, by George W. Sandusky, Keene, from a well 89 ft. deep, located on his place. Sample milky with precipitated sulfur and strong odor of hydrogen sulfid.

ANALYSIS—One gallon contains 192.5 grains of solid matter (3.31 grams per liter) composed mainly of sodium chlorid (common salt) with some sodium carbonate, small amounts

of calcium and magnesium carbonates and sodium sulfate.

It is an alkaline sulfur water, hydrogen sulfid being present to the extent of 1.23 grains per gallon.

JOHNSON COUNTY.

LABORATORY No. 43597—Water from a well 100 ft. deep on the property of Dr. W. T. Atkinson, Paintsville, sent by the Big Sandy Bottling Company, J. E. Atkinson, Secretary and Treasurer, May 6, 1914. Water clear and colorless with a very slight sediment.

ANALYSIS—One gallon contains 62.2 grains of solid matter (1.066 gram per liter) composed of sodium chlorid, sodium carbonate, calcium carbonate, magnesium carbonate and traces of iron, silica, potassium sulfate and lithium carbonate. The water is alkaline, due to the sodium carbonate present. It is an alkaline saline water.

The sanitary tests show a faint trace of nitrite, no nitrate, and a very strong test for free amonia which, taken in connection with the bacteriological examination, is rather unfavorable.

KENTON COUNTY.

LABORATORY No. 43660—Spring water sent by A. C. Nutter, Covington, June 11, 1914. Water clear and colorless.

ANALYSIS—One gallon contains 123.9 grains of solid matter (2.124 grams per liter) composed of calcium sulfate, magnesium sulfate, sodium chlorid, small amounts of calcium carbonate and magnesium carbonate and traces of iron, silica, and potassium sulfate.

It is a saline sulfated water containing enough magnesium sulfate to render it mildly laxative.

LAUREL COUNTY.

LABORATORY No. 43788—Spring water sent by Carrie A. McKnight, Lily, August 20, 1914. Sample contained a good deal of red ferruginous sediment.

ANALYSIS—One gallon contains 72.8 grains of solid matter (1.248 gram per liter) composed of magnesium sulfate, calcium sulfate, sodium sulfate, ferrous sulfate and traces of silica, sodium chlorid and potassium sulfate.

It is a weak magnesian chalybeate water and should have medicinal value.

LAWRENCE COUNTY.

LABORATORY NO. 43571--Water from the Coca-Cola Bottling Company, Louisa.

ANALYSIS—

Total solids	277 parts per million
Ignited solids	215 " " "
Chlorin	9 " " "
Nitrate nitrogen	16 " " "
Nitrite	None
Free ammonia	Trace
Sulfates	Very small
Calcium	Moderate
Magnesium	Very small
Iron and silica	Traces
Sodium carbonate	Present
Potassium and lithium	Traces

Bacteriological examination by Dr. Pinnell gave:

Total bacteria per cc., 1,050.
No colon or typhoid bacteria.
No gas producing bacteria.
No indol reaction.

The analysis shows that the water is slightly alkaline in character and should be a good, wholesome drinking water except that there are two items in the analysis that may be objectionable. One is the rather large bacterial count, but this may have been caused by using a bottle that was not sterilized before filling. The other is the high proportion of nitrate nitrogen, but we sometimes find this in the water of deep wells that are undoubtedly free from surface contamination.

LABORATORY NO. 43807—Well water sent by L. A. Garred, Louisa, August 28, 1914. The water comes from 240 feet under ground and leaves a white precipitate on the ground over which it flows. It is supposed to be a white sulfur water. Sample clear and colorless.

ANALYSIS—One gallon contains 17.3 grains of solid matter (.296 gram per liter) composed of sodium carbonate, calcium carbonate, magnesium carbonate and sodium chlorid, with traces of iron, silica, potassium sulfate, lithium carbonate and strontium carbonate.

The water is alkaline due to the sodium carbonate present. It would probably have some value as a diuretic but is not a sulfur water.

LEE COUNTY.

LABORATORY NO. 43682—Water from well of J. S. Pemberton at his residence in St. Helens, brought July 7, 1914. The well is 15 feet deep, water entering at 11 feet in a 4 inch bed of coal over hard sandstone. It is a 6 inch boring at the bottom of a dug well 9 feet deep. Sample contained a brown, ferruginous sediment when received.

ANALYSIS—One gallon contains 4.0 grains of solid matter (.068 gram per liter) composed of calcium carbonate, magnesium carbonate, ferrous carbonate, sodium chlorid, a very small amount of calcium sulfate and traces of silica and potassium sulfate.

The sanitary tests show no nitrite, 0.6 part nitrogen of nitrates, and a distinct test for free ammonia.

It is a weak chalybeate water.

LETCHER COUNTY.

LABORATORY NO. 43384—Water sent by Grant Ison, Jeremiah, January 6, 1914, from a drilled well 30 ft. deep. Water clear and colorless.

ANALYSIS—One gallon contains 7.6 grains of solid matter (.13 gram per liter) composed of calcium sulfate, sodium chlorid, magnesium carbonate and ferrous carbonate.

It is a weak chalybeate water containing much less than the average amount of solid matter.

LINCOLN COUNTY.

LABORATORY No. 43603—Water from a well bored within about a year, at the house of Mr. J. W. Bailey, near the depot at Moreland. The water is said to act as a laxative and has been used with good results by a number of persons. Sample brought by Raymond Walker, Moreland, in June, 1914.

ANALYSIS—One gallon contains 103.0 grains of solid matter (1.776 gram per liter) composed of calcium sulfate, magnesium sulfate, sodium chlorid and traces of iron, silica, strontium and lithium salts.

It is a saline sulfated water and contains enough magnesium sulfate to give it a laxative effect.

LABORATORY NO. 43679—Well water sent by T. A. King, Moreland, June 30, 1914.

ANALYSIS—One gallon contains 44.5 grains of solid matter (.772 gram per liter) composed of sodium chlorid, calcium sulfate, calcium carbonate, magnesium carbonate and traces of iron, silica, iodids and bromids, potassium sulfate and lithium carbonate.

Bacteriological examination by Dr. Pinnell gave: Bacteria per cc., 12400; colon bacteria, 26; lactose bile tube, 50% gas in 48 hours; Dunham's tube, positive indol reaction in 5 days.

The mineral analysis indicates a weak saline water which should have medicinal value. The bacteriological report, however, indicates contamination.

LIVINGSTON COUNTY.

LABORATORY NO. 43695—Spring water sent by Ed. Calvert, Birdsville, July 9, 1914.

ANALYSIS—One gallon contains 169.1 grains of solid matter (2.9 grams per liter) composed mainly of sodium chlorid, calcium sulfate and magnesium sulfate with small quantities

of calcium carbonate and magnesium carbonate and traces of iron, silica, potassium sulfate and lithium carbonate.

This is a magnesian water and doubtless has laxative properties.

LABORATORY No. 43925—Spring water sent by Ed. Calvert, Birdsville, November 3, 1914. Sample clear and colorless with a very slight sediment.

ANALYSIS—One gallon contains 171.5 grains of solid matter (2.94 grams per liter) composed of sodium chlorid, calcium sulfate, magnesium sulfate, sodium sulfate, calcium carbonate, magnesium carbonate and traces of iron, silica, potassium sulfate and lithium.

It is a saline sulfated water and would doubtless prove laxative in effect.

LABORATORY No. 43980—Spring water sent by Ed. Calvert, Birdsville, December 14, 1914. Sample clear and colorless with very little sediment.

ANALYSIS—One gallon contains 100.4 grains of solid matter (1.73 gram per liter) composed of calcium sulfate and magnesium sulfate, mainly, with small amounts of sodium chlorid, calcium chlorid, magnesium carbonate and traces of iron, silica, potassium sulfate and lithium carbonate.

It is quite similar to No. 43925 in composition and would have the same properties.

LABORATORY No. 43983—Water sent by John S. Clarke, Pinckneyville, January 13, 1914.

ANALYSIS—One gallon contains 33.8 grains of solid matter (.58 gram per liter) composed of calcium carbonate, magnesium carbonate, sodium chlorid and calcium sulfate, a small amount of iron and traces of silica and of potassium and lithium salts.

It contains very little more mineral matter than an ordinary spring or well water.

LOGAN COUNTY.

LABORATORY NO. 43367—Sulfur water sent by J. H. Follin, Oakville, received December, 22, 1913. Sample gave strong test for sulfids.

ANALYSIS—One gallon contains 109.9 grains of solid matter (1.884 grams per liter). Sodium sulfid is present to the extent of 19.9 grains per gallon.

It is a saline sulfur water containing a good deal of magnesium sulfate. It doubtless has medicinal value.

LABORATORY NO. 43760—Mineral water from a new well, sent by A. R. McLean, Russellville, July 23, 1914. Sample clear and colorless with some white flocculent sediment.

ANALYSIS—One gallon contains 448.4 grains of solid matter (7.786 grams per liter) composed mainly of calcium sulfate, magnesium sulfate and sodium sulfate, small amounts of sodium chlorid and iron and traces of lithium and potassium sulfate.

This would be classed as a strongly sulfated water and would doubtless have a laxative effect.

McCRACKEN COUNTY.

Two samples of spring water sent by Julian Grear, Paducah, in June, 1914, from springs about one mile apart. Water clear and colorless with a little black flocculent sediment.
LABORATORY NO. 43686—Labeled "Sulfur Spring Water."

ANALYSIS—One gallon contains 41.7 grains of solid matter (.724 gram per liter) composed of calcium carbonate, calcium sulfate, magnesium carbonate, a small amount of sodium chlorid and traces of sodium sulfid, hydrogen sulfid, silica, iron, potassium sulfate and lithium carbonate.

It is a weak sulfur water.

LABORATORY NO. 43687—Labeled "Calimett (?) water."

ANALYSIS—One gallon contains 95.5 grains of solid matter (1.638 gram per liter) composed of calcium carbonate, magnesium carbonate, calcium sulfate, small amounts of sodium

chlorid and ferrous carbonate, traces of silica, potassium sulfate and lithium carbonate and a faint trace of hydrogen sulfid.

MARION COUNTY.

LABORATORY NO. 43791—Mineral water sent by T. S. Osborne, Loretto, August 5, 1914. Sample clear and colorless.

ANALYSIS—One gallon contains 497.2 grains of mineral matter (8.524 grams per liter) composed mainly of sodium chlorid and calcium sulfate, some calcium carbonate and magnesium carbonate and traces of iron, silica, potassium sulfate and lithium carbonate.

It is a saline sulfated water and should prove laxative in effect.

MEADE COUNTY.

LABORATORY NO. 43786—Spring water sent by D. C. Gray, Brandenburg, July 27, 1914.

ANALYSIS—One gallon contains 12.0 grains of solid matter (.205 gram per liter) composed of small amounts of calcium carbonate, magnesium carbonate, sodium chlorid, sodium sulfid and traces of iron, silica, potassium and lithium salts.

It is a very weak sulfur water and might have some medicinal value.

MERCER COUNTY.

LABORATORY NO. 43685—Water sent by W. W. Van Arsdale, Van Arsdale Station, received July 6, 1914. Sample clear and colorless with no sediment.

ANALYSIS—One gallon contains 33.6 grains of solid matter (.576 gram per liter) composed of calcium sulfate, calcium carbonate, magnesium carbonate and sodium chlorid with traces of iron, silica and potassium sulfate.

The analysis indicates an ordinary well water.

LABORATORY NO. 43754—Water from the Chinn mines on the Kentucky River, brought July 27, 1914, by Mrs.

Chinn. Sample slightly turbid with a little ferruginous sediment.

ANALYSIS—One gallon contains 78.8 grains of solid matter (1.352 gram per liter) composed mainly of sodium chlorid, with moderate amounts of calcium sulfate, calcium carbonate, magnesium carbonate and ferrous carbonate and traces of silica, potassium and lithium.

It is a very weak saline water.

Three mineral waters from Graham Springs, formerly Harrodsburg Springs, at Harrodsburg, brought November 11th, 1914, by Ben C. Allen, owner of the property.

LABORATORY NO. 43931—Marked No. 1—From the original spring known as the "Greenville spring" or the Old Harrodsburg Spring. Sample perfectly clear.

ANALYSIS—One gallon contains 208.7 grains of solid matter (3.586 grams per liter) composed mainly of calcium sulfate and magnesium sulfate with some calcium carbonate, a little sodium chlorid and traces of iron, silica and potassium sulfate.

This is a magnesian water and would doubtless have a laxative effect.

LABORATORY NO. 43932—Marked No. 2—From a well about 75 to 100 ft. deep, bored by Mr. Allen about three years ago on the south-west side of the hotel. This is supposed to be the same stream as the spring opened by Dr. Graham in front of the hotel and on lower ground. The water in the well seems to fluctuate with that in the spring. Very slight sediment.

ANALYSIS—One gallon contains 197.8 grains of solid matter (3.400 grams per liter) composed of sodium chlorid, calcium sulfate, magnesium sulfate and calcium carbonate, with traces of iron, potassium sulfate and lithium chlorid.

It differs from No. 43931 in containing more sodium chlorid.

LABORATORY NO. 43933—Marked No. 3—From a well about 190 feet deep bored by Mr. Allen about the same time as No. 2, about one-eighth mile from the hotel, near the Perry-

ville Pike and on lower ground, in the bottom. A pocket of gas was struck before water was obtained. Sample turbid as if from precipitated sulfur.

ANALYSIS—One gallon contains 310.0 grains of solid matter (5.316 grams per liter) composed of sodium chlorid, calcium sulfate, calcium carbonate, magnesium sulfate and traces of iron, silica, potassium sulfate, lithium carbonate, iodids and bromids.

This water contains less magnesia than the others. It is a saline sulfated water.

LABORATORY NO. 43982—Mineral water sent by G. Alford, Alford, December 10, 1914, from a well 55 to 60 feet deep. The water stands 40 feet deep in the well. Water foul smelling with some black sediment.

ANALYSIS—One gallon contains 188.7 grains of solid matter (3.244 grams per liter) composed mainly of sodium chlorid with some calcium sulfate, calcium carbonate, magnesium carbonate, a small amount of iron and traces of silica, potassium sulfate, sodium iodid, sodium bromid, lithium carbonate and strontium sulfate.

It is a salt water and evidently contained a little sulfur when taken from the well, probably as sodium sulfid.

MORGAN COUNTY.

Two spring waters sent by Leonard Wells, Wrigley, August 19, 1914. Samples contained a small ferruginous sediment.

LABORATORY NO. 43789—No. 1

ANALYSIS—One gallon contains 12.7 grains of solid matter (.218 gram per liter) composed of calcium carbonate, magnesium carbonate, calcium sulfate, sodium chlorid and iron, with traces of potassium sulfate and silica.

LABORATORY NO. 43790—No. 2.

ANALYSIS—One gallon contains 11.3 grains of solid matter (.192 gram per liter) and in composition is very similar to

No. 43789, with the exception that it does not contain quite as much iron.

They are both weak chalybeate waters and probably have some value as such.

Three samples of water sent by Dr. J. M. Waldeck, Ezel, August 21, 1914.

LABORATORY NO. 43797—"No. 1, Floyd Carr open well." Slightly turbid water with a small sediment.

ANALYSIS—One gallon contains 151.8 grains of solid matter (2.602 grams per liter) composed mainly of magnesium sulfate with some calcium sulfate and sodium chlorid, and traces of iron, silica, bromids, iodids, potassium sulfate and lithium sulfate. It is a magnesian water of considerable strength and should have the usual laxative properties of such waters.

LABORATORY NO. 43798—"No. 2, Otto Rosnick drilled well." Slightly turbid water with a small sediment.

ANALYSIS—One gallon contains 64.2 grains of solid matter (1.100 gram per liter) and in composition is similar to No. 43797 except that it contains a good deal of ferrous sulfate and no iodids or bromids. It is a chalybeate, magnesian water; so-called "Alum water." It would doubtless have some medicinal value.

LABORATORY NO. 43799 — "No. 3, Spring No. 1, Silas Perrott." Clear, colorless water with very little sediment.

ANALYSIS—One gallon contains 4.5 grains of solid matter (.079 gram per liter) composed of small quantities of sodium chlorid, calcium sulfate, magnesium sulfate and ferrous sulfate, with traces of silica and potassium sulfate. It is a weak chalybeate water.

Two spring waters sent by A. J. Fraley, Wrigley, September 7, 1914.

LABORATORY NO. 43836 — Marked "Amyx Spring No. 1, water just as it comes out." Sample contained some reddish, ferruginous sediment.

ANALYSIS—One gallon contains 9.1 grains of solid matter (.156 gram per liter) composed of calcium carbonate, magnesium carbonate, calcium sulfate and sodium chlorid, with traces of iron, silica, potassium sulfate and lithium carbonate.

LABORATORY NO. 43837—Marked "Amyx Spring No. 2, water just as it comes out." Sample contained more reddish ferruginous sediment than No. 43836.

ANALYSIS—One gallon contains 6.5 grains of solid matter (.112 gram per liter). In composition it is similar to No. 43836 except that it has more iron. The iron is in sufficient quantity to class it as a chalybeate water and it should have some medicinal value.

NELSON COUNTY.

LABORATORY NO. 43787—Water sent by L. Hus, Samuels, during first week of August, 1914.

ANALYSIS—One gallon contains 79.8 grains of solid matter (1.37 gram per liter) composed mainly of sodium chlorid with small amounts of calcium sulfate, calcium carbonate and magnesium carbonate and traces of iron, silica, potassium sulfate and lithium carbonate.

It is a weak saline water possibly of slight medicinal value.

OHIO COUNTY.

LABORATORY NO. 43854—Well water sent by John W. Stevens, Beaver Dam, received September 28, 1914. The well is in the City of Beaver Dam. It is 66 feet deep and water stands about 40 feet deep. Sample clear and colorless.

ANALYSIS—One gallon contains 64.6 grains of solid matter (1.114 gram per liter) composed mainly of sodium chlorid and sodium carbonate with traces of calcium carbonate, magnesium carbonate, ferrous carbonate and silica.

It is an alkaline saline water and should have some value as a diuretic and in some forms of stomach trouble.

PERRY COUNTY.

LABORATORY No. 43456—Water from North Fork of Kentucky River at Hazard, received from Professor F. P. Anderson, State University, February 24, 1914. Sample turbid containing brownish suspended clay.

ANALYSIS—of the unfiltered water.	Parts per million.
Total solids, dried at 100° C.	131.8
Ignited solids	111.8
Silica and clay	64.4
Ferric oxid, alumina, etc,	14.4
Calcium oxid	5.6
Magnesia	A trace
Chlorin	3.
Sulfate	A trace
Nitrate and nitrite	Traces.

A determination of total solids in the filtered, clear water gave:

Total solids, dried at 100° C.	98.
Ignited solids	65.

LABORATORY No. 43521—Water from Hazard, brought to the laboratory March 27, 1914, by G. C. Wilson, State University, to be tested for boiler use. Sample clear, except a slight white, flocculent sediment.

ANALYSIS	Parts per million.
Total solids at 100° C.	353.
Ignited solids	330.
Total alkalinity, as calcium carbonate	185.
Alkalinity of soluble carbonate, as sodium carbonate	63.6
Chlorin	67.
Equivalent to sodium chlorid	110.

Qualitative tests showed calcium and magnesium small; sulfate, very small; no nitrite or nitrate.

The water contains sodium carbonate and moderate quan-

tities of calcium and magnesium carbonates. It should produce a soft deposit in the boiler.

ROCKCASTLE COUNTY.

LABORATORY NO. 43924—Water sent for the Rockcastle Milling Company, Inc., by J. E. Riddle, Brodhead, November 1, 1914, from a well 16 feet deep, the water standing 8½ feet deep in the well. It was dug 43 years ago and used for 20 years, then filled up. It was opened again 3 months ago and is used for boiler feed. The water glasses do not last with only 90 pounds steam. The inside of pipes which convey the water is slightly reddish.

ANALYSIS—

Total solid matter	7.6	grains	per	gallon
Ignited solid matter	5.1	"	"	"
Organic and volatile matter	2.5	"	"	"
Sodium chlorid, NaCl	1.6	"	"	"
Total alkalinity, as $CaCO_3$	1.8	"	"	"

Sulfates small, calcium and magnesium both small. There is a trace of silica and a distinct test for iron. The reddish color in the pipes is due to oxid of iron.

The analysis does not suggest any cause for the breaking of the gauges. It should be a good boiler water.

ROWAN COUNTY.

LABORATORY NO. 43402—Spring water sent by I. E. Pelfrey, Elliottsville, received January 28, 1914. Sample contained a slight flocculent ferruginous sediment.

ANALYSIS—One gallon contains 16.9 grains of solid matter (.29 gram per liter) composed of sodium chlorid, calcium sulfate, calcium carbonate, magnesium carbonate and iron carbonate.

It is a weak chalybeate water.

SCOTT COUNTY.

LABORATORY NO. 43826—Well water sent by Lee Hiles, Sadieville, received September 10, 1914, from a well 22 ft. deep, on Turkey Foot and Rogers Gap pike, 2 miles east of the latter place.

ANALYSIS—One gallon contains 50.7 grains of solid matter (.870 gram per liter) composed mainly of sodium chlorid, calcium carbonate and magnesium carbonate with small amounts of calcium sulfate and sodium carbonate and traces of iron, silica and lithium carbonate.

It is a weak alkaline saline water containing somewhat more solid matter than the average shallow well water. It should be a very good water for domestic use and may have some medicinal value.

SHELBY COUNTY.

LABORATORY NO. 43792—Mineral water sent by W. W. Howerton, Shelbyville, August 17, 1914, from well 1200 ft. deep on his farm seven miles south-east of Shelbyville on the Locust Grove pike, near Guist Creek. Sample foul smelling with some black flocculent sediment.

ANALYSIS—One gallon contains 282.1 grains of solid matter (4.836 grams per liter) composed of sodium chlorid, calcium carbonate, magnesium carbonate and iron carbonate with traces of silica, sodium borate and lithium carbonate.

It is a weak saline water and should have some medicinal value.

LABORATORY NO. 43890—Mineral water sent by Warren Howerton, Simpsonville, October 3, 1914, from a well 75 feet deep, located a mile and three-quarters north of Simpsonville. Sample clear and colorless with some whitish sediment.

ANALYSIS—One gallon contains 211.2 grains of solid matter (3.63 grams per liter) composed of sodium chlorid, calcium carbonate, magnesium carbonate, sodium sulfate, a

small amount of sodium carbonate and traces of iron, silica, iodids, bromids, zinc, potassium sulfate, lithium and strontium.

It is an alkaline saline water and should have medicinal value.

SIMPSON COUNTY.

LABORATORY No. 43761—Sulfur water sent by Cleveland Hinton, Franklin, received July 31, 1914. Sample clear and colorless, with some whitish, dirty looking sediment.

ANALYSIS—One gallon contains 38.7 grains of solid matter (.664 gram per liter) composed of sodium chlorid, calcium carbonate, magnesium carbonate, calcium sulfate, sodium sulfid and traces of silica, lithium and potassium. Hydrogen sulfid, free and combined, is present to the extent of 2.6 grains per gallon.

It is a sulfur water and would have the usual medicinal properties.

LABORATORY No. 43762—Water from a well recently bored on the public square in the town of Franklin, sent by Dr. W. H. Arnold, Acting Mayor, July 13, 1914.

ANALYSIS—	Parts per million.
Silica, SiO_2	5.6
Ferric oxid, etc., Fe_2O_3	4.0
Calcium, Ca	145.7
Magnesium, Mg	30.7
Sodium, Na	81.0
Potassium	Small
Lithium	Trace
Sulfate radicle, SO_4	167.0
Chlorin, Cl	66.0
Carbonate radicle, CO_3	143.9
Total	643.9
Total solids, dried at 100° C.	702.0
Ignited solids	512.0
Alkalinity, stated as calcium carbonate, $CaCO_3$	240.0

Probable Combinations—	Parts per million.	Grains per gallon.
Ferric oxid, etc., Fe_2O_3	4.0	.23
Calcium carbonate, $CaCO_3$	240.0	13.99
Calcium sulfate, anhydrous, $CaSO_4$	164.1	9.56
Magnesium sulfate, anhydrous, $MgSO_4$	65.8	3.84
Magnesium chlorid, anhydrous, $MgCl_2$	70.2	4.09
Sodium chlorid, NaCl	20.1	1.17
Silica, SiO_2	5.6	.33
Total	569.8	33.22

This is rather a hard water for domestic use, though it is quite wholesome for drinking and may have some medicinal qualities.

LABORATORY NO. 43827—Sulfur water sent by J. A. Kohlhepp, Franklin, September 1, 1914, from a well near State Line. Much of the sulfur had precipitated out when the water was examined.

ANALYSIS—One gallon contains 205.1 grains of solid matter (3.524 grams per liter) composed of calcium sulfate, magnesium sulfate, sodium chlorid, sodium sulfid, a small amount of calcium carbonate and traces of potassium sulfate and lithium sulfate. There is also a small amount of hydrogen sulfid.

It is a sulfur water containing rather large amounts of calcium and magnesium sulfates. It would probably be laxative in effect.

Two samples of water sent by V. D. Hammond, Franklin, October 14, 1914. Both samples contained some dark colored sediment and both had a little odor of hydrogen sulfid when opened.

LABORATORY NO. 43892—marked "Jug No. 1."

ANALYSIS—One gallon contains 128.3 grains of solid matter (2.182 grams per liter) composed of calcium sulfate, magnesium sulfate, sodium sulfate, small amounts of calciun carbonate and magnesium carbonate and traces of sodium

sulfid, iron, silica, iodids and bromids. Hydrogen sulfid is present in very small quantity, about .2 grain per gallon.

It is a weak sulfur water containing a large amount of calcium sulfate.

LABORATORY NO. 43893—marked "Jug No. 2."

ANALYSIS—One gallon contains 215.6 grains of solid matter (3.714 grams per liter). In composition is is similar to No. 43892. It contains .9 grain of hydrogen sulfid per gallon.

It would have the same effect as No. 43892.

TODD COUNTY.

LABORATORY NO. 43747—Mineral water sent by W. J. Dickenson, Trenton, for sanitary and mineral examination. Received July 22, 1914. Sample clear and colorless with a little sediment.

ANALYSIS—One gallon contains 99.5 grains of solid matter (1.714 gram per liter) composed of calcium sulfate, calcium carbonate, magnesium carbonate and sodium chlorid, with traces of iron, silica and potassium sulfate.

The sanitary tests show no nitrite, no free ammonia and only a trace of nitrate.

It is a weak saline sulfated water and may have some medicinal value. The sanitary tests are very favorable.

LABORATORY NO. 43838--Salt sulfur water sent September 15th, 1914, by G. E. Garth, Jr., Trenton. Sample contained a little black sediment.

ANALYSIS—One gallon contains 293.0 grains of solid matter (5.024 grams per liter) composed mainly of sodium chlorid, calcium sulfate and magnesium sulfate, with small quantities of calcium carbonate, sodium sulfid and iron and traces of silica, potassium sulfate, lithium and strontium carbonates. Hydrogen sulfid, free and combined, is present to the extent 6.1 grains per gallon.

It is a salt sulfur water and should have some medicinal value.

WARREN COUNTY.

LABORATORY No. 43680—Chalybeate water sent by L. J. Kieffer, Bowling Green, July 1. 1914. Sample cloudy with a considerable amount of dark brown sediment.

ANALYSIS—One gallon contains 25.1 grains of solid matter (.43 gram per liter) composed of calcium carbonate, magnesium carbonate, iron carbonate, sodium chlorid, traces of silica, potassium sulfate and lithium carbonate.

It contains enough iron to be classed as a chalybeate water and should have some medicinal value.

WEBSTER COUNTY.

LABORATORY No. 43763—Water received July 24, 1914, from Thomas O. Long, Providence, from an under-ground stream struck in sinking a new air shaft for the Ruckman Coal Company's mine at that place. This is a large stream "in the soapstone just above the slate." It has been thought of as a source of supply for the city of Providence, if suitable.

The sample contained some ferruginous sediment which was not included in the analysis. The original water, therefore, contains more iron than is shown by the analysis.

ANALYSIS—	Parts per million.
Silica, SiO_2	2.8
Ferric oxid, etc., Fe_2O_3	3.0
Calcium, Ca	30.9
Magnesium, Mg	10.0
Sodium, Na	12.9
Potassium	Small
Lithium	A trace
Sulfate radicle, SO_4	52.4
Chlorin, Cl	6.0
Carbonate radicle, CO_3	27.0
Total	145.0

Total solids, dried at 100° C.	170.0
Ignited solids	124.0
Alkalinity, stated as calcium carbonate, $CaCO_3$	45.0

Probable combinations	Parts per million.	Grains per gallon.
Ferric oxid, etc., Fe_2O_3	3.0	.17
Calcium carbonate, $CaCO_3$	77.3	4.51
Magnesium carbonate, $MgCO_3$	5.2	.30
Magnesium sulfate, anhydrous, $MgSO_4$	42.1	2.45
Sodium sulfate, anhydrous, Na_2SO_4	27.8	1.62
Sodium chlorid, NaCl	9.9	.58
Silica, SiO_2	2.8	1.6
Total	168.1	9.79

The notable amount of iron present would be objectionable in a water for domestic use. The greater part of it could be removed, however, along with most of the calcium carbonate, by treatment with the proper quantity of lime and settling or filtration.

WOODFORD COUNTY.

LABORATORY NO. 43555—Well water sent by Dr. W. C. McCauley, Versailles, received April 8, 1914. Sample clear and colorless with practically no sediment.

ANALYSIS—One gallon contains 27.7 grains of solid matter (.476 gram per liter) composed of calcium sulfate, calcium carbonate, magnesium carbonate and sodium chlorid, with traces of iron, silica, potassium sulfate and lithium carbonate.

The analysis indicates an ordinary well water.

METEOROLOGICAL SUMMARIES

FOR THE YEAR 1914.

Compiled from the records of the U. S. Weather Bureau Station in the main building of State University.

Monthly and Annual Mean Temperature.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annl
1872											37	27	
1873	30	35	42	53	66	74	75	74	67	53	40	39	54. 0
1874	36	38	44	46	66	77	78	75	71	57	45	38	56. 0
1875	27	29	42	49	64	72	76	71	64	52	43	43	52. 7
1876	41	39	41	52	65	72	77						
1887											44	35	
1888	31	36	41	56	63	72	76	74	63	51	46	37	54. 0
1889	37	32	46	55	63	69	75	72	65	52	43	50	55. 0
1890	44	45	39	56	63	77	76	71	67	56	49	37	56. 6
1891	37	41	40	57	62	76	73	73	72	55	43	43	56. 0
1892	28	41	39	54	63	76	75	75	68	57	41	33	54. 1
1893	23	36	43	57	61	72	79	74	70	57	43	37	54. 4
1894	38	34	49	54	62	75	76	76	71	58	41	37	55. 9
1895	28	23	43	56	62	75	73	76	73	52	45	37	53. 7
1896	34	35	38	62	71	72	75	75	67	54	48	38	55. 9
1897	30	37	48	53	59	72	76	74	72	64	46	37	55. 7
1898	38	36	49	50	65	74	76	76	72	56	43	33	55. 8
1899	34	24	42	56	67	75	77	77	68	61	48	33	55. 1
1900	36	31	39	55	66	72	77	79	73	65	45	37	56. 3
1901	34	29	44	49	63	74	80	74	67	58	40	31	53. 6
1902	32	25	45	53	68	71	77	74	67	59	53	34	54. 8
1903	32	36	50	53	68	68	77	74	70	57	40	28	54. 4
1904	30	31	46	48	64	72	74	74	69	57	44	34	53. 5
1905	24	25	49	54	66	72	75	74	68	55	44	35	53. 5
1906	37	32	36	57	64	72	74	76	71	55	45	36	54. 5
1907	40	32	52	45	59	69	76	73	68	53	42	37	53. 8
1908	33	33	50	55	65	72	76	75	72	58	48	38	56. 1
1909	37	41	43	54	62	73	73	74	66	53	53	28	54. 6
1910	32	31	54	54	59	69	75	73	70	60	40	29	53. 7
1911	38	40	43	52	70	74	76	76	72	58	40	41	56. 6
1912	23	28	39	57	65	69	75	72	70	59	44	36	53. 1
1913	42	33	44	53	65	73	78	77	69	56	49	38	56. 5
1914	37	29	40	54	66	76	78	75	67	59	46	30	54. 6

Monthly and Annual Precipitation.

1872											1.21	3.30	
1873	2.53	4.05	3.73	2.89	6.05	4.49	3.37	2.94	1.60	5.47	1.92	4.48	43.52
1874	5.41	4.89	5.90	6.81	0.79	3.55	6.26	1.57	2.89	0.92	4.27	3.83	47.09
1875	2.61	3.12	6.18	2.06	2.43	4.16	11.24	0.62	1.72	2.37	5.87	3.68	46.06
1876	6.06	1.66	3.63	4.20	2.16	4.13	3.84						
1887											3.02	2.71	
1888	4.39	2.93	5.82	3.17	3.29	2.97	4.21	8.76	1.22	3.02	5.15	1.88	46.81
1889	5.66	1.78	1.63	1.52	3.53	3.49	5.82	1.15	6.79	3.06	5.34	1.73	41.50
1890	5.34	8.13	9.91	3.59	4.71	7.43	3.14	7.32	1.82	2.38	3.54	4.05	61.36
1891	4.70	4.36	7.63	1.85	1.17	5.33	3.23	6.48	1.26	1.33	5.38	2.82	45.51
1892	2.35	3.10	4.01	6.57	5.32	3.81	6.22	3.28	4.10	0.45	3.72	3.03	45.96
1893	2.10	4.44	3.30	5.81	3.88	4.24	3.11	1.86	2.25	5.59	3.36	2.61	42.55
1894	3.58	3.33	2.13	4.19	3.81	4.44	0.87	3.67	4.05	1.40	1.38	3.45	36.32
1895	5.60	0.52	2.79	3.17	4.05	2.93	5.07	1.56	0.33	1.28	2.52	5.50	35.32
1896	1.25	3.15	5.41	0.40	3.20	3.74	10.39	3.37	4.25	1.27	4.30	2.56	43.29
1897	2.59	6.33	6.55	5.80	4.48	4.77	4.34	3.21	0.80	0.38	4 83	5.11	49.19
1898	9.56	2.20	8.18	3.29	6.13	7.94	5.72	2.99	3.55	5.27	2.89	2.80	60.52
1899	6.69	2.84	8.61	2.16	3.63	2.55	0.97	4.18	1.90	2.09	1.70	2.92	40.24
1900	2.13	3.17	1.98	1.23	3.54	2.19	2.80	5.75	1.85	0.79	6.38	1.86	33.67
1901	1.49	0.62	2.23	4.52	2.67	3.70	2.61	3.74	2.18	1.33	1.73	3.50	30.32
1902	4.77	0.90	2.92	1.27	2.43	5.19	2.33	1.89	2.60	2.11	3.09	6.60	36.10
1903	1.68	6.16	3.24	3.29	1.75	2.71	2.62	1.49	0.81	2.12	2.84	1.99	30.70
1904	1.92	2.38	4.75	3.08	2.60	2.51	3.13	2.44	1.71	0.57	0.53	3.10	28.72
1905	2.04	2.13	5.87	2.87	5.54	3.31	4.94	4.11	3.20	3.45	3.58	4.13	45.17
1906	2.29	1.84	6.45	1.11	3.15	4.68	3.89	4.92	5.03	0.74	3.95	4.54	42.59
1907	9.06	1.89	4.13	1.83	3.89	3 65	4.42	2.07	2.72	2.76	2.67	2.28	41.37
1908	1.85	4.81	8.17	4.99	4.20	2.12	3.60	2.98	0.38	0.72	1.65	2.13	37.60
1909	3.35	6.86	3.97	6.72	4.15	5.41	5.98	1.26	4.88	2.05	1.96	2.77	49.36
1910	4.46	4.11	0.46	4.22	6.24	5.92	7.66	4.15	7.92	1.67	1.72	2.81	51.34
1911	2.44	2.21	2.31	4.46	1.07	3.01	0.92	2.84	4.37	3.67	3.84	6.20	37.34
1912	1.78	2.50	4.36	6.89	5.11	2.15	4.70	3.23	2.09	0.51	1.02	3.66	38.00
1913	10.35	2.61	6. 0	2.41	4.32	3.29	2.43	1.00	1.76	3.40	4.00	2.74	44.35
1914	2.50	3.87	2.24	2.23	1.65	4.77	2.63	4.69	1.82	5.32	1.62	4.40	37.74

Annual Meteorological Summary for the Year 1914.

Month.	Temperature. Degrees Fahrenheit.							Moisture						Per cent of Sunshine.	Wind.						Number of Days.							
	Mean.			Extreme				Relative Humidity. Per cent. 7 a. m.	Precipitation. In Inches.				Total Snowfall, Ins.		Average Hourly Velocity.	Prevailing Direction.	Maximum For five mins.			Clear.	Partly Cloudy	Cloudy.	With trace of snow.	Thunderstorms.	Fog.	Freezing or below.	Temp. 90 or above.
	Maximum.	Minimum.	Monthly.	Maximum.	Date.	Minimum.	Date.		Total.	Maximum in 24 hours.	Date.	Days with .01 inch or more.					Velocity.	Direction.	Date.									
January	44	30	37	66	28	13	13	82	2.50	1.57	30-31	6	1.4	32	13.6	S	44	SW	31	7	8	16	8	0	3	19	0
February	38	21	29	62	6	2	24	85	3.87	1.63	18-19	14	5.3	44	12.0	S	38	S	7	11	5	12	10	1	11	26	0
March	47	32	40	71	25	12	2	84	2.24	0.97	10-11	13	5.6	45	11.5	S	44	NW	1	8	5	18	10	1	7	19	0
April	63	44	54	83	27	23	9	81	2.23	0.65	25	8	T	54	10.2	SE	39	SW	1	8	9	13	1	3	3	4	0
May	76	56	66	92	28	37	1	70	1.65	1.20	4-5	4	0	71	9.2	S	42	NW	7	14	12	5	0	3	0	0	3
June	86	65	76	99	27	53	17	77	4.77	2.97	4-5	8	0	72	8.3	SW	40	NW	25	14	13	3	0	8	0	0	11
July	88	67	78	100	12	57	19	76	2.63	1.23	15	8	0	66	7.8	S	34	NW	26	14	10	7	0	10	0	0	11
August	84	66	75	91	19	60	30	83	4.69	1.77	24-25	12	0	56	7.4	S	30	SW	10	12	10	9	0	9	4	0	4
September	76	57	67	90	21	46	26	81	1.82	1.12	23-24	6	0	70	7.8	NE	27	NW	6	16	10	4	0	2	1	0	0
October	67	51	59	84	7	26	27	85	5.32	1.77	14-15	11	0	41	7.7	NE	31	NW	26	9	9	13	0	3	9	2	0
November	56	36	46	75	7	8	20	73	1.62	1.27	29-30	6	T	55	10.9	SW	38	NW	15	16	6	8	2	0	1	10	0
December	36	24	30	62	1	-7	15	94	4.40	0.87	3-4	16	10.7	22	9.6	W	34	W	13	3	6	22	10	0	11	22	0
					Jul.		Dec.				Jun.								Mar.									
The Year.	64	46	55	100	12	-7	15	81	37.74	2.97	4-5	112	23.0	52	9.7	S	44	NW	1	132	103	130	41	40	50	102	29

INDEX

Adams Fund work 6–8
Agricultural Economics, report of work in 27–30
Agricultural extension, work of Department of 16
Agronomy, work of Department of 35–37
Alford, G., analysis of mineral water from 108
Allen, Ben C., analyses of mineral waters from 107
Allen, R. M., report by 75–83
Analyses of mineral and potable waters 85
Anderson, F. P., analysis of river water brought by 111
Animal Husbandry (Beef Cattle, Sheep and Swine), work of Department of 38–49
(Horses, Dairy Cattle and Poultry) work of Department of 50–58
Appointments to Station Staff 3
Arnold, W. H., analysis of well water from 114
Atkinson, W. T., analysis of well water from 100
Averitt, S. D., A. M. Peter and J. S. McHargue, analyses of mineral and potable waters by 85
Bailey, J. W., analysis of mineral water from 103
Black, W. P., analysis of mineral water from 88
Blatz, Herman, analysis of mineral water from 87
Board of Control vii
Board of Trustees, ... vi
Bohannan, Chas. D., report by 27–30
Bourbon County, analysis of mineral water from 85
Boyd County, analyses of mineral waters from 85–86
Breathitt County, analysis of well water from 86
Breckinridge County, analysis of mineral water from 86
Bullitt County, analysis of mineral water from 87
Busaths' Candy Shop, analysis of well water from 99
Caldwell County, analyses of mineral waters from 87–89
Calvert, Ed., analysis of mineral water from 103–104
Canada, J. F., analyses of mineral waters from 87
Carmody, John H., report by 31–34
Casey County, analyses of mineral waters from 89
Chemistry, work of Department of 59–62
Chinn Mines, analysis of water from 106
Christian County, analyses of mineral waters from 89–90
Clarke, John S., analysis of mineral water from 104
Coca-Cola Bottling Co., analysis of mineral water from 101
Crittenden County, analysis of mineral water from 91
Curtis, H. E., report by 65
Dade, C. L., analysis of mineral water from 89
Dickenson, W. J., analysis of mineral water from 116
Director's Report 1–15
Doom, E. P., analyses of mineral waters from 94–95
Dority, Mrs Annie M., analysis of well water from 90
Dunstall, H. D., analysis of sulfur water from 94
Entomology and Botany, work of Department of 66–72
Experimental Fields 6

Extension, work of Department of 16
Fayette County, analyses of mineral waters from. 91-93
Feeding Stuffs, work of Department of 63-64
Fertilizer, work of Department of. 65
Financial statement. . . . . viii-ix
Fleming County, analyses of mineral waters from. 93
Follin, J. H., analysis of sulfur water from 105
Food and Drugs, work of Department of 75-83
Foster, J. T., analysis of mineral water from 98
Fraley, A. J., analyses of spring waters from. 109
Franklin County, analysis of mineral water from 94
Gardner, W. N., analysis of mineral water from 98
Garman, H., report by 66-72
Garrard County, analysis of spring water from 94
Garred, L. A., analysis of well water from 102
Garth, G. E. Jr., analysis of sulfur water from 116
Gifts to the Experiment Station. 14
Good, E. S., report by 38-42
Graham, Robert, report by 43-49
Graham Springs, analyses of mineral waters from 107
Gray, D. C., analysis of spring water from 106
Grear, Julian, analyses of spring waters from 105
Hammond, V. D., analyses of mineral waters from 115
Hardin, Mrs. Louisa F., analysis of mineral water from. 99
Hendrix, Mrs. E. W., analysis of mineral water from. 97
Hiles, Lee, analysis of well water from. 113
Hinton, Cleveland, analysis of sulfur water from. 114
Hise, T. D., analyses of mineral waters from. 93
Hooper, J. J., report by. 50-58
Hopkins County, analyses of mineral waters from. 94-98
Horticultural extension, work in 31-34
Horticulture, work of Department of. 73-74
Howerton, Warren, analysis of mineral water from 113
Howerton, W. W., analysis of mineral water from 113
Hulett, W. D., analysis of sulfur water from. 89
Hus, L., analysis of mineral water from 110
Ison, Grant, analysis of well water from 102
Jefferson County, analyses of mineral waters from 98-99
Jessamine County, analysis of sulfur water from 99
Johnson County, analysis of well water from. 100
Johnson, M. E., analyses of well waters from. 91-92
Kenton County, analysis of spring water from 100
Kieffer, L. J., analysis of mineral water from 117
King, T. A., analysis of mineral water from 103
Kohlhepp, J. A., analysis of sulfur water from 115
Laurel County, analysis of spring water from. 100
Lawrence County, analyses of mineral waters from. 101-102
Layman, C. E., analyses of mineral waters from 85-86
Lee County, analysis of well water from 102
Letcher County, analysis of mineral water from. 102
Letter of Transmittal. v
Lincoln County, analyses of mineral waters from 103
Livingston County, analyses of mineral waters from 103-104
Logan County, analyses of mineral waters from 105
Long, Thos. O., analysis of mineral water from. 117
McCauley, W. C., analysis of well water from 118

McCracken County, analyses of spring waters from 105
McHargue, J. S., A. M. Peter and S. D. Averitt, analyses of mineral and potable waters by 85
McKnight, Carrie A., analysis of spring water from 100
McLean, A. R., analysis of mineral water from. 105
Marion County, analysis of mineral water from 106
Martin & Boyd, analysis of mineral water from 90
Mathews, C. W., report by 73–74
Meade County, analysis of spring water from. 106
Mercer County, analyses of mineral waters from 106–108
Millett, P. J., analysis of mineral water from. 85
Moore, Lon, analysis of spring water from 94
Morgan County, analyses of mineral waters from 108–109
Mutchler, Fred, report by. 16–34
Neff, Thos. M., analysis of well water from. 92
Nelson County, analysis of mineral water from 110
New buildings and equipment 5
Nutter, A. C., analysis of spring water from 100
Ohio County, analysis of well water from 110
Osborne, T. S., analysis of mineral water from 106
Pelfrey, I. E., analysis of spring water from 112
Pemberton, J. S., analysis of well water from. 102
Perry County, analyses of mineral waters from 111
Peter, A. M., S. D. Averitt and J. S. McHargue, analyses of mineral and potable waters by 85
Peter, A. M., report by 59–62
Pierson, Jas. M., analysis of well water from 92
Pruett. W. D., analysis of mineral water from 88
Publications, List of 10–14
Redden, H. E., analysis of mineral water from 97
Report of the Director 1–15
Research work. 6–8
Resignations from Station Staff. 4
Riddle, J. E., analysis of well water sent by 112
Roberts, George, report by. 35–37
Rockcastle County, analysis of well water from. 112
Rockcastle Milling Co., analysis of well water from. 112
Rowan County, analysis of spring water from 112
Russell, H. W., analysis of mineral water from. 95
Sandusky, Geo. W., analysis of sulfur water from 99
Scott County, analysis of well water from 113
Scovell memorial tablet. 14
Seargeant, M., analysis of well water from. 86
Serum Laboratory, work of. 43–49
Shelby County, analyses of mineral waters from 113
Simpson County, analyses of mineral waters from 114–116
Smith, J. W., analysis of sulfur water from 93
Staninger, E. H., analyses of mineral waters from 96–97
Staff of Experiment Station vii
State appropriation, work under 8–10
Station Staff vii
Stephens, M. D., analysis of mineral water from 86
Stevens, John W., analysis of well water from 110
Tabor, W. I., analysis of mineral water from 91
Todd County, analyses of mineral waters from 116

Turner, J. D., report by 63–64
Van Arsdale, W. W., analysis of mineral water from 106
Veterinary Department, work of 43–49
Waldeck, J. M,, analyses of mineral waters from 109
Walker, Raymond, analysis of mineral water brought by 103
Warren County, analysis of mineral water from 117
Waters, analyses of mineral and potable 85
Weather Data 119–120
Webster County, analysis of mineral water from 117
Wells, Leonard, analyses of spring waters from 108
Wilcher, M. S.. analyis of well water from 89
Wilkins, Ed, analysis of sulfur water from 90
Wilson, G. C., analysis of mineral water brought by 141
Woodford County, analysis of well water from 118
Work under State appropriation 8–10
Zenor, Charley, analysis of water from spring of 98

TWENTY-SEVENTH ANNUAL REPORT

OF THE

Kentucky Agricultural Experiment Station

FOR THE YEAR 1914.

PART II.

Bulletins for the Year 1914.

Nos. 178 to 189, inclusive.

CONTENTS.

No.	Bulletins.	Page
178	Alfalfa and Sweet Clover. *George Roberts, E. J. Kinney and H. B. Hendrick*	1
179.	Construction and Equipment of Dairy Barns. *W. D. Nicholls*	35
180.	The Inheritance of Coat Colors in Horses. *W. S. Anderson*	119
181.	1. Suggestions Relative to the Prevention of Hog Cholera. 2. List of Publications of the Kentucky Agricultural Experiment Station. *J. H. Kastle and Robert Graham*	147
182.	Hog Cholera and Its Control, with Foreword by Joseph H. Kastle, Director of the Kentucky Agricultural Experiment Station. *Robert Graham and E. W. Mumma*	167
183.	Some Kentucky Weeds and Poisonous Plants. *H. Garman*	253
184.	Six Different Species of Nodule Bacteria. *H. Garman and M. L. Didlake*	341
185.	Concentrated Commercial Feeding Stuffs. *J. D. Turner and H. D. Spears*	365
186.	Experiments With the Sharples Mechanical Milker. *J. J. Hooper and J. W. Nutter*	473
187.	The Life-history and Habits of the Corn-ear Worm (*Chloridea obsoleta*). *H. Garman and H. H. Jewett*	511
188.	The Relation of Sulfur to Soil Fertility. *O. M. Shedd*	593
189.	Commercial Fertilizers. *H. E. Curtis, Wm. Rodes and B. D. Wilson*	631

Kentucky

Agricultural Experiment Station

of the

State University

BULLETIN NO. 178

ALFALFA AND SWEET CLOVER

LEXINGTON, KENTUCKY
MARCH, 1914

STATE UNIVERSITY PRESS
LEXINGTON, KY.

KENTUCKY AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

RICHARD C. STOLL, Chairman, Lexington, Ky.
CHARLES B. NICHOLS, Lexington, Ky.
LEWIS L. WALKER, Lancaster, Ky.
HENRY S. BARKER, President of the University.
THE DIRECTOR, Secretary, ex-officio.

JOSEPH H. KASTLE, Director.

STATION COUNCIL

THE DIRECTOR

A. M. PETER
H. E. CURTIS
H. GARMAN
C. W. MATHEWS
R. M. ALLEN
J. D. TURNER
E. S. GOOD
GEORGE ROBERTS
T. R. BRYANT
J. J. HOOPER

DEPARTMENTAL ORGANIZATION

ADMINISTRATION

THE DIRECTOR, Head.
H. E. CURTIS, Bursar.
HYWEL DAVIES, Purchasing Agent.
O. L. GINOCHIO, Secretary to Director.
ADDIE LEE DEAN, Librarian.
ANNA WALLIS, Clerk.
CORNELIA C. PAGE, Clerk.

AGRONOMY

GEORGE ROBERTS, Agronomist, Head.
E. J. KINNEY, Assistant Agronomist.
S. C. JONES, Soil Survey.
A. E. EWAN, Supt. Experiment Fields.
H. B. HENDRICK, Extension in Agronomy.
JESSIE F. CASWALL, Clerk.
B. F. SCHERFFIUS, Tobacco Expert, U. S. Dept. Agriculture.

ANIMAL HUSBANDRY
(Beef Cattle, Sheep and Swine)

E. S. GOOD, Head.
ROBERT GRAHAM, Veterinary Science, In Charge Hog Cholera Serum Production.
E. W. MUMMA, Asst. In Charge Hog Cholera Serum Production.
G. C. ROUTT, Asst., in Animal Husbandry.
O. S. CRISLER, Hog Cholera Serum.
R. L. PONTIUS, Hog Cholera Serum.
W. V. SMITH, Asst. in Animal Husbandry.
M. G. GINOCHIO, Clerk.
C. B. WILSON, Hog Cholera Serum.
LAWRENCE GINOCHIO, Clerk.
E. J. GOTT, Hog Cholera Serum.

ANIMAL HUSBANDRY
(Dairy Cattle, Horses and Poultry.)

J. J. HOOPER, Head.
W. S. ANDERSON, Asst. Horse Husb'd.
W. D. NICHOLLS, Asst. in Dairying.
J. W. NUTTER, Supt. Dairy Farm.
D. D. SLADE, Supt. Poultry Farm.
P. E. BACON, Elmendorf Milk Records.
F. WALLACE UTTERBACK, Clerk.

CHEMISTRY

A. M. PETER, Chief Chemist, Head.
S. D. AVERITT, Chemist.
J. S. McHARGUE, Asst. Chemist.
ETHEL V. T. CASWALL, Clerk.

ENTOMOLOGY AND BOTANY

H. GARMAN, Entomologist and Botanist, Head.
MARY L. DIDLAKE, Laboratory Asst.
E. C. VAUGHN, Asst. in Seed Inspection and Plant Breeding.
H. H. JEWETT, Research Asst. Entom.
H. R. NISWONGER, Asst. in Field Work and Nursery Inspection.
LOUISE BEWLAY, Clerk.

EXTENSION

T. R. BRYANT, Head.
H. B. HENDRICK, Agronomy.
J. H. CARMODY, Horticulture.
H. W. RICKEY, Poultry.

FEED

J. D. TURNER, Head.
H. D. SPEARS, Chemist.
ELMER INGRAM, Chief Inspector.
ROGER W. JONES, Inspector.
FANNY C. ROGERS, Clerk.

FERTILIZER

H. E. CURTIS, Chemist, Head.
B. D. WILSON, Assistant Chemist.
WM. RODES, Assistant Chemist.
ELMER INGRAM, Inspector.
R. W. JONES, Inspector.
ANNA WALLIS, Clerk.

FOOD AND DRUGS.

R. M. ALLEN, Head.
J. O. LaBACH, Chief Chemist.
L. A. BROWN, Chemist, Drugs.
J. W. McFARLIN, Chief Food Inspector.
W. R. PINNELL, Bacteriologist.
C. S. PORTER, Inspector, Drugs.
WALTER SCHEPPELMAN, Inspector, Bakery Sanitation.
E. F. WORTHINGTON, Inspector, Dairy Sanitation.
W. G. TERRELL, Inspector, Foods.
LILLIE LISTON, Chief Clerk.
AMY V. LYONS, Clerk.

HORTICULTURE

CLARENCE W. MATHEWS, Head.
J. H. CARMODY, Extension in Horticulture.
F. W. HOFMAN, Asst. in Horticulture.
G. B. WURTZ, Consulting Meteorologist.
MURIEL CASWALL, Clerk.

RESEARCH

THE DIRECTOR, Head.
H. GARMAN, Entomologist and Botanist.
D. J. HEALY, Bacteriologist.
E. S. GOOD, Animal Husbandry.
O. M. SHEDD, Chemist.
MARY L. DIDLAKE, Asst. Entomologist and Botanist.
G. D. BUCKNER, Chemist.
H. H. JEWETT, Research Asst. in Entom.
G. C. ROUTT, Assistant In Animal Husbandry.

Notice

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Director.

BULLETIN NO. 178

ALFALFA AND SWEET CLOVER

By GEORGE ROBERTS, E. J. KINNEY *and* H. B. HENDRICK.

ALFALFA

The numerous attempts to grow alfalfa in Kentucky have more often resulted in failure than in success. The crop is profitably grown under all climatic conditions found in the United States, and is found thriving in all sections of Kentucky. It is therefore evident that the many failures in this State are not due to climatic conditions, but to soil conditions. Good crops of alfalfa may be grown in any part of the State where the soil requirements discussed in the following pages exist naturally or may be provided by amending the soil. These requirements are, good drainage, sufficient plant food, lime, freedom from weeds, and inoculation.

Drainage

Alfalfa will not thrive on a soil which is not well drained. If water stands on the ground for more than half a day at a time, or if under-drainage is not such that free water moves out of the subsoil readily, the ground is not suited to alfalfa. If water stands within three feet of the surface for more than a day or so at a time, the soil should be drained before attempting to grow alfalfa upon it.

It is often possible to judge by the appearance of the subsoil whether ground is suited to alfalfa. If within two or three feet from the surface the soil is white, grayish or yellowish gray in a soil type in which the normal color of the subsoil is yellow or red, its adaptability to alfalfa is questionable,

for this condition is generally an indication of poor drainage. This statement is based upon our experience with a field on the Experiment Station farm on which part of the alfalfa either died or became quite weak during the winter and spring following the fall in which it was seeded.

On April 18, when the surface soil of the field had just become dry enough to work after rather heavy rains, samples of soil were taken from three places in the field where the alfalfa was weak or dead, and three samples where the alfalfa was good. In each place both surface and subsoil were examined, the surface sample representing the first 7 inches, and the the subsoil sample the 8th to 24th inches.

The subsoil samples taken where the alfalfa was weak or dead were all grayish yellow, very compact and plastic, while the subsoil samples taken where the alfalfa was good, were all red and showed a granular structure. The surface samples taken where the alfalfa was weak or dead contained nearly 4 per cent more moisture than the surface samples taken where the alfalfa was good, while the difference between the corresponding subsoils was a little more than one-half per cent, showing a decided difference in drainage in the places in which the two groups of samples were taken * No doubt many "spotted" fields of alfalfa may be accounted for by similar conditions.

Good surface drainage is not necessarily an indication of good under-drainage. It is not uncommon to find a hillside with poor under-drainage and a level bottom at the base of the hill well drained. Under-drainage is determined more by the nature of the subsoil and lower lying strata than by the lay of the land.

Poor drainage may be remedied by the use of tile drains. For alfalfa the drains should be laid from three to three and one half feet deep. The use of dynamite for promoting drainage is sometimes recommended. Its indiscriminate use for

*Examination was also made of the condition of iron in the subsoils. Ferrous iron was found in the subsoil of all places where the alfalfa was poor or dead, but it was not found in the subsoil where alfalfa was good. This statement may have some interest for scientific workers.

this purpose is to be avoided, for only under certain conditions will it afford relief. If there is an impervious stratum of soil which may be broken by dynamite so as to allow the water to escape into a pervious stratum that will carry it away, then its use for this purpose may be advisable. Since it costs about $20 per acre to use dynamite, it would seem better, as a rule, to add a little to this sum and tile drain the ground, and thus afford permanent relief. The use of dynamite in preparing the seed bed for alfalfa is discussed on a subsequent page.

A Fertile Soil is Required

Alfalfa is not a crop adapted to poor land. Although under proper conditions it has the power to obtain part of its nitrogen from the air through the agency of bacteria living upon its roots, the crop makes heavy drafts upon the other soil elements of plant food. According to analyses given by Hopkins,* four tons of alfalfa hay, a moderate yield for a season, contain 18 lbs. of phosphorus and 96 lbs. of potassium, whereas a 50 bushel corn crop including the stover contains only 11.5 lbs. of phosphorus and 35.5 lbs. of potassium. These figures readily show that alfalfa will more rapidly exhaust the soil of these elements than the growing of corn.

Alfalfa is a good crop for improving and maintaining the fertility of soils, provided the crop is fed and the manure is properly conserved and returned to the soil together with such other materials as may be required. There is no crop or rotation of crops, however, that will permanently maintain fertility without returns of plant food and organic matter to the soil.

In addition to a liberal stock of mineral plant food, alfalfa on Kentucky soils requires a good supply of humus, or to use a better expression, organic matter. When soil has a high content of organic matter, good crops of alfalfa can be grown without lime if all other conditions are favorable. It is believed, however, that in such cases the crop makes heavier drafts upon the soil nitrogen than if lime were present. On

*Page 154, Soil Fertility and Permanent Agriculture.

the Experiment Station farm one piece of alfalfa lasted for 5 years on a small field on which cattle had been fed, and was thrifty when plowed up in order that the ground might be used for other purposes. It gave three and four cuttings per year ranging from 3 to 5 tons per acre. The same result was obtained on other places on the farm of exceptionally high content of organic matter. Examination of these soils showed slight acidity and no carbonate of lime. On other parts of the farm of moderate content of organic matter, alfalfa could not be grown with success without lime.

Throughout the Blue Grass region of Kentucky the soils generally contain sufficient mineral plant food, and phosphates and potassium salts are not required. Lime will, in most cases, be required within this area as well as in other parts of the State. Its use will be discussed in a subsequent part of this bulletin. In all parts of the State outside of the Blue Grass region the soils are more or less deficient in phosphorus, and in preparing soil for alfalfa in such localities, phosphate in some form should be added. 500 to 1000 lbs. per acre of acid phosphate may be used if lime is applied or is naturally contained in the soil. 300 to 600 lbs. per acre of steamed bone meal may be used, or 1000 to 2000 lbs. of finely ground raw phosphate rock, if the soil is well supplied with organic matter. These materials should be applied to the unbroken ground, and well disked in before breaking the ground. If the larger amount of phosphate were used on some crop preceding alfalfa, there would be no serious draft upon it and it would be better distributed in the soil by the cultivation of the preceding crop. Some growers top dress their fields with acid phosphate in the spring and disk it in. This should be done only when the soil is well supplied with lime.

Not enough experimental work has yet been done to determine whether potash is necessary for alfalfa outside the Blue Grass region, but its use has not, as a rule, been profitable on other crops, especially on those types of soil having good clay subsoils.

Nitrate of soda is sometimes used as a top-dressing. This is not to be advised as a general practice, but it may be used on a

young or backward crop in order to strengthen it for the winter or to push it ahead of weeds and grass. The rate of application in such cases is 100 lbs. per acre applied broadcast when the alfalfa is dry.

Lime Requirements of Alfalfa

For its best development alfalfa requires a soil containing lime, that is, carbonate of lime. (Limestone rock is carbonate of lime.) Its function is to promote the development and activity of the nodule-forming bacteria. Some Kentucky soils contain carbonate of lime naturally, but it is deficient in most of the cultivated soils of the State, even in limestone regions. It is a common belief that soils derived from limestone contain lime. The reason they do not is, that limestone is slowly soluble in water and has been dissolved out by centuries of rainfall. An evidence of the solubility of limestone is the deposition of carbonate of lime on the walls of teakettles in which water of limestone regions is used. One reason the semi-arid regions of the west are so well adapted to alfalfa is because the lime has not yet been leached out by rains.

Kentucky soils that contain carbonate of lime generally show limestone rock outcropping on them, or contain fragments of limestone. Limestone rock may be identified by its physical appearance and by the use of hydrochloric acid (muriatic acid) which produces a vigorous effervescence when applied to it. This acid may be obtained from any druggist.

There are some tests that any careful man can make to give some indication of the condition of his soil as regards lime. One is the litmus paper test which is made as follows: A moist clod of soil is broken open, a piece of blue litmus paper (which may be obtained from druggists) is inserted and the pieces of soil are pressed firmly together. The paper is allowed to remain in contact with the soil for ten minutes and is then removed and dried. If it is red or pink on drying it indicates an acid condition of the soil. Care should be taken not to let the fingers touch the paper or the soil at the point of insertion.

A test that will show the presence of carbonate of lime in

the soil is carried out in the following manner: In a ball of moist soil, make a shallow depression and pour into it some strong hydrochloric acid. If carbonates are present there will be an effervescence. It will not be very vigorous unless there is a very large amount of carbonates in the soil.

By using these two tests in a careful manner one may gain some idea as to the necessity for applying lime.

If it is found desirable to add lime to the soil, the use of ground limestone is recommended,* although burned lime may be used with good effect if the ground limestone cannot be obtained as cheaply. A suitable application for alfalfa is four tons per acre of ground limestone, or two tons of burnt lime. It is best to apply the material on the plowed ground and disk it in thoroughly, although it may be applied and disked in before the ground is broken.

The Kentucky Experiment Station has been making experiments with limestone in growing alfalfa for the last three years, the results of which are given in the following tables.

The soil of the Experiment Station farm is typical limestone soil of the central Blue Grass region. It shows only slight acidity, about 40 pounds of burnt lime per acre being the theoretical amount necessary to correct the acidity to the depth of seven inches.

In the fall of 1910 a field was sown in alfalfa, part of which was limed at the rate of 1½ tons per acre with completely air-slaked lime (calcium carbonate) and part was left unlimed. After the first cutting in 1912, 2½ tons per acre of ground limestone were applied to the limed plot and disked in. This was done in order to bring the application up to the standard of four tons per acre. It is doubtful, however, if limestone applied in this way is effective. The yields per acre of field cured hay were as follows:

*A discussion of the use of different forms of lime for agricultural purposes may be found in Circular No. 11 of the Kentucky Experiment Station, which may be had free upon application.

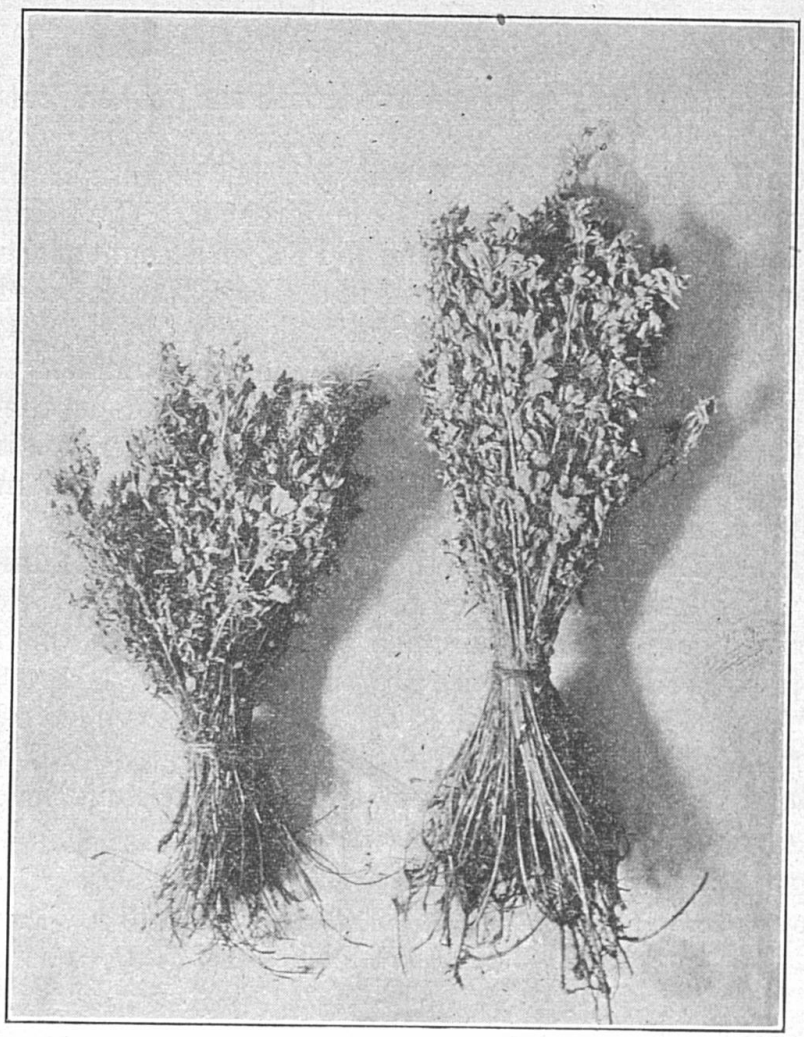


FIG. 1, Typical Samples of Limed and Unlimed Alfalfa, Kentucky Experiment Station Farm

	Limed	Unlimed	Increase
First cutting 1911	3640 lbs.	2060 lbs.	1580 lbs.
First cutting 1912	4760	3900	860
Second cutting 1912	3740	3280	460
First cutting 1913	4600	4280	320
Total	16740	13520	3220

The year 1911 was one of severe drouth and only one cutting was obtained, drouth being very injurious to young alfalfa. The third cutting in 1912 was not weighed because of a misunderstanding on the part of the foreman. The field was plowed up after the first cutting in 1913, on account of the appearance of weeds and blue grass in the larger part of the field which was not under experimentation.

A notable difference between the limed and unlimed parts of this field was the greater abundance of weeds on the unlimed part. The hay of the first cutting from the unlimed part was nearly half weeds, and the plot remained much weedier than the limed plot throughout the experiment.

A noticeable feature was the gradual decrease of difference in yields between the limed and unlimed plots, due to increased yields on the unlimed part. The soil of this field was fairly well supplied with organic matter.

In August 1912 another field of alfalfa was sown on which limestone was used at different rates. The soil of this field, it should be stated, was rather deficient in organic matter. The yields per acre of field cured hay for 1913 were as follows:

Amount of limestone per acre	First cutting	Second cutting	Total	Increase
None	600 lbs.	771 lbs.	1371 lbs	____lbs.
6 tons	2228	1592	3820	2449
4 tons	2450	2010	4460	3089
2 tons	1943	1607	3550	2179
2 tons and 300 lbs. sulfate of potash	2418	1530	3948	2577

A diagram of the plots on which these experiments were conducted, and on which subsoiling experiments (See page 15) were also conducted, together with treatments and

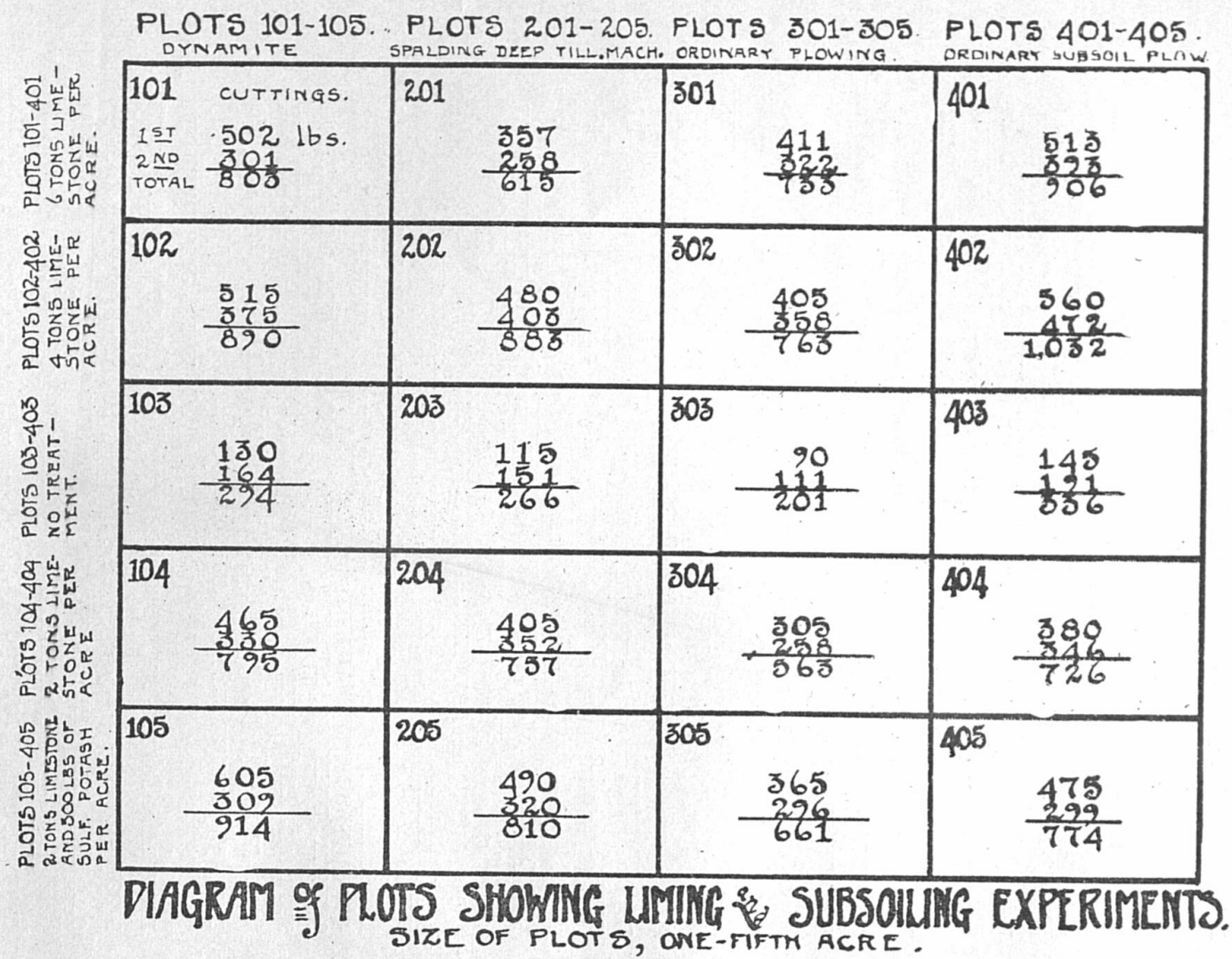


DIAGRAM of PLOTS SHOWING LIMING & SUBSOILING EXPERIMENTS.

SIZE OF PLOTS, ONE-FIFTH ACRE.

Fig. 2.

yields, is here given for the benefit of those who wish to make a more detailed study of the experiments.

The year 1913 was also one of severe drouth, and only two cuttings were made, the second of which showed the effects of drouth. The yields given are each the average of four one-fifth acre plots.

From these yields it appears that an application of 4 tons of limestone per acre gives larger yields than 2 tons per acre, but that increasing the application to 6 tons per acre does not give a further increase. The decrease obtained with 6 tons of limestone is only apparent, being due to a thin stand on plots 201 and 401.

Sulfate of potash, used with two tons of limestone, gave an increase for the first cutting, as compared with the yield of the corresponding plots on which two tons of limestone were used without sulfate of potash, but for the second cutting the reverse was true, with the exception of two of the plots, 304 and 305. The increase from the use of potash for the first cutting was 475 lbs. per acre. As sulfate of potash costs not less than $2.50 per hundred lbs. its use is not recommended on the type of soil represented by the Station farm.

The alfalfa on the plots treated with sulfate of potash and two tons of limestone was more uniformly green at the first cutting than on the plots treated with the same amount of limestone only, but was not any greener than that grown on the plots treated with four tons and six tons of limestone per acre. We believe that the effect of potash was to cause a more thorough inoculation of the alfalfa during the growth of the first crop. At the second cutting there was no difference in the color of the alfalfa. The falling off in yield of the plots treated with sulfate of potash is to be explained, we believe, by a somewhat thinner stand, and not by any injurious effect of the material.

Another fact to be noted is that the difference between limed and unlimed plots is not so great for the second as for the first cutting, the unlimed plots all showing an increase for the second cutting, while the limed plots all show a decrease.



FIG. 3. Limed and Unlimed Alfalfa, Kentucky Experiment Station Farm.



FIG. 4. Another View of Alfalfa Shown in Fig. 3.

This increase on the unlimed plots is due, we believe, to more thorough inoculation at the time of the second cutting, the lack of lime retarding inoculation during the growth of the first crop. The color of the alfalfa at the time of the two cuttings would seem to bear out this statement.

Another plot of alfalfa, adjacent to these, which was limed at the rate of 4 tons per acre and seeded in the spring of 1912, yielded 4800 lbs. per acre for the first cutting and 1560 lbs. for the second cutting in 1913.

It is of interest in this connection to note that the unlimed alfalfa contained only 2.06 per cent of nitrogen, whereas the average for the limed alfalfa was 2.60 per cent. These percentages of nitrogen are equivalent to 12.87 and 16.17 percent of protein respectively. The analyses were made on the first cutting, and are calculated on the basis of 12 per cent moisture content in the hay. As the best limed plots yielded four times as much hay as the unlimed plots it will be seen that the limed soil produced five times as much protein as the unlimed soil.

Injurious Effects of Weeds and Grasses

Weeds and grasses are perhaps responsible for as many failures with alfalfa as any other single cause. In April, 1909, a field on the Station farm was seeded in alfalfa. It came up well and gave promise of a splendid stand, but weeds and wild grasses appeared and by the middle of August it was all dead. No amount of clipping would keep the weeds down, and they were too large to destroy by cultivation by the time the alfalfa was old enough to stand cultivation. This same field produced good crops with fall seeding made the next year when the weeds had been killed out by summer fallowing.

The spring seeding just discussed in connection with liming, gave a perfect stand, but frequent clipping and cultivation throughout the season were necessary to keep down weeds and grasses. The alfalfa was saved but no hay was obtained the first year, although good yields were obtained the second year as the figures will show.

It is recommended by some authorities that alfalfa be

sown in the spring with a nurse crop, the purpose of the nurse crop being to keep down weeds. In the spring of 1912 a plot was sown on the Station farm with oats as a nurse crop. The seeding was made at the same time as the plot just described and on adjoining ground similarly prepared and treated with limestone. The alfalfa came up well but by the time the oats could be cut for hay it had all died.

Preparation of the Soil and Seeding

The seed bed for alfalfa should be deep, well pulverized, well compacted, and should be made as free as possible from weeds and grasses before seeding time. A good practice is to subsoil in the fall preceding the seeding of alfalfa. Subsoiling the same season in which the alfalfa is sown is not advisable, as the subsoil may not settle back properly before seeding time, and thus interfere with good moisture conditions.

Experiments on the Station farm indicate that subsoiling with the ordinary subsoil plow is just as effective as other methods. In the fall of 1911 an acre was prepared by each of the following methods: By dynamiting the subsoil, by plowing with the Spalding Deep Tilling Machine to a depth of 12 inches, by subsoiling in the ordinary way to a depth of 12 inches, and by plowing with the ordinary moldboard to a depth of 6 or 7 inches. In the spring of 1912 this ground was seeded to oats which were cut for hay. The ground was then broken to a depth of 5 or 6 inches and put in thorough preparation for alfalfa, which was seeded in August. Two cuttings of alfalfa were made in 1913, the excessive drouth preventing further cuttings and reducing the yield of the second crop.

The yields per acre of field cured oats and alfalfa are given below. As these experiments were made on the same ground as the liming experiments previously discussed (See diagram page 11) only the limed plots are used in making up these acre yields for alfalfa. The figures are pounds per acre.

Method of Preparation.	Yield of Oats Hay 1912	Yield of Alfalfa 1913.			
		1st Cutting.	2nd Cutting.	Total.	Increase Over Ordinary Plowing.
Ordinary plowing	3895	1858	1542	3400	----
Dynamiting	3850	2609	1644	4253	853
Deep tilling	4320	2165	1666	3831	431
Subsoiling	4305	2410	1887	4297	897

It costs about $20 per acre to subsoil with dynamite, while an acre may be subsoiled with an ordinary subsoil plow at a cost of about $3.00.

Ground should be broken and put in preparation for alfalfa some time in advance of seeding. As we recommend seeding in August, oats, potatoes, or any other crop that may be removed early enough to allow preparation of the ground not later than the middle of July, may be grown. Or some winter cover crop, like rye or crimson clover, may be turned under, but it should be done early enough to permit decomposition before seeding time. Sweet clover is a splendid crop to grow in preparing ground for alfalfa, and as it has the same nodule bacteria as alfalfa, it will get the soil thoroughly inoculated for alfalfa, provided of course the sweet clover is infected. After breaking the ground the soil should be well pulverized. After rains it should be harrowed to conserve moisture. If weeds and grass appear, the ground should be harrowed to destroy them. If one feels that he can afford to lose the use of the ground for a year, the best plan is to prepare the soil in the spring and fallow it through the summer.

August 15 to 20 is the best time to sow alfalfa in Kentucky. If sown later than this date, the crop may not make sufficient growth to withstand the winter, although later seedings often succeed. The Station does not recommend spring seeding for the reason that it is very difficult to keep down weeds and grasses until the crop is well established.

Just before seeding, the ground should be harrowed lightly and rolled in order to compact the seed bed. There need be no fear of packing the soil too much if it is not rolled when too wet. About fifteen pounds of good seed tested for

purity and germination should be used per acre. The best means of applying the seed is by the use of the disk drill made for the purpose, which places the seed in drill rows 4 inches apart. These drills distribute the seed evenly and cover them to a uniform depth. If the seeding is made by any other means the seed should be divided into equal parts and seeded in cross directions in order to secure uniformity of distribution. The seed should be covered to a depth of about half an inch. The ground should not be rolled after seeding if moisture conditions are at all favorable. A heavy rain upon rolled ground is apt to produce a crust that will prevent many of the seed from coming through. If moisture conditions are not good and there is no prospect of immediate rains, the ground may be rolled the third or fourth day after seeding.

Inoculation

For its best growth alfalfa must bear the nitrogen gathering bacteria upon its roots. If grown without inoculation the crop draws upon the soil for its nitrogen and does not improve the land in so far as plant food is concerned. Hopkins* has shown that alfalfa not bearing the nitrogen gathering bacteria not only makes a smaller yield, but that the percentage of nitrogen in the plant is much smaller. The same fact is brought out in an indirect way in the liming experiments presented in this bulletin in which it is shown that the unlimed alfalfa contained 2.06 per cent of nitrogen, while the average for the alfalfa limed at different rates was 2.60 per cent. The unlimed alfalfa was inoculated, but the organisms were without doubt less active than where lime was used.

The presence of these organisms is indicated by small nodules upon the roots. Care must be exercised in looking for them, for if the plant is pulled up, the nodules may be stripped off. The proper way to make the examination is to take up a plant with a spade, leaving the soil adhering to its roots. The soil is then carefully removed by hand, or still better, the

* Ill. Exp. Sta. Bull. No. 76

plant thus removed is placed in a bucket of water to soften the soil which is then washed from the roots. The nodules are about the size of a pinhead or a little larger,

Inoculation may be effected by securing laboratory cultures, either commercial or prepared by some government laboratory, and treating the seed according to directions always furnished with the culture. Inoculation may also be effected by taking soil from an alfalfa or sweet clover patch known to be inoculated and scattering it upon the desired place at the rate of 200 to 400 pounds per acre and immediately harrowing it in. After alfalfa has come up it may be inoculated with soil scattered just before a rain.

When to Cut Alfalfa

Fall sown alfalfa should not be clipped. It needs all the growth it makes for winter protection.

The time for cutting is best determined by the appearance of new shoots at the crowns of the plants and not by the appearance of bloom, although the bloom generally appears simultaneously with the new growth. Cutting should not be delayed after the new growth appears, as it not only injures the succeeding crop, but the delay may prevent the cutting of an additional crop at the end of the season. In case alfalfa stops growing the first season, it should be cut regardless of this rule. If clipping is necessary to keep down weeds the first season, the rule may be disregarded, but under ordinary circumstances it is a safe one to follow.

In this State three, and sometimes four cuttings are made in a season, three being more usual.

Curing Alfalfa

The same principles apply in curing alfalfa as in curing other hays. True curing is effected by the transpiration of water through the leaves, or in other words, by wilting, and not by sunburning. As soon as the hay is in a wilt it should be thrown into windrows in order to allow the wilting process to continue. When sufficiently cured, it should be put into shocks. It is impossible to state how much time is required

for curing, as it depends upon weather conditions and the amount of moisture in the ground. In favorable weather hay cut in the morning may be put into the shock in the afternoon, where it should remain until well cured. Alfalfa should not be put into the barn too green, as there is some danger of spontaneous combustion. The shocks should be as narrow and tall as can be made to stand, and they should be combed down well to facilitate the shedding of water. They should be kept well built up and packed down in the center, so that in settling they will shed water well. Each forkful of hay should be put down so that the stems will lie straight, instead of being doubled up and mashed down. Hay caps made of canvas will protect the shocks against serious damage in rainy weather.

The tedder may be of advantage in unfavorable weather or with very heavy alfalfa, but usually this Station has found that it may be cured as well without the tedder.

The one point to emphasize in curing alfalfa is to cure it without sunburning and the consequent loss of leaves, which are the the most valuable part of the crop.

Care of the Field

If the ground on which alfalfa is grown is free from weeds and grasses, it will need very little care, but such fields are the exception and not the rule. Crab grass and foxtail generally appear toward the latter part of the season. In case weeds and grasses appear, the ground should be harrowed immediately after cutting the alfalfa. This may be done with a disk harrow set at such an angle as not to injure the crowns. After using the disk harrow it is well to follow with a sharp tooth harrow. A better implement still is the spring tooth harrow. No injury will be done the alfalfa by harrowing.

The profitable life of an alfalfa field depends upon conditions. Usually in Kentucky it is not advisable to try to keep a field more than four or five years. This is especially true in the Blue Grass region, where blue grass frequently takes the field in this time.

Rotations Including Alfalfa

A very profitable rotation, where one's system of farming is adapted to it, is that practiced by Mr. Joseph E. Wing. It consists of alfalfa four years followed by corn for two years, with a cover crop and heavy manuring between the two crops of corn. This rotation is admirably adapted to beef cattle feeding. Three fields would accommodate this rotation. With fall seeding of alfalfa some crop that could be removed early, like wheat, would have to follow the corn, thus giving alfalfa only three years. But as alfalfa is not as expensive to seed as clover, when the longer life of alfalfa is considered, this is not objectionable.

Another good way to bring alfalfa into a cropping system, is to have one field more than the regular rotation requires and keep it in alfalfa while the regular rotation is being run on the other fields. For example, if a four year rotation is being run, a fifth field would lie in alfalfa, while a complete turn of the rotation is made on the other four fields. Then the alfalfa field is plowed up and brought into the rotation and field No. 1, previously employed in the rotation, is put into alfalfa, while a complete turn of the rotation is made on fields No. 2 to No. 5. In this way each field is brought into alfalfa in its turn.

Feeding Value of Alfalfa

Alfalfa is considered the most valuable of all roughages. It is palatable and is highly prized on account of its high protein content. The following table made up of figures taken from Henry's "Feeds and Feeding" gives the protein content of a number of feeds:

	Pounds crude protein per 100 lbs. feed.	Pounds digestible protein per 100 lbs. feed.
Alfalfa	16.3	11.7
Wheat bran	15.4	11.9
Red clover hay	12.3	7.1
Alsike clover hay	12.8	8.4
Sweet clover hay	18.0	11.9

	Pounds crude protein per 100 lbs. feed.	Pounds digestible protein per 100 lbs. feed.
Soy bean hay	14.9	10.6
*Cowpea hay	*8.9	*5.8
Timothy hay	6.0	3.4
Red top hay	7.9	4.8
Orchard grass hay	8.1	4.9
Corn stover	3.8	1.4
Corn, grain	10.3	7.8
Soy bean seed	33.5	29.1
Cowpea seed	20.5	16.8

It will be seen that alfalfa is about the same as wheat bran in both crude and digestible protein content.

*This figure is without doubt too low. Analyses from other sources give from 12 to 16 per cent of protein in cowpea hay.

SWEET CLOVER

Sweet clover is a plant closely allied to alfalfa in botanical characteristics, chemical composition, and soil requirements. What has been said of soil conditions and inoculation for alfalfa, applies with equal force to sweet clover, with the exception that it will grow in soils quite deficient in organic matter, provided lime is present.

The only part of the State in which sweet clover is being grown with general success without applying lime, is in northern Kentucky in the region of Pendleton and adjoining counties.

On the Station farm attempts to grow it on normal soil without lime have not been satisfactory, although some growth has been obtained. In the spring of 1912 two plots of sweet clover were sown, one being limed and one unlimed. The crop was harvested for hay in 1913, the limed plot yielding 5300 lbs. of field cured hay per acre and the unlimed plot 2100 lbs. per acre. The limed plot was entirely free from weeds, while the unlimed plot contained a large percentage of weeds. Figure 5 shows these two plots just before harvest.

On the experiment field at London, Kentucky, an attempt was made to grow sweet clover on thirteen different plots, the seeding being made in 1912. The crop failed to grow except where lime was used, although it was seeded where fertilizing materials were used without lime. Figures 6 and 7 show a plot treated with limestone, rock phosphate and sulfate of potash, and an untreated plot. The yield of hay in 1913 from the treated plot was 2570 lbs. per acre. The yield from an adjoining plot similarly treated, except that acid phosphate was substituted for rock phosphate, was 2840 lbs. Both plots had rather a thin stand and would doubtless have produced much larger yields with a good stand. This soil is thin, sour, and deficient in phosphorus. Its normal yield of corn is about 20 bushels per acre.

The best time to seed sweet clover is in February and March

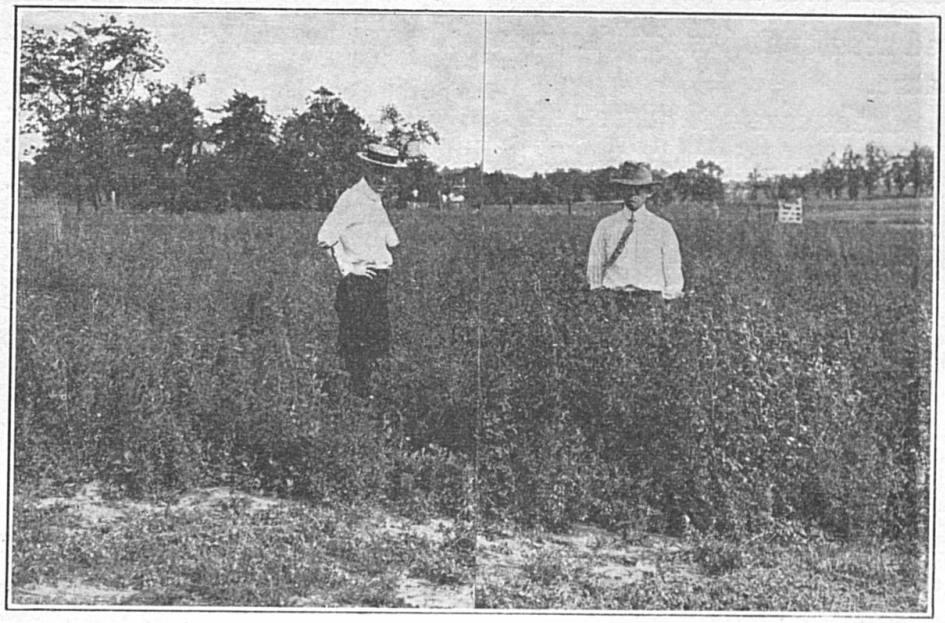


Fig. 5. Limed and Unlimed Sweet Clover, Kentucky Experiment Station Farm.

on frozen ground. It may be seeded on wheat, oats, or rye, or on clean corn stubble. It seems to make a better start on firm ground than on freshly prepared ground.

The crop may be sown on prepared ground in April or May. In this case the ground should be thoroughly firmed down and the seed should be covered to a depth of about one-half an inch. Seeding may also be done from August 15 to September 1. Sweet clover does not stand the winter well unless it makes a good growth before cold weather. For this reason it is not safe to sow it late. About 15 lbs. of the hulled seed or 20 lbs. of the unhulled seed should be sown to the acre.

Great care should be exercised to secure seed of good germination. It is not unusual to find seed on the market showing only 25 to 30 per cent germination, or even less. A germination test may easily be made by placing a definite number of seed, say 200, between moist pieces of blotting paper which are kept between two plates or saucers in a warm place. The sprouted seeds should be removed and counted every two or three days after germination has well begun.

Sweet clover seed is quite expensive, but farmers may save their own seed. It is an easy matter to beat them out with a flail or stick after the plants have become quite dry. Sweet clover will reseed itself indefinitely when some plants are allowed to mature seed, as in the case of pasturing.

As February and early March are the favorite time for sowing sweet clover, the matter of inoculation presents some difficulties. So far as the authors are aware, no experiments have been made to show whether or not it is effective to inoculate seed with laboratory cultures of bacteria for seeding on the surface at this season. It seems probable, however, that the practice would be safe.

It is suggested that in case inoculated soil may be had, it may be scattered on the sweet clover field when spring growth has begun. If inoculated soil cannot be obtained, the laboratory culture of bacteria may be mixed with enough water to moisten sufficient soil to scatter over the ground at the rate of 200 lbs. per acre. The soil should be thoroughly mixed.



FIG. 6. A Good Growth of Sweet Clover on London Experiment Field on soil treated with limestone, phosphate rock and sulfate of potash.

If it is not allowed to become too moist, it may be scattered with a grain drill with fertilizer attachment. The soil should be applied just preceding a rain, as sunshine may kill the organisms. In this connection it is well to remember that the bacteria of alfalfa and sweet clover are interchangeable.

Sweet clover makes rank growth under favorable conditions and has power to fix large amounts of nitrogen. As stated, it grows quite well on soils deficient in organic matter and nitrogen, provided lime and sufficient mineral plant food are present. For this reason it is a valuable plant in restoring worn soils. Sweet clover is also valuable in reclaiming washed lands, especially in regions in which blue grass will grow, as the two crops grow well together. A good practice for reclaiming badly washed land is to plant it to locust trees, sweet clover and a little later to blue grass. The three plants make a combination that soon stops all washing and rapidly improves the soil. Sweet clover is also valuable in improving the physical character of the soil, because of its long roots which open up the subsoil.

There are two varieties of sweet clover commonly grown, the white and the yellow, so called from the color of their bloom. The white variety makes much the ranker growth and is better for improving soils. It is claimed by some that the yellow variety is better for hay on account of its finer stems. The white variety may be made into good hay by sowing it thickly and cutting it at the proper stage, which is just before it blooms. It rapidly becomes woody after this stage.

Complaint is often made that stock will not eat sweet clover either as pasture or as hay. This is because animals are not accustomed to it. It is no uncommon occurrence for stock to refuse alfalfa the first time it is offered them. Cattle, sheep and hogs may be taught to eat sweet clover. In the sweet clover area of the northern part of the State, animals eat it with great relish and thrive on it. On the Station farm an acre of sweet clover was planted for hogs in 1913. When they were first turned into it they would not touch it. When

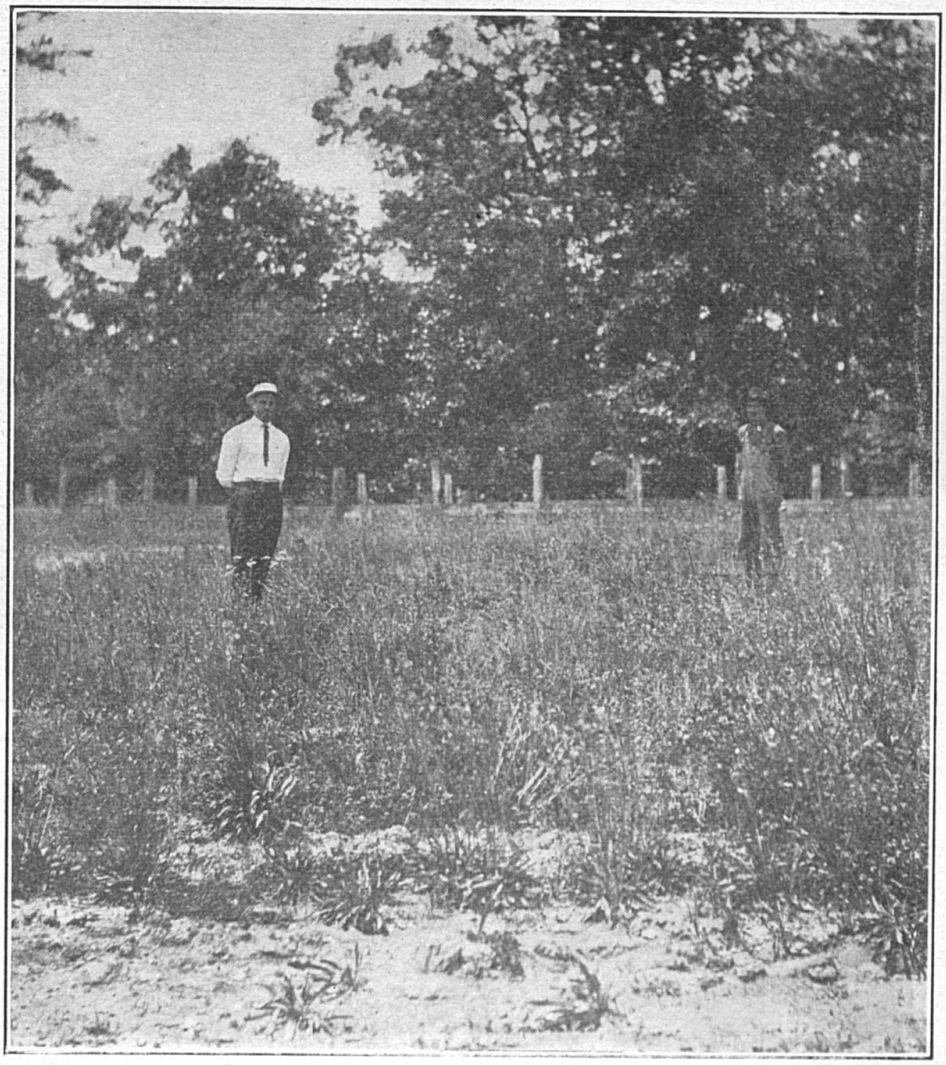


FIG. 7. Untreated Plot on London Experiment Field on which sweet clover was sown. The clover is all dead. The vegetation shown consists of weeds and wild grasses.

"starved" to it, they soon ate it greedily and later had to be removed to keep them from grazing it too closely.

Sweet clover is a biennial plant. It may be pastured or clipped the first year, but not too closely. If it is desired that it should produce seed the second year, it should not be pastured very closely and should not be clipped, although it is sometimes cut early and rather high.

Objection is sometimes made that sweet clover is a pest, and that it is difficult to rid a farm of it. The difficulty that most farmers have is to get it to grow at all. The only thing necessary to get rid of it is to prevent its going to seed the second year, either by clipping or plowing it up.

The idea that it is a weed no doubt originated from the fact that it is seen to grow vigorously along pikes, railroads, and in rocky, deserted places. This is because of its great liking for limestone.

In composition sweet clover compares favorably with alfalfa. Samples of the 1913 crop on the Station farm showed a content of 2.09 per cent of nitrogen equivalent to 13.06 per cent of protein. Henry's "Feeds and Feeding" gives it as the equal of alfalfa in digestible protein.

In addition to being a valuable nitrogen gathering and forage plant, the bloom of sweet clover is highly prized by beekeepers as a source of honey.

APPENDIX

By permission, the experience of Mr. W. P. Givens, of Junction City, Ky., in growing alfalfa is here given. Mr. Givens is one of the most successful growers of this crop in the State. He now has sixty acres of splendid alfalfa upon his farm and intends to increase this to the one hundred acre mark. He is an experienced tobacco grower, but considers alfalfa a better crop and has entirely discontinued the growing of tobacco. He learned how to grow alfalfa before sowing a large acreage.

Mr. Givens' farm of 400 acres is four miles south of Danville, in the southern part of the Blue Grass region. Mr. Givens practices general farming.

The interest of Mr. Givens in alfalfa grew from reading in agricultural journals the value of this crop to live stock feeders. In 1907 he selected three acres from his cattle feed lot and plowed and prepared the seed bed just before the time for sowing. The field was well drained and, of course, rich in humus. The seed was sown in August after being inoculated with bacterial culture furnished by the United States Department of Agriculture. In the spring of 1908, just before the first cutting, Mr. Givens noticed that the alfalfa was turning yellow. Immediately after cutting, the ground was disked and 600 pounds of slaked lime, 400 pounds of finely ground Tennessee rock phosphate, and 400 pounds of cotton seed meal per acre were applied through the fertilizer attachment of a grain drill. The cotton seed meal, while rich in nitrogen, was used to make the lime and phosphate rock sow from the drill.

Mr. Givens states that in 1908 three crops were cut, while each year since four cuttings have been made, and he believes that five cuttings could have been removed without injury to the alfalfa. The year 1911 was a very poor one for hay on account of early dry weather, but four cuttings were removed that year, and Mr. Givens says that his three acres



FIG. 8. View of Alfalfa Field of W. P. Givens, Junction City, Ky.

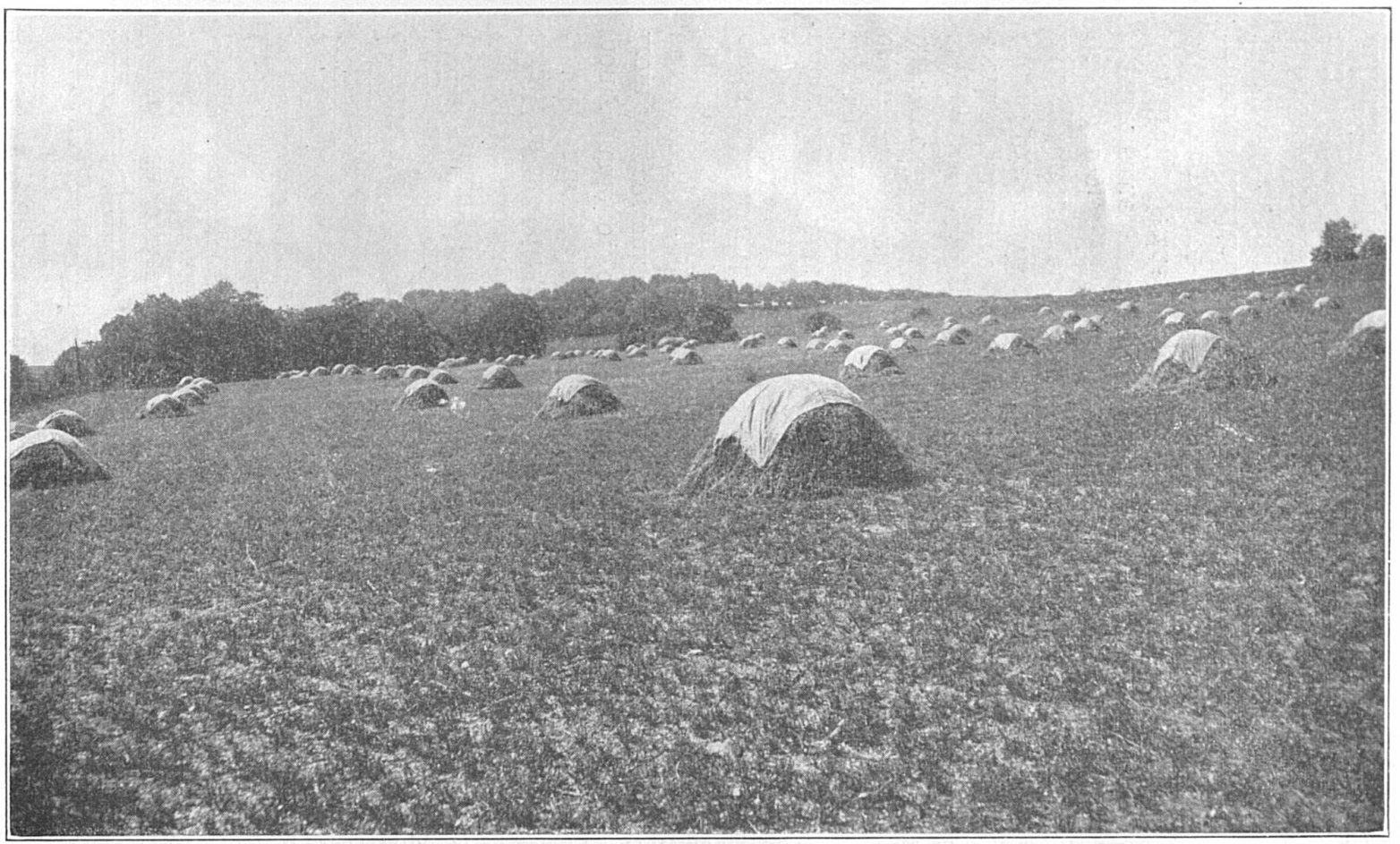


FIG. 9. Another View of Alfalfa Field on Mr. Givens' Farm.

of alfalfa furnished more feed than his seventy acres of timothy. Alfalfa, when well established, withstands drouth better than most crops. In 1912, the sixth year of cutting, the estimated yield was 8 tons per acre, and from 15 to 20 tons were sold at the barn for $20 per ton. The first cutting of this three-acre field in 1913 was hauled to Danville and sold for $146. No crop in extensive farming is more profitable than alfalfa.

The importance of cutting alfalfa just at the right time is emphasized by Mr. Givens. He thinks that the common "cure all" of clipping when alfalfa turns yellow kills the plants in many instances. The time to cut alfalfa is when the young shoots appear at the crowns of the plants. The alfalfa is cut with a mower, allowed to wilt, then raked into small windrows, shocked and capped. The caps are commonly made of canvas, but Mr. Givens uses covers made from four cotton seed meal sacks, left double, sewed together at two edges, and weighted with pieces of stone or brick at the four corners. The sewing of the covers cost him three cents each, and they have been preserved and used with perfect satisfaction for several years. The hay, after curing under these caps for two days of good weather, is hauled to the barn and has never been known to spoil in the shocks or in the barn. Immediately after each cutting Mr. Givens cultivates the ground even while the alfalfa is yet in shock. He has for this purpose a spring tooth harrow with teeth much narrowed at the points, but often uses instead the double cutting disk. He says, "When I get through cultivating my alfalfa it looks almost like a corn field prepared for planting."

After some years of experience with the three-acre field, Mr. Givens decided to grow alfalfa more extensively, and in the latter part of August, 1912, following a wheat crop, he prepared the land and sowed twenty-six acres. In this case 1,000 pounds per acre of rock phosphate were turned under, then 1,500 pounds of ground limestone per acre were applied and worked into the soil. The inoculation was this time effected by using about 150 pounds per acre of soil from the

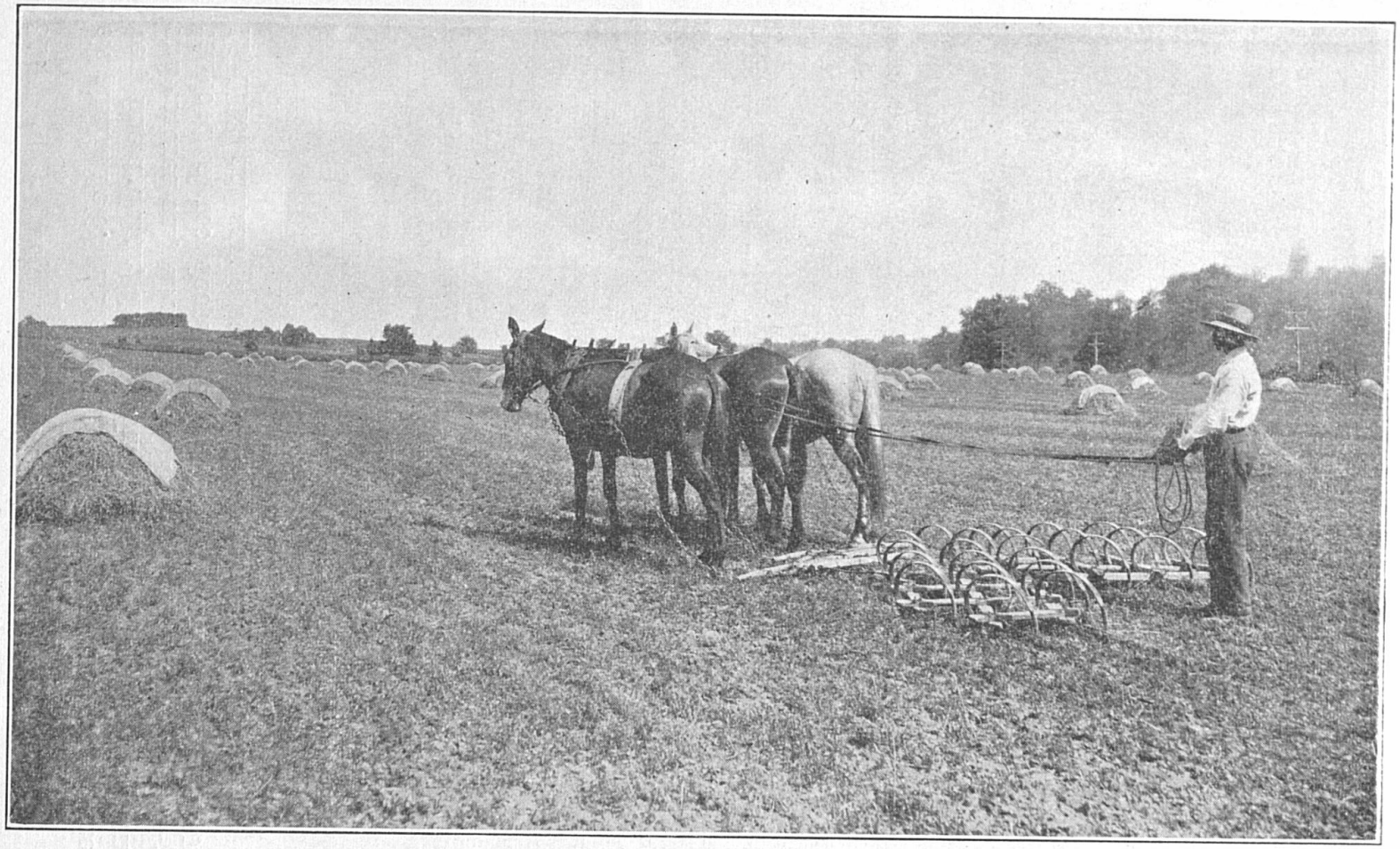


FIG. 10. Cultivating Alfalfa With Spring Tooth Harrow on Farm of Mr. Givens.

old alfalfa field. After inoculation, the seed bed was made very fine and firm, then 20 pounds of seed per acre were sown and covered only about one-half an inch. Small seeds are often covered too deeply. The writer visited this field May 15, 1913, and saw a beautiful and valuable crop of alfalfa.

Kentucky

Agricultural Experiment Station

of the

State University

BULLETIN NO. 179

CONSTRUCTION AND EQUIPMENT OF DAIRY BARNS

LEXINGTON, KENTUCKY
JUNE, 1914

STATE UNIVERSITY PRESS
LEXINGTON, KY.

KENTUCKY AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

RICHARD C. STOLL, Chairman, Lexington, Ky.
CHARLES B. NICHOLS, Lexington, Ky.
LEWIS L. WALKER, Lancaster, Ky.
HENRY S. BARKER, President of the University.
THE DIRECTOR, Secretary, ex-officio.

JOSEPH H. KASTLE, Director.

STATION COUNCIL

THE DIRECTOR

A. M. PETER
H. E. CURTIS
H. GARMAN
C. W. MATHEWS
R. M. ALLEN
J. D. TURNER
E. S. GOOD
GEORGE ROBERTS
T. R. BRYANT
J. J. HOOPER

DEPARTMENTAL ORGANIZATION

ADMINISTRATION

THE DIRECTOR, Head.
H. E. CURTIS, Bursar.
HYWEL DAVIES, Purchasing Agent.
O. L. GINOCHIO, Secretary to Director.
ADDIE LEE DEAN, Librarian.
ANNA WALLIS, Clerk.
CORNELIA C. PAGE, Clerk.

AGRONOMY

GEORGE ROBERTS, Agronomist, Head.
E. J. KINNEY, Assistant Agronomist.
S. C. JONES, Soil Survey.
A. E. EWAN, Supt. Experiment Fields.
H. B. HENDRICK, Extension in Agronomy.
JESSIE F. CASWALL, Clerk.

ANIMAL HUSBANDRY

(Beef Cattle, Sheep and Swine)

E. S. GOOD, Head.
ROBERT GRAHAM, Veterinary Science, In Charge Hog Cholera Serum Production.
E. W. MUMMA, Asst. In Charge Hog Cholera Serum Production.
O. S. CRISLER, Hog Cholera Serum.
R. L. PONTIUS, Hog Cholera Serum.
W. V. SMITH, Asst. in Animal Husbandry.
M. G. GINOCHIO, Clerk.
C. B. WILSON, Hog Cholera Serum.
LAWRENCE GINOCHIO, Clerk.
E. J. GOTT, Hog Cholera Serum.

ANIMAL HUSBANDRY

(Dairy Cattle, Horses and Poultry.)

J. J. HOOPER, Head.
W. S. ANDERSON, Asst. Horse Husb'd.
J. W. NUTTER, Supt. Dairy Farm.
W. D. NICHOLLS, Asst. Dairying.
D. D. SLADE, Supt. Poultry Farm.
H. W. RICKEY, Poultry Clubs.
P. E. BACON, Elmendorf Milk Records.
F. WALLACE UTTERBACK, Clerk.

CHEMISTRY

A. M. PETER, Chief Chemist, Head.
S. D. AVERITT, Chemist.
J. S. McHARGUE, Asst. Chemist.
ETHEL V. T. CASWALL, Clerk.

ENTOMOLOGY AND BOTANY

H. GARMAN, Entomologist and Botanist, Head.
MARY L. DIDLAKE, Laboratory Asst.
E. C. VAUGHN, Asst. in Seed Inspection and Plant Breeding.
H. H. JEWETT, Research Asst. Entom.
H. R. NISWONGER, Asst. in Field Work and Nursery Inspection.
LOUISE BEWLAY, Clerk.

EXTENSION

T. R. BRYANT, Head.
H. B. HENDRICK, Agronomy.
J. H. CARMODY, Horticulture.
H. W. RICKEY, Poultry.

FEED

J. D. TURNER, Head.
H. D. SPEARS, Chemist.
ELMER INGRAM, Chief Inspector.
ROGER W. JONES, Inspector.
FANNY C. ROGERS, Clerk.

FERTILIZER

H. E. CURTIS, Chemist, Head.
B. D. WILSON, Assistant Chemist.
WM. RODES, Assistant Chemist.
ELMER INGRAM, Inspector.
R. W. JONES, Inspector.
ANNA WALLIS, Clerk.

FOOD AND DRUGS.

R. M. ALLEN, Head.
J. O. LaBACH, Chief Chemist.
L. A. BROWN, Chemist, Drugs.
J. W. McFARLIN, Chief Food Inspector.
W. R. PINNELL, Bacteriologist.
C. S. PORTER, Inspector, Drugs.
WALTER SCHEPPELMAN, Inspector, Bakery Sanitation.
E. F. WORTHINGTON, Inspector, Dairy Sanitation.
W. G. TERRELL, Inspector, Foods.
LILLIE LISTON, Chief Clerk.
LENA LISTON, Clerk.

HORTICULTURE

CLARENCE W. MATHEWS, Head.
J. H. CARMODY, Extension in Horticulture.
F. W. HOFMANN, Asst. in Horticulture.
G. B. WURTZ, Consulting Meteorologist.
MURIEL CASWALL, Clerk.

RESEARCH

THE DIRECTOR, Head.
H. GARMAN, Entomologist and Botanist.
D. J. HEALY, Bacteriologist.
E. S. GOOD, Animal Husbandry.
O. M. SHEDD, Chemist.
MARY L. DIDLAKE, Asst. Entomologist and Botanist.
G. D. BUCKNER, Chemist.
H. H. JEWETT, Research Asst. in Entom.

Notice

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Director.

BULLETIN NO. 179

THE CONSTRUCTION AND EQUIPMENT OF DAIRY BARNS.

By W. D. Nicholls.

The object of this bulletin is to meet the increasing demand of dairymen, or those embarking in the dairy business, for information on the construction and equipment of dairy buildings. In dealing with this subject we have kept in mind the needs of the average farmer of limited capital who, when he builds, is forced to make every dollar count. Wealthy men who operate dairies as a means of diversion may hire architects and contractors to erect buildings at high cost. The average farmer, however, must be his own architect, and in many cases his own contractor. For the help of such we have prepared the accompanying plans. In these plans economy and efficiency have been kept paramount, and every inch of waste space has been avoided. Conditions and requirements of farmers are so varied that it is not likely that any plan herein presented should be copied in its entirety. Their purpose is rather to serve as suggestions which may be modified to meet individual requirements.

Costly Barns not Necessary:—Experience has shown that elaborate and costly barns are not necessary for permanence, sanitation, comfort of cows, or convenience in the production of clean milk. Money invested in elaborate barns is seldom recovered when the farm is sold. Some of the most expensive barns we have seen have been the most

inconvenient and impractical. In many cases this is due to the fact that they were planned by city architects knowing little or nothing of the operations necessary in handling cows and milk. In building such barns display and fancy appearance are often the first consideration.

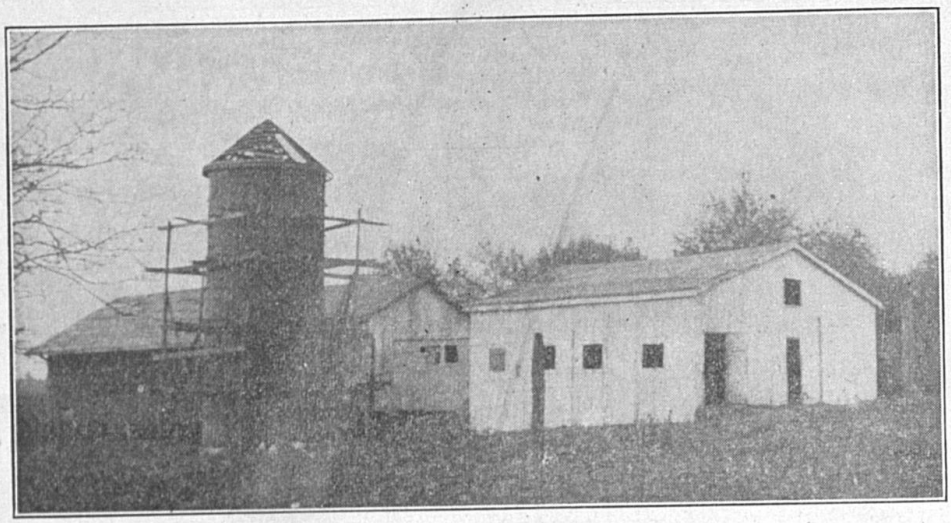


FIG. 1, An old barn which was rebuilt at a very small outlay. A high grade of certified milk was produced in this barn. The front section was used as a milking barn, and the rear section as a covered yard or rest shed.

REMODELING OF BARNS:—In many cases farmers may find it desirable to remodel or add to an old barn for dairy purposes. It is often much better to do this than to incur the expense of building a new barn. Frequently tobacco barns and barns of other types can be converted into excellent dairy barns at slight expense. The plans and dimensions given herein should be of assistance to farmers who wish to make such changes. The Kentucky Agricultural Experiment Station will render assistance in remodeling barns.

CAREFUL PLANNING AND STUDY NECESSARY BEFORE BUILDING:—Ordinarily the building of a barn is an event which occurs very seldom in the life of a farmer and for this reason a great deal of thought and study should be given before beginning the project. By careful planning, the labor of caring for the cows may be reduced one half.

Many mistakes may be made in building a barn and frequently these are not discovered until it is too late to correct them. Mistakes in arrangement may compel a great many unnecessary steps and require work to be done at a disadvantage day after day, year in and year out. Mistakes may be made in the location of the silo, in the placing of doors, or in the dimensions of platforms, gutters, passageways and alleys, and the location of posts. These details should be considered beforehand and such mistakes avoided. The most important points in the building of dairy barns are taken up in the following pages.

Economy and Moderate Cost.

The cost of the barn should be in keeping with the value, size and income-producing capacity of the farm, and within the bounds sanctioned by conservative business management. Money invested in a dairy barn should be required to pay at least 10 per cent. a year. This is necessary to cover interest, depreciation, taxes, insurance, etc. Thus if $1000 were invested in a barn to house 20 cows, $100 a year would have to be charged for barn rent. This would amount to $5 per head. If milk is sold at an average price of 15 cents per gallon, $33\frac{1}{3}$ gallons of the yield of each cow would be required to pay rent on the stall which she occupies.

A good business farmer seldom puts more than $50 per cow, in a dairy barn. Good substantial barns are often built for much less. Wealthy men sometimes build barns which cost $1,000 to $1,500 per cow. If rent were charged the cows for use of these buildings it would amount to $100 to $150 a year for each cow. Such expense, of course, makes it utterly impossible to secure profits from such dairies even with the most economical methods of feeding and management.

Sometimes too little money is invested in dairy buildings in which case undue labor is required in taking care of the cows. Work is often done at a great disadvantage, as for instance when silage must be carried to the cows in baskets.

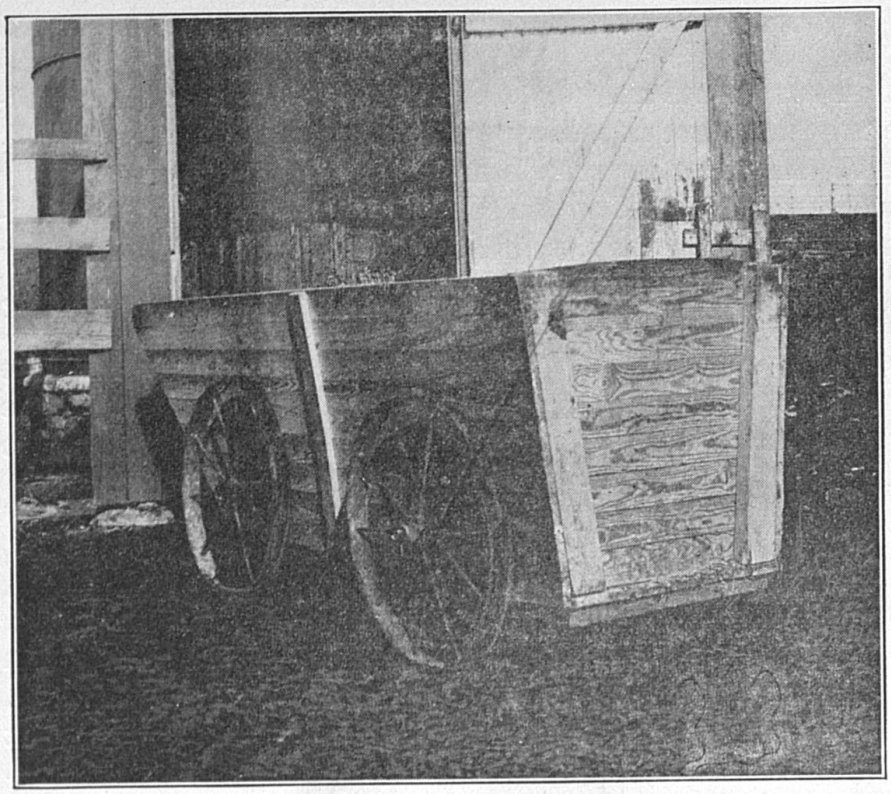


FIG. 2. A home-made ensilage truck. The wheels were taken off of old grain harvesting machines. Axles were made by the local blacksmith. Total cost, $5.00. Capacity 20 bushels.

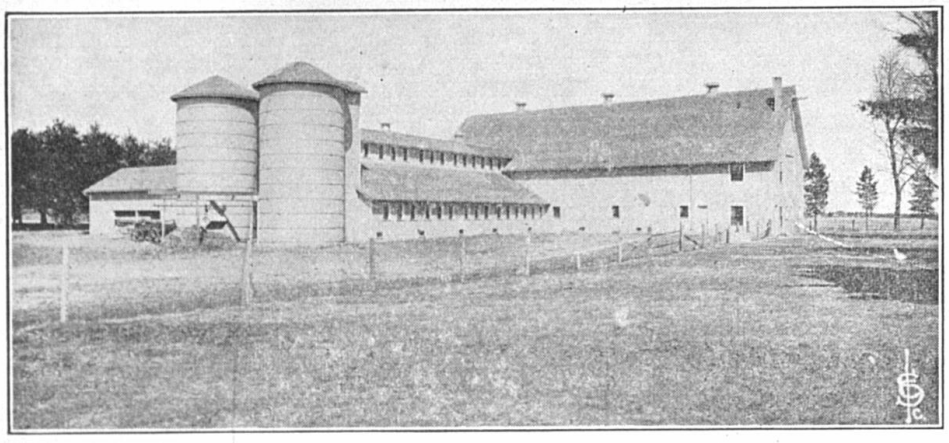


FIG. 3. Dairy barn at the Iowa Agricultural College. Note the overhead litter carrier and rigid track at the rear of the barn. This barn is a model for experimental purposes, but is too elaborate and costly for the average dairy farm.

Arrangement to Save Labor.

Dairy work must be done twice a day every day in the year. A slight fault in arrangement may mean a large amount of extra work in a year's time.

CONVENIENCE IN FEEDING:—Dairy cows consume large amounts of feed, especially rough feeds such as hay and silage. Unless care is taken to arrange for the saving of labor the feeding of stock will require a large amount of unnecessary work. To reduce labor the feed should be stored as close to the point of feeding as possible. For a long barn a truck for conveying ensilage and other roughage to the cows, often saves a great amount of labor. The location of the silo is of great importance in saving labor. It may be so located that the silage can be transferred from the silo to an inexpensive truck with a single handling, thence pushed along a feed way in front of the cows and transfered to the manger, with less than one-fourth the labor required when it is brought from the silo to the cows in baskets. Dairy cows require large amounts of hay and this hay should not have to be transported very far from the hay mow to the cows. An overhead loft is to be recommended because it permits the feeding of hay with a minimum of labor.

CONVENIENCE IN HANDLING MANURE:—In a dairy barn cleanliness requires that all manure be removed at least once a day. Means should therefore be provided for removing this material quickly and easily. Bad construction in this particular may make it necessary to remove manure by means of a wheelbarrow,—a method entailing a large amount of hard and disagreeable work. The barn may be so planned that a team can be driven through from end to end, the litter being removed directly from the gutter to wagon or spreader and thence drawn at once to the field; or an overhead litter carrier system may be used, making the labor very much less than that required by the wheel barrow method.

SAVING STEPS IN HANDLING MILK:—One of the most serious mistakes which can be made is to locate the milk house so as to require a great number of unecessary steps and the loss of

time in taking milk from barn to milk room. Some idea of the loss of time and energy may be had by a little calculation. Thus if the milk from each cow is carried 50 feet further than necessary this means an extra distance of 12 rods for each cow daily. If forty cows were milked this means one and one half miles a day or 547½ miles in a year. The same principle applies to unecessary steps in cleaning out the stable and feeding the cows.

The milk room should be located adjoining or very close by the dairy barn. Figures 30 and 33 show the milk room so located as to save steps. When forty cows or more are milked in one stable there should be four sections of stanchions and a central cross passage way leading to the milk room which should be located at the center of one side of the barn.

Sanitation and Provision for Easy Cleaning.

The dairy barn is a place where human food is produced. Moreover this food is used in an uncooked state and in many instances for infant feeding. Cleanliness must therefore be observed in every operation and the barn must be so constructed as to permit of easy, thorough and frequent cleaning and as nearly as possible the avoidance of all dust. The floor should be smooth and without crevices for dirt to collect and it should also be hard and impervious to water so as to allow washing and scrubbing when necessary. A further discussion of these points is given in the section on stable floors.

Comfort and Health of the Cows.

To do her best the cow must be comfortable, and this fact must be borne in mind in the construction of stalls, stanchions and mangers. This point is further considered in the discussion of stanchions, stalls, and rest sheds.

To promote the cow's health, an abundance of sunlight must be provided, also an abundance of fresh air.

PROVIDING LIGHT FOR THE STABLE: — An abundance of light is the best and cheapest germicide and is also a great aid to cleanliness. Dirt and dust are more easily detected in

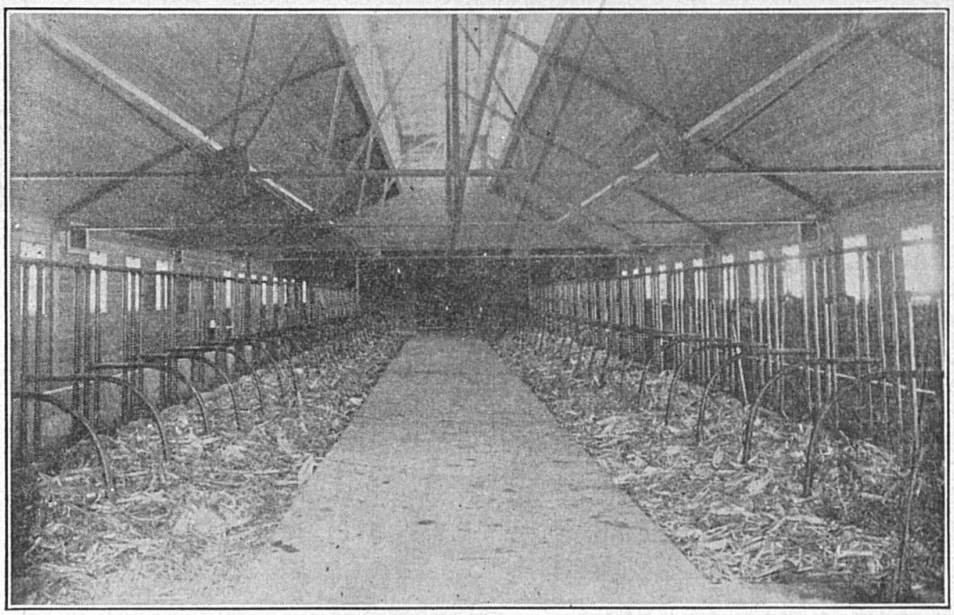


FIG. 4.7 The interior of this dairy barn is well lighted, but the construction is too expensive for the average dairyman. Another objection is that there is no loft room overhead for hay.

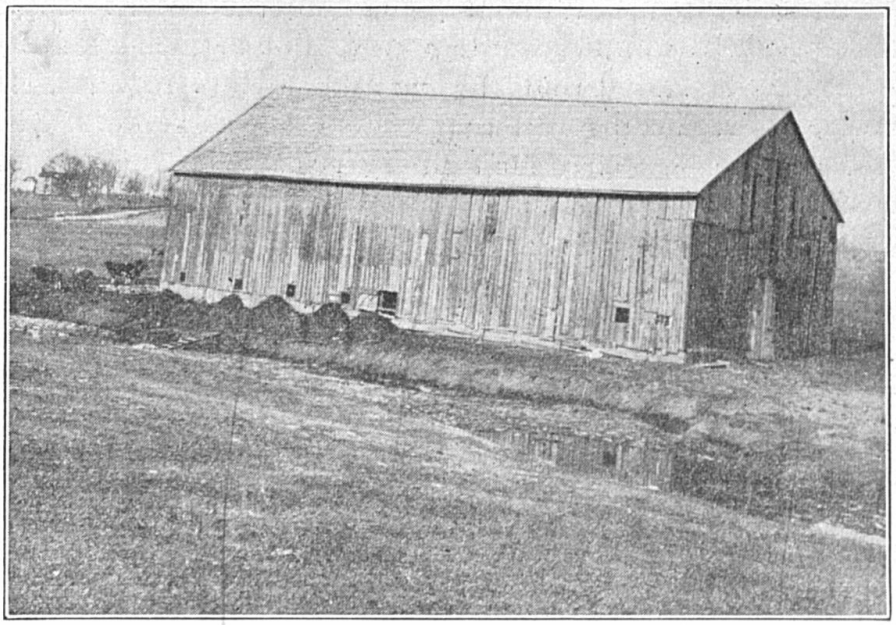


FIG. 5. A dairy barn having no windows except the holes in the wall through which manure is removed. Note the filthy conditions caused by piling the manure against the barn. The drainage is also bad, resulting in a very muddy barn yard.

a light barn. A dark barn is usually a dirty barn. Sufficient windows should be used to allow 4 square feet of light for each cow and the windows should be so placed as to insure an even distribution of light. In arranging windows particular care should be taken to avoid odd sized panes, otherwise when a pane is broken a larger pane must be cut to replace it. Probably the best size of pane for ordinary use is one 10 by 12 inches, each sash containing 9 of these panes and each window consisting of a single sash set flush with the inside of the wall and hinged at the bottom so as to open inward. This directs the current of incoming air upward over the backs of the cows thus avoiding a direct draft. Windows should be placed 4½ to 5 feet above the floor to prevent breakage by the cattle. When vertical siding is used the windows are sometimes arranged to slide horizontally.

VENTILATION:—Since the climate of Kentucky is mild, an expensive system of ventilation is seldom to be advised. Ample ventilation can nearly always be secured by leaving one or more windows open. Figure 6 shows an automatic ventilating system. Without going into the details of the numerous factors entering into a system of artificial ventilation, it may be stated that the essential points required for an effective artificial ventilating system are as follows: The room must be as nearly air-tight as possible. The foul air duct must start near the floor and run up at least two feet above the highest point of the roof. It should be smooth on the inside, air-tight, as nearly vertical as possible, and with no sharp curves. The dimensions of foul air ducts will depend upon the situations available for placing them. They should not extend out far enough to obstruct the passage ways. To avoid this they may be placed in the four corners of the building.

The fresh air inlets are placed on each side of the barn near the floor. When cows face inward the fresh air ducts may pass between studs and joists and deliver over the heads of the cows. Where cows face outward the fresh air ducts should deliver near the juncture of side walls and ceiling. The entrance of air should always be in front of the cows so

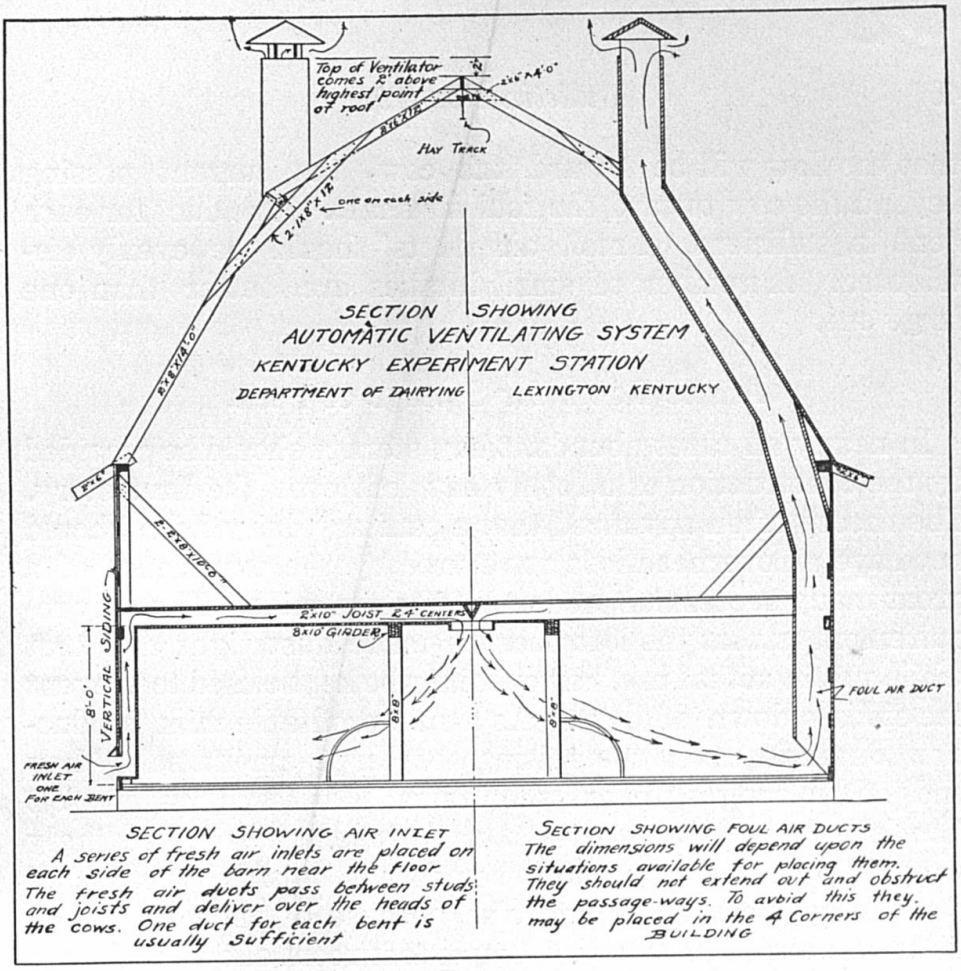
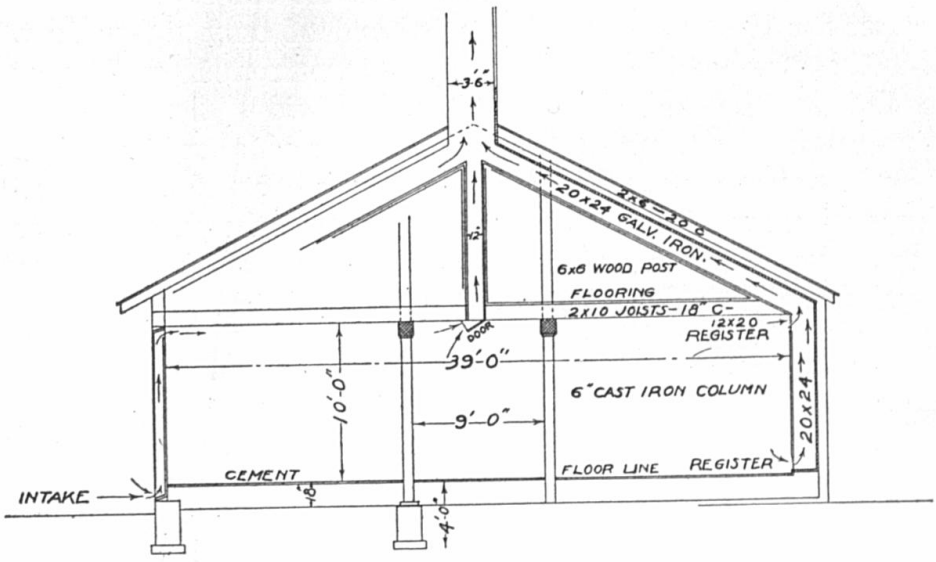


FIG. 6



VENTILATION SYSTEM OF KENTUCKY STATION DAIRY BARN.

FIG. 7

that the flow will be toward the cow, the current passing beyond the cow toward the foul air shaft. One duct for each bent is sufficient. Fresh air ducts should be evenly distributed. A number of small intakes are better than one large one.

Ample Room for Storage of Feed.

In nearly all cases abundant hay storage should be provided by the construction of a roomy hay loft over the first story. The theory often advanced that a sanitary dairy barn should not have an overhead loft, is refuted by the experience of a great many successful producers of clean milk. The only requirement is that the loft floor be made dust tight and that while not in actual use, hay openings be kept closed to prevent the sifting down of dust. As a rule profitable milk production depends upon the raising of large amounts of hay and other roughage on the farm. *A large roomy loft furnishes by far the cheapest hay storage.* It is exceedingly wasteful to stack hay and other forage outside, because of damage by weathering and also because of the greatly increased labor of handling. Ample loft room allows all hay to be placed directly in the barn from the swath or shock. Moreover a deep loft is economical because one roof provides shelter for 10 to 20 feet of hay instead of only a few feet. It is therefore desirable to make the barn from 18 to 20 feet to the eaves. This plan not only provides the cheapest storage but also permits of a large saving of labor in feeding.

Some dairymen, as for instance those located in the outskirts of large cities, grow little or no roughage, and these require less loft room since the greater part of the hay used is purchased in bales. Such dairymen, however, will do well to have sufficient loft room to provide a place to store feed for a considerable length of time, as lower prices may usually be obtained when feed is purchased early in the season and in large quantities and stored for use during the feeding season.

Strong and Durable Construction.

The frame work of the barn should be strong enough to withstand heavy winds and the weight of hay stored above. The size of posts, girders and joists will depend upon the depth of the hay mow. The size and number of rafters and roof supports will depend on the width of the barn.

Foundations should be high enough to protect sills and posts from decay. An excellent plan is to bring the foundation up to the bottom of the windows. Too low foundations are a very common fault with barns in this State, and greatly reduce the life of farm buildings. Other factors in insuring durability are first-class siding and roofing material. Attention to the above points will mean the reduction of labor and expense for upkeep and repairs.

Size of the Barn.

This depends upon the size of the farm, kind and number of stock and the kind of farming to be followed, the amount of forage raised, etc. The barn should be large enough to meet the present needs of the farm, and to allow for a reasonable growth in crop and stock production. The width of barns is discussed in another section and is shown in detail in the various drawings given. The length may be varied to suit individual needs.

VERY LARGE BARNS NOT PRACTICABLE:—Ordinarily when home grown silage and roughage feeds are produced no more than 60 to 80 cows should be placed in one stable. The number should never be so large as to require that silage and hay be hauled long distances from fields to barn, and manure from barn to fields. We know one instance in which several hundred cows are milked in one central barn, with the result that much of the corn put in the silos has to be hauled several miles; the cows have to be driven long distances to pasture and the hauling of manure is enormously expensive. Instead of having one large barn in which several hundred cows are milked, it would be much better to

have several smaller barns so distributed that each will be situated close to the fields where the forage is grown, and where the manure is to be distributed. It would be much more economical to transport the milk to one large central dairy house than to haul feed and manure such long distances as are required when a very large central barn is used.

Often after a barn has been built it becomes necessary to enlarge it. The builder of a barn should always have in mind the possibility of enlarging the barn should it become necessary to do so. Most of the plans herein given permit of enlargement by simply adding one or more bents at one end.

Appearance.

In planning a barn its appearance, especially the view of the building when approached from the highway should be given a reasonable amount of consideration. The front should be made as neat and attractive as possible. Many farmers have the name of the farm and the kind of stock raised painted in large letters on the front of the barn. This improves the appearance and often has an advertising value. If possible the cows should be turned in and out of the stable at the rear end. The barn yard should preferably be at the rear of the barn, and the manure shed or dump should be at the rear and far enough away to avoid contamination of the air of the milking barn.

Site for the Barn.

The dairy barn should be located so as to avoid odors and contamination from hog pens, chicken houses and other places which are liable to be unclean. Surface water should drain away from the building. We are led to emphasize this point because we have been in so many barn yards which were veritable seas of mud due to the mistake having been made of selecting low building sites and in imperfectly grading the surface.

If possible the barn should run north and south so that the sunlight may enter from both sides during the day. It will be an advantage to provide an ell to the main building as this permits of a barnyard sheltered from cold winds from the north and west.

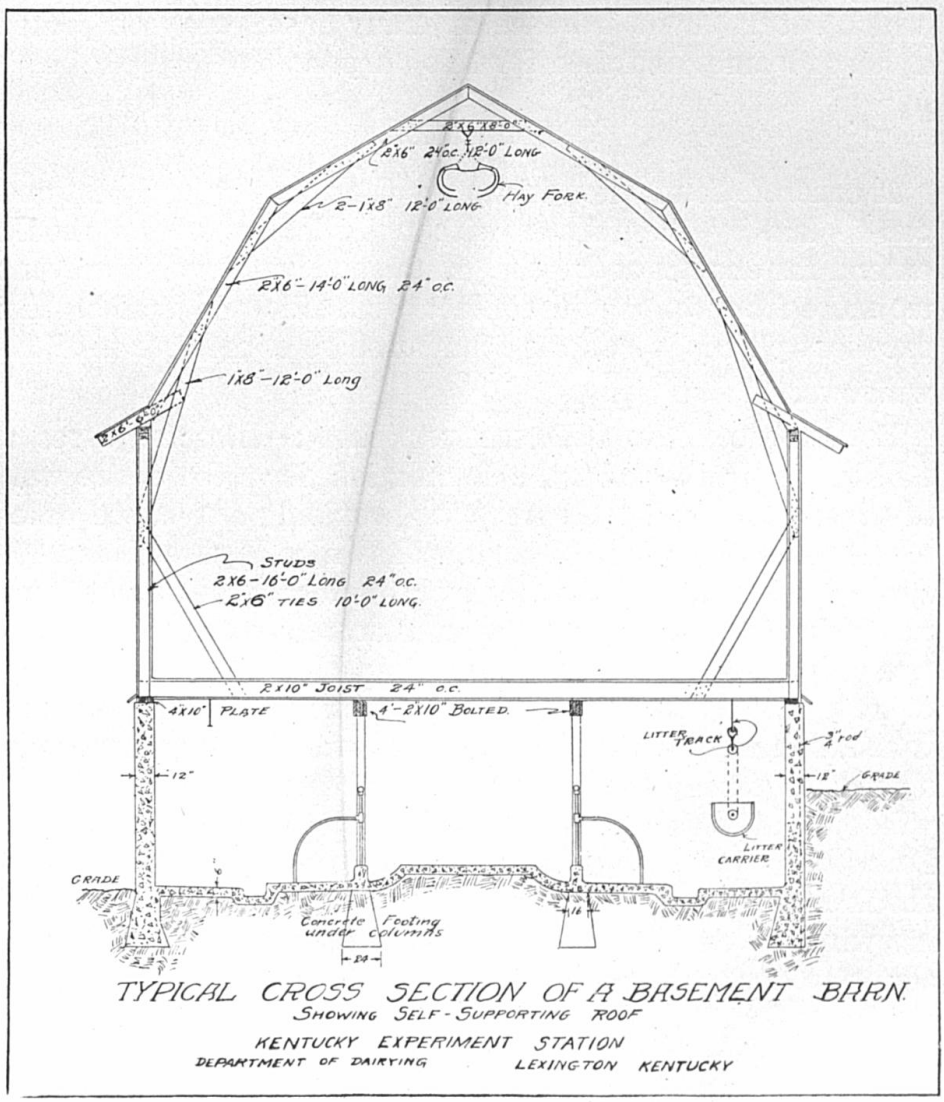


FIG. 8. Cross section of basement barn. Note self-supporting roof and large amount of room for the storage of hay.

PROVIDING AGAINST A MUDDY BARNYARD:—A muddy barnyard may be avoided by first grading so as to permit proper

drainage and then covering the surface with several inches of broken stone upon which is placed a layer of cinders or gravel. This forms a hard smooth surface which does not get muddy and which permits the easy scraping up of the droppings of the cows at frequent intervals. Loose stones which encumber the surface of many farms may be picked up at odd times and used for this purpose.

Foundation.

A concrete foundation is usually the cheapest and best and can be laid by the farmer with unskilled labor. It should extend far enough above the ground and floor level to prevent moisture from coming in contact with sills and frame. An excellent plan is to run the foundation up to the bottom of the windows.

FOUNDATION FOR A BASEMENT BARN:—In some cases a still better plan is to let the foundation form the entire wall of the first story of the barn, thus providing a so-called basement barn. This type of barn is shown in Figures 8 and 37. Provision is made for driving a wagon on to the second floor of the barn. The entire superstructure is devoted to storage purposes. Modern hay lifting machinery makes it easy to transfer hay from wagon to hay mow. In building the foundation an inner and outer form are used and the walls should be strongly reinforced. Spaces should be left for windows at proper distances and of proper dimensions. Foundation walls are usually 12 inches wide. On no account should a basement dairy barn be constructed without providing windows on both sides of sufficient size and number to admit an abundance of light.

Width and Length of Dairy Barns.

From the standpoint of economy of floor space and cutting down cost of concrete floors and roofing it is desirable to have the barn as narrow as possible, consistent with efficiency and sanitation. Ample loft room may be provided by running the side walls 18 to 20 feet to the eaves and using a

gambrel roof. Thirty feet is as narrow as a two row stable should be made. This width does not permit of driving into the stable with a team, but in most cases this makes no difference, since an overhead litter carrier furnishes a cheap and easy means of removing manure. Plans are given in

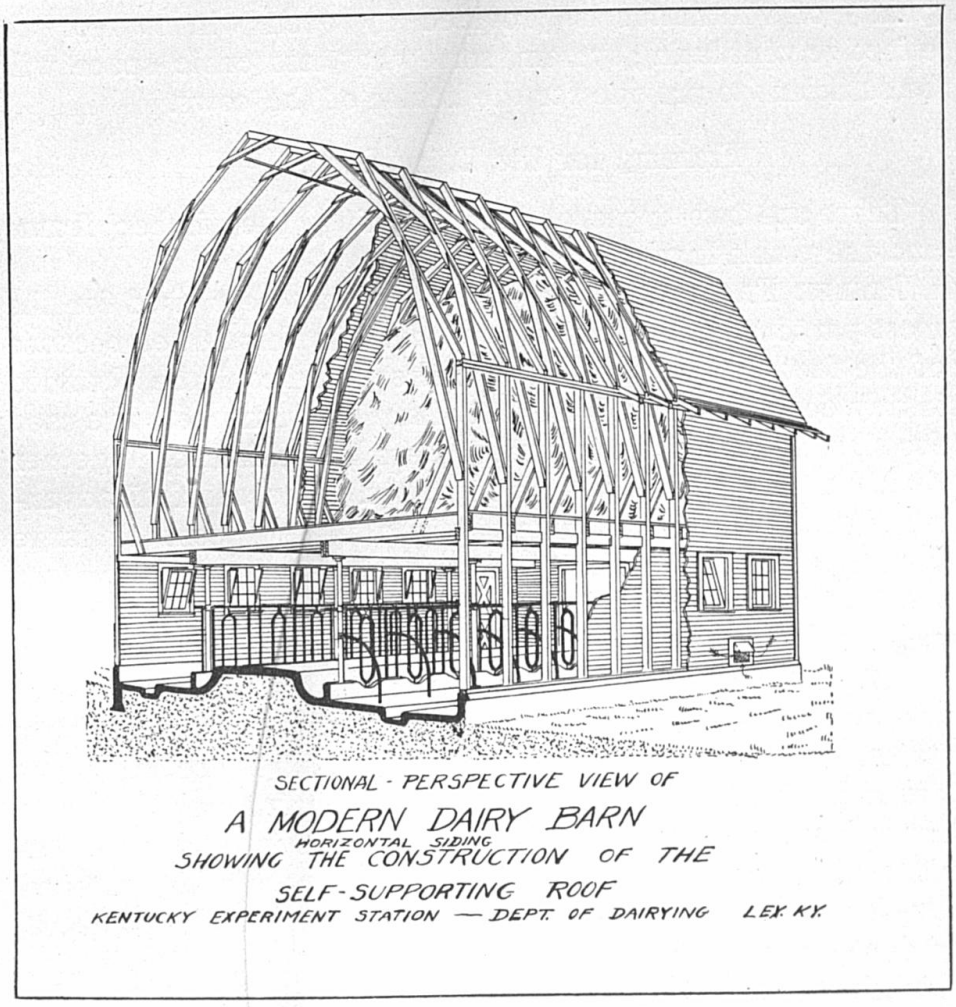


FIG. 9. Barn framed for horizontal siding.

this bulletin for barns varying in width from 30 to 36 feet. The length of the barn will be governed by the number of cows to be quartered. Usually dairy barns are built in bents either 10 or 14 feet long. Ten ft. bents provide for three stalls, 14 ft. bents for four stalls between posts.

HEIGHT FROM FLOOR TO CEILING:—This should not be less than 7½ feet in the clear and eight feet is preferable. The distance should not exceed 9 feet since a greater height results in the stable being cold during severe winter weather. The United States Government score card for barns calls for a cubic space of at least 500 cubic feet per cow. However, if plenty of ventilation is provided by open windows or an effective ventilating system, somewhat less cubic space will be sufficient to provide for the health of the cows.

Framing for the Dairy Barn.

There are two types of barn framing, the timber frame and the plank frame.

TIMBER FRAMIMG:—Timber framing has been used for the most part in the construction of barns in this State, because of the fact that timber has been cheap and could be obtained in any desired size and length. Large solid timbers are used for sills, beams, ties and posts, these being framed together by means of mortise and tenon joints. The chief disadvantages of the timber framing lie in the high cost of large timbers and in the difficulty of handling them, and in the fact that many of the timbers have their strength reduced in the making of mortise and tenon joints.

THE PLANK FRAME:—The plank frame barn has come into use in recent years in all of the leading dairy and stock raising states, and at the present time nearly all barns are being constructed with this type of framing. In constructing the plank frame barn the use of long square timbers is discarded. In place of these, two inch planks are used, these being fastened together by the free use of spikes. Since a built-up beam, girder or post is much stronger than ordinary solid timber, this gives greater strength and is also considerably less expensive. This type of framing is illustrated in Figures 9 and 10. The most important advantages of the plank frame barn are as follows: It permits a saving in the cost and amount of lumber. The timbers are more easily handled. A plank frame barn is more quickly and easily constructed than one of the timber frame type, and less skilled labor is

required in erecting it. There is no weakening of timbers by the use of mortise and tenon joints. The plans given in this bulletin are adapted to either type of construction which the builder may desire to use.

FRAMING FOR HORIZONTAL SIDING:—Figure 9 shows a barn having the plank frame arranged for horizontal siding. The

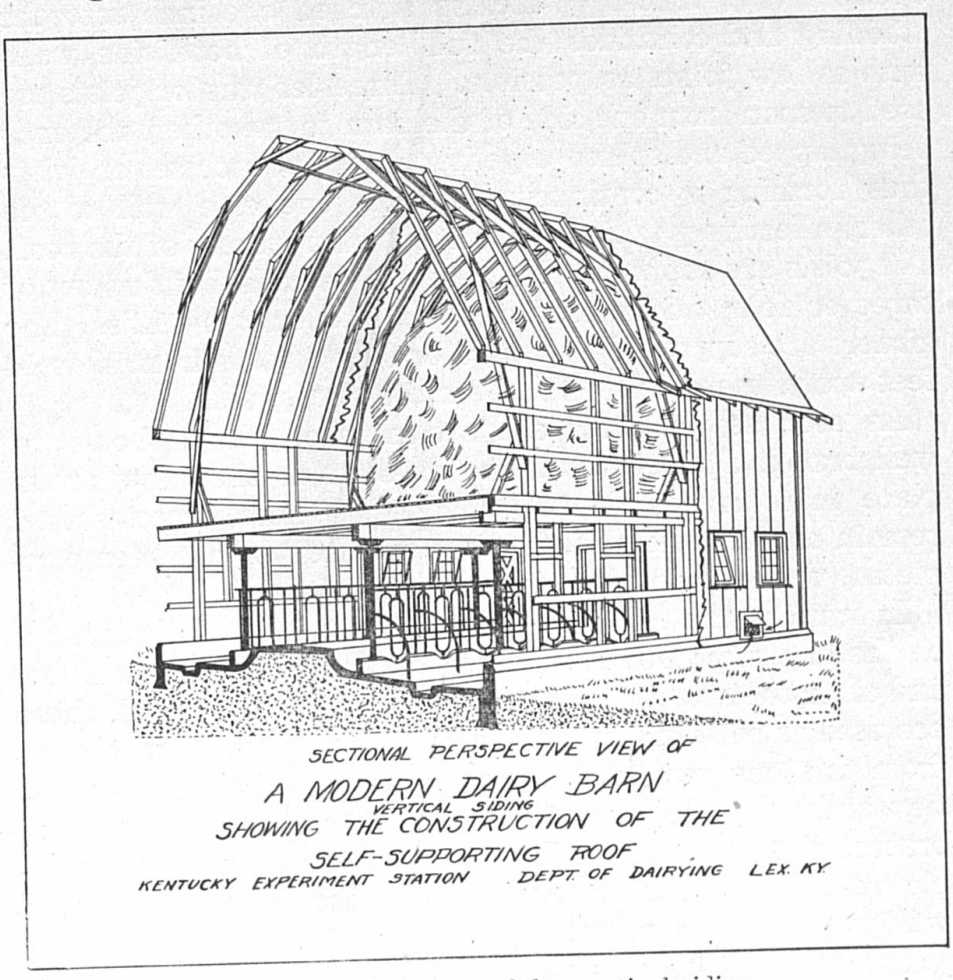


FIG. 10. Barn framed for vertical siding.

building is placed on a concrete foundation, on top of which the sills are securely attached by bolts. The 2 by 6 studs are spaced 24 inches on centers. The length may be from 4 to 20 feet, according to the depth of hay mow desired. A double 2 by 6 inch plate is spiked on top, this plate tying the

studs together and keeping them in a straight line and forming a sill for the rafters. The joists supporting the hay mow are made of 2 by 8's or 2 by 10's according to the depth of the hay mow, and are spaced the same as the studding, so that the end of each joist may be spiked against the sides of the studs, and at the same time rest on a 2 by 6 ledger or "ribbon," which is notched one inch into the studding and continues the full length of both side walls with as few joints as possible. Three lengths of joists are used to span from one side of the barn to the other, the ends being lapped and spiked together securely, each set of joists thus forming a continuous tie from one side wall to the other, effectively taking up the outward thrust of the roof. The joists are supported by a set of girders built up out of three or four thicknesses of 2 by 10's or 2 by 12's. The girders are supported by 6 by 6 or 6 by 8 posts from 10 to 14 feet apart, these being placed on concrete piers.

As soon as the studs are set in place, they should be well braced against wind, and as soon as the joists are in place more braces should be added. These braces should remain until the siding is in place and the roof has been completed, then they may be taken out.

In framing the roof one set of rafters is carefully laid out on the hay mow floor, or other convenient level platform, and after the exact length of each piece is computed, these are used as patterns and the required number of pieces cut from this one set of patterns. When all rafters, braces, ties and collar beams have been cut, each set of rafters, braces, ties, etc., are spiked together so as to form a complete arch rib which will reach from the plate of one side wall to that of the other.

The best method of procedure is to build all these arches laid flat, one on top of the other, on the building, the ends of each arch (the heels of lower rafters) resting on the wall plates at the point where it is to be secured after it is raised to a vertical position.

After all of the arches are completed the end arch is hoisted up to a vertical line, perfectly plumbed, well spiked into

place, and well braced, a block and rope are hooked to the collar beam (the top horizontal beam to which the hay track is fastened) of the arch that is in place, and with this the arch is hoisted, plumbed, and nailed in place and this method is con-

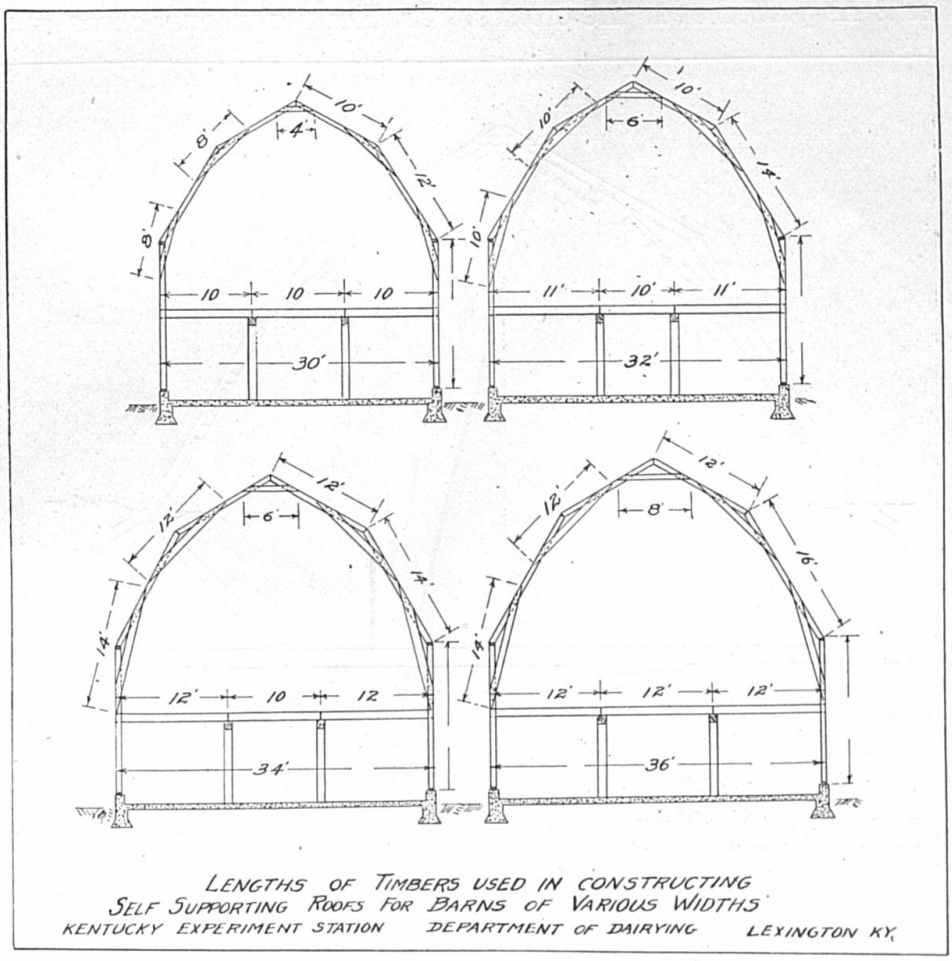


FIG. 11. (Courtesy Louden Machinery Company, Fairfield, Iowa.)

tinued until all are in place. These arches can be raised and set in place by three or four men, while with the old method of heavy purlin and post construction, six or eight may be necessary to help hoist the heavy frame.

Siding consists of one thickness of ship-lap or weatherboarding placed over the studs.

FRAMING FOR VERTICAL SIDING:—This plan provides for the use of streamers for the attachment of the siding. The siding usually consists of 1 by 10 barn siding with 3 inch battens placed over the cracks. In Kentucky our climate is

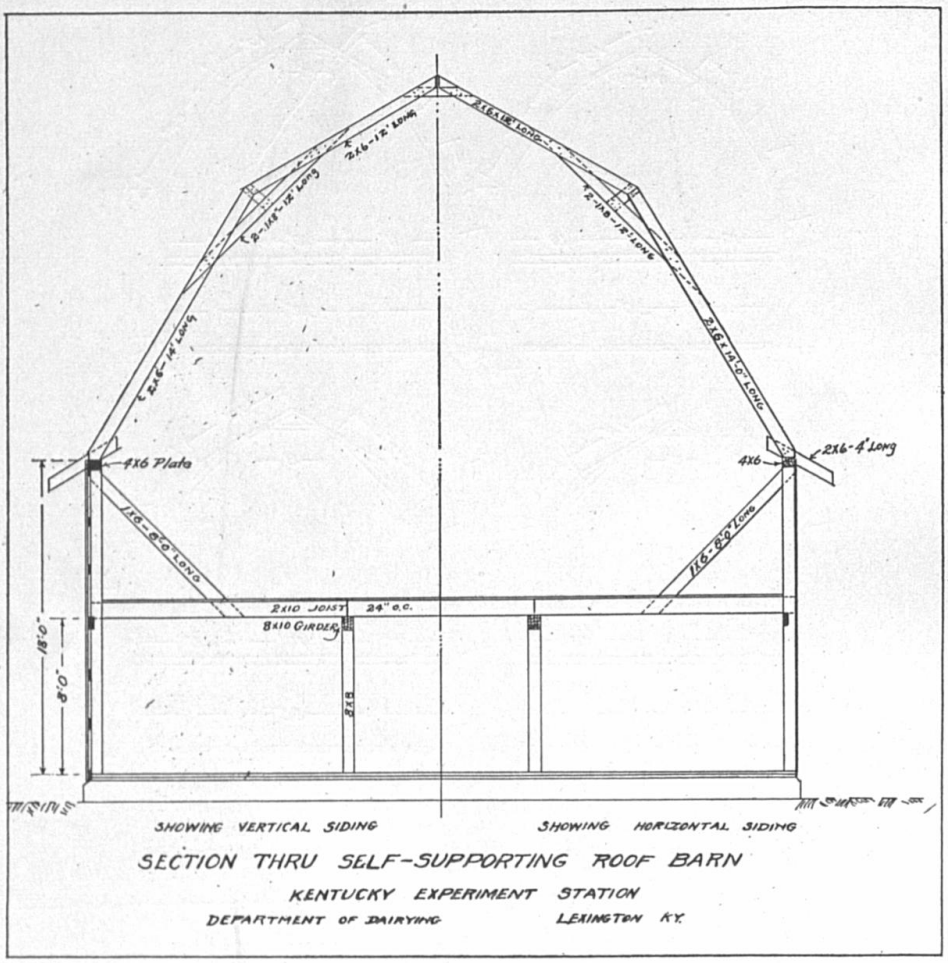


FIG 12. Roof frame, middle bent. For horizontal siding at right and for vertical siding at left.

mild and a single thickness of siding is sufficient for the barn walls. The heavy double walls used in northern latitudes to insure warmth are not required in this State.

ROOF FRAMING:—Barn roofs are of two general types, the

common gable roof and the gambrel or self supporting roof. The former is in common use in Kentucky, and therefore needs no description.

GAMBREL OR SELF SUPPORTING ROOF:—This roof has many advantages over the old style gable roof, the most important being that it gives more loft room for hay storage and its use does away with heavy supporting posts and cross beams, which interfere with the unloading of hay. This type of

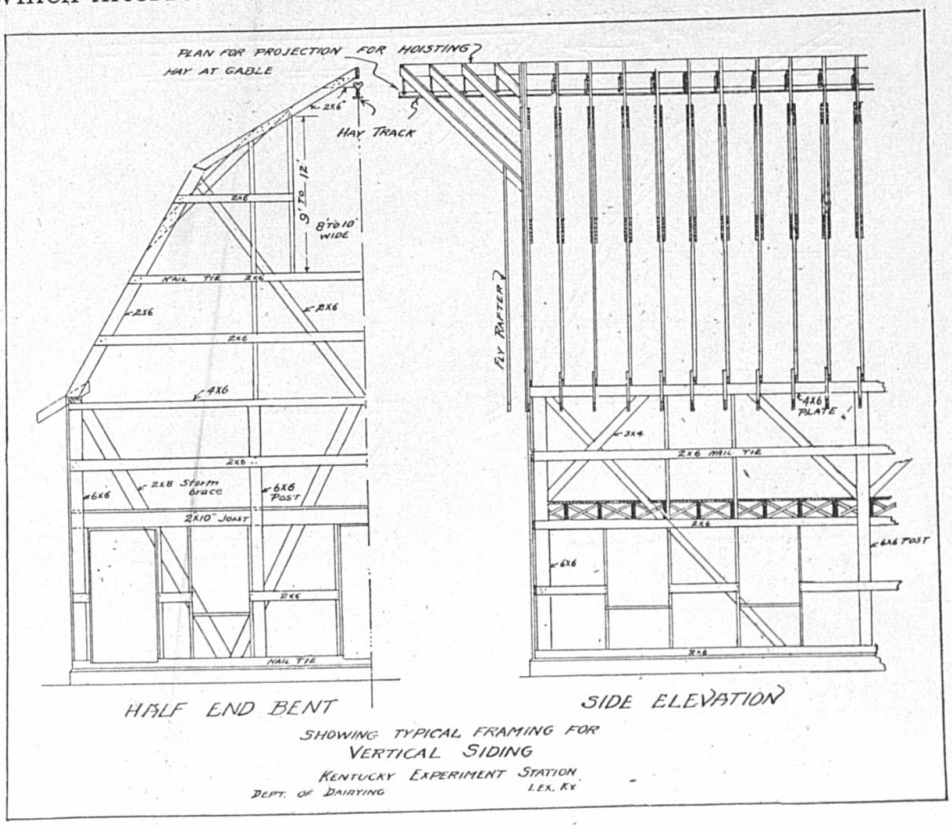


FIG. 13. Framing for vertical siding.

roof is very strong and is easier to erect and cheaper than the old style gable roof. The construction of this framing suitable for barns not exceeding 36 feet wide is shown in a number of figures in this bulletin. (Figs. 9, 10, 11, 12, 13 and 14.)

Stable Floor.

The stable floor should be constructed of material which

can easily be kept clean. It should be durable, impervious to water, sanitary, and not unduly expensive. Wooden floors may be used, but they rot out in three to five years, and have the disadvantage of becoming water-soaked when washed and scrubbed. The objections to concrete stall floors, and the means of meeting these objections will be mentioned in the section on cow stalls. Considering their

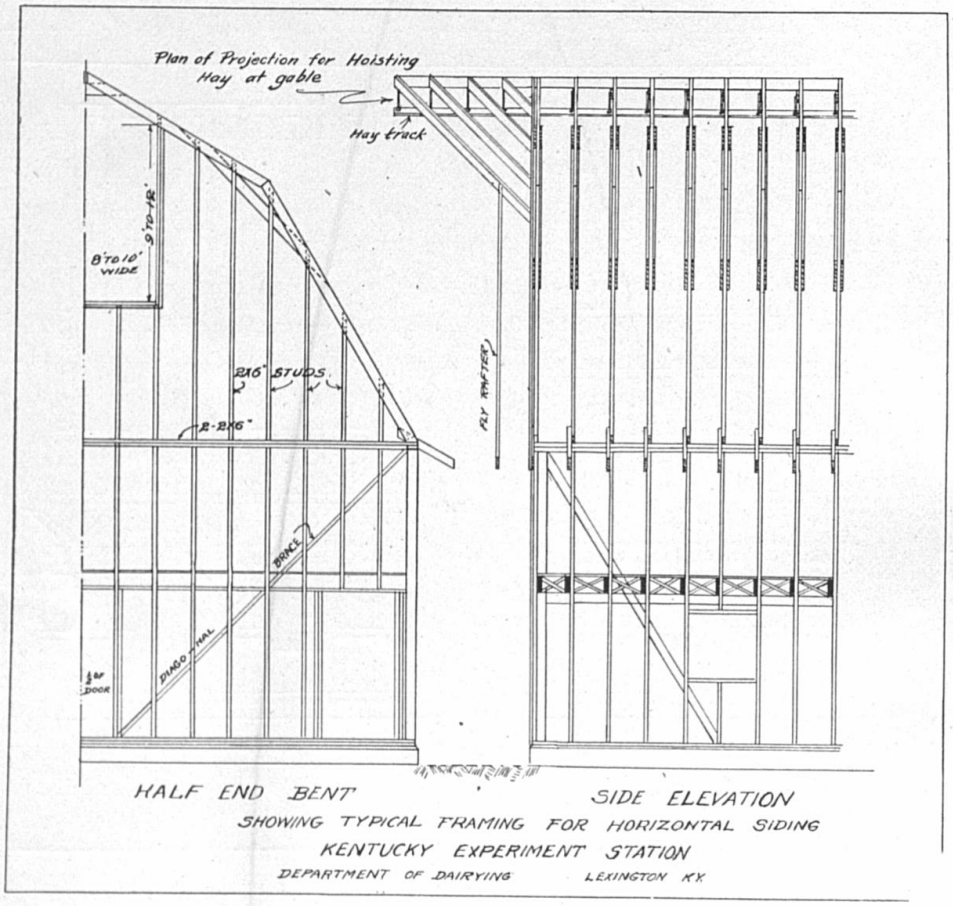


FIG. 14. Framing for horizontal siding.

durability, concrete floors are cheaper in the long run than other kinds, and they greatly reduce the labor of keeping the stable clean and free from odors. The usual thickness of the concrete floor is 4 inches of the concrete grout and one inch facing. For the grout a mixture of one

part Portland cement, two and one-half parts sand, and five parts crushed stone or gravel is used; for the one inch facing, one part Portland cement and two parts sand. These materials are mixed thoroughly on a tight wooden platform. In the proportions given above four bags of cement, 10 cubic feet of sand and 20 cubic feet of crushed stone will lay 45 to 50 square feet of surface. Complete instructions for laying concrete stable floors will be furnished upon application to the Department of Animal Husbandry of this Experiment Station.

CONCRETE FLOOR NOT NECESSARILY EXPENSIVE:—Figure 29 shows a Kentucky dairy barn having a concrete floor. Loose stones picked up from the surface of the fields, and sand from a near-by creek were used in making the concrete for this floor. The proprietors of the dairy superintended the mixing of the concrete, using their regular farm labor. A local stone-mason, who had had some previous experience in plastering, and digging cisterns and other related work, was hired by the day to do the work of finishing the concrete. The cost of the concrete work in this barn (84 by 34 feet), including mangers and gutters, was as follows:

Wages of finisher at $2.50, and two helpers at $1.50, six days, $33. Sixty barrels Portland cement at $1.75, $105, making a total cash outlay of $138, or less than 5 cents a square foot. As the hauling of materials used, and the breaking of the stone was done by the farm labor at times when the other work was not pressing, the cost for these items was very small.

Interior Arrangement of the Barn.

It is desirable to have the side walls and ceiling of the barn smooth and tight, and to avoid corners and ledges which catch dust and cobwebs. The loft floor should be made of tongued and grooved flooring to prevent the sifting down of dust. Ceiling over joists is not necessary and entails extra expense, and is justified only where appearance is to be made an item of especial importance.

Plans and dimensions of feed ways, mangers, gutters,

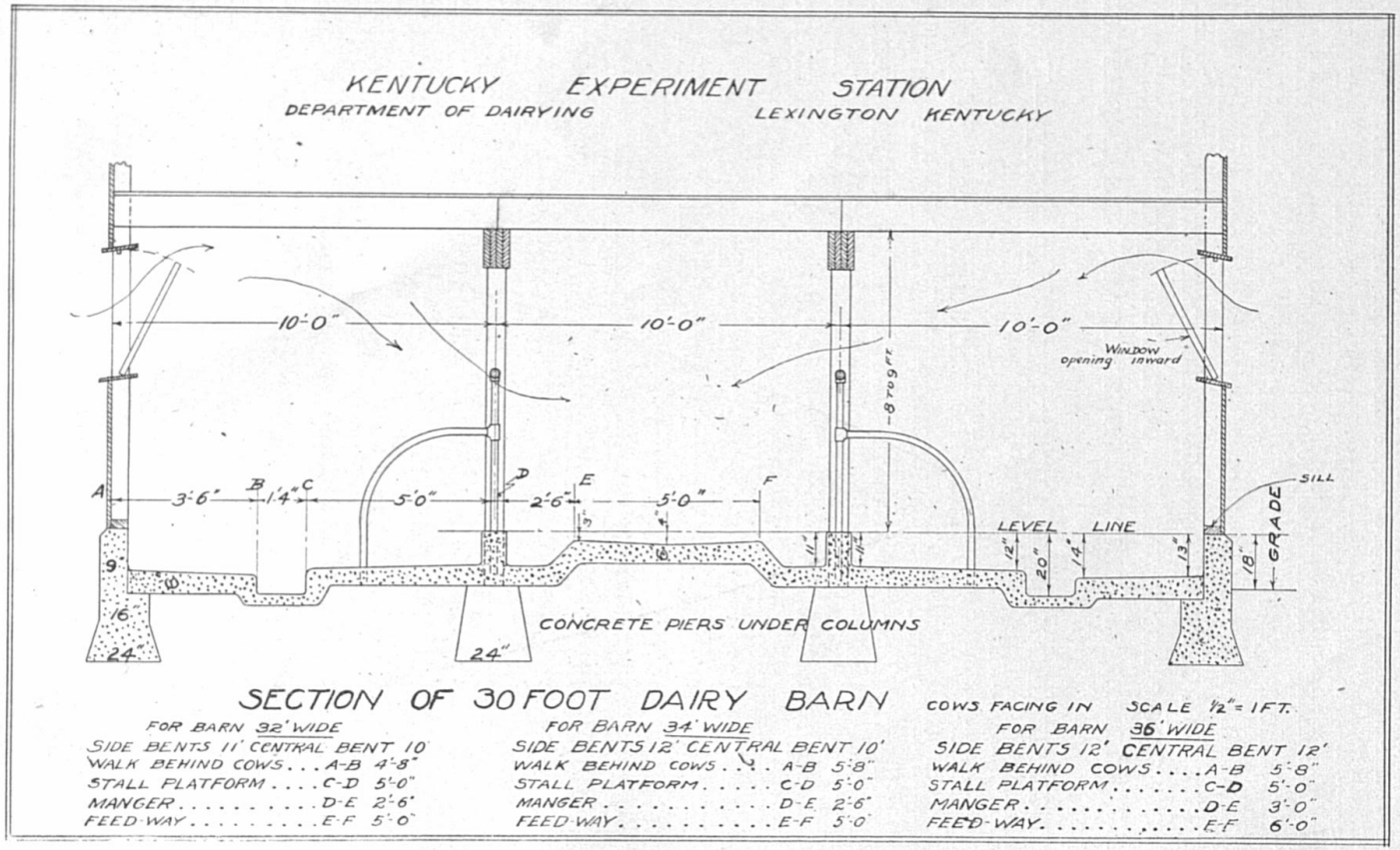


FIG. 15. Section of barn—cows facing inward.

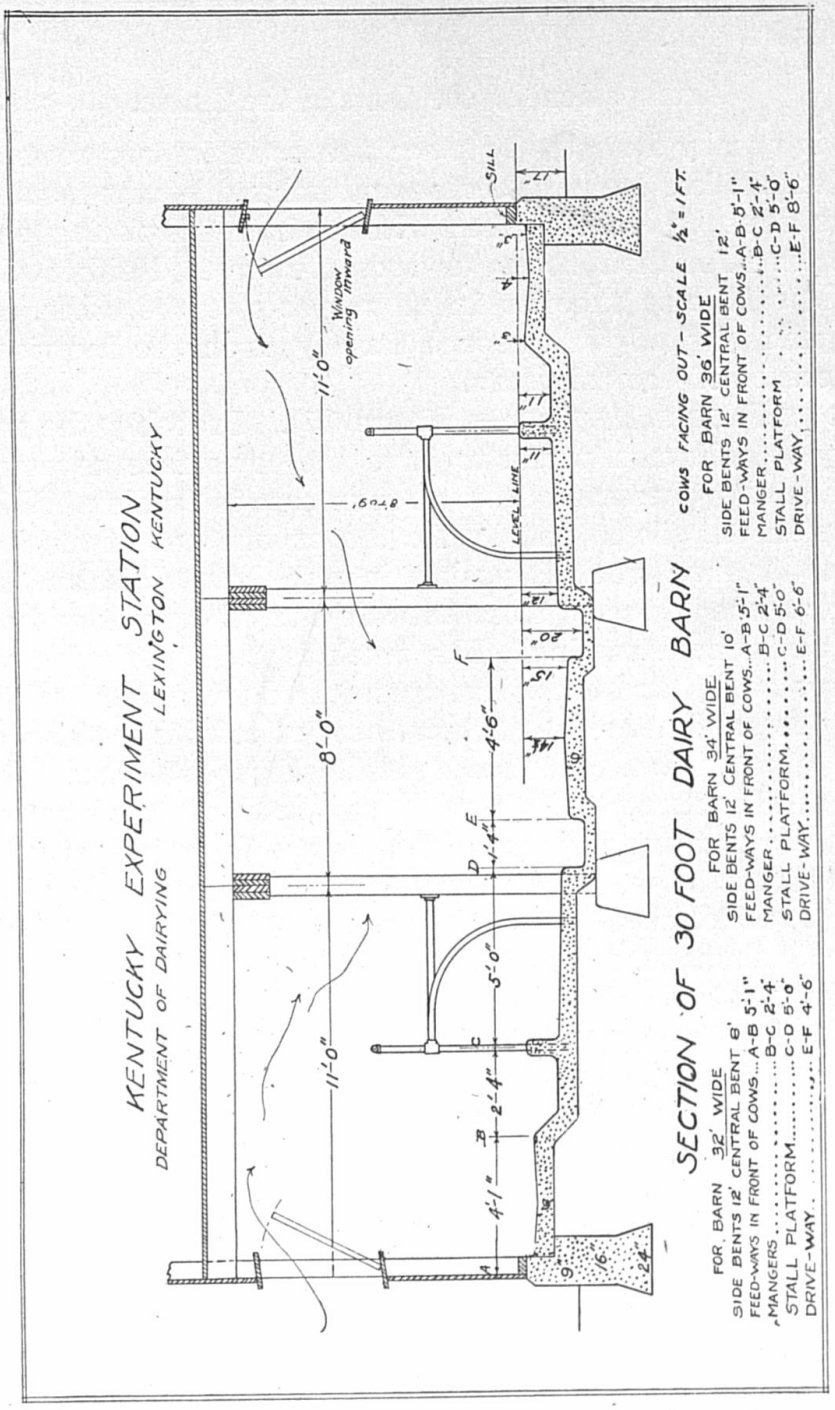


FIG. 16. Section of barn—cows facing outward.

etc., are shown in the details of the various drawings given in this bulletin.

Arrangement of the Cows in the Stable.

It is usually desirable to place the cows in two rows, as this entails less labor in feeding and in handling the manure. Cows may be placed either with their heads facing each other or with their heads towards the wall. Neither plan can be said to be superior in all respects to the other, and the plan adopted will depend largely upon the individual preference of the dairyman.

COWS FACING INWARD;—(Figure 15). Probably the majority of dairymen prefer to have the cows face a central feeding alley because of the greater ease in feeding. With this plan the silo is usually located at one end of the feed alley. A large truck is pushed into the silo chute and the silage pitched directly from the silo into the truck without any additional handling. The truck is then pushed down the feed alley and the silage transferred with a fork to the mangers on either side. A large herd of cows is in this way very quickly and economically fed. Figure 30 shows this plan of silo location. This plan may be used to advantage when the greatest economy of floor space is desired since it permits of the use of a narrower barn, 30 feet being sufficiently wide for all practical purposes, while 32 or 34 feet gives an abundance of room. With a width of 36 feet there is an unnecessary waste of floor space.

COWS FACING OUTWARD:—(Fig. 16). With this arrangement there are two feed alleys and one manure alley. Usually when cows are thus placed, a width of 36 feet is to be preferred. This width permits of a driveway wide enough for a team to be driven through from end to end, the manure being loaded directly from gutters to wagon or spreader and taken at once to the field and scattered without additional handling, thus allowing a great saving of time and work. If the barn is narrower than 36 feet it will not be possible to drive through with a team to remove the manure, and an overhead carrier may then be used to advantage.

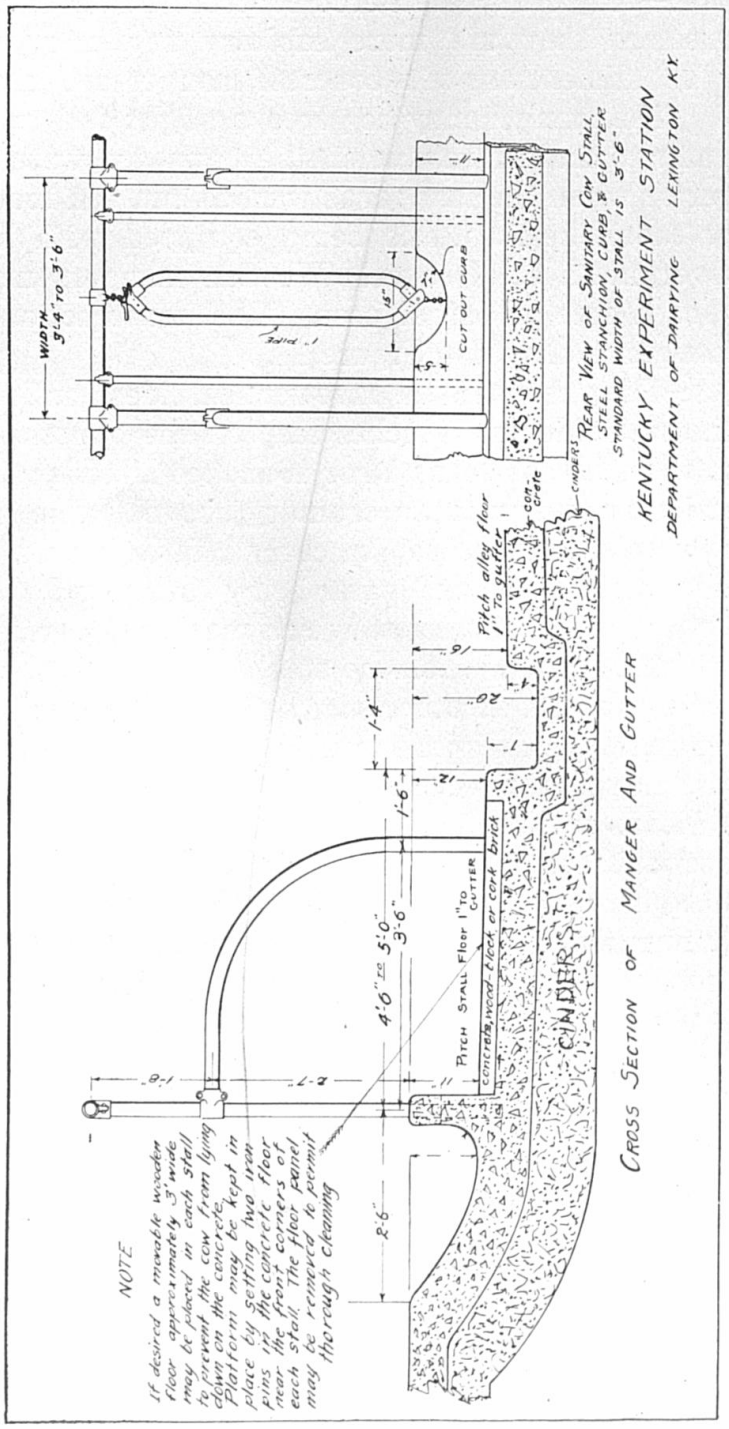

KENTUCKY EXPERIMENT STATION
DEPARTMENT OF DAIRYING LEXINGTON KY.
REAR VIEW OF SANITARY COW STALL, STEEL STANCHION, CURB, & GUTTER
STANDARD WIDTH OF STALL IS 3'-6"
CROSS SECTION OF MANGER AND GUTTER
CINDERS
CONCRETE
Pitch alley floor 1" to gutter
Pitch Stall Floor 1" to Gutter
Concrete head block of cork brick
CUT OUT CURB
WIDTH 3'-4" TO 3'-6"
NOTE
If desired a movable wooden floor approximately 3' wide may be placed in each stall to prevent the cow from lying down on the concrete. Platform may be kept in place by setting two iron pins in the concrete floor near the front corners of each stall. The floor panel may be removed to permit thorough cleaning

FIGURE 17.

MANGERS:—All points considered concrete mangers are to be preferred, as they are more sanitary and more easily cleaned. The dimensions of a concrete manger are given in Figure 17. The manger may be given a slight fall to allow surplus water to drain away when the cows are watered in the manger or when the manger is washed out. A four inch sewer pipe should be used, this being equipped with a perforated cover and a solid cover. Wooden mangers may be installed for a smaller initial cost. The construction of a wooden manger is shown in Figure 18.

GUTTERS:—The gutter should have vertical sides 6 or 7 inches deep on the stall side and 4 inches deep on the opposite side. The width should be at least 14 or 16 inches in order that it may be easily cleaned with an ordinary shovel. The gutter should be given sufficient drop to carry off the water when the stable is washed out, the water being carried off by a six inch sewer pipe, the entrance to which may be covered with a perforated top for use when the stable is being washed out and a solid top for use at other times to prevent the escape of liquid manure. A frequent trouble in washing out the cow stable is the clogging up of the gutter sewer pipes. To avoid this some means must be employed to prevent chaff and coarse material from getting into the pipe. A bell trap will answer this purpose. It is best to have the outlet from gutter and manger at one end of the barn if the rows of cows are not too long. This arrangement is shown in Figure 30. For long barns, however, with this plan, to secure sufficient fall the gutter must be quite deep at the discharge end. To avoid this the bottom of the gutter may be made to slope from the ends to the middle. This is shown by the small dotted lines in Figure 33. The principal danger with this arrangement is the clogging up of gutters, in which case it may be necessary to tear out the concrete across the barn in order to remove the obstruction. For this reason it is safer to have the discharge at one end so that when the sewer pipe becomes clogged the obstruction may be removed without the necessity of tearing up the concrete floor.

The width of the manure alley back of the two rows of cows

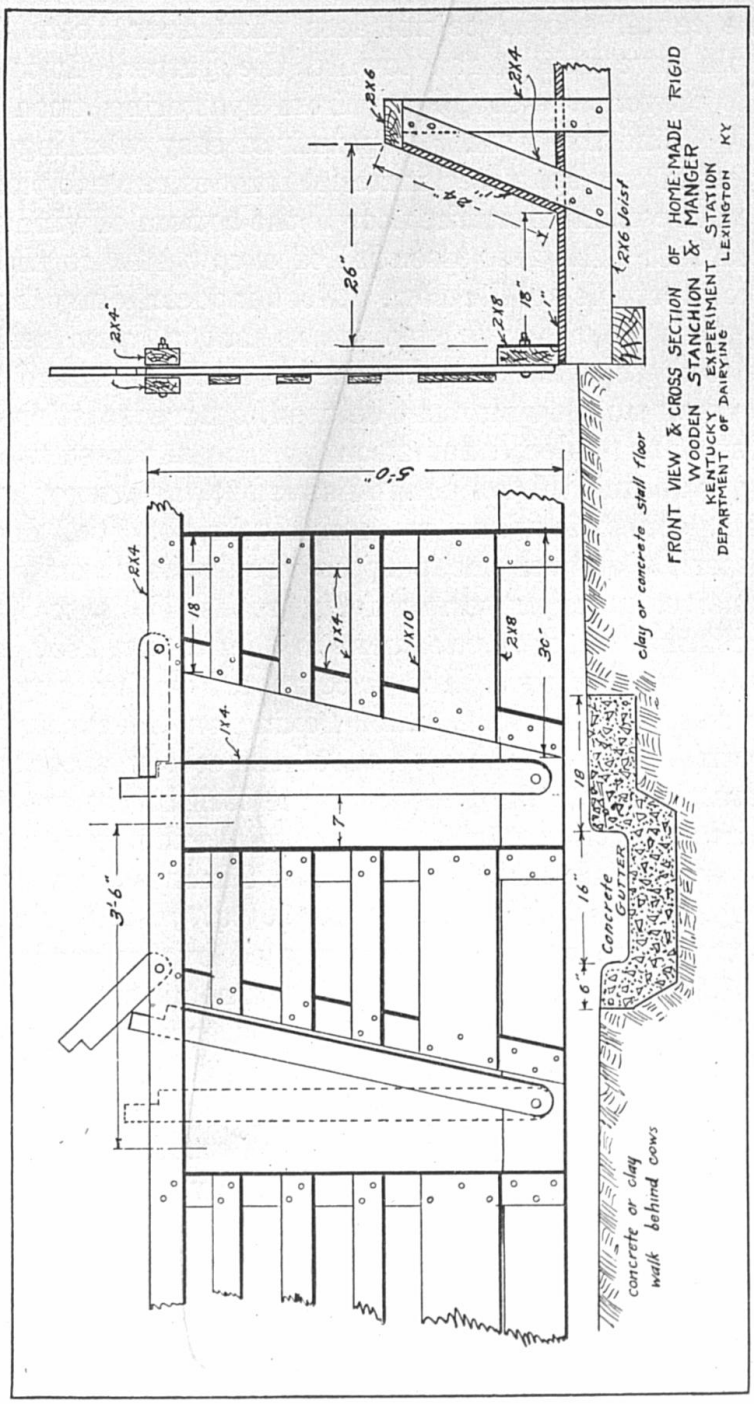

FRONT VIEW & CROSS SECTION OF HOME-MADE RIGID WOODEN STANCHION & MANGER
KENTUCKY EXPERIMENT STATION
DEPARTMENT OF DAIRYING LEXINGTON KY
2X6
2X4
26"
2X8
18"
2X6 Joist
2X4
5'-0"
2X4
18
1X4
1X10
2X8
30"
1X4
clay or concrete stall floor
7
18
3'-6"
6"
16"
Concrete GUTTER
concrete or clay walk behind cows

FIGURE 18.

facing the center should be not less than four feet. The alley should have a slight fall toward the gutter. It is impossible to prevent the droppings from spattering upon the side walls behind the cows. To permit of easy washing and cleaning off of this spattered material it is desirable to plaster the wall with cement from the floor to the bottom of windows.

COW STALLS:—The first essential of a cow stall is that it shall be comfortable to the cow. Most modern dairy barns are equipped with concrete stall floors but a very serious objection to these is the fact that they are cold and hard and a large amount of bedding must be used, otherwise stiffness, rheumatism, and udder inflamation will be the result. An effort to get around this objection has led to the use of such materials as cork brick, and wooden blocks for stall floors. These materials answer the purpose very satisfactorily but are expensive. For covering forty stalls 3½ ft. x 5 ft., deducting 4 inches for a curb next to the gutter, 2650 cork bricks would be required. The price quoted on these by the manufacturers is $168.75 f. o. b. Lexington, Kentucky, or $4.20 per stall. To this must be added the cost of a concrete base several inches thick upon which the cork bricks are laid. This will add approximately $1.50 per stall to the cost.

Using creosoted blocks, 3 inches wide, 8 inches long, and 3 inches deep, forty stalls would require 70 sq. yds. of blocks, 54 blocks to the sq. yd. The price quoted by the manufacturers is $1.95 f. o. b. Lexington, this amounting to $3.41 per stall. These blocks must be set with a base of concrete, the crevices between the blocks being filled with asphalt. This and the concrete base will cost approximately $2 per stall. Blocks are made of yellow pine and creosoted with 16 to 20 pounds of oil per cubic foot. They make a very durable floor. A less costly covering for the stall floor may be made by constructing a slatted rack which is placed in the stall over the concrete or by constructing a movable wooden floor approximately three feet wide. One of these is placed in each stall being kept in place by setting two iron pins in the concrete floor near the front corners. The false floor covering should be removed at frequent intervals to permit

of thorough cleaning. During warm weather when the cows do not remain in the barn over-night these wooden floors are removed and stacked away to be replaced when the cows are again confined in the stable over-night.

Some dairymen follow the plan of having the concrete extend 12 to 18 inches forward from the gutter, the remainder of the platform being clay. Figure 18 shows this arrangement, which is comfortable to the cows, but would not be permissible in the production of certified milk, since a clay floor can not be thoroughly washed.

WIDTH OF COW STALL:—The standard width of a cow stall is 3 feet 6 inches. For small cows a width of 3 feet is sometimes used, but this is somewhat narrow. A 14-foot bent accommodates 4 stalls 3½ feet wide, a 10-foot bent three stalls 3 feet 4 inches wide, and a 12-foot bent 4 stalls 3 feet wide.

LENGTH OF COW STALL:—For small cows like the Jersey the length of the stall from gutter to manger should be 4½ feet, for long cows like the Holstein or Shorthorn, five feet, and for very long cows 5½ feet. The platform should not be too long, as this will cause the droppings to fall upon the platform resulting in the cows being soiled when they lie down.

It is desirable to have stalls to accommodate both short and long cows. One plan to accomplish this is to make the platform on one side of the barn five feet long and on the other side four feet six inches, the former being used for long cows, the latter for short ones. (See Figure 30). Another plan is to place the gutter at an angle, the long cows being placed at the long end and the short ones at the short end. This plan is shown in Figure 35.

STALL PARTITIONS:—These are not strictly necessary, but are considered desirable by a majority of dairymen. Curved pieces of iron pipe 1¼ inches in diameter serve admirably for such partitions. This pipe may be purchased of jobbers in plumbing supplies or from manufacturers of stable equipment. It should be very little more expensive than a partition constructed of wood and is more easily kept clean.

STANCHIONS AND TIES:—Many patent stanchions and stalls have been placed upon the market and some of these possess points of merit. The principal objection to them is their expensiveness. Figure 17 shows one of these patented stalls and stanchions. Stanchions of this type sell at from $5 to $10

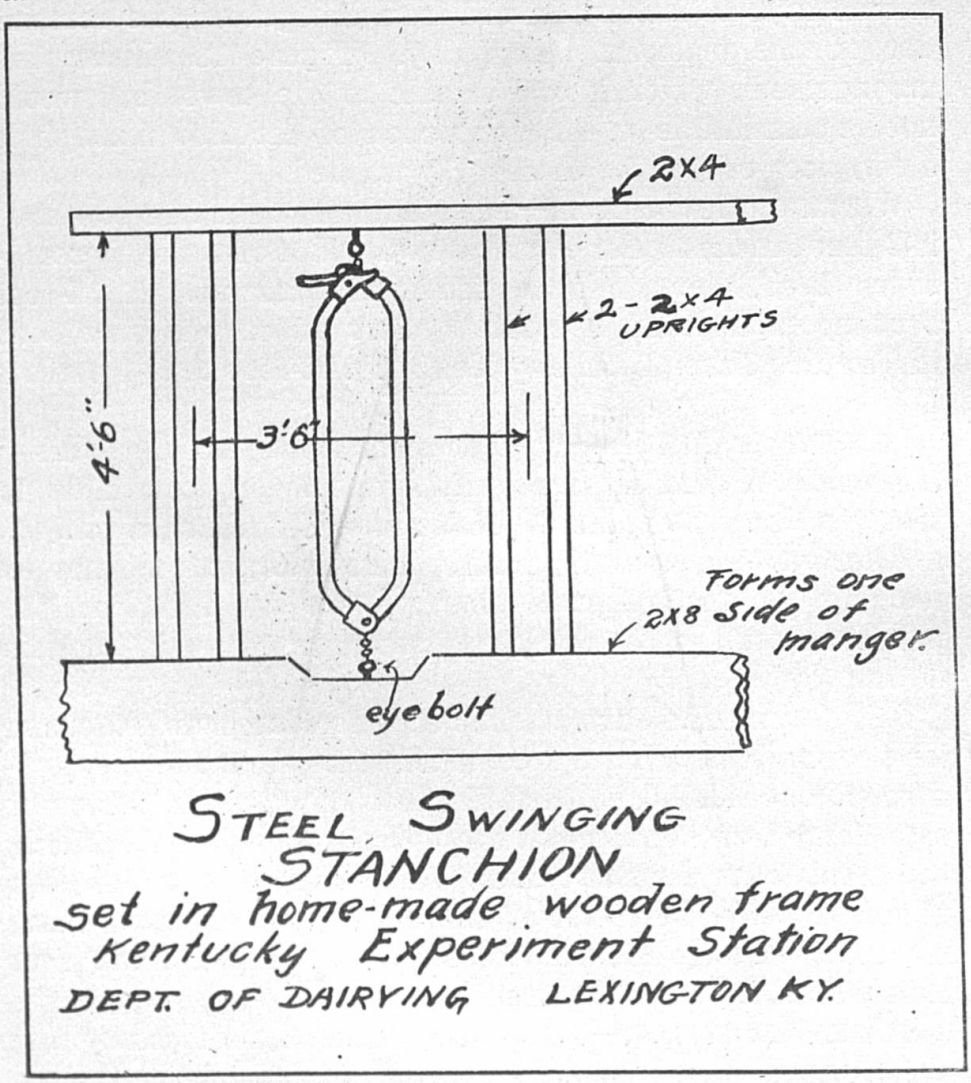


FIGURE 19

each, this including the swinging stanchion, the pipe frame work, and the iron piping which forms the stall partition.

While this patented equipment adds to the neatness and appearance of the interior of the stable, it is by no means

indispensable. A simple chain tie costing 20 cents is just as comfortable for the cows and will answer all practical purposes. Such a tie should appeal to those who are just beginning in the dairy business and do not wish to incur the heavy expense of installing high priced equipment.

The old style rigid stanchion shown in Figure 18 is still used in many dairies. One would expect this stanchion to be uncomfortable to the cow resulting in a lower milk yield. However, the experience of a large number of users of such stanchions indicates that little or no bad effects re-

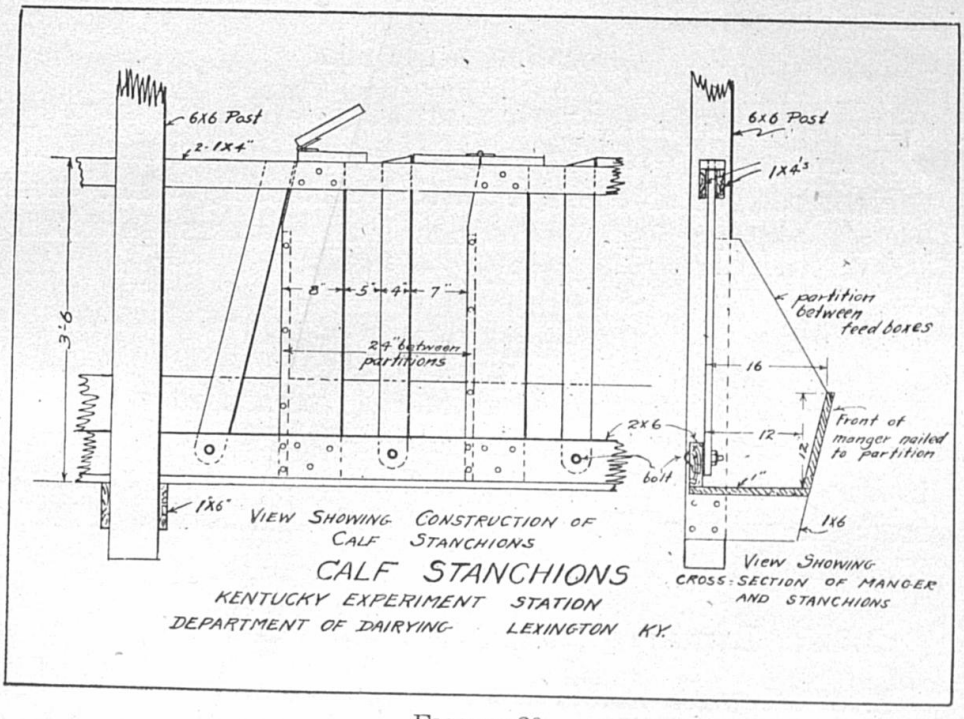


FIGURE 20

sult from their use, but undoubtedly swinging stanchions are more comfortable, and are to be preferred. Such stanchions without the iron framework can be purchased for about $1.35 each and can be hung in a home constructed wooden frame with entirely satisfactory results and at low cost. (See Figure 19.)

HAY CHUTE:—It is important that this be located so as to discharge the hay as close to the point of feeding as

possible. The location of hay chutes is shown in the various drawings. Their location, however, may be changed if desired. Where the silo is located at one end of the barn ,hay may be pitched down into the silo chute at one end, and, if desirable, another chute may be located at another convenient point.

ROOM FOR MILL FEEDS:—This is preferably located on the first floor as is shown in a number of drawings. It may, however, be placed on the second floor, the feed being conveyed through a feed chute to a feed truck or bin on the first floor.

Location of the Silo.

This is shown in the various drawings. The silo should be so located as to permit of easy feeding of the cows, and convenient setting of ensilage cutting machinery. The building and construction of silos has been discussed in another publication issued by this Station.

Separate Dairy Barn.

It is desirable that no other animals be housed in the barn in which the cows are milked, although sanitary milk can be produced in such a barn, provided other stock are separated from the milking department by tight partitions. Figures 27, 30 and 31 show separate milking barns.

Milking Barns Providing Quarters for Extra Dairy Stock.

Most dairymen find it desirable to raise some young stock, and in building barns desire to provide quarters for these, and in many cases also for dry cows and cows with young calves. Sometimes a stall for the herd bull is also provided in the main dairy barn. Figures 28 and 33 give plans for barns providing for calves, yearlings, bull, and cows with young calves as well as cows in milk. In each case provision has been made for ease in feeding and for the removal of manure with the minimum amount of work, the passageways being so designed that a wagon or spreader may be driven through

or backed into the part of the barn devoted to the extra dairy stock.

Mangers and Stanchions for Calves.

Figure 20 shows a front view and cross section of a cheap and effective calf stanchion and manger. Calves are confined in these stanchions while being fed and are released after feeding. This plan provides for a partition between the feed boxes the purpose of which being to prevent the calf from sucking the ear of the calf next to it.

Combination Barn for Dairy Stock and Horses.

Figures 34, 35 and 36. In many cases dairymen find it

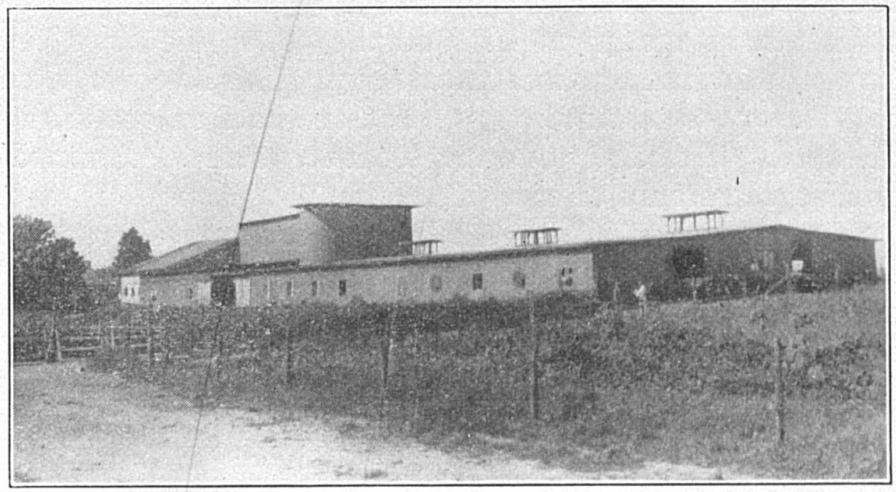


FIG. 21. Exterior view of a covered barn yard on a large certified dairy farm in Kentucky. Note the roof, which is almost flat. Milking barn adjoins the covered yard at the front.

desirable to have extra dairy stock and horses quartered in the same barn with cows in milk, as this permits a saving of labor in feeding and caring for the stock. These three plans provide for this arrangement. It is somewhat difficult to plan a combination barn because of the trouble of keeping stock separate. Therefore with a fair sized dairy herd it is usually a better policy to have separate barns for dairy stock and other stock. There is also danger of odors from horse

and calf stalls contaminating the milk. The plans submitted herewith prevent troubles from odors by the use of sliding doors which effectually cut off the milking room from the rest of the barn.

Separate Milking Barn and Rest Shed System.

With this plan the cows run loose in a large shed except at milking time. All the roughage is fed in this shed and in some cases the grain feed also. There is a separate room or stable usually near by or adjoining in which the cows are milked and in which they usually receive all or part of their grain feed. This stable is not contaminated by dusty bedding or hay and hence is more sanitary than the stable in which cows sleep and receive roughage. The milking stable need not be large enough to hold all the cows, the cows being turned in in groups to suit its capacity. This however, should be sufficient to accomodate at least one-half or one-third of the herd. If smaller than this too much time is consumed in turning the groups of cows in and out.

The milking stable should have a concrete floor and be thoroughly sanitary in construction. Ties or stanchions are provided to hold the cows while being milked, also mangers for feeding grain. The rest shed should be built substantially but may be of rough construction. It is usually a low building and has a floor of natural earth. The roof is nearly flat and is usually covered with tar paper or galvanized iron. No overhead loft need be provided although there may be a loft if desired. This, however, will add to the expense of framing and roofing.

The covered barn yard system has several advantages. It gives freedom and exercise to the cows and protects the herd from cold rough winds of the winter season. It also permits of the handling of manure very economically. Since the cows are not milked in the shed it is not necessary to remove the manure from it every day, this usually being allowed to accumulate to be hauled when convenient. A wagon or spreader is driven into the shed and the manure

transferred directly from the shed floor to the spreader and drawn to the field without any additional handling.

The most serious objection to the rest shed system is the fact that over twice as much bedding is required to keep the cows clean.

Figure 23 shows a cross section of a covered barn yard arranged with a central feed way, and two lines of rigid wooden stanchions and mangers in which the cows are fed.

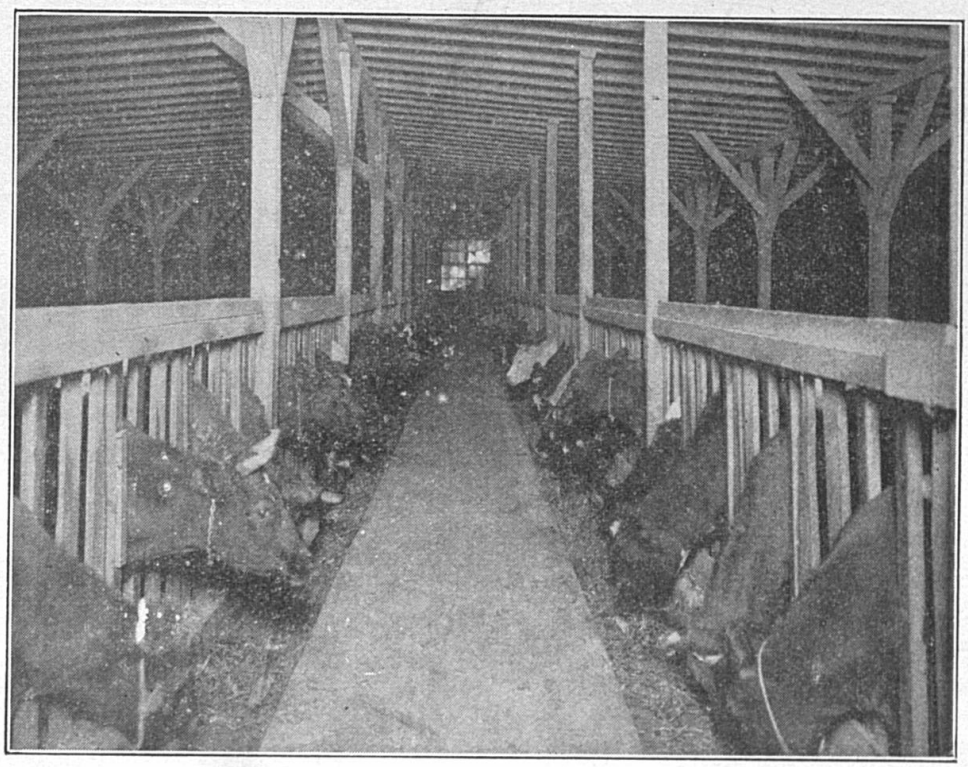


FIG. 22. Interior view of covered barn yard shown in Fig. 21. Note the concrete mangers and feed way, and the rigid wooden stanchions.

This plan is in practical use on a number of farms and has proven very satisfactory. Before feeding time the stanchions are closed. Ensilage and hay are then conveyed in a large truck and placed in the mangers. When this preparation has been completed the stanchions are opened, and the cows place their heads through the stanchions and proceed to eat, the stanchions then being closed to prevent the cows horn-

ing each other while eating. Having finished their meal, they are turned out to run loose. Water tanks of ample capacity should be located in the covered yard, giving the cows constant access to an abundance of clean water of a moderate temperature.

The width of the rest shed shown in Figure 23 is 64 feet. The shed may be made wider than this, but a greater width would result in the interior being too dark.

The shed should be made of sufficient length to accommodate the number of cows in the herd. The supporting posts should be as few as possible as cows are inclined to run each other against these posts. Long bents are therefore desirable.

One Story Dairy Barn.

In this type of dairy barn, storage for feed is provided in a separate building. This arrangement, however, is in most cases undesirable, since cheaper storage and economy of labor can be secured by having a two-story barn with an overhead hay-loft.

Round Dairy Barn.

According to Professor Wilbur J. Frazer, of the Illinois Experiment Station, a round barn for 40 cows requires 22 per cent. less walls and from 34 to 58 per cent. less material than a rectangular building with accommodation for the same number of animals. However, there are many practical objections to the round barn.

1st. The location of the silo in the center is not satisfactory and this space can not be used to advantage for any other purpose.

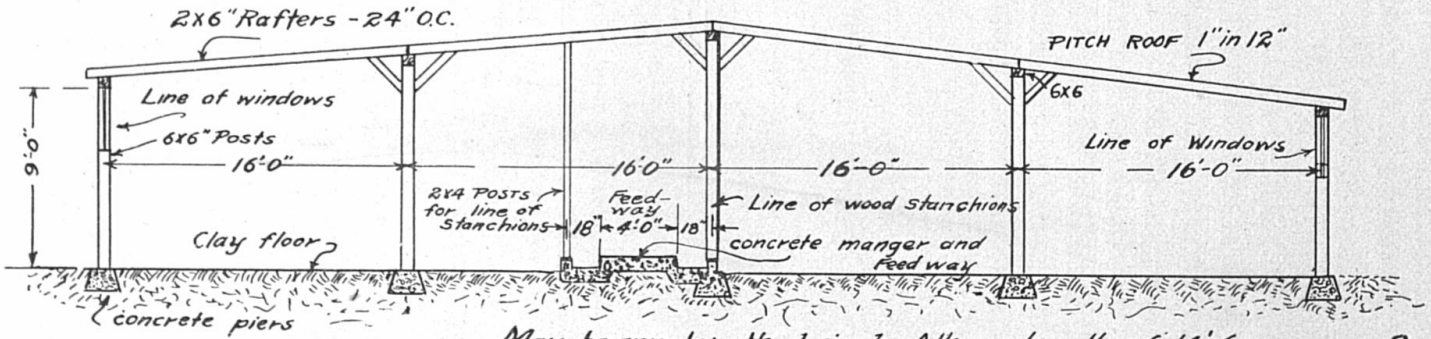
2nd. When the barn is of large size sufficient light can not be provided for the interior.

3rd. There are too many supporting timbers.

4th. Much space is wasted on the second floor in the driveway.

5th. Unloading hay is very difficult.

These objections are founded on the experience of those



CROSS SECTION OF A COVERED BARN-YARD OR REST-SHED
WITH ARRANGEMENT FOR FEEDING COWS
KENTUCKY EXPERIMENT STATION LEXINGTON KY.
DEPARTMENT OF DAIRYING.

FIGURE 23

who have used this type of structure. After several years' trial, the round barn at the Maryland Experiment Station was torn down for the reason that it proved altogether unsatisfactory.

EQUIPMENT FOR HANDLING MANURE:—A very satisfactory method of handling manure both from a sanitary and labor-saving standpoint, is the overhead litter-carrier method. In this an elongated tank, usually constructed of galvanized iron, is supended from an overhead track running immediately behind the cows and along the edge of the manure gutter. Two common types of overhead carriers are in use, one running upon a rigid track, the other upon a wire or cable track.

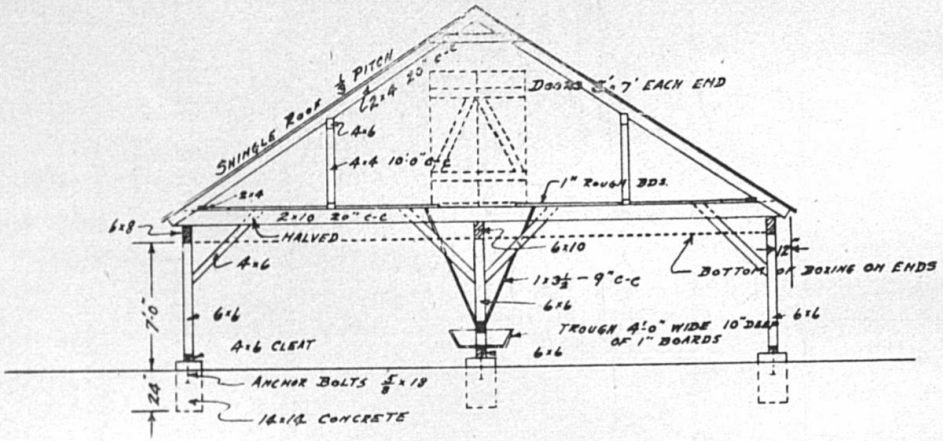


FIG. 24. Cow shed (covered barn yard) at the Kentucky Agricultural Experiment Station.

THE ROD TRACK CARRIER:—This carrier runs on a large cable wire. Unlike the other type, this carrier cannot be raised or lowered, hence in transferring the material from gutter to carrier an unnecessarily high lift is required. On being filled the carrier is pushed toward the dumping point, the cable being so stretched as to permit the carrier to run out by gravity to the dumping point where it discharges automatically by striking a trigger. The end of the rod track is attached to a post so arranged that by the tightening or loosening of a turn buckle the proper tension in the track may be maintained. This works very well when the

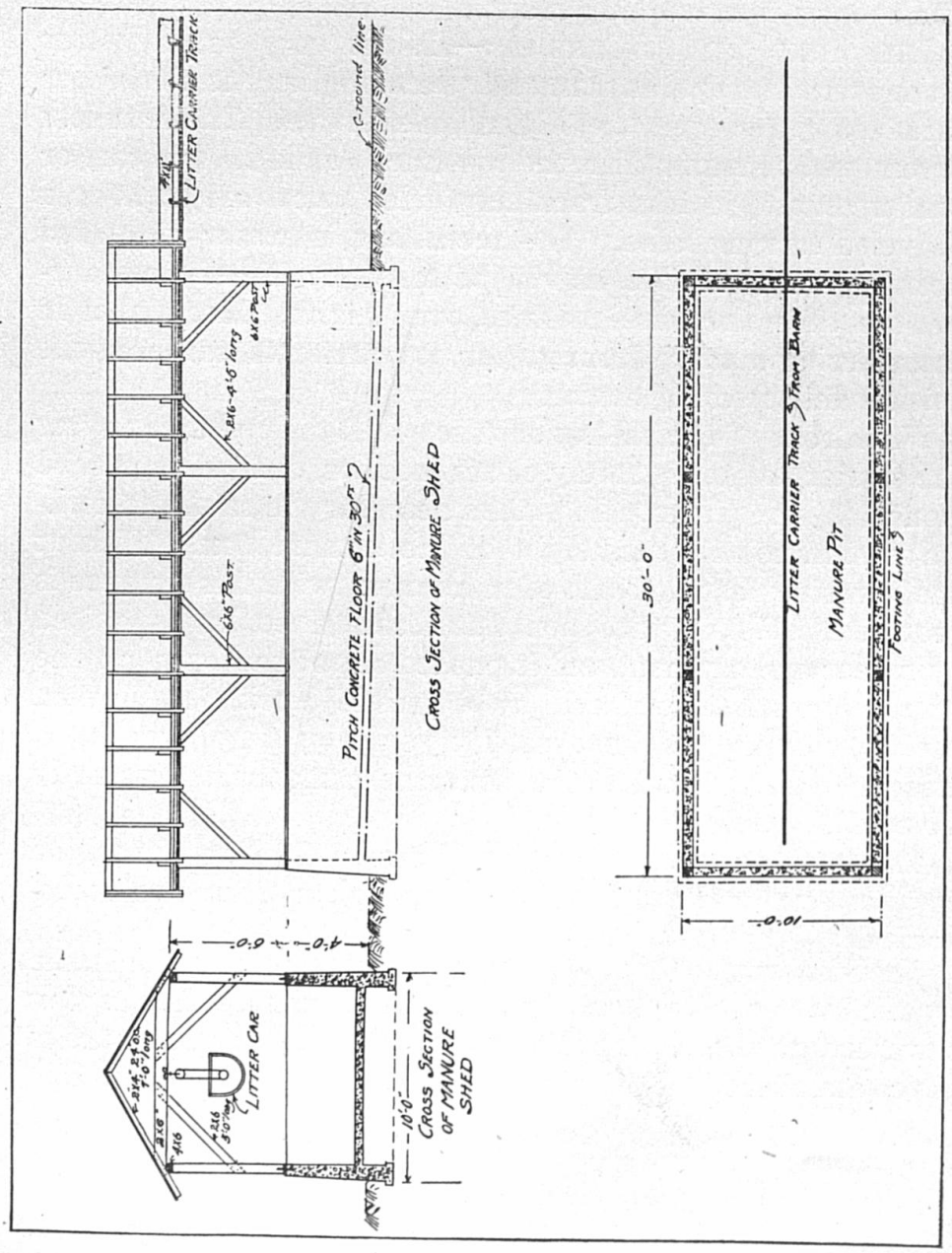


FIG. 25. Plan for an inexpensive manure shed.

outfit is new, but this kind of carrier frequently gets out of order and causes trouble and annoyance and constant attention to keep it in working order.

THE RIGID TRACK CARRIER:—This is very much better from every standpoint than the preceding, and is altogether satisfactory for every day dependable service. The first cost is somewhat greater than the rod track carrier. The carrier runs upon a rigid iron track suspended below the track on a swiveled carrier frame. The metal box is water tight and holds as much manure as will be made by fifteen cows during the time they are confined over night. Much labor in transferring manure from gutter to carrier is saved by the raising and lowering device.

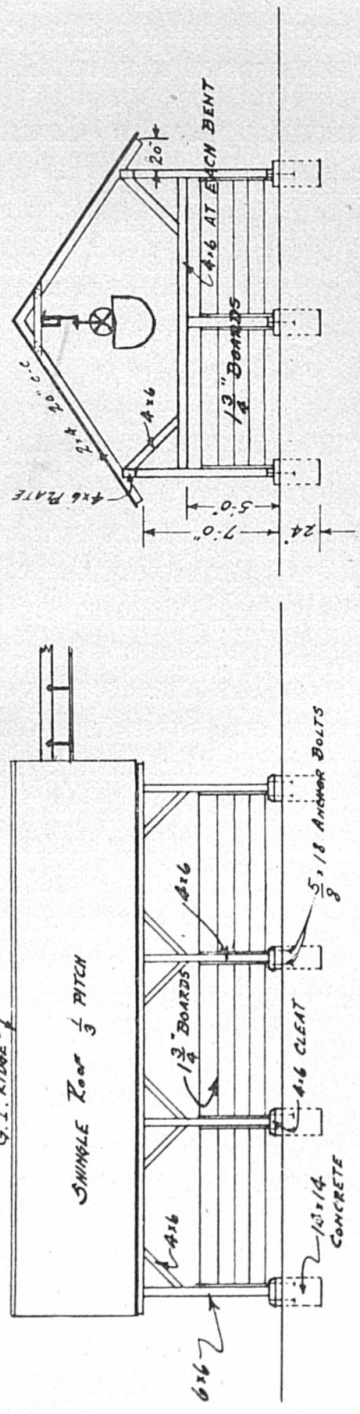
When ready for cleaning out the stable the operator lowers the carrier so that it barely clears the floor, thus being pushed alongside the gutter. It is then necessary to raise the forkful of manure only the height of the manure box. Without the lowering feature a lift of more than twice this distance is required. When the box has been filled it is raised by a gear arrangement and is pushed out of the barn on the track, supported overhead by a trestle work. It is then readily emptied at the dumping point by simply pulling a trigger which releases the box, the same being instantly inverted, discharging its load.

The total cost of an outfit for a barn of 40 cows should be in the neighborhood of $75, this including track and accessories.

The ideal way of handling manure removed from the stable by the litter carrier is to dump it under a manure shed having a water tight floor. By this means all of the liquid manure is saved and there is no loss by leaching. (See Figures 25 and 26.)

Equipment for Handling Hay.

For economy of labor in unloading hay and placing it in the hay mow, particularly in barns having deep hay lofts, a power hay fork should be installed. This carrier should be so arranged as to hold the load at a height barely to clear the floor or the level of hay. This permits a great saving



MANURE SHED

FIG. 26. Manure shed at Kentucky Agricultural Experiment Station.

of time and power and by its use the hay does not have to be dropped from a great height. The cost of such a hay fork with track and accessories is about $35.

Water Supply for Cows.

Few farmers realize the importance of a plentiful supply of water for their cows. In very many cases low milk yields are directly due to lack of sufficient water. As a matter of fact plenty of water is just as necessary as plenty of feed. Many modern dairy barns are arranged for watering the cows in the stable. The plan of placing the water in the manger is a good one, but care must be exercised to supply fresh clean water each time or foul conditions will result. A number of manufacturers of dairy barn equipment offer for sale individual watering devices which are attached to the stanchion framework, permitting the cow to drink at will. Since these are expensive and often are difficult to keep clean and sanitary we cannot recommend their general use. If cows are not watered in the stable there should be a large water tank conveniently located in the barn yard. A good plan is to have the water used in cooling the milk piped to discharge into the stock tank.

To take the chill off the water during cold weather a tank heater may be used. This device costing only a few dollars is submerged in the water tank and a small fire kept going in it. Cows will drink a much larger amount of this water and will consequently give more milk.

COST AND BILLS OF MATERIALS OF BARNS DESCRIBED IN THIS BULLETIN.

The costs of materials given in this bulletin were obtained by sending the bills of materials to several extensive dealers in this and other states, asking for their lowest cash bids, the correspondence being carried on in such a way that the writer's official connection with the Experiment Station was not known to the firms making the quotations. This plan was used to secure the very lowest prices in a competitive market. The prices quoted are on the materials delivered f. o. b. a railroad station 60 miles from Louisville.

In estimating costs it is assumed that the dairy farmer will hire carpenters by the day and will himself assume the supervision of the building, also do the grading, using his own labor and teams. No cost is charged for stone or sand, as these can nearly always be obtained on the farm without cost. These and other materials are to be hauled with farm teams. Concrete floors are to be laid with day labor and the cost in this way should not exceed 5 cents per square foot. The costs given below include iron swinging stanchions set in a wooden frame work. Painting is not included, as it is expected that this will be done by the regular farm labor at times when the routine farm work is not pressing.

When the building of a barn is contemplated, preparations should begin early in the spring and foundation and concreting material hauled as opportunity is offered. All other materials should be placed on the ground, and the actual building can then be done after the busy cropping season. A barn can be erected in this way at a surprisingly low cash outlay and will give as good service and be as satisfactory in every way as barns costing two or three times as much.

Barn Number 1. Milking Barn For 24 Cows. (See Fig. 27.)

The dimensions of this barn are 42x32 feet, and 18 feet from foundation to eaves. This is a very simple, practical and economical milking barn and is especially suited to the needs of the dairyman having a medium sized herd. A large amount of storage room for hay is provided. The drawing shows a width of 32 feet. The cost would be somewhat reduced by having a width of 30 feet. Some dairymen prefer a barn 34 feet wide and this plan may easily be changed to the

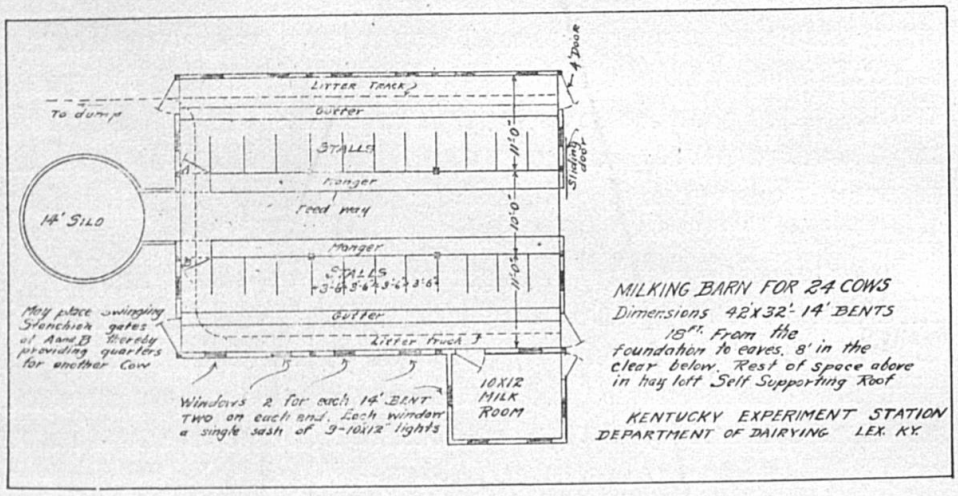


FIG. 27. Barn No. 1.

latter dimension at a slightly added cost. Either horizontal or vertical siding may be used, the cost being practically the same in either case. Bills of materials for both styles of siding are given below.

Cost of Barn No. 1.

Cost of Materials	$374.00
Carpentry Work	60.00
Labor on Foundation	5.00
Cost of Concrete Floor	67.20
24 Iron Swinging Stanchions set in home constructed wooden frame work complete at $1.50	36.00
Total	$542.20

A modern, up-to-date sanitary dairy barn, accommodating 24 cows, with a very large loft for hay storage and equipped with concrete floors, mangers, gutters, and feed-way and iron swinging stanchions, can thus be built for a cash outlay of $22.60 per cow.

Bill of Materials for Barn No. 1.—Horizontal Siding—Self Supporting Roof.

18 Feet to Eaves. Dimensions 42 x 32 Feet.

Sills—
- West side, 3 pieces 2x6x14.
- East side, 3 pieces 2x6x14.
- Two ends, 4 pieces 2x6x10.

Studs—
- West side, 22 pieces 2x6x18.
- East side, 22 pieces 2x6x18.
- Two ends, 28 pieces 2x6x18.
- For north end above eaves, 8 pieces 2x6x14.
- For north end above eaves, 4 pieces 2x6x12.
- For south end above eaves, 8 pieces 2x6x14.
- For south end above eaves, 4 pieces 2x6x12.
- Corner storm braces for sides, 4 pieces 2x8x24.
- Corner storm braces for ends, 4 pieces 2x8x24.

Plates—
- West side (nail together 2 pieces 2x6) 6 pieces 2x6x14.
- East side, 6 pieces 2x6x14.
- North end, 4 pieces 2 x6x16.
- South end, 4 pieces 2x6x16.

Center posts, 8 pieces 6x6x7.
Girders, 6 pieces 6x10x14.
Side joists, 44 pieces 2x10x12.
Center joists, 22 pieces 2x10x10.
Joist support or ribbon, 6 pieces 2x6x14.
Roof Truss—
- Top section of rafters, 44 pieces 2x6x10.
- Ridge pole, 3 pieces 1x6x16.
- Side section of rafters, 44 pieces 2x6x14.
- Braces between side and top, 88 pieces 1x6x10.
- Braces between side and posts, 44 pieces 1x6x10.
- Braces between studs and joist, 44 pieces 1x6x8.
- Braces at top (collar beam), 22 pieces 2x6x6.

Extension at eaves, 44 pieces 2x6x4.
Cornice, 13 pieces 1x6x14.

Window framing, 16 pieces ⅞x8x14.
Weather strips for window frames, 16 pieces ½x1x12.
Loft floor tongue and grooved second grade y. p., 1400 sq. ft.
Roofing, 2,400 sq. ft. actual surface measurement, 21,600 shingles.
4 in. sheathing 4 in. space between, 1,500 sq. ft.
Siding (drop siding No. 2 grade)—
For sides, 1,500 sq.ft.
For ends, 1,800 sq. ft.
Hardware—
Roofing nails required (3 lbs. per 1,000 shingles) 66 lbs.
2 kegs 20d nails—200 lbs.
3 kegs 8d nails—300 lbs.
5 pairs screw barn door hinges.
16 pairs 3-inch strap hinges for windows.
10 ft. track for sliding door.
1 pair barn door hangers complete.
16 window sash, 9 lights 10x12 inches.

Bill of Materials for Barn No. 1—Vertical Siding—Self Supporting Roof—18 Feet To Eaves.

Sills—
West side, 3 pieces 2x6x14.
East side, 3 pieces 2x6x14.
For ends, 4 pieces 2x6x10.
Posts—
For sides, 8 pieces 6x6x18.
For center, 4 pieces 6x6x7.
For center on ends, 4 pieces 6x6x18.
Plates—
For sides using 2 by 6's, 6 pieces 4x6x14.
For ends (built up of 2 by 6's), 2 pieces 4x6x32.
Joists—
Side joists, 44 pieces 2x10x12.
Central joists, 22 pieces 2x10x10.
Joist ribbon or bearer, 6 pieces 2x10x14.
Girders, 6 pieces 6x10x14.
Side framing—
Supporting studs between side posts, 12 pieces 2x6x18.
Braces at top of side posts, 16 pieces, 3x4x6.
Nail ties for sides, 24 pieces, 2x6x14.
Diagonal storm braces, 4 pieces, 2x8x22.
End framing—
Nail ties above eave, 4 pieces 2x6x16.
Nail ties above eave, 4 pieces 2x6x14.
Nail ties above eave, 8 pieces 2x6x12.

Nail ties below eave, 16 pieces 2x6x16.
Diagonal braces on corners, 4 pieces 2x8x22.
Diagonal braces in center, 8 pieces 2x6x18.
Upright braces, 4 pieces 2x6x12.

Roof Truss—
Top section of rafters, 44 pieces 2x6x10.
Ridge pole, 3 pieces 1x6x16.
Side section of rafters, 44 pieces, 2x6x14.
Braces between top and sides, 88 pieces 1x6x10.
Braces between side and post, 20 pieces 1x8x10.
Braces between studs and joists, 20 pieces 1x6x8.
Braces at top (collar beam), 22 pieces, 2x6x6.
Extension at eaves, 44 pieces 2x6x4.
Cornice, 13 pieces, 1x6x14.

Windows—
Framing, 16 pieces ⅞x8x14.
Weather strips, 16 pieces ½x1x12.

Siding (Barn Board Boxing Second Grade).
For sides, 100 pieces 1x10x18.
Strips for sides, 100 pieces, ½x3x18.
For ends, 76 pieces 1x10x18.
Strips for ends, 76 pieces ½x3x18.
Ends above eaves, 60 pieces 1x10x18.
Strips for ends above eaves, 60 pieces ½x3x16.

Loft floor tongue and groove y. p., 1,400 sq. ft.

Roofing—
2,400 sq. ft. of surface—21,600 shingles.
4 in. sheathing required, 4 inches spacing—1,500 sq. ft.

Hardware—
Roofing nails required (3 lbs per 1,000 shingles) 66 lbs.
2 kegs 20d. nails—200 lbs.
3 kegs 8d. nails—300 lbs.
5 pairs screw barn door hinges.
16 pairs 3-inch hinges for windows.
16 window sash, 9 lights 10x12.
10-feet barn door track.
1 pair barn door hangers.

Barn Number II.

This barn is similar to Barn No. I, except that quarters are provided for extra dairy stock by two additional 14-ft. bents.

Cost of Barn No. II.

Cost of materials	$598.00
Carpentry work	80.00
Labor on foundation	8.00
Concrete floor of milking room	67.20
Swinging stanchions for 22 cows at $1.50	33.00
Total	$786.20

Bill of Materials for Barn No. II.

18 Feet to Eaves. Dimensions 70x32 Feet. Horizontal Siding. Self Supporting Roof.

Sills—
- West side, 5 pieces 2x6x14.
- East side, 5 pieces 2x6x14.
- Two ends, 4 pieces 2x6x10.

Studs—
- West side, 36 pieces 2x6x18.
- East side, 36 pieces 2x6x18.
- Two ends, 28 pieces 2x6x18.
- For north end above eaves, 8 pieces 2x6x14.
- For north end above eaves, 4 pieces 2x6x12.
- For south end above eaves, 8 pieces 2x6x14.
- For south end above eaves, 4 pieces 2x6x12.

Plates—
- West side (nail 2 pieces 2x6 together) 10 pieces 2x6x14.
- East side (nail 2 pieces 2x6 together) 10 pieces 2x6x14.
- North end (nail 2 pieces 2x6 together) 4 pieces 2x6x16.
- South end (nail 2 pieces 2x6 together) 4 pieces 2x6x16.

Center posts, 12 pieces 6x6x7.
Girders, 10 pieces 6x10x14.
Girder support or ribbon 10 pieces 2x6x14.
Side joists, 72 pieces 2x10x12.
Center joists, 36 pieces 2x10x10.
Roof truss—
- Top section of rafters, 72 pieces 2x6x10.
- Ridge pole, 5 pieces, 1x6x16.
- Side section of rafters, 72 pieces 2x6x14.
- Braces between side and top, 144 pieces 1x6x10.

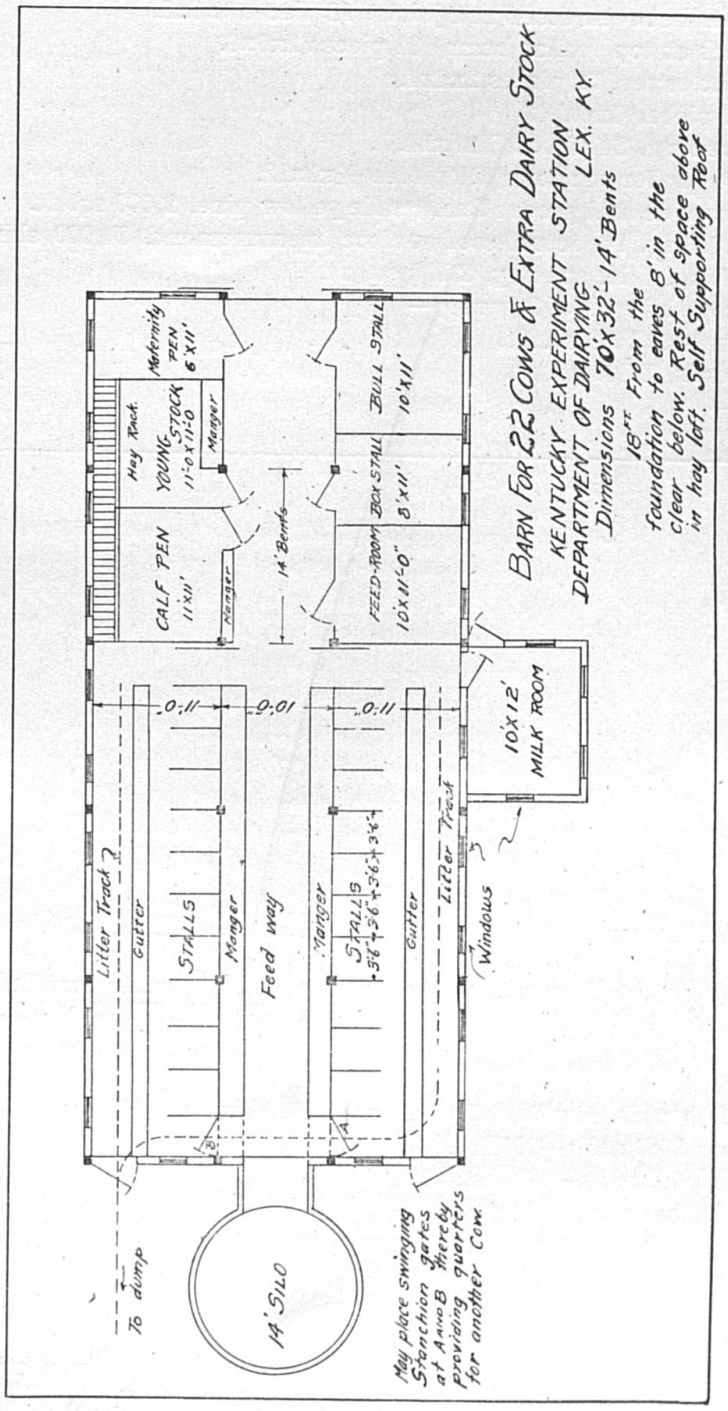


FIG. 28. Barn No. 2.

Braces between side sections and posts, 72 pieces 1x6x10.
Braces between studs and joists, 72 pieces 1x6x8.
Braces at top (collar beam) 31 pieces 2x6x6.
Extension at eaves, 72 pieces 2x6x4.
Cornice, 17 pieces 1x6x14.
Window framing, 24 pieces ⅞x8x14.
Weather strips for windows, 24 pieces ½x1x12.
Loft floor tongue and groove 2nd. grade yellow pine, 2,400 sq. ft.
Roofing, 3,764 sq. ft. actual roof surface measurement, 34,000 shingles.
4 in. sheathing, 4 in. spacing, 2,100 sq. ft.
Siding (Drop siding, No. 2 grade)—
For sides, 2,500 sq. ft.
For ends, 1,800 sq. ft.
Hardware—



FIG. 29. (No. 3.) Barn and dairy house on a Kentucky certified dairy farm. Furnishes quarters for 48 cows. Cost $1,070.50 or $22.30 per cow.

Roofing nails required (3 lbs. per 1,000 shingles) 100 lbs.
3 kegs 20d. nails—300 lbs.
4 kegs 4d. nails—400 lbs.
12 pairs barn door hinges.
24 pairs 3-inch strap hinges for windows.
40 feet track for sliding barn doors.
4 pairs barn door hangers complete.
24 window sash, 9 lights 10x12.
For feed room, stall and pen partitions, mangers, etc., in section for feed room and extra dairy stock, 1,000 ft. of 1 inch stuff.

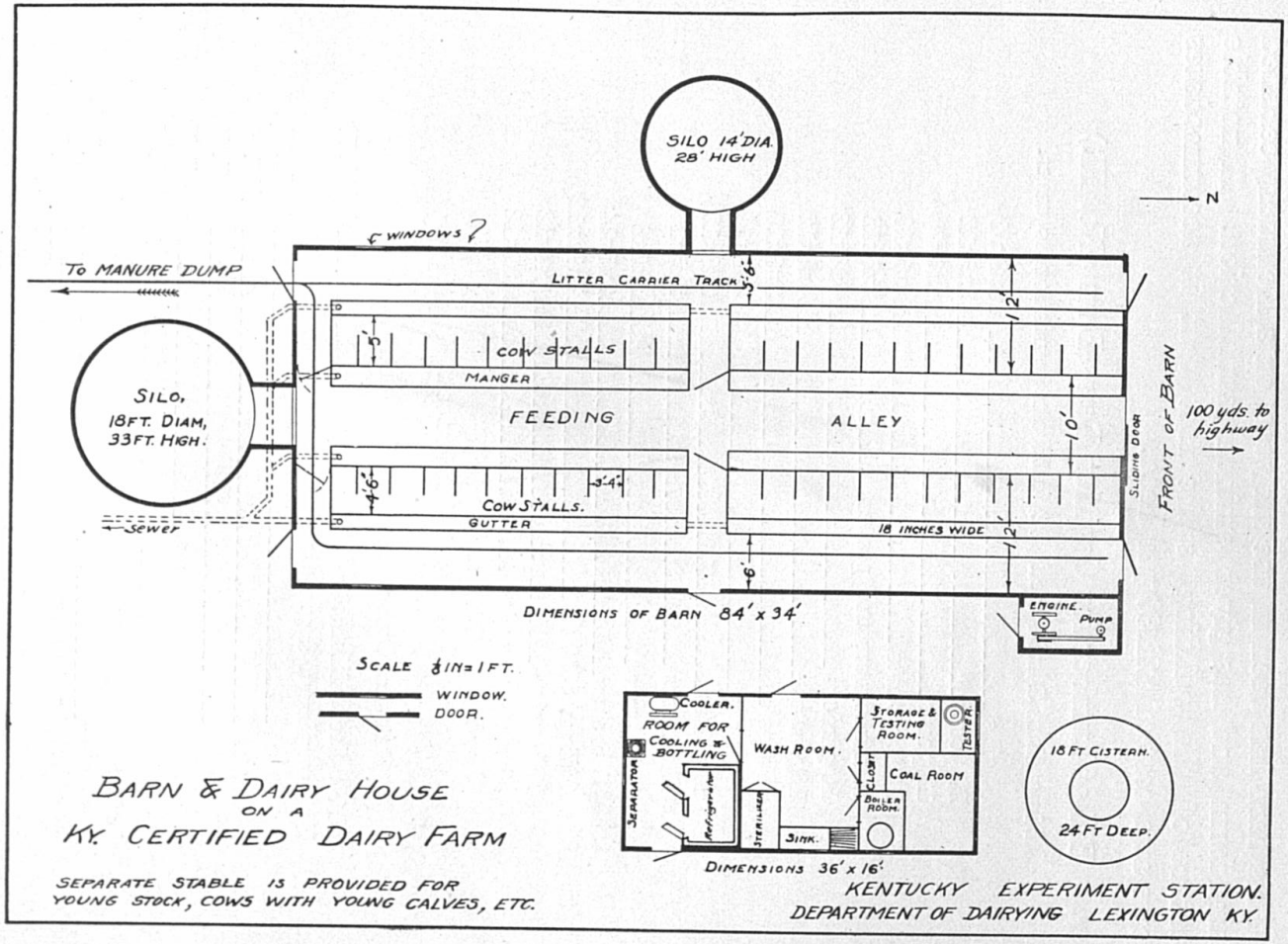


FIG. 30. Floor plan of Barn No. 3.

Barn Number III in Use On a Kentucky Certified Dairy Farm.

This barn has been in use six years on a Kentucky certified dairy farm and has given eminent satisfaction. A notable feature of the building is the fact that it accommodates cows at a cost of $22.30 per head.

Bill of Lumber for Certified Dairy Barn (No. III.)

Dimensions 84x34 feet. 12 feet from foundation to eaves.

34 sills	6x8x12½
20 posts	5x5x12
12 posts	6x6x7
14 top posts	5x5x13
90 streamers and plates	2x5x12
14 girders	6x6x12
16 plates	4x6x12
8 ties	2x6x10
40 joists	2x8x10
80 joists	2x8x12
80 rafters	2x5x16
80 rafters	2x5x8
30 braces	2x5x14
Siding, 3300 ft.	1x12x12
270 strips	¾x4x12
50 pieces cornice	1x7x12
Sheathing, 4000 ft.	

Total, 17,191 feet.

Detailed Cost of Certified Dairy Barn (No. III.)

17,000 feet of lumber at $2 per hundred	$ 340.00
Yellow pine t. & g. flooring for loft floor (second grade)	72.00
Shingles	170.00
Windows	25.00
Hinges, bolts, and nails	46.00
Carpentry work	200.00
Labor laying foundation, one man 3 days at $2.50 per day	7.50
60 barrels Portland cement for concrete floor	105.00
Labor for laying concrete floor	33.00
48 iron swinging stanchions set in wooden frame work	72.00
Total	$1070.50

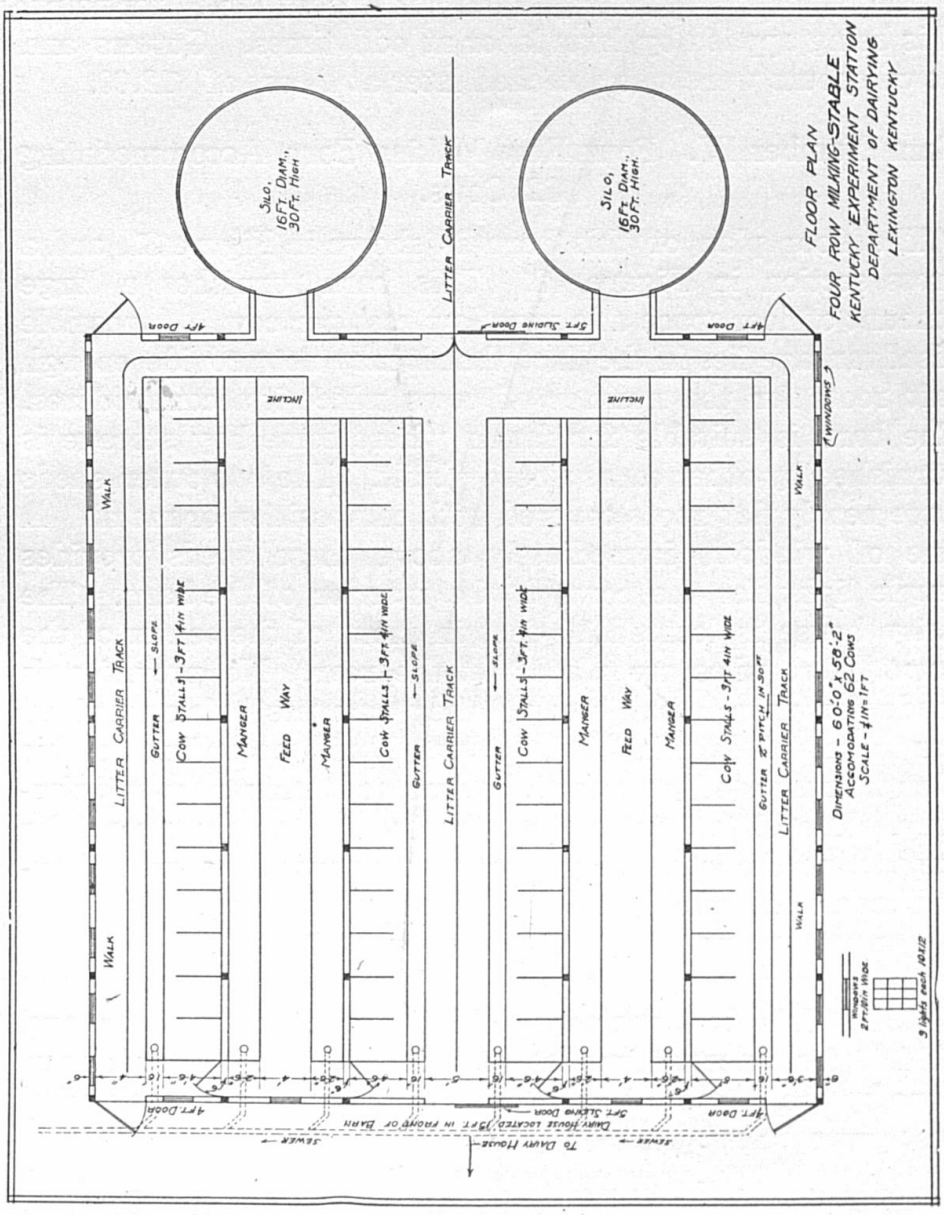


FIG. 31. Barn No. 4.

The total cost of this certified dairy barn accommodating 48 cows, was $1070.50, this including concrete floor and iron swinging stanchions. This is a cost of $22.30 per head.

The building was later painted at a cost of $25.00 for paint, this being applied by farm labor at odd times. Gutters and down spouts were also attached later at a cost of $12.00.

Barn Number IV. Four Row Milking Barn Accommodating 62 Cows.

The floor plan of this barn is shown in Figure 31, and a cross section in Figure 32. This barn furnishes a large amount of floor space at a very low cost per cow. A possible disadvantage lies in the fact that it may not provide enough loft room for the number of cows which it accommodates. The barn is suitable for farms where some hay storage is furnished by other barns already built. The two outer sheds have nearly flat roofs covered with composition or metal. A line of windows immediately above these sheds provides ample light for the cows in the interior of the barn. The dairy house is located 15 feet in front of the center of the barn. Two silos are placed at the rear. No provision is made for extra dairy stock, other quarters being provided for these. A barn in Shelby county built according to this plan a number of years ago, has proved eminently satisfactory. The 18 ft. central bent has proved amply strong for supporting the load of hay above, this part of the mow having been filled with baled hay a number of times.

The total actual cost of this barn was $2121.42.

As 62 cows were quartered in it the cost per cow was $34.21. This cost includes $628.00 for concrete floor and $104.00 for concrete foundation. This work could have been done by the farmer at half the cost charged in the detailed cost given below.

Detailed Cost and Bill of Materials for Four Row Cow Barn (No. IV.)

This estimate is for the barn complete, ready for occupancy. The owner graded the ground to a level and fur-

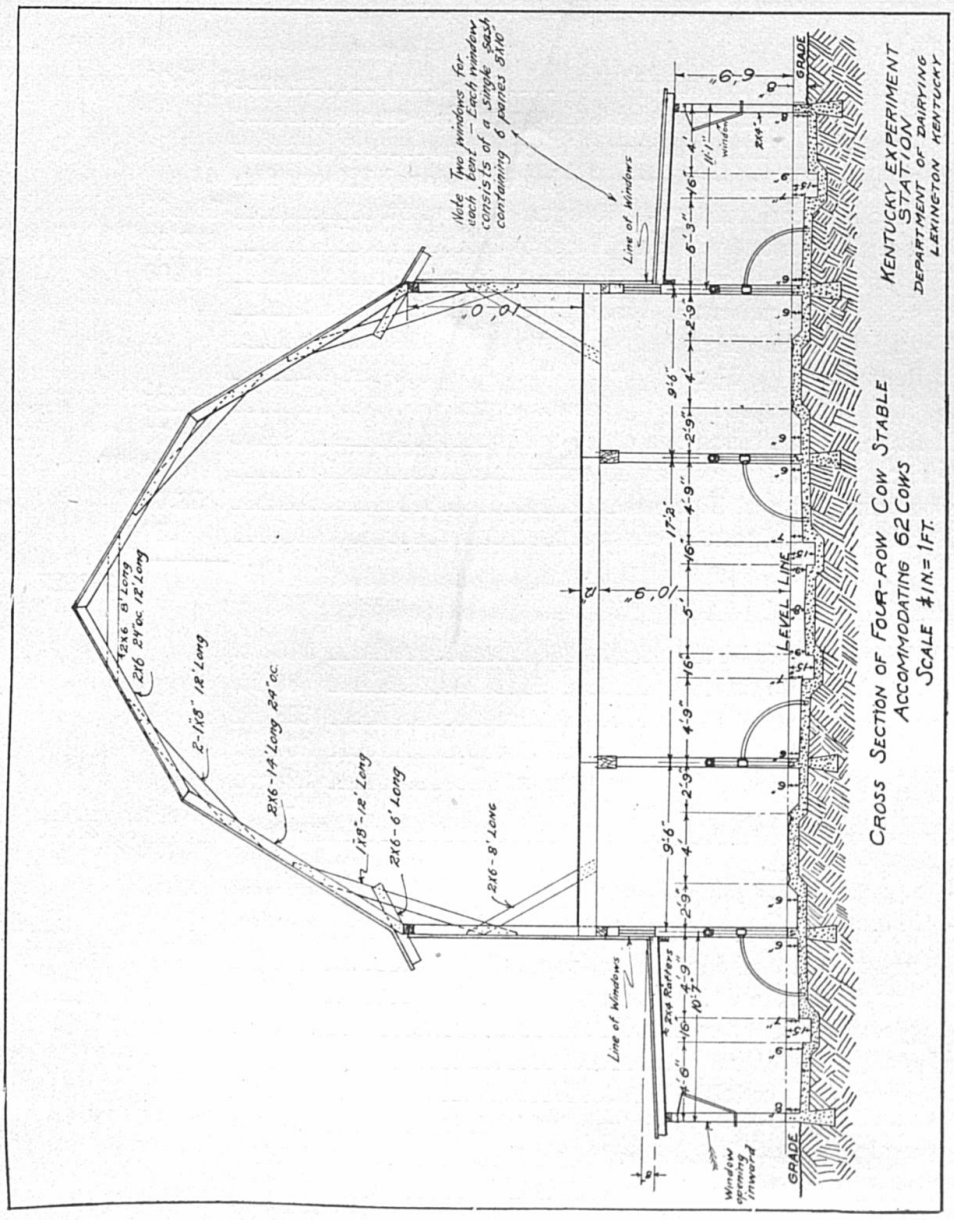

Note Two windows for each bent - Each window consists of a single sash containing 6 panes 8X10
Line of Windows
GRADE
2X6 - 8' Long
2X6 24" oc. 12' Long
2-1X8 12' Long
2X6 - 14' Long 24" oc.
1X8 - 12' Long
2X6 - 6' Long
2X6 - 8' Long
LEVEL LINE
2X6 Rafters
Line of Windows
Window opening inward
GRADE
CROSS SECTION OF FOUR-ROW COW STABLE
ACCOMMODATING 62 COWS
SCALE 1 IN. = 1 FT.
KENTUCKY EXPERIMENT STATION
DEPARTMENT OF DAIRYING
LEXINGTON KENTUCKY

FIG. 32.

nished stanchions, manure carrier, and track for same. The contractor furnished all other material and labor, put in all concrete work, frame work for iron stanchions, and stall partitions.

Digging for trenches and pillars		$ 5.00
207 feet of ground wall, size 8x18 equal 208 cu. ft		
32 pillars, size 12x12x24 equal 75 cu. ft		
240 ft. side wall above ground, size 6x12 equal 120 cu. ft.		
16 perch of concrete at $6.50 equal 403 cu. ft.		104.00
3922 sq. ft. cement work at 16 cents		627.52
50 anchor bolts, size ½x20 inches at 8 cents		4.00
Top rail for stanchion 1½ black pipe equal 210 lin. ft.		
42 upright bars 1½ x 5 " " " 210 lin. ft.		
66 bent bars 1½ x 5 " " " 330 lin. ft.		
1½ inch black pipe at 7½ cents equal 750 lin. ft.		56.25
62 fittings for stanchions at 25 cents		15.50
Bending 66 stall pieces at 10 cents		6.60
80 black 1½ T's at 17 cents		13.60
170 threads 1½ pipe at 4 cents		6.80
		$ 839.27

Framing bill for sheds—		
250 lin. ft. sill 2x4	166 ft.	
130 lin. ft. plate 2x4	86 ft.	
66 pieces rafters 2x4x12	528 ft.	
66 pieces side studs (cut) 2x4x12	264 ft.	
24 pieces end studs (cut) 2x4x14	224 ft.	
Lumber at $22.50	1268 ft.	$ 28.53
For main barn—		
16 pieces side posts 6x8x20	1280 ft.	
16 pieces inner posts 6x8x10	640 ft.	
128 lin. ft. 6x10 inside girder (use 2x10's)	640 ft.	
130 lin. ft. 4x10 outside girder (use 2x10's)	433 ft.	
2 pieces 6x6x16 cap	96 ft.	
4 door posts 4x4x14	76 ft.	
4 door posts 4x4x12	64 ft.	
130 lin. ft. 4x6 top plates (use 2x6's)	260 ft.	
66 pieces upper side studs (2x6x12)	792 ft.	
130 lin. ft. 2x10 side stringer	216 ft.	
32 center joists 2x12x18	1152 ft.	
164 side joists 2x10x9	2460 ft.	
35 studs for end below eaves 2x4x12	280 ft.	
35 studs for end above eaves 2x6x20	700 ft.	
54 pieces for window frames 2x6x12	640 ft.	

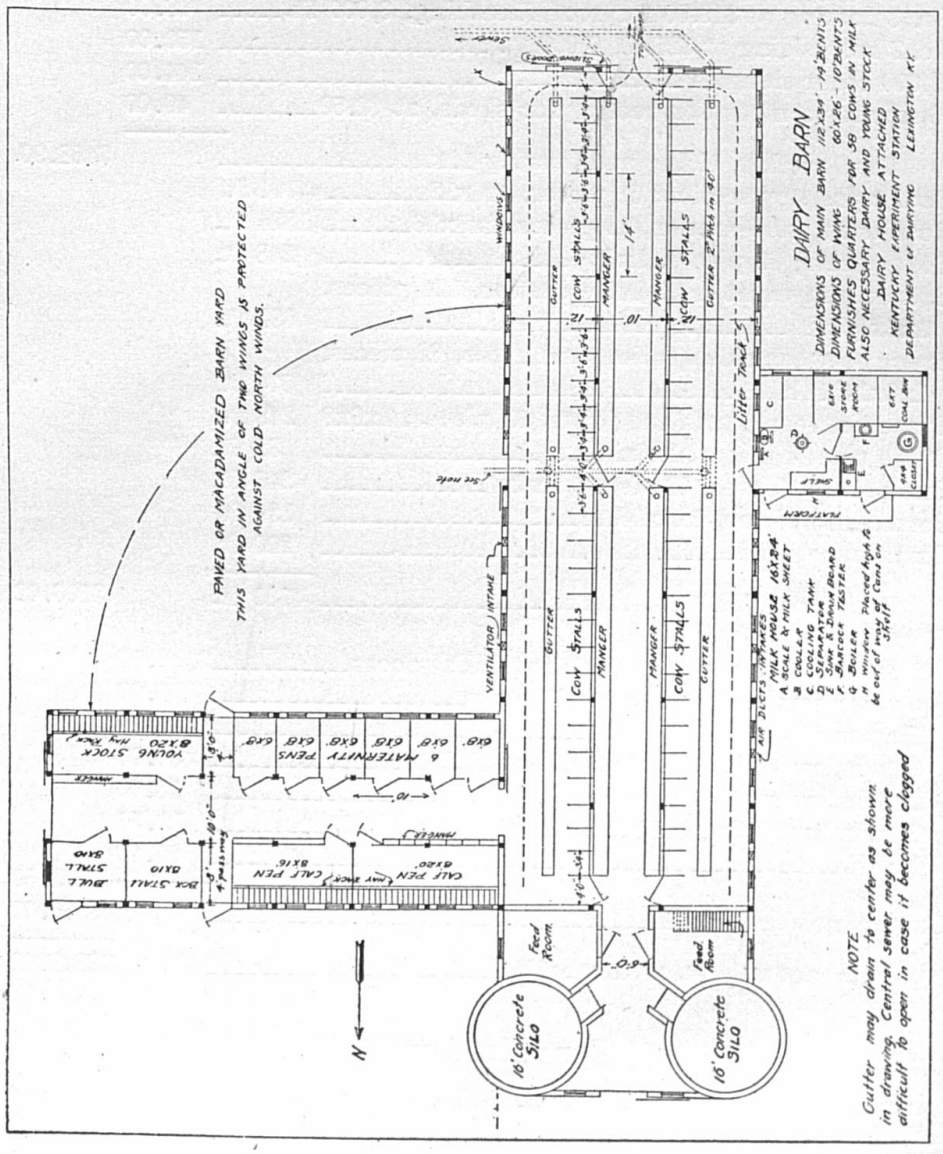


FIG. 33. Two wing dairy barn (No. 5).

8 storm braces 2x8x12	240 ft.		
Uncounted	200 ft.		
Lumber at $22.50	10,169 ft.		$228.80
No. 3 flooring at $16.00, 4?4 feet face count		$ 76.90	
No. 3 flooring at $16.00 for roof sheathing, 3,000 ft.		48.00	
No. 2 barn siding at $25.00, 6,000 ft.		150.00	
32,000 cedar shingles		144.00	
16 squares composition roofing for sheds, at $2.50		40.00	
Total roofing, siding and flooring			$458.90
Roof truss, top section, 62 pieces, 2x6x12	744 ft.		
Roof truss, side section, 62 pieces, 2x8x16	1324 ft.		
Collar beam, 31 pieces, 2x6x8	248 ft.		
Braces between top and side section, 124 pieces, 1x8x12	992 ft.		
Brace between side sections and studs, 62 pieces, 1x8x14	574 ft.		
Brace between studs and joists, 62 pieces, 1x6x8	248 ft.		
Ridge pole, 4 pieces, 1x6x16	32 ft.		
Extension at eaves, 62 pieces, 2x6x4	248 ft.		
Cornice, 15 pieces, 1x6x16	120 ft.		
Extra uncounted	200 ft.		
Lumber at $22.50	4730 ft.		$106.42
Hardware—			
2 sets of hardware complete for sliding doors		$ 6.00	
4 pairs barn door hinges at 25 cents		1.00	
Hardware for loft doors		10.00	
30 window sash, 9 lights 10x12 at $1.20		36.00	
24 window sash, 6 lights 8x10 at $0.75		18.00	
54 window strips, hinges and buttons, at $0.25		13.50	
Nails		25.00	
			$109.50
Carpentry work			$350.00
Total actual cost of this barn			$2121.42

Barn Number V.

Figure 33 shows a dairy barn providing quarters for 58 dairy cows, and extra dairy stock. The main part of the barn is 114 feet long by 34 feet wide and 18 feet from foundation to eaves and has a roof of the self-supporting type. The wing is placed at right angles to the main part of the barn and is 60 feet long and 26 feet wide, 16 feet from

foundation to the eaves, and has a gable roof. This plan furnishes a space in the angle which is used for a barn yard, protecting the cows from cold north and west winds. Two concrete silos are placed at the front of the barn and there are two feed rooms between the silos and the end of the barn. The rigid walls of the concrete silos are well adapted to this arrangement. Stave silos would give trouble on account of the walls pulling away when the hoops are tightened. In this plan there is a transverse passage way across the barn at the center, permitting the milk to be carried directly to the dairy house with the smallest number of steps. Manure is removed by means of an over-head litter carrier. The drawing shows the track leaving the barn at the rear end. Ordinarily the track supports would interfere with the unloading of hay at this point. However, a removable or swinging section may be used to avoid this interference. This might also be accomplished by having a door at the point marked X in the drawing, and removing the manure through this door. If desirable, the south end of the barn in the drawing may be used for the front, in which case the manure would be removed to a dump at the rear of the silos or it might be taken out through and emptied beyond the end of the annex. For a moderately large dairy this plan could hardly be improved upon in economy of construction, saving of labor, and other essentials. The plan calls for a special ventilating system. This, however, in this latitude is not necessary. The cost of this barn would be materially reduced by eliminating the feed room shown in front and storing the feed above.

Cost of Two Wing Barn.

Cost of materials	$1409.45
Carpentry work	300.00
Laying foundation	25.00
Concrete floor in milking section	225.00
58 iron swinging stanchions	87.00
	$2046.45

Bill of Materials for Two Wing Dairy Barn. (No. V.)

For Main Part of Barn, 112x34 Feet.

Sills—
- West side, 8 pieces, 2x6x14.
- East side, 8 pieces, 2x6x14.
- For ends, 4 pieces, 2x6x10.

Studs—
- West side, 57 pieces, 2x6x18.
- East side, 57 pieces, 2x6x18.
- Two ends, 30 pieces, 2x6x18.
- For north end above eaves, 10 pieces, 2x6x14.
- For north end above eaves, 4 pieces, 2x6x12.
- For south end above eaves, 10 pieces, 2x6x14.
- For south end above eaves, 4 pieces, 2x6x12.
- Corner storm braces for sides, 4 pieces, 2x8x22.
- Corner storm braces for ends, 4 pieces, 2x8x22.

Plates—
- For sides (built up with 2x6's), 18 pieces, 4x6x14.
- For ends (built up with 2x6's), 2 pieces, 2x6x34.

Posts for center, 18 pieces, 6x6x7.
Girders, 16 pieces, 6x10x14.
Side joists, 114 pieces, 2x10x12.
Center joists, 57 pieces, 2x10x10.
Joist bearer or ribbon, 16 pieces, 1x6x14.
Roof Truss—
- Top section of rafters, 114 pieces, 2x6x12.
- Ridge pole, 9 pieces, 1x6x16.
- Side section of rafters, 114 pieces, 2x6x14.
- Braces between side and top sections, 228 pieces, 1x6x12.
- Braces between side sections and stud, 114 pieces, 1x6x14.
- Braces between studs and joists, 114 pieces, 1x6x8.
- Braces at top (collar beam), 57 pieces 2x6x6.
- Extension at eaves, 114 pieces, 2x6x4.
- Cornice, 20 pieces, 1x6x16.

Window framing, 29 pieces, ⅞x8x14.
Weather strips for windows, 29 pieces, ½x1x12.
Loft floor, t. and g., yellow pine, second grade, floor space 4,000 sq. ft.
Roofing, 6,500 sq. ft. actual surface, 58,500 shingles.
4 in. sheathing, 4 in. spacing, 4,000 sq. ft.
Siding (drop siding), No. 2 grade—
- For sides 4,000 sq. ft.
- For ends 2,000 sq. ft.

Hardware—
- 6 kegs of 20d. nails, 600 lbs

8 kegs 8d. nails, 400 lbs.
Roofing nails, 3 lbs. per 1,000 shingles, 180 lbs.
9 pairs door hinges.
29 pairs 3 in. strap hinges for windows.
29 window sash (9 10x12 lights).
60 feet track for sliding barn doors.
6 pairs hangers complete.

Wing for Main Barn. Size of Wing 26x60 ft., Gable Roof. 16 Feet to Eaves.

Sills—
North side, 5 pieces 2x6x12.
South side, 5 pieces 2x6x12.
End, 2 pieces, 2x6x10.
Studs—
For north side, 30 pieces 2x6x16.
For south side, 30 pieces 2x6x16.
For end, 10 pieces 2x6x16.
For end above plate, 8 pieces 2x6x12.
For end above plate, 3 pieces 2x6x8.
Plates—
North side (nail 2x6's together), 1 piece 4x6x60.
South side (nail 2x6's together), 1 piece 4x6x60.
End, 1 piece 4x6x26.
Center posts, 14 pieces 6x6x7.
Girders, 12 pieces, 6x10x10.
Girder support or ribbon, 12 pieces 2x6x10.
Side joists, 62 pieces 2x10x8.
Center joists, 31 pieces 2x10x10.
Window framing, 23 pieces ⅞x8x14.
Window weather strips, 23 pieces ½x1x12.
Rafters (gable roof), 62 pieces 2x8x18.
Ridge pole, 4 pieces 1x8x16.
Collar beam, 31 pieces 2x8x8.
Extension at eaves, 13 pieces 2x4x10 (cut up into 2 ft. 6 in. lengths.)
Loft floor, tongued and grooved yellow pine No. 2 grade—
1700 square feet required.
Roofing shingles required 20,000.
Sheathing for roof required 1500 square feet.
4 in. sheathing, 4 inch spacing.
Drop siding No. 2 grade—
For sides 2000 square feet.
For ends 600 square feet.
For stalls and pen partitions, mangers, etc., 2000 sq. feet of 1 in. stuff.

Bill of Materials for Two Wing Dairy Barn. (No. V.)

For Main Part of Barn, 112x34 Feet.

Sills—
- West side, 8 pieces, 2x6x14.
- East side, 8 pieces, 2x6x14.
- For ends, 4 pieces, 2x6x10.

Studs—
- West side, 57 pieces, 2x6x18.
- East side, 57 pieces, 2x6x18.
- Two ends, 30 pieces, 2x6x18.
- For north end above eaves, 10 pieces, 2x6x14.
- For north end above eaves, 4 pieces, 2x6x12.
- For south end above eaves, 10 pieces, 2x6x14.
- For south end above eaves, 4 pieces, 2x6x12.
- Corner storm braces for sides, 4 pieces, 2x8x22.
- Corner storm braces for ends, 4 pieces, 2x8x22.

Plates—
- For sides (built up with 2x6's), 18 pieces, 4x6x14.
- For ends (built up with 2x6's), 2 pieces, 2x6x34.

Posts for center, 18 pieces, 6x6x7.
Girders, 16 pieces, 6x10x14.
Side joists, 114 pieces, 2x10x12.
Center joists, 57 pieces, 2x10x10.
Joist bearer or ribbon, 16 pieces, 1x6x14.
Roof Truss—
- Top section of rafters, 114 pieces, 2x6x12.
- Ridge pole, 9 pieces, 1x6x16.
- Side section of rafters, 114 pieces, 2x6x14.
- Braces between side and top sections, 228 pieces, 1x6x12.
- Braces between side sections and stud, 114 pieces, 1x6x14.
- Braces between studs and joists, 114 pieces, 1x6x8.
- Braces at top (collar beam), 57 pieces 2x6x6.
- Extension at eaves, 114 pieces, 2x6x4.
- Cornice, 20 pieces, 1x6x16.

Window framing, 29 pieces, ⅞x8x14.
Weather strips for windows, 29 pieces, ½x1x12.
Loft floor, t. and g., yellow pine, second grade. Floor space 4,000 sq. ft.
Roofing, 6,500 sq. ft. actual surface, 58,500 shingles.
4 in. sheathing, 4 in. spacing, 4,000 sq. ft.
Siding (drop siding), No. 2 grade—
- For sides 4,000 sq. ft.
- For ends 2,000 sq. ft.

Hardware—
- 6 kegs of 20d. nails, 600 lbs

8 kegs 8d. nails, 400 lbs.
Roofing nails, 3 lbs. per 1,000 shingles, 180 lbs.
9 pairs door hinges.
29 pairs 3 in. strap hinges for windows.
29 window sash (9 10x12 lights).
60 feet track for sliding barn doors.
6 pairs hangers complete.

Wing for Main Barn. Size of Wing 26x60 ft., Gable Roof. 16 Feet to Eaves.

Sills—
North side, 5 pieces 2x6x12.
South side, 5 pieces 2x6x12.
End, 2 pieces, 2x6x10.
Studs—
For north side, 30 pieces 2x6x16.
For south side, 30 pieces 2x6x16.
For end, 10 pieces 2x6x16.
For end above plate, 8 pieces 2x6x12.
For end above plate, 3 pieces 2x6x8.
Plates—
North side (nail 2x6's together), 1 piece 4x6x60.
South side (nail 2x6's together), 1 piece 4x6x60.
End, 1 piece 4x6x26.
Center posts, 14 pieces 6x6x7.
Girders, 12 pieces, 6x10x10.
Girder support or ribbon, 12 pieces 2x6x10.
Side joists, 62 pieces 2x10x8.
Center joists, 31 pieces 2x10x10.
Window framing, 23 pieces ⅞x8x14.
Window weather strips, 23 pieces ½x1x12.
Rafters (gable roof), 62 pieces 2x8x18.
Ridge pole, 4 pieces 1x8x16.
Collar beam, 31 pieces 2x8x8.
Extension at eaves, 13 pieces 2x4x10 (cut up into 2 ft. 6 in. lengths.)
Loft floor, tongued and grooved yellow pine No. 2 grade—
1700 square feet required.
Roofing shingles required 20,000.
Sheathing for roof required 1500 square feet.
4 in. sheathing, 4 inch spacing.
Drop siding No. 2 grade—
For sides 2000 square feet.
For ends 600 square feet.
For stalls and pen partitions, mangers, etc., 2000 sq. feet of 1 in. stuff.

Hardware –
- Shingle nails, 60 pounds.
- 2 kegs 20d. nails, 200 pounds.
- 4 kegs 8d. nails, 400 pounds.
- 14 pairs door hinges.
- 23 pairs window hinges.
- 20 feet barn door track.
- 2 pairs barn door hangers.
- 23 window sash, 9 10x12 lights.

Entry and Feed Rooms Between Silos and Main Barn.
Eight Ft. to Eaves. Self Supporting Roof.

Sills—
- Side, 2 pieces 2x4x10.
- End, 2 pieces 2x4x14.
- Center, 2 pieces 2x4x14.

Plates—
- Side, 2 pieces 2x4x10.
- End, 2 pieces 2x4x12.

Studs—
- For sides, 10 pieces 2x4x8.
- For ends below eaves, 12 pieces 2x4x8.
- For ends above eaves, 6 pieces 2x4x14.
- For ends above eaves, 4 pieces 2x4x18.
- Posts, 4 pieces 4x4x7.
- Girders, 4 pieces 4x10x12.
- Side joists, 10 pieces 2x6x12.
- Center joists, 5 pieces 2x6x10.
- Center joists, 6 pieces 2x6x14.
- Center joists, 2 pieces 2x6x16.

No. 2 tongued and grooved flooring for loft floor, 500 square feet.
No. 2 tongued and grooved flooring for inside walls, 250 square feet.
Boxing (No. 2 grade)—
- For sides, 200 square feet.
- For end, 500 square feet.
- 7200 shingles for roof.
- 500 square feet, 4 inch sheathing, 4 inch spacing.
- Window framing, 6 pieces ⅞x8x14.
- Window weather strips, 6 pieces ½x1x12.

Roof truss—
- Top section of rafters, 18 pieces 2x6x12.
- Side section of rafters, 10 pieces 2x6x14.
- Ridge pole, 2 pieces 1x6x12.
- Braces between side and top, 36 pieces 1x6x12.
- Braces at top (collar beam), 24 pieces 2x6x6.
- Extension at eaves, 10 pieces 2x6x4.

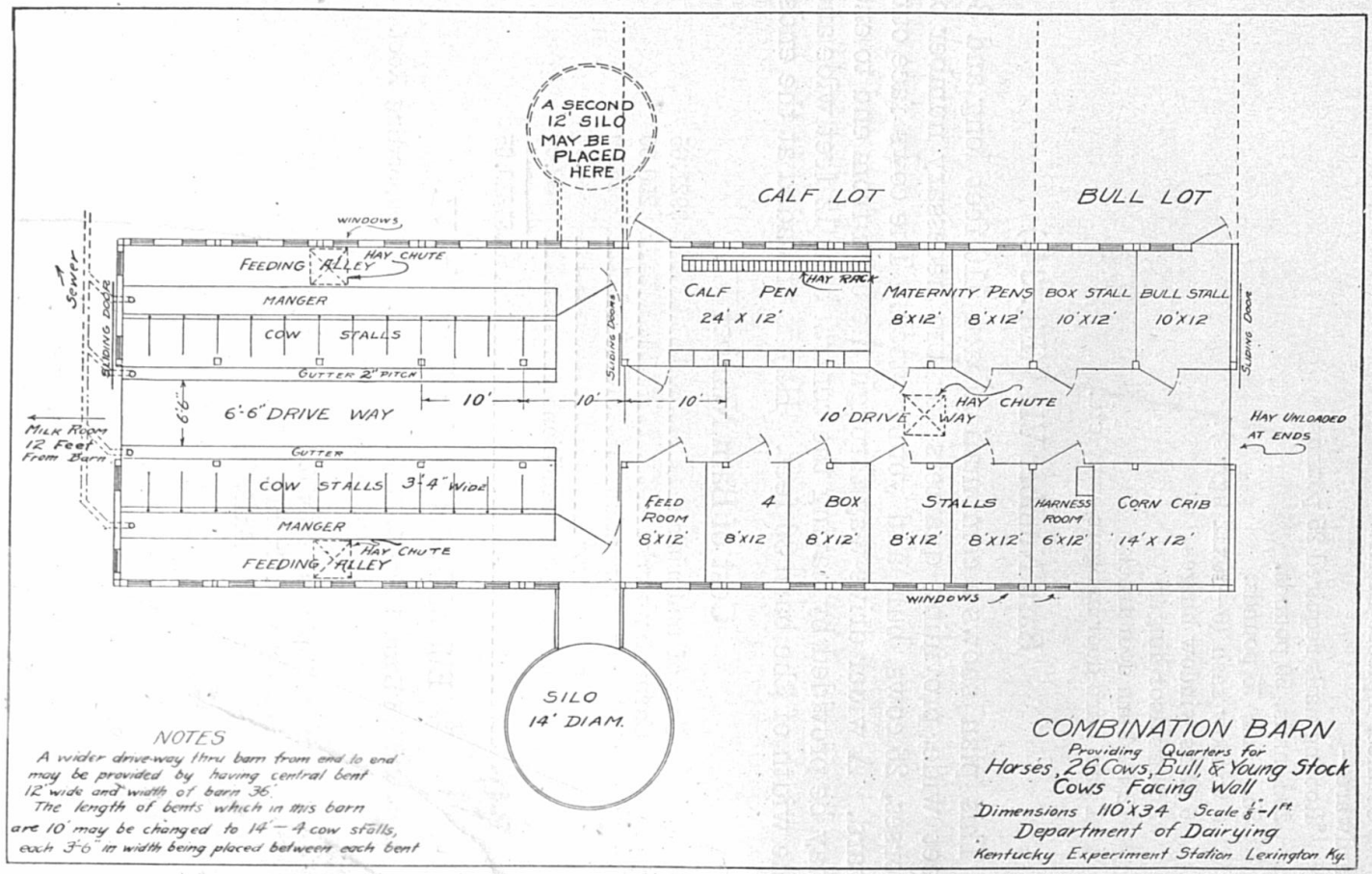


FIG. 84. Barn No. 6.

Cornice, 4 pieces 1x6x16.

Hardware—

Roofing nails required 25 pounds.
20d. nails, 50 pounds.
8d. nails, 75 pounds.
6 window sash (9—10x12 lights).
6 pairs window hinges.
2 pairs door hinges.
12 ft. barn door track.
1 pair barn door hangers complete.

Barn Number VI. (Fig. 34.)

This plan shows a combination barn 110 feet long and 34 feet wide, providing quarters for the necessary number of horses, 26 cows, bull, and young stock. The cows face outward. A wider drive-way through the barn from end to end may be provided by having the central bent 12 feet wide and the width of the barn 36 feet. Hay is unloaded at the ends.

Cost of Barn Number VI.

Cost of materials	$921.65
Carpentry work	250.00
Labor on foundation	15.00
Concreting floor	85.00
26 iron swinging stanchions	39.00
Total	$1310.65

Bill of Materials for Barn No. VI.

Combination Barn, 110x34, 18 Feet to Eaves. Self Supporting Roof. Horizontal Siding.

Sills—

West side, 7 pieces, 2x6x16.
East side, 7 pieces, 2x6x16.
For ends, 4 pieces, 2x6x12.

Studs—

West side, 56 pieces, 2x6x18.
East side, 56 pieces, 2x6x18.
Two ends, 28 pieces, 2x6x18.
North end above eaves, 10 pieces, 2x6x14.
North end above eaves, 4 pieces, 2x6x12.
South end above eaves, 10 pieces, 2x6x14.
South end above eaves, 4 pieces, 2x6x12.

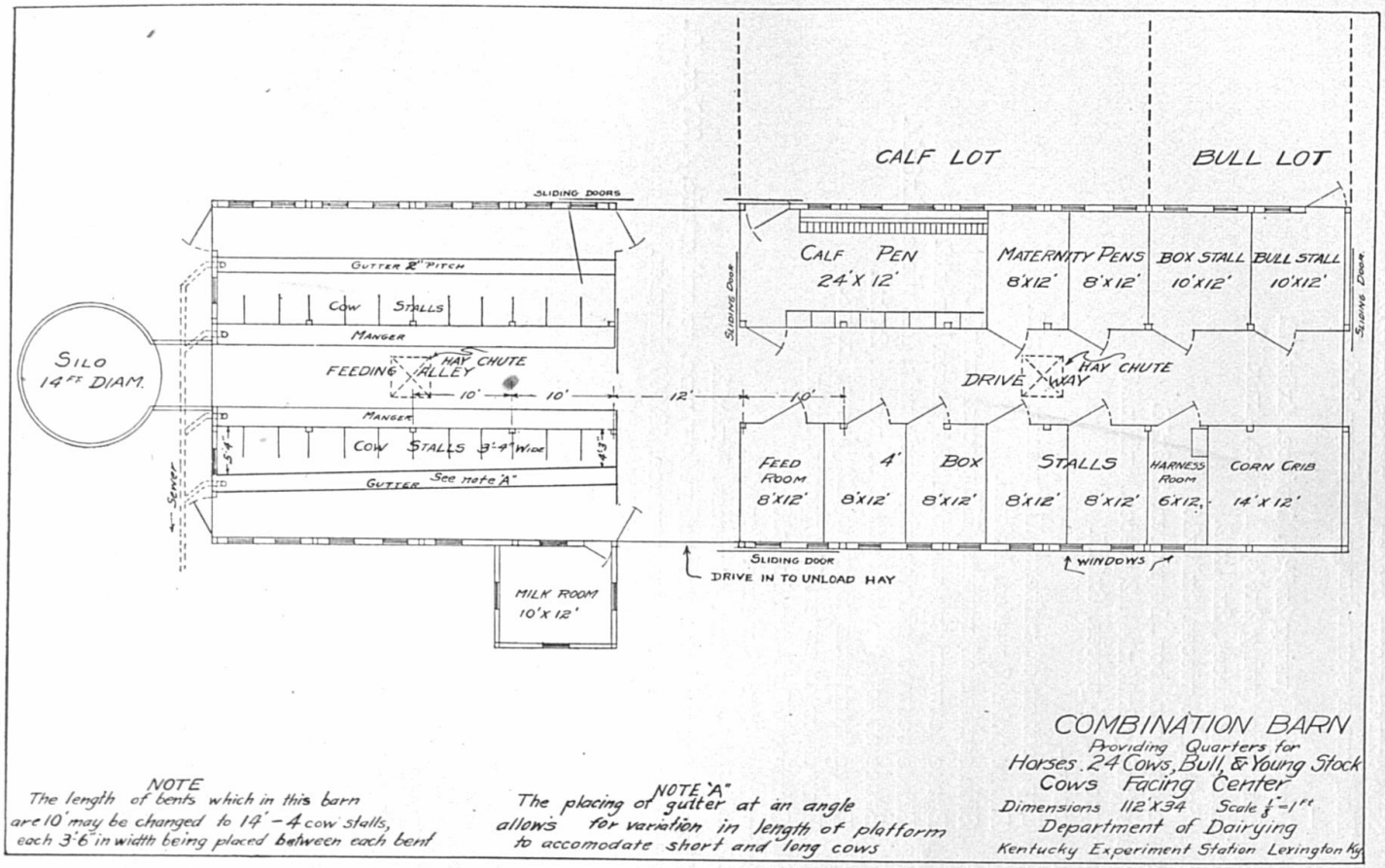


FIG. 35. Barn No. 7.

Side corner storm braces, 4 pieces, 2x8x22.
End corner storm braces, 4 pieces, 2x8x22.

Plates—
West side (using 2x6's), 1 piece, 4x6x112.
East side (using 2x6's), 1 piece, 4x6x112.

Side joists, 112 pieces, 2x10x12.
Center joists, 56 pieces, 2x10x10.
Joist bearer or ribbon, 14 pieces, 2x6x16.
Girders (using 2x10x14), 2 pieces, 6x10x110.
Center posts, 24 pieces, 6x6x7.

Roof truss—
Top section of rafters, 112 pieces, 2x6x12.
Ridge pole, 7 pieces, 1x6x16.
Side section of rafters, 112 pieces, 2x6x14.
Brace between top and side, 224 pieces, 1x6x12.
Brace between side section and studs, 112 pieces, 1x6x14.
Brace at top (collar beam), 56 pieces, 2x6x6.
Brace from stud to joist, 112 pieces, 1x6x8.
Extension at eaves, 112 pieces, 2x6x4.
Cornice, 20 pieces, 1x6x16.

Window framing, 43 pieces, ⅞x8x14.
Window weather strips, 43 pieces, ½x1x12.
Loft floor, tongued and grooved yellow pine, second grade, 4,000 sq. ft.
Roofing, 6,400 sq. ft. actual surface, 58,000 shingles.
4 in. sheathing, 4 in. spacing, 3,500 sq. ft.

Siding (drop siding, No. 2 grade—)
For sides, 4,000 sq. ft.
For ends, 2,000 sq. ft.

Hardware—
6 kegs of 20d. nails, 600 lbs.
8 kegs of 8d. nails, 400 lbs.
Roofing nails, 180 lbs.
16 pairs door hinges.
43 pairs window hinges.
43 window sash (9 10x12 in. lights).
52 feet of track for sliding doors.
5 pairs sliding door hangers complete.

For feed room, stall and pen partitions, mangers, etc., in section for feed room and extra dairy stock, 2,000 sq. ft. 1-inch stuff.

Barn Number VII. (Fig. 35.)

Figure 35 shows a combination barn 112 feet long and 34 feet wide, the cows facing a central feed way. One bent is 12 feet wide, permitting a team to be driven through the

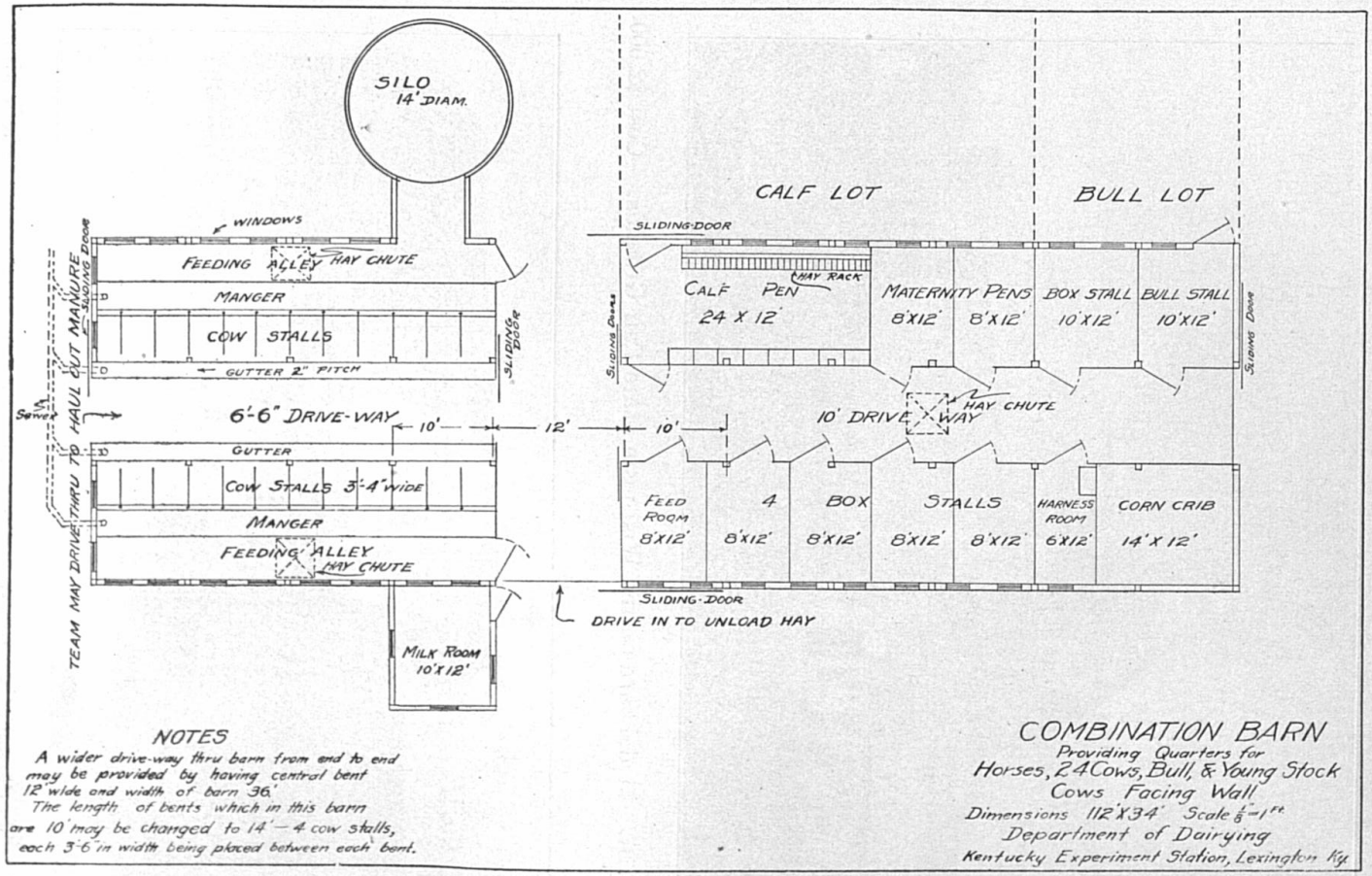


FIG. 36. Barn No. 8.

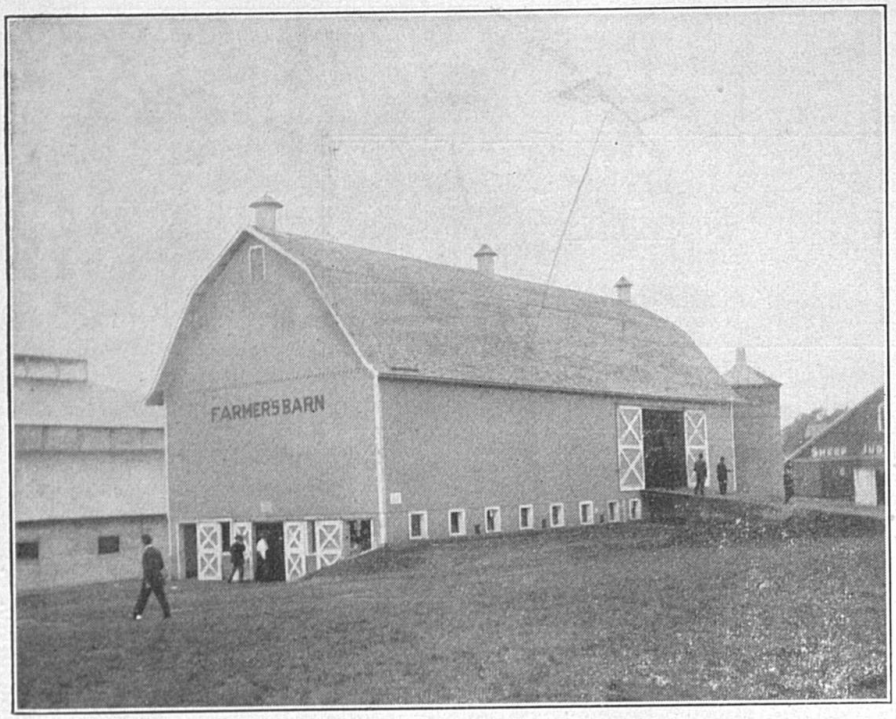


FIG. 37. Model barn on the Wisconsin State Fair Grounds. Cost $2,000.

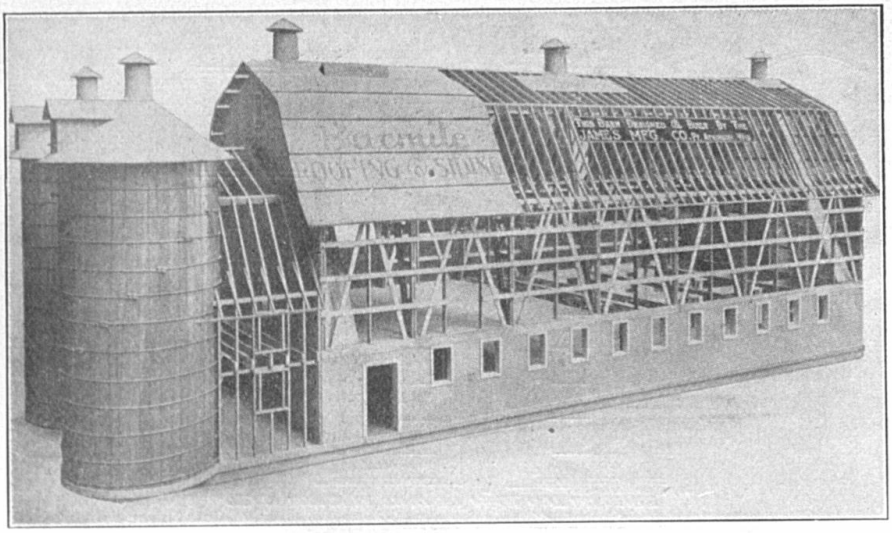
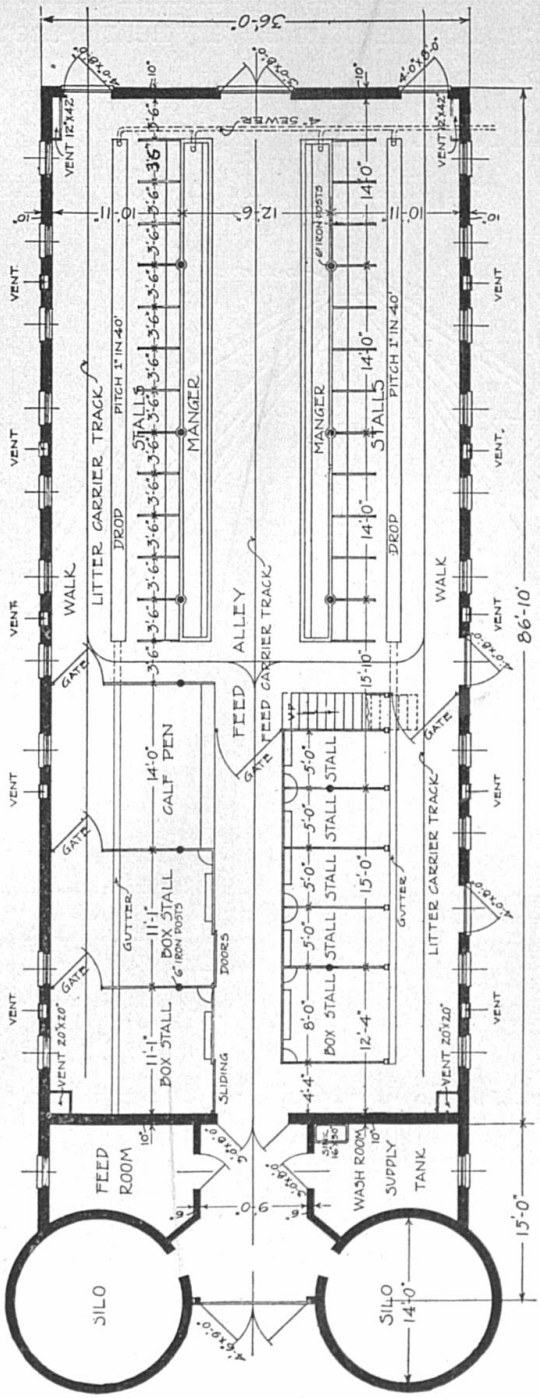


FIG. 38. Perspective of Wisconsin model barn. (Courtesy James Manufacturing Company.)



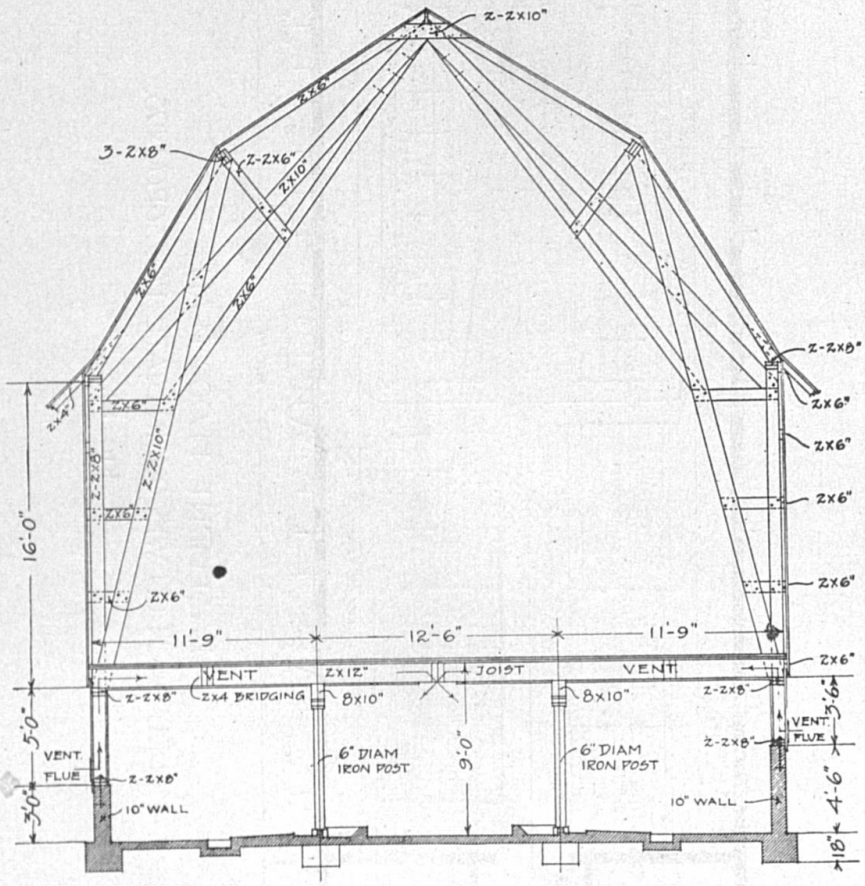
BASEMENT FLOOR PLAN
MODEL BARN ON WISCONSIN STATE FAIR GROUNDS.

FIG. 39.

barn transversely for the purpose of unloading hay. The bill of materials and cost for this barn is very nearly the same as for barn Number Six.

Barn Number VIII. (Fig. 36.)

Figure 36 shows a combination barn in most points similar to Number Six.


2-2X10"
2X6"
3-2X8"
2-2X6"
2X10"
2X6"
2X6"
2-2X8"
2X6"
2X6"
2X6

Specifications for Wisconsin Model Barn. (Fig. 37.)

First. Concrete wall against bank is 4 ft. 6 in. high; on other side 3 ft. 0 in.

One-half inch bolts are put in wall every 10 feet to hold sill in place.

The floors in basement are made of concrete of proper consistency, and stall floors are given one inch pitch.

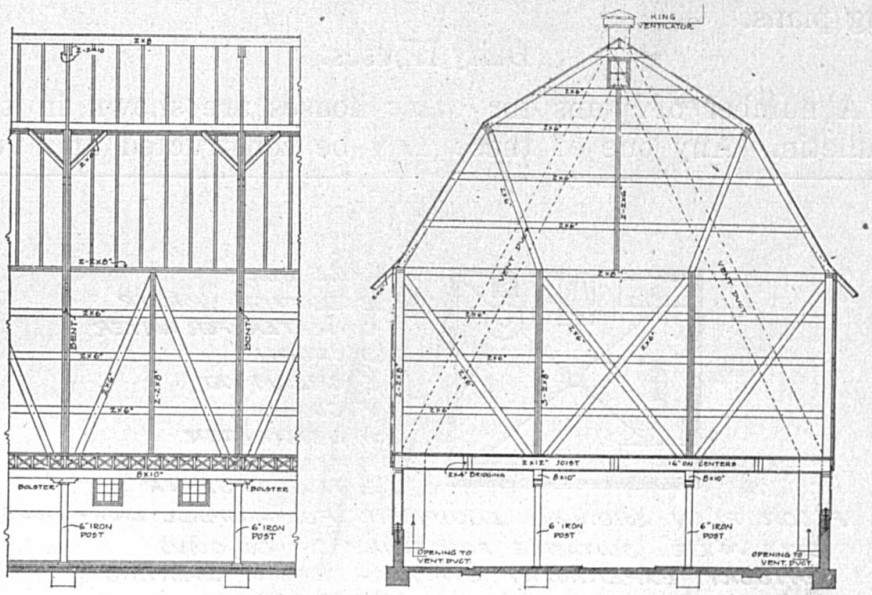


FIG. 41. Wisconsin Model Barn.

Second. All framing lumber is to be as follows:

Girders	8 in. x 10 in.
Floor joists	2 in. x 12 in.
Studding	2 in. x 8 in.
Rafters	2 in. x 8 in.
Roofing	2 in. x 6 in.
Siding	1 in. x 8 in. center matched.

Third. All doors and windows are cased on both sides with 4 inch casing.

Windows in basement are made in one sash with

double lights, and hinged at the bottom so as to swing in at the top.

Ventilation. Intake flues are put in just above the sills as shown in plans, running in between the studding and ceiling joists to middle of beam. Outtake flues are shown in plans. They are double sided with 6 inch center matched boards with paper between.

All other necessary information is given in the accompanying plans.

Dairy Houses.

A number of plans for dairy houses are shown in this bulletin. Any one of these may be constructed at a very

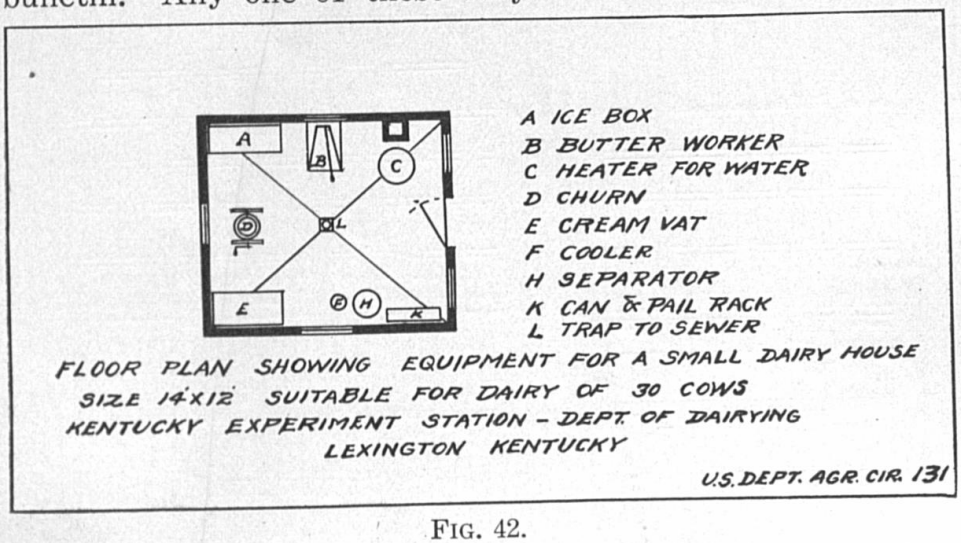


FIG. 42.

moderate cost. The house shown in Figures 42 and 44, suitable for a 30 cow dairy, may be built at a total cost of $25 this including a concrete floor.

ACKNOWLEDGMENTS.

The author of this bulletin wishes to acknowledge his obligations for valuable suggestions and criticisms to Prof. J. A. Farra of the Department of Farm Mechanics of the Kentucky College of Agriculture; the Louden Machinery Company, Fairfield, Iowa, The James Manufacturing Company, Ft. Atkinson, Wisconsin; and to Mr. Elmer Robertson, who made most of the drawings.

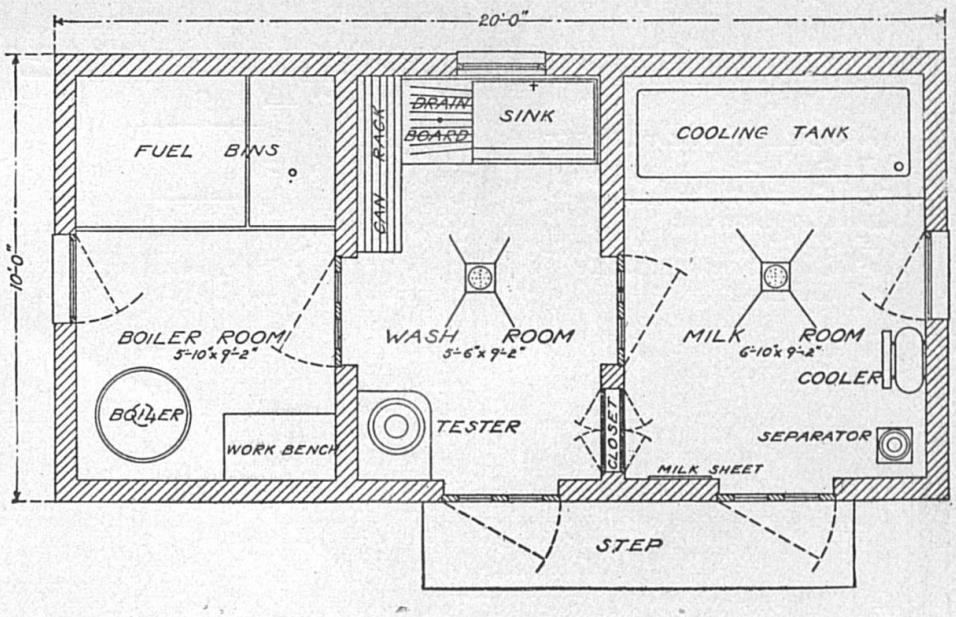


FIG. 43. Floor plans of inexpensive dairy house. showing general arrangement (United States Department of Agriculture).

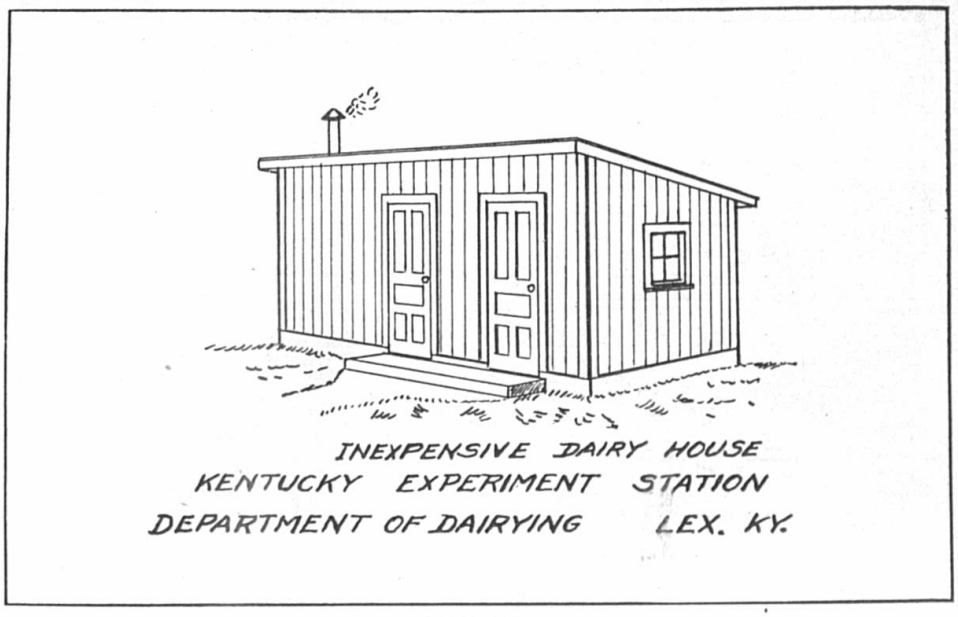


FIG. 44.

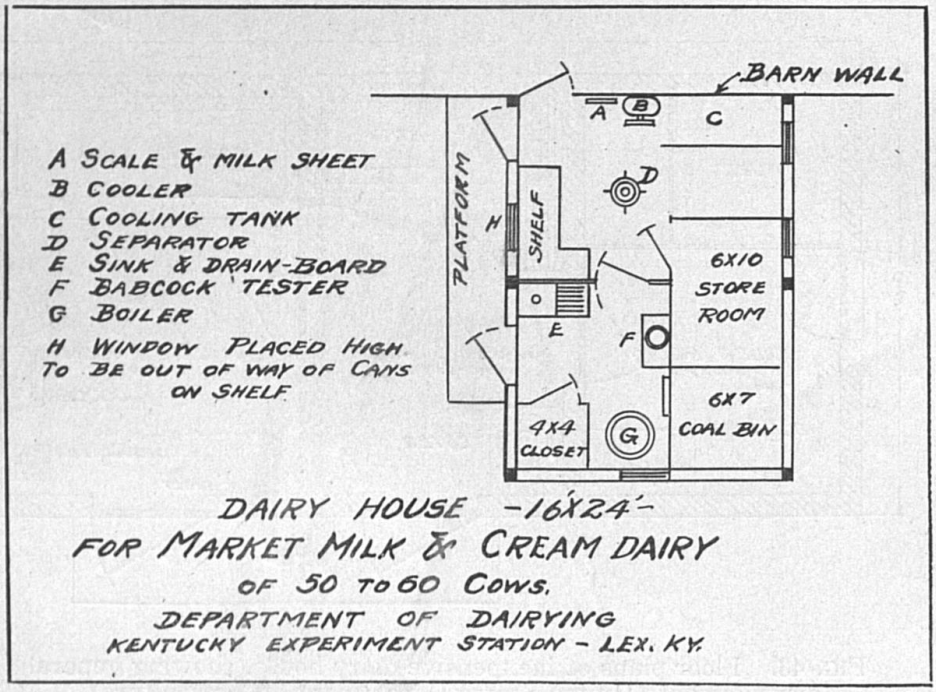

A SCALE & MILK SHEET
B COOLER
C COOLING TANK
D SEPARATOR
E SINK & DRAIN-BOARD
F BABCOCK TESTER
G BOILER
H WINDOW PLACED HIGH TO BE OUT OF WAY OF CANS ON SHELF
BARN WALL
PLATFORM
SHELF
6X10 STORE ROOM
6X7 COAL BIN
4X4 CLOSET
DAIRY HOUSE -16X24'-
FOR MARKET MILK & CREAM DAIRY
OF 50 TO 60 COWS.
DEPARTMENT OF DAIRYING
KENTUCKY EXPERIMENT STATION - LEX. KY.

FIG. 45.

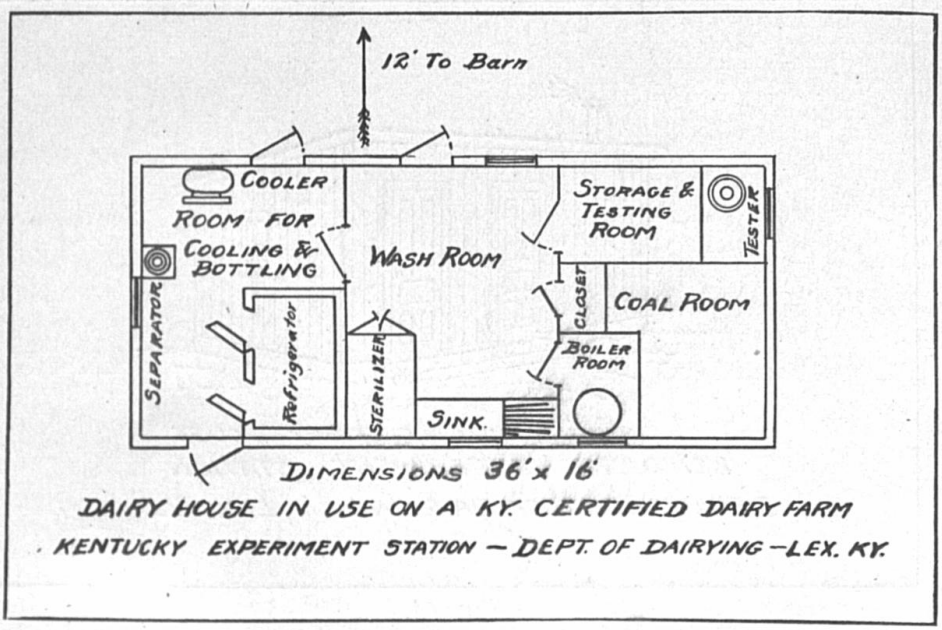

12' To Barn
COOLER
ROOM FOR COOLING & BOTTLING
WASH ROOM
STORAGE & TESTING ROOM
TESTER
SEPARATOR
REFRIGERATOR
STERILIZER
SINK
CLOSET
COAL ROOM
BOILER ROOM
DIMENSIONS 36'x 16'
DAIRY HOUSE IN USE ON A KY. CERTIFIED DAIRY FARM
KENTUCKY EXPERIMENT STATION — DEPT. OF DAIRYING — LEX. KY.

FIG. 46.

THE DAIRY BARN AT THE KENTUCKY AGRICULTURAL EXPERIMENT STATION.

By J. J. HOOPER.

The barns used at the different State Experiment Stations are, as a general thing, larger and more expensive than those employed by the average dairyman. This is due to the experimental work for which they are adapted. The barn equipment at the Kentucky Station will compare very

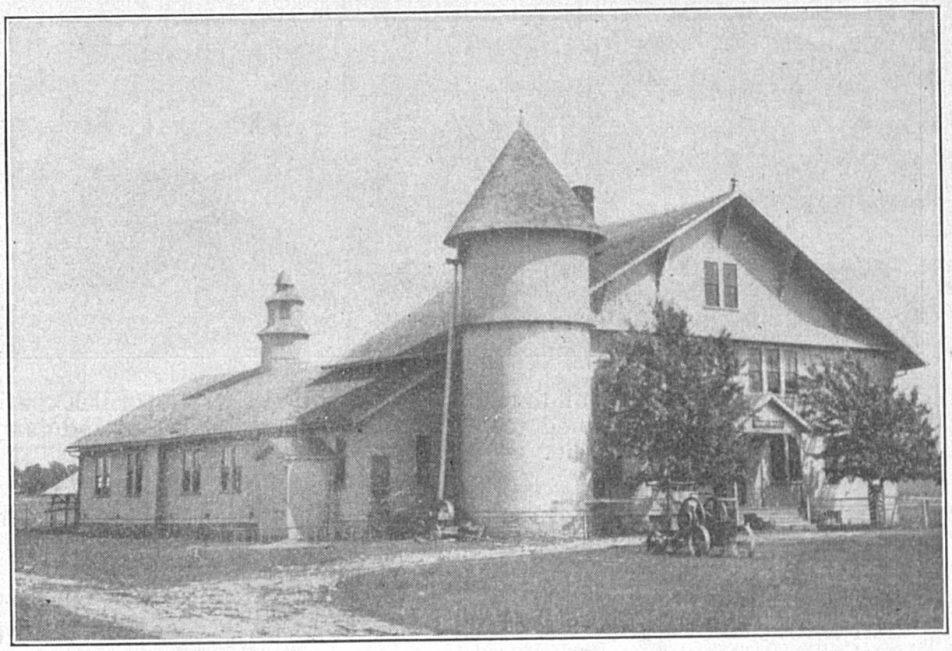


FIG. 47. Dairy barn at Kentucky Agricultural Experiment Station.

favorably with that found on any of the Experiment Station farms in America. This barn was erected under the supervision of the lamented Director M. A. Scovell.

The dairy barn at the Kentucky Agricultural Experiment Station is an adaptation of the Swiss style of architecture of

deep overhanging eaves. The building consists of a main portion of two stories and a basement 68 feet long by 37 feet wide, two ells each 60 feet long and a milk room 14 by 22 feet.

The basement underlying the entire main portion of the barn has a natural limestone bottom. The basement is used to furnish space for the heating plant, the boilers, and the storage of extra milk bottles, etc. The barn is lighted by electricity, and a motor supplies power for the milking machine, which is operated in this barn. The first floor of the main portion contains two offices, a dairyman's room, bath room and feed room. This floor is ceiled throughout with hard pine natural finish. The second story is used for

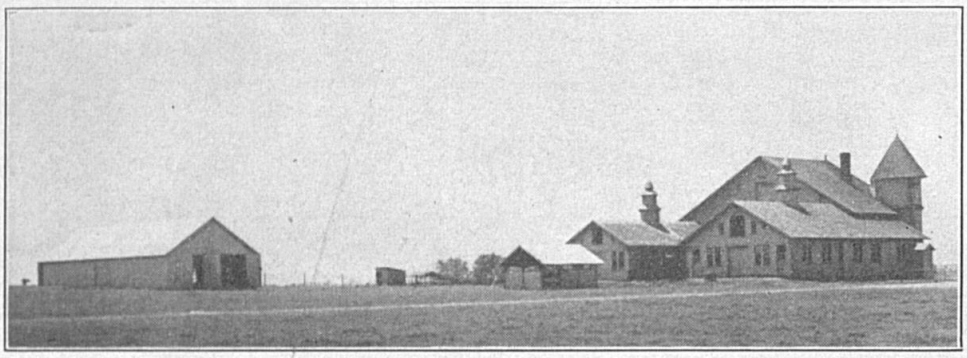
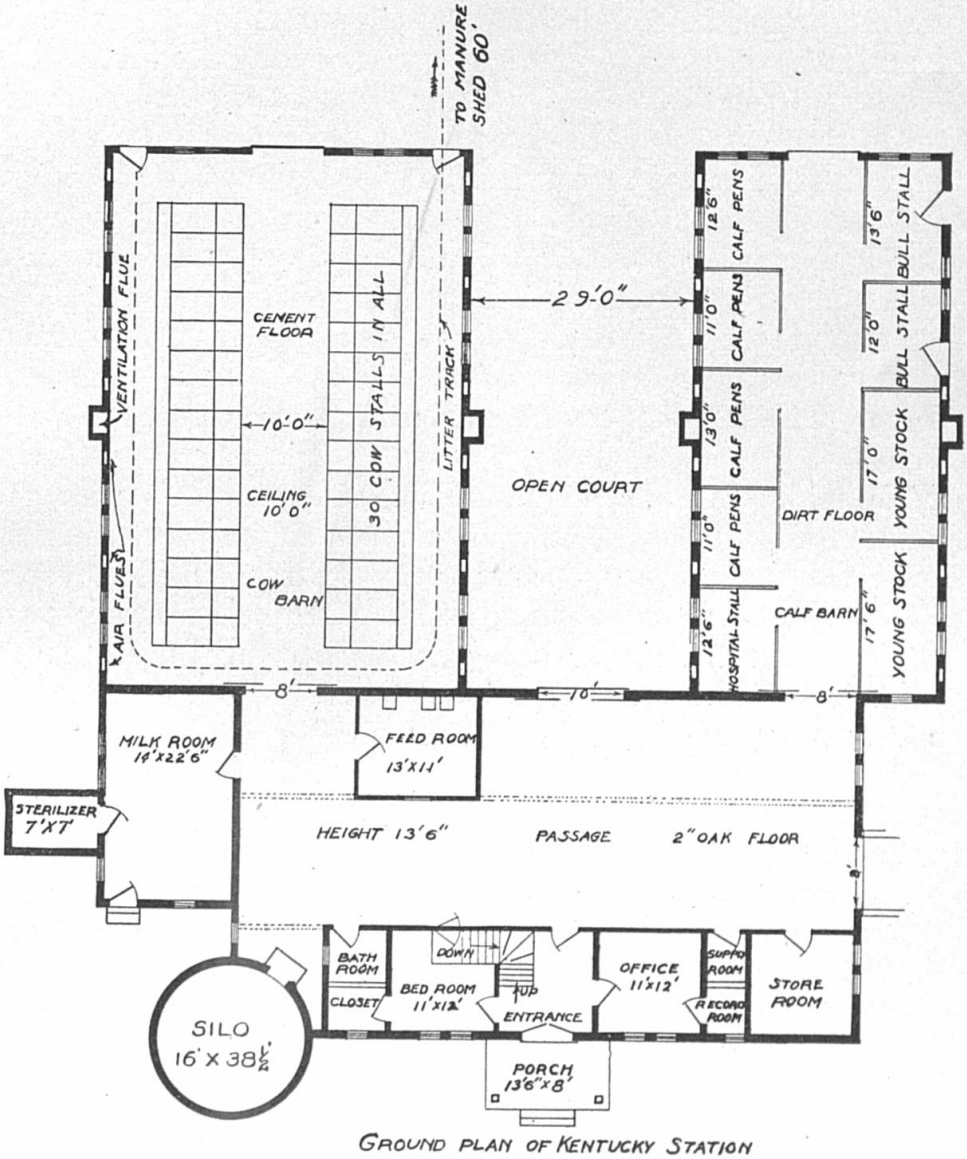


FIG. 48. View of dairy buildings at the Kentucky Agricultural Experiment Station. Cow shed to left, manure shed in center, and dairy barn at right of halftone.

the storage of hay and grain feeds, the grain bins being connected with the feed room below by chutes.

The cow stable in the north wing is 60 by 39 feet in size with a loft above for the storage of hay and bedding. The floor is cemented and the cement plaster runs to a height of four feet all around. The side walls and the floor are easily washed free from dirt. The remainder of the walls and ceiling are finished in hard pine and varnished. Stalls are fitted up to accomodate thirty cows. These are constructed of gas pipe embedded in the cement floor and the upper spaces are fitted with two inch netting made of No. 9 wire. The



GROUND PLAN OF KENTUCKY STATION DAIRY BARN

FIG. 49.

animals are fed from galvanized iron troughs 14 inches wide and extending across the front of the stalls. The cows are tied with a single rope. Each stall furnishes a separate compartment and the cows are not troubled in any way by their neighbors. A manure gutter 18 inches wide runs the length of the stalls in the rear. The manure is handled in an overhead litter carrier. The manure is taken directly to the manure shed and at frequent intervals is spread on the fields.

The second ell is 60 by 27 feet with a clay floor and is ceiled throughout. It contains 9 box stalls built of oak. Two are solid and high and are used for bulls and sick animals. The remaining stalls are made of oak paling 4 feet high fitted with rigid stanchions for holding the calves while they are being fed. A system of ventilation is provided for both wings.

The milk room is cemented throughout on steel laths. It is equipped with an electric driven centrifugal separator, a large ice box, a double compartment wash sink, a turbine bottle washer, slate shelving, and hot and cold water pipes. Steam connections are also placed conveniently. A large sterilizer supplies a convenient means of sterilizing milk bottles, milk buckets and other utensils.

Often the regulations proposed by Boards of Health require that the milk room shall be placed many feet distant from the barn. This is to prevent the contamination of the milk by bacteria and by the atmosphere of the barn. It is noteworthy, however, in this connection that due to the scrupulous cleanliness practiced at the Experiment Station dairy the bacterial count is exceedingly small, and yet the milk room is near the barn and both are under the same roof. The limit that is usually allowed for certified milk is 10,000 bacteria per cubic centimeter. The milk produced in this barn shows a much lower count than 10,000. In fact, the average bacterial count publicly published by the Board of Health of Lexington for the past seven months (October to April, 1914, inclusive) has been 1703 bacteria per cubic centimeter of milk, while the count for the past four months (January to April inclusive) has averaged 362 bacteria per cubic centimeter.

The silo at one corner of the barn is 16 feet in diameter by 38½ high. The outside of the silo is weather boarded like the barn and the interior lining is constructed of two sheathings of seven-eighths inch ship-lap siding with two layers of tarred paper between. Two years ago it became necessary to line the silo with a layer of cement two inches thick. This barn was constructed in 1902 and at that time cost $8,500 complete. The manure shed is located sixty feet from the barn, and is so arranged that its side walls can be taken down while it is being emptied. The cow shed is 30

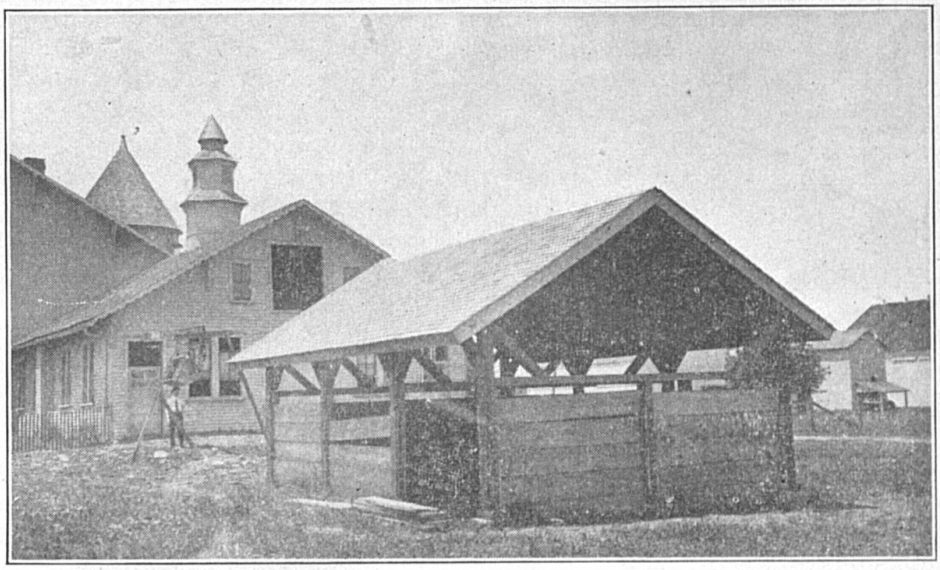


FIG. 50. Manure shed at Kentucky Agricultural Experiment Station. Planks removed from one bent.

by 70 feet, and contains a hay loft and a hay rack which is 50 feet long. At the bottom of the hay rack is arranged a feed trough so that none of the hay is lost and trampled under foot. Also silage, cut up corn stover, rye hay and other coarse material are fed in this trough. A large water tank is located in one corner of this shed and salt is kept accessible to the cows here. There are six doors in the outside walls of the shed, which make it possible for the cows to find ready egress when chased by another cow. For this reason we have not had any cows hooked or injured.

Kentucky

Agricultural Experiment Station

of the

State University

BULLETIN NO. 180

THE INHERITANCE OF COAT COLORS IN HORSES.

BY

W. S. ANDERSON.

LEXINGTON, KENTUCKY
JULY, 1914

STATE UNIVERSITY PRESS
LEXINGTON, KY.

(119)

KENTUCKY AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

RICHARD C. STOLL, Chairman, Lexington, Ky.
CHARLES B. NICHOLS, Lexington, Ky.
LEWIS L. WALKER, Lancaster, Ky.
HENRY S. BARKER, President of the University.
THE DIRECTOR, Secretary, ex-officio.
JOSEPH H. KASTLE, Director.

STATION COUNCIL

THE DIRECTOR

A. M. PETER
H. E. CURTIS
H. GARMAN
C. W. MATHEWS
R. M. ALLEN
J. D. TURNER
E. S. GOOD
GEORGE ROBERTS
T. R. BRYANT
J. J. HOOPER

DEPARTMENTAL ORGANIZATION

ADMINISTRATION

THE DIRECTOR, Head.
H. E. CURTIS, Bursar.
HYWEL DAVIES, Purchasing Agent.
O. L. GINOCHIO, Secretary to Director.
ADDIE LEE DEAN, Librarian.
ANNA WALLIS, Clerk.
CORNELIA C. PAGE, Clerk.

AGRONOMY

GEORGE ROBERTS, Agronomist, Head.
E. J. KINNEY, Assistant Agronomist.
S. C. JONES, Soil Survey.
A. E. EWAN, Supt. Experiment Fields.
H. B. HENDRICK, Extension in Agronomy.
JESSIE F. CASWALL, Clerk.

ANIMAL HUSBANDRY

(Beef, Cattle, Sheep and Swine.)

E. S. GOOD, Head.
ROBERT GRAHAM, Veterinary Science, In Charge Hog Cholera Serum Production.
E. W. MUMMA, Asst. In Charge Hog Cholera Serum Production.
O. S. CRISLER, Hog Cholera Serum.
R. L. PONTIUS, Hog Cholera Serum.
W. V. SMITH, Asst. in Animal Husbandry.
M. G. GINOCHIO, Clerk.
C. B. WILSON, Hog Cholera Serum.
LAWRENCE GINOCHIO, Clerk.
E. J. GOTT, Hog Cholera Serum.

ANIMAL HUSBANDRY

(Horses, Dairy Cattle and Poultry.)

J. J. HOOPER, Head.
W. S. ANDERSON, Asst. Horse Husb'd.
W. D. NICHOLLS, Asst. Dairying.
J. W. NUTTER, Supt. Dairy Farm.
D. D. SLADE, Supt. Poultry Farm.
H. W. RICKEY, Poultry Clubs.
P. E. BACON, Elmendorf Milk Records.
F. WALLACE UTTERBACK, Clerk.

CHEMISTRY

A. M. PETER, Chief Chemist, Head.
S. D. AVERITT, Chemist.
J. S. McHARGUE, Asst. Chemist.
ETHEL V. T. CASWALL, Clerk.

ENTOMOLOGY AND BOTANY

H. GARMAN, Entomologist and Botanist, Head.
MARY L. DIDLAKE, Laboratory Asst.
E. C. VAUGHN, Asst. in Seed Inspection and Plant Breeding.
H. H. JEWETT, Research Asst. Entom.
H. R. NISWONGER, Asst. in Field Work and Nursery Inspection.
LOUISE BEWLAY, Clerk.

EXTENSION

T. R. BRYANT, Head.
H. B. HENDRICK, Agronomy.
J. H. CARMODY, Horticulture.
H. W. RICKEY, Poultry.

FEED

J. D. TURNER, Head.
H. D. SPEARS, Chemist.
ELMER INGRAM, Chief Inspector.
ROGER W. JONES, Inspector.
FANNY C. ROGERS, Clerk.

FERTILIZER

H. E. CURTIS, Chemist, Head.
B. D. WILSON, Assistant Chemist.
WM. RODES, Assistant Chemist.
ELMER INGRAM, Inspector.
R. W. JONES, Inspector.
ANNA WALLIS, Clerk.

FOOD AND DRUGS

R. M. ALLEN, Head.
J. O. LaBACH, Chief Chemist.
L. A. BROWN, Chemist, Drugs.
J. W. McFARLIN, Chief Food Inspector.
W. R. PINNELL, Bacteriologist.
C. S. PORTER, Inspector, Drugs.
WALTER SCHEPPELMAN, Inspector, Bakery Sanitation.
E. F. WORTHINGTON, Inspector, Dairy Sanitation.
W. G. TERRELL, Inspector, Foods.
LILLIE LISTON, Chief Clerk.
LENA LISTON, Clerk.

HORTICULTURE

CLARENCE W. MATHEWS, Head.
J. H. CARMODY, Extension in Horticulture.
F. W. HOFMANN, Asst. in Horticulture.
G. B. WURTZ, Consulting Meteorologist.
MURIEL CASWALL, Clerk.

RESEARCH

THE DIRECTOR, Head.
H. GARMAN, Entomologist and Botanist.
D. J. HEALY, Bacteriologist.
E. S. GOOD, Animal Husbandry.
O. M. SHEDD, Chemist.
MARY L. DIDLAKE, Asst. Entomologist and Botanist.
G. D. BUCKNER, Chemist.
H. H. JEWETT, Research Asst. in Entom.

NOTICE

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Director.

BULLETIN No. 180

THE INHERITANCE OF COAT COLORS IN HORSES

By W. S. Anderson.

When the scientific study of horse breeding was begun it seemed wise to seek the laws governing the transmission of coat colors, as a preliminary work. The apology, if one be necessary, for devoting so much time to the color of the horse is, that this is only a part of a larger study, the determination of the unit characters of the horse. We can make poor progress in this larger work unless we accomplish the easier task. If there be a law governing the transmission of color, may we not infer that a law of somewhat like nature will govern the transmission of the more essential qualities of the horse? If it can be proved that colors are unit characters and their inheritance obeys the Mendelian Law of dominants and recessives, we believe one very important step will have been taken to solve the whole problem of breeding horses.

The business of breeding horses is a very large one. No other animal is quite so valuable as the horse. Immense sums of money are invested in farms and studs for his production. The value of the horses themselves is over a thousand million of dollars. In number, the horses in this country are over twenty-one million. The large farmers may have automobiles, engines and other mechanical devices, but they still have horses and continue to use them in large numbers for a great variety of purposes. The small farmer's most valuable possession is the faithful family horse. Yet, how little is known about the scientific breeding of this valuable animal. Hogs and cattle we are producing to order but the production of the horse is still a haphazard business. Any effort that will aid the breeder in producing better horses will be an effort well spent.

The horse breeding industry of Kentucky is a very extensive one. The limestone of the state is rich in phosphorus which gives a soil unsurpassed for blue grass. It is conceded that no other

single food is so good for the growing horse as is this Kentucky blue grass.

The climatic conditions are almost ideal for rearing horses. The winters are not so long and severe as to necessitate extended periods of shelter at great expense. The summers are not so excessively hot that growth can not continue. The grass and climate unite to secure ideal conditions for producing solidity and strength of bone and tendon. This has resulted in the breeders of the State turning to the production of light horses. The American Saddle Horse had his origin in Kentucky. In other states he is often referred to as the Kentucky Saddle Horse, which is a tribute to the state that produced him.

Without Kentucky the history and development of the Standard Bred Horse, or American Trotter, would be quite different from what it is today. At the present time a very large percent of the really great trotting sires are in Kentucky. For almost a century Kentucky has been producing the Thoroughbred horse. At this time the demand for this type is not so extensive as it has been, but there are some most excellent Thoroughbred stallions in Kentucky, and a number of studs supplied with high grade brood mares.

The draft breeds are gaining a foothold in the State with the indications that their numbers will continue to increase. Grade mares from draft stallions out of saddle, trotting or thoroughbred dams make the ideal mother for the mule. The production of mules is one of the most wide-spread of the breeding activities of the State.

It is the aim of the research work in Horse Husbandry to ultimately place the breeding of horses and mules on a more scientific basis than it has been in the past.

To discover the laws governing the transmission of coat color has been the object of extended effort. The purpose of this bulletin is to give all available figures on the subject and an interpretation of the tables. It will be shown that there are laws governing the inheritance of color in horses. It will also be shown that horses of desired color can be produced at will.

COAT COLORS.

The stud books recognize the following colors in horses: gray, roan, dun, bay, brown, black and chestnut. As a rule the variations of each of these colors are not recorded in the stud books.

The gray coat is made up of white and black hairs and varies from the almost white to the almost black, and includes a large class of horses whose coat is of the dappled pattern. When young, the gray horse exhibits this dappled condition or is what is designated iron gray, but as age comes on the dapples disappear and white and black hairs are to be found. Later on the black may almost be lost and result in a white horse. This white, however, does not seem to be of the same nature as the white found on spotted ponies and some classes of horses. This latter is a snow white often with white skin underneath, while the white found on the old horse is due to the partial disappearance of the black hairs.

The roan pattern assumes three forms. One of these is the red-roan in which the coat is composed of bay and white hairs. The second is the blue-roan which constitutes a coat of black and white hairs. The other form of the roan pattern is the chestnut roan. The coat in this case is due to white and chestnut hairs.

The dun or cream colored coat is not found in any great numbers. It varies in shade from the dark to the light cream. Once in a while the mane and tail have the same cream color as the body coat, but the most usual condition is dun body and black mane and tail with black on feet and legs.

The fashionable color for almost all classes of horses is the bay. The average bay horse has bay hairs on the body, but black on the legs, mane and tail. This black may extend along the back and up the legs to the body and even appear on the underline of the barrel. When the sides of the body show black in alternating patches with bay, the horse is frequently registered as a brown. This brown is known among horsemen as a mahogany brown. As common practice allows mahogany browns to be registered brown it makes it quite difficult to interpret some results as shown by matings. The mahogany brown is a bay. The coat is a compromise between bay and black but it is not a blending although it

resembles a blend. In technical terms it is a simplex bay, that is, a bay produced by two germ cells one of which carries the *determiner* for bay, the other carrying the *determiner* for black. The bay *factor* in this union not showing the usual dominant strength which should exclude black hairs from the body. The mahogany bay represents the one extreme of bay horses and varies from this condition to the bay that has no black hairs on body or legs. The bay hair varies in shade from the very dark wine colored bay to the very light shade close to chestnut.

In all the stud books examined the horses registered as brown may vary in shade from the dark or mahogany bay to black. As noted above the so-called mahogany brown is a dark bay and should be so registered, although custom sanctions the other method. The horse which is called seal brown by horsemen is almost a black horse. The top line is all black, as is the mane and tail. The legs, except for possible white markings, are black up to the body. The body is very dark, in some cases showing a lighter shade near the flanks and back of the nostrils. The flanks and muzzle are said to be tan in color.

The lighter shade, called tan, on muzzle, flanks and sometimes the hips is not due to the presence of brown hairs for the reason that there are no true brown horse hairs unless some shades of bay or chestnut be so called. The tan shade is due to an alternation of black and bay hairs. The bay hairs being very dark and in many cases only showing bay on the outward ends. The horse designated as seal brown is a black in which not all the bay has disappeared. There is just enough of the bay tendency left to produce lighter shades in places on the body.

Black varies in shade from the so-called seal brown to the jet black. Most black horses when exposed to the sun for some weeks show a faded condition, and the ends of the hair show a bay tinge.

The chestnut coats present a variety of shades from the dark liver color to the light sorrel. The mane and tail follow closely the body shades in variety, the lighter chestnuts often showing the crushed strawberry or flaxen shade in the hair of the mane and tail, enough white hairs being present among the chestnut ones to give it the light effect.

In going through the American Saddle Horse Register we se-

cured the color in 5,591 matings, which involve the color of 16,773 horses. To these numbers we are able to add from Sturtevant's tables 8,464 matings, giving a total of 14,055 matings or the color of 42,165 horses. This number is sufficiently large, it seems to us, to enable proper deductions to be drawn, unless it is in the case of the rare colors.

The tables herein given make no distinction in the shades enumerated for the reason that the registration books do not give them. The percentages are figured in round numbers so as to exclude all fractions.

The tabulated matings and the resultant foals are:

RESULT OF MATING VARIOUS COLORS IN SIRES AND DAMS.

CHESTNUT X CHESTNUT.

Breed	*Chestnut*	*Black*	*Brown*	*Bay*	*Authority*
Thoroughbred	1095	9	(bay or brown)		Hurst
Shire	44	1	1	5	Wilson
Trotter	69	0	0	0	Sturtevant
Saddle	410	0	0	0	Anderson
Total	1618	16 not chestnut			
	99%	1%			

CHESTNUT X CHESTNUT.

Suffolk	12497	0	0	0	Anderson

CHESTNUT X BLACK.

Saddle	111	83	20	124	Anderson
	33%	24%	6%	37%	

CHESTNUT X BROWN.

Saddle	60	32	31	130	Anderson
	24%	12%	12%	52%	

CHESTNUT X BAY.

Saddle	597	56	49	764	Anderson
	41%	4%	3%	52%	

BLACK X BLACK.

Percheron	0	49	2	not black	Harper
Shire	2	39	0	3	Wilson
Clydesdale	0	36	2	0	Wilson
Trotter	2	34	4	2	Sturtevant
Saddle	7	137	7	0	Anderson
Total	11	295	15	5	
	3%	90%	5%	2%	

BLACK X BROWN.

Breed	*Chestnut*	*Black*	*Brown*	*Bay*	*Authority*
Thoroughbred	0	8	20	12	Wilson
Shire	4	39	36	19	Wilson
Clydesdale	1	61	106	34	Wilson
Trotter	1	11	9	5	Sturtevant
Saddle	8	79	48	45	Anderson
Total	14	198	219	115	
	3%	36%	40%	21%	

BLACK X BAY.

Thoroughbred	14	1	27	33	Wilson
Shire	19	39	43	125	Wilson
Clydesdale	7	40	67	104	Wilson
Trotter	7	16	31	48	Sturtevant
Saddle	76	199	93	324	Anderson
Total	123	295	261	634	
	10%	22%	20%	48%	

BROWN X BROWN.

Thoroughbred	11	6	114	78	Wilson
Shire	2	7	27	20	Wilson
Clydesdale	0	32	165	34	Wilson
Trotter	0	5	7	7	Sturtevant
Saddle	0	14	21	18	Anderson
Total	13	64	334	157	
	2%	11%	59%	28%	

BAY X BROWN.

Thoroughbred	123	10	365	744	Wilson
Shire	5	23	56	133	Wilson
Clydesdale	5	25	254	206	Wilson
Trotter	8	9	31	81	Sturtevant
Saddle	36	65	111	285	Anderson
Total	177	132	817	1449	
	7%	5%	32%	56%	

BAY X BAY.

Thoroughbred	270	1	125	1295	Wilson
Shire	28	13	18	287	Wilson
Clydesdale	5	6	59	243	Wilson
Trotter	9	1	3	46	Sturtevant
Saddle	162	86	95	960	Anderson
Total	474	107	300	2831	
	13%	3%	8%	76%	

ROAN X CHESTNUT.

Chestnut	*Black*	*Brown*	*Bay*	*Gray*	*Roan*
9	3	2	9	1	14

ROAN X BLACK.

1	11	3	1	0	15

ROAN X BROWN.

1	5	16	18	1	28

ROAN X BAY.

9	5	13	39	1	50

ROAN X GRAY.

0	0	3	0	5	7

ROAN X ROAN.

0	0	0	3	2	9

GRAY X NOT-GRAY.

	Gray	*Not-Gray*	
Thoroughbred	73	56	Wilson
Shire	146	186	Wilson
Clydesdale	9	15	Wilson
Trotter	141	142	Sturtevant
Saddle	70	129	Anderson
Total	439	528	
	46%	54%	

GRAY X GRAY.

All Breeds	47	18
	72%	28%

EXPLANATION OF TABLES.

It will be seen from the foregoing that out of 1,618 matings of chestnut with chestnut all the foals are chestnut except 16. Sturtevant gives from 69 such matings all chestnut foals. In like manner Anderson reports 410 chestnut matings producing chestnut foals. This makes a total of 479 foals from chestnut matings among the two breeds, trotter and saddle horse, without an exception. It is true that there were in the saddle horse records four bay colts reported from chestnut sire and dam. The breeders of them are still living and inform us that it is a typographical mistake in the record. Diligent effort in the last few years has been made to find a living colt from chestnut parents that is not chestnut itself. All efforts have been in vain, although we have asked

in the breeding journals for the information so as to give it the widest publicity.

There can be no doubt that either mistakes in the records or in the reports for registration are numerous enough to account for the 16 exceptions given in the above tabulation. There are those chestnut horses whose color is so close to that of a light bay that it would be remarkable if mistakes were not made in reporting the color for registration. Then, too, it is not always easy to determine what the color of the mature horse is to be by examining the young foal. As a rule the colt that has the dark mane and tail and dark legs will shed out to be a bay, while the one which has the light mane, tail and legs will shed to be a chestnut.

There is a tendency to blend in bay and chestnut. While the blend is not complete by any means, its tendency is apparent and at times gives trouble to foretell the color of the mature horse. We have examined a bay stallion that had on his ankle a small space covered exclusively with chestnut hairs. From the tail of one horse we have secured bay, chestnut and white hairs. It is these animals on the border line that are so liable to be registered bay when in fact they are chestnut. We find numerous errors in all the registration records which we have been able to examine. The color of the horse has always been a minor consideration in registration, the pedigree being considered the important thing. Often the pedigree is mutilated by typographical mistakes. Why should we not expect the color to be changed in the same way?

The other writers on this subject have not given any figures showing the behavior of chestnut when mated to bay, brown and black. We find that black X chestnut matings give 33 per cent. chestnut, 24 per cent. black, 6 per cent. brown, and 37 per cent. bay. Brown X chestnut give 24 per cent. chestnut, 12 per cent. black, 12 per cent. brown, and 52 per cent. bay. Bay X chestnut result in 41 per cent chestnut, 4 per cent. black, 3 per cent. brown, and 52 per cent. bay. The behavior of bay with chestnut is just what is to be expected if chestnut is recessive, as it seems to be. But it is in the matings of chestnut with black and brown that the real difficulty is encountered. Why should chestnut and black matings give 37 per cent. bay? Why should chestnut and brown mat-

ings give 52 per cent. bay? With these exceptions chestnut certainly behaves as a recessive to all other coat colors in horses.

Another strong evidence of the hypostatic position of chestnut is found in the matings in which it is not involved in the color of either the sire or the dam. Black X black matings give 3 per cent. chestnut foals. Black X brown give 3 per cent. chestnut foals. Black X bay give 10 per cent. chestnut. Brown X bay give 7 per cent. chestnut. Brown X brown 2 per cent. chestnut. Bay X bay give 13 per cent. chestnut. Here are six classes of matings with



FIG. 1. This is a chestnut mare. She was mated to a chestnut sire. The foal is chestnut because it is not possible for it to have been any other color. This mare has produced 18 living foals. Every time she has been mated to a chestnut stallion the foal has been chestnut.

no external evidence of chestnut in the animals mated, yet regularly there come from them chestnut foals. This certainly is the way a unit-character should behave, and to behave this way it must be recessive. A striking example of the recessive nature of chestnut is to be found in The Theorist, a trotting bred stallion. The three generations immediately before him are of solid colors other than chestnut. The fourth generation before him has one chest-

nut individual, and the fifth generation two. He is chestnut in color.

There are some stallions that are homozygous for their own colors and are unable to produce even from chestnut mares any chestnut foals. The two bay trotting stallions, Bingen and Alcyo, we have found, do not produce any chestnuts, although each one has had numerous mares who to other stallions do produce chestnut foals.

Since the above was put in type a statement comes to us, in response to our request, which verifies the position that chestnut is recessive. The records of the Suffolk Horse Society of England show that there have been registered 12497 chestnut horses from chestnut matings. From the beginning of their records to the present, the chestnut has been breeding true. Their records alone would prove our position that chestnut is a true recessive.

Black is dominant to chestnut and hypostatic to brown, bay, gray and roan. The percentages are from a total of 326 black X black matings: 90 per cent. black, 3 per cent. chestnut, 5 per cent. brown, 2 per cent. bay. The brown and bay from black matings are very small, not enough to vitiate the conclusion that black is hypostatic to these two colors as well as to gray and roan. Under the present methods of registration there can be no sharp line of demarcation between bay, black and brown. We are confident that as the records are now made up enough errors have crept in, by registering bay or brown, to account for the exceptions above mentioned. In the opinion of the writer, from true black horses mated to true black, only black and chestnut foals will be obtained. The percentages of black colts from the cross of black and brown and black and bay are 36 per cent. and 22 per cent. respectively; just about the figures that the Mendelian law would require.

In regard to brown and bay no little difficulty is encountered. Wilson says:

> "The relative positions of bay and brown remain to be settled; and although there is evidence in favor of brown being dominant to bay, this conclusion is not clearly established. It must be remembered these are the colors breeders have the greatest difficulty in discriminating; and errors affect sires and dams and foals. In regard to sires it has been possible to cor-

> rect the registered colors in several cases; and while every correction has increased the evidence in favor of brown being dominant, it is still possible there may be other explanations as, for instance, that bay is a diluted brown."

Wilson's conclusion is that brown is dominant to bay, although he expresses a doubt as to the correctness of his own conclusions.

In his interpretation of the figures, Sturtevant goes the line of least resistance. He says:—

> "I am unable to agree with Wilson that bay and brown can satisfactorily be separated. I base this upon my own observation, upon the frequent changes from bay to brown and vice versa which he (Wilson) mentions finding in the Clydesdale records, and the similar changes which I have observed among Harness Horse records, and upon frequent recording of English Thoroughbreds as 'bay or brown.' My conclusions, then, are that brown and bay are not distinct, brown being merely a dark bay."

Wilson is in error when he states that brown is dominant to bay. When bay is mated to brown the product is 56 per cent. bay, 32 per cent. brown, 4 per cent. black and 7 per cent. chestnut. There are 2575 bay by brown matings, enough to show that the percentages can be relied upon. Were bay recessive to brown there should be 56 per cent. of brown foals instead of 56 per cent. of bays.

In the tabulation given above the stud book records are taken for brown. As indicated elsewhere in this bulletin mahogany bays are usually registered as brown. All mahogany bays are genetically bay and should be registered as bay.

The seal brown which constitutes the larger number of horses registered as brown is just a light shade of black horse and should be so registered. To make all stud books conform to a uniform standard the so-called brown should be eliminated. The mahogany browns should all be classed with bays. The seal browns should be classed with blacks. Should this be done the black horse would have its variations in shade as do the other recognized colors.

Sturtevant's proposition to place all browns in the bay class as black bays is in part correct. He is correct in so far as the

mahogany shade is concerned. To follow his suggestion and to classify the seal brown as bay would leave the records about as incorrect as they now are.

Another solution of this matter of black, bay and brown was suggested by A. B. Coxe:

> "Might it not be possible that bays, browns and blacks should be considered as a unit and that their appearance could be controlled by an independent factor; something on the same principle of the dilute factor in rabbits' color as set forth by Professor Castle? We have different shades of chestnut and also of gray roans, might not these different shades also be controlled by this dilute factor? Should we not divide the colors in three classes: (1) Gray roans; (2) bay, brown and black; (3) chestnut of different shades? Each class to be controlled by one factor, and then the different shades of these units to be controlled by an independent factor."

It is no little temptation to adopt this short series as it relieves at one stroke so many difficulties. Black with the shade seal brown and bay are just as distinct colors as are chestnut and gray. This being so, we believe that each must have a separate factor or factors, even though it may make the factors for color very numerous in the germ cells. For example, from gray X bay matings there are produced gray, bay, black and chestnut, four colors, showing that in the germ cells of a hybrid gray horse there must be the factors for four colors.

In view of all the evidence the series seems to be: chestnut recessive to all, black dominant to chestnut and recessive to all others, bay dominant to chestnut and black and recessive to the three coordinate colors, gray, roan and dun.

The colors can be arranged in three series.

Gray	Roan	Dun
Bay	Bay	Bay
Black	Black	Black
Chestnut	Chestnut	Chestnut

The color at the top of the series being dominant to all members of the series. Chestnut comes last and is recessive to all

above. There is no question that bay is recessive to gray, roan and dun, and dominant to chestnut and black.

Our records show 3712 bay matings, and there is not a single gray, roan, or dun horse thus produced. This is convincing evidence that bay is hypostatic to the three colors which head the various series.

The evidence of the dominant nature of bay to black and chestnut is that out of the 3712 bay matings 76 per cent. are bay, 3 per

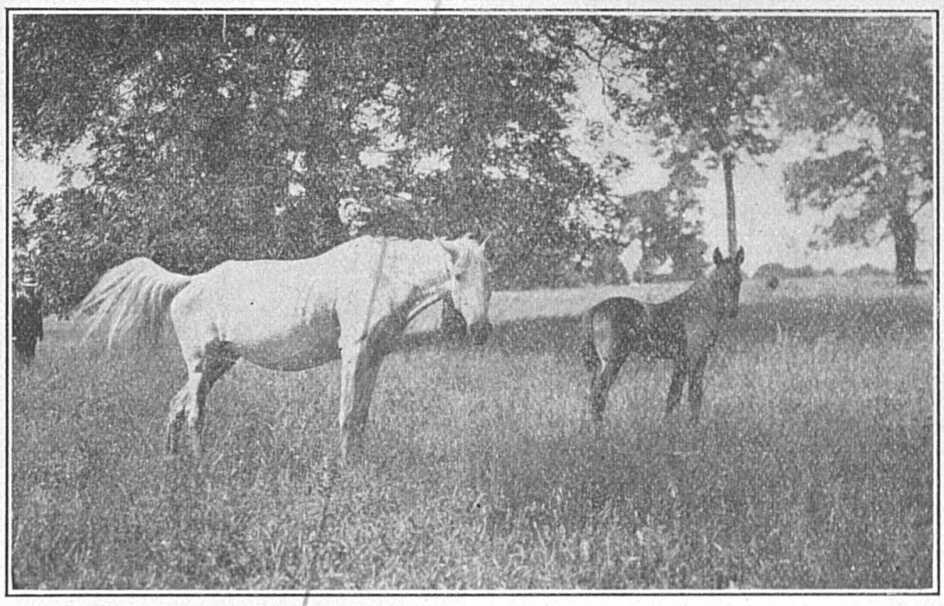


FIG. 2. The gray mare shown in this figure is the dam of the mare in Fig. 3, who is by a bay stallion The foal here shown is black, and will never be able to transmit the gray of its dam.

cent. black, 13 per cent. chestnut and 8 per cent. the so-called brown.

That gray and roan are dominant to bay there can be no doubt. Nine hundred and sixty-seven foals from matings gray X not-gray produced 46 per cent. gray and 54 per cent. not-gray. It is known that homozygous gray when mated with any of the four popular colors will always produce a gray. It is only from a heterozygous gray that other than a gray can be produced. We have no records that would indicate the comparative strength of dun, roan and gray. For the present we place them at the top of the series as of coordinate strength.

The factor for the roan pattern seems to be independent of the factor for color. There are the three factors, or three causes, for the colors, chestnut, black and bay. Intimately mingle white hairs with chestnut and the result is a chestnut roan. White hairs with the black coat in sufficient numbers give the blue or black roan. The bay, or strawberry, roan is due to a mingling of white with the bay coat-color. The factor, or cause, for the roan condition appears to work independent of the determiners for the colors.

There is a reason in the behavior of color factors, in transmission, why a coming foal shall be a bay. Acting in the same germ cells for this foal is the factor for the roan condition and the combined result of the two factors is to produce a bay roan. Should the factors for color have been black or chestnut instead of bay the roan factor would have acted in the same manner except the result on the foal would have been a black roan or a chestnut roan, according to the resultant of the factors for those colors.

The determiner for roan is present or not present in the germ plasm. If present it will be seen in the coat of the mature horse. Its presence is dominant over its absence. It in no way interferes with the inheritance of the colors among themselves.

Like the gray, roan cannot always be detected in young foals. They appear to be bay or black at first, and some show this condition until they shed, when the roan becomes visible.

When once in the germ plasm of a strain of horses its persistence is remarkable. The famous trotting sire Jay Bird got his roan from his grand-mother, Lady Franklin, about whose ancestry we know nothing. A large per cent of the get of Jay Bird were roan and it lingers in his descendants to some extent even to the present. When it disappears it is like the gray, it will not reappear, and to get it again it is necessary to go back to it.

A good illustration came to our attention recently. An intelligent horse breeder bred the progeny of a famous gray horse for five or six generations. He lost the gray at the beginning, but did his breeding expecting it to reappear with each new generation. He of course met with disappointment.

So alike is the behavior of gray and roan that the evidence points to a unity of the two. The gray horse is, perhaps, one

form of the black roan. When the pattern is in the dappled form which with the black disappears with age, we call it gray. The question we raise here is: Should not this gray be considered one form of the black pattern? The writer is confident that further research will identify the factors for gray and roan.

VALUE OF COLOR.

The question is often asked concerning the value of coat color

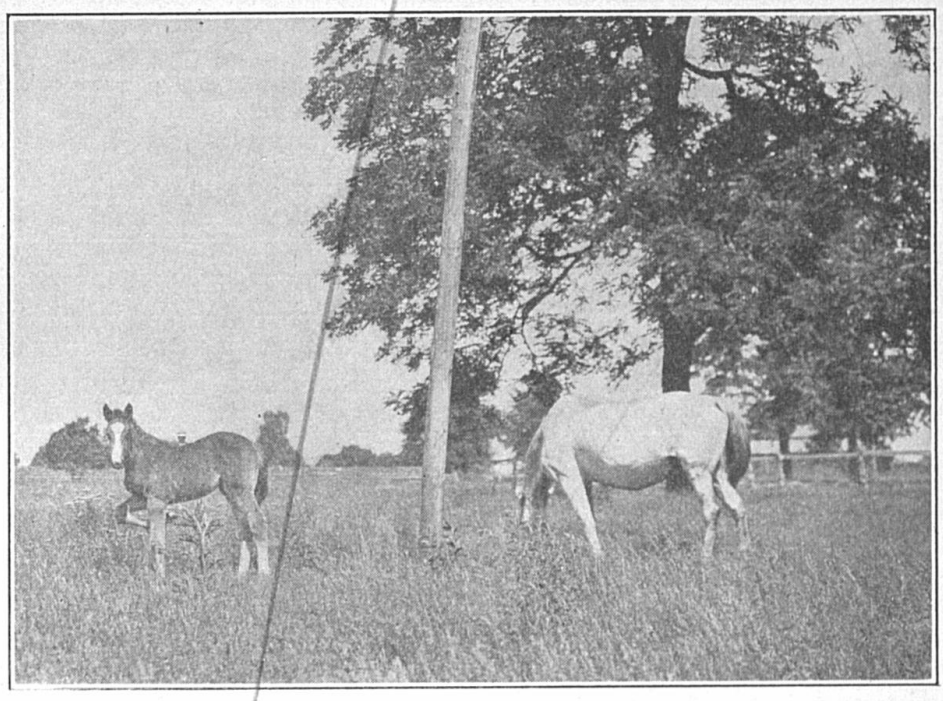


FIG. 3. This gray mare is out of the gray shown in Fig. 2 by a bay horse. The gray dominated in her case and she can transmit it. The bay foal by her side has lost the gray and cannot transmit it.

in horses. There seems to be among some breeders the idea that strength or endurance goes with the color.

There is no semblance of truth in the traditional ideas of this nature. There is no evidence that points of value are in any way connected with the inheritance of coat color. The factors or determiners which control the transmission of color, so far as we have been able to discover in this study, are independent of all

other qualities. The color of itself is no indication of a good horse or of a worthless one.

It is usually considered that black color is the one essential for a mule, but some of the best spans of mules in Central Kentucky are gray, while at least one most valuable pair is dun.

The statement cannot be made too emphatic that speed, intelligence, vigor and other good traits are inherited independently of color. While it is true the color is no indication of the real value of the horse there are those who care for one color more than for the others. This is true when spans or pairs are needed. It is imperative that they be of the same color and the same shade of color if they are to be matched. There should be no very great difficulty in breeding horses for any desired color.

The laws governing the heredity of colors promise to be of the greatest value as an indication of the method for further research for the laws controlling the transmission of gait, speed, style, conformation, intelligence, stamina, docility, and all the qualities which add value to the horse. The present study, at least shows that the breeding of horses can be put upon a more scientific basis. There are small bodies, or chromosomes, in the germ cells which determine what the color shall be. It is only a fair inference that there are similar determiners in the germ cells for the transmission of every valuable trait. The future studies must be directed to the discovery of the laws which govern the inheritance of desired qualities. The physical basis of heredity rests in the small bodies, or chromosomes, within the nucleus of the germ cells. There appears to be a separate body for each quality whether it is from man's view point, good or bad. The physical basis for traits are called factors or determiners. Each factor or determiner controls one quality called a unit character. The horse like all complex living organisms is made up of unit characters, some desirable, some undesirable. For man something like twenty-five hundred traits or units have been catalogued. The laws governing the transmission of many of the human traits have been formulated.

Our studies show the colors of horses to be unit characters and that they behave as simple Mendelian units. That is, they do not blend so as to lose their identity; but the weaker or recessive ones disappear altogether in the external appearance of the horse,

while the factors, for them remain latent in the germ plasm. We call gray dominant because a pure bred gray mated with a bay, black or chestnut, will invariably produce a gray foal. While a gray foal will always come from such a mating the foal will be a hybrid gray and part of its germ cells will contain the factor for gray and a part for the bay, if the other parent was a bay. In the mating of hybrid grays, germ cells may meet both of which

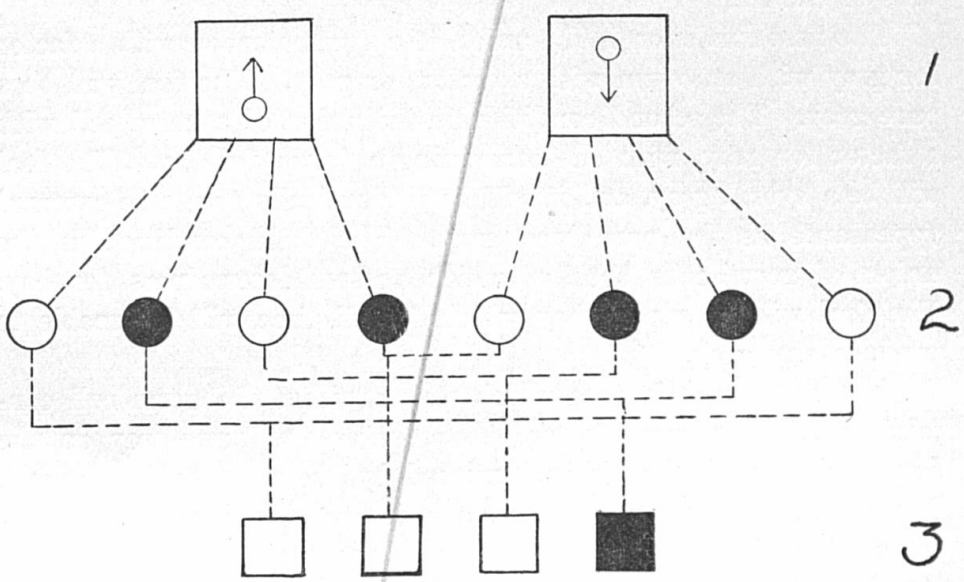


FIG. 4. The squares in No. 1 represent bybrid gray and bay horses, the one male, the other female. The horses will be gray in appearance, as the gray is dominant over the bay. The circles in No. 2 represen the germ cells of each sex. The white ones carry the determiner for gray. The black ones carry the determiner for bay. By the laws of chance the unions will be as indicated when large numbers are considered. From eight germ cells the pairs will, on the average, be: One pair of white, one pair of black, and two pair of white and black. The last produce hybrid grays as in No. 3, the pair, both white, give a pure gray, while the two blacks result in a pure bay.

contain factors for bay and a bay horse will result. The bay color thus coming from two hybrid grays illustrates the behavior of a recessive. It recedes in the presence of the gray to reappear in a later generation.

A most interesting fact concerning a recessive trait like bay is that when it is produced from parents one or both of which possess in their coat color a dominant color like gray, the bay foal

can in no way transmit the gray of its ancestry. The reason for this is a pure bred gray produces germ cells all of which carry the factor for gray. The pure bred bay can only produce germ cells with the bay determiner. When a hybrid gray foal comes from one gray and one bay parent it can produce two distinct kinds of germ cells. One kind contains a determiner for gray, the other kind a factor for bay. Mate hybrids and three conditions result by the laws of chance.

The first condition is the union of a spermatazoon with a factor for gray with an ovum with a factor for gray. The foal will be a pure gray. The second condition is the union of a germ cell with a factor for gray, with one containing a factor for bay. The foal will be a hybrid gray, and it will have identically the same external appearance as the pure bred gray. The third condition is the union of germ cells both of which possess determiners for bay. The foal will be a pure bay which for all time will be unable to produce any gray.

It makes no difference which sex furnishes the germ cell containing the dominant factor. It behaves the same way in the fertilized egg whether it is furnished by the male or the female. To expect, as is often the case, a well bred stallion to reproduce his good qualities from all classes of mares is to hope for the impossible. The sire reproduces those features of himself which happen to be dominant over the corresponding features of the mare to whom he is mated. The mare will impress herself for all traits, in her appearance, which are dominant over the corresponding traits in the sire.

The black trotting sire, Mainleaf, was mated to a bay and white spotted mare. It would be supposed that with all his rich ancestry of trotting blood that he would completely dominate the common pony ancestry. The foal in its color gave no evidence of its paternal ancestry. It is bay and white, because bay and white spots are dominant to black.

THE CAUSE OF COLOR.

It may be of interest to add some statements concerning the cause of pigmentation. All colors of the hair coat are caused by a chemical compound known under the general name of melanin.

One class of the melanins, called melano-proteins, is a protein molecule modified so as to possess the property of the melanins. Melano-proteins have been obtained from black wool, red and brown horse hair, and auburn human hair.

A fundamental characteristic of the chemical precursors of the melanins, is their power to take up, under different conditions, different amounts of oxygen, small amounts of oxygen producing

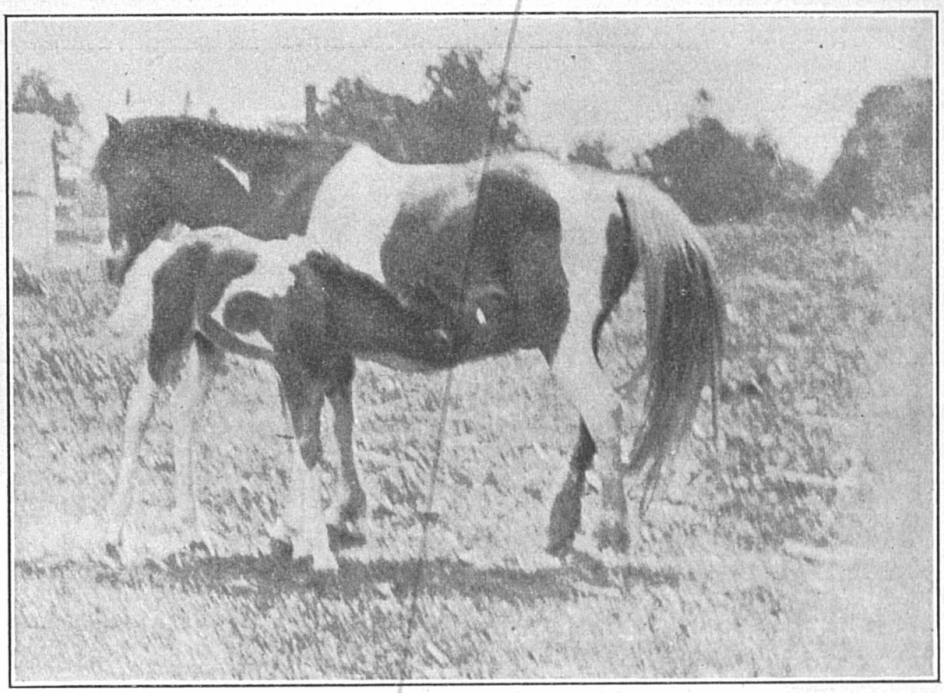


FIG. 5. Bay and white spotted pony mare with a bay and white spotted foal by Mainleaf, a jet black trotting stallion. The sire here had no control over the color. The foal, however, can transmit the black color because it is recessive to the bay-white color.

the lighter shades of pigmentation, while larger amounts cause the darker shades until the black is reached.

That which produces the pigment of the various colors in horses is a chemical substance possessed by all of them. The color of the hair or any part of it is finally due to, as suggested by Kastle:

1. An oxidizing enzyme of the nature of tyrosinase.

2. The presence of an oxidizable cromogen as tyrosin or some similar compound; that is, some phenyl decomposition product of protein.

3. The extent to which the cromogen is oxidized by the enzyme.

As the oxidizable cromogen is present in all bodies, in the skin and hair, except possibly in albinos; and as the oxidizing enzyme is believed always to be present, the important question is, what determines the extent to which the cromogen is oxidized by the enzyme? This investigation of the inheritance of coat colors in horses proves that there is a uniformity in transmission of color from generation to generation. There must be some cause for this exact uniformity.

That which determines the extent to which the cromogen is oxidized must reside in the germ cells. The name given to it is *factor* or *determiner*. We know nothing of the chemical nature of the factors which must occupy very small space within the chromosomes of the sex cells. The vital function which they perform is to control the enzyme in its oxidation of the cromogen. Did the determiners for color not do this, there could be no uniformity of color from generation to generation.

There are in animal coat colors, two kinds of white, one is dominant and the other is recessive. The white of the guinea pig is recessive. The white of the Chester White hog and of the white horse are dominant. It has been suggested by Gortner that the dominant white is due to the presence of an inhibitory enzyme in the epithelial cells which prevent the action of the oxidase; and that recessive whites differ by not having the power to produce pigments. The recessive white lacks the chromogen or oxidase, or both; nor do they possess the anti-oxidase which distinguishes the dominant white. This being the case the one type would always be dominant its determiner being the anti-enzyme, and the other type, or albinos, would of necessity be recessive, in as much as, while they lack the power to produce pigment they are also without the means of inhibiting pigment production when the elements for its formation are present.

THE PHYSICAL CONDITION OF THE PIGMENT.

The shades of human hair color are not as distinct as the shades of color found in horse hair. One can see on the streets

almost every variety of human hair, yellow, light brown, dark brown and black, with every conceivable intermediate shade. Even the red will display a great number of shades.

Microscopic examination would seem to indicate that the pigments for human hair are of two kinds. A red or reddish yellow which alone causes the red hair in all its shades, and a brown or sepia brown which produces in its varying intensity all the shades for the light yellow to the dark brown and black.

The red hair is due to a pigment that stains the hair diffusely. In black hairs the pigment is in the form of dark granules. The more numerous and dense the granules the darker the hair. When both are found together the granules of the brown obscure the diffuse red coloring.

The horse, in his coat color, exhibits much more nearly than does human hair color, the Mendelian unit characters. The microscopic examination shows a condition not very greatly different from the pigment of human hair. There is found the diffuse red pigment, perhaps also a granular red and the sepia black granules. The presence of the sepia black obscure the diffuse red. The nature of the black granules is interesting for the reason that they are not black but a very dark brown. The black effect is caused by the great number of the brown granules. The greater the number the blacker seems to be the hair, the fewer the lighter is the shade.

By a combination of these two pigments the various colors of the horse are produced. The surprising condition is that the colors as they are designated chestnut, black and bay do not show a tendency to blend as do human hair color, and shade from one extreme of black to the other of red. Instead of this the three colors are, for the most part, distinct. There are a few horses on the border line but this blending is the exception rather than the rule.

This is why we insist that there is a factor, one or more, for one kind of red, called chestnut, one or more factors for the other kind of red classified as bay; one or more factors for black.

By common consent C has been the letter to represent the factor for chestnut, H is the symbol for the black factor, B for bay and G for gray patterns. R. will stand for the determiner for Roan and D. for dun. While only one symbol is

used for the physiological cause of color it must be remembered that there may be one or more factors to cause a single color.

Dr. C. B. Davenport comes to the conclusion that there are two factors for black pigmentation in the full blooded negro. When hybrids produced from full blooded negroes and caucasians are interbred one in sixteen of the progeny is white and one in sixteen is black, a segregation which allows him to conclude that there are two factors each for the pigmentation of the two races.

Perhaps this same condition is to be found in the black color of horses. Two factors may be necessary for the jet black horse and the presence of but one gives the lighter shades of seal brown and with the factor for chestnut may produce the bay. Should this hypothesis be true it solves the problem of bay horses from chestnut and brown matings and chestnut and black matings.

BREEDING HORSES TO COLOR.

Chestnut is recessive and behaves as a recessive should. Chestnut horses mated produce chestnuts. There are no known exceptions to this statment. The breeder who cares to produce chestnut horses has a very easy task. Chestnut stallions mated to chestnut mares will give only chestnut foals.

There is evidence which indicates that the breeder can produce at will the different shades of chestnut provided the shades are available for mating. The dark or liver shade, the one most desired, seems to breed true when both sire and dam possess it. The lighter shade, with crushed strawberry mane and tail, also breeds true when both sire and dam are of this shade.

The American Saddle Horse is going rapidly to the chestnut color. In the second volume of The American Saddle Horse Register there are 73 matings of chestnut sire and dam. In the fifth and last volume there are 186 such matings. The tendency to chestnut in saddle horses is also true of thoroughbreds and trotters. One type of draft horse, the Suffolk Punch, was founded by a chestnut stallion in 1768 and the breed is characterized by the chestnut color.

The chestnut of the Suffolk Punch varies from the very dark

to the very light with seven shades recognized. This corresponds to the shades found in the light horses of America.

The reason for the tendency to chestnut is because of its recessive nature. Once in the germ plasm of a horse it persists until animals having that color are produced. All other colored horses may carry the factor for chestnut and in fact most of them do. All matings, even gray by gray, produce chestnut horses in smaller or larger proportions. The three light horse types of Kentucky are

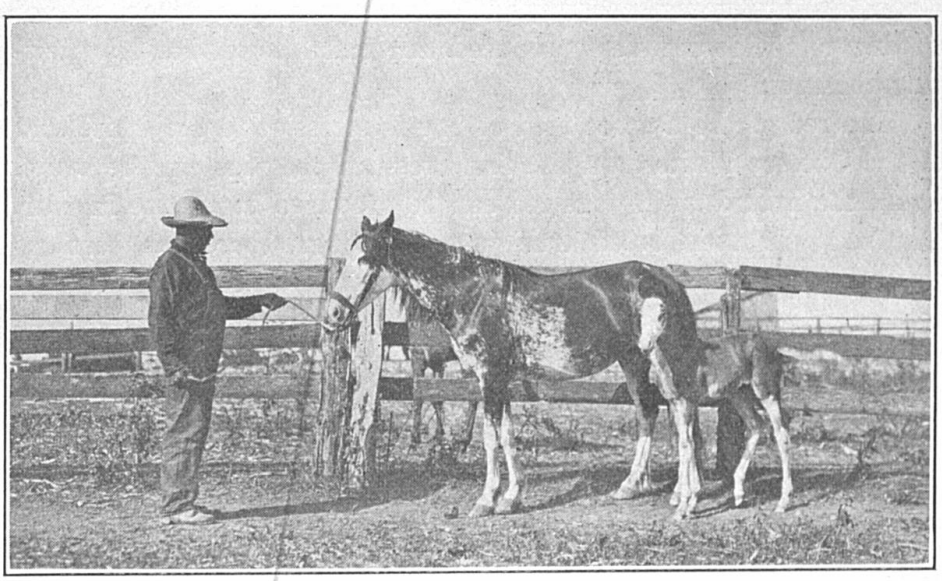


FIG. 6. This is a hybrid pony mare with blotches of white, with a foal by the saddle stallion, Dandy Jim, who is a mahogany bay. The foal takes its color and markings from its dam exclusively. White spots are dominant over solid color.

producing a greater percent of chestnuts now than they produced a half century ago.

Attention is called to the standard bred horse The Theorist, which is chestnut in color with the light flaxen mane and tail. He has three generations of ancestors immediately before him without a chestnut horse being among them. Of the 16 individuals in the fourth generation one only is chestnut, while the fifth generation of 32 finds two chestnuts. This shows the persistence of the recessive character.

"The Theorist" produced from an ancestry with so little chest-

nut in it will breed as true for chestnut as if he had been the product of all chestnut ancestry. This is the way a recessive character behaves. When it makes itself visible in the body of the organism it ever after breeds true.

It would be supposed that a Suffolk Punch horse which has been bred true since 1768 for chestnut color would be more prepotent than The Theorist for example. There are no evidences that this is true. One chestnut is no stronger from the standpoint of production than another. The so called doubling of the chestnut blood by producing chestnuts from chestnut parentage is not adding to the individuals produced any extra power for transmitting chestnut.

The red of the Duroc breed of hog is recessive to the white coat of the Chester Whites. On the first cross all the pigs will be white. From the hybrid white pigs red can be produced about one in four. The red will then breed true just as though there has been no white in the immediate ancestry. The same is true of chestnut coat color in horses, it breeds true no matter how it may have been produced. Chestnuts from gray or bay matings breed as true as from chestnut matings.

It is a more difficult problem to produce a family of black horses, as the black color can carry as a submerged recessive, the factors for chestnut. A small number, perhaps not more than 3 per cent, of foals from black matings will be chestnut. If sires and dams are discarded who do produce chestnut there is no reason why a family of black horses can not be established in each breed. While the evidence is not conclusive it indicates that bay will not be produced from black matings. The apparent exceptions to this in the records are so few that it appears more likely that the bays recorded from black matings are mistakes. Counting these mistakes the only difficulty will be in the small percentage of chestnuts that will be produced. Constant elimination of these will in time enable the breeder to secure in the germ plasm of his stud nothing but black.

To produce a family of bay horses will require more time and patience than to obtain a family of blacks. The external appearance of the bay tells us nothing of his genetic qualities other than that he carries in his germ plasm the bay factor. Whether there are

black and chestnut factors also can only be determined by his record in the stud. Occasionally a bay sire like Bingen produce no chestnut foals. By rigid selection from such sires and dams of same nature a bay family could be evolved. It would not be an easy task but it could be done. Outside the draft breeds gray is not fashionable. This has resulted in the gradual disappearance of gray in the lighter breeds of horses. A few gray mares are to be found in the three light horses of Kentucky, but the males are almost uniformly gelded. It is not improbable that the near future will see the American Saddle Horse, the Thoroughbred and the Trotter without gray representatives.

From existing grays in these three breeds it would be an almost impossible task to build up a gray strain. There is bay, black, and chestnut in the germ plasm of these grays and to select a gray which would be free from all these factors would be a slow and difficult process. It could be done but would take unlimited time.

The task of getting a gray family would be easy for the Percheron breeder, for in his breed there are pure bred grays in sufficient numbers to make the segregation easy.

Kentucky
Agricultural Experiment Station

State University, Lexington, Kentucky

BULLETIN NO. 181

I. Suggestions Relative to the Prevention of Hog Cholera

BY

JOSEPH H. KASTLE and ROBERT GRAHAM

II. List of Publications of the Kentucky Agricultural Experiment Station

STATE UNIVERSITY PRESS
LEXINGTON, KY.
August, 1914.
(147)

KENTUCKY AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

RICHARD C. STOLL, Chairman, Lexington, Ky.
CHARLES B. NICHOLS, Lexington, Ky.
LEWIS L. WALKER, Lancaster, Ky.
HENRY S. BARKER, President of the University.
THE DIRECTOR, Secretary, ex-officio.

JOSEPH H. KASTLE, Director.

STATION COUNCIL

THE DIRECTOR

A. M. PETER
H. E. CURTIS
H. GARMAN
C. W. MATHEWS
R. M. ALLEN
J. D. TURNER
E. S. GOOD
GEORGE ROBERTS
J. J. HOOPER

DEPARTMENTAL ORGANIZATION

ADMINISTRATION

THE DIRECTOR, Head.
H. E. CURTIS, Bursar.
HYWEL DAVIES, Purchasing Agent.
O. L. GINOCHIO, Secretary to Director.
ADDIE LEE DEAN, Librarian.
ANNA WALLIS, Clerk.
CORNELIA C. PAGE, Clerk.

AGRONOMY.

GEORGE ROBERTS, Agronomist, Head.
E. J. KINNEY, Assistant Agronomist.
S. C. JONES, Soil Survey.
A. E. EWAN, Supt. Experiment Fields.
JESSIE F. CASWALL, Clerk.

ANIMAL HUSBANDRY

(Beef Cattle, Sheep and Swine)

E. S. GOOD, Head.
ROBERT GRAHAM, Veterinary Science, In Charge Hog Cholera Serum Production.
E. W. MUMMA, Asst. In Charge Hog Cholera Serum Production.
O. S. CRISLER, Hog Cholera Serum.
R. L. PONTIUS, Hog Cholera Serum.
W. V. SMITH, Asst. in Animal Husbandry.
M. G. GINOCHIO, Clerk.
C. B. WILSON, Hog Cholera Serum.
LAWRENCE GINOCHIO, Clerk.
E. J. GOTT, Hog Cholera Serum.

ANIMAL HUSBANDRY

(Dairy Cattle, Horses and Poultry)

J. J. HOOPER, Head.
W. S. ANDERSON, Asst. Horse Husb'd.
J. W. NUTTER, Supt. Dairy Farm.
W. D. NICHOLLS, Asst. Dairying.
D. D. SLADE, Supt. Poultry Farm.
P. E. BACON, Elmendorf Milk Records.
F. WALLACE UTTERBACK, Clerk.

CHEMISTRY

A. M. PETER, Chief Chemist. Head.
S. D. AVERITT, Chemist.
J. S. McHARGUE, Asst. Chemist.
R. PFANSTIEL, Asst. Chemist.
ETHEL V. T. CASWALL, Clerk.

ENTOMOLOGY AND BOTANY

H. GARMAN, Entomologist and Botanist, Head.
MARY L. DIDLAKE, Laboratory Asst.
E. C. VAUGHN, Asst. in Seed Inspection and Plant Breeding.
H. H. JEWETT, Research Asst. Entom.
H. R. NISWONGER, Asst. in Field Work and Nursery Inspection.
LOUISE BEWLAY, Clerk.

FEED

J. D. TURNER, Head.
H. D. SPEARS, Chemist.
E. H. NOLLAU, Asst. Chemist.
ELMER INGRAM, Chief Inspector.
ROGER W. JONES, Inspector.
FANNY C. ROGERS, Clerk.

FERTILIZER

H. E. CURTIS, Chemist, Head.
B. D. WILSON, Assistant Chemist.
WM. RODES, Assistant Chemist.
ELMER INGRAM, Inspector.
R. W. JONES, Inspector.
ANNA WALLIS, Clerk.

FOOD AND DRUGS

R. M. ALLEN, Head.
J. O. LaBACH, Chief Chemist.
L. A. BROWN, Chemist, Drugs.
J. W. McFARLIN, Chief Food Inspector.
W. R. PINNELL, Bacteriologist.
C. S. PORTER, Inspector, Drugs.
WALTER SCHEPPELMAN, Inspector, Bakery Sanitation.
E. F. WORTHINGTON, Inspector, Dairy Sanitation.
W. G. TERRELL, Inspector, Foods.
LILLIE LISTON, Chief Clerk.
LENA LISTON, Clerk.

HORTICULTURE

CLARENCE W. MATHEWS, Head.
F. W. HOFMANN, Asst. in Horticulture.
G. B. WURTZ, Consulting Meteorologist.
MURIEL CASWALL, Clerk.

RESEARCH

THE DIRECTOR, Head.
H. GARMAN, Entomologist and Botanist.
D. J. HEALY, Bacteriologist.
E. S. GOOD, Animal Husbandry.
O. M. SHEDD, Chemist.
MARY L. DIDLAKE, Asst. Entomologist and Botanist.
G. D. BUCKNER, Chemist.
H. H. JEWETT, Research Asst. in Entom

Notice

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Director.

BULLETIN NO. 181.

I. SUGGESTIONS RELATIVE TO THE PREVENTION OF HOG CHOLERA.

By Joseph H. Kastle and Robert Graham.

Hog cholera is the greatest menace to successful hog raising in Kentucky. It is by far the most contagious and fatal of any of the diseases of swine. The disease is due to an ultra-microscopic virus which is present in the blood, the excreta and in the carcasses of all infected animals. The infection may be carried from infected to healthy herds by a number of agencies, such as running water, birds, dogs, new stock from infected sources and also on the shoes of persons who have walked over infected areas. We can only hope to control, and ultimately eradicate, hog cholera by honest, conscientious and painstaking efforts on the part of all farmers and hog raisers looking to the effective isolation of all animals having the disease, scrupulous cleanliness in the handling and care of hogs, disinfection of infected premises, the burning of all carcasses of hogs that have died of this disease, proper care in the selection of fresh stock and the careful and intelligent use of hog cholera serum. There is absolutely no question but that hog cholera can be prevented and controlled, at least to a degree, through the careful observance of a few simple, prophylactic measures, together with the use of hog cholera serum. With a view of aiding all those engaged in the raising and fattening of hogs in their efforts to prevent and control this disease, the following suggestions have been formulated relative to the care

and precautions to be observed in the proper handling of hogs.

General Care and Management of Hogs. Hogs should be fed a balanced ration consisting of such materials as corn and various corn products, bran, wheat middlings, oil meal, tankage and distillers' dried grains and, whenever possible, they should be supplied with forage crops, such as green alfalfa or alfalfa hay. Excellent results have also been obtained at the Experiment Station by grazing hogs fed corn meal as the chief ration, on young barley, rye, wheat and oats, so that by the use of such crops during the winter and spring months, forage for hogs can be secured in this climate practically the year round. By reason of its low protein content, a ration of corn or corn meal alone is not suitable for the growing pig. It should always be supplemented with other feeds rich in protein, such as oil meal, tankage, distillers' dried grains, etc. For further information on the feeding of hogs, the reader is referred to Bulletin No. 175, by Professor E. S. Good, of the Kentucky Agricultural Experiment Station, on the growing and fattening of hogs in the dry lot and on forage crops.

Hogs should be supplied with an abundance of pure, clean water, plenty of shade in hot weather, dry bedding, and airy, light, well ventilated hog houses.

New Stock. Great care should be exercised in the purchase of new stock in order to secure healthy, vigorous animals, free from disease. In this connection, it is well to bear in mind that hog cholera has an incubation period lasting from 5 to 20 days, during which time the animal may appear normal to all intents and purposes. In this connection, it should always be borne in mind that improperly disinfected freight cars and public stock pens are constant sources of infection. Separate quarters should therefore be provided for the isolation of all newly purchased animals, where they may be kept from the rest of the herd for a period of three weeks, and kept under observation for any symptom of the disease that may appear.

Loss of appetite, sluggishness or general weakness on the part of such isolated animals, or a tendency to carry the abdomen tucked up, the development of diarrhea or of a temperature (by rectum) of over 103 to 103.5 degrees, afford good grounds for suspecting the presence of this disease.

Disinfection. Following an outbreak of hog cholera in a herd, a thorough cleaning up and disinfection of hog lots and quarters must be resorted to. Fire and fresh air-slaked lime are the most efficient agents for the destruction of the hog cholera virus. Accordingly, the carcasses of all hogs that have died of hog cholera, together with the excreta and all litter, bedding and refuse contained about the hog lot, pens and houses should be raked up and burned. Fresh air-slaked lime should be abundantly scattered about the hog lots, or the premises disinfected with a 3 per cent. solution of cresol compound and the hog houses whitewashed.

Disposition of Hog Cholera Carcasses. The disposition of the carcasses of hogs that have died of hog cholera, in out-of-the-way places, on the surface of the ground where the infection may be carried for miles by running water, or where it may be widely disseminated by dogs and birds, is in reality little short of criminal, and is in violation of the live stock sanitary laws of the State. It is required by law to burn all such carcasses, and not to do so lays the offender liable to arrest and prosecution.

The Sale and Transportation of Sick Hogs. Sick hogs, or hogs from a herd in which hog cholera is known to exist, or hogs suspected of incubating this disease, should not be sold; neither should they be driven along public highways or transported in cars from place to place, or placed in public stock yards or pens. In other words, the only way to properly control this disease is to isolate it and though it may work a temporary hardship on the individual owner to do this, it is certainly, ultimately, to his interest and to the interest of the great body of hog raisers within the bounds of the State, to do all in his power to establish and maintain a rigid and effective quarantine with respect to this disease.

Prevention of Hog Cholera by Means of Hog Cholera Serum. The only means of protecting the hog against hog cholera is by inoculation with hog cholera serum, or with hog cholera serum and virus. Inoculation with serum alone confers an immunity lasting from six to eight weeks, during which time the animal is not susceptible to the disease. Inoculation with serum alone is known to veterinarians and bacteriologists as the *serum-alone* method. The double treatment, or the *serum-simultaneous* method consists in the simultaneous inoculation of the animal on one side of the body with serum and on the other side with virus. Animals thus treated show a lasting or permanent immunity to hog cholera. While the serum-simultaneous method confers upon the animal a more permanent immunity than serum alone, it is borne by the animal with greater difficulty and is attended by a greater number of fatalities, and furthermore, unless it is properly controlled, it is liable to result in the establishment of centers of infection in non-infected territory.

In certain instances it has been found advantageous to combine the serum-alone method with the serum-simultaneous method. This combined method of treatment consists in the administration of a preliminary dose of serum alone, followed several days later by the double, or serum-simultaneous inoculation. As is the case with practically all vaccines, viruses and biological products, the use of hog cholera serum and virus as a preventive against hog cholera is attended with certain risks and dangers which are greatly increased and augmented in the hands of inexperienced and unskilled persons.

In administering serum and virus, the hogs should be penned up the night before and handled as quietly and expeditiously as possible, and all instruments used in the inoculation should be thoroughly sterilized by boiling in water immediately before the injection or administration.

It should be borne in mind that even under the best possible conditions, certain losses of hogs, following the inoculation, are unavoidable. The following report of the work done

in hog cholera eradication during the month of June by the Experiment Station, shows, however, as low a mortality attending and following the inoculation as has been obtained elsewhere in the United States, and will serve to give a correct idea of the great saving accomplished through the careful and intelligent use of serum and virus.

Summary of Results With Hog Cholera Serum for the Month of June, 1914.

Apparently Healthy Herds.

Number herds treated simultaneously	35	
Number hogs treated simultaneously	1,229	
Number hogs suspicious (temp. over 103.5)	207	
Number hogs reported	1,229	
Number hogs not reported	---	
Number herds reported	35	
Number herds not reported	---	
Number hogs treated lived	1,181	96.1 per cent.
Number hogs treated died from all causes	48	3.9 per cent.

Suspicious and Possibly Exposed Herds.

Number herds treated serum—alone and simultaneously	8	
Number hogs treated serum—alone and simultaneously	317	
Number hogs suspicious (temp. over 103.5)	32	
Number hogs reported	317	
Number hogs not reported	---	
Number herds reported	8	
Number herds not reported	---	
Number hogs treated lived	313	98.74 per cent.
Number hogs treated died from all causes	4	1.26 per cent.

Suspicious and Sick Herds.

Number herds given serum-alone	57	
Number hogs given serum-alone	1,831	
Number hogs suspicious (temp. over 103.5)	584	
Number hogs reported	1,634	
Number hogs not reported	197	
Number herds reported	51	
Number herds not reported	6	
Number hogs treated lived	1,467	89.8 per cent.
Number hogs treated died from all causes	167	10.2 per cent.

Summary.

Total number of herds treated	100	
Total number of hogs treated	3,377	
Total number of hogs treated reported	3,180	
Total number of hogs suspicious (temp. over 103.5)	823	
Total number of hogs lived	2,961	93.1 per cent.
Total number of hogs died	219	6.9 per cent.

Farmers and hog raisers can obtain hog cholera serum upon application to Dr. Robert Graham, Kentucky Agricultural Experiment Station, Lexington, Kentucky, in any amounts desired, at one cent per cubic centimeter, C. O. D.

Virus is supplied by the Experiment Station only to veterinarians and county live stock inspectors, or to properly qualified persons having permission in writing from the Director of the Experiment Station, to administer the same.

General Conditioners. So-called "general conditioners" have been found to be advantageous in the maintenance of healthy conditions in hogs, and many such conditioners have been proposed. The following is a typical conditioner, which will be found to act favorably upon swine receiving the same:

Common salt	15 pounds
Wood ashes	5 pounds
Wood charcoal	5 pounds
Powdered copperas (*ferrous sulphate*)	1 pound
Sodium sulphate	1 pound
Antimony sulphide	1 pound
Sulphur	1 pound
Sodium hyposulphite	1 pound
Air-slaked lime	1 pound

The ingredients composing this mixture may be procured at any drug store for about 10 cents per pound or less. One ounce of the mixture is fed with about ten pounds of feed, or the hogs are allowed free access thereto.

Internal Parasites. The hog is found to harbor a number of internal parasites which act prejudiciously to the health and general well-being of the animal. The following preparation has been found to be of value in the correction of conditions resulting from the presence of internal parasites in hogs:

Santonin	2½ grains
Areca nut	1 drachm
Calomel	2 grains
Sodium bicarbonate	2 drachms

Lice. Under certain conditions hogs are also greatly troubled with lice for the removal of which any of the coal

tar dips may be employed, or the hogs may be sprayed with an emulsion of crude oil or kerosene.

Patent Medicines. Patent medicines and all so-called *hog cholera cures*, other than serum, should be avoided. At best, these preparations are only conditioners and under no circumstances do any of them possess any real curative properties for hog cholera. Many of them are also very expensive, considering the actual value of their ingredients, and their continued use in the attempt to counteract hog cholera is often a source of great expense to hog raisers and accomplishes nothing in the cure and prevention of this disease.

For further information on the subject of hog cholera, address Dr. Robert Graham, Hog Cholera Serum Laboratory, Kentucky Agricultural Experiment Station, Lexington, Kentucky.

II. LIST OF PUBLICATIONS OF THE KENTUCKY AGRICULTURAL EXPERIMENT STATION.

(Those marked with an asterisk (*) are no longer available.)

BULLETINS.

No.

* 1. Do Fertilizers Affect the Quality of Tobacco? December 23, 1885.
* 2. Corn Fodder as Food for Stock. January 4, 1886.
* 3. Milk.
* 4. Distillery Slop.
* 5. Analyses of Feeding Stuffs.
* 6. Clover.
* 7. Fertilizers.
* 8. Experiments with Wheat. September 25, 1886.
* 9. Experiments with Potatoes. March 1, 1887.
* 10. Fertilizer Analyses. May, 1887.
* 11. Wheat Experiments. September, 1887.
* 12. Fertilizer Analyses. December 31, 1887.
* 13. Commercial Fertilizers. April, 1888.
* 14. Analyses of Commercial Fertilizers. July, 1888.
* 15. Wheat Experiments. September, 1888.
* 16. Potato Experiments. December, 1888.
* 17. Corn Experiments. February, 1889.
* 18. 1. Hemp Experiments. 2. Notes on Treatment of an old Apple Orchard. April, 1889.
* 19. Experiments in Pig Feeding. May, 1889.
20. Commercial Fertilizers. July, 1889.
* 21. Wheat Experiments. The Grain Louse. September, 1889.
* 22. Potato Experiments. December, 1889.
* 23. 1. Experiments with Oats. 2. Tests of Fertilizers on Meadow Land. February, 1890.
* 24. Broom-rape of Hemp and Tobacco. March, 1890.
* 25. Strawberries. April, 1890.
* 26. Corn Experiments. April, 1890.
27. Experiments with Commercial Fertilizers on Hemp. April, 1890.
* 28. Tobacco Experiments. May, 1890.
29. Commercial Fertilizers. July, 1890.
* 30. Wheat Experiments. A New Wheat Insect. August, 1890.
* 31. Some Strawberry Pests. December, 1890.
* 32. Strawberries. Vegetables. March, 1891.
* 33. Corn Experiments. April, 1891.
* 34. Commercial Fertilizers. August, 1891.
* 35. 1. Experiments with Wheat. 2. Experiments with Oats. September, 1891.
* 36. Commercial Fertilizers. December, 1891.
* 37. Experiments with Potatoes. December, 1891.
* 38. 1. Vegetables. 2. Strawberries. March, 1892.
39. Marls. March, 1892.

* 40. Some Common Pests of the Farm and Garden. March, 1892.
* 41. Commercial Fertilizers. July, 1892.
* 42. 1. Experiments with Wheat. 2. Experiments with Oats. September, 1892.
* 43. Commercial Fertilizers. December, 1892.
* 44. Bordeaux Mixture for Apple Pests. January, 1893.
* 45. Field Experiments with Fertilizers. 1. Corn. 2. Potatoes. 3. Tobacco. April, 1893.
* 46. Commercial Fertilizers. August, 1893.
* 47. 1. Pests of Shade and Ornamental Trees. 2. An Experiment on Plum Rot. December, 1893.
* 48. Commercial Fertilizers. January, 1894.
* 49. 1. Destructive Locusts in Kentucky. 2. The Bud-worm of Tobacco. March, 1894.
* 50. 1. Fruit Growing in Kentucky. 2. Notes upon Vegetables. April, 1894.
* 51. Commercial Fertilizers. August, 1894.
* 52. Commercial Fertilizers. I. Official Analyses. 2. Analyses of Farmers' Samples and Samples Collected by Deputy Inspectors. December, 1894.
* 53. 1. Spraying for Codling Moth. 2. The Use of Arsenites on Tobacco. 3. The Use of Bisulphide of Carbon and Hydrocyanic Acid Gas on Low-growing Plants. December, 1894.
* 54. Notes on Vegetables. March, 1895.
* 55. Field Experiments with Fertilizers. 1. Corn. 2. Potatoes. 3. Tobacco. 4. Hemp. April, 1895.
* 56. Analyses of Commercial Fertilizers. August, 1895.
* 57. 1. Wheat Experiments. 2. Oat Experiments. September, 1895.
* 58. Cutworms in Kentucky. November, 1895.
* 59. Spraying Experiments in 1895. December, 1895.
60. Analyses of Commercial Fertilizers. 1. Official Analyses. 2. Analyses of Farmers' and Inspectors' Samples. December, 1895.
* 61. Potatoes. 1. Experiments with Fertilizers. 2. Insects and Fungus Pests. 3. Tests of Varieties. March, 1896.
* 62. Strawberries. March, 1896.
* 63. Tobacco. May, 1896.
64. Analyses of Commercial Fertilizers. July, 1896.
65. Analyses of Commercial Fertilizers. 1. Official Analyses. 2. Analyses of Other Samples. December, 1896.
* 66. Tobacco. February, 1897.
* 67. The San Jose Scale in Kentucky. May, 1897.
* 68. Analyses of Commercial Fertilizers. May, 1897.
* 69. Wheat. 1. Test of Varieties. 2. Test of Fertilizers. 3. Description of Varieties. 4. Treatment for Smut. September, 1897.
* 70. 1. The Woolly Mullein. 2. The Gape Disease of Poultry. December, 1897.
71. Analyses of Commercial Fertilizers. 1. Official. 2. Analyses of other Samples. December, 1897.
* 72. Potatoes. 1. Experiments with Fertilizers. 2. Corrosive Sublimate and Sulphur for Potato Scab in 1896. 3. Corrosive Sublimate for Potato Scab in 1897. February, 1898.
* 73. Strawberries. February, 1898.
* 74. 1. The Chinch-bug. 2. Earthworms a Source of Gapes in Poultry. May, 1898.
75. Commercial Fertilizers. June, 1898.
76. Commercial Fertilizers. August, 1898.

* 77. Wheat. 1. Test of Varieties. 2. Test of Fertilizers. 3. Notes and Descriptions. 4. Red Rust of Wheat. September, 1898.
* 78. Ginseng, Its Nature and Culture. November, 1898.
79. Commercial Fertilizers. December, 1898.
* 80. 1. Some Pests Likely to be Disseminated from Nurseries. 2. The Nursery Inspection Law. March 1899.
* 81. 1. Method of Avoiding Lettuce Rot. 2. Potato Scab Experiments. March, 1899.
82. Commercial Fertilizers. July, 1899.
* 83. Wheat. Experiments with Fertilizers. Variety Tests. Notes and Descriptions. August, 1899.
84. The Elms and Their Diseases. November, 1899.
* 85. Commercial Fertilizers. December, 1899.
* 86. Inspection and Analyses of Foods. January, 1900.
* 87. Kentucky Forage Plants—The Grasses. Analyses of some Kentucky Grasses. May, 1900.
88. Commercial Fertilizers. August, 1900.
* 89. Wheat. Test of Varieties. Test of Fertilizers. Descriptions of Varieties. September, 1900.
* 90. Commercial Fertilizers. December, 1900.
* 91. 1. Enemies of Cucumbers and Related Plants. 2. Experiments with Potato Scab. 3. Food of the Toad. March, 1901.
* 92. Grapes. April, 1901.
* 93. 1. Diseases of Nursery Stock. 2. Rabbits and Their Injuries to Young Trees. June, 1901.
* 94. Wheat. 1. Tests of Varieties. 2. Description of Varieties. September, 1901.
95. Commercial Fertilizers. September, 1901.
* 96. 1. The Hessian Fly. 2. Dangerous Mosquitoes in Kentucky. 3. Poisonous and Edible Mushrooms. November, 1901.
97. Commercial Fertilizers. December, 1901.
* 98. 1. Kentucky Forage Plants—The Clovers and Their Allies. 2. Notes on True Grasses in the Plots in 1900-1901. 3. Analyses of Forage Plants from the Plots. February, 1902.
* 99. Oats. 1. Test of Varieties. 2. Treatment for Smut. 3. Test of Fertilizers. 4. Relative Value of the Varieties for Feeding. April 1902.
100. Inspection and Analyses of Foods. February, 1902.
*101. A Comparison of Feeds for Pigs. May, 1902.
102. Commercial Fertilizers. September, 1902.
*103. Hessian Fly Experiments. December, 1902.
104. Commercial Fertilizers. December, 1902.
*105. The Broom-rapes. March 1903.
*106. Feeding Dairy Cows. April, 1903.
*107. Seventeen-Year Locusts in Kentucky. May, 1903.
*108. Some Results in Steer Feeding. July, 1903.
109. Commercial Fertilizers. September, 1903.
*110. Nursery Inspection and San Jose Scale. December, 1903.
*111. The Hessian Fly in 1902-1903. December, 1903.
112. Commercial Fertilizers. December, 1903.
*113. Protein Content of the Wheat Kernel. February, 1904.
*114. Insects Injurious to Cabbage. June, 1904.
*115. Wheat. Field Tests of Varieties. September, 1904.
*116. 1. On an Injury to Fruits by Insects and Birds. 2. The Apple Tree Measuring Worm. 3. The Fall Beauty, A New Apple. December, 1904.

117. Commercial Fertilizers. December, 1904.
118. Corn. Field Tests. March, 1905.
119. Labels on Adulterated and Imitation Foods Sold in Kentucky. April, 1905.
*120. 1. Some Tree-and Wood-Infesting Insects. 2. Cabbage Snakes. May, 1905.
121. Commercial Fertilizers. August, 1905.
*122. Corn. Method of Selecting Seed Corn; A Chemical Study of the Composition of a Number of Varieties of Kentucky Corn. December, 1905.
123. Commercial Fertilizers. December, 1905.
*124. On the Adulterants and Weed Seeds in Kentucky Samples of Bluegrass, Orchard grass, Timothy, Red Clover and Alfalfa Seeds. March, 1906.
*125. Observations and Experiments on Clover, Alfalfa and Soy Beans. March, 1906.
126. Soils. 1. Methods and Uses of Soil Analysis; 2. Analyses of Soils in 1904-05. 3. On the Determination of Humus in Soils. April, 1906.
127. The Inspection of Seeds under the Kentucky Pure Seed Law. September, 1906.
128. Commercial Fertilizers. December, 1906.
*129. Tobacco. 1. Selection of Seed Plants and Care of Seed. 2. Improved Methods of Handling the Crop. 3. Elimination of Undesirable Varieties.
130. 1. The Food of the Crow Blackbird. 2. The Corn Root-Worms. June, 1907.
131. Concentrated Commercial Feeding Stuffs. 1. Operation of the Feeding Stuffs Law. 2. Analyses of Inspectors' Samples. 3. Registration for 1907. December, 1907.
132. Commercial Fertilizers. December, 1907.
*133. 1. Spraying Apple Trees. 2. Apple Orchard Pests in Kentucky. January, 1908.
134. Milk Supply of Kentucky—Louisville. February, 1908.
*135. Wheat. 1. Test of Varieties. 2. Chemical Study of Varieties. June, 1908.
136. Commercial Fertilizers. September, 1908.
137. The Army Worm. December, 1908.
138. Commercial Fertilizers. December, 1908.
139. Tobacco. 1. Cultivation. 2. Curing. 3. Marketing. January, 1909.
*140. 1. How to Purchase and Use Commercial Fertilizers. 2. Sources of Fertilizing Materials. 3. Care of Farm Manures. 4. Green Manure Crops. March, 1909.
*141. Concentrated Commercial Feeding Stuffs. 1. General Discussion. 2. Discussion of Results. 3. Analyses of Inspectors' Samples. 4. Analyses of Forage Plants and Hays. March, 1909.
142. Carnation Root-Knot. April, 1909.
*143. Sheep Scab. May, 1909.
144. Information on Food and Drug Inspection and Investigation. November, 1909.
145. 1. Some Lessons from the Corn Shows. 2. Corn Pests. December, 1909.
146. Commercial Fertilizers. December, 1909.
*147. Common Insecticides and Fungicides with Directions for Treatment of Farm Pests. March, 1910.
148. 1. Seed Testing Apparatus. 2. Study of Conditions under which our Germination Tests are Made. May, 1910.

149. Bleached Flour. September, 1910.
150. The Preservation of Drugs. September, 1910.
151. An Outbreak of Gadflies in Kentucky. October, 1910.
152. Commercial Fertilizers. December, 1910.
*153. Boys' Corn Clubs and Improved Methods of Corn Growing. March, 1911.
*154. Blowing Stumps with Dynamite. June, 1911.
*155. Wheat. 1. Variety Tests. 2. Cultural Directions. 3. Treatment of Diseases. July, 1911.
156. Concentrated Commercial Feeding Stuffs. August, 1911.
157. The Dipping of Sheep for Scabies in Tobacco Dips with and without the Addition of Flowers of Sulphur. September, 1911.
158. Commercial Fertilizers. December, 1911.
159. A Preliminary Study of Kentucky Localities in which Pellagra is Prevalent. January, 1912.
160. Parturient Paresis (Milk Fever) and Eclampsia; and the Internal Secretion of the Mammae as a Factor in the Onset of Labor. February, 1912.
*161. Soy Beans. February, 1912.
162. The Soils of Webster County. March, 1912.
*163. Corn Production. March, 1912.
164. The Catalpas and Their Allies. February, 1912.
165. Investigations of the Etiology of Infectious Abortion of Cows and Mares. April, 1912.
166. The Diagnosis of Infectious Abortion in Cattle. June, 1912.
167. Forage Poisoning in Stock. September, 1912.
168. Commercial Fertilizers. December, 1912.
169. The Woody Plants of Kentucky. January, 1913.
170. Concentrated Commercial Feeding Stuffs. January, 1913.
171. Part 1. Feeding Dairy Cows. Part 2. Experiments in Feeding Cows and Calves. April, 1913.
172. Fumigation and Spraying. May, 1913.
173. The Municipal Abattoir. August, 1913.
174. The Sulphur Content of Some Typical Kentucky Soils. September, 1913.
175. The Growing and Fattening of Hogs in the Dry Lot and on Forage Crops. October, 1913.
176. 1. Jack Stock of Kentucky. 2. Rearing of Mules. 3. Brood Mares for Producing Mules. 4. Experiments in Feeding Mules. November, 1913.
177. Commercial Fertilizers. December, 1913. (In Press.)
178. Alfalfa and Sweet Clover. March, 1914.
179. Construction and Equipment of Dairy Barns. June, 1914.
180. The Inheritance of Coat Colors in Horses. July, 1914.
181. 1. Suggestions Relative to the Prevention of Hog Cholera. 2. List of Publications of the Kentucky Agricultural Experiment Station. August, 1914.

CIRCULARS.

(Agricultural Extension.)

No.
* 1. Soil Fertility—George Roberts.
* 2. Alfalfa—E. J. Kinney.
* 3. Silo Facts—A. J. Reed.
4. Making Wheat Growing More Profitable in the Bluegrass—E. J. Kinney.

5. Survey of Beef Cattle Feeding in Kentucky—J. J. Hooper.
6. Orchard Spray Calendar—J. H. Carmody.
7. Crimson Clover—E. J. Kinney.
8. Alfalfa (Reprint)—E. J. Kinney.
9. Sweet Clover or Melilotus—E. J. Kinney.
10. Hairy or Winter Vetch—E. J. Kinney.
11. Soil Fertility (Reprint)—George Roberts.
12. A Malignant Catarrhal Fever of Horses and Mules—Robert Graham.
13. Poultry Raising in Kentucky—J. J. Hooper.
14. Anti-Hog Cholera Serum—E. S. Good and Robert Graham.
15. Methods Practiced at the Kentucky Agricultural Experiment Station Dairy—J. W. Nutter.
16. The Agricultural Needs of Kentucky—J. N. Camden, H. Weissenger and H. M. Froman.
17. Economic Value and the Future of the Thoroughbred Horse—J. N. Camden.
18. Silo Building—W. D. Nicholls.
19. Community Improvement Clubs—C. D. Bohannan.
20. Malignant Catarrhal Fever of Cattle—Robert Graham, E. W. Mumma and R. L. Pontius.
21. Black Leg and Its Prevention by Means of Protective Vaccination—Robert Graham and E. W. Mumma.
22. The Meaning and Value of Soil Analysis—George Roberts.
23. Immune Hogs and Distillery By-Products—Robert Graham and E. S. Good.
24. Orchard Spray Calendar—J. H. Carmody.
25. Poultry Raising in Kentucky—J. J. Hooper and D. D. Slade.
26. Varieties of Fruits for Kentucky—C. W. Mathews and J. H. Carmody.

NEWSPAPER BULLETINS.

(Agricultural Extension.)

No.

* 1. When to Spray and What to Use.
* 2. Soy Beans.
* 3. Forage Crops in Kentucky.
* 4. Summer Course in Agriculture.
* 5. Catch Crops and Cover Crops.
* 6. Summer Care of Orchards.
* 7. The Farm Dairy.
8. Alfalfa.
* 9. Selecting and Caring for Seed Corn.
10. Home Buttermaking.
11. Smuts of Wheat and the Hessian Fly.
12. Rye as a Cover Crop.
* 13. Hog Cholera.
* 14. Forestry for the School and Farm (1)
15. Forestry for the School and Farm (2)
* 16. Bread Making.
* 17. Care of Farm Machinery.
18. Short Courses in Agriculture.
* 19. Feeding Dairy Cows.
* 20. Pneumonia in Swine.
* 21. Lessons Derived from Kentucky Dairy Show.
22. Agricultural Extension.
* 23. Fatal Disease Caused by Spoiled Corn and Roughage.
24. Securing Good Seeds.

* 25. Orchard Pruning.
26. The Farm Special Train.
27. Lime for Agricultural Purposes.
28. Distribution of Anti-Hog Cholera Serum in Kentucky.
29. Legume Crops and the Nitrogen Supply.
30. Swine.
31. Improving Wheat Varieties.
32. Dodder in Clover.
33. Preventing the Souring of Milk in Hot Weather.
34. Bread Making.
35. Concrete Silos Popular in Kentucky.
36. The "White Fungus" as a Means of Destroying the Chinch-Bug in Cornfields.
37. Dairy Farming.
38. Infectious Abortion of Cows.
39. Timely Seed Corn Hints.
40. The Fall Army Worm Injuring Alfalfa and Rye in Kentucky.
41. Free Seed Testing for Kentucky.
42. Mycotic Stomatitis.
43. Disposal of Dead Hogs.
44. Farmers' Week and Agricultural Short Courses.
45. Assistance for Kentucky Orchardists.
46. Starting the Dairy Herd.
47. Distribution of Farm Labor.
48. San Jose Scale in Kentucky.
49. Soil Fertility and Farm Management Problems.
50. Make the Home Orchard Produce this Year.
51. Rape.
52. Codling Moth.
53. Difficult Churning.
54. Preparation, Planting and Cultivation of the Corn Field.
55. Summer Courses in Agriculture.
56. Rearing of Chicks.
57. Pear Blight.
58. Agricultural Extension in Kentucky.
59. Lubrication of Farm Machinery.
60. Raising of Calves on Skimmed Milk.
61. Agricultural Extension and the Rural Community.
62. Selecting the Milk Cow.
63. Cover Crops.
64. Getting the Most out of Farm Manure.
65. Seasonable Suggestions on Seed Corn.
66. Starting an Apple Orchard.
67. A Promise of Relief from the Injuries of the Destructive San Jose Scale.
68. Care of Farm Machinery.
69. Farmers' Week at the Agricultural College.
70. Subsoiling.
* 71. Rejuvenating the Old Orchard.
72. Alfalfa in Kentucky.
73. The Place of Agriculture in Kentucky Schools.
74. Paint for the Farm.
75. Pruning Grape Vines.
76. Forage Poisoning Threatens to Cause Heavy Losses in Outbreaks among Horses and Mules.
77. Pruning Fruit Trees.
78. The Treatment of Hog Cholera.

79. Protection Against "Wormy" Fruit.
80. A New Live Stock Exchange.
81. Treatment for Cutworms and Flea Beetles in Tobacco Beds.
82. How to Avoid Potato Scab and Dry Rot.
83. Fire Blight or Pear Blight.
84. Lime for Agricultural Purposes.
85. The Elm Trees About Kentucky in Danger from the Imported Leaf Beetle.
86. Hog Cholera Prevalent in Kentucky.
87. Needs of the Kentucky Live Stock Exchange.
88. Some Facts in Regard to Crimson Clover.

REPORTS.

*First Annual Report, 1888.
Second Annual Report, 1889.
Third Annual Report, 1890.
Fourth Annual Report, 1891.
Fifth Annual Report, 1892.
Sixth Annual Report, 1893.
Seventh Annual Report, 1894.
*Eighth Annual Report, 1895.
Ninth Annual Report, 1896.
*Tenth Annual Report, 1897.
Eleventh Annual Report, 1898.
Twelfth Annual Report, 1899.
Thirteenth Annual Report, 1900.
Fourteenth Annual Report, 1901.
Fifteenth Annual Report, 1902.
Sixteenth Annual Report, 1903.
Seventeenth Annual Report, 1904.
Eighteenth Annual Report, 1905.
Nineteenth Annual Report, 1906.
Twentieth Annual Report, 1907.
Twenty-First Annual Report, 1908.
Twenty-Second Annual Report, 1909.
Twenty-Third Annual Report, 1910.
Twenty-Fourth Annual Report, 1911.
Twenty-Fifth Annual Report, 1912. In Press.
Twenty-Sixth Annual Report, 1913. In Press.
Biennial Report, 1911-1913.

MISCELLANEOUS PUBLICATIONS.
(Agricultural Extension.)

Hand Book for Agricultural Clubs. March, 1912.
More and Better Wheat for Central Kentucky. Joseph H. Kastle. August, 1913.

LIST OF PUBLICATIONS OF THE FOOD AND DRUG DEPARTMENT.

BULLETINS.

No.

* 86. Inspection and Analyses of Foods. January, 1900.

*100. Inspection and Analyses of Foods. February, 1902.

*119. Labels on Adulterated and Imitation Foods Sold in Kentucky. April 15, 1905.

134. Milk Supply of Kentucky—Louisville. February, 1908.

144. Information on Food and Drug Inspection and Investigation. Guaranty Clause; Use of Artificial Color; Bleached Flour; Watered Oysters; Old Stock; The Use of the Word Approximately Decision of the Bureau of Internal Revenue with Respect to the Purchase of Alcoholic and Other Liquors for Analysis under the State Food and Drugs Act; Labeling of Drugs Retailed from the Original Packages; General Information Regarding Drug Inspection. November 20, 1909.

149. Bleached Flour. September 1, 1910.

150. The Preservation of Drugs. September 25, 1910.

173. The Municipal Abattoir. August 1, 1913.

CIRCULARS.

*Circular of Information Regarding the Kentucky Pure Food Law: Antiseptics, Baking Powder, Butter, Butterine or Oleomargarine, Cheese, Coffee, Candy, Cider, Flour, Fruit Jellies, Butters, Preserves, Canned Fruits, Fruit Conserves, Confections, Fruit Juices and Syrups, Honey, Lard, Milk, Molasses and Syrups, Olive Oil, Spices, Mustard, Pepper, etc., Tea, Vinegar. June 21, 1898.

*Circular of Information Regarding the Kentucky Pure Food Law: Adulterations, Antiseptics, Butter, Candy, Cheese, Cider, Coffee, Cream, Flour, Fruit Jellies, Butters, Preserves, Canned Fruits, Conserves, Confections, Fruit Juices and Syrups, etc., Guaranty of Purity, Honey, Labeling, Lard, Milk, Mince Meat, Molasses and Syrups, Oleomargarine, Olive Oil, Spices, Mustard, Pepper, etc., Tea, Vinegar. July 19, 1900.

*Circular to Grocers as to Sale and Labeling of Stock.

*Circular to Grocers with respect to Co-operation, and Form of Guaranty.

*Circular to Dealers: Form of Guaranty and other Information. April 30, 1902.

*Circular: Soda Fountain Syrups, Pops, Ciders, Grape Juices, etc. 1906.

*Circular to Dairymen, the Inspection of Whose Plants Appears in Bulletin 134. January 8, 1907.

*Circular to Dairymen, the Inspection of Whose Plants Appears in Bulletin 134. May 29, 1907.

*Circular to Dairymen in Covington and Newport and Vicinity. May 30, 1907.

*Circular to Kentucky Creameries. January 10, 1908.

*Circular for the Information and Guidance of the Manufacturers of and Dealers in Baking Powder, and Others Concerned. November 17, 1908.

*Circular for the Information and Guidance of the Manufacturers of and Dealers in Vinegars, and Others Concerned. December 8, 1908.

Rules and Regulations for the Enforcement of the Sections Pertaining to Drugs in the "Act for Preventing the Manufacture and Sale of Adulterated or Misbranded Foods, Drugs, Medicines and Liquors, and Providing Penalties for Violations Thereof," Passed by the Kentucky Legislature of 1908 and Approved March 13, 1908.

*Circular to Druggists: Information with Respect to Section 6, Paragraph 3 of Food and Drugs Act. Substitution; Rule 3,—Distinctive Tests for Identification of Purity and Strength of Products. May 5, 1909.

*Circular for the Information and Guidance of the Manufacturers of and Dealers in Bleached Flour, and Others Concerned. June 8, 1909.

Circular Requesting Opinion of Physicians as to the Use of Benzoic Acid in Foods. July 30, 1909.

*Circular to Owners of Plants, Notifying them of the Sanitary Inspection, and Asking for Statement to be Published with same. November, 1909.

*Circular to Manufacturers of Alcoholic Beverages, Requesting them to File their Labeling under Section 12 of the Act. December, 1909.

Food Inspection Regulation 7.—Bakeries, Bakery Supplies, and Bakers' Products. January 1, 1910. (Re-Issued June 15, 1914.)

Poster Bulletin 1.—(The above printed on poster, in German and English.)

*Circular to Kentucky Millers, Requesting Information about Bleached Flour. May 13, 1910.

*Circular requesting Information about Soda Fountains. May 28, 1910.

Circular to Druggists Concerning Old Stock "Patents." 1910.

*Circular to Kentucky Bakers. 1910.

*Circular to Kentucky Bakers. 1910.

*Circular to Kentucky Retail, Wholesale, and Manufacturing Druggists with Respect to School for Druggists. March 8, 1911.

*Circular to Kentucky Retail, Wholesale, and Manufacturing Druggists with Respect to School for Druggists. May 11, 1911.

Kentucky Notices of Adulteration or Misbranding, Vol. 1, Cases 5001-5117. October 1, 1911.

*Circular to Patent and Proprietary Medicine Firms, Requesting them to File Their Labels under Section 12 of the Act. September 30, 1911.

*Circular to Flavoring Extract Manufacturers, Requesting Them to File Their Labels under Section 12 of the Act. October 1, 1911.

*Circular to Patent and Proprietary Medicine Firms, Requesting Them to File Their Advertising Copy under Section 12 of the Act. 1911.

Circular to Retail Grocers of Kentucky: Dried Fruits Bleached with Sulphur, Artificial Vinegar, Lard Substitutes, Rice, the Labeling when Polished and Coated, Labeling Required to be Plain, Oleomargarine and Process Butter, Meats, Poultry, and Fish, Fresh and Cold Storage, Care of Ice Boxes, Sanitary Handling of Bread and other Bakery Products, Labeling to Show Artificial Ingredients in Bakery Products, Oysters, Watering and Insanitary Methods, Storage and Unsound Eggs, Misbranding and Misrepresentation as to Weight and Measure, Guaranty of Purity, Plan of Inspection. January 30, 1912. (Re-issued May 1, 1914.)

Kentucky Notices of Adulteration or Misbranding, Vol. 1, Cases 5118-5249. March 1, 1912.

Circular,—Co-operative Work on U. S. P. Preparations. June 18, 1912.

Circular,—The Manufacture and Keeping of Aromatic Spirit Ammonia and Sweet Spirit of Nitre. June 18, 1912.

Circular to Dairymen and Milk Dealers: The Dairy Score Card, Plans for and Costs of Dairy Equipment, Bacteriological Examinations, Skimming and Watering, Unclean Dairies, Delivery from Wagon Cans on Streets, Co-operation, Milk Dealers, Hotels and Restaurants. August 1, 1912.

Circular to Citizens of the State: Analysis of Sample Sent in; Information as to Whether Any Product is Adulterated or Misbranded; Assist Cities and Towns in Sanitary Surveys; Assist Taechers, Woman's Clubs, etc., Liniments, Paris Green, etc., Proper Items of Equipment for Bottlers, Dairymen, etc., Plan of Work, Instructions to Consumers. 1912.

Food Inspection Regulation 8.—Sanitary Regulation of the Killing, Handling, and Sale of Meat and Meat Products. July 1, 1913.

*Circulars to Mayors, Boards of Health, and Health Officers of Kentucky: Co-operation in Milk Inspection Work during Summer Months. July 7, 1913.

Poster Bulletin 2.—Bad Eggs and the Kentucky Pure Food Law. September 1, 1913.

Circular of Information to Pop Bottlers: Use of Saccharin, Proper Labeling, Re-use of Crown Corks, Old Style Rubber Stopper, Proper Method of Washing Bottles, Use of Contaminated Water, Danger of Lead Poisoning. September 15, 1913.

*Circular to Kentucky Master Bakers: As to Use and Opening of Experimental Bakery. October 15, 1913.

Circular to Druggists: Variations in Elixir Iron, Quinine and Strychnine, Phosphates, etc. March 1, 1914.

Circular to Commission Merchants, Retail Grocers, Produce Dealers, and Producers, Kentucky Egg Supply. March 1, 1914.

Circular to Kentucky Pharmacists: U. S. P., 8th Revision, Weights and Measures, Manufacturing and Storage of Products. May 1, 1914.

Circular to the Kentucky Millers: Submit Samples of Flour for Free Baking Test. May 25, 1914.

Circular to Kentucky Bakers: Submit Samples of Flour for Free Baking Test. May 25, 1914.

Circular to Health Officers of Kentucky: Information as to How They May Bring Prosecution, Under the Kentucky Food and Drugs Act, For Insanitary Conditions. July 28, 1914.

REPORTS.

*First Report. (Bulletin 86.)—The Inspection and Analysis of Foods. January 1, 1900.

Second Report of the Kentucky Agricultural Experiment Station on Adulterated Food Products, to the Governor of Kentucky. January 31, 1902.

Report of the Kentucky Agricultural Experiment Station to the Governor of Kentucky on the Enforcement of the Pure Food Law. 1905.

Report of the Director on the Enforcement of the Food and Drugs Act for the Years 1908 and 1909. February 23, 1910.

Report of the Kentucky Agricultural Experiment Station on the Enforcement of the Food and Drugs Act for the Years 1910 and 1911. March 1, 1912.

Report to the Governor and Legislature on Food and Drug Control Work, July 1, 1911, to June 30, 1913.—Seventh Biennial Report. December 9, 1913.

Kentucky
Agricultural Experiment Station
State University, Lexington, Kentucky

BULLETIN NO. 182

Hog Cholera and Its Control

BY

ROBERT GRAHAM and E. W. MUMMA



STATE UNIVERSITY PRESS
LEXINGTON, KY.
August, 1914

KENTUCKY AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

RICHARD C. STOLL, Chairman, Lexington, Ky.
CHARLES B. NICHOLS, Lexington, Ky.
LEWIS L. WALKER, Lancaster, Ky.
HENRY S. BARKER, President of the University.
THE DIRECTOR, Secretary, ex-officio.

JOSEPH H. KASTLE, Director.

STATION COUNCIL

THE DIRECTOR

A. M. PETER
H. E. CURTIS
H. GARMAN
C. W. MATHEWS
R. M. ALLEN
J. D. TURNER
E. S. GOOD
GEORGE ROBERTS
J. J. HOOPER

DEPARTMENTAL ORGANIZATION

ADMINISTRATION

THE DIRECTOR, Head.
H. E. CURTIS, Bursar.
HYWEL DAVIES, Purchasing Agent.
O. L. GINOCHIO, Secretary to Director.
ADDIE LEE DEAN, Librarian.
ANNA WALLIS, Clerk.
CORNELIA C. PAGE, Clerk.

AGRONOMY.

GEORGE ROBERTS, Agronomist, Head.
E. J. KINNEY, Assistant Agronomist.
S. C. JONES, Soil Survey.
A. E. EWAN, Supt. Experiment Fields.
JESSIE F. CASWALL, Clerk.

ANIMAL HUSBANDRY

(Beef Cattle, Sheep and Swine)

E. S. GOOD, Head.
ROBERT GRAHAM, Veterinary Science, In Charge Hog Cholera Serum Production.
E. W. MUMMA, Asst. In Charge Hog Cholera Serum Production.
O. S. CRISLER, Hog Cholera Serum.
R. L. PONTIUS, Hog Cholera Serum.
W. V. SMITH, Asst. in Animal Husbandry.
M. G. GINOCHIO, Clerk.
C. B. WILSON, Hog Cholera Serum.
LAWRENCE GINOCHIO, Clerk.
E. J. GOTT, Hog Cholera Serum.

ANIMAL HUSBANDRY

(Dairy Cattle, Horses and Poultry)

J. J. HOOPER, Head.
W. S. ANDERSON, Asst. Horse Husb'd.
J. W. NUTTER, Supt. Dairy Farm.
W. D. NICHOLLS, Asst. Dairying.
D. D. SLADE, Supt. Poultry Farm.
P. E. BACON, Elmendorf Milk Records.
F. WALLACE UTTERBACK, Clerk.

CHEMISTRY

A. M. PETER, Chief Chemist, Head.
S. D. AVERITT, Chemist.
J. S. McHARGUE, Asst. Chemist.
R. PFANSTIEL, Asst. Chemist.
ETHEL V. T. CASWALL, Clerk.

ENTOMOLOGY AND BOTANY

H. GARMAN, Entomologist and Botanist, Head.
MARY L. DIDLAKE, Laboratory Asst.
E. C. VAUGHN, Asst. in Seed Inspection and Plant Breeding.
H. H. JEWETT, Research Asst. Entom.
H. R. NISWONGER, Asst. in Field Work and Nursery Inspection.
LOUISE BEWLAY, Clerk.

FEED

J. D. TURNER, Head.
H. D. SPEARS, Chemist.
E. H. NOLLAU, Asst. Chemist.
ELMER INGRAM, Chief Inspector.
ROGER W. JONES, Inspector.
FANNY C. ROGERS, Clerk.

FERTILIZER

H. E. CURTIS, Chemist, Head.
B. D. WILSON, Assistant Chemist.
WM. RODES, Assistant Chemist.
ELMER INGRAM, Inspector.
R. W. JONES, Inspector.
ANNA WALLIS, Clerk.

FOOD AND DRUGS

R. M. ALLEN, Head.
J. O. LaBACH, Chief Chemist.
L. A. BROWN, Chemist, Drugs.
J. W. McFARLIN, Chief Food Inspector.
W. R. PINNELL, Bacteriologist.
C. S. PORTER, Inspector, Drugs.
WALTER SCHEPPELMAN, Inspector, Bakery Sanitation.
E. F. WORTHINGTON, Inspector, Dairy Sanitation.
W. G. TERRELL, Inspector, Foods.
LILLIE LISTON, Chief Clerk.
LENA LISTON, Clerk.

HORTICULTURE

CLARENCE W. MATHEWS, Head.
F. W. HOFMANN, Asst. in Horticulture.
G. B. WURTZ, Consulting Meteorologist.
MURIEL CASWALL, Clerk.

RESEARCH

THE DIRECTOR, Head.
H. GARMAN, Entomologist and Botanist.
D. J. HEALY, Bacteriologist.
E. S. GOOD, Animal Husbandry.
O. M. SHEDD, Chemist.
MARY L. DIDLAKE, Asst. Entomologist and Botanist.
G. D. BUCKNER, Chemist.
H. H. JEWETT, Research Asst. in Entom.

Notice

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Director.

BULLETIN No. 182.

REVIEW OF THE HOG CHOLERA SERUM WORK AT THE KENTUCKY AGRICULTURAL EXPERIMENT STATION SINCE 1910.

In 1910 the General Assembly of Kentucky passed an act providing for the establishment at the Kentucky Agricultural Experiment Station of a plant for the production of serum and virus for the prevention of hog cholera, and appropriated the sum of two thousand dollars for this purpose. The small laboratory and equipment provided out of these funds proved entirely inadequate for the production of sufficient serum wherewith to combat this disease. Recognizing the further needs of the farmers of the State in this direction, the General Assembly of Kentucky, at its session in 1912, passed an act providing an annual appropriation of fifty thousand dollars to the Kentucky Agricultural Experiment Station, to be employed in part for enlarging the hog cholera serum laboratory, and for the production of hog cholera serum and virus in larger quantities, "said serum and virus to be furnished the farmers of the State at partial cost of production, and not to exceed one cent per cubic centimeter, and to be distributed through such channels as the Director of said Experiment Station may deem advisable for the protection of the swine interests of the State." The new serum laboratory, hyperimmune sheds and infection sheds, erected out of funds provided for in this second act, were completed in June, 1913. As may be seen from Plate No. 1 of this bulletin, the new serum laboratory is a two-story brick building. The first floor contains a general preparation room, in which the hogs are washed and weighed

(Plate 2); a large, commodious operating room, where the blood is drawn from the hyperimmunes (Plate 3); a room for the washing and sterilization of all instruments and utensils (Plate 4); and a room for the final preparation and bottling of the serum. The second story contains two offices for the veterinarians in charge, and a well-equipped pathological and bacteriological laboratory for the study and investigation of the diseases of farm animals. The basement contains two cold storage rooms in which the serum is stored; a room in which to mix the serum; a boxing and shipping room, and a room for the heating plant. The first floor and basement are made of reinforced concrete, and no pains have been spared to make this one of the most up-to-date hog cholera serum laboratories in the country. The hyperimmune sheds have a capacity of from three to five hundred hogs, depending on the size of the animals. (Plate 5).

The old serum laboratory has recently been enlarged and remodeled and converted into a separate virus house.

The following tabular statement will serve to give some idea of the growth and development of the work of hog cholera eradication at the Experiment Station since the inauguration of this work in 1910:

Serum Produced.

1911	287,814	cubic centimeters	
1912	1,036,435	" "	
1913	4,427,120	" "	
1914	1,322,221	" "	(To June 1st)
Total	7,073,590	cubic centimeters	

Number of Hogs Inoculated.

	Herds	Hogs	
1911	140	5,730	
1912	414	17,591	
1913	923	47,673	
1914	830	31,063	(To June 1st)
Total	2,307	102,057	

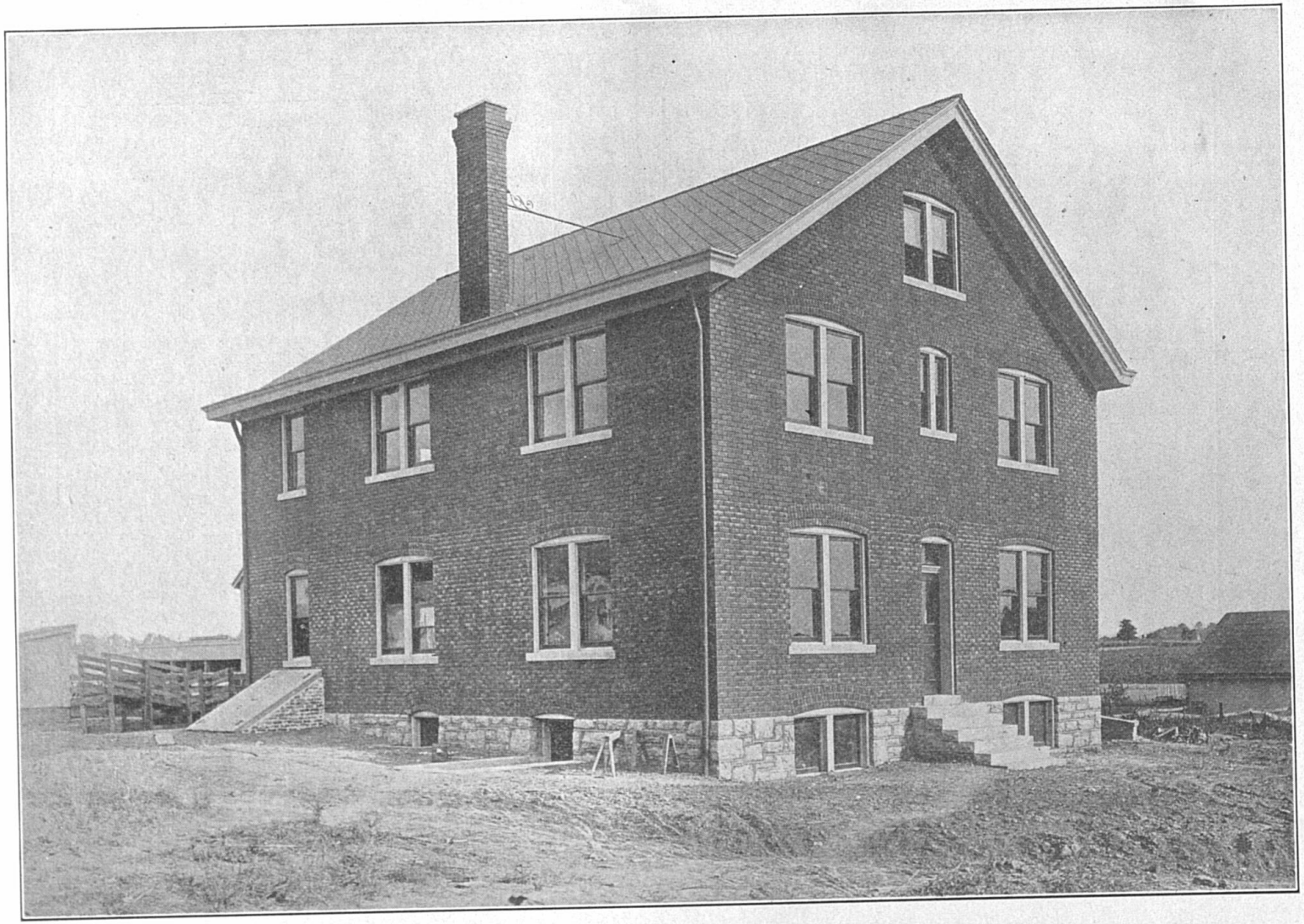


PLATE 1. New Serum Laboratory.

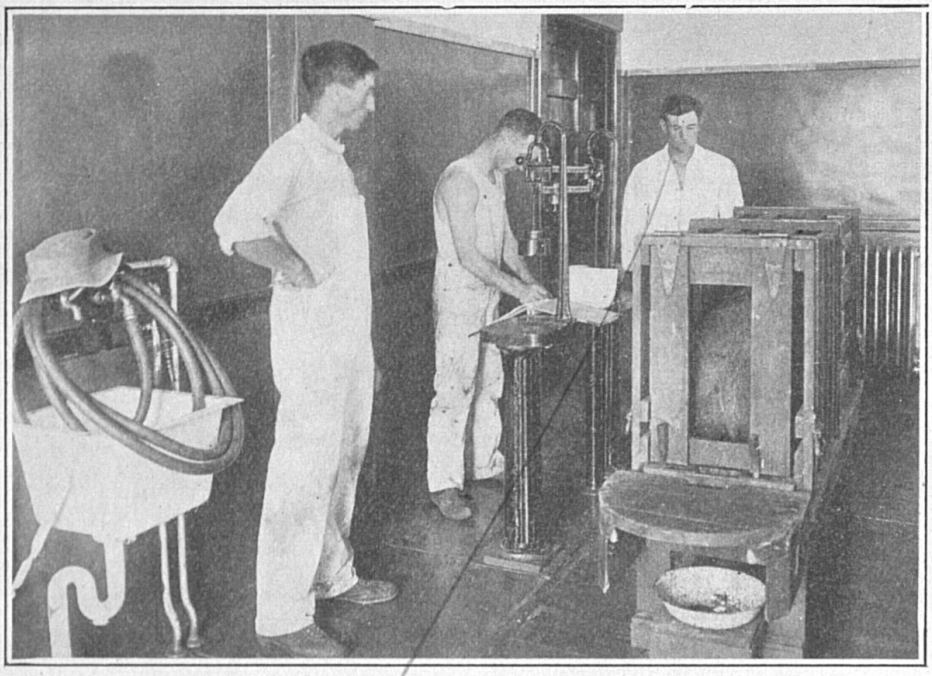


PLATE 2. Weighing and receiving room where each hyperimmune hog is weighed before being bled.

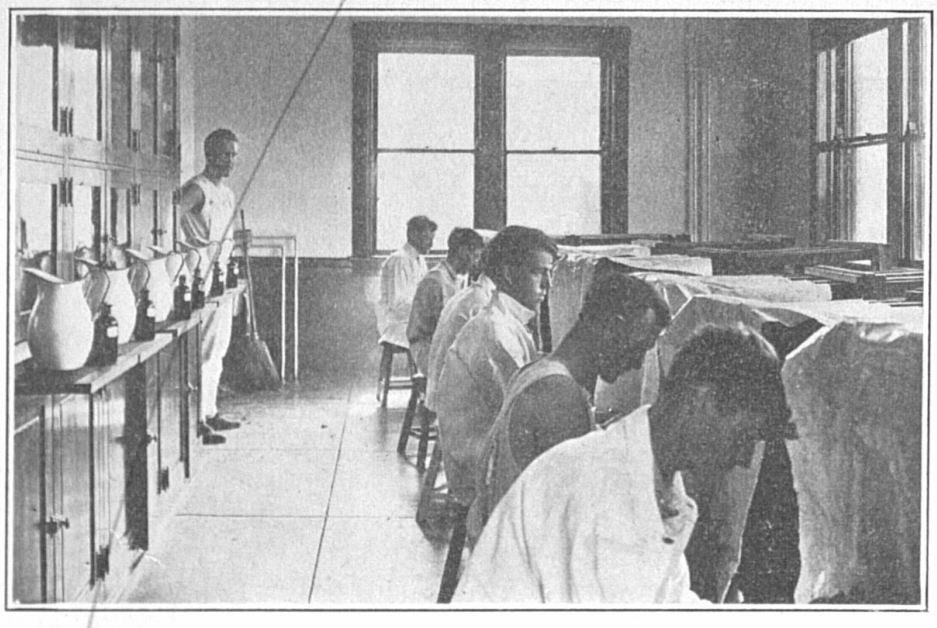


PLATE 3. Drawing immune serum from the tail.

Results.

	Lived		Died		
1911	88.2	per cent.	11.8	per cent.	
1912	91.2	per cent.	8.8	per cent.	
1913	90.2	per cent.	9.8	per cent.	
1914	91.8	per cent.	8.2	per cent.	(To June 1st)
Average	90.35	per cent.	9.65	per cent.	

Number of counties in which hog cholera serum has been used, 78.

It will be seen from the above that since the beginning of this work, upwards of seven million cubic centimeters of hog

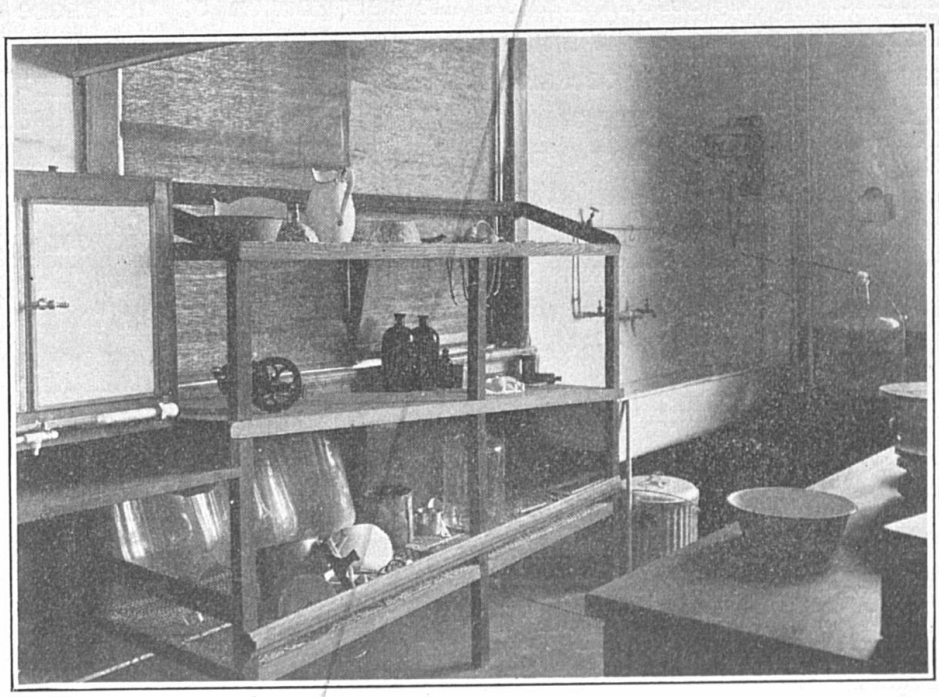


PLATE 4. Sterilizing room.

cholera serum have been produced at the serum laboratory, and that over one hundred thousand hogs have been treated with serum, with a saving of over 90 per cent. of the individual animals thus treated.

During the summer of 1912, the late Director of the Experiment Station, Dr. M. A. Scovell, placed four trained men in the field in different parts of the State, at the Station's expense, to inoculate hogs and to train veterinarians and

other competent persons in the proper administration of the serum and in the diagnosis of hog cholera. The result is that there are now located in various parts of the State, a considerable number of veterinarians and other competent persons who have been trained in the diagnosis of hog cholera and the administration of hog cholera serum. During the past year, practical demonstrations in the inoculation of hogs have been given by the veterinarians at the hog cholera serum laboratory. In this way a number of veterinarians and farmers have been trained in the use and proper administration of the serum, and in the recognition of the more important clinical signs and symptoms of hog cholera. It is proposed also to give occasional lectures and practical demonstrations on the care of hogs, disinfection after hog cholera, the disposal of hog cholera carcasses, etc., etc.

The object of this bulletin is to put in the hands of Kentucky farmers and hog raisers a reasonably clear and comprehensive account of this disease, in all of its phases. The eradication of hog cholera in this State, if it is ever to be accomplished, will require the earnest and intelligent co-operation of all concerned, and the observance by farmers and hog raisers of a few simple, prophylactic precautions, such as the maintenance of cleanly, sanitary conditions in the hog lot and hog house, vigorous disinfection following an outbreak of cholera and the proper isolation of sick and suspected animals. The burning of carcasses of hogs that have died of hog cholera, will materially aid the Experiment Station in the control and eradication of this highly contagious disease, and at the same time, it will materially benefit all engaged in the raising of hogs.

Except in so far as it contains statistics showing the growth and development of this work since it was first inaugurated by the Experiment Station, in 1910, this bulletin contains nothing new or original. As already indicated, it has for its object to give a general yet comprehensive account of this disease. Particular attention is called to the recommendations of the United States Department of Agriculture, relative to the maintenance, upon the farm, of

cleanly conditions, disinfection, the proper disposition of carcasses of dead hogs, etc., etc., as outlined in the proposed hog cholera clubs. With a little effort any man of average intelligence can put into practical operation the simple rules of hygiene therein laid down, respecting the prevention and control of this disease, and their careful observance will go a long way towards the eradication and control of the disease not only upon the single farm, but throughout the community and the State at large.

Those familiar with medical progress during the last half century know that ignorance, superstition, uncleanliness and disease go hand in hand, whereas a general understanding of the nature of disease, cleanliness and the observance of the laws of hygiene have gone far to promote healthful conditions generally, and to prevent and eradicate various infectious diseases. In many of our great cities to-day, vigorous educational campaigns are being conducted against such diseases as typhoid fever and tuberculosis, with the most beneficent results. We need, therefore, to inaugurate here in Kentucky, a campaign of education among farmers and hog raisers against hog cholera. It is with this object that this bulletin on the cause and nature of hog cholera has been prepared by Drs. Graham and Mumma.

JOSEPH H. KASTLE, Director,
Kentucky Agricultural Experiment Station.

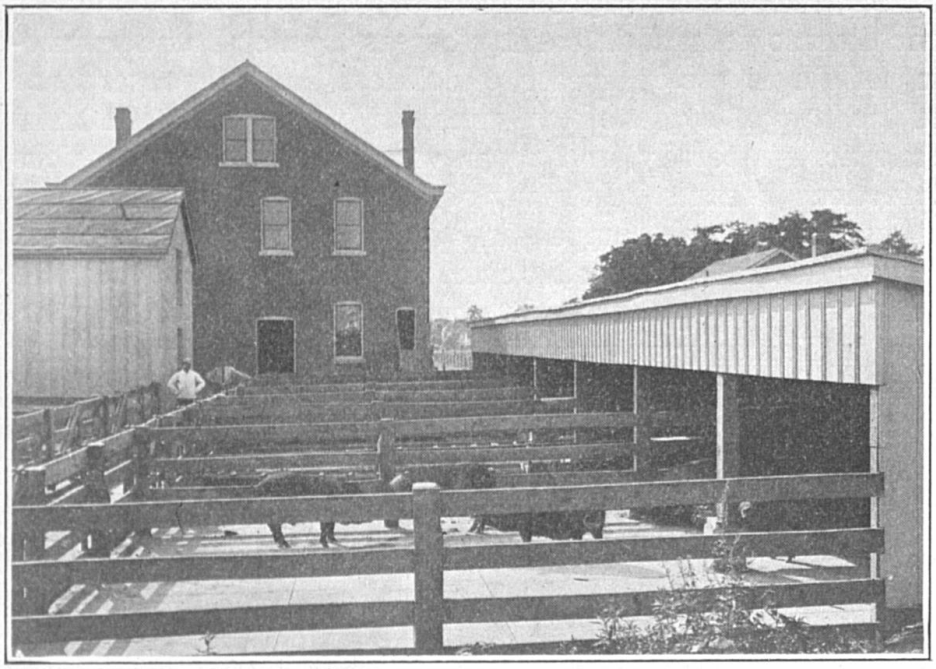


PLATE 5. One side of the hyperimmune shed at the rear of the serum laboratory.

HOG CHOLERA AND ITS CONTROL.

By Robert Graham and E. W. Mumma.

Hog cholera is not a new disease. It has existed for many years over large areas of the United States. The first outbreak was reported in Ohio in 1833 by the United States Bureau of Animal Industry. The disease was probably imported into Ohio with an European shipment of hogs, spreading thence throughout the states along the lines of commerce. Hog cholera has caused enormous losses to hog raisers. Dr. C. H. Stange, Director of the State Biological Laboratory of the Iowa State College, estimates the loss in Iowa in 1912 at thirteen million dollars. Dr. R. A. Craig, of Purdue University, LaFayette, Indiana, estimates the yearly losses in that State at approximately three million dollars. Kentucky loses annually approximately two million dollars as a direct result of this disease. The actual death loss, however, should not only be included in this figure, but also the loss from early shipment and marketing of the animals before they are mature in order to avoid the disease. Again, a great loss is sustained in pure bred herds which cannot be reckoned at the average market price of pork per pound. Thus, in 1912 the loss in Madison County, Kentucky, alone was estimated at from forty to fifty thousand dollars. Christian and Henderson Counties sustained even a heavier loss in the year 1913.

Hog cholera and swine plague are terms used interchangeably. These two diseases as well as pneumonia, often occur at the same time in the same herd, alone or simultaneously in the same animal. When swine plague occurs alone, losses are slight. A differential diagnosis is not practicable in the majority of cases. The diseases, however, are roughly dif-

ferentiated by naming one swine plague when the lesions predominate in the lungs, and hog cholera when intestinal lesions predominate. With reference to the two diseases, Dr. W. B. Niles, of the Government Experiment Station at Ames, Iowa, says:

> "My opinion is that while there is possibly a disease which we might term swine plague, it does not occur, at least alone, to such an extent as to cause serious loss in a herd. In fact, I do not believe that it needs to be taken into account. If it should occur in such an acute form as to cause loss I do not believe the serum we make would prevent it. My contention is that while there is a swine plague organism, it does not cause much trouble unless associated with hog cholera, and even then the hog cholera virus is so nearly responsible for the loss that the serum will prevent it."

The United States Department of Agriculture in a circular released February 6th, 1914, says in this regard:

> "Remember that hog cholera kills millions of hogs where other diseases kill thousands. Dismiss from your mind all thought of such diseases as 'lung plague,' 'infectious pneumonia,' 'pig typhoid,' etc., for these are generally merely fanciful designations given to hog cholera by uninformed men."

The discovery of the role played by the filtered virus of hog cholera in the development of the disease, caused considerable confusion in the classification of the infectious diseases of swine, in consequence of which a special committee on the nomenclature of swine diseases and their etiology was appointed by the United States Live Stock Sanitary Association. This committee, composed of Drs. Moore, Dorset and Mohler, submitted the following report in 1911:

> "1. Hog Cholera. The name hog cholera shall be given to the infectious communicable disease of swine occurring in epizootics, caused by a filterable virus. This disease is characterized by fever, loss of appetite, rapid emaciation, ulceration of the intestinal mucosa, usually diarhoea and ecchymoses or petechial hemorrhages in various organs and tissues, especially the kidneys and the skin on the ventral surface of the body.
>
> "2. Salmonellosis. The name salmonellosis shall be

given to the infectious disease of hogs (formerly described as hog cholera), possessing a low degree of contagiousness, caused by the Bacillus suispestifer (formerly Bacillus cholera suis), and scarcely distinguishable from hog cholera by the symptoms and post mortem lesions.

"3. Swine Plague. The name swine plague shall be given to the infectious disease of hogs occurring sporadically and enzootically, due to the Bacillus suisepticus. The disease is frequently associated with hog cholera, and produces somewhat similar lesions, but with a greater tendency to pneumonia and pleuritis.

"The name and etiological factors shall be as follows:

"For Hog cholera. A filterable virus until further information concerning it is recorded.

"For Salmonellosis. Bacillus suispestifer, Kruse (formerly known as Bacillus cholera suis).

"For Swine Plague. Bacterium suisepticus, Kruse (fomerly known as the bacillus of swine plague.)"

Hog cholera is characterized by its contagiousness and high death rate. It attacks swine in two forms, acute and chronic. The former is characterized by a sudden onset and rapid course in development, which terminates in the death of the animal. In the chronic form of the disease, the animal lingers for weeks and even months, with ultimately the same result. Although some hogs apparently recover from cholera, the setback from a severe attack of the disease usually makes them unprofitable animals for the herd. However, mild attacks with complete recovery produce an immunity to subsequent attacks of cholera. The so-called outbreaks of hog cholera with a loss of one or two animals in the herd are questionable, for if a correct diagnosis were made, some digestive disturbance or parasitic infection would invariably be found to be the cause of the trouble. The acute and chronic types of cholera are manifestly different, though the causative factor is the same in both cases. The type of the disease is determined by the virulency of the infection and the resisting powers of the hog. It is a well known fact, demonstrated in nearly every outbreak of hog cholera, that certain hogs of the same herd are more susceptible than others.

The lesions of the acute type may not be so well defined as those of the sub-acute or chronic type of the disease. Indeed, a carcass from the very acute type may not show sufficient lesions to permit the infection to be diagnosed as hog cholera. The lesions in the peracute type resemble very closely those of hemorrhagic septicemia. In the chronic type of the disease the intestinal lesions predominate, with circumscribed ulcers in any portion of the alimentary canal especially at the ileocaecal valve.* The latter is the most certain lesion of hog cholera and when found is sufficient evidence to determine the diagnosis of this disease. In general outbreaks the most acute type prevails at first, and is followed by the less acute or even the chronic form. The infection in being passed from one animal to another may gradually become weaker although in some herds every animal succumbs; in others a few may survive. The different types of the disease are often confusing to swine owners, and it should be borne in mind that hog cholera can be present with varied external symptoms.

The Cause.

In 1885, Salmon and Smith† of the Bureau of Animal Industry of the United States Department of Agriculture isolated a small motile bacillus from the tissues of cholera hogs. They designated this micro-organism the Bacillus cholera suis, because they considered it the primary cause of hog cholera. Their findings were confirmed by bacteriologists in this country and abroad, so that the etiolgy of hog cholera was thought to have been definitely established.

Working upon this assumption scientists have devoted their time for approximately twenty years to the discovery of a vaccine or serum to be used as a preventive, the Bacillus suispestifer (formerly called Bacillus cholera suis) being used as a working basis in these investigations. The vaccines and serums thus prepared, however, did not give satisfactory results as applied under ordinary farm conditions. It may be said that during the period of

*The union of large and small intestine.

†Report of the United States Department of Agriculture 1889.

twenty years following the discovery of the Bacillus suispestifer, little or no progress was made in combating the disease. During the course of experiments with the Bacillus suispestifer carried on by the Bureau of Animal Industry of the United States Department of Agriculture, it was noticed that hogs susceptible to real hog cholera did not contract the disease by association with hogs sick from inoculations with the Bacillus suispestifer. This opened a new field of research in the etiology of this disease and experiments were carried on demonstrating the following.

First. That the blood of cholera hogs, when injected into susceptible hogs, produces death with greater regularity than the Bacillus suispestifer.

Second. That after the hog cholera blood is passed through the Chamberland and Berkefeld filters to remove all micro-organisms, so far as the microscopical and cultura demonstrations are concerned, it still possesses the power to produce the disease.

Third. That the only reasonable explanation reached was that hog cholera is caused by an organism of such minute size and structure that it passed through the porcelain filter. Such organisms are referred to as filterable, infinitesimal, invisible and ultra-microscopic viruses. The following table by James Law* shows the relation of the cholera bacillus and the filterable virus in hog cholera, which is very interesting.

"The infinitesmal filterable hog cholera microbe.	Bacillus suispestifer.
1. Very contagious from pig to pig by simple exposure.	1. Not contagious by exposure.
2. Filtered injections subcutem constantly virulent, usually fatal.	2. Pure cultures injected subcutem, usually harmless to pig; deadly to rabbit and guinea pig.
3. Injections of blood subcutem, constantly virulent and fatal.	3. Injections of blood subcutem, usually harmless.
4. Intravenous injections of blood constantly virulent and fatal.	4. Blood intravenously virulent and fatal.
5. Cases that recover strongly immune.	5. Recovered cases show little immunity."

*Veterinary Medicine. Law, Vol. IV. p, 46.

The above table tends to prove that the filterable virus is the primary cause of hog cholera with the Bacillus suispestifer playing the part of a secondary invader, though it must not be overlooked as a factor in the etiology of hog cholera for the reason that the organism discovered by Salmon and Smith accounts for some of the lesions which characterize this disease. Uhlenhuth* found the hog cholera bacillus to be present in the intestine of healthy hogs in 51 out of 600 cases examined. Hutyra† considers the virus responsible not only for the so-called hog cholera, but for swine plague as well. In presenting these various opinions it is well to remember that the cause of the disease remains no longer a matter of contention. The ultra-microscopic organism or virus is believed to be the primary cause, and the Bacillus suispestifer is considered an important but secondary invader. The actual identification of the filterable virus has not as yet been accomplished.

Symptoms of Hog Cholera.

Probably the first symptom noticed by the owner of a herd in which hog cholera exists is a loss of appetite, appearing at first in only one or two hogs, but spreading rapidly each day to healthy hogs. The disease may be well along in the period of incubation, in apparently healthy looking swine. In the acute form of the disease, the animals may die with the external appearance of very few of the symptoms. However, when affected with the sub-acute form of the disease, the hogs may linger several days before death. In the chronic form of the disease, which covers the longest period of any type of hog cholera before death (two weeks to as many months) the appetite may be normal for a few days, which increases the owner's confidence in their condition, to be followed by the absolute refusal of food and water, and later by death. Vomition is frequently observed. Owing to the fever present the infected hogs consume water more readily and regularly than feed. The eating of dirt

*Arbeiten, a. d. Karserlicher Gesundheitsamt. Bd XXVII (1908) p. 425.
†Pathology and Therapeutics of the Diseases of Domestic Animals, Vol. 1.

and other foreign material is quite commonly observed. Some hogs will recover from the chronic type of the disease but they are frequently stunted in growth so that they prove unprofitable to keep, for the reason that they cannot be fattened and may remain a constant source of danger to newly purchased animals by harboring the infection and gradually discharging the same in their excreta.

The skin secretions are abnormal, showing a red, rusty tinge, which become thickened and collect on the outside of the thighs, abdomen, ears or coronets. The skin itself often shows reddish spots or areas of congestion over the snout, ears, or about the coronet and abdomen, which vary in size from a pin point to large blotches which become diffuse and darker as death approaches. These blotches may assume a purplish color at death. The skin lesions are more noticeable in the Chester White and Yorkshire breeds. Along with loss of appetite the animals become emaciated very rapidly. Weakness and loss of strength are very apparent. Affected hogs generally seclude themselves in straw ricks, and in other out of the way places. Diseased animals when forced to move, walk slowly with an unsteady gait. This is especially noticeable in the hind legs, which wobble and weave as the body weight is alternately shifted. In standing the hind quarters are unsteady and sometimes refuse to support the weight of the animal. The abdomen is tucked up so that a very gaunt appearance is presented. Sometimes the animals are constipated and at other times diarrhea exists. These two conditions often alternate in the course of the disease and either is symptomatic. The diarrheal discharge varies in color and consistency, and is frequently influenced by the feed. It may be more or less tinged with blood. In constipation the feces are sometimes covered with mucous, while the urine is highly colored and sometimes tinged with blood. Inflammation of the sheath in barrows and boars with an amassing of urine and dilation of the terminal pouch is quite characteristic.

The respiration and pulse beat are quickened and abnormal in character. Thumps sometimes occur. When the mucous

membrane and lining of the throat and interior passages are inflamed and thickened, the respirations are noisy and difficult. At times a thick, tenacious discharge, streaked with blood, exudes from the nostrils and there is a deep, short hacking cough. The writers have observed a continuous hemorrhage from the nasal passages of very fat hogs suffering from cholera, which lasted from two to three days. When the lungs are inflamed (pneumonia), the respirations are quickened and labored, and when the pleural membranes are involved, the respiratory effects are more severe and accompanied by a quickened and increased breathing. Severe pain is produced when the hand is pressed on the chest walls.

The eyes are frequently affected. At first they show an increased lachrymal secretion of normal consistency which collects and thickens on the lashes so that the lids are finally glued together, making the animal partially or completely blind. One or both eyes may be affected. The central nervous system may also be involved. The manifest symptoms are those of inflammation of the brain and spinal cord. The animal may suffer from frequent convulsions during which it may die, or it may pass into a sleepy, comatose condition, also ending in death.

In most cases the body temperature of animals in a cholera herd permits the detection of the absolutely sound animals which are worthy subjects for the serum treatment and the elimination of the affected ones, for which the treatment would probably be too late. The body temperatures of recently affected animals showing no noticeable symptoms of the disease, as well as of those in the advanced stages, are often found to be from two to five degrees above normal.* The higher the fever the more marked the depression of the animal, but in animals approaching death the temperature returns to normal or may even fall to sub-normal. Temperature therefore, is of little value in animals showing symptoms of the chronic form of the disease.

* In full grown hogs the normal temperature varies from 101 to 103 degrees Fahrenheit, and in pigs weighing 100 pounds and under, the body temperature usually is 101 to 103½ degrees Fahrenheit.

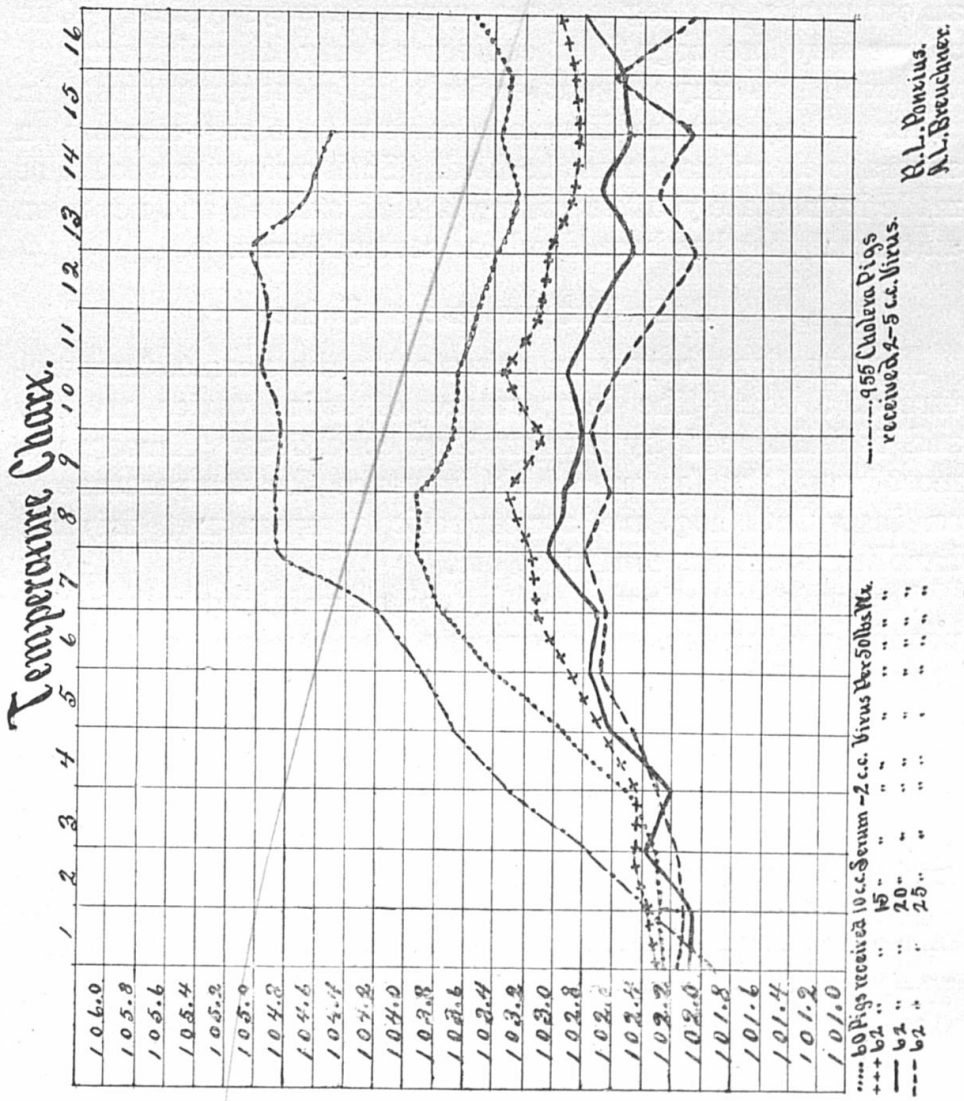

Temperature Chart.
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
106.0
105.8
105.6
105.4
105.2
105.0
104.8
104.6
104.4
104.2
104.0
103.8
103.6
103.4
103.2
103.0
102.8
102.6
102.4
102.2
102.0
101.8
101.6
101.4
101.2
101.0
60 Pigs received 10 c.c. Serum - 2 c.c. Virus Per 50 lbs Wt.
62 " " 15 " " " " " " "
62 " " 20 " " " " " " "
62 " " 25 " " " " " " "
955 Cholera Pigs received 2-5 c.c. Virus.
R.L. Pontius.
A.L. Breuchner.

PLATE 6.

It should be borne in mind that all symptoms do not appear in every outbreak of hog cholera. Some outbreaks show one set of symptoms and other outbreaks show another. If all the described symptoms do not happen to appear one is not justified in saying the disease is not hog cholera, for all outbreaks of hog cholera are not always typical. One owner may lose hogs from cholera as may his neighbor, yet the two herds may present entirely different symptoms. In order to diagnose the disease conclusively, a post-mortem on several sick animals must be held. Such autopsies should be made immediately after killing a sick animal, and never on an animal that has been dead for several hours.

Body Temperature of Swine.

The question frequently arises as to the normal temperature of a hog. The temperature of swine varies greatly, and is influenced by surrounding conditions. Among the most important factors which influence the temperature of an individual hog are atmospheric temperature, driving, handling, hauling, confining, etc.

On twelve hundred healthy pigs, weighing a hundred pounds and under, the average temperature was 102.1 degrees Fahrenheit. (Plate 6). These temperatures were taken between the hours of seven and nine o'clock in the morning, and at an interval of twenty-four to forty-eight hours after being received at the Biological Laboratory. These shoats were used for the production of virus and for testing the potency of serum.

From the temperature chart it is observed that on the twelfth day the maximum temperature of nine hundred and fifty-five cholera inoculated pigs was 105.5 degrees Fahrenheit. The average life of a susceptible pig after inoculation was eleven days.

Sixty shoats receiving 10 cubic centimeters of serum per fifty pounds against 2 cubic centimeters of virus, reached a maximum average temperature on the eighth day following the inoculation, of 103.9 degrees Fahrenheit. Nineteen of these pigs died of chronic cholera.

Sixty-two pigs received 15 cubic centimeters of serum per fifty pounds against 2 cubic centimeters of virus, and on the eighth day following the inoculation showed a maximum average temperature of 103.3 degrees Fahrenheit. Six of these sixty-two pigs died of cholera.

Sixty-two pigs were given 20 cubic centimeters of serum per fifty pounds against 2 cubic centimeters of virus and on the eighth day after inoculation showed a maximum average temperature of 103 degrees Fahrenheit. All of these pigs survived the inoculation.

Sixty-two pigs received 25 cubic centimeters of serum per fifty pounds against 2 cubic centimeters of virus and reached a maximum temperature on the eighth day following inoculation of 102.8 degrees Fahrenheit. One of this number died of cholera.

From this observation it is indicated that simultaneous inoculation may influence the temperature by a mild temperature reaction when complete and full doses of serum are given. This no doubt occurs under field or farm conditions. The herds which appear dull after inoculation no doubt undergo a marked rise in body temperature.

In view of the temperature observations it seems that swine registering over 103.5 degrees Fahrenheit should not receive the simultaneous treatment. In older animals the body temperature is slightly lower and when the temperature registers over 103 degrees Fahrenheit they should not receive the simultaneous treatment. A great many times there is some doubt as to the cause of the elevation of temperature, and virus is administered to animals showing a higher temperature than indicated with perfect results while at other times the reverse is true. In order to remedy this element of danger it is well to administer serum alone to young and growing hogs that register a temperature of over 103.5 degrees Fahrenheit and to older swine showing a temperature of over 103 degrees Fahrenheit regardless of the cause. They can then be isolated or marked and given the simultaneous treatment a week or ten days later.

Predisposing and Accessory Causes With Method to Be Observed in Warding Off the Disease.

Anything which lowers the vitality of an animal renders it more susceptible to disease upon exposure to a virus or pathogenic micro-organism. For example, a one-sided ration of corn fed to hogs may greatly reduce their resistance to hog cholera. Stagnant ponds in poorly drained hog lots; insanitary, ill-ventilated houses; cold, damp sleeping quarters or no sleeping quarters at all; filthy troughs, buckets and slop barrels, are conditions which tend to lower the vitality of the pig and make it more susceptible to disease. These things in themselves do not cause cholera, but they render an animal less resistant, and therefore an easy victim on exposure to this malady. Healthy hogs possess but a slight degree of resistance against hog cholera, hence it is necessary to keep the hogs in the best possible growing condition, in order that they may maintain the maximum amount of resistance against the invasion of the virus. The *so-called remedies and cures for hog cholera, so plentiful upon the market, cannot be considered worthy of mention as cures, or even preventives in the true sense of the word.* Some of these preparations, however, are efficient tonics which, under average conditions, are beneficial in improving the general tone of the system. The practice of so many hog raisers of keeping slack, wood ashes, salt, sulphur, lime and charcoal in the hog lot is to be commended. A good tonic and laxative for hogs, given in Farmer's Bulletin No. 24, by Dr. Salmon, ex-Chief of the Bureau of Animal Industry, is as follows:

Wood charcoal	1 pound
Sulphur	1 pound
Sodium chloride	2 pounds
Sodium bicarbonate	2 pounds
Sodium hyposulphite	2 pounds
Sodium sulphate	1 pound
Antimony sulphide	1 pound

These ingredients are mixed together in the proper amounts and given in the slop or dry feed. A tablespoonful

of the mixture is sufficient for a 200-pound hog. This should not be given more often than once a day, and every other day is generally sufficient except when animals are under treatment. This prescription cannot be relied upon to prevent hog cholera, and is of value only in so far as it improves the general health of the animal.

By reason of the fact that hog cholera is the most widely spread disease among hogs and it tolls the greatest loss to the swine industry, and for the reason further that it is a disease in which sanitation and hygiene play an important part, more attention should be given to its prevention through proper feeding, housing and improvement of the general sanitary conditions connected with the raising of hogs.

Quarantining and Management.

The following precaution should be observed in the quarantining and management of hogs:

1. Newly purchased hogs should be quarantined for thirty days before they are admitted to permanent quarters or allowed to run with the rest of the herd. The purchase of hogs from a healthy herd does not necessarily obviate the danger of cholera as the infection may be picked up in transportation.

2. Dip or spray the quarantine animals at the end of the quarantine period to make doubly sure that they do not harbor infection.

3. It is not advisable even after taking the above precautions, to purchase swine apparently healthy, from recently infected cholera herds, for the reason that even healthy immune animals from infected herds might scatter the infection. This is especially true of the animals coming from herds affected with the chronic form of the disease.

4. Farmers should consider public highways, stock yards and stock cars as infected. Cholera hogs are often penned, stationed or conveyed in the same without subsequent disinfection. Under prevailing conditions, hogs which are appar-

ently healthy at shipment may show symptoms of cholera in eight to thirty days, although healthy prior to shipment.

5. Care should be observed when visiting farms where hogs are dying with cholera and *infected hog pens should not be entered,* as the virus may be carried on the shoes or clothing.

6. All dogs should be kept tied up in order to prevent them from visiting neighboring farms to feed on the carcasses of cholera hogs, thereby bringing the infection home on their feet, or perchance introducing the disease by bringing back a portion of the carcass.

7. Birds (pigeons, sparrows, buzzards and crows) may also carry the infection on their feet from pen to pen and should be kept away if possible.

8. Do not haul to market sick or exposed hogs for a neighbor, as the infection may be carried home on the hog rack, and washed from the rack to the ground by subsequent rains, thereby introducing the infection in your own herd.

9. Running streams draining an infected pasture or hog lot usually carry the infection down the stream and thus scatter the disease. Avoid pastures drained by common streams when cholera hogs are pastured with access to the stream above.

10. Do not throw the carcasses of cholera hogs in the stream or pond, as it simply serves to spread the contagion. All cholera hogs should be burned.

Disinfection.

In order to avoid sweeping outbreaks of hog cholera, hog raisers often dispose of their hogs and in a few weeks or months thereafter purchase other stock only to discover the infection is still present and that the recent additions to their herd contract cholera. It is not known how long the germ causing cholera will live about hog houses, ponds and straw stacks, but it is not safe to buy susceptible hogs for at least a year and there are cases on record of premises harboring the infection for four or five years.

A common question asked by farmers whose premises

have frequently been the site of hog cholera outbreaks is, how long does the virus of hog cholera remain virulent without the use of thorough artificial disinfection? It is next to impossible to accurately answer this query, because of the wide range of conditions covered. In general it might be said that the virus of hog cholera can resist the direct rays of the sun for only a few hours, but where this minute organism is sheltered by boards under troughs and beneath the wooden floors of stables, it would remain virulent for a very long space of time. Cold plays a very small part in the destruction of hog cholera virus and even the severest winter weather encountered in this section would not be sufficient to destroy it alone. Old torn down houses, fences and straw stacks where cholera pigs have slept should be burned. This will often be the cheapest procedure in the long run. Where this is not practicable thorough disinfection should be carried out. This should be executed in the most exacting way. Partial or inefficient disinfection is practically useless. To disinfect where fumigation with formaldehyde cannot be used, the spray pump furnishes the best means. It should be borne in mind that the disinfectant does not destroy the micro-organism with which it does not come in contact. All large accumulations of bedding, manure and cobs should be removed and burned. Every place that may harbor a micro-organism should be reached with the disinfectant. Special care should be given to drive it into every crack, under every loose board, on top of every beam and into every partly concealed hole, as well as upon every exposed surface. Liquor cresolis compositus, 6 ounces for every gallon of water, or 1½ pounds of lime and ½ pound of carbolic acid to each gallon of water, or one of the coal-tar dips of a strength of one part of the dip to 15 parts water, are best for this purpose. A better emulsion can be obtained with these dips by adding a small quantity of alkali to the water. After disinfecting the hog house, fencing, feeding troughs and floors with any of the above mentioned solutions they should be whitewashed with lime water containing one pound of chloride of lime to about three gallons of water. This may be applied with a brush

but better with a spray pump. The hog lot should be cleaned and lime scattered about the ground. A saturated solution of iron sulphate can be sprayed about the hog pasture with excellent results, or a thin layer of straw can be burnt over infected ground.

Advice to the Attendant.

The care and treatment of a cholera herd require work and close attention to details on the part of the persons having this work in hand. The indifferent, careless treatment is invariably rewarded with poor results.

1. Clean the troughs after each feeding and thoroughly disinfect them with Liquor cresolis compositus, or with one of the coal-tar dips. It is a good plan if possible to turn the troughs bottom side up after cleaning until the next meal to avoid contamination or to allow a mild antiseptic solution to stand in them between meals. The small amount which adheres to the trough after draining is harmless provided any of the coal-tar preparations are used. Exclude whole corn from the feed of exposed or sick hogs. Give a light, laxative diet of a thin slop of shorts with the prescribed dose of the tonic powder previously referred to. The dose administered will vary with conditions.

2. Copper sulphate (powdered bluestone) may be given in the slop. Dr. R. A. Craig, of the Indiana Experiment Station, recommends the use of 8 ounces of finely powdered bluestone dissolved in a gallon of water. One pint of this stock solution to about eight gallons of water or thin slop is given once a day. This should be employed previous to the time the symptoms appear, as a possible preventive and continued for several days after the hogs have apparently recovered.

3. Do not give the hogs any more feed than they will clean up.

4. The attendant of the healthy herd should not feed or enter the yards or pens of the sick animals. If this is not possible, in cases where only one man is available, he should

always change his outer clothing and thoroughly disinfect or change his shoes.

5. Do not use slop pails or slop barrels in common for healthy and sick herds.

6. Note the relation of the yards of the healthy herd to those of the sick herd with special reference to drainage. If the drainage is from the infected yard to the healthy pen, it will be only a matter of time until the infection is carried by surface drainage to the healthy lot, and all efforts to control and check the outbreak by disinfection and quarantine will be in vain. In controlling outbreaks of hog cholera every little detail must receive consideration, for if only half done, it is just as well not to observe any of these measures at all.

7. *Burn Carcasses of Cholera Hogs.* The dead body of the hog carries the virus of cholera in abundance and burning or deep burying furnishes the only sure means of getting rid of the infection, Burning is always to be preferred to burying. Do not allow other hogs, dogs, birds or chickens to come in contact with the carcass. Do not transport a carcass to an isolated spot on the farm thinking that this is sufficient elimination to insure the health of the remainder of the herd. If buried, place the carcass under four feet of earth and cover it with lime; it is preferable to destroy it by fire as buried carcasses have been unearthed after several years and have caused outbreaks of cholera. Burning can be accomplished by first firing a small pile of wood, or cornstalks, and laying the animal belly down on the pile, but the destruction of a carcass is facilitated by digging two trenches twelve to eighteen inches wide and five to twelve feet in length that intersect each other at right angles. (Plate 7.) This allows a draft no matter which way the wind. Four iron bars are placed across the top of the trenches at their intersection to support the carcass. Before the hog is placed on the iron bars the carcass should be opened through the thoracic and abdominal cavities with a butcher knife, and a cupful or more of kerosene poured over the abdominal organs. The carcass should then be placed belly down on the bars. The heat is thus

kept in the body of the hog and as soon as the contents of the stomach and intestines have burned the fat will ignite and will of itself nearly destroy the carcass. Do not try to burn a hog by placing it on its back. If a little kerosene is poured on the fuel it will greatly hasten the burning of the carcass. The fire is then started directly below, using at first dry pine boards and later ordinary stove wood is heaped below and on top of the carcass. Soon the carcass is inwrapped in flames and its complete destruction is only a matter of a short time.

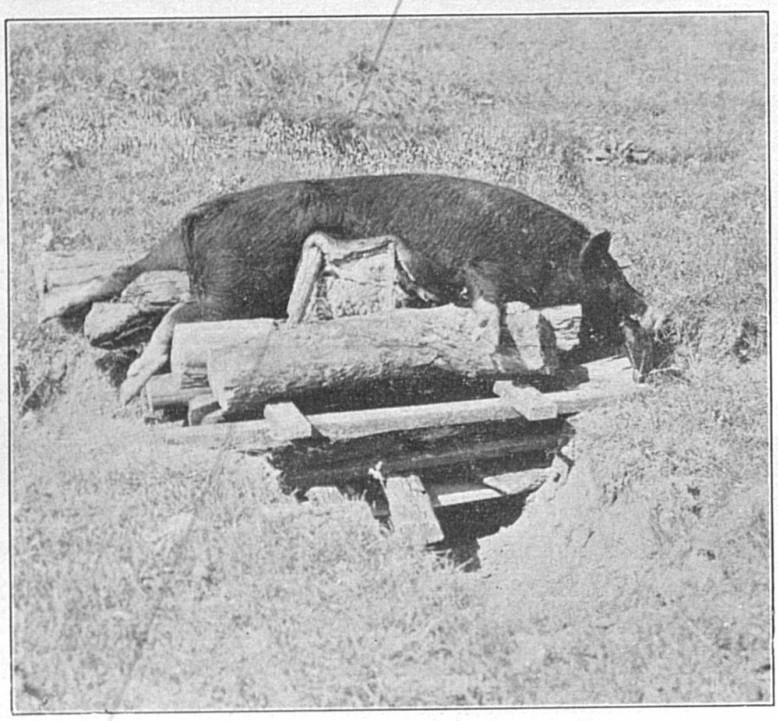


PLATE 7. Method of burning hog cholera carcasses.

This is a very simple yet efficient and easy method of burning diseased carcasses and should be practiced in destroying animals that have died of any infectious disease on the farm.

Post-Mortem.

With respect to the appearance of a hog after death from hog cholera, Dr. M. Dorset, Chief of the Biochemic Division of the United States Bureau of Animal Industry, says:*

*Farmers Bulletin No 379.

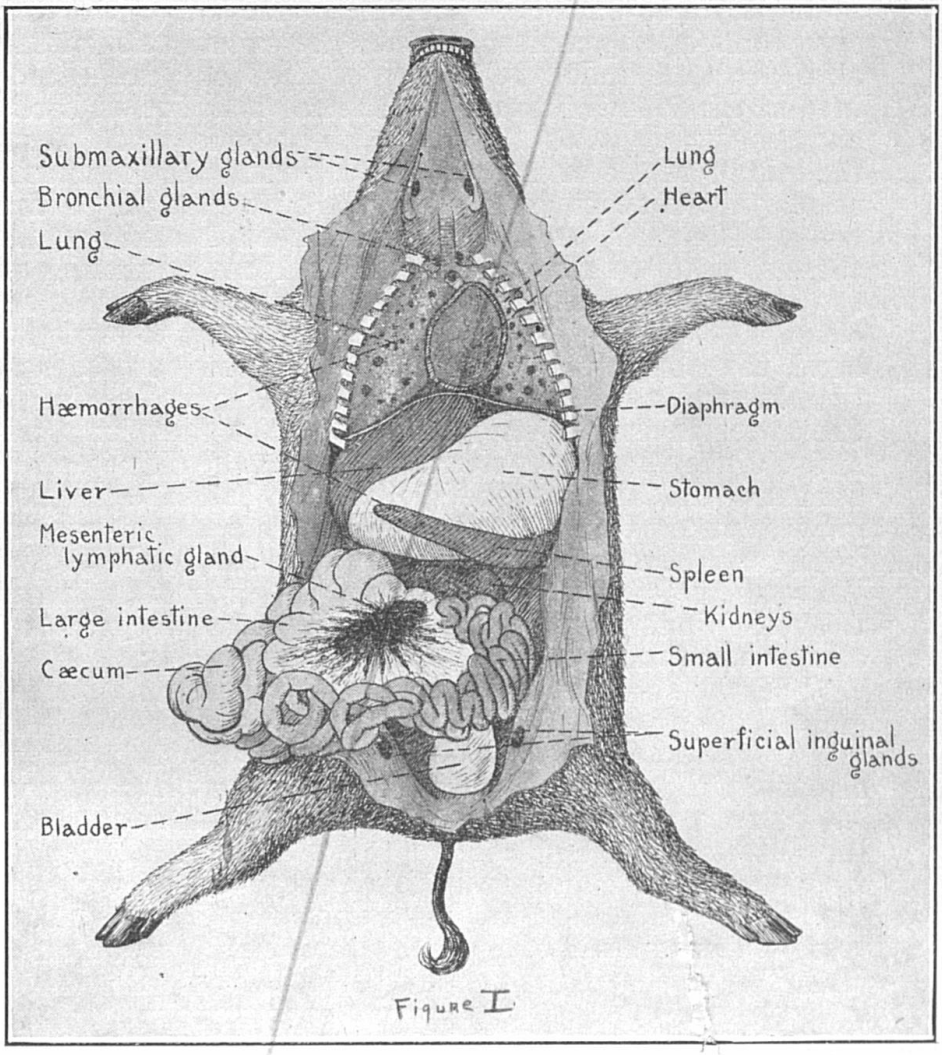


PLATE 8. Showing the relation of the internal organs of the hog.

"In regard to the examination of hog carcasses on the farm, it may be well to state that while hog cholera is not communicable to man, there is always danger of the hog being infected with other diseases, such as tuberculosis and anthrax, which are highly dangerous to man, and for this reason care should be exercised in examining carcasses of sick hogs so as to avoid a cut or scratch on the hands which might serve as a point for the inoculation of disease.

"The post-mortem examination of a hog should begin with the skin, which may show the red or purplish

blotches which have been mentioned above as one of the symptoms of hog cholera. When the examination of the skin has been made, the organs of the body are examined in the following manner: The hog is laid on its back, and, beginning at the throat, an incision is made along the middle of the chest and belly, through the skin and underlying fat, and extending the entire length of the body. The next step is to dissect back the skin of the chest so that the ribs are exposed. Now, beginning at the lower border of the ribs, about one or two inches on either side of the breast bone, and cutting toward the head, the ribs on both sides are severed, the central portion, including the breast bone, being removed entirely. Crosswise incisions, extending from the first long incision toward each leg, are now made in the skin in such a manner that this may be laid back on both sides of the body, thus exposing to view the various organs which lie in the chest and abdominal cavities. (See Plate 8). While the carcass is being opened, care should be taken to avoid injuring the organs. The important organs are examined as follows.

"LUNGS. The healthy lungs are pink in color, soft, and filled with air. Occasionally, in that portion of the lungs nearest the neck, small, solid, dark areas may be seen in healthy hogs. Such areas without other lesions are not to be regarded as indicating hog cholera. In acute cases of hog cholera the surface of the lungs frequently show numbers of small red spots of varying size which are caused by the rupture of minute blood vessels, thus allowing the blood to escape into the tissue. (Plate 9.) These spots can not be washed off with water and when found are an important indication of hog cholera. It is not unusual to find that large portions of the lungs are consolidated, and instead of being soft, filled with air, and pink in color, as is the case in normal lungs, the organs are heavy, solid, and of a grayish or dark-red color. This consolidation of the lungs is not so characteristic of hog cholera as the reddish spots mentioned above.

"HEART. The heart is inclosed in a thin membranous sac which can be easily slit open and removed so as to permit a satisfactory examination of the organ. In cases of hog cholera, the surface of the heart may show bloody-looking blotches similar to those seen in the lungs and which, like those in the lungs, can not be washed off

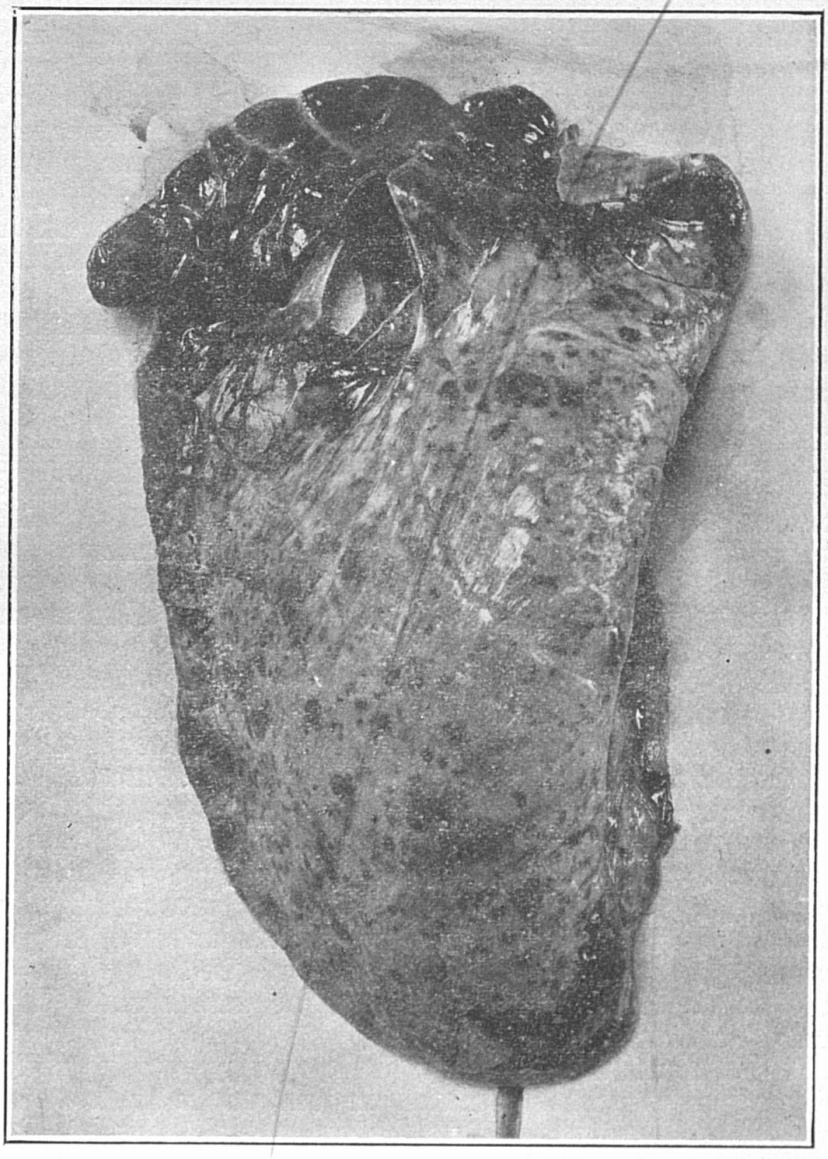


PLATE 9. Lung tissue from cholera hog.

with water. These bloody spots on the heart are rarely seen except in very acute and virulent forms of hog cholera.

"LIVER. In cases of hog cholera the liver generally shows no marked change from the normal condition. It may be at times darker than normal in color, and if cut with a knife blood will exude. This indicates simply that the organ is congested. In some cases the liver may be of a light-grayish color, due to the increase of fibrous substances. Neither of these conditions is especially characteristic of hog cholera.

"SPLEEN. The spleen, or melt, which is found on the right-hand side of the hog's body as viewed at autopsy, lying a little below and to the right of the stomach, is in acute cases of hog cholera found almost without exception to be quite large, dark, and soft. In the prolonged, chronic cases, however, the spleen may be even smaller than normal and rather grayish in color.

"KIDNEYS. The kidneys, which lie beneath the intestines as viewed at autopsy, can be easily removed by pulling aside the soft fat and tissues which surround them and cutting the round tube which holds them to the body. The thin fibrous tissue which surrounds the kidneys should be carefully peeled off without cutting into or injuring the organ, and if the case is one of acute hog cholera, it is very likely that the normal light-brown color of the kidneys will be found to be changed to a much darker color, and there may be seen over the surface a number of very dark-red points, some of these no larger than a pin point, whereas others may be larger than the head of a pin. The appearance of the kidneys frequently reminds one of the speckling of a turkey's egg. These spots are caused by the escape of blood from the small blood vessels in the same way as the larger reddish spots which occur in the lungs and on the heart. Both kidneys should be examined. (Plate 10.)

"STOMACH. The stomach is the large white pouch-like organ which is situated in the upper part of the abdominal cavity next to the lungs and by the side of and partly underneath the liver. Usually the external surface of the stomach shows no change from normal, though occasionally there may be observed small red spots similar to those which have been described as appearing in the lungs, heart, and kidneys. The stomach

should be opened by cutting the front wall from one end to the other. The partly digested food which is usually found within the stomach is removed and water poured in so as to clean the inner surface and permit a satisfactory examination. The normal stomach lining is a uniform, rather wrinkled, pinkish-looking membrane. It is smooth and free from distinct hemorrhages. In cases of hog cholera it is not infrequent to find large portions

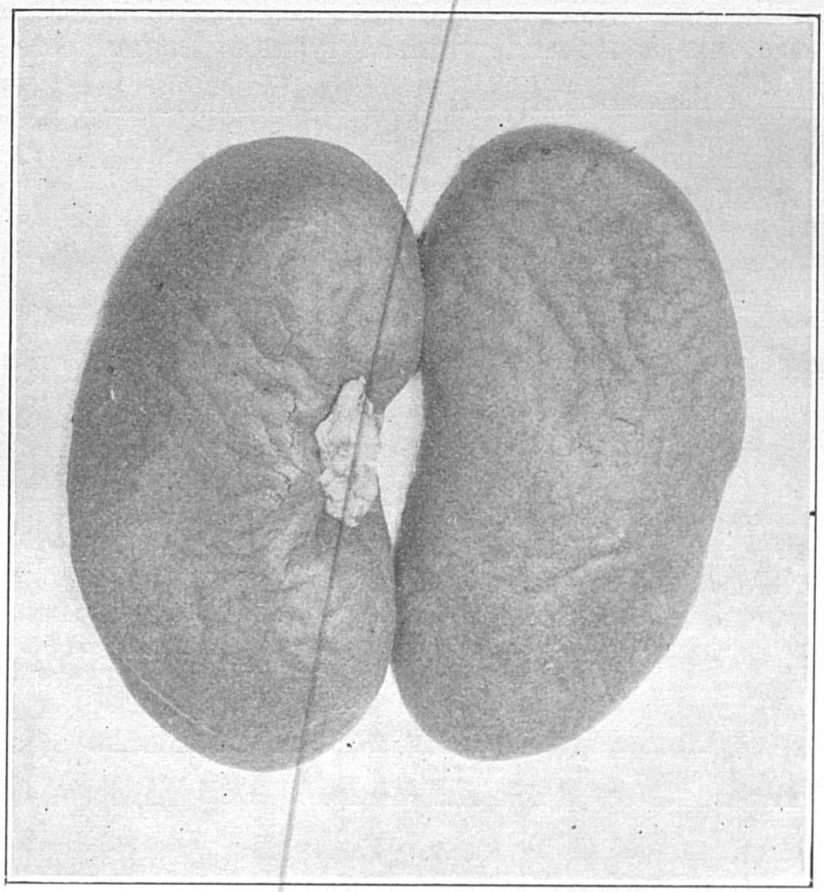


PLATE 10. Kidneys from cholera hog.

of this lining membrane of the stomach very much inflamed and red, and a careful examination will frequently show that this lining membrane has been ulcerated. The ulcerated portion usually extends over a considerable area of the lining membrane of the stomach and is separated from the healthy portion by a more or less distinct line.

"SMALL INTESTINE. The intestines are connected directly to the stomach. The small intestine is that portion which begins at the stomach and continues until a distinct union is made with a portion of the large intestine known as the cecum or blind gut. In normal hogs both the outer and inner surfaces of the small intestine resemble considerably those of the stomach, though of course the walls of the intestine are not nearly so thick. The small intestine is well supplied with small blood vessels which can be distinctly seen. In some acute and virulent types of hog cholera the

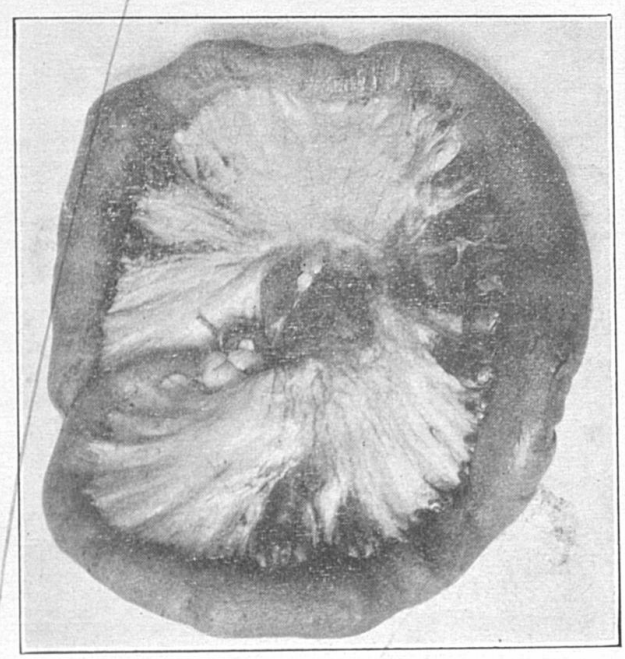


PLATE 11. Hemorrhages in mesentary and on outer surface of small intestines.

outer surface of the small intestine may be literally covered with bloody spots, giving one the impression that blood had been spattered over these organs, but upon washing them with water it will be found that these bloody areas can not be removed. There is no other characteristic lesion of the outer surface of the small intestine. (Plate 11.) The inner lining, however, may at times, in cases of hog cholera, be congested and inflamed, so that the normal wrinkled inner surface is greatly thickened and covered with a yellowish exudate

or coating, or it may be dotted with small bloody spots like those seen on the outer surface of the intestine.

"LARGE INTESTINE. The large intestine differs markedly from the small intestine in general appearance, being larger in circumference and of more uneven surface. The appearance of the large and small intestines in health and their relative positions in the body are shown in Plate 8. In cases of hog cholera the outer surface of the large intestine may show the same hemorrhagic spots that have been mentioned as occurring on the small intestine, but it is the inner lining that shows the most important changes.

In acute cases of hog cholera the inner lining of the large intestine is frequently found to be blood stained and small areas of a bloody extravasation are seen. It is also frequently found that the feces contained in the large intestine are bloody, due to blood having escaped from the bleeding portion of the intestine. In the case of hogs which do not die quickly from the disease—that is, in chronic cases—we are apt to find on the inner surface of the large intestine what are generally regarded as the most characteristic lesions of hog cholera. These are the so-called 'button' ulcers. These ulcers are usually round, hard, and yellowish, with a dark center, and are distinctly raised above the surrounding healthy inner surface of the large intestine. They vary greatly in size, some being very small points, whereas others are larger than a silver 25-cent piece. Once these lesions have been seen, they can not be mistaken afterwards. A very good idea of their appearance is given in Plate 12.

The finding of the typical button ulcer may be considered as a positive indication of hog cholera, and it is the only lesion that can be regarded as absolutely diagnostic, though the bloody points or hemorrhages in the kidneys, heart, and other organs of hogs are rarely seen in diseases other than hog cholera in the United States.

"LYMPHATIC GLANDS. Aside from the lesions of the various organs which have been described, the changes which take place in the lymphatic glands of a hog that has died from hog cholera are of much importance. These glands are found in different parts of the body. The most important ones to be examined are those in the inguinal region; these will be readily found and recog-

nized by the farmer. These glands are situated in the fat just under the skin of the abdomen, near the median line of the body, and between the hind legs (see plate 8). These glands, if normal, will be found to be of a rather light-grayish color. After normal glands have been seen the changes which occur in cases of hog cholera will be readily recognized. These changes consist chiefly in an

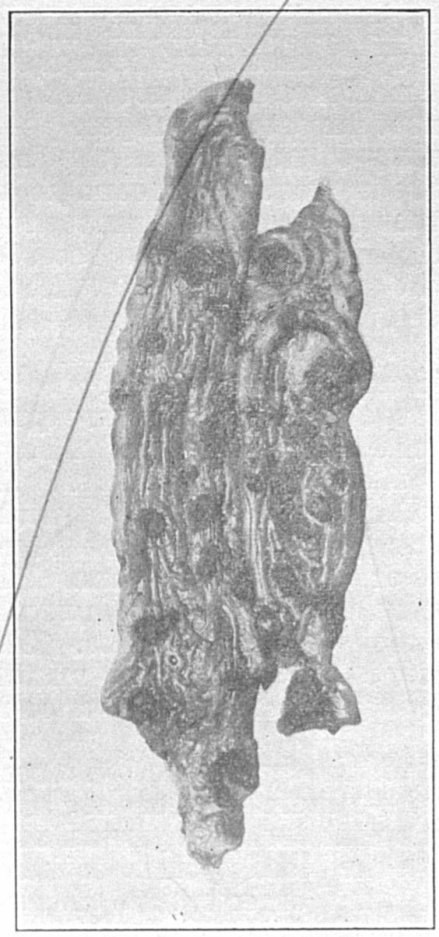


PLATE 12. Intestinal ulcers from case of hog cholera.

enlargement of the glands together with a marked reddening. At times these glands are so red as to appear almost black, and if they are cut through with a knife it will be found that the exterior or rind is the portion chiefly affected. Other lymphatic glands which undergo a change of this kind in hog cholera are found at the

angles of the lower jaw, in the neighborhood of the heart, and beneath the liver and stomach.

"SUMMARY OF POST-MORTEM APPEARANCES. To recapitulate, then the important lesions found after death from hog cholera are as follows:

1. Reddening of the skin.
2. Bloody spots in the lungs, on the surface of the heart, in the kidneys, on the outer surface and inner lining of the intestines and the stomach.
3. Reddening of the lymphatic glands.
4. Enlargement of the spleen.
5. Ulceration of the inner lining of the large intestine.

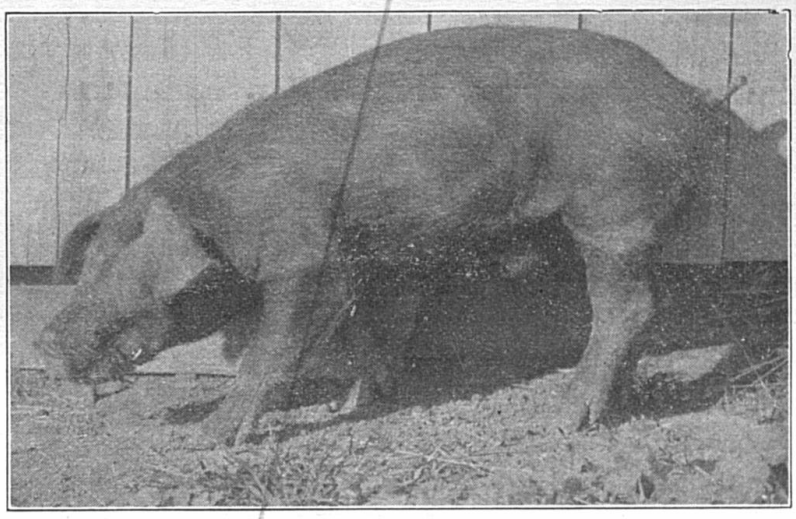


PLATE 13. Hog sick with cholera.

Any one or all of these lesions may be found in a hog which has died from hog cholera. It is rare to find all in any individual case, although at times we do find a perfectly typical picture showing all of the lesions described above. On the contrary, it has also been noticed that hogs suffering with a virulent form of hog cholera may at autopsy show only an enlarged spleen or a hemorrhagic or bloody condition of the lymphatic glands. In the lingering or chronic cases of hog cholera it is usual to find the intestinal button-like ulcers, while the hemorrhagic lesions described above are, as a rule, absent."

Losses From Inoculation.

It is frequently reported that healthy hogs are killed by inoculation. In a great many instances the chronic form of the disease exists in the herd without the owner being aware of it. The loss of one pig every five or six days does not cause alarm, but it is a very suspicious symptom of chronic cholera. A complete and true history of the herd should be given to the veterinarian before treatment, and the owner should be very careful to know that the serum to be used is potent. There are some commercial serums which do not give satisfactory results. In all cases of irregular results examined, complications existed, and not always was the serum lacking in potency. Hog raisers should secure serum from laboratories which have a State or Government license. In case the Experiment Station is unable to supply hog cholera serum, the names of these establishments will be furnished on application.

Irregular results in inoculation may occur when there is heavy infestation of parasites, when lice or worms are present; when tuberculosis or pneumonia exists in the herd; when too small a dose of serum or when too large a dose of virus is administered; when animals are ringed or castrated after inoculation, and when pens and sheds are allowed to become filthy and insanitary. Animals that are not perfectly healthy should not be subjected to the serum-simultaneous method of immunization.

Inherited Immunity.

A dam which has received the serum-alone treatment does not seem to transmit immunity to her pigs. Pigs from dams immunized by the serum-simultaneous method inherit a passive form of immunity. At the age of four to six weeks, however, they are frequently found susceptible to the disease. In some cases it has been shown that up to the age of three weeks, suckling pigs can withstand the subcutaneous inoculation of a quantity of cholera blood that would produce death in a susceptible animal of almost any size. We have given small quantities of virus to pigs from dams that had

been immunized by the serum-simultaneous method with but few fatalities. Inasmuch as we were not certain that these pigs were subsequently exposed to the infection, the length of the immunity produced by virus alone in such pigs is still uncertain.

Securing New Stock.

The first thing to be done after the premises and hog houses have become infected is to thoroughly disinfect them before new stock is purchased. When new stock is purchased, they should be vaccinated by the simultaneous method. There are many breeders who are furnishing immune hogs, and this department will gladly refer parties to these breeders.

Veterinarians Should Inoculate When Possible.

It is far better for swine owners to employ well-trained veterinarians to administer the serum. Great stress is to be laid upon the proper administration, and it is a dangerous procedure for the farmer to handle the virulent blood, as it is a very easy matter to start an outbreak of hog cholera from an overdose of same. Veterinarians who have received proper instructions in the method, and are qualified to handle the infectious materials can reduce this danger to a minimum. Owners should insist that veterinarians employed by them be properly qualified.

Uniform Method of Hog Cholera Eradication.

Hog cholera has caused a great loss to the State of Kentucky in the last few years. In order to combat this disease, a uniform method, in addition to the hearty co-operation of everyone concerned, is essential. There are many different plans to accomplish this great undertaking, most of which are beyond our reach, because of shortage of funds and the inability to establish proper quarantine in infected herds. An act of Congress indicates a far more liberal policy than ever before in assisting farmers to stamp out this disease, and government co-operation in combating hog cholera, is already under way in Henderson County, Kentucky.

The problem of supplying sufficient serum for all exposed herds has been solved by the erection of a laboratory sufficiently equipped for the purpose of preparing this product. It has a capacity of producing 300,000 cubic centimeters of serum per week. This serum is sold at one cent per cubic centimeter to the farmers of this State. The aim of the hog cholera serum laboratory and experts from the Experiment Station is to assist in every possible way in co-operating with the farmers and veterinarians in stamping out this disease.

Resolutions Unanimously Adopted at a Conference of Federal and State Officials in Charge of Hog Cholera Suppression, Auditorium Hotel, Chicago, Illinois, March 3rd, 1914.

Dr. A. D. Melvin, Chief, Bureau of Animal Industry, U. S. Department of Agriculture, Chairman of the Meeting.

The following important resolutions are of interest to all swine breeders. These resolutions were unanimously adopted at a conference of Federal and State officials in charge of hog cholera suppression, and if followed out will assist materially in suppressing hog cholera in Kentucky:

"We regard hog cholera as one of the greatest questions before the public at this time. The disease has been prevalent many years, with losses fluctuating between wide limits. The heaviest losses, as shown by the best available data, were 120 and 130 hogs per thousand in 1887 and 1897, respectively. The estimates for 1913 are 100 loss per thousand, and the indications are that the disease is passing through another period of rapid increase. In view of the high cost of living, such enormous losses of a valued food product must be regarded as a calamity.

"The main problem at this time is to control the disease. With progress now being made, both in science and practice, it may be expected that the question of eradication will come up later; but, unquestionably, the matter of control will be uppermost for years to come.

"For success, the first requirement is an honest and earnest purpose to co-operate as between all the interests involved, especially the scientists, the veterinary profession, farmers, common carriers, and packing interests.

"The control and final eradication of hog cholera will depend largely upon the education of farmers to the importance of observing sanitary principles.

"The serum-alone treatment may be given by anyone without danger of causing hog cholera. Such harm as follows this treatment is due mostly to ignorance in the use of serum or of sanitation. While it is preferable to have serum used only by competent veterinarians, it is not deemed advisable to require that laymen may not use serum alone.

"The closest possible supervision of the manufacture and distribution of serum should be provided to assure its purity and potency. It is believed that this should be in charge of the federal authorities in such plants as may properly come under their supervision, and provisions should be made in the different States to duplicate and supplement the federal efforts along this line.

"It is desirable for the States to manufacture serum, but neither by the size of the plant nor by the price of the product, should this effort be monopolized by the States.

"The simultaneous treatment should be used by those who have had special training. The ideal arrangement would be to allow its use only by federal and state veterinary officers. Other officers who have had sufficient training in the use of virus, and in sanitation, may use the simultaneous treatment with safety. Where it is not possible to restrict virus to official hands because of shortage of funds or lack of officers, or for other uncontrollable reasons, it should be used only by such persons as have been given a special permit after receiving instruction, which is as thorough and detailed as feasible, and who show that they understand the essential fundamental principles. But in any such case, the unofficial layman should be permitted to use virus only in his own herd, and then only if the district is already infected.

"The manufacture, distribution and use of virus should be rigidly supervised by federal and state authorities.

"Quarantine and sanitary measures should be much more actively emphasized and enforced. Especially, is it important that freight cars which have carried infected stock shall be promptly disinfected after unloading, and infected premises should be rigidly quarantined.

"The prevailing practice of rushing sick stock to

market should be discouraged in every way possible, and in lieu of such disposal of sick herds, the owners and other persons concerned should be advised and encouraged to treat them with anti-hog cholera serum.

"The promulgation and enforcement of all live stock sanitary regulations should remain invested in the live-stock sanitary boards and state veterinarians of the various states.

"Progress in combating hog cholera is being made. Special credit is due to individual efforts on the part of veterinarians and farmers. The intelligent interest of county agricultural agents is commended, and it is believed that these agents should give chief attention to assisting farmers to secure the aid of competent veterinarians, and when that is not possible, they should assist the farmers themselves to take proper remedial measures, always emphasizing the importance of sanitation. There is recommended the temporary assignment of a competent veterinarian by the state government, independently or in cooperation with the federal government, to any district where difficulties on account of hog cholera are most acute, his services to be available to farmers without cost, for the purpose of demonstrating the best methods in different communities.

"Work of the highest character is being done in the United States Bureau of Animal Industry, which Bureau brought out the serum treatment for hog cholera, a treatment which has been adopted in most states and countries where the disease exists. We acknowledge with appreciation the action of Congress, whereby far more liberal provision than ever before has been made to investigate and combat the ravages of hog cholera. Similar provision has been made in several states, but the legislatures are urged to make more liberal appropriations of this character.

"There should be the closest co-operation between state and federal authorities, and all persons concerned should be willing to suppress their own opinions on relatively unimportant matters, and follow the lead of federal authorities in the interest of the adoption of uniform methods throughout the entire country.

(Signed): G. R. WHITE, Tennessee.
W. M. JARDINE, Kansas.
W. B. NILES, U. S. Dept. of Agriculture.
WARD GILTNER, Michigan.
R. A. PEARSON, Iowa, Chairman."

Hog Cholera Clubs.

With the object of combating hog cholera, State anti-hog cholera clubs have been formed in certain States under the auspices of the United States Department of Agriculture and the College of Agriculture of the respective States. It is hoped that at no distant date, arrangements can be made for the formation of a number of anti-hog cholera clubs in various counties in Kentucky. The following is the prospectus of the anti-hog cholera clubs of the State of Missouri, setting forth the object and plan of operation of this organization. The plan of operation is such as to commend itself to all interested in the raising of swine.

"Object.

"The object of this organization is to eradicate hog cholera from the farms of the members of this club and from the neighborhood and county; and to encourage proper methods of hog farm management that will insure a permanent freedom from hog cholera, and a minimum of losses from the ordinary swine diseases to the end of establishing and maintaining swine breeding and swine feeding upon a safe and profitable basis on our farms.

"Plan of Operation.

"1. DISINFECTION: The destruction of the germs of the disease is essential to success in eradicating hog cholera. Fire is the most efficient means of destroying hog cholera virus and where it is applicable should be employed. Fresh air-slaked lime stands next in value as a general disinfecting agent for the destruction of hog cholera germs. Next in order is the compound cresol solution made according to the formula of the United States Pharmacopoeia, and used in a 3 per cent water solution—all these agents can be used to good advantage. Lime should be used freely on the floors of hog houses and over the grounds of the breeding pens and feed lots. The litter and dung should be scraped into piles, mixed with fresh air-slaked lime, a little water added, and after standing two or three days, scattered on the fields. Whitewash the inside of hog houses and cots, or spray thoroughly with a 3 per cent solution of compound cresol solution.

"2. QUARANTINE QUARTERS OR ISOLATION HOSPITAL. There should be provided separate pens where sick hogs can be taken at the first signs of sickness and where hogs can be placed for two or three weeks after being purchased before being turned in with the rest of the herd. No hogs under any conditions should be brought on the place without going through this quarantine.

"3. BURN ALL CARCASSES. It is the requirement of the law that all hogs dying from any disease be burned, as shown on page 222 of the Session Acts of the 47th Missouri General Assembly. Failure to observe this statute subjects the offender to arrest and prosecution. Also, burn the carcass of any other animal that may have died from any disease or accident, as carcasses attract dogs and buzzards that may have fed upon cholera hogs.

"4. INFECTION CARRIERS. Special watch should be made of dogs, pigeons, buzzards, crows and persons coming from infected premises, as all are quite liable to bring cholera germs on the place. But if the foregoing are carefully carried out throughout the community there will be little infection to carry, and danger from this source will be practically eliminated.

"5. NOTIFICATION. The law prescribes that when cholera occurs on any farm, the owner shall notify the neighbors. When non-members of this organization persist in maintaining sources of infection, steps should be taken to notify the State Veterinarian, whose duty it is to establish an official quarantine.

"6. PREVENTIVE INOCULATION. The object of this campaign is to eradicate hog cholera at the least possible cost, and to depend more on sanitary measures and good hog farm management than on the use of serum. However, whenever an outbreak of cholera does occur, the Veterinary Department, College of Agriculture, University of Missouri, Columbia, Mo., should be notified at once, and serum will be supplied at cost for vaccinating the affected herds and, if necessary, other herds that may have been exposed.

"7. PURE WATER SUPPLY. Hogs should not be given access to ponds or running streams, particularly if the source of such streams is not on the farm of the person concerned.

"8. EXTERNAL PARASITES. External parasites are a menace to the health of hogs. To rid them and their

quarters of these pests, a spray of crude oil or kerosene emulsion is particularly recommended.

"9. WORMS. When the herd is infested with worms it is well to use Santonin, 6 grains, calomel, 4 grains, per 100 pounds weight of hog. Feed in a thin slop after the hogs have had no feed for a day or two. A good mixture to keep before the hogs to prevent worms is: Sal soda, 3 pounds; Glaubers salts, 3 pounds; Copperas, 3 pounds; common salt, 3 pounds; sulphur, 1 pound; charcoal, 4 pounds. Mix thoroughly and keep in a trough in a convenient place.

"10. BALANCED RATIONS. A balanced ration aids materially in keeping hogs in good health. When feeding in the dry lot, corn can be balanced by feeding corn 6 parts and oil meal 1 part; or corn 3 parts and shipstuff 1 part; or corn 10 parts and tankage 1 part. Leguminous roughness is also excellent.

"11. FORAGE CROPS HARVESTED BY THE HOGS: From the time rye, wheat, clover or alfalfa starts in the spring until the last pasturing goes in the fall, hogs should be kept out in the fields. Rape planted in rows will make pasture throughout the season, and it can scarcely be equaled as a forage for hogs. It cannot be urged too strongly to keep hogs on the plowed fields rather than on permanent pasture. This applies from the standpoint of health, labor and soil fertility. A good three year rotation for hogs is: 1. Corn and cowpeas. 2. Soy beans—for winter feed. 3. Rape.

"12. SHADE, CORN AND WATER: Temporary shade should be provided in such a way that it can be moved from place to place. When throwing out corn, throw it in different places. An old wagon filled with corn hauled out and left in one place until fed out, then refilled and hauled to another, and so on around, makes an excellent plan. Water should be supplied from barrels or tanks, hauled to different places in the fields where the hogs are pasturing.

Instruments for Vaccination.

Glass barrel syringes should be used for this work. A twenty cubic centimeter syringe is preferable for the administration of serum, while a ten cubic centimeter syringe is preferable for administering virus. (See plates 14 and 15.) It is not convenient to draw the serum from the bottle into the syringe, and sterile containers must be used. These containers should be of porcelain or granite-ware, with movable covers, so that they will stand boiling and will not be easily broken or upset. Containers as well as syringes should be thoroughly boiled for about five minutes before using. The most convenient place to inject the serum is in the inner face of the thigh or in the neck. Serum and virus should always be injected into opposite sides of the body.

The Dosage for Serum.

10 c. c. up to 10 lbs. in weight.
15 c. c. for all sizes between 10 and 20 lbs.
20 c. c for all sizes between 20 and 50 lbs.
30 c. c. for 75 lbs. or more than 50 lbs.
50 c. c. for 150 lbs. or more than 100 lbs.
60 c. c. for 200 lbs. or more than 150 lbs.
70 c. c. for 250 lbs. or more than 200 lbs.
80 c. c. for 300 lbs. or more than 250 lbs.
90 c. c. for 400 lbs. or more than 300 lbs.
100 c. c. for more than 400 lbs.

The Dosage for Virus.

$\frac{1}{8}$ c. c. for pigs up to 4 weeks of age.
$\frac{1}{4}$ c. c. for pigs 4 weeks to 50 pounds.
$\frac{1}{2}$ c. c. for sizes 50 to 100 pounds.
1 c. c. for sizes over 100 pounds.

According to an act of the General Assembly, approved by the Governor, March 11, 1912, anti-hog cholera serum and virus are to be furnished to the farmers of the State at partial cost of production, and not to exceed one cent per cubic centimeter and to be distributed through such channels as the

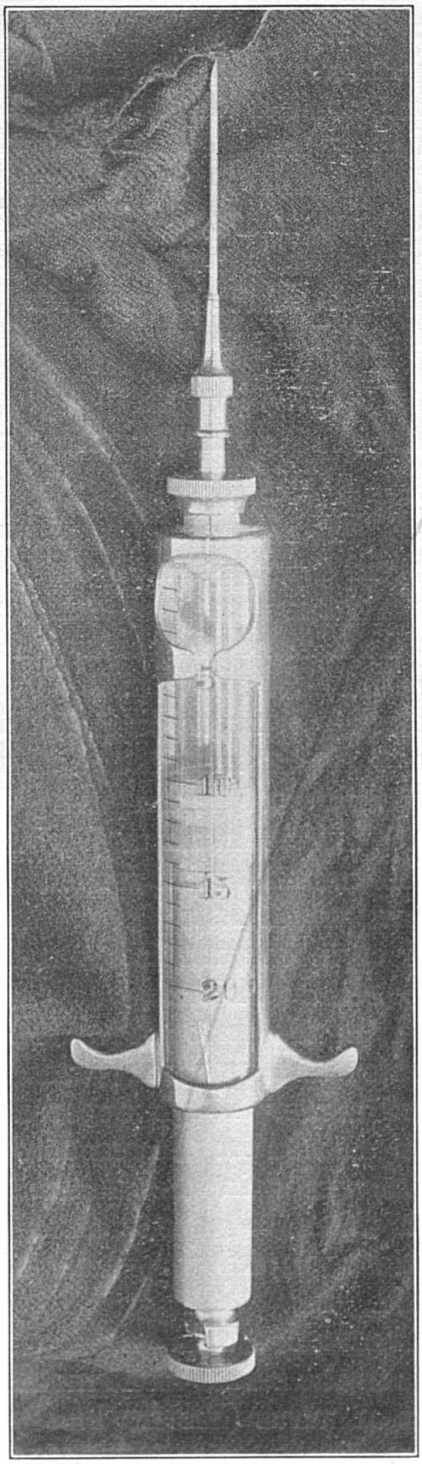


PLATE 14. Serum syringe.

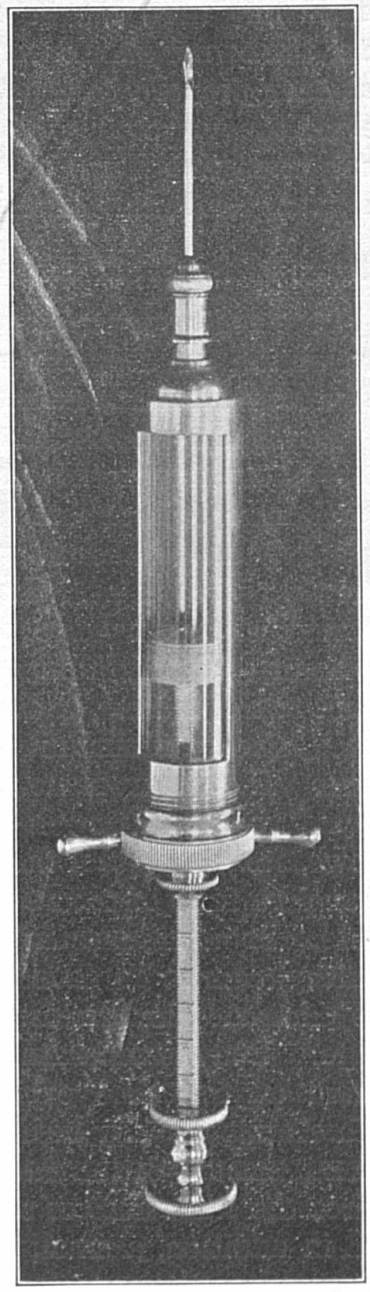


PLATE 15. Virus syringe.

Director of the said Experiment Station may deem advisable for the protection of the swine interests of the State.

From the dosage for serum and virus given on page 212 of this bulletin, the cost of serum and virus necessary to vaccinate any herd can be readily calculated. In addition to this, the owner should employ a competent veterinarian who has been properly instructed in this work and who has received the approval and endorsement of the veterinarian in charge of the Hog Cholera Serum Laboratory of the Kentucky Agricultural Experiment Station.

Three Methods of Inoculating Hogs to Prevent Hog Cholera.

There are three methods used in inoculating hogs for the prevention of hog cholera, viz: The serum alone method; the serum-simultaneous method; and the combination method.

THE SERUM-ALONE METHOD. As the name suggests, this method consists in the use of serum alone on healthy hogs which have been exposed to the disease. It is also advantageously used in herds on adjoining farms or on fields adjacent to places where cholera exists. If the infection is not present, or occurs subsequent to the use of serum alone, the immunity is only temporary or passive in nature, lasting about two months. If during this time the infection is introduced, a longer immunity is gained which lasts six months or more. The serum-alone method of inoculation is often employed when making a show circuit, exhibiting at fairs, shows, etc., to protect the hogs during the period of travel and to avoid a fatal exposure in infected cars or stock yards en route. Some animals in infected herds, though apparently healthy, cannot be saved by this method for the reason that they harbor the disease well advanced in the incubation stage. Body temperatures are taken to detect those infected at the time of inoculation. In this way unhealthy animals may usually be eliminated.

THE SERUM-SIMULTANEOUS METHOD. This method requires the same dose of serum as in the serum-alone method, and in addition, a small amount of virus (cholera blood) is injected into the opposite thigh or opposite side of the neck



PLATE 16. Method of inoculating a pregnant sow.

of the pig. This method is employed when the disease or infection is not present. In order to produce a permanent immunity, it is neccssary to artificially inoculate the animal by introducing cholera blood simultaneously with the administration of the serum. This method is also usually employed in infected herds on all hogs not showing visible symptoms of the disease and not registering a temperature above 103 degrees Fahrenheit in the winter time or 103.5 degrees Fahrenheit in the summer time. There are, however, some dangers in employing this method, but if the potency of the serum has been properly tested, as well as the virulency of the virus, and if consideration is given to the condition of the animals to be treated and their susceptibility to the disease, there is practically no danger. It is a well known fact that some hogs are much more susceptible than others to vaccination. This results occasionally in severe transitory effects which last for a few days, but the hog should completely recover. Occasionally a hog so treated may die of cholera and serve as a means of scattering the infection to adjoining lots. If cholera should develop in one animal so treated, it should be isolated and cared for as a true case of hog cholera. The additional expense of the serum-simultaneous method over the serum-alone method is so small that it need not be considered.

THE COMBINATION METHOD. The combination method consists in first using serum alone, followed by the injection of serum and virus in ten or twelve days. This method has the advantage of preparing the animal for the serum-simultaneous treatment, and practically removes all danger of loss following the serum-simultaneous treatment. It should be used especially in valuable herds where the loss of one or two animals would more than pay the entire cost of the vaccination.

How to Determine the Method to Use in Inoculating a Herd*

The proper method to employ in inoculating a herd is, at times, no easy matter to determine. The following mode of procedure will aid the veterinarian and farmer in reaching a

*Circular 14, Experiment Station, E. S Good and R. Graham.

decision. First, a complete history of the herd should be obtained. This history should consist in determining first of all if the herd is diseased or if any of the animals on the place have died and from what cause; the prevalence of hog cholera on adjoining farms or in the immediate vicinity, and the time which has elapsed since the last outbreak of hog cholera occurred on the premises. The history of all newly purchased hogs should also be obtained, if possible. All this information must be fully recorded in the "remarks column" of the record blank furnished by the Experiment Station with every shipment of serum, and returned to the Station. Before a method of inoculation is decided upon it should be ascertained beyond a doubt whether or not the sick animals in the herd are suffering from cholera. In order to do this, the temperature of a sick hog should be taken, after which it should be killed and a post-mortem examination made. If sufficient lesions are not found for diagnostic purposes in the first post-mortem, other sick animals should be killed and subjected to post-mortem examination so that the operator may determine whether the disease is or is not hog cholera. No one should attempt to inoculate hogs until he is qualified to definitely diagnose hog cholera from the symptoms and the post-mortem lesions. Animals that have died are not good subjects for post-mortems as there is danger of the operator contracting blood poisoning through abrasions on the skin of the hands, and, moreover, the natural color of the organs is soon altered after death.

It may or may not be profitable to inoculate hogs in a herd affected with cholera. The serum is a preventive and not a cure, and if all or the greater number of hogs in the herd show visible symptoms of the disease, it is useless to inoculate. However, if the outbreak of the disease has only recently started, a goodly number of the hogs showing visible symptoms of the disease may be saved. In such a herd the serum-alone method should be used and all of the inoculated animals allowed to run on the infected ground. By this method, those hogs that have not already

picked up some of the infection in the natural way, are liable to do so later. This will result in more or less permanent immunity. In other words, the result will practically be the same as if healthy hogs had received the serum-simultaneous inoculation. The temperature of each animal should be taken and recorded. Some animals may appear to be in a perfectly healthy condition, and yet may be incubating the disease. Such animals will generally show temperatures considerably above normal, in some instances as high as 108 degrees Fahrenheit. Animals showing a temperature of 105 degrees or lower may be saved sometimes by the use of serum-alone or in infected herds, there may be even some chance of saving those showing higher temperatures, provided there are no visible symptoms of the disease. It is best to double the dose of serum on pigs showing temperatures but exhibiting no visible symptoms of cholera. In young hogs a temperature of over 103.5 degrees Fahrenheit, or over 103 degrees Fahrenheit in mature hogs, indicates fever, especially if the history of the herd indicates infection with cholera. If an apparently healthy herd is located near an infected herd of hogs, the simultaneous method should be used. No one but an expert, however, should attempt this method of vaccination. Great care must be exercised by the operator in determining that the disease is not already in the herd in the incubation stage. If it is present, no virus should be used, for if employed, it would simply add to the infection already present and result in the loss of animals. The simultaneous treatment can be given to animals in such a herd showing no clinical symptoms of the disease and not registering a temperature over 103 degrees Fahrenheit for mature animals, and 103.5 degrees Fahrenheit for pigs and shoats. Individuals having temperatures higher than this should be given serum-alone. If the weather is warm, the work should be done early in the forenoon or late in the afternoon.

A complete history of the herd to be treated, as well as of neighboring herds, must be filed with the Experiment Station before virus will be sent to the operator.

The serum-alone method should be employed on all recently infected farms or on farms that have had more or less permanent infection for years. All young pigs should be given serum alone before they are ten days old, and a second injection of serum alone, at or about weaning time.

Sows that are suckling pigs should never be given the serum-simultaneous treatment, but both sow and pigs should be given serum alone. After the pigs are weaned, the sows and pigs may be given the simultaneous treatment provided they all look healthy and show normal temperatures.

The serum-alone method should be employed on animals that are about to be shipped on a show circuit. If the circuit extends over a few weeks, it might be well to re-inoculate such a herd four or five weeks after the first inoculation.

Pigs from dams that have been immunized by the serum-simultaneous method before being bred, may be given serum and virus when they are from ten days to three weeks old. Such pigs derive considerable immunity from their dams until they reach this age, and hence stand the simultaneous treatment well. To secure permanent immunity, they should again be inoculated by the serum-simultaneous method when they are weaned. It should be borne in mind, however, that pigs from immune dams and immune sires are not permanently immune. The method mentioned above is the one employed in immunizing the Experiment Station pigs and has been successful so far. The premises on which these pigs run must be considered permanently infected, inasmuch as the building for housing virus pigs for the production of cholera blood, used in hyperimmunization, is located on the same grounds.

It is unwise in extremely warm weather to give a healthy herd of hogs the simultaneous treatment in a non-infected territory, simply for the reason that one or two pigs may become infected with the disease and thus act as a source of infection to neighboring farms.



PLATE 17. Inoculating small pig in hind flank.

Method Employed in Keeping the Experiment Station Herd Constantly Immune.*

The breeding herd at the Experiment Station has been kept immunized against hog cholera by the following

*Circular 14, Experiment Station. E. S. Good and R. Graham.

method: All brood sows are immunized by the simultaneous method before they are bred. So far one immunization by this method has been found sufficient to protect the life of the sow from cholera, and some of our sows were vaccinated three years ago. The pigs farrowed from these sows are given the simultaneous treatment before they are three weeks old. They are again vaccinated by the simultaneous method within a week or two after they are weaned. The pigs are never ringed or castrated at the time they are vaccinated.

Pigs from dams that have been immunized by the simultaneous method have considerable immunity against hog cholera until they are three weeks of age. Pigs stand the simultaneous treatment well at this time. After three weeks old, pigs from immune dams may become infected with hog cholera, hence vaccinating such pigs by the simultaneous method before they are three weeks old protects them from the disease until weaning time, and if given the simultaneous treatment after they are weaned they are usually permanently immunized, at least this has been the experience with the Experiment Station herd which has been more or less exposed to infection most of the time.

The combination method of vaccination against hog cholera consists in using the serum-alone method, followed in eight or ten days by the serum-simultaneous method. This method is recommended in vaccinating valuable pure bred herds, especially if highly fitted for show or sale purposes. There is usually a loss of from one to two per cent. of the hogs vaccinated by the simultaneous treatment, whereas no loss should be sustained by the combined method.

Rules to be Observed in Ordering Serum from the Experiment Station.

The following rules for the distribution of serum from the Kentucky Agricultural Experiment Station have been adopted generally:

1. All serum is shipped C. O. D.

2. Serum cannot be returned. This ruling has been made necessary by experience.

3. Do not try to economize in the dosage recommended. A trifle under the prescribed dose may be the cause of losing an animal. An underdose means poor results and is not only worthless but a dangerous procedure if the simultaneous method is employed, since it may result in the death of the hog. Poor inoculation is worse than none at all.

4. Hogs of all sizes and ages are subjects for serum treatment by any of the methods mentioned.

5. Serum is put up in bottles containing 250 cubic centimeters, 500 cubic centimeters and 1000 cubic centimeters, and is packed securely in ice.

Items to be Remembered in Using Serum and Virus.

1. The special hog cholera syringes endorsed by the Bureau of Animal Industry should be used in vaccinating hogs.

2. All syringes and receptacles used for serum and virus while the work of vaccination is being done should be previously sterilized by boiling in water for at least five minutes.

3. Never use serum and virus in the same syringe in administering the serum-simultaneous method.

4. Anti-hog cholera serum is primarily a *preventive*, not a cure. When used in large quantities for its slight curative properties, it must be employed at the request of the owner of the animals and with the full understanding of its limited curative powers. We do not recommend its use except in rare instances for curative purposes.

5. The incubation period of hog cholera is from five to twenty days. This means that a pig, though apparently sound, may be quite advanced in the disease. This condition often leads to irregular results in treatment. Do not expect uniform results after the disease has actually appeared in the herd.

6. Do not castrate, ring or mark animals with the knife at the time of inoculation. Pregnant sows frequently abort after being treated with the serum-simultaneous method. It is not advisable to vaccinate them with the serum-simultan-

eous method later than the eightieth (80) day in pregnancy, unless the life of the sow is threatened. Serum alone may be administered safely at any time.

7. In inoculating hogs four men should be on hand to catch and hold them. The securing of hogs should be done quietly, with system and dispatch. If well assisted, one man can inoculate from two to three hundred hogs in one day.

8. Whenever advisable, the owner should consent to allow the operator to kill and hold post-mortem examinations on such animals as he considers necessary to aid in diagnosing the disease.

9. The owner should provide a clean, dust-free place in which to administer the serum. It should be thoroughly cleaned and sprinkled with a good disinfectant solution before the work is started. The hogs must likewise be clean and free from dirt and filth.

Anti-Hog Cholera Serum.

Method of Producing the Dorset-Niles Anti-Hog Cholera Serum.

After years of experimentation, Drs. Dorset and Niles of the United States Bureau of Animal Industry, produced an anti-hog cholera serum that will successfully prevent and control outbreaks of hog cholera.

Cultures of the virus of hog cholera (not including the Bacillus suipestifer) cannot be produced in the laboratory, but are always present in the blood of cholera hogs. The cholera blood or virus, as it is designated, is drawn under aseptic precautions from a pig sick with cholera. In the production of virus, susceptible shoats are inoculated intramuscularly on the inside of the thigh with five cubic centimeters of virus. Within eight to fourteen days, provided the pig is susceptible and the virus virulent, acute cholera will develop. Shoats weighing from thirty to ninety pounds are most desirable for this purpose.

The blood so drawn is defibrinated and used immediately or it is chilled and used the following day for hyperimmunizing purposes. The carcass is examined after the

blood is drawn in order to ascertain such lesions of hog cholera as may be present.

The virus obtained in this way is used to hyperimmunize an immune hog by one of the four methods mentioned before. A hog may gain immunity to hog cholera by passing through an outbreak of the disease or by being artificially immunized with serum alone and natural infection present or by serum and virus. The administration of large

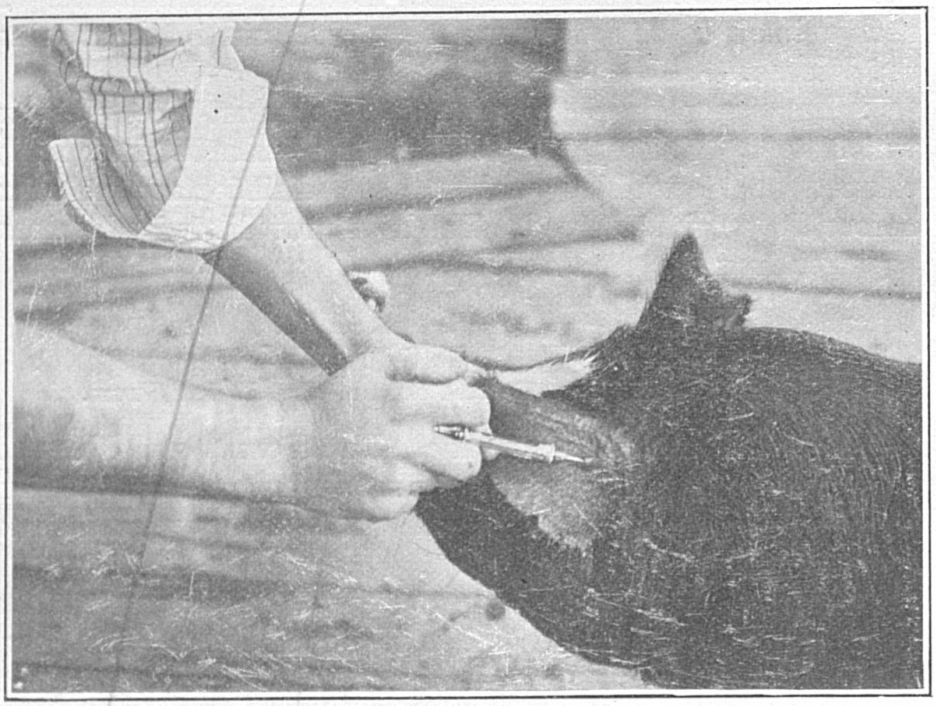


PLATE 18. Applying intradermal tuberculin test to serum hog.

amounts of virus to an immune hog results in a hyperimmune hog. The blood of a hyperimmune hog protects susceptible pigs against hog cholera. The process is known, therefore, as hyperimmunizing.

There are four ways or methods of transforming an immune hog into a hyperimmune hog.

1. The quick subcutaneous method.
2. The slow subcutaneous method.
3. The intraperitoneal method.
4. The intravenous method.

Bleeding of Hyperimmunes.

Anti-hog cholera serum is the defibrinated blood of hyperimmune hogs, to which the proper amount of antiseptic has been added in order to preserve it. In a bacteriological sense it is a concentrated solution of antibodies which antagonize and destroy the virus of hog cholera.

Ten days after hyperimmunization the first tail bleeding is made. This is repeated for two successive times seven days apart. At the fourth drawing seven days later the hog is killed by bleeding from the carotid. In cases where the animal has been a good serum producer and the tail is long enough, the animal may be re-hyperimmunized. In such cases the fourth bleeding is taken from the tail instead of the carotid. It is convenient to re-hyperimmunize immediately after the fourth tail drawing and before taking the animal from the crate. We have found that the introduction of the virus aids in equalizing blood pressure. Our experience indicates this to be a good practice. In ten days the fifth tail drawing is taken and at intervals of one week the sixth and seventh drawings are made. One week later when the eighth drawing is taken from the carotid artery the life of the animal ends. The amount of blood taken at a drawing varies. Some hogs will stand the loss of blood better than others. About five cubic centimeters per pound body weight are extracted at each tail drawing, though in some cases as high as ten cubic centimeters may be drawn.

The blood is drawn into sterile covered milk bottles and afterward defibrinated. To the fibrin free blood or serum, carbolic acid is added to the extent of one-half of one per cent. The serum from each hog is kept in a separate bottle until the hog is killed. Each drawing is labeled on the bottle with date. This is done to avoid mixing any serum from hogs that upon post-mortem examination show lesions of any disease, such as tuberculosis, etc. The serum is stored in a refrigerator from the time it is drawn until it is sent to the field for use.

Determination of the Potency of Serum.

The potency of all serum is tested before it is sent out from the laboratory. After the entire bleeding of several hyperimmunes is obtained, the serum is mixed in a large sterile container. The Kentucky Agricultural Experiment Station endeavors to produce a uniform serum. In order that it may come up to requirements, the potency of all serum thus obtained is determined in the following manner: Eight shoats weighing 50 to 100 pounds each are inoculated; two receive 10 cubic centimeters for each 50 pounds of live weight, two 15 cubic centimeters, two 20 cubic centimeters. At the same time in the opposite thigh two cubic centimeters of virulent blood are given. From five to twenty shoats are inoculated with virulent blood of the same origin without the preventive serum to check the virulency of the virus. If the latter, or "controls" as they are often called, succumb to the disease while those which have been inoculated with the preventive serum live, the Department is justified in considering the serum potent as a preventive against the disease, hog cholera. It should never be used on hogs showing visible symptoms of hog cholera for it is then too late. It should be confined to hogs that have recently been exposed but show no symptoms of the disease.

Common Parasites of Swine.

Parasites of swine are divided into internal and external with respect to their location on the host. The external parasites of hogs include the hog louse and the hog mite which causes mange. The internal parasites consist of those affecting the muscles, and round worms of the intestinal canal.

LICE (*Haematopinus suis*). The hog louse is a common parasite of swine which hog raisers must guard against. If properly handled it is not a serious problem, yet when it gains a hold on a young litter of pigs it may result in permanently stunting them. If lice are not eliminated they multiply rapidly. They are irritating and cause a general

unthrifty condition of pigs, spreading from one animal to another by contact. Frequently, sucking pigs but a few days old are heavily infested from the mother before the owner realizes it. They may develop anywhere or at any season of the year, but are more abundant in hog houses where animals congregate in large numbers. The body heat is sufficient to develop the egg or mite even during the winter months. The eggs are of a yellowish color and attach themselves to the hair about the shoulders, forearm, neck or lower part of the ham.

TREATMENT. Dipping hogs in a coal tar disinfectant will kill hog lice. It cannot, however, be depended on to destroy the egg or nits. Dipping should be repeated in ten or twelve days in order to destroy any lice which develop subsequent to first dipping. The houses at the same time should be thoroughly cleaned of all litter and loose bedding and thoroughly disinfected and whitewashed. It is well to add 2½ pounds of dissolved pure carbolic acid crystals to each fifty gallons of whitewash. Scatter air-slaked lime about the floor of the hog house. Crude oil is very efficient for killing lice and if thoroughly applied will kill the eggs. If crude oil is used it can be hand sprinkled on the hogs when they are confined in a small place. A satisfactory method of applying crude oil in the summer is by pouring the oil in a sanitary hog wallow. The oil remains on the water and results in a thorough application to the hogs. Kerosene emulsion is frequently used to kill lice but it may prove too irritating. Tobacco dip is efficient in killing hog lice and can be used advantageously in a dipping tank. Bedding the hog house with tobacco stems seems to control and prevent lice in hogs and is recommended by many prominent hog raisers.

Mange.

Mange or scabies of the pig is not frequently met with in Kentucky, but the fact that it does occur occasionally warrants a brief description of it in this bulletin.

It is due to a variety of the ordinary mange mite (Sarcoptes scabiei, var. squamiformis) and the results produced

occur as a sequel to the parasite burrowing beneath the skin. It is found almost invariably only in large piggeries and then usually in combination with some other condition, as cholera, rickets, pyobacillosis, insufficient nutrition, poor sanitary conditions, etc.

SYMPTOMS. Violent itching, especially on the head, about the ears and eyes, on the back, sides of the body and between the thighs. Dry scales of the epidermis collect on the surface, the bristles fall out and the skin becomes rough and wrinkled. As the disease progresses the skin becomes greatly thickened.

In general the treatment recommended for lice may be successfully used, especially in the early stages of the condition. Old chronic cases of mange are very difficult to treat owing to the inability of the disinfectants to penetrate the skin sufficiently to destroy the parasites which have burrowed beneath it.

Internal Parasites.

Internal parasites in pigs are not spontaneous. They usually develop from eggs laid by adult worms in the intestinal tract of other hogs. Eggs or cysts are passed by mature worms in the feces of the older hogs and are picked up from the feeding floor or about the hog lot by the young pigs whose digestive functions develop the eggs into mature parasites in the intestines. The result of picking up large numbers of eggs soon manifests itself in the pigs, and the drain on its system in furnishing food and nourishment for only a few worms is sufficient ofttimes to derange its digestive system and cause unthriftiness and death. The secret of thrifty pigs and pigs free from worms lies in cleanly quarters. Prevent them from becoming infected. The individual hog house located in a good blue grass pasture where hogs have not been fed for one year will do a great deal to prevent worms in pigs. A rotation or change of hog lots from year to year is very effective as it is almost impossible to expose pigs and keep them free from worms. At weaning time the pigs should not be allowed to run with

older hogs nor should they be fed in the same place. Keep them separate.

Parasites of the Digestive Tract.

The pig is an excellent host for a large number of internal parasites, due mainly to the diversity of the food eaten and to the natural tendency of the hog to eat any and all kinds of foodstuffs within reach. The so-called "round worms" are practically the only ones met with, and up to this date there is no case recorded of the infestation of swine with tape worms (flat).

SYMPTOMS. A large percentage of all hogs are infested with worms, but usually not in such numbers as to materially interfere with the normal development of the animal. It is, of course, to be borne in mind that they may at any time increase sufficiently to produce an unthrifty condition easily recognized by hog raisers. The only absolutely reliable symptom is to see the animal pass the parasite but the prominent clinical manifestations may be summarized as follows: Inability to take on weight even when the appetite is normal; dull, lusterless condition of the hair coat; paleness of the mucous membranes; alternating diarrhea and constipation; frequent snapping at the sides. Occasionally nervous symptoms will be present, manifested by convulsions which appear suddenly and last but a short time.

The common intestinal parasites in order of their importance are as follows:

1. The Echinorhynchus gigas (see Plate 19) is a thick, cylindrical, white worm, thickest at the head and gradually tapering toward the tail, which is slightly pointed. The body is annular upon its surface, i. e., apparently made up of a series of rings, and it possesses no digestive tract. The development of the worm requires an intermediate host which in a large measure limits its spread. The eggs laid by the adult worm are passed in the feces of the pig and spread over the ground where they are taken up by the white worm or larva of the ordinary June bug and hatch into the larval stage. If this worm is eaten by the pig the

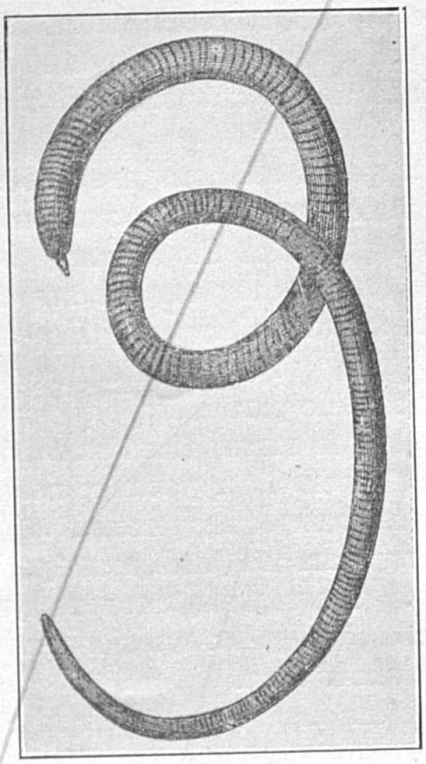


PLATE 19. Echinorhynchus gigas (after Neumann).

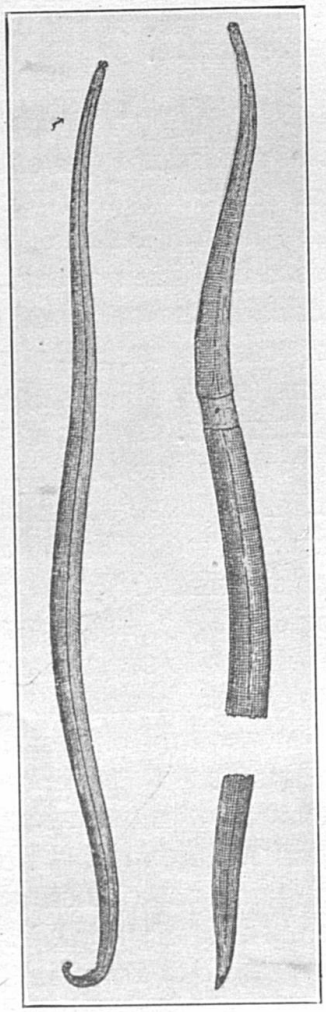


PLATE 20. Ascaris suis (after Neumann).

membrane surrounding the larva is digested, setting free this larva, which now attaches itself to the mucous membrane of the intestines by means of small hooks surrounding the head and there undergoes its future development. Even in the adult stage, at which time the worm often attains the length of twelve inches, it is found adhering to the wall of the intestine.

LESIONS PRODUCED. At the points of attachment, greyish nodules are produced which often contain pus and are con-

tinually in a state of inflammation. Occasionally the worm burrows entirely through the intestinal wall, producing peritonitis and rapid death of the animal. It has been stated that this worm only affects swine which have been fed in the open air. The treatment will be taken up in a separate chapter.

2. ASCARIS SUIS. Unlike the worm just described, these important parasites undergo their development from ova or embryos which are ingested in contaminated feed soiled by the feces of already infected animals. Thus the cycle of transmission is directly from animal to animal, and this fact may largely account for their widespread distribution.

Their characteristics are as follows: White or yellowish white in color; smooth bodies which taper at both ends, eight to twelve inches in length; when examined closely the digestive tract and reproductive organs may be clearly seen through the semi-transparent surface. The worm has a mechanism whereby attachment to the intestinal wall is possible but we have never observed the worm so attached, they invariably being found free in the intestinal contents.

A great number of autopsies held in the laboratory and on farms seem to indicate that this is the common worm found in the hogs of Kentucky.

Approximately 70 per cent. of all pigs upon which complete post-mortems have been held show the presence of worms, and practically three-fourths of these cases are due to the Ascaris suis.

3. TRICHOCEPHALUS CRENATUS (*Whipworm.*) These are rather common but unimportant worms, found usually in the large intestines and most often in the caecum. They are shaped much like a whip the lash of which forms the head end of the body. They vary in length from one and one-half to three inches; are greyish brown in color and occur free in the intestinal contents or in the secretion covering the mucous membrane. Like the worm previously described, they develop from the ova or eggs, which are

commonly taken into the body through the medium of contaminated drinking water.

Measles of the Pig.

Measles is a condition due to the presence in and between the muscles of the pig of a cyst, within which is found the larval form of an adult tape worm of man. It is most likely one of the oldest diseases recorded in history and is said to have been the chief reason for the edict issued by Moses compelling his followers to eliminate pork from their diet.

The condition is rarely if ever determined during the life of the animal and the cysts are only found during the autopsy. The term measles is sometimes erroneously applied to a slight inflammation of the skin over the abdomen which is caused by digestive disturbances.

TREATMENT. To remove internal parasites from hogs, either of the following prescriptions is recommended:

Santonin	2½ grains.
Areca Nut	1 drachm.
Calomel	2 grains.
Sodium Bicarbonate	1 drachm.

The above ingredients should be mixed and given to a one hundred pound hog in the feed.

Oil of Turpentine	4 drachms.
Raw Linseed Oil	6 ounces.

These prescriptions may be increased, depending upon the number of hogs to be treated, by allowing the quantities given in the prescription for each hundred pound hog. Before administering either of the above prescriptions, the animals to be treated should be starved twelve hours. The treatment may be repeated in three or four days, subsequent to dieting.

General Conditioners.

It has long been a current opinion among live stock men that a general conditioning powder is essential for the welfare of farm animals and that only when such substances are administered regularly are animals kept in good condition. Some men go so far as to claim that the feeding of a

certain compound actually increases the food value and fat-producing qualities of feeds. It is perhaps needless to say that such statements will not stand the light of scientific investigation and such opinions are always reached by the association of several related facts, viz: The herd is producing regularly and profitably upon the present system of feeding; in this herd a certain stock food is used according to given directions. Therefore this preparation is an excellent

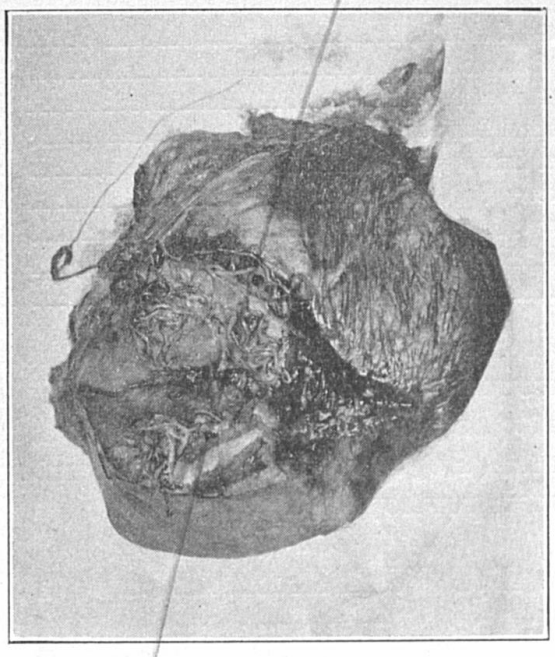


PLATE 21. Verminous bronchitis of the pig. The worms (Strongylus paradoxus) are formed in the small air passages of the lungs. The condition is quite common in this section, but is usually not recognized until the animal is slaughtered.

thing for animals. We have always found that these results are in large part due to the husbandman's faithful attention to the secondary directions given with the food in question, i. e., a thorough disinfection of the premises, a practical plan of balancing the ration, proper routine of watering and feeding, etc.

These advertised remedies include in part the following constituents: Copperas, copper sulphate (blue vitriol), char-

coal, salt, magnesium sulphate, fenugreek, sulphur, cayenne pepper, gentian, arsenic, sodium bicarbonate, sodium hyposulphite, iron, etc. The following constitutes a tonic mixture equally efficient and about one-fifth the cost of the advertised remedies. This mixture, however, must not be considered as a specific preventive for hog cholera or for any other disease of hogs, or as a corrector of unfavorable surroundings generally but it is recommended with limitations for swine:

Common Salt	15 lbs.
Wood Charcoal	5 lbs.
Wood Ashes	5 lbs.
Powdered Copperas	1 lb.
Sodium Sulphate	1 lb,
Antimony Sulphide	1 lb.
Sulphur	1 lb.
Sodium Hyposulphite	1 lb.
Lime	1 lb.

The ingredients are to be pulverized and thoroughly mixed and to be given in doses of one ounce to every ten pounds of grain fed, or to be placed where the hogs will have access to it at any time. Hogs require a certain amount of mineral matter for their development and growth.

A Review of the Work Accomplished by the Kentucky Agricultural Experiment Station With Anti-Hog Cholera Serum.

As a result of the Experiment Station's campaign against hog cholera in the State of Kentucky for the past four years, there have been amassed in the office of the laboratory, records covering over a hundred thousand animals treated with anti-cholera serum in a total of two thousand three hundred and seven herds.

It is next to impossible to state the exact saving in dollars and cents to the swine breeders of Kentucky as a result of this work, but with the figures at hand accompanied by the condition of health at the time of vaccination, it is possible

to make an approximation of this figure. The herds and premises upon which the immune serum has been used have been, in the great majority of cases, either infected at the time or directly exposed to infection. Accepting this as a fact we have 102,087 hogs which would in all likelihood have developed hog cholera in a few weeks or months from the time our attention was called to them had hog cholera serum not been administed.

Our records show that of this number of treated hogs 90.59 per cent. lived and were marketed. On the other hand had they not been protected by the use of the immune serum, it is probable that at least 75 per cent. or a total of approximately 76,565 hogs, would have died in the course of a few weeks as a result of the cholera infection. Figuring these animals as being worth $4.00 per head it is conservatively estimated that this saving of hogs would have amounted to $306,260.00. This seems to us to be a fair estimate of the financial value of hog cholera serum to the swine breeders of the State within this period and does not include the stimulus which the swine industry received in consequence.

The following statement covers the production, distribution and administration of hog cholera serum by the Kentucky Agricultural Experiment Station for the calendar years 1911, 1912, 1913, and for the first six months of 1914, the latter by months.

Results in Hog Cholera Eradication.

In 1910 the General Assembly of Kentucky appropriated the sum of $2,000.00 for the erection of a laboratory at the Kentucky Agricultural Experiment Station for the production and distribution of anti-hog cholera serum wherewith to combat the disease in the State of Kentucky. During the year 1911, 287,814 cubic centimeters of serum were produced. The following is a record of the work accomplished with this serum:

Record of Hogs Vaccinated in Kentucky in 1911.

Number herds treated	140	
Number hogs in herds	6355	
Number hogs sick at time of vaccination	797	
Number hogs with high temperatures (over 103.5)	1046	
Number hogs vaccinated	5730	
Method—Simultaneous	65 herds.	
" —Serum-alone	75 herds.	
Number herds reported	122	
Number hogs reported	4133	
Number hogs reported lived	3645	88.2 per cent.
Number hogs reported dead from all causes	488	11.8 per cent.
Number herds not reported	18	
Number hogs not reported	1597	

In 1912 the General Assembly appropriated $50,000.00 to the Experiment Station, a portion of which was to be used for the enlargement of the hog cholera serum laboratory and for the production of sufficient serum to meet the demands of Kentucky farmers. During that year 1,036,435 cubic centimeters of serum were produced and placed at the disposal of all hog raisers in the State. The following is a report of the work accomplished during the year 1912.

Record of Work for Year 1912.

Number of herds treated	414	
Number hogs in herds	19,656	
Number hogs sick	1,915	
Number hogs with high temperatures	2,395	
Number hogs vaccinated	17,591	
Method—Simultaneous treatment	339 herds.	
" —Serum-alone	75 herds.	
Number herds reported	365	
Number hogs reported	15,076	
Number hogs reported lived	13,754	91.2 per cent.
Number hogs reported died	1,322	8.8 per cent.
Number herds not reported	49	
Number hogs not reported	2,515	

In the year 1913, 4,427,120 cubic centimeters of serum were produced and the following work accomplished:

Record of Hogs Vaccinated in 1913.

Number herds treated	923
Number hogs in herds	52,489

Number hogs sick	636	
Number hogs with high temperature	5,766	
Number hogs vaccinated	47,673	
Method—Simultaneous	541 herds.	
" —Serum-alone	382 herds.	
Number herds reported	726	
Number hogs reported	38,117	
Number hogs reported lived	34,366	90.2 per cent.
Number hogs reported dead from all causes	3,751	9.8 per cent.
Number herds not reported	197	
Number hogs not reported	9,556	

Summary of the Work for the Years 1911, 1912 and 1913.

Number herds treated	1,477	
Number hogs in herds	78,500	
Number hogs sick at time of vaccination	3,348	
Number hogs with high temperature (over 103.5 degrees)	9,207	
Number hogs vaccinated	70,994	
Method—Simultaneous treatment	945 herds.	
" —Serum-alone treatment	532 herds.	
Number herds reported	1,213	
Number herds not reported	264	
Number hogs reported	57,326	
Number hogs not reported	13,668	
Number hogs reported lived	51,765	90.3 per cent.
Number hogs reported died	5,561	9.7 per cent.

The following maps indicate the progress of the work by counties for the years 1911, 1912 and 1913, each dot representing a herd of hogs treated:

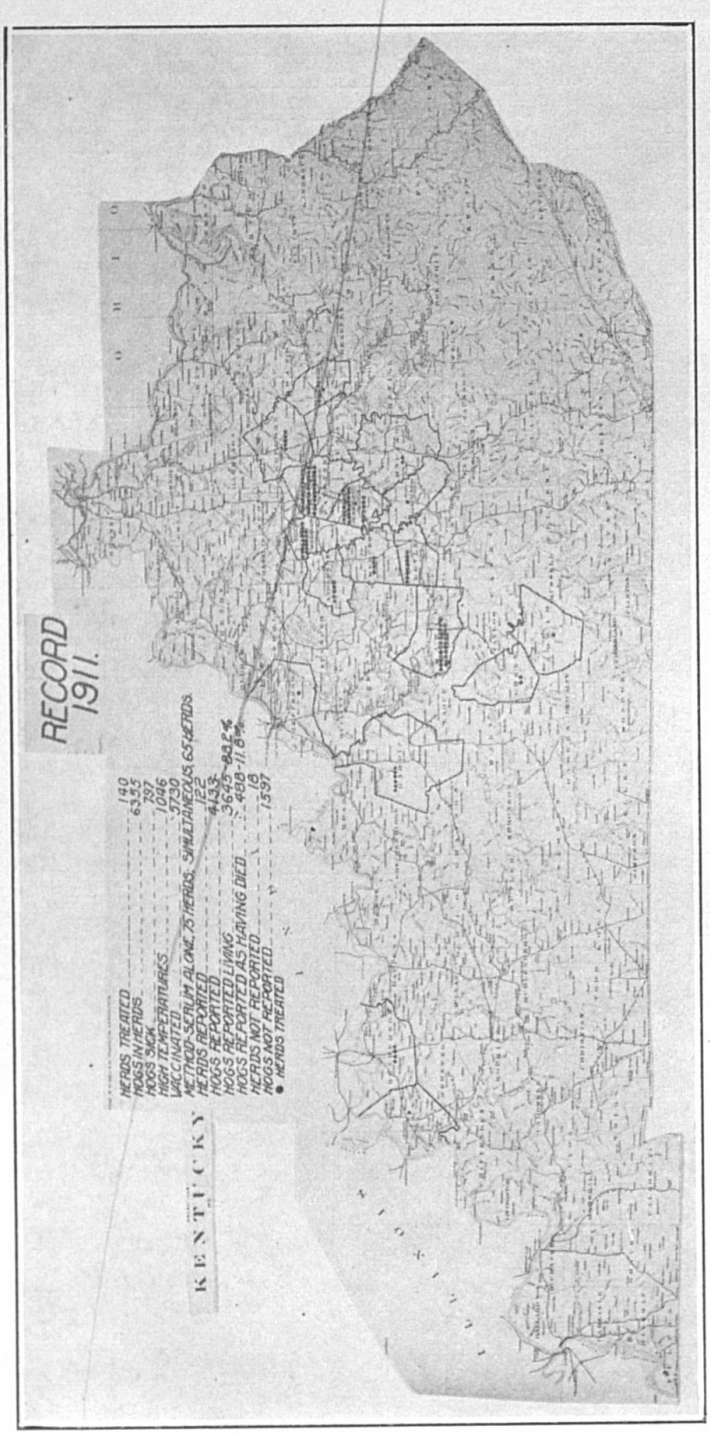


PLATE 22. Map showing hog cholera work in Kentucky for the year 1911.

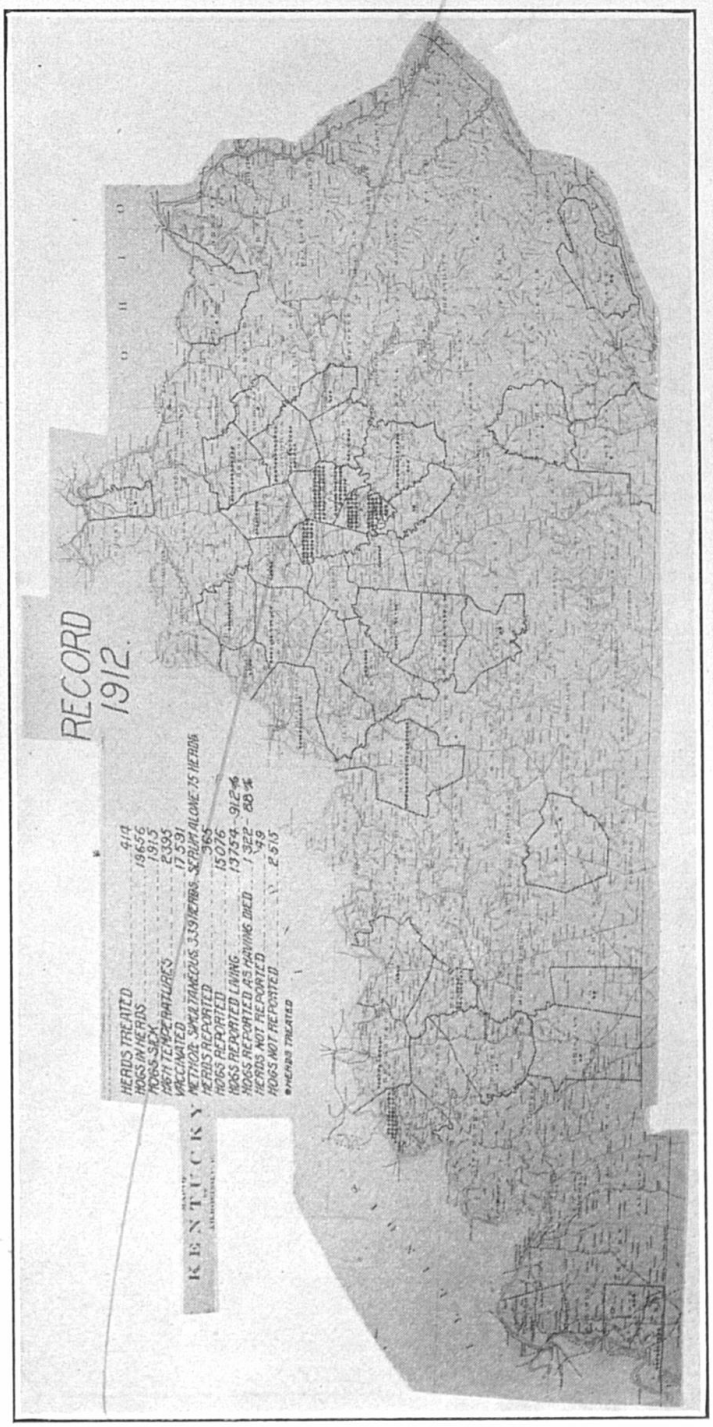


PLATE 23. Map showing hog cholera work in Kentucky for the year 1912.

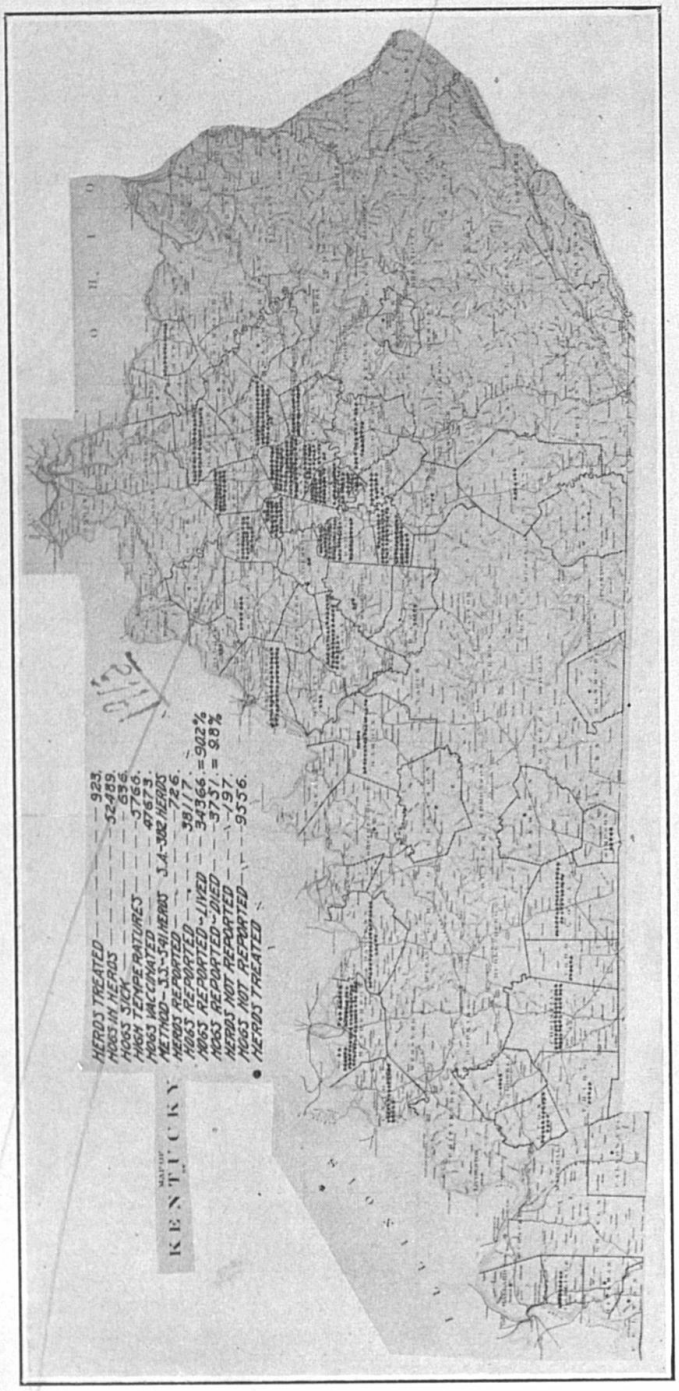


PLATE 24. Map showing hog cholera work in Kentucky for the year 1913.

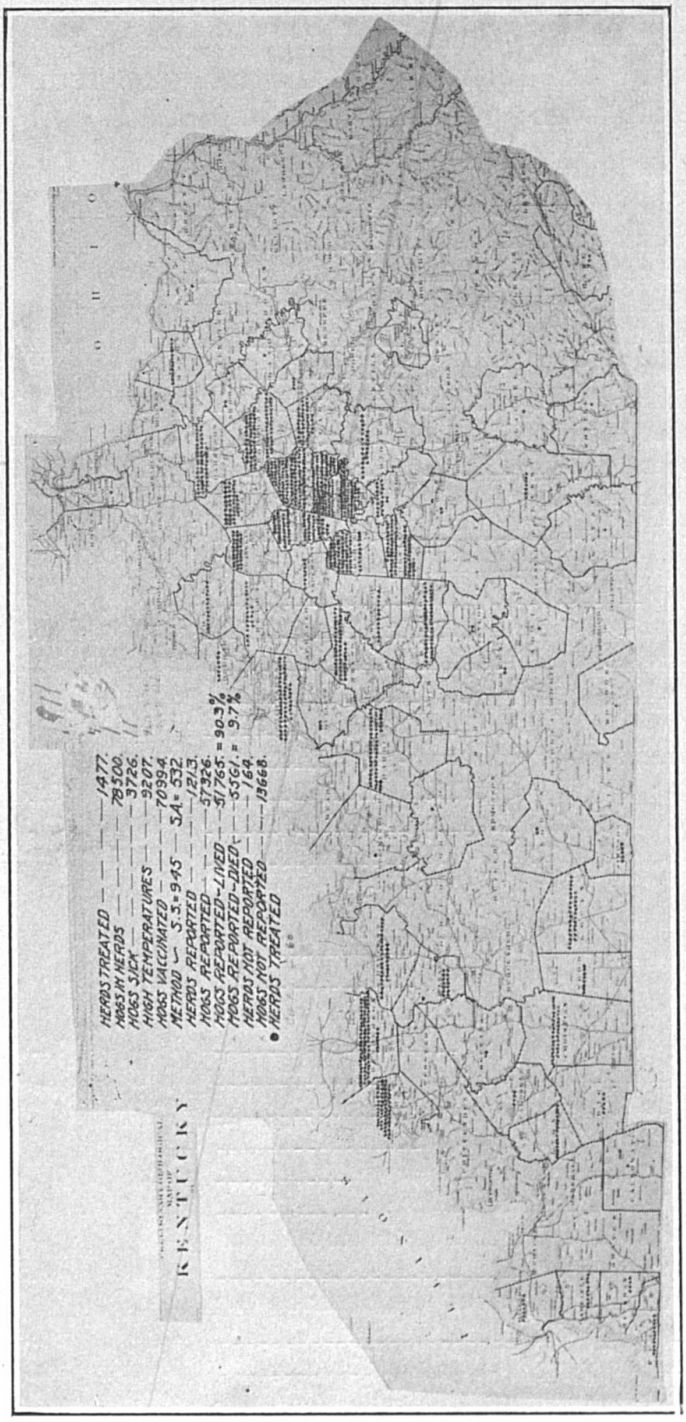


PLATE 25. Map showing hog cholera work in Kentucky for the years 1911, 1912 and 1913, inclusive.

During the first six months of the year 1914, 1,322,221 cubic centimeters of serum were produced at the Serum Laboratory. The following is the monthly record of the work accomplished:

January, 1914.

Number herds treated	139	
Number hogs in herds	5789	
Number hogs sick	370	
Number hogs showing high temperature (over 103.5 degrees)	914	
Number hogs vaccinated	5370	
Number hogs reported	4920	
Number hogs lived	4379	89.01 per cent.
Number hogs died	541	10.99 per cent.
Number herds given simultaneous treatment	54	
Number hogs given simultaneous treatment	2632	
Number hogs lived	2256	89.9 per cent.
Number hogs died	253	10.1 per cent.
Number hogs reported	2509	
Number herds given serum-alone	85	
Number hogs given serum-alone	2738	
Number hogs lived	2123	88.1 per cent.
Number hogs died	288	11.9 per cent.
Number hogs reported	2411	

February, 1914.

Number of herds treated	128	
Number of hogs in herds	4,637	
Number of hogs suspicious (temperature over 103.5 degrees)	953	20.6 per cent.
Number of hogs vaccinated	4,531	
Number of herds reported	116	
Number of hogs reported	4,260	
Number of herds not reported	12	
Number of hogs not reported	271	
Number of suspicious hogs reported dead from all causes	469	49.2 per cent.
Number of suspicious hogs saved by serum	484	50.8 per cent.
Number hogs reported lived	3,791	89.1 per cent.
Number exposed herds treated simultaneously	40	

Number exposed hogs treated simultaneously	1,392	
Number hogs not reported	70	
Number of hogs treated lived	1,214	91.8 per cent.
Number of hogs treated died from all causes	108	8.2 per cent.
Number exposed and sick herds given serum alone	88	
Number exposed and sick hogs given serum alone	3,139	
Number hogs not reported	201	
Number hogs lived	2,577	87.7 per cent.
Number hogs died from all causes	361	12.3 per cent.

March, 1914.—Apparently Healthy Herds.

Number herds treated simultaneously	34	
Number hogs treated simultaneously	968	
Number hogs suspicious (temperature over 103.5 degrees)	202	
Numher hogs reported	936	
Number hogs not reported	32	
Number herds reported	32	
Number herds not reported	2	
Number hogs treated lived	906	96.7 per cent.
Number hog treated died from all causes	30	3.3 per cent.

Suspicious and Infected Herds.

Number herds treated serum-alone and simultaneously	25	
Number hogs treated	1,030	
Number hogs suspicious (temperature over 103.5 degrees)	127	
Number hogs reported	960	
Number hogs not reported	70	
Number herds reported	24	
Number herds not reported	1	
Number hogs treated lived	909	94.6 per cent.
Number hogs treated died from all causes	51	5.4 per cent.

Suspicious and Sick Herds.

Number herds given serum-alone	86	
Number hogs given serum-alone	3,072	
Number hogs suspicious (temperature over 103.5 degrees)	718	
Number hogs reported	2,817	
Number hogs not reported	255	

Number herds reported	79	
Number herds not reported	7	
Number hogs treated lived	2,558	90.8 per cent.
Number hogs treated died from all causes	259	9.2 per cent.

April, 1914—Apparently Healthy Hogs.

Number herds treated simultaneously	43	
Number hogs treated simultaneously	1364	
Number hogs suspicious (temperature over 103.5 degrees)	193	
Number hogs reported	1364	
Number hogs not reported	000	
Number herds reported	43	
Number herds not reported	000	
Number hogs treated lived	1249	91.57 per cent.
Number hogs treated died from all causes	115	8.43 per cent.

Suspicious and Possibly Exposed Herds.

Number herds treated, serum-alone and simultaneously	21	
Number hogs treated, serum-alone and simultaneously	1183	
Number hogs suspicious (temperature over 103.5 degrees)	184	
Number hogs reported	1158	
Number hogs not reported	25	
Number herds reported	20	
Number herds not reported	1	
Number hogs treated lived	1101	95.08 per cent.
Number hogs treated died from all causes	57	4.92 per cent.

Suspicious and Sick Herds.

Number herds given serum-alone	103	
Number hogs given serum-alone	4229	
Number hogs suspicious (temperature over 103.5 degrees)	872	
Number hogs reported	4127	
Number hogs not reported	102	
Number herds reported	97	
Number herds not reported	6	
Number hogs treated lived	3694	89.5 per cent.
Number hogs treated died from all causes	433	10.5 per cent.

Summary.

Total number of hogs treated	6776	
Total number of hogs treated reported	6649	
Total number of hogs suspicious (temperature over 103.5 degrees)	1249	

Total number of hogs lived	6044	90.9 per cent.
Total number of hogs died	605	9.1 per cent.

May, 1914—Apparently Healthy Herds.

Number herds treated simultaneously	38	
Number hogs treated simultaneously	1592	
Number hogs suspicious (temperature over 103.5 degrees)	195	
Number hogs reported	1565	
Number hogs not reported	27	
Number herds reported	37	
Number herds not reported	1	
Number hogs treated lived	1496	95.6 per cent.
Number hogs treated died from all causes	69	4.4 per cent.

Suspicious and Possibly Exposed Herds.

Number herds treated serum-alone and simultaneously	19	
Number hogs treated serum-alone and simultaneously	1081	
Number hogs suspicious (temperature over 103.5 degrees)	127	
Number hogs reported	990	
Number hogs not reported	91	
Number herds reported	17	
Number herds not reported	2	
Number hogs treated lived	943	92.25 per cent.
Number hogs treated died from all causes	47	4.75 per cent.

Suspicious and Sick Herds.

Number herds given serum-alone	94	
Number hogs given serum-alone	3296	
Number hogs suspicious (temperature over 103.5 degrees)	879	
Number hogs reported	3044	
Number hogs not reported	252	
Number herds reported	85	
Number herds not reported	9	
Number hogs treated lived	2739	89.9 per cent.
Number hogs treated died from all causes	305	10.1 per cent.

Summary.

Total number of hogs treated	5969	
Total number of hogs treated reported	5599	
Total number of hogs suspicious (temperature over 103.5 degrees)	1201	
Total number of hogs lived	5178	92.48 per cent.
Total number of hogs died	421	7.52 per cent.

June, 1914—Apparently Healthy Herds.

Number herds treated simultaneously	35	
Number hogs treated simultaneously	1229	
Number hogs suspicious (temperature over 103.5 degrees)	207	
Number hogs reported	1229	
Number hogs not reported	0	
Number herds reported	35	
Number herds not reported	0	
Number hogs treated lived	1181	96.09 per cent.
Number hogs treated died from all causes	48	3.91 per cent.

Suspicious and Possibly Exposed Herds.

Number herds treated serum-simultaneously	8	
Number hogs treated serum-simultaneously	317	
Number hogs suspicious (temperature over 103.5 degrees)	32	
Number hogs reported	317	
Number hogs not reported	0	
Number herds reported	8	
Number herds not reported	0	
Number hogs treated lived	313	98.73 per cent.
Number hogs treated died from all causes	4	1.27 per cent.

Suspicious and Sick Herds.

Number herds given serum-alone	57	
Number hogs given serum-alone	1831	
Number hogs suspicious (temperature over 103.5 degrees)	584	
Number hogs reported	1634	
Number hogs not reported	197	
Number herds reported	51	
Number herds not reported	6	
Number hogs treated lived	1467	89.8 per cent.
Number hogs treated died from all causes	167	10.2 per cent.

Summary.

Total number of herds treated	100	
Total number of hogs treated	3377	
Total number of hogs treated reported	3180	
Total number of hogs suspicious	823	
Total number of hogs lived	2961	93.1 per cent.
Total number of hogs died	219	6.9 per cent.

Summary of Results From January 1st, 1914 to July 1st, 1914.

Total number of herds treated	830	
Total number of hogs vaccinated	31,093	
Total number of hogs treated reported	29,321	
Total number of hogs suspicious (temperature over 103.5 degrees)	6,187	
Total number of hogs not reported	1,772	
Total number of hogs treated lived	26,726	91.15 per cent.
Total number of hogs treated died from all causes	2,595	8.85 per cent.

Summary of Results for the Years 1911, 1912, 1913 and to July 1st, 1914.

Total number of herds treated	2,307	
Total number of hogs vaccinated	102,087	
Total number of hogs treated reported	86,647	
Total number of hogs suspicious (temperature over 103.5 degrees)	18,742	
Total number of hogs not reported	15,410	
Total number of hogs treated lived	78,491	90.59 per cent.
Total number of hogs treated died from all causes	8,156	9.41 per cent.

REGULATIONS OF THE KENTUCKY LIVE STOCK SANITARY BOARD RELATIVE TO HOG CHOLERA.*

"Section 1. No swine shall be shipped, driven, trailed or otherwise brought into the State of Kentucky for other than immediate slaughter without having been inoculated by the serum alone treatment within thirty days before shipment or by the serum simultaneous treatment at least twenty-one days before date of shipment.

Section 2. No swine within the State of Kentucky diseased with what is known as hog cholera or which have been exposed to such disease shall be shipped, driven or otherwise removed over public highways from one farm or lot to another farm or lot or be kept in a field or enclosure adjacent to any public highway or through which a running stream flows except as hereinafter provided.

Section 3. Wherever a case of hog cholera is suspected to exist it shall be the duty of the person owning said animal or any other person to notify the County Live Stock Inspector and the County Live Stock Inspector shall immediately make an examination and if he finds cholera to exist to order a quarantine of such animal or animals and of any exposed animals. The County Live Stock Inspector may order the destruction of any diseased animal and the treatment of any exposed animal by the serum alone treatment; or the County Live Stock Inspector after an examination of the exposed animal or animals may authorize the shipment of such animal or animals as do not show any clinical symptoms of the disease, for immediate slaughter. The movement of such exposed animals to market shall be in wagons, cars or boats that have been thoroughly disinfected by one of the methods enumerated in the general provisions heretofore prescribed and after the said exposed hogs have been disinfected with a 2 per cent. solution of cresol compound or a 3 per cent solution of 95 per cent. pure carbolic acid or a coal tar cresote dip of one part of dip to fifty parts of water.

Section 4. The carcass of any hog that has died within the State of Kentucky from the disease known as hog cholera shall be burned on the premises upon which it died. The hauling of carcasses of animals dying from said disease upon the public highways of this State or the disposal of them into flowing streams is strictly forbidden. This rule does not

*Rules and Regulations of the State Live Stock Sanitary Board, Regulation III, pages 17 to 22.

apply to disposal of carcasses within a city limit. Any wagon or vehicle used for the removal of carcasses of swine dying from the disease of hog cholera is prohibited upon the public highways of the State of Kentucky with the exception of the streets of an incorporated town, unless they have been thoroughly disinfected by one of the methods heretofore prescribed.

Section 5. All swine shipped into the State for exhibition purposes shall be accompanied by a certificate issued by the State Veterinarian, Assistant State Veterinarian or other legally authorized inspector of the State from which the shipment is made or an inspector of the United States Bureau of Animal Industry, showing that such swine are free from the disease of cholera and shall have had the serum simultaneous treatment at least three weeks prior to entry into the State, or serum alone treatment within thirty days prior to shipment.

Section 6. Public stock yards at market centers shall be considered as infected with hog cholera and no movement of swine therefrom shall be made for breeding or stocking purposes except as follows: Swine intended for purposes other than immediate slaughter may be shipped from public stock yards provided, that on inspection within twenty-four (24) hours after arrival by an inspector duly authorized by this Board, they are found to be free from symptoms of cholera and other contagious or infectious diseases, and that they are treated by a competent veterinarian, under supervision of said inspector, in a portion of the stock yards set aside for that purpose, in accordance with one or other of the methods set forth under (a) and (b), (c) and (d) following:

(a) Serum alone method. The swine may be given the serum alone inoculation with hog cholera serum prepared under license from the National Secretary of Agriculture, or approved by the State Live Stock Sanitary Board or the Kentucky Agricultural Experiment Station. After receiving this treatment they shall be disinfected in a 2 per cent. solution of cresol compound U. S. P. and be held in non-infected pens for at least six hours before being loaded for transportation.

(b) Serum simultaneous method. The swine may be given the simultaneous inoculation with hog cholera serum and virus prepared under license from the National Secretary of Agriculture, the State Live Stock Sanitary Board, or the Kentucky Agricultural Experiment Station. After receiving this treatment they shall be held under supervision

for a period of not less than twenty-one days. If at the close of this period they exhibit no symptoms of hog cholera or other contagious disease, they shall be disinfected in a 2 per cent. solution of cresol compound U. S. P. and be held in non-infected pens for at least six hours before being loaded for transportation.

(c) Clean and disinfected cars or other vehicles only shall be used for the movement of swine which have been given the serum alone inoculation or the serum simultaneous inoculation, and such movement must in every case be under certificate issued by an inspector of the Bureau of Animal Industry, or State or County Live Stock Inspector, or other duly authorized official indorsed by an inspector of the Bureau of Animal Industry.

(d) Cars and other vehicles and pens or yards which have contained shipments of diseased or exposed swine shall be cleaned and disinfected as soon as possible after unloading. Cars that have contained shipments of swine destined to market centers shall not be removed until the inspector has ascertained the condition of the live animals and either released the cars or given notice that they shall be cleaned and disinfected. Cleaning and disinfecting shall be done by first removing all litter and manure and then saturating the interior surfaces of the cars and woodwork, flooring and ground of the chutes, alleys and pens with a solution made with 4 ounces of cresol compound U. S. P. to each gallon of water, to which should be added sufficient lime (not to exceed 1½ pounds per gallon) to show where it has been applied.

Section 7. That all serums, virus and other biological products used in the treatment of animal diseases can only be sold or offered for sale or distribution in the State of Kentucky under a specific permit of the Kentucky State Live Stock Sanitary Board. All serums, virus and other biological products manufactured or licensed by the United States Bureau of Animal Industry or manufactured by the Kentucky Agricultural Experiment Station, Lexington, Kentucky, are hereby approved by this board.

Section 8. No person, firm or corporation shall be permitted to bring into the State of Kentucky any virus containing the germs of hog cholera, whether the use of such virus by competent persons is authorized by this Board or not, unless it is used under the general direction of a State or County Live Stock Inspector, graduate veterinarians employed by the Kentucky Agricultural Experiment Station, or a representative of the United States Bureau of Animal Industry.

Section 9. No virus shall be used except under the general direction of State or County Live Stock Inspectors, graduate veterinarians regularly employed by the Kentucky Agricultural Experiment Station, or a representative of the United States Bureau of Animal Industry, and then only upon hogs enclosed in pens separate from the non-inoculated hogs with proper sanitary provisions, and kept confined for at least twenty-one days after the use of said virus. But no hogs shall be given the serum-simultaneous treatment where drainage from pens in which they are confined is directly into any flowing stream, and no person shall be permitted to enter said pens except the immediate attendants of said hogs. Every precaution must be taken to prevent the contamination of flowing streams with hog cholera germs, and to prevent the germs from being carried by human beings, rats, birds or other means from one herd of hogs to another. These sanitary provisions must be under the general direction of the State Live Stock Sanitary Board, State or County Live Stock Inspector, graduate veterinarians regularly employed by the Kentucky Agricultural Experiment Station, or a representative of the United States Bureau of Animal Industry.

Section 10. No restriction is placed on the use of the serum-alone treatment by veterinarians or live stock owners, but this Board advises any farmer or live stock owner to employ a competent veterinarian, or correspond with the authorities of the Kentucky Agricultural Experiment Station, Lexington, Kentucky, for general directions before undertaking the use of the serum."

ERRATUM.

The word suispestifer as this occurs on pages 179, 180, 181 and 182, should be spelled suipestifer.

Kentucky
Agricultural Experiment Station
State University, Lexington, Kentucky

BULLETIN NO. 183

Some Kentucky Weeds and Poisonous Plants

BY

H. GARMAN.



STATE UNIVERSITY PRESS
LEXINGTON, KY.
August, 1914
(253)

KENTUCKY AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

RICHARD C. STOLL, Chairman, Lexington, Ky.
CHARLES B. NICHOLS, Lexington, Ky.
LEWIS L. WALKER, Lancaster, Ky.
HENRY S. BARKER, President of the University.
THE DIRECTOR, Secretary, ex-officio.

JOSEPH H. KASTLE, Director.

STATION COUNCIL

THE DIRECTOR

A. M. PETER
H. E. CURTIS
H. GARMAN
C. W. MATHEWS
R. M. ALLEN
J. D. TURNER
E. S. GOOD
GEORGE ROBERTS
J. J. HOOPER

DEPARTMENTAL ORGANIZATION

ADMINISTRATION

THE DIRECTOR, Head.
H. E. CURTIS, Bursar.
HYWEL DAVIES, Purchasing Agent.
O. L. GINOCHIO, Secretary to Director.
ADDIE LEE DEAN, Librarian.
ANNA WALLIS, Clerk.
CORNELIA C. PAGE, Clerk.

AGRONOMY.

GEORGE ROBERTS, Agronomist, Head.
E. J. KINNEY, Assistant Agronomist.
S. C. JONES, Soil Survey.
A. E. EWAN, Supt. Experiment Fields.
JESSIE F. CASWALL, Clerk.

ANIMAL HUSBANDRY

(Beef Cattle, Sheep and Swine)

E. S. GOOD, Head.
ROBERT GRAHAM, Veterinary Science, In Charge Hog Cholera Serum Production.
E. W. MUMMA, Asst. In Charge Hog Cholera Serum Production.
O. S. CRISLER, Hog Cholera Serum.
R. L. PONTIUS, Hog Cholera Serum.
W. V. SMITH, Asst. in Animal Husbandry.
M. G. GINOCHIO, Clerk.
C. B. WILSON, Hog Cholera Serum.
LAWRENCE GINOCHIO, Clerk.
E. J. GOTT, Hog Cholera Serum.

ANIMAL HUSBANDRY

(Dairy Cattle, Horses and Poultry)

J. J. HOOPER, Head.
W. S. ANDERSON, Asst. Horse Husb'd.
J. W. NUTTER, Supt. Dairy Farm.
W. D. NICHOLLS, Asst. Dairying.
D. D. SLADE, Supt. Poultry Farm.
P. E. BACON, Elmendorf Milk Records.
F. WALLACE UTTERBACK, Clerk.

CHEMISTRY

A. M. PETER, Chief Chemist, Head.
S. D. AVERITT, Chemist.
J. S. McHARGUE, Asst. Chemist.
R. PFANSTIEL, Asst. Chemist.
ETHEL V. T. CASWALL, Clerk.

ENTOMOLOGY AND BOTANY

H. GARMAN, Entomologist and Botanist, Head.
MARY L. DIDLAKE, Laboratory Asst.
E. C. VAUGHN, Asst. in Seed Inspection and Plant Breeding.
H. H. JEWETT, Research Asst. Entom.
H. R. NISWONGER, Asst. in Field Work and Nursery Inspection.
LOUISE BEWLAY, Clerk.

FEED

J. D. TURNER, Head.
H. D. SPEARS, Chemist.
E. H. NOLLAU, Asst. Chemist.
ELMER INGRAM, Chief Inspector.
ROGER W. JONES, Inspector.
FANNY C. ROGERS, Clerk.

FERTILIZER

H. E. CURTIS. Chemist, Head.
B. D. WILSON, Assistant Chemist.
WM. RODES, Assistant Chemist.
ELMER INGRAM, Inspector.
R. W. JONES, Inspector.
ANNA WALLIS, Clerk.

FOOD AND DRUGS

R. M. ALLEN, Head.
J. O. LaBACH, Chief Chemist.
L. A. BROWN, Chemist, Drugs.
J. W. McFARLIN, Chief Food Inspector.
W. R. PINNELL, Bacteriologist.
C. S. PORTER, Inspector, Drugs.
WALTER SCHEPPELMAN, Inspector, Bakery Sanitation.
E. F. WORTHINGTON, Inspector, Dairy Sanitation.
W. G. TERRELL, Inspector, Foods.
LILLIE LISTON, Chief Clerk.
LENA LISTON, Clerk.

HORTICULTURE

CLARENCE W. MATHEWS, Head.
F. W. HOFMANN, Asst. in Horticulture.
G. B. WURTZ, Consulting Meteorologist.
MURIEL CASWALL, Clerk.

RESEARCH

THE DIRECTOR, Head.
H. GARMAN, Entomologist and Botanist.
D. J. HEALY, Bacteriologist.
E. S. GOOD, Animal Husbandry.
O. M. SHEDD, Chemist.
MARY L. DIDLAKE, Asst. Entomologist and Botanist.
G. D. BUCKNER, Chemist.
H. H. JEWETT, Research Asst. in Entom.

Notice

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Director.

BULLETIN NO. 183

SOME KENTUCKY WEEDS AND POISONOUS PLANTS.

BY H. GARMAN,

ENTOMOLOGIST AND BOTANIST.

Weeds giving most trouble in Kentucky are in the main those infesting farm land in other states. They are partly importations from foreign countries or other states, or else are natives of the country and have adapted themselves to the changed conditions produced by farming and other operations in which man engages. More than twice as many of our troublesome weeds come to us from foreign countries, as are natives of America, and most of them have been introduced with other seeds or with packing about imported plants. Large numbers of them have been brought here as seeds mixed with low grade forage seeds or imported with screenings to be used in adulterating seeds sold in this country. As examples of these troublesome importations the following may be mentioned: Pigeon grass, green foxtail, Johnson grass, cheat, yard grass, crab grass, wild onion, curled dock, sour dock (*Rumex acetosella*), knot grass (*Polygonum aviculare*), lamb's quarters, pigweed, corn cockle, bouncing Bet, shepherd's purse, poison hemlock (*Conium maculatum*), clover and alfalfa dodder, broom-rape, dead nettle, Jimson weed, mulleins, narrow-leaved plantain, white-top, dandelions, dog fennel, ox-eye daisy, Canada thistle, prickly lettuce.

It would be difficult to make as formidable a list from among native weeds. As a matter of fact these are the weeds of which farmers most often complain, and if we had kept our fields free from them, as we might have done by proper inspection of imported seeds and plants, much of the labor in suppressing weeds now necessary on our farms would have been prevented. Ignorance of the matter has entailed on our farmers a lasting heritage of toil and loss. The present condition of our fields would not be so much to our discredit if it had been solely a result of our ignorance and that of foreign shippers. The latter have sent us many bushels of weed seeds knowingly and with intent to defraud, and people calling themselves Americans have been parties to the transaction.

While native weeds are generally not as aggressive on cultivated ground as are many of the introductions, we have some that make constant work for the gardener and farmer. The broom sedge, tall red-top, poke root, cat briers, several species of cocklebur and ironweed, are examples. We have nothing quite equal, however, to wild onion (*Allium vineale*), dodder of clover, and the broom-rape of hemp and tobacco. These two latter are in fact parasites, and are absolutely destructive to the crops they attack. Our own members of the botanical groups to which they belong are much less injurious.

The Dissemination of Weeds.

Attention has already been called to the frequency with which weed seeds are scattered when mixed with seeds to be sown for crops. The seeds of some are generally present in clover and alfalfa seeds, and the weeds have been associated with these forage plants in our fields so long that it is now difficult to get seed in the market that is absolutely free. The narrow-leaved plantain, sour dock (*Rumex acetosella*), curled dock, pigweed, dodder and others are being sold in some quantities at the present time with both clover and alfalfa. It is the most insidious route by which pernicious weeds have been introduced. But they are not dependent

on such means, tho commonly spreading more slowly when left to their natural means. The broom sedge, thistles, the dandelion and wild lettuce, are examples of plants that spread rapidly by means of hairy appendages on the seeds. Some, like the cockleburs and Spanish needles, attach themselves to the coats, tails and manes of animals, and to our own clothing, to get about. Many are dependent on the washing of soils, and would not spread rapidly did not man assist. This he does in various ways—by soil transferred with trees and smaller plants, in packing of different sorts, and as already pointed out, with forage seeds. In short he has simply carried his weed pests with him wherever he has gone.

Weed Laws.

It would hardly seem necessary to enact laws to keep him from doing this, and it would not be necessary if everybody were intelligent in such things and some other people were honest and careful. A good deal of the trouble has come from neither buyer nor seller knowing exactly what was in the forage seeds handled. The deliberate sale of screenings to be used mixed with clover and alfalfa seeds is of course a more serious matter from the point of view of culpability, and it is this more than anything else that calls for laws fixing the percentages of weed seeds and other impurities allowable in seeds that are to be sold. The question as to what percentages are fair and practicable can be determined by an examination of the averages of purity of high grade seeds sold by different seedsmen during a series of years. Such examinations have been made, and in the present condition of the seed business the following may be considered about what the highest grades of forage seeds should test when bought for seeding purposes.

It is customary in seed laws, excepting our own, to exclude from the market forage seeds containing the seeds of the most noxious weeds. Wild onion bulbs, clover and alfalfa dodder seeds, and the seeds of broom-rape should condemn any seeds with which they occur. In fact it would greatly

help farmers if laws were enacted in all the states forbidding the sale of seeds in which the seeds of such pests are found, and providing that in Grade 1 of forage and field seeds not more than one per cent. of foreign seeds of any sort shall be allowed.

Standards of Purity for High Grade Seeds.

Alfalfa	97	Flax	98
Barley	99	Foxtail	90
Beans, Soy	99	Hemp	98
Beans, Garden	99	Millet, Common	98
Bermuda Grass	90	Millet, Hungarian	98
Bluegrass, Kentucky	75	Millet, German	98
Bluegrass, Canada	80	Millet, Pearl	98
Brome-Grass, Smooth	90	Oats	98
Broom Corn	98	Oat Grass	85
Buckwheat	96	Onion	99
Clover, Alsike	95	Orchard Grass	80
Clover, Crimson	98	Pea, Canada Field	98
Clover, Mammoth	98	Pea, Garden	99
Clover, Red	98	Rape	98
Clover, Sweet	90	Red-top	80
Clover, White	92	Rye	99
Corn, Field	99	Rye Grasses	95
Corn, Kaffir	94	Sorghum	95
Corn, Sweet	99	Teosinte	99
Corn, Pop	99	Timothy	98
Cowpea	98	Tobacco	99
Fescue, Meadow	94	Velvet Grass	90
Fescue, Red	94	Vetches	98
Fescue, Sheep	94	Wheat	99

Poisonous Plants.

So many instances of poisoning, both of human beings and of animals, from eating plants and feeds, have been brought to my notice during the past half dozen years that it seems desirable to publish in this list an account of the common Kentucky plants to which cases of poisoning have been ascribed. The special frequency with which they have occurred during the past two years probably does not indicate an increase in the numbers of such cases of poisoning, but only a growing disposition of our people to recognize

them for what they are and to call the attention of Station workers to them. Scores of animals, horses, and mules chiefly, have died in Kentucky during the past year from what is known as "forage poisoning." Corn, oats, hay, and silage have all been charged with the trouble. Many samples of plants, feeds and fodders used have been examined, in each case proving to be more or less moldy, or otherwise objectionable.

During the summer months when stock depends largely on pasturage those who complain generally charge injury to poisonous plants growing in pastures, and of these we have a rather large list in Kentucky, some of which have acquired notoriety as causes of the death of domestic animals. But exact experiments are needed to show the effect of most of them, and similar tests could well be made to get and record the symptoms and effects of those to which trouble has been definitely traced.

An examination of a pasture in Shelby County, made August, 1903, after a drought and when cattle had died, it was supposed from eating poisonous plants, will serve as an example of what stock may feed upon in pastures when the accustomed pasturage becomes scant and dried out.

List of Plants Observed.

1. Red Cedar (*Juniperus virginiana*). Said to be somewhat poisonous to stock.
2. Green Foxtail Grass (*Setaria viridis*).
3. Nimble Will (*Muhlenbergia schreberi*).
4. Timothy (*Phleum pratense*).
5. Red-top (*Agrostis alba*).
6. Orchard Grass (*Dactylis glomerata*).
7. Bluegrass (*Poa pratensis*).
8. Wild Rye (*Elymus virginicus*).
9. Frank's Sedge (*Carex frankii*).
10. Yard Rush (*Juncus tenuis*).
11. Black Walnut (*Juglans nigra*).
12. Willow (Black ?).
13. Beech (*Fagus grandifolia*).
14. Schneck's Red Oak (*Quercus schneckii*), the *Q. texana* of Gray's Manual.

15. White Oak (*Q. alba*).
16. Chinquepin Oak (*Q. muhlenbergii*).
17. White Elm (*Ulmus americana*).
18. Hackberry (*Celtis occidentalis*).
19. Clear Weed (*Pilea pumila*).
20. Curled Dock (*Rumex crispus*).
21. Smartweed (*Polygonum hydropiper*).
22. Knot-grass (*Polygonum aviculare*).
23. Lamb's Quarters (*Chenopodium album*).
24. *Poke Root (*Phytolacca decandra*). Known to be poisonous and observed to have been eaten.
25. Bouncing Bet (*Saponaria officinalis*).
26. Peppergrass (*Lepidium virginicum*).
27. Hedge Mustard (*Sisymbrium officinale*).
28. Blackberry (Rubus sp).
29. Cinquefoil (*Potentilla monspeliensis*).
30. Apple (*Pyrus malus*). Several trees with apples.
31. *Wild Black Cherry (*Prunus serotina*).
32. Wild Senna (*Cassia marylandica*).
33. Honey Locust (*Gleditschia triacanthos*).
34. White Melilot (*Melilotus alba*). Suspected of poisoning stock.
35. Red Clover (*Trifolium pratense*).
36. White Clover (*Trifolium repens*).
37. *Black Locust (*Robinia pseudacacia*).
38. Upright Wood Sorrel (*Oxalis stricta*).
39. Poison Ivy (*Rhus toxicodendron*).
40. Soft Maple (*Acer saccharinum*).
41. Sugar Maple (*Acer saccharum*).
42. Wild Grape (*Vitis cordifolia*).
43. Prickly Sida (*Sida spinosa*).
44. Wild Carrot (*Daucus carota*).
45. Wild Parsnip (*Pastinaca sativa*).
46. Red Ash (*Fraxinus pennsylvanica*).
47. Blue Ash (*Fraxinus quadrangulata*).
48. *Common Milkweed (*Asclepias syriaca*).
49. White Verbena (*Verbena urticaefolia*).
50. Catnip (*Nepeta cataria*).
51. Peppermint (*Mentha piperita*).
52. Horse Nettle (*Solanum carolinense*).
53. *Jimson Weed (*Datura stramonium*).
54. Mullein (*Verbascum thapsus*).
55. Moth Mullein (*Verbascum blattaria*).
56. Trumpet Flower (*Tecoma radicans*).
57. *Catalpa speciosa.*

58. Common Plantain (*Plantago rugelii*).
59. Narrow-leaved Plantain, Buckhorn (*Plantago lanceolata*).
60. Bracted Plantain (*Plantago aristata*).
61. Common Elder (*Sambucus canadensis*).
62. Buckberry (*Symphoricarpos orbiculatus*).
63. Teasel (*Dipsacus sylvestris*).
64. Indian Tobacco (*Lobelia inflata*).
65. Dandelion (*Taraxacum officinale*).
66. *Wild Lettuce (*Lactuca canadensis*).
67. Horse-weed (*Ambrosia trifida*).
68. Ragweed (*Ambrosia artemisiifolia*).
69. Iron Weed (*Vernonia altissima*).
70. Frost Flower (*Aster ericoides*).
71. White-top (*Erigeron annuus*).
72. Horse-weed (*Erigeron canadense*).
73. Sweet Balsam (*Gnaphalium polycephalum*).
74. Yarrow (*Achillea millefolium*).
75. Dog Fennel (*Anthemis cotula*).
76. Burdock (*Arctium minus*).
77. Common Bull Thistle (*Cirsium lanceolatum*).

The most noticeable poisonous plant in these pastures was wild black cherry. It was evident from the broken branches, still bearing some of the withered leaves, that the stock had fed on the foliage, and the gnawed condition of other poisonous plants, marked with a star above, showed that the animals were suffering from depraved appetites.

On the fourth of July, 1908, another pasture, this time at Frankfort, Kentucky, was examined with reference to the presence of poisonous plants, several shorthorns having died mysteriously, it was thought as a result of something poisonous eaten. Weeds were very numerous. The following were observed, those known to be poisonous being, as in the preceding list, marked with a star.

Broom Sedge (*Andropogon virginicus*). Common.
Red Cedar. Young, frequent.
Bluegrass.
Black Walnut. Common.
White Oak. Common.
May Apple (*Podophyllum peltatum*). Common.
Curled Dock.
Blackberry.

*Wild Black Cherry. Young, frequent.
Honey Locust. Young, frequent.
Red Clover.
White Clover.
*Black Locust. Young and old common, the former having been browsed.
Poison Ivy. Frequent.
*Common Milkweed. Frequent but not observed to have been browsed.
Horse Nettle (*Solanum carolinense*). Very common.
Common Mullein.
Moth Mullein.
Trumpet Flower.
Ruellia ciliosa.
Common Plantain (*Plantago rugelii*).
Narrow-leaved Plantain (*Plantago lanceolata*).
Buckberry (*Symphoricarpos orbiculatus*).
Prickly Lettuce (*Lactuca scariola*).
Common Ragweed.
Iron Weed (*Vernonia altissima*).
White-top (*Erigeron annuus*).
Yarrow.
Common Bull Thistle (*Cirsium lanceolatum*).
Bull Thistle (*C. altissimum*).

The poisonous plants growing in both pastures become doubly suspicious and of these the wild black cherry assumes in my mind an ominous appearance, especially because it was found common in several other pastures in which animals have recently died.

These cases illustrate the condition of many pastures in the State. Some are much worse in the number of weeds and poisonous plants present, others are of course better. Some attention given to learning the characteristics of poisonous species would be time well spent on the part of farmers. Generally it would be a simple matter involving but little labor to get rid of them. Merely running a mower over pastures from time to time during the summer keeps weeds from producing new crops of seeds and in time coupled with the occasional use of a grubbing hoe on the most persistent will get rid of them.

Doubtless some of the deaths of animals running in pas-

tures are due to something else. Accidental poisoning with Paris green, intentionally placed in pastures, or obtained by stock through the carelessness of some one, is among the possibilities, when animals suddenly become sick and die. Chemical analysis of the contents of stomachs will show whether such poisons are present or not. Most of the cases of recent occurrence are unquestionably not due to arsenical poisoning, and since many of them occur in winter when dry feeds are the rule it becomes evident that vegetable poisons developed in feeds are the cause of some of the loss. Some of the possible sources of trouble are given below, with comments on their nature and on the symptoms resulting from feeding silage or other feeds infested with them.

Corn Molds as a Cause of the Death of Animals.

Attention has frequently of late been drawn to moldy corn, silage and other feeds as sources of sickness and death in farm animals, and a study of these growths has shown them to be too often present in feeds. Corn itself, when taken from the field, is likely to be infested with several species, sometimes, encouraged by the injuries of the corn ear worm, a large percentage of a crop being affected. During the winters of 1912-13 and again in 1913-14 the complaints reaching the Station were frequent and it became evident that many animals were being lost as a result of eating damaged silage, corn and ground feeds.

PURPLE MOLD (*Monascus purpureus*), has been given an evil reputation of late, and certainly grows freely in corn silage under some circumstances, tho it is not invariably present in the silage fed to animals that die; some other fungi, species of Penicillium and Aspergillus, are more frequently to be found in samples coming to us. This fact leads me to believe that poisons are produced by several molds. Certainly not all of the cases in Kentucky are the result of eating silage on which *Monascus purpureus* is present. This fungus appears in the surface layer of silage. It does not grow very deep in the interior even of this layer,

and in masses kept in the laboratory worked in only from the edges, producing where most exposed a purple zone, then farther in a white one.

Under the microscope small globular fruiting bodies (about 0.002 inch in diameter) of the fungus are found to bear on the outside the broken threads of the fungus, and within appear more or less coarsely granular, according to the stage of maturity. They finally when broken give up great numbers of small spores about 0.0005 inch in diameter.

Its decided purple color will attract attention at once. Some other red and purple species have been taken by me from moldy corn direct from the shock, among them a new species, *Sporotrichum atropurpureum*, Peck, but they seem not to attack silage.

The green molds found on silage are largely restricted to the surface layers, and the simple precaution of removing and destroying this layer before feeding from the silo should do away largely with the danger from them all. They quickly appear on silage if kept moist whenever it is exposed to the air, a fact which suggests the importance of keeping silos closed as completely as possible at all times.

Corn from the shock and even that stored in cribs immediately after husking, ought to be examined and all moldy ears be rejected. Several mold fungi are constantly present in our fields, one at least (*Diplodia zeae*) being capable of making its way to the grain without help. Most of the rest are admitted to the grain by the corn worm. They are all to be looked upon as unwelcome and as calculated to be unwholesome when eaten.

Seed corn should be inspected for molds with special care, a pink mold (a Fusarium) is very common in our fields and causes many grains apparently sound to assume a pink color. What appears to be the same fungus is found on corn that is germinating badly in the field. Such corn ought not to be planted. It introduces the mold into the field in the first place; it invites the attacks of several insects, such as the seed corn maggot, and thus makes necessary a good deal of

replanting which ought not to be charged directly to the insects.

Some comments on these molds have appeared in several of our bulletins, to which the reader is referred. The study thus far given the matter indicates that much of the trouble can be avoided by (1) care in selecting seed corn; (2) rotation directed to avoid the attacks of the corn worm; (3) care in constructing silos; (4) the rejection of moldy silage in the surface layers.

Ergot as a Source of Trouble.

On the heads of rye and certain grasses black horn-like objects develop, often in large numbers in Kentucky, and project more or less from among the chaff. They vary widely in size and shape according to the grass attacked. On rye they are large, long and easily seen as one walks along the edges of a field. On wheat they are shorter and thicker. On bluegrass they are slender and small but shaped somewhat like those on rye. On red-top they are minute and slender. They were formerly assumed to represent a single parasitic fungus, the *Claviceps purpurea* of botanists, but of late there is a disposition to make several different species, that common in our own bluegrass pastures at times being probably *Claviceps microcephala*. They are all regarded as objectionable and are suspected of causing disease in stock. In 1894 I examined the pastures for ergot with special care. It was then exceptionally common on bluegrass, and complaints reached the Station at the time of cases of abortion and ill health of stock thought to be the result of eating the infested pasturage. At this time English bluegrass (*Festuca pratensis*) and orchard grass (*Dactylis glomerata*) were also found to be infested. We find red-top seed obtained in our market to be very commonly ergotized.

When eaten by animals ergot acts as a vegetable poison, exciting a prolonged contraction of certain muscles, including those of the blood vessels, and thus impedes circulation so as to prevent nutrition and the carrying away of waste from the tissues, the result being to destroy the life of the

parts in which the circulation of the blood is most hampered. It is this power over the muscles that gives ergot its value as a medicine, and also its dangerous effect on gravid stock, in causing abortion.

The black, seed-like objects on the heads of grasses were at one time regarded as freaks or monstrous growths. Even so late as 1841 a learned professor of botany of Cambridge University, England, asserted that they were "a monstrous state of the seed in which the embryo, and particularly one part of it, is preternaturally enlarged." In a general way they look like the grains of smut (bunt) so common in wheat. Unlike bunt, however, the black masses are white centrally. They are shown by the microscope to consist of a number of small thick-walled cells, and contain among other constituents a large percentage of oleic, palmitic and phosphoric acids and of potash.

When ergot occurs in pastures the proper thing to do is to run a mower over the grass so as to cut off the tops, which can then be raked up and burned. It is by eating the tops alone that there is danger to animals. Since the black, seed-like objects do not retain their vitality for more than two seasons when lying in the soil, it should be possible by keeping the tops removed for several seasons in succession to diminish the number of ergotized plants so that stock would not be endangered.

Kentucky Pasture Weeds.

Weeds growing in pastures vary from year to year, and with locality. Sometimes in the Bluegrass country common ragweed is exceedingly common, and then it becomes scarce again. White-top has been known almost to take a pasture, and the frost flower (*Aster ericoides*) has been seen in such quantities that it was difficult to get thro it. The ox-eye daisy may take a pasture in the same way, if it is allowed to have its way. They can all be suppressed by practices known to every farmer, and of these the frequent use of a mower to prevent the development of seeds is the

most important. Many of them are annuals, and to keep them from developing the seed crop for a few years will certainly diminish their numbers greatly.

The perennials, such as curled dock, narrow-leaved plantain, ironweed and yarrow, can be dealt with by the grubbing hoe, or by the use of a spud, consisting of a handle like that of a rake, with a chisel-shaped piece of steel fastened to the end. A very handy spud of this sort is sold by some of the seedsmen for about seventy-five cents. It consists of a long handle, a chisel like that of an ordinary spud and a cross bar at its upper end by means of which it can be driven by the foot deep into the ground so as to cut off long stout roots of weeds.

Hand pulling is a good way to remove many weeds, such as hedge mustard, peppergrass and even the plantains; but it is most effective and easily done immediately after a heavy rain.

Various chemical substances and preparations have been used against weeds by me during the past twenty-five years, among them strong solutions of copper sulfate, salt, coal oil, crude oil and lime-sulfur solution. They can be employed to advantage under some circumstances, especially on limited areas, but the great difficulty in their use comes from the quantities required to do thoro work, their destructiveness to valuable plants and the labor and expense of applying them on a large scale. Poisonous preparations, such as sodium arsenite, formerly sometimes sold as proprietary herbicides, have always seemed to me rather dangerous for use in the hands of those ignorant as to their true nature, and seem scarcely worth recommending when we have as effective and less dangerous preparations at our command.

The use of a twenty per cent. solution of iron sulfate is practicable at times in both lawn and pasture. It does not affect grasses much, and is not dangerous to stock. Its effect differs widely with the character of a weed. Some are little affected because of the character of their foliage. Others are decidedly checked, and by a couple of sprayings with a good field sprayer can be kept from producing seeds,

if they are not actually killed. Among these are the whitetop, sour dock, dandelion and plants of the mustard family.

But while it may in exceptional cases be advisable to resort to this herbicide, it must be said that if the general treatment with mower, hoe and spud is employed, there will be no call for herbicides unless it be for some of the deep-rooted perennial docks. In their case the spud will remove the top and part of the root, leaving a convenient place for the introduction of a dose of crude carbolic acid, crude oil, or coal oil, to prevent later growth.

The following list of weeds was made recently from a bluegrass pasture in Fayette County. It will convey a good idea, with the appended notes on the species, of the weeds which give most trouble. It is not a complete list.

Bluegrass Pasture Weeds.

Crab Grass (*Digitaria sanguinalis*). Common.
Foxtail (*Setaria glauca*). Common.
Dropseed (*Muhlenbergia schreberi*). Common.
Cheat (*Bromus secalinus*). Not common.
Sedge (*Carex cephalophora*). Not common.
Yard Rush (*Juncus tenuis*). Not common.
Clear Weed (*Pilea pumila*). Frequent.
Curled Dock (*Rumex crispus*). Occasional.
Sour Dock (*Rumex acetosella*). Occasional.
Knot Grass (*Polygonum aviculare*). Frequent.
Pigweed (*Amaranthus retroflexus*). Occasional.
Chickweed (*Cerastium vulgatum*). Frequent.
Chickweed (*Cerastium viscosum*). Frequent.
Peppergrass (*Lepidium virginicum*). Common.
Shepherd's Purse (*Capsella bursa-pastoris*). Common.
Hedge Mustard (*Sisymbrium officinale*). Common.
Wood Sorrel (*Oxalis stricta*). Frequent.
Wood Sorrel (*Oxalis corniculata*). Common.
Cranes' Bill (*Geranium carolinianum*). Not common.
Milk Purslane (*Euphorbia maculata*). Frequent.
Common Mallow (*Malva rotundifolia*). Occasional.
Common Milkweed (*Asclepias syriaca*). Rare.
Corn Gromwell (*Lithospermum arvense*). Common.
Nettle-leaved Vervain (*Verbena urticaefolia*).
Henbit (*Lamium amplexicaule*). Common.
Common Nightshade (*Solanum nigrum*). Occasional.

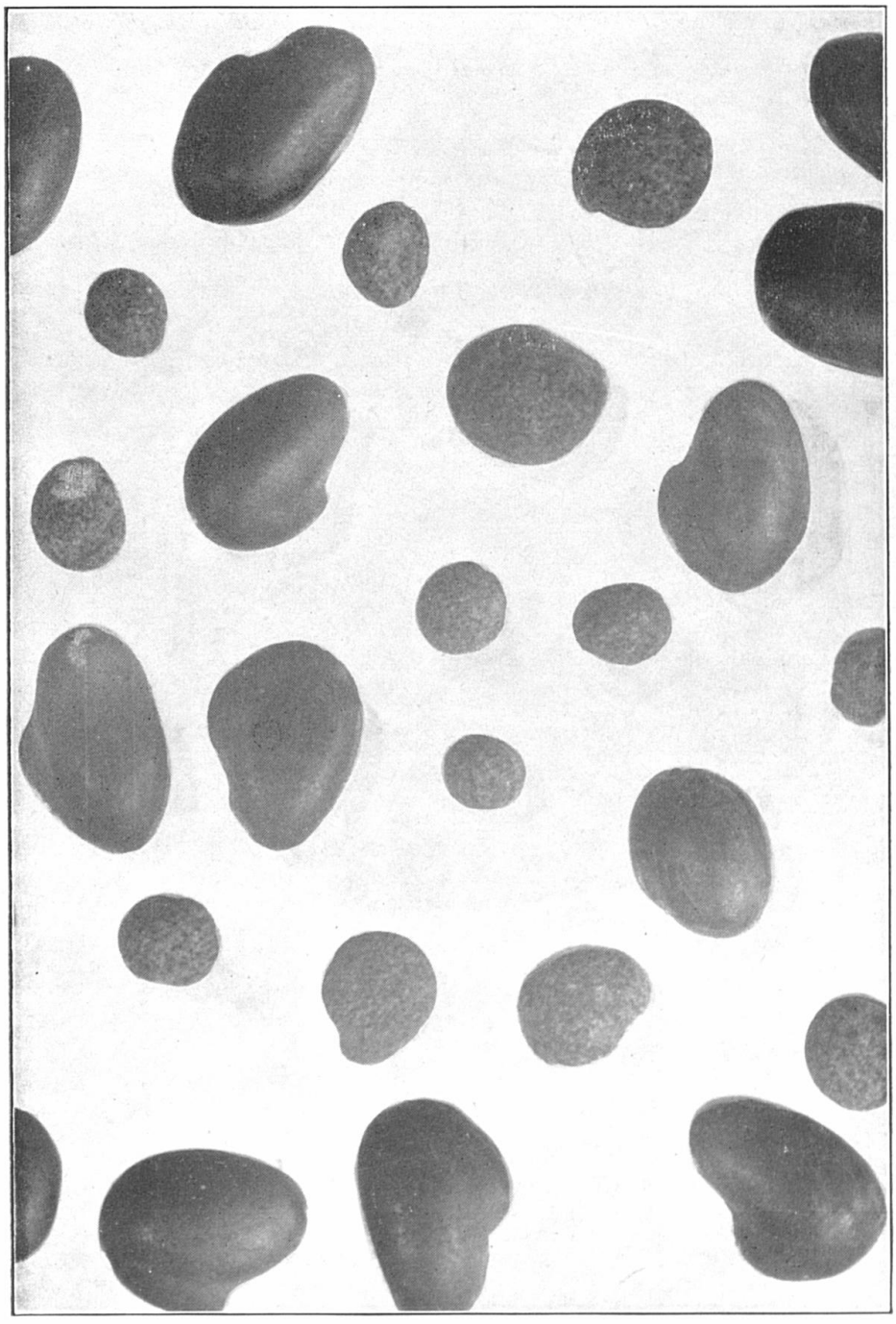


FIG. 1. A sample of Red Clover Seeds with Dodder Seeds. Enlarged.
Photographed by E C. Vaughn.

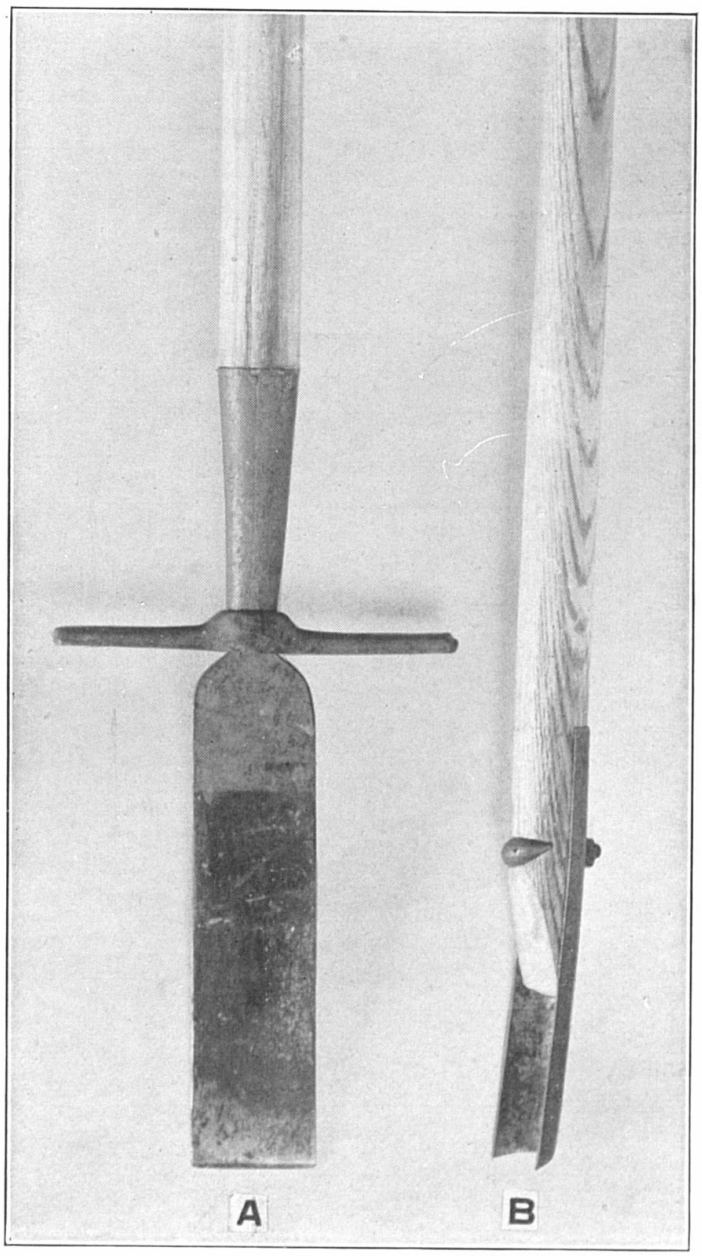


FIG 2. A. A strong Spud useful in destroying strong-rooted perennial weeds; B, A Spud for use against Dandelions and other small weeds.

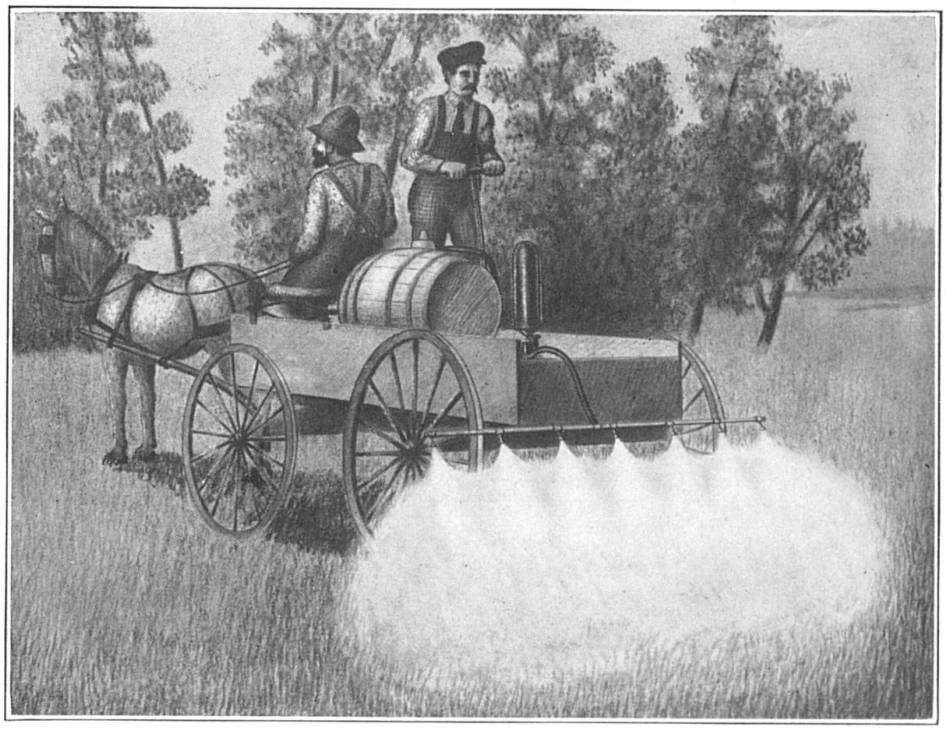


FIG. 3. A Weed Sprayer made by attaching a bar with seven nozzles at end of wagon.

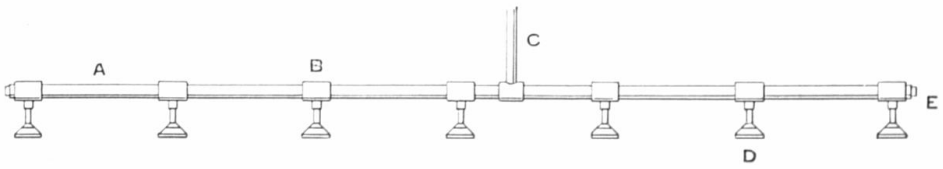


FIG. 4. Showing construction of Nozzle Bar.

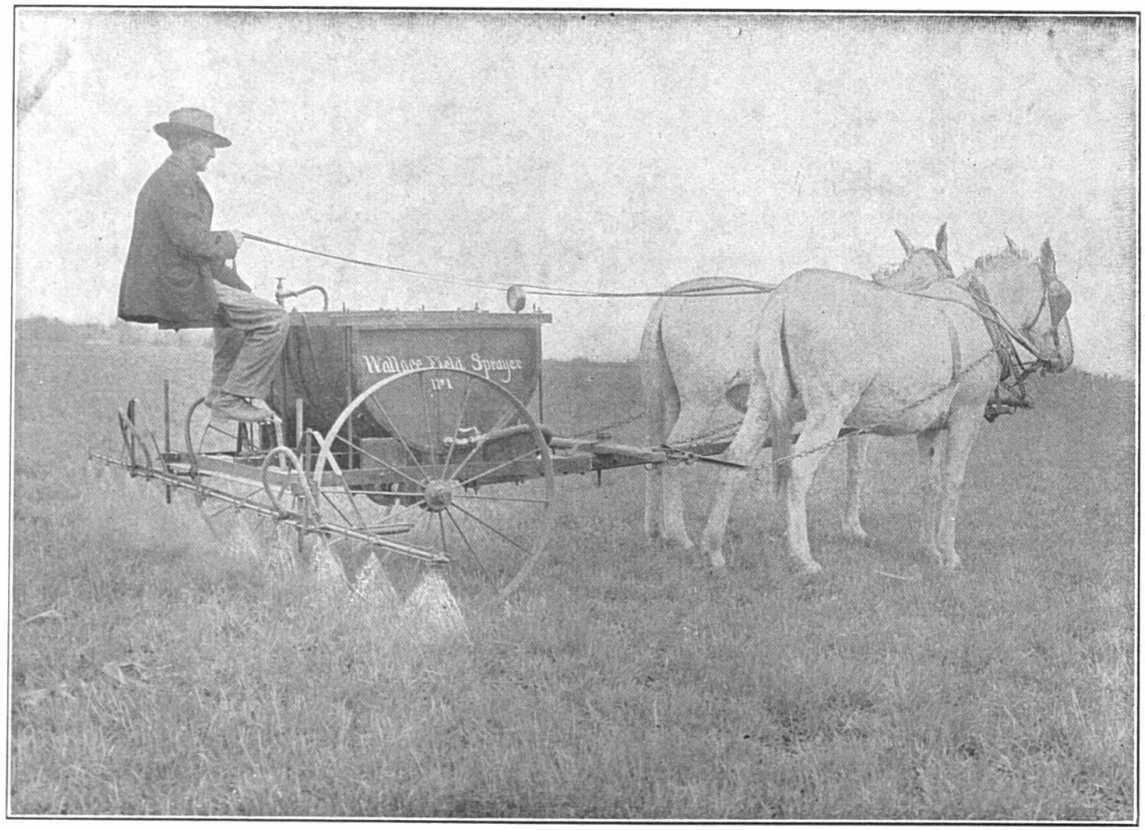


FIG. 5. A Compressed Air Weed Sprayer in use on the Experiment Farm.

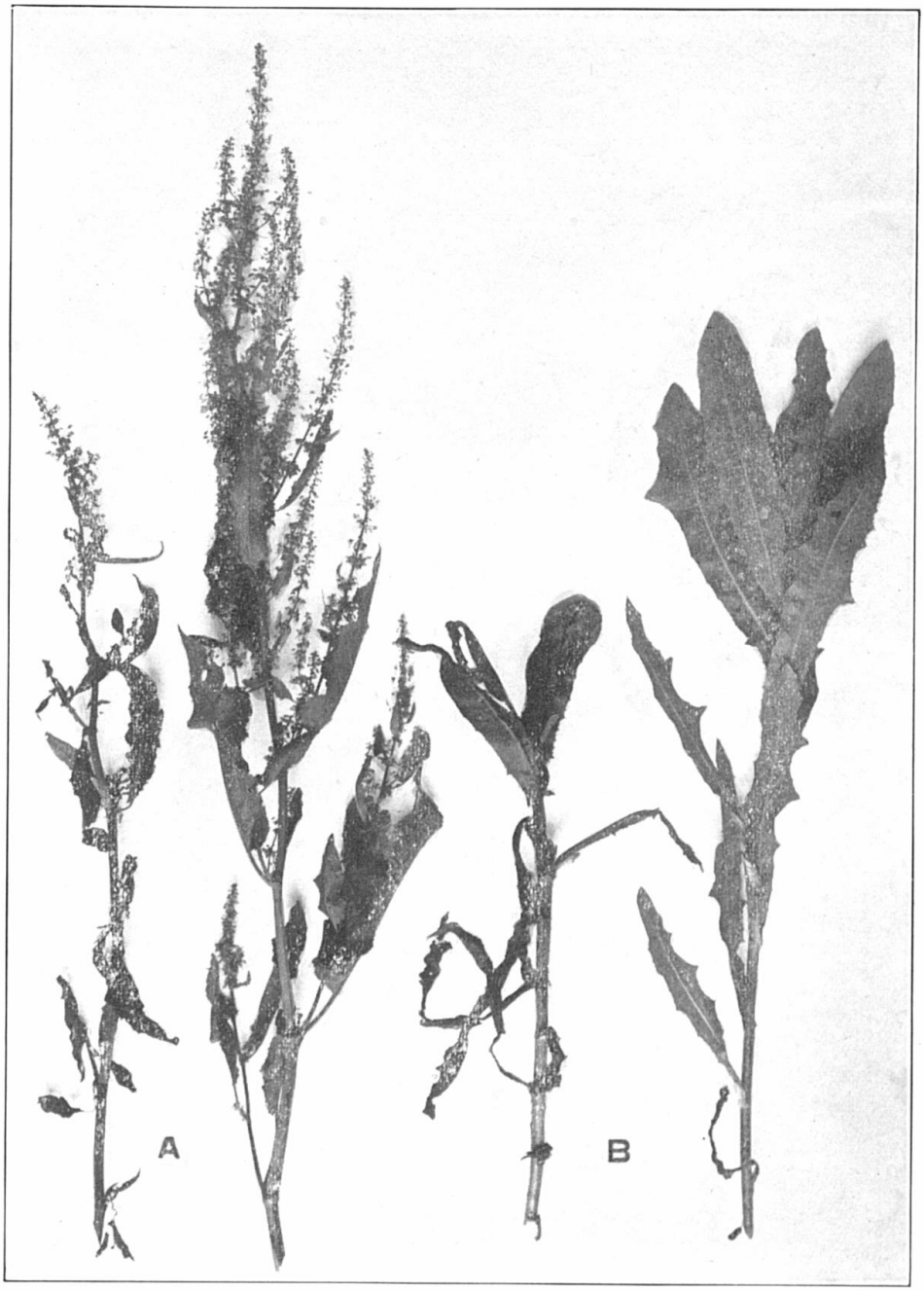


FIG. 6. A, showing result of spraying Curled Dock with twenty per cent. Iron Sulfate. Plant at left sprayed. B, showing result of spraying Prickly Lettuce with same solution. Experiment Farm, June 6, 1907.

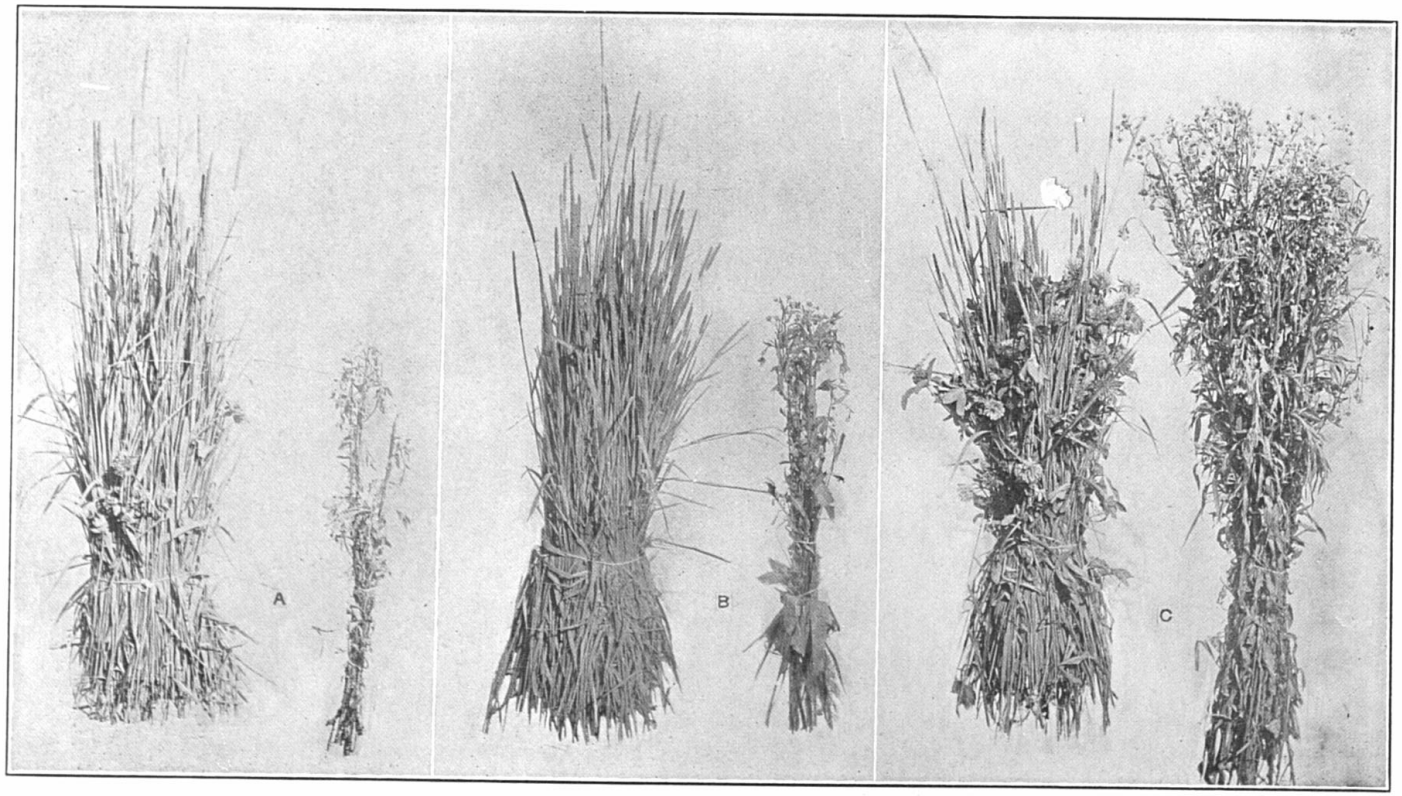


FIG. 7. A, Timothy from four square feet in strip sprayed twice with twenty per cent. iron sulfate; white-top in this area shown at the right. B, Timothy and white-top from four square feet in strip sprayed once with twenty per cent. iron sulfate. C, Timothy and white-top from four square feet of same meadow, not sprayed. Note that the Clover among the Timothy was injured by the spray.

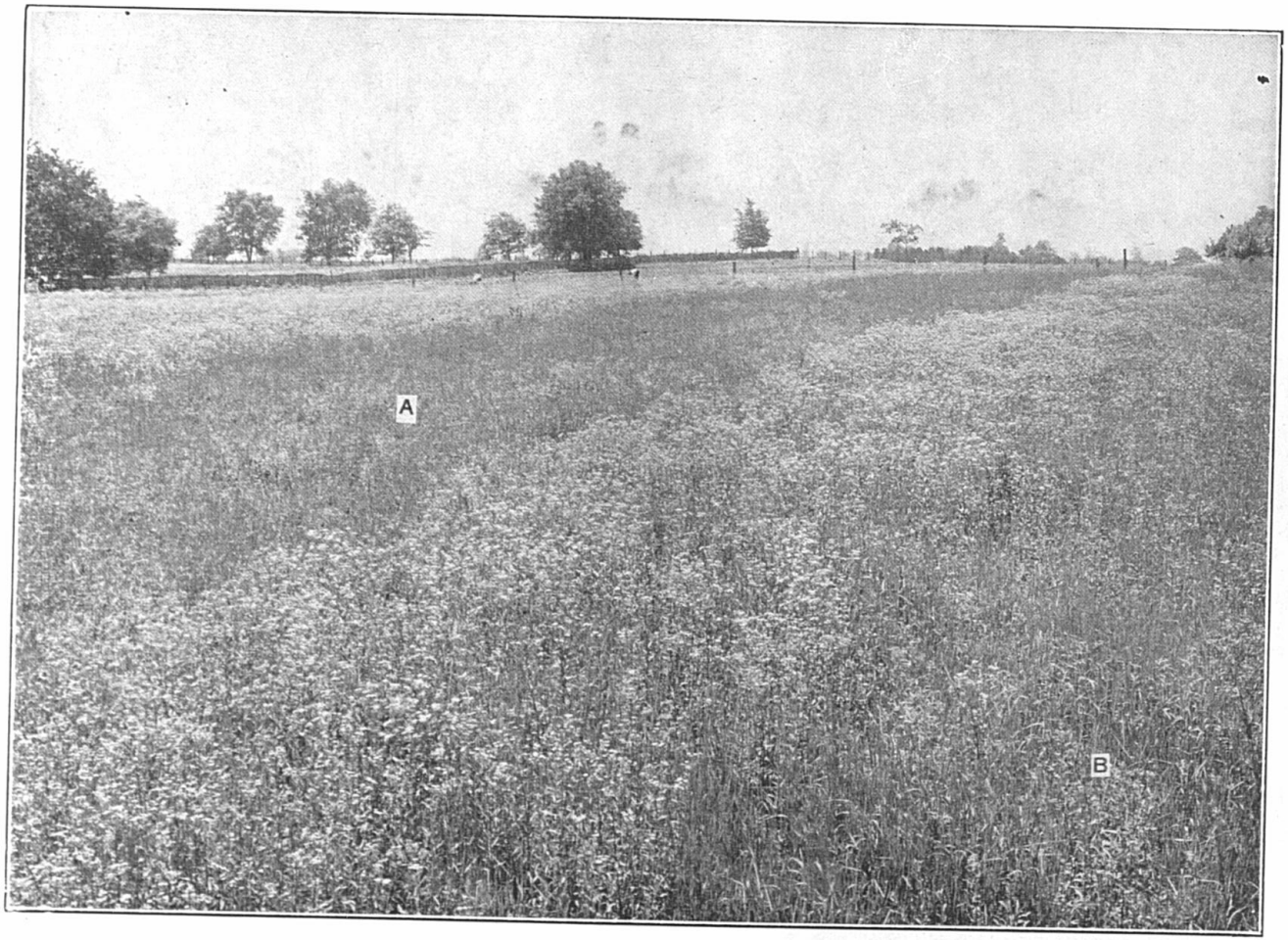


FIG. 8. A and B, Showing strips of Timothy sprayed with twenty per cent iron sulphate for white-top. Experiment Farm, June 12, 1908.



FIG. 9. A head of Rye infested with Ergot; two Ergotized Seeds at right. Photographed by H.Garman.



FIG. 10. a, Bluegrass infested with Ergot. b, An Ergotized Seed, enlarged.

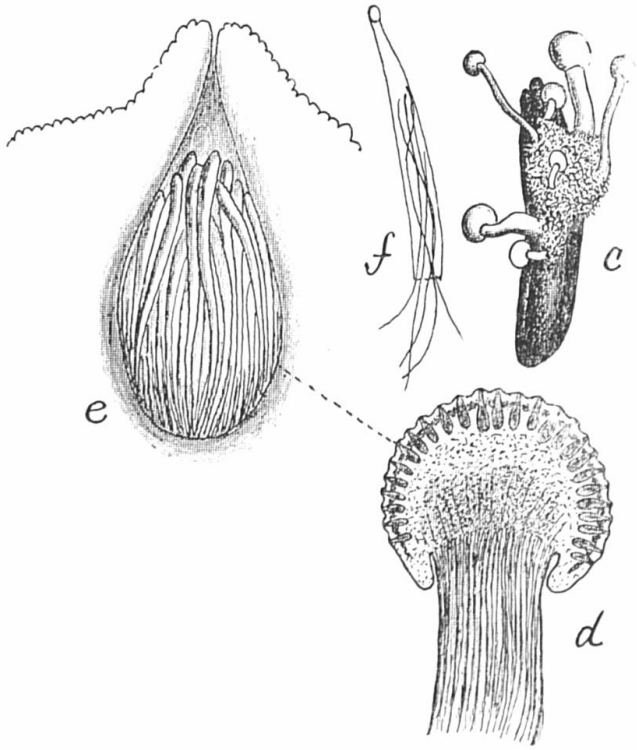


FIG. 11. c, An Ergotized seed with small mushroom-like fruiting bodies of Ergot. d, A section through fruiting body, showing developed spores about margin. e, Perithecium with enclosed spore sacs. f, An ascus or spore sac, with thread-like spores partly discharged. After Tulasne.

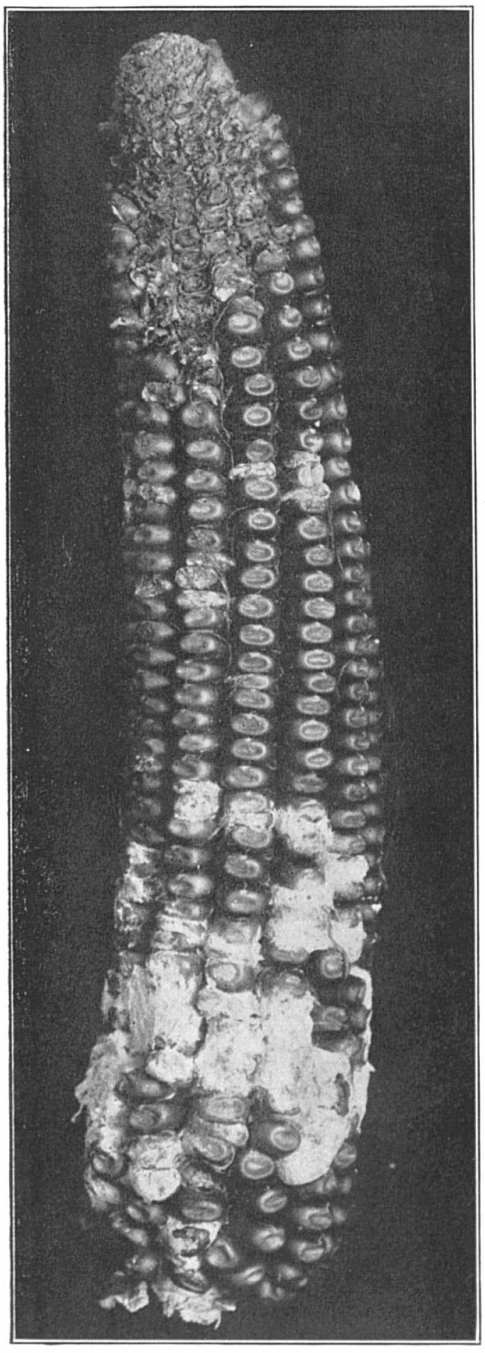


FIG. 12. Field corn injured by mold introduced by the Corn-ear Worm.

Horse Nettle (*Solanum carolinense*). Very Common.
Moth Mullein (*Verbascum blattaria*). Frequent.
Iron Weed (*Vernonia altissima*). Frequent.
White-top (*Erigeron annuus*). Common.
Horse Weed (*E. canadensis*). Frequent.
Horse Weed, Great Ragweed (*Ambrosia trifida*). Occasional.
Ragweed (*A. artemisiifolia*). Common.
Spanish Needles (*Bidens bipinnata*). Frequent.
Sneezeweed (*Helenium autumnale*). Frequent, in wet places.
Yarrow (*Achillea millefolium*). Common.
Dog Fennel (*Anthemis cotula*). Occasional.
Burdock (*Arctium minus*). Frequent in places.
Dandelion (*Taraxacum officinale*). Common.
Prickly Lettuce (*Lactuca scariola*). Occasional.

Meadow Weeds.

The weeds appearing in meadows vary more widely in general character than is the case in pastures. It depends a good deal on what has occupied the land previously as to what species will predominate. In a red-top meadow in Muhlenberg County some years ago I found the yard rush (*Juncus tenuis*) very common and troublesome, tho commonly it is an obscure weed holding its own along paths and on waste land more because it is not considered worthy of attention than because of its aggressiveness. White-top will of course take a timothy or alfalfa meadow in Bluegrass Kentucky if not kept clipped constantly. Even the woody trumpet flower (*Tecoma radicans*) is locally a little troublesome in timothy meadows. Of course dodder is likely to be introduced with alfalfa and clover seeds. The following list will give an idea of what one may expect to find in any alfalfa on land fairly well looked after:

Weeds in Alfalfa Meadow.

Green Foxtail (*Setaria viridis*).
Curled Dock (*Rumex crispus*).
Bitter Dock (*Rumex obtusifolius*).
Smartweed (*Polygonum sp.*).
Black Bindweed (*Polygonum convolvulus*).

Lamb's Quarters (*Chenopodium album*).
Pigweed (*Amaranthus retroflexus*).
Night-flowering Catchfly (*Silene noctiflora*).
Peppergrass (*Lepidium virginicum*).
Hedge Mustard (*Sisymbrium officinale*).
Velvet Leaf (*Abutilon theophrasti*).
Henbit (*Lamium amplexicaule*).
Ragweed (*Ambrosia artemisiifolia*).

In a timothy meadow examined June 23, 1909, the following weeds were conspicuous from the numbers present:

Cheat (*Bromus secalinus*). Frequent at edge of meadow.
Curled Dock (*Rumex crispus*).
Sour Dock (*Rumex acetosella*). Common in clumps.
Peppergrass (*Lepidium virginicum*).
Trumpet Flower (*Tecoma radicans*).
Horse Weed (*Ambrosia trifida*).
White-top (*Erigeron annuus*). Common.
Yarrow (*Achillea millifolium*).
Frost Flower (*Aster ericoides*). Not in bloom.
Wild Lettuce (*Lactuca canadensis*).

All of the following weeds occur in Kentucky and are represented in the herbarium of this Department of the Station. No attempt is made to give a complete list, and numerous other Kentucky species could have been included. Some of those omitted will perhaps be regarded by farmers as worthy of mention.

The illustrations used in this bulletin are original, except Figure 11. A few of them have been used previously by the writer.

Scouring Rush Family (Equisetaceae).

Scouring Rush, Horse-Tail Rush (*Equisetum arvense*). These plants have cylindrical jointed stems, coated with silica, and furnishing a harsh and indigestible forage even if it were not otherwise hurtful. Some cases of poisoning have been attributed to it and the death of animals has been charged to a related species found in Europe. Its effect when eaten has been claimed to be astringent, stimulating, and diuretic, but the weight of testimony is to the

effect that when it is abundant and horned cattle eat it for some time, diarrhea is produced and the affected animals lose in weight, in case of dairy cows producing also less milk and of inferior quality, the butter from such milk being "hard and bad," according to one author. Serious injury was formerly done to cattle by the above species on flat meadows of Holland, where the plant flourishes. As early as 1756 Linnaeus, the Swedish naturalist, asserted that cattle brought to these meadows from Friesland became consumptive. Nosemann, as quoted by Storer*, states that the fat of animals pastured on the plant is white and has a greasy taste, and that calves bedded with hay containing scouring rush pick out and eat the rush freely, becoming as a result affected with diarrhea and fits. Horses are also sometimes injuriously affected by it, though it is believed less severely than cattle.

The testimony as to the injurious nature of the plant is of such character as to enjoin the greatest care on the part of farmers in avoiding it, both in hay and pasture.

It occurs everywhere in Kentucky, generally in greatest numbers in damp flat land and along streams. The fruit or spores are produced on special conical heads at the free ends of thick, simple stems, jointed like the more slender, branched sterile growths of the plant, most commonly seen. These thick fertile stems may reach a height of a foot or two, and a diameter of a quarter inch, the sterile stems being much more slender, and the growth as a rule less tall.

Grass Family (Gramineae).

Broom, Broom Sedge (*Andropogon virginicus*). This is one of the commonest pasture and meadow grasses in Kentucky, but is local and partial to rather poor soil, tho it will grow almost anywhere. It is commonly 18 to 20 inches in height, but when undisturbed in good soil may reach a height of three feet or more. It grows in clumps, but may

* "On the chemical composition of the common Field Horsetail or Scouring Rush (*Equisetum arvense*)" Bulletin of the Bussey Institution, vol. II, p. 166.

occupy large tracts quite thickly. In fall and winter the dry reddish brown growth persists in quantities, and is a characteristic feature of pastures of Central and Western Kentucky. It has been observed from the eastern to the western borders of the State, occurring in valleys even in the heart of the mountains. It is scattered by winds, the long silky hairs about the seeds serving to render the seeds bouyant; also in some cases on the coats of sheep. A native plant.

Johnson Grass (*Sorghum halepense*). This grass is not as common in Kentucky as it is farther south, but is likely to be encountered anywhere in small quantities, and when specially favored by situation sometimes assumes the character of a weed, its persistence being due to the underground rootstocks by which it then spreads.

Its known value as a forage plant is decidedly in its favor when it appears in meadow and pastures. Animals are fond of it and thrive upon it. In cultivated ground it can be suppressed by winter plowing followed by close cultivation for a season or two. On the Experiment Station farm where I sowed it twenty years ago, it gave no trouble, tho disposed to spread into the paths about the plot. It appeared at one time on the Campus of the University also, but disappeared again after being kept cut closely for a couple of seasons. It thrives on low ground and rich soils, but appears temporarily from scattered seeds in the most unfavorable soils and situations.

The plant is a coarse one, sometimes reaching a height of six feet or more, with broad blades, and mid-rib whitish. The panicles are large, spreading, often with a purplish hue when maturing. From Europe.

Crab Grass (*Digitaria filiformis*). Collected at Clinton, Kentucky.

Crab Grass (*Digitaria sanguinalis*). This is one of our most troublesome grass weeds, occurring everywhere in cultivated ground, in meadows, pastures, lawns, and along roadsides. It has some value for hay, and when other forage becomes scarce is sometimes cut for this use. Its seeds are

often scattered among seeds of forage plants, but the plant is now so common on all cultivated land that but little relief would be afforded by keeping forage seeds free from it. Close cultivation, and the use of the hoe discourage it in time. It is an annual and any treatment that keeps it from producing its seeds is a help. Introduced from Europe.

Old Witch Grass (*Panicum capillare*). This grass is sometimes seen about cultivated ground, but is not to be regarded as a pest, except locally. It is sometimes called tickle grass, and tumble grass, because the rather large panicles break off and are blown about by the wind in the latter part of summer. Native.

Panicum dichotomiflorum. This is a rank growing grass, with broad blades and brushy panicles of small flowers. It grows to a height of three or four feet when not cut, and while it may become common and objectionable on restricted areas, is generally found a clump or two in a place. It is easily destroyed with a hoe. Native.

Panicum anceps. This grass has been collected at Hopkinsville, Guthrie, and elsewhere in the central part of Kentucky. It has recently been reported from the eastern end of the State as a troublesome weed. Native.

Pigeon Grass (*Setaria glauca*). A common weed in all fields and elsewhere. Not very troublesome, however. In bloom throut late summer. From Europe.

Setaria verticillata. Frequent in cultivated ground, but not so often seen as the preceding. From Europe.

Green Foxtail (*Setaria viridis*). A common weed everywhere. From Europe.

Reed Canary Grass (*Phalaris arundinacea*). This is a coarse, harsh, broad-bladed grass of which the common striped ribbon grass is a variety. It is partial to low damp ground, where it produces a fair crop of forage consisting largely of blades. In our experimental forage plots it has proved one of the most persistent species tested, lasting for ten years or more and producing each year a growth from

two and a half to three feet high. An analysis of the plant published in 1900 from a sample taken from one of our plots shows this grass to be equal in some of its conditions to samples of timothy. The analysis is given below:

Ash, 9.98; protein, 9.76; fiber, 23.63; nitrogen-free extract, 53.02; fat, 3.61; phosphoric acid, 0.65; nitrogen, 1.56; potash, 2.43.

As a poisonous or unwholesome plant its reputation is uncertain, and should be investigated. It is to be remembered that both corn and sorghum are accused of having in some of their conditions proved hurtful to animals. Reed canary grass has had the name "Crazy Grass" applied to it because of a supposed effect on horses. Introduced from Europe, or Asia.

Dropseed (*Muhlenbergia schreberi*). This inconspicuous grass is a common weed in lawns and pastures. Native.

Yard Grass, Goose Grass (*Eleusine indica*). A flat-stemmed low-growing grass of dooryards where it thrives about ash heaps and along little used walks, making a good deal of trouble because of its persistence and the difficulty of cutting it with a lawn mower. In good soils the stems may reach a height of thirty inches or more and bear four (sometimes two) to six diverging flower-bearing thickish spikes at the extremities. Tho an annual, it produces a good deal of forage when favorably situated. Animals eat it freely. Analysis shows it to belong among our best grasses in the matter of nutritive constituents. Introduced.

Tall Red-top (*Tridens flavus*). This tall, wiry grass is often seen in lawns and along railroads. It has little value at any stage for forage, and should be got rid of by keeping it from seeding, and grubbing it out in late summer, when the tufts become conspicuous. To be recognized by its purplish panicles, with sticky branches, this feature continuing on the upper part of the stem. A perennial. Native.

Stink Grass (*Eragrostis megastachya*). This strong smelling grass is likely to be found in any cultivated field, along

paths, etc. It is easily destroyed with the hoe. The "buggy" odor will distinguish it from any other weedy grass occurring here. From Europe.

Cheat or Chess (*Bromus secalinus*). Common everywhere along farm roads and in wheat fields. It has no value of any sort and when mixed with hay is generally rejected by animals. It is not difficult of eradication if taken when young. The seeds should never be allowed to mature on a farm. They are sometimes scattered with forage seeds, but not often with wheat, judging by the seed wheat inspected by me. Annual. From Europe.

Upright Chess or Cheat (*Bromus racemosus*). Upright chess has been collected thus far only at Cave City, in May, 1898. An introduced species, probably from Europe.

Corn Brome or Chess (*Bromus squarrosus*). A single specimen of this chess is in the collection from Lexington. Introduced from Europe.

Downy Cheat or Brome Grass (*Bromus tectorum*). A downy species sometimes observed along railroads and elsewhere in May. The panicles are decidedly drooping, and the glumes bear long slender bristles or awns. In a general way it is much like common cheat, and is probably not often recognized by farmers as different. From Europe.

Hairy Wood Chess (*Bromus purgans*). Collected on the banks of Kentucky River at Tyrone and Clay's Ferry. A native species not thus far observed in cultivated ground.

Quack Grass, Couch Grass (*Agropyron repens*). This is not as common in Kentucky as it is farther north and west. It has been noted at Lexington, and has been sent me once or twice from Western Kentucky. From Europe.

Sedge Family (Cyperaceae).

Nut Grass (*Cyperus esculentus*). On low wet ground this sedge is often very common in cultivated ground. Native.

Carex cephalophora. Common in bluegrass pastures. The

seeds are often found in the bluegrass seed crop. It is not particularly troublesome.

Rush Family (Juncaceae).

Yard Rush (*Juncus tenuis*). Common everywhere in yards, about lawns, pastures, etc., flourishing in both shade and sunshine. A wiry plant about ten inches high or less, producing large numbers of minute seeds in its oval brown capsules in late summer. The seeds are sometimes found among forage seeds. From Europe or Northern Africa.

Lily Family (Liliaceae).

Wild Leek (*Allium tricoccum*). Native.

Wild Onion (*Allium cernuum*). Native.

Wild Onion (*Allium canadense*). Native.

Wild Onion, Field Garlic (*Allium vineale*). This plant occasions more complaint from farmers than any other, except perhaps dodder of clover. It is very prevalent in Southern and Western Kentucky, occurring in all sorts of cultivated land and flourishing in any neglected ground. It produces in summer heads of small bulblets instead of flowers, and others develop in the soil. The former look very much like grains of wheat in general shape, and are sometimes found in seed wheat, with which they are doubtless sometimes sown. These bulblets are especially objectionable because of the flavor they give flour in case many are present in the wheat used. They give a flavor to milk also, when common in pastures.

There is no easy way of getting rid of them. Spraying with iron sulfate does not help, because of the character of growth of the plant. Coal oil, crude oil, crude carbolic acid, and probably other substances, can be made to kill plants, but are so destructive to everything else as not to be very practicable when the weeds are numerous and widely scat-

tered*. When the soil is moist and moderately loose, they can be pulled up by hand so as to remove most of the bulbs in the soil. This should be done before the tops mature so as to avoid scattering the bulblets. All such plants should be burned, since the bulbs and bulblets are wonderfully persistent and will grow after having been dried for months. The grubbing hoe may be used under some circumstances to advantage. Winter plowing sometimes rids a field of most of the plants by throwing the bulbs to the surface where they are exposed to alternate freezing and thawing. Putting land in corn or tobacco the following season is a good practice, since it discourages the growth of such plants as escape the frost. From Europe.

Star of Bethlehem (*Ornithogalum umbellatum*). Common in old lawns about dwellings, where it grows in tufts and is sometimes so numerous as to be the cause of complaint. It produces small bulbs and in general resembles an onion, tho lacking the characteristic flavor. In May it produces an attractive white flower. It seems to have been much planted in former times as an ornamental and still clings to old premises when not wanted. It is only necessary to grub it up in winter. From Europe.

Lily of the Valley (*Convallaria majalis*). The lily of the valley is well known in households everywhere because of its small, white, sweet-scented, nodding flowers. Tho commonly seen only about dwellings, it sometimes escapes, and in any case is occasionally eaten by animals with bad effect. All parts of the plant are regarded as poisonous, tho in small quantity they are not fatally so. Animals most often eat the plant when allowed the freedom of the lawn. The plant is partial to shaded places where it grows

*Dr. J. C. Arthur, of Purdue University, Lafayette, Indiana, recently called my attention to some experiments made with orchard heating oil on wild onion, mentioned by him in a brief article published January 3, 1913, in "Science." Dr. Arthur claims that a spray of this oil was made to destroy the bulbs of wild onion, both on the tops of the plants and in the soil, and that while the oil kills everything growing on the land, its effect is soon gone, when crops may be grown again.

in dense clumps, the broad leaves largely concealing the flowers. Native and introduced.

Carrion Flower (*Smilax herbacea*). The carrion flower is a climbing herb, the leaves broad oval and bearing a pair of tendrils on the petiole, the flowers insignificant and ill-scented, the fruit a small black berry borne in roundish clusters (umbels).

Green Brier, Cat Brier (*Smilax rotundifolia*). These woody, prickly stemmed plants are sometimes a source of trouble because of their presence in orchards and pastures. Both sides of the oval leaves are green. They should be grubbed out in winter. Native.

Saw Brier (*Smilax glauca*). Stems prickly or smooth, the leaves decidedly gray beneath and smaller than those of the preceding. Native—Menifee County.

Smilax bona-nox. Leaves heart-shaped or fiddle-shaped, green both sides, the margins often bristly. Stems prickly. Native—Livingston County.

Orchid Family (Orchidaceae).

Yellow Lady's Slipper (*Cypripedium hirsutum*). In a note published in the Bulletin of the Torrey Botanical Club, Vol. VI, p. 15, in 1879, a writer calls attention to the case of Prof. H. H. Babcock, who was several times poisoned about the face, as if by poison ivy, when he had not handled this plant, but had handled either the yellow lady's slipper named above or the northern *C. spectabile.* Babcock's note was published in The Pharmacist, Chicago, January, 1872. Later Dr. R. E. Kunze in the same volume of the Bulletin suggests that this was simply a recurrence of the rash due to previous poisoning with poison ivy. Dr. Kunze asserts that tons of the plants are handled by eclectic physicians and no case of poisoning by any of them is known. Very convincing evidence was, however, obtained by Dr. D. T. McDougal with reference to one of these species in 1893 and reported in the Minnesota Botanical Studies, in 1897. He states that in September 7, 1898, he brushed a specimen of *C. specta-*

bile lightly across the biceps muscle of his left arm and that fourteen hours later the arm was much swollen from the shoulder to the end of his fingers. The skin touched by the plant was very badly inflamed and with maculae, "accompanied by the usual symptoms of dermatitis and constitutional disturbance." The arm was reduced to its usual size at the end of ten days, but the effects lasted for a month.

Such effects are not produced on everybody, and perhaps depend on the condition of the body at the time, possibly also on the condition of the plant. Something of the same sort may be said about poison ivy. It does not poison everybody, and may poison some, it is claimed, even by emanations.

The plant is well known under the above name and sometimes also as the yellow moccasin flower. Its root stocks are collected for the manufacture of a medicine, considered useful in nervous disorders. A second species, also occurring in Kentucky, with a small flower, is sold to pharmacists for the same purpose. Neither plant is now common in Kentucky, probably a result of the persistent search made for them by collectors of herbs.

Nettle Family (Urticaceae).

Nettle (*Urtica gracilis*). An obscure plant reaching a height of eighteen inches or two feet, with rather narrow, pointed, sharply toothed leaves and insignificant greenish flowers clustered along the upper part of the stem. Native.

Weak Nettle (*Urtica chamaedryoides*). A slender plant with broad heart-shaped, coarsely toothed opposite leaves, the flowers arising in the axils along a large part of the stem. Native.

Rich Weed, Clear Weed (*Pilea pumila*). This is another obscure plant found in odd corners about premises, but easily got rid of. The thin leaves are entire, lance-shaped, long pointed. Like others of the family the flowers are in small clusters, scattered along the stem at the bases of the leaves. Native.

Pellitory (*Parietaria pennsylvanica*). Pellitory occurs about premises with the preceding, from which it may be distinguished by its broad oval, simply, regularly toothed leaves. Native.

Dock Family (Polygonaceae).

Curled Dock, Yellow Dock (*Rumex crispus*). A coarse perennial plant with large leaves and tall stems, largely leafless, bearing numbers of small flowers, these at length producing numerous shining angled brown seeds enclosed in a three-winged envelope. The seeds are often found among clover and other forage seeds. The weed is not one of the most troublesome, since the plants are scattered ordinarily, and can be cut out with a hoe. From Europe.

Rumex mexicanus. Lexington, Ky., May 3, 1910. Native.

Pale Dock (*Rumex altissimus*). Not as common as the curled dock, and found mostly along streams. The edges of the leaves are not curled. Native.

Bitter Dock (*Rumex obtusifolius*). A coarse species, the leaves heart-shaped at base. Frequent about farms. From Europe.

Sour Dock, Field Sorrel, Sheep Sorrel (*Rumex acetosella*). This is a slender, low-growing plant, introduced from Europe, which has of late overrun the cultivated land of Kentucky. It has been introduced in large quantities with clover and other seeds, and is being scattered still further with several of our small-seeded forage plants. The name sour dock fits it because of its sour leaves. It is a small plant, not often exceeding 8 or 10 inches in height, but in good soil reaching a height of 19 inches or a little more. It often appears in patches. The leaves vary a good deal, but are often halberd-shaped. The flowers are rusty red, and when plants are numerous their hue draws attention to them among grasses. They are fully expanded in May. Spraying with 20 per cent. iron sulfate can be made to keep such plants from producing crops of seeds, but the roots are likely to persist and will

send up tops whenever they are not looked after. Close cultivation and the use of the hoe seem to be the most effective means of dealing with the pest. Clover and bluegrass seeds in which sour dock seeds are mixed in large quantities should not be sown.

Knot Grass (*Polygonum aviculare*). This is a common plant about dooryards, along walks and elsewhere. Its spreading habit renders it difficult to cut and keep from seeding. From Europe and Asia.

Polygonum erectum. A broader-leaved, more erect plant than the preceding. Also found about dooryards. Native.

Smartweed (*Polygonum pennsylvanicum*). Native.

Smartweed (*Polygonum careyi*). One specimen from Stanford. Native.

Smartweed (*Polygonum hydropiper*). From Europe.

Water Smartweed (*Polygonum acre*). From tropical America.

Prince's Feathers (*Polygonum orientale*). A tall erect species with bright purple spikes of flowers, and broad leaves. Often grown as an ornamental about dwellings, but sometimes seen as an escape. From India.

Lady's Thumb (*Polygonum persicaria*). From Europe.

Polygonum setaceum. Collected by me at Guthrie, Ky., August 11, 1902. Native.

Mild Water Pepper (*Polygonum hydropiperoides*). Native.

Polygonum virginiana.—Guthrie, Ky., August 11, 1902.

Arrow-leaved Tear-thumb (*Polygonum sagittatum*). From Asia.

Black Bindweed (*Polygonum convolvulus*). A vine, the leaves with pointed tips and two acute lobes at base. From Europe.

Climbing False Buckwheat (*Polygonum scandens*). A vine, leaves heart-shaped, the lobes at base rounded, the stems smooth. From Japan.

Polygonum dumetorum. Similar to *P. convolvulus*, but the stems not rough. From Europe.

Goosefoot Family (Chenopodiaceae).

Mexican Tea (*Chenopodium ambrosioides*). From tropical America.

Jerusalem Oak (*Chenopodium botrys*). From Europe.

Lamb's Quarters (*Chenopodium album*). A common weed in gardens. Not a serious pest. From Europe.

Chenopodium murale. From Europe.

Chenopodium boscianum. Native.

Amaranth Family (Amaranthaceae).

Pigweed (*Amaranthus retroflexus*). A very common, broad-leaved weed in gardens, fields and barnyards. From tropical America.

Purple Weed (*Amaranthus paniculatus*). Frequent in good ground, but not as common as the preceding. From tropical America.

Tumble Weed (*Amaranthus graecizans*). Not very common in Bluegrass Kentucky, Lexington. Native.

Thorny Amaranth (*Amaranthus spinosus*). Very common everywhere in Kentucky. From tropical America.

Pokeweed Family (Phytolaccaceae).

Poke Root (*Phytolacca decandra*). This weed is of such striking appearance that it is well known to all Kentucky farmers. It grows to a large size, 5 or 6 feet in height in good soils and with a spread of branches almost as great. Its stems and twigs are purple and green, smooth, with a waxy bloom, and very succulent. The clusters of black berries are rather attractive and tempting in appearance but are insipid and inedible to man, though sometimes eaten by birds. The young shoots with some resemblance to aspara-

gus are sometimes prepared for the table like the latter. The writer has found them not particularly good, certainly much less palatable than asparagus.

The plant has a bad reputation; animals are said to have died as a result of eating the leaves. Possibly this was due to eating an excessive quantity. Even white clover may in such case cause trouble. It is certain that under some circumstances the berries may be eaten by birds, and young shoots, as stated above, are not unwholesome. Native.

Indian Chickweed Family (Aizoaceae).

Carpet Weed, Indian Chickweed (*Mollugo verticillata*). A small plant growing in mats, with simple slender leaves widening outwardly and in whorls of about five. The obscure flowers scattered along stems and arising from the axils of the leaves. Not troublesome. Introduced.

Pink Family (Caryophyllaceae).

Thyme-leaved Sandwort (*Arenaria serpyllifolia*). A slight plant. Collected at Lexington. From Europe.

Sandwort (*Arenaria patula*). Common along Kentucky River from April to June, when the seeds are mature. A graceful native plant with small white flowers.

Chickweed (*Stellaria graminea*). A slight species with linear leaves, collected only at Crow Hickman in Daviess County, May 4, 1912.

Great Chickweed (*Stellaria pubera*). More erect than the next and with larger leaves. Collected at various points along Kentucky River. A native species.

Common Chickweed (*Stellaria media*). The chickweeds, of which we have several belonging to the genera Stellaria and Cerastium, are not closely discriminated by the ordinary observer. This one grows in the same situations as the others, about lawns, roadsides and pastures, where it forms dense growth completely covering the ground, the slender stems finally attaining a height of eight or nine inches. The

surface is not very evidently downy, the stem leaves are mostly short, broad, ovate and without petioles. The small white flowers are inconspicuous, the petals deeply cut, the seed capsules ovate. Annual, scattered by the seeds. Introduced from Europe.

Mouse-ear Chickweed (*Cerastium vulgatum*). This is a taller plant than the next, and a perennial, hence conspicuous in May when *C. viscosum* is brown. Its leaves are linear and pointed. It often covers the ground completely, where bluegrass is wanting. Plants are about six inches high. From Europe.

Cerastium viscosum. A downy annual common in pastures of Bluegrass Kentucky in early spring. Completely matured and brown by the end of May, the rather slender capsules being largely empty by the twenty-fourth of this month. Leaves oval. From Europe.

Cerastium nutans. Collected at Tyrone, Ky., in April. Native.

Corn Cockle (*Agrostemma githago*). The common name of this introduced plant is a misnomer for this country, since it grows among small grains and not among corn (maize). It is frequently seen also along roadsides and in fence corners on farms. It is an upright annual with narrow opposite leaves, and bears a few rather handsome purple red flowers at the ends of the branches, the petals expanding about an inch. In good soil it may reach a height of two feet ten inches or more. In early May the erect plants may be noted among grasses and small grain, where they are recognizable for their gray green hue due to a soft white silky pubescence with which stems and leaves are clothed. In the latter part of May the elongate flower buds about three-fourths inch long and with five characteristic linear calyx lobes, appear, and by May 24 some of the flowers have expanded, most of them being out ordinarily by the end of the month.

The seeds are sometimes seen among wheat seed, and the weed is now frequently scattered from infested fields in this country.

Both plant and seeds contain a poison commonly known as saponin. The seeds are frequently encountered by us in feeds, fragments often occurring in brans, screenings, and mixed feeds, where they may, if present in large quantity, prove unwholesome or even fatally poisonous. Flours containing the ground seeds are said to have been the cause of death in human beings. Poultry, eating screenings are liable to get too many cockle seeds, and samples of such screenings with complaints of the death of poultry eating them have sometimes been sent to this Station.

The seeds are black, about 1/8 inch in greatest diameter, varying from triangular to quadrangular in outline, roughened with small tubercles, these arranged in curved lines, and often affording a means of recognizing fragments when they occur in ground feeds. In human beings symptoms of poisoning by this plant are: Headache, vertigo, vomiting, rapid pulse, difficulty in standing, coma.

In animals the lining in the alimentary canal becomes irritated and inflamed, resulting in vomiting, diarrhea, dizziness, difficulty in moving, etc. The poison is believed actually to kill nervous or muscular tissues with which it comes in contact.

This is one of the unquestionably dangerous plants. From Europe.

White Campion, White Cockle (*Lychnis alba*). A hairy, stocky plant reaching a height of one and a half to two feet, bearing opposite, slender, pointed leaves and white flowers expanding about three-fourths inch. Observed several times at Lexington among grass grown from European seeds.

Sleepy Catchfly (*Silene antirrhina*). This is a rather common weed in Kentucky meadows, where it produces a slender growth about a foot high, the tapering stems with sticky purple regions at intervals, upon which the ripe seeds catch when dropping from the capsules and where occasional small beetles and other insects become mired. The name catchfly is derived from this fact. The small flowers at the ends of slender pedicels form numerous brown capsules

about one-fourth inch long finally. As with other members of the pink family, the leaves are opposite, and they are so small and slender as to be scarcely noticeable. The plant is suspected of being poisonous. When common in clover fields its effect on stock eating the hay should be observed closely. Common in May and June. Native.

Silene dichotoma. Collected in cultivated ground at Lexington. From Europe.

Night-flowering Catchfly (*Silene noctiflora*). A small plant, tho sometimes attaining a height of about eighteen inches, with sticky, downy stems and leaves. Flowers white, the petals deeply cleft, opening at night during June and July, leaving at length inflated veiny calyx tubes about the seed pods. The leaves are rather broad, simple, opposite, lance-shaped above and without stems (petioles), those below becoming widest outwardly and contracting at the base into a sort of petiole. Not a very common or troublesome weed. Probably introduced with clover seed from Canada.

Bladder Campion (*Silene latifolia*). As seen in our meadows, this is often a tall, slender, sometimes branching plant, reaching a height of two feet or more, tho often less tall. It bears above numerous white flowers soon leaving the inflated calyx tubes inclosing the seed capsules. Leaves meeting around the stems, smooth. A perennial, its seeds often introduced and thus now widely scattered in meadows. Probably from Europe originally.

Bouncing Bet, Soapwort, Hedge Pink (*Saponaria officinalis*). Everywhere along pikes, railroads, and about old premises one is likely to encounter the dense patches of this plant, the growth commonly about a foot or eighteen inches high and consisting in large part of the lance-shaped, smooth, pointed, opposite leaves. In midsummer the extremities of the stems bear numerous rather attractive rose-colored flowers. It is one of the old-time ornamentals belonging to the period of the "Star-of-Bethlehem," periwinkle and blackberry lily. As a weed it is not to be feared, since it is easily subdued.

The leaves impart a soapy quality to water, hence the name soapwort. Saponin is obtained from the roots and leaves, and has medicinal properties. Perennial. From Europe.

Deptford Pink (*Dianthus armeria*). Lexington, Bowling Green. In meadow. Eaten and said to be relished by horses. Not common except locally. Introduced.

Purslane Family (Portulacaceae).

Purslane, Pussley (*Portulaca oleracea*). Tho not as common in Kentucky as it is farther north, this odd, succulent weed is well known to most farmers and gardeners. It commonly grows in prostrate mats, the thick watery stems constituting a large proportion of its weight, the leaves tho numerous being small. Flowers small, yellow, leaving minute globular seed capsules, opening by a transverse cleft at about the middle. Hogs are fond of it. An annual, introduced from Europe.

Crowfoot Family (Ranunculaceae).

Small-flowered Crowfoot (*Ranunculus abortivus*). Native.

Wood Anemone (*Anemone quinquefolia*). A slight perennial, about eight inches high, with white flowers appearing in early April. Poisonous. A native plant of woodland.

Common Garden Larkspur (*Delphinium ajacis*). Frequently observed in pastures. Flowers range from pale pink to deep blue. From Europe.

Dwarf Larkspur, Stagger Weed (*Delphinium tricorne*). Very early in spring, before other herbage becomes common, this native larkspur springs up along the banks of streams and in woods, growing generally in rich soil, and producing a rank succulent growth of five-parted leaves among which are produced the showy, blue, spurred flowers, which sometimes become pink or white. The plant is only observed in early spring, and most cases of poisoning are reported in April or May. Native.

Black Snakeroot, Black Cohosh, Bugbane (*Cimicifuga racemosa*). In mountainous sections this plant is often seen in partially cleared land used for pasture. The small white flowers crowded together in long tapering racemes at the ends of branches present a showy appearance in late June. A native species.

White Baneberry, Cohosh (*Actaea alba*). A rank growing, rank smelling plant with compound leaves and white berries, growing in rich woods and sometimes in partially cleared woodland pasture. Native.

Barberry Family (Berberidaceae).

May Apple, Mandrake (*Podophyllum peltatum*). This common plant is known to every one familiar with our woods in early spring. The rank, succulent growth of stems and leaves, and large white flowers are unlike anything else occurring in the State. The unripe fruit is sometimes thought to be the cause of digestive troubles with cattle which eat it. The milk from cows that eat the plant is said to cause illness in children. Native.

Laurel Family (Lauraceae).

Sassafras (*Sassafras variifolium*). A common tree and often complained of as a pest in recently cleared pasture land. The sprouts of this plant, with persimmon, green brier and others make work for those desirous of clearing land quickly.

Mustard Family (Cruciferae).

Whitlow Grass (*Draba verna*). A small introduced annual weed from three to four inches high, exceedingly common in some pastures in April and May. It may be recognized at a distance by the light green hue of the patches in which it is disposed to grow. When droughts restrict the area occupied by white clover and bluegrass this weed, with several other small species, occupies the vacant places and becomes noticeable. By May 20 the seed capsules are largely empty and only the white papery middle partitions remain attached to

the plant, the leaves at the base of the plant being dry and withered.

Short's Bladder Pod (*Lesquerella globosa*). A slight, finely downy plant, the hairs appearing star-shaped when magnified, growing abundantly on waste land along railroads, etc., in early spring. Flowers light yellow. Seed pod globose, four seeded. Leaves small, commonly linear-lanceolate, often with entire margins. In bloom about May 7. It has been thought to have medicinal value, and may possibly affect stock if eaten. It was described originally as *Vesicaria globosa*, and later became known as *Vesicaria shortii*, having been so named by the botanist Torrey in honor of Dr. Short, of Kentucky. Native.

Stinkweed, Frenchweed (*Thlaspi arvense*). Under date of May 7, 1914, a correspondent, Mr. F. B. Threlkeld, sent to the Station from Kenton County a weed of which he wrote:

> "I send you by this mail a specimen of weed which I would very much like to have identified. Where it makes its appearance in alfalfa it is so thick it kills the alfalfa. Does it propagate only from seed? Is it annual? I have cut it out carefully with a hoe for several years about this time, but it comes again the following spring and spreads. How can I get rid of it?"

The plant inclosed proved to be the Canadian stinkweed. This is the only instance of its occurrence here that has come to my knowledge. Evidently the seeds had been introduced with alfalfa or other seeds sown on the land. While the weed is one of the most common and troublesome everywhere in Canada, it is not at present well known in the United States, and it was a surprise therefore to have it sent to the Station from Kentucky with statements indicating its having come to stay.

Tho an annual, it is quite persistent against any ordinary treatment. The seeds are matured early, and continue to be produced at the ends of the stems during a large part of the summer. Hence, even when cut in May, some of the seeds are likely to resow the land. Yet persistent attention

with hoe and other weed-destroying tools will suppress the worst of our weeds, and stinkweed should prove no exception. It is especially important that it be suppressed where recently introduced. Perhaps others besides Mr. Threlkeld have had recent experience with it.

The plant, as its common name indicates, has a rank and disagreeable odor, stands erect and reaches a height of eighteen inches, tho often smaller. Smooth, the stem leaves arrow-shaped and clasping the stem by their bases, the margins toothed. Pods flat, large, notched at the tip and nearly three-fourths inch in diameter, at length turning greenish brown.

When eaten by cows this weed is said to impart a disagreeable flavor to the milk. It is evidently a dangerous weed should it prove permanently adapted to this latitude.

Pepper Grass (*Lepidium virginicum*). Tho a very common and familiar weed everywhere, this plant has not acquired a bad reputation in Kentucky. It begins to show itself in May, and by the last of the month is in bloom at the tips of its branches, with some flat seed pods developed, tho still green. From this time until frost, peppergrass may be seen in bloom and during a large part of the summer with ripe seeds also. On October 23, 1909, it was noted as still alive after several frosts, the lower stem leaves still green. It is common in lawns and pastures, but may be found almost anywhere either in town or country. Caged birds like the seeds and probably poultry feed on the capsules at times.

Plants reach a height of fifteen inches with an expanse of fourteen or more in some cases, the branches spreading outward. The stem leaves are narrow, contracting to the base, widest near the tip, a few teeth being present along the margins. The pods are flat, nearly circular in outline seen from the side, with a slight nick at the tip. They measure a little more than a sixth inch commonly, the width being a little less, while the stalk or pedicel is of about the length of the pod. The pods mature from below, and in October the

small white flowers may be seen at the tips while the brown pods long mature are scattered along the branches. A native species.

Shepherd's Purse (*Capsella bursa-pastoris*). This, with the preceding species, is well known from its constant presence about human habitations. The fact that they are not much disposed to spread greatly elsewhere indicates that man himself disseminates them. The seeds of both are found among forage seeds offered for sale. It is in bloom, with some fully developed pods, in the middle of April, and in the latter part of May reaches a height of one foot to eighteen inches, many of the seeds at this time being ripe. Flowers small, white, appearing at the ends of branches, the heart-shaped, flattened seed pods, about one-fourth inch long, maturing along the branches below the flowers. Leaves largest at base of plant, irregularly cut and lobed. Upper leaves linear or lanceolate, with small scattered teeth along the margins. From Europe.

Wild Radish (*Raphanus raphanistrum*). Occasional plants observed among young alfalfa, where probably introduced with the alfalfa seeds, those of the wild radish having been found by us in samples of alfalfa seeds obtained in the market. The plants have a disagreeable odor. From Europe.

Brassica juncea. From Asia.

Black Mustard (*Brassica nigra*). From Europe.

Hedge Mustard (*Sisymbrium officinale*). A well known weed, reaching a height of one and one-half to two feet, with slender spreading branches. The small yellow flowers conspicuous in May. Straggling dried plants may be seen in pastures in late September, still with ripe seeds. Plants measure at this time as much as thirty-two inches in height and expand eighteen inches. The pods are about five-eighths inch long and one twenty-fifth inch in diameter, are cylindrical and contain small, angular, slightly glossy seeds. Not a troublesome pest. From Europe.

Mouse-ear Cress (*Sisymbrium thalianum*). This small species has been collected near Kentucky River at High Bridge and Brooklyn Bridge. A recent case of its presence in a field near Chilesburg in large numbers has been brought to my attention. The plant grows to a height of from six to eight inches, branching freely, bearing small white flowers, and at length small, cylindrical, linear seed pods, rather more than one-fourth inch long. The stems rise from the midst of a cluster of ovate, coarsely, simply-toothed leaves.

Rose Family (Rosaceae).

Indian Strawberry (*Duchesnea indica*). This rather attractive trailing plant is common locally about Lexington in lawns. Its bright red berries resembling those of the common strawberry are quite deceptive, their appearance leading one to expect them to be more palatable. Flowers yellow, the calyx double, the outer divisions three-toothed.

Rough Cinquefoil (*Potentilla monspeliensis*). Lexington, June 20, 27, July 2. From Asia.

Avens (*Geum canadense*). Native.

Geum vernum. Native.

Wild Black Cherry (*Prunus serotina*). The wilted leaves of this common tree are sometimes eaten from branches that are broken by storms, or boys, or otherwise, and a good many cases of poisoning and death from this source have been reported to me at one time and another. The fresh leaves are thought to be not unwholesome, but at a certain stage of wilting, prussic acid appears in the leaves. The obvious remedy is that of destroying the trees, or keeping the branches pruned so that stock cannot reach them. Native.

Clover Family (Leguminosae).

Kentucky Coffee Tree (*Gymnocladus dioica*). The large black pods of this common Kentucky tree drop to the ground during the winter months, and are sometimes eaten by cattle, apparently enticed by the sweetish substance about the seeds. It is claimed that they are unwholesome, if not

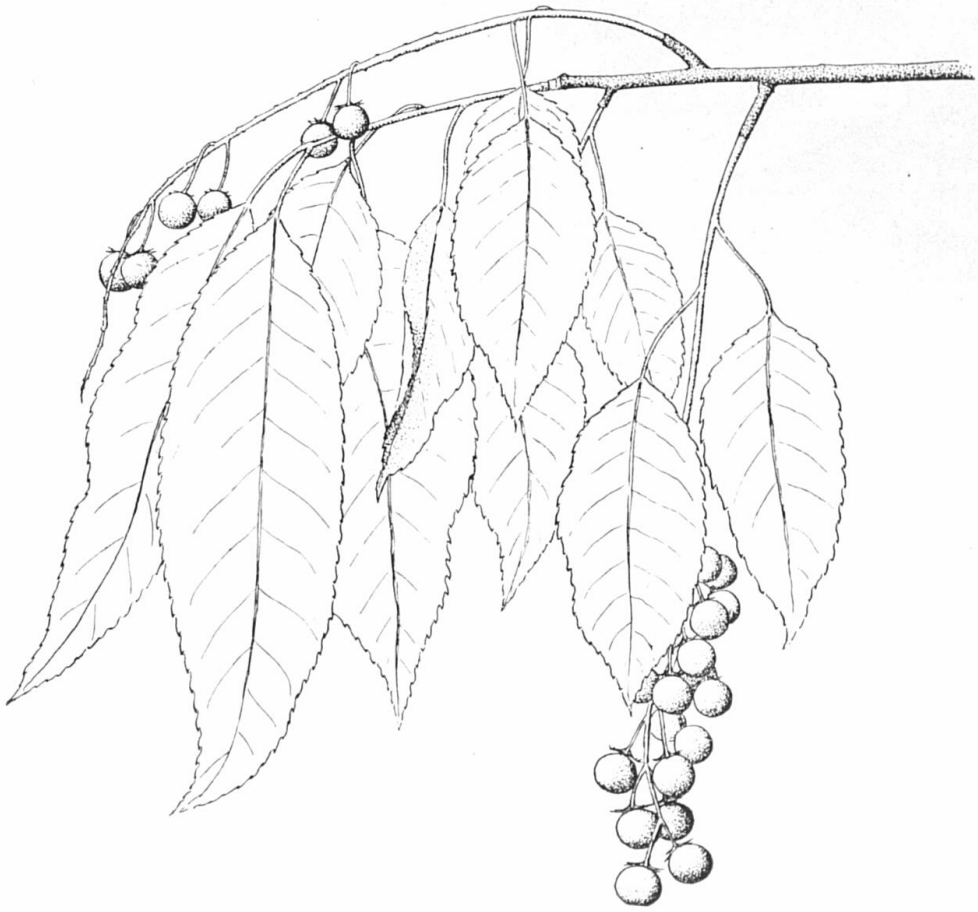


FIG. 13. Wild Black Cherry (Prunus serotina).

actually poisonous, and cases of suspected poisoning should be closely examined to determine the facts. It would be a simple matter to remove the pods from pastures, if they are likely to give trouble.

The tree is easily recognized in winter by the pods. These are thicker and broader than those of any other native tree. The seeds are extremely hard, olive green or blackish, flattened and, looked at from the broad face, roundish. They measure three-fourths inch in diameter and are about two-fifths inch thick. The only other tree with as large a pod is the honey locust, easily recognized at all times by its large forked spines. Its pods are not so broad, are much thinner, but may be as long or longer, while the seeds are much smaller than those of the coffee tree, measuring only about one-half inch long in greater diameter and about one-eighth inch thick. A native tree.

Rattle Box (*Crotalaria sagittalis*). A low-growing, annual, insignificant plant sometimes found at the edges of woods, along railroads, etc., among other herbage. Specimens from Leitchfield, Grayson County, measure seven inches in height, the slender, pointed leaves, gray pubescent, the pods about three-fourths inch long, inflated, and finally black. Cut with hay it is said to have caused the death of animals. Native.

Black Locust (*Robinia pseudacacia*). That a tree so well and favorably known, and withal so very common in Kentucky, both in cultivation and growing wild, should be accused of causing the death of animals is only another instance of the fact that the truth may lie before our faces for long periods without being recognized. The black locust is a valuable tree for the posts it produces, and has some favor among beekeepers because of the honey it furnishes in early spring, but its bark is known to pharmacists to contain a very poisonous albuminoid substance, and the leaves and young shoots are believed to have, in some cases, caused death when eaten. In pastures the young shoots should be kept suppressed, and the trees themselves be kept trimmed well up so as to keep the foliage out of the reach of stock. Native.

Wood Sorrel Family (Oxalidaceae).

Sheep's Sorrel (*Oxalis violacea*). A common plant in some mountain counties. Flowers pale violet. Native.

Yellow Sorrel (*Oxalis priceae*). Bowling Green, where it was first collected by the late Miss Sadie F. Price. Native.

Great Sorrel (*Oxalis grandis*). Native. Tyrone, Jackson.

Common Field Sorrel, Upright Wood Sorrel (*Oxalis stricta*). A common plant in cultivated ground and lawns. The same common name is applied to a dock, *Rumex acetosella*. Smaller than *O. corniculata*, the peduncles bearing only two flowers. Native.

Oxalis filipes. Collected by me in Southern Kentucky. Native.

Lady's Sorrel, Wood Sorrel (*Oxalis corniculata*). A common weed of no great consequence, found about dwellings, along roadsides, in pastures and cultivated ground thruout the summer months. In May it appears among other weedy growth, its thin, heart-shaped leaflets, yellow flowers, downy stems and light green color distinguishing it from anything else, except *O. stricta*, a much smaller plant. It reaches finally a height of about a foot and then bears numerous elongate, five-sided, pointed pods, three or more on a stem. While the leaves have an acid taste in all of these plants they are very different from the sour dock or field sorrel (*Rumex acetosella*) of our fields. Introduced with forage seeds from Europe.

Geranium Family (Geraniaceae).

Crane's Bill (*Geranium carolinianum*). A common weed in the western end of the State. Sometimes common in nurseries. Complained of as troublesome May 18, 1914, in alfalfa in Metcalfe County. Because of its low spreading growth it is not easily suppressed with a mower in pastures. Not difficult to destroy with a hoe. Native.

Long Stalked Crane's Bill (*Geranium columbinum*). From Europe.

Spurge Family (Euphorbiaceae).

Croton capitatus. A downy, gray plant, sometimes common in pastures in Bluegrass Kentucky. Native.

Three-seeded Mercury (*Acalypha virginica*). Native.

Three-seeded Mercury (*Acalypha gracilens*). Native.

Three-seeded Mercury (*Acalypha ostryaefolia*). Native.

Castor-oil Plant (*Ricinus communis*). A well-known, rank growing annual, frequently employed about dwellings and on lawns as an ornamental. From the seeds has been secured a very poisonous substance said to prove fatal even when accidentally introduced into cuts or abrasions about the eyes or nostrils. The residue left from the seeds after extracting the oil is known to be very poisonous. Stock sometimes eat the seed with fatal effect.

The leaves have been recommended as a means of keeping mosquitoes out of dwellings. For this purpose they are brought into houses in pots. The plants are grown about dwellings in Egypt, the insects obtaining a poison it is thought from the leaves. From the tropics.

Euphorbia (*Euphorbia preslii*). Native.

Milk Purslane (*Euphorbia maculata*). Several low-growing members of the genus Euphorbia are found about pastures and cultivated ground. This one is the commonest, and while not difficult, in most situations, to suppress, is constantly present, and may, because of its milky juice, be looked upon as a source of trouble if eaten by hungry animals. Tho the branches often reach a length of a foot or more, they are inclined to lop over and hence the growth is not ordinarily conspicuous. The small leaves are marked with a reddish spot. Flowers and fruit are not conspicuous. A native species.

Snow-on-the-Mountain (*Euphorbia marginata*). A tall annual with conspicuous white-margined leaves about the small flowers, giving the plant an ornamental appearance. It is sometimes planted about dwellings, and is often seen grow-

ing spontaneously along roadsides. Some years ago large tracts of it were observed by me along the Ohio River at Hawesville. The acrid milky juices of plants of this sort are regarded as poisonous. Rubbed on the tender parts of the skin it produces an effect similar to that of poison ivy, and doubtless cases thought to be due to the latter plant have sometimes been the result of contact with this Euphorbia. It is attractive in appearance, and children are likely to pluck the foliage and thus become poisoned. Writing of the plant in 1890 in the Botanical Gazette, Dr. J. Schneck stated that he had himself been poisoned about the neck by the juice, and that his experience explained frequent cases of what he had regarded as ivy poisoning. The juice produces an eruption like that of ivy, but finer. In children the whole surface affected may be blistered. As with poison ivy the rash subsides on treatment with sugar of lead. Native.

Euphorbia corollata. Native.

Euphorbia dentata. Native.

Euphorbia obtusata. Native.

Euphorbia commutata. Native.

Sumach Family (Anacardiaceae).

Poison Elder (*Rhus vernix*). This plant is best known for its poisonous effect on the skin. It is said to be eaten by stock without ill effect. It occurs only in swamps, and is not a common plant in Kentucky, taking the State as a whole. The poisonous principle has been supposed to be a volatile oil by some botanists, and by others a germ. More recent and careful studies indicate that in both of the poisonous species is is a rather heavy oil, to which the name Toxicodendrol is applied, soluble in alcohol, ether and benzol. It is not volatile, and hence, supposed instances of the poisoning of people who have not touched the plant, must be accounted for under supposition that they came in contact with the plant unconsciously, or with something else against which the plant had been rubbed. The poison is present in all parts of the plant. Native.

Poison Ivy (*Rhus toxicodendron*). This woody vine is common thruout Kentucky. It is often seen thickly covering fence posts, and as often trails over the ground at the edges of fields or on rocky banks, adapting itself to a great variety of situations and presenting a good deal of variation in character of growth and leafage. It may always be known from the Virginia creeper, with which it is sometimes confounded, by its three leaflets, the Virginia creeper having five. The flowers are inconspicuous, but the whitish berries become noticeable in the latter part of summer, bearing, when ripe, some resemblance in shape and size to mistletoe berries. Its commonness would lead one to expect more frequent poisoning than occurs. It is probable that conditions of weather favor the production of the poison and possibly some conditions of the skin may favor its attack. The fact seems to be that some persons are generally immune and may handle the plant without ill effect. Others are very sensitive, tho, as suggested in writing of the poison elder, poisoning without contact with the oil is very improbable. An irritating oil, such as this, would naturally be supposed to cause serious harm to the digestive tract in case the plant is eaten, but it is claimed that the leaves are devoured with impunity by stock. The matter deserves further attention, however. Native.

Staff Tree Family (Celastraceae).

Bittersweet, Staff Tree, Waxwork (*Celastrus scandens*). The bittersweet is an attractive native vine, or climbing shrub, found everywhere in thickets and in openings, clambering over fences, rocks and shrubs, and in the absence of support, sometimes sprawling on the ground. The foliage is bright glossy green. The globular berries burst open in the fall and exhibit the bright, orange red pulp of the center. The bark contains resins and a volatile oil thought to be of service in medicine. The foliage is regarded as poisonous.

Horse Chestnut Family (Sapindaceae).

Horse-chestnut (*Aesculus hippocastanum*). This handsome tree is often planted about parks and lawns where stock may reach the foliage and fruit. It is a near relative of our native buckeyes, and with them is to be looked upon with suspicion when cases of poisoning occur. From Asia and Europe.

Ohio Buckeye (*Aesculus glabra*). A common tree in woodland pastures and along streams in Kentucky. Easily recognized, and distinguished from the next species by the prickly hulls of its fruit. Both fruit and leaves are regarded as poisonous and capable of causing abortion. Native.

Sweet Buckeye (*Aesculus octandra*). The sweet buckeye is most common in the mountains of Eastern Kentucky. The smooth hulls of its fruit are characteristic. It is believed to be poisonous. Native.

Red Buckeye (*Aesculus pavia*). This is a shrubby growth with red blossoms. The fruit is much like that of the sweet buckeye, but smaller. The leaves and fruit are sometimes charged with causing abortion in cattle. The red buckeye has been observed by me only in the extreme western end of the State. Native.

Mallow Family (Malvaceae).

Velvet Leaf (*Abutilon theophrasti*). A common weed in cultivated ground, but not one of the most troublesome species. It pulls up completely and easily. Annual. From India.

Sida (*Sida spinosa*). A small plant which reaches a height of fourteen inches in some cases. Common in meadows and pastures, but not troublesome. From the Tropics.

Common Mallow, Cheeses (*Malva rotundifolia*). To be seen everywhere about lawns. Stems with broad, obscurely lobed leaves lie along the ground and bear white or pink flowers, producing fourteen seeds arranged in a disc-shaped

mass. A biennial with a long root that makes necessary a good deal of grubbing to destroy it completely.

Passion Flower Family (Passifloraceae).

Small Passion Flower (*Passiflora lutea*). A native plant, not uncommon along fences. Flower much smaller and less showy than that of the following species.

Passion Flower, May Pops (*Passiflora incarnata*). The passion flower is a common plant in Kentucky, growing by waysides and along fences, wherever a strip is left without cultivation. It is not seen in pastures except such as have recently been established on land previously neglected. Roaming stock may find the plants about thickets.

It is a perennial herb inclined to lop over other herbage, with acutely lobed (generally three) and finely toothed leaves. The conspicuous and rather handsome fringed flowers are alternately purple- and whitish-ringed. The fruit is large, roundish, oval, and measures a couple of inches in length.

Hay made from the plant when eaten freely has been known to cause the death of a horse, according to Chestnut. The seeds are regarded as edible, and the plant is collected by manufacturing pharmacists to be used in the preparation of medicines believed to have various virtues.

A second species (*P. lutea*) with smaller yellow flower and less deeply and more bluntly lobed leaves, the edges entire, is also found in Kentucky. Both are native. (See above.)

Evening Primrose Family (Onagraceae).

Evening Primrose (*Oenothera biennis.*)—A coarse, erect, tall, annual, native plant springing up by roadsides and in meadows, sometimes in cultivated ground in such numbers as to be a source of annoyance. I have seen fields along the Louisville and Nashville Railroad above Cave City in which this weed was the predominating growth. Often reaching a height of three feet or more. The pale yellow flowers transcient, finally leaving along the stems numerous brown seed pods about one inch long, which split open at the tips.

Cut-leaved Evening Primrose (*Oenothera laciniata*). This is another species calculated at times to give trouble. Wm. P. Cropper, of Boone County, wrote June 2, 1910, stating that the weed was "about to take a 20-acre river bottom field." In a general way it is like the common species, but its leaves are cut into long teeth. A native species.

Sundrops (*Oenothera fruticosa*). Native.

White Evening Primrose (*Oenothera speciosa*). A weed with a handsome poppy-like flower, sometimes seen growing abundantly in pastures. Local and not common, taking the State as a whole. Native.

Parsley Family (Umbelliferae).

Snakeroot, Rattlesnake Master (*Eryngium yuccifolium*). A coarse plant with rigid leaves like those of a grass and bristly margined, the flowers button-shaped masses. Occurs on rather wet ground. Native.

Snakeroot (*Sanicula marilandica*). Native.

Snakeroot (*Sanicula canadensis*). Native.

Snakeroot (*Sanicula trifoliata*). Native.

Pennywort (*Hydrocotyle rotundifolia*). Introduced in a park at Louisville, where it is reported as spreading. Not listed by Gray. An importation from Tropical Asia.

Harbinger-of-Spring (*Erigenia bulbosa*). A small plant of early spring, occurring in open woods. Native.

Chaerophyllum procumbens. A common plant on farms and along railroads in Bluegrass Kentucky. A weak-stemmed, pale green plant especially noticeable in April and May. Native.

Sweet Cicely (*Osmorhiza claytoni*). Native.

Hemlock, Poison Hemlock, Spotted Hemlock, Snakeweed (*Conium maculatum*). This seems to be the plant used in European countries in ancient times to destroy the life of condemned persons. Introduced into this country long ago, it

has spread over much or all of the best agricultural sections, and is now likely to be found by roadsides and pastures anywhere in Kentucky. In our herbarium are specimens from Winchester, in Clark County, where the species is noted as especially common. It has become common also along the Town Branch, west of Lexington. The plant grows to a height of several feet, branches extensively, and bears umbels of small white flowers and finely divided leaves, the leaflets differing from those of *Cicuta maculata* in being cut into slender lobes or divisions. The leaves have a rank, disagreeable odor. The species may be recognized by the purple-stem in conjunction with other characters given. It is a biennial. Poisoning by this plant is due to a volatile oil, which, however, is not entirely absent from the dried plants, though present in greatest quantity in the fresh leaves and other parts about the time the seeds begin to ripen. The symptoms are stupor, delirium, palsy and asphyxia, according to Lindley. Remedies are, emetics, the stomach pump, tannin, artificial respiration, etc. From Europe.

Water Hemlock, Beaver Poison, Cowbane (*Cicuta maculata*). This is one of the most dangerous poisonous plants. A rank-growing, strong-smelling plant, with hollow stem, and compound leaves, these being cut into lance-shaped, pointed, serrate leaflets. The small whitish flowers are in umbels, as usual with plants of the parsnip and carrot family. All parts of the plants are very poisonous. The clusters of spindle-shaped roots thrown up by ditchers, or by the plow, in spring, are very likely to attract the attention of children, and sometimes of adults, who taste them out of curiosity. Death is generally the result. Animals sometimes browse the leaves when hungry and die as a consequence.

The effects of eating water hemlock are, vomiting, dizziness, dilated pupils, convulsions. The antidotes are emetics, the stomach pump, coffee, tannic acid, etc. Native.

Honewort (*Cryptotaenia canadense*). Native.

Fool's Parsley (*Aethusa cynapium*). Lexington, July to September. From Europe.

Meadow Parsnip (*Thaspium aureum*). Native.

Thaspium barbinode. Native.

Thaspium pinnatifidum. Native.

Thaspium trifoliatum. Native.

Polytenia nuttallii. Native.

Wild Parsnip (*Pastinaca sativa*). A common weed in meadows, and grassland of other sorts. It appears in May, and by the last of the month is a coarse, tall plant, the stems furrowed and ridged, with umbels four or more inches across, bearing small yellow flowers. The large compound leaves measure eight inches in length and are cut into about eleven doubly serrate divisions, the strong petioles clasping the stalk. Biennial. From Europe.

Dill (*Anethum graveolens*). From Europe.

Hemlock Parsley (*Conioselium chinense*). Native.

Carrot, Queen Anne's Lace (*Daucus carota*). The seeds are often found in samples of forage seeds. Common by roadsides in Kentucky. The numerous small white flowers in large, flattish, compound umbels, the central flowers dark hued. A graceful plant, sometimes employed for household decoration. Biennial.

Laurel Family (Ericaceae).

Great Laurel, Rose Bay, Rhododendron (*Rhododendron maximum*). This beautiful evergreen plant is common in the mountains of Eastern Kentucky in shaded gullies. It commonly grows to a height of ten to fifteen feet, bears thick, broad, glossy leaves, and in June, clusters of handsome rose-colored flowers at the ends of the twigs. Its poisonous nature when eaten by animals seems to be well established. Native.

Mountain Laurel, Calico Bush, Lampkill (*Kalmia latifolia*). A very common shrub everywhere in the mountains, and extending westward along Green River. It bears bright green, glossy, thickish leaves and handsome, faintly rose-

colored, bowl-shaped flowers, these being produced in great profusion. It is one of our handsomest native woody plants. Unfortunately it has a reputation of having caused trouble when eaten by animals, especially sheep, and the flowers are known to produce a poisonous honey. The flesh of grouse, in the crops of which the leaves of this plant were found, is said to have in some instances caused death to those who ate it. Native.

Olive Family (Oleaceae).

Privet (*Ligustrum vulgare*). An evil reputation has been attached to this introduced plant, now used for ornamental hedges. Probably other members of the genus, such as *Ligustrum ovalifolium* (California privet) and *Ligustrum ibota*, are also to be looked upon with suspicion. Animals are likely to crop the foliage of such hedges when other vegetation is scarce. From Europe.

Dogbane Family (Apocynaceae).

Periwinkle, Myrtle (*Vinca minor*). An evergreen trailing vine with scattered blue flowers in early spring. Common on old premises. Introduced.

Large Periwinkle (*Vinca major*) Leaves and flowers larger than in the common species. Not often seen. Introduced from Europe.

Dogbane (*Apocynum androsaemifolium*). Plants with milky juice are generally to be regarded with suspicion, and this one is no exception to the rule. It is not uncommon about meadows and in open woodland in Western Kentucky. It grows to a height of two or three feet. The leaves compared with those of the common milkweed, are small, oval, pointed. The pods are produced in pairs and are very slender and tapering. Native.

Indian Hemp (*Apocynum cannabinum*). This is a much smaller plant, which grows in tufts in clayey or gravelly soil in Western Kentucky. The flowers are a little more than

half the size of those of *A. androsaemifolium*. The pods are in pairs and slender. Native.

(Milkweed Family (Asclepiadaceae).

Asclepiodora viridis. Native.

Butterfly Weed, Pleurisy Root (*Asclepias tuberosa*). The bright orange red flowers of this milkweed distinguish it from all of the others. The leaves are narrow, crowded on the stems, and both leaves and stems bear a whitish pubescence. The plant is widely scattered in the State along railroads, and on neglected land. It is not common in Bluegrass Kentucky. I have seen more of it in Edmonson County, about Dickey's Mills, than elsewhere in the State. It is suspected of being poisonous to stock. Native.

Purple Milkweed (*Asclepias purpurascens*). Common on low ground, along streams and ditches. Native.

Swamp Milkweed (*Asclepias incarnata*). Native.

Common Milkweed, Wild Cotton, Silkweed (*Asclepias syriaca*). A well known and oommon plant of pastures, meadows and roadsides. Its milky juice is poisonous, and when animals die from unknown causes in pastures, the tissues of milkweed should be looked for in the stomach. Ordinarily it will not be eaten by well fed animals. During droughts it may prove tempting, as does almost everything else in the shape of a plant. The rough, large pods produce a beautiful, glossy fiber, but it seems to be too brittle and short to be of value in the production of useful fabrics. Milkweed is not difficult to eradicate; the occasional use of a hoe is sufficient in all ordinary cases.

Some other species occurring in the State, *A. verticillata*, for example, may be regarded with suspicion. Native.

Asclepias variegata. Native.

Asclepias quadrifolia. Native.

Asclepias perennis. Native.

Asclepias verticillata. Native.

Green Milkweed (*Acerates floridana*). Native.

Green Milkweed (*Acerates viridiflora*). Native.

Angle-pod, Sand Vine (*Gonolobus laevis*). Frequent and troublesome in a nursery at Warsaw, Kentucky, July 28, where it was twining about young trees. Common and troublesome at Maysville on flat land subject to overflow. Native.

Short's Angle-pod (*Vincetoxicum shortii*). High Bridge, Jessamine County. Native.

Morning Glory Family (Convolvulaceae).

Cypress Vine (*Ipomoea quamoclit*). An old ornamental, sometimes found holding its own in out-of-the-way places.

Small Red Morning Glory (*Ipomoea coccinea*). Madison County, Breckinridge County. From tropical America.

Ivy-leaved Morning Glory (*Ipomoea hederacea*). Fayette County, Todd County. From tropical America.

Common Morning Glory (*Ipomoea purpurea*).—This fine ornamental sometimes runs wild and makes trouble as a weed. From tropical America originally.

Wild Potato Vine (*Ipomoea pandurata*). A long, trailing vine with heart-shaped or fiddle-shaped leaves and large white flowers, purple in the throat, and an immense thickened root. Common locally, generally on low ground along the larger streams. Difficult to deal with because of its hidden store of nutriment. Native.

Small Morning Glory (*Ipomoea lacunosa*). Fayette County, Breckinridge County. Native.

Hedge Bindweed, Devil's Vine. Rutland Beauty (*Convolvulus sepium*).—A vigorous, persistent vine, which clambers over other plants and interferes with their growth. In one instance, occurring near Lexington, it became so numerous in a forty acre field of wheat as to make necessary the cutting of two acres. In a nursery on the banks of the Ohio

River, at Maysville, it was found in 1904 to be extremely common and troublesome from its disposition to enwrap young trees from the ground up, causing them to grow crooked. The leaves are pointed and halberd-shaped. Flowers, commonly one in a place, white, or pink, about two inches long with large bracts at base. From Eastern Europe.

Field or Small Bindweed (*Convolvulus arvensis*). This pest is one of the worst occurring in Kentucky, because of its persistence. After being cut out with a hoe, or harrow, the fragments of its roots send up new shoots. It is a vine, like the hedge bindweed, but is smaller, the leaves blunter at the tips, the pink, or white flowers, without large bracts at the base and not more than half as large as those of the hedge bindweed.

A correspondent living at Danville, Kentucky, wrote in April of this year that this weed had "about taken" his lawn. In January he had the roots collected and destroyed as far as practicable, but found it very difficult to get rid of entirely because any fragment overlooked seemed to produce new plants. Applications of salt and chemicals of other sorts have not proved effective where tried, and the only treatment calculated to reduce the numbers is close cultivation for a number of years to keep the vines suppressed and thus starve the roots, or else sowing the infested land in some crop that will smother the bindweed. Alfalfa is believed to do this very completely, and fields that have been in this forage crop for a number of years are said to show a marked contrast with adjoining land because of the absence of bindweed where alfalfa was grown. Pasturing with hogs, or sheep is said to destroy the weed. From Europe.

Clover and Alfalfa Dodder (*Custuta epithymum*). Clover and alfalfa dodder, now regarded as one species, appeared in Kentucky during the past twelve years, its seeds having been imported in large quantities with imperfectly cleaned clover and alfalfa seeds. In a letter dated May 26, 1902, Mr. W. T. Kane, of Fallsburg, wrote to the Station: "I also send

you today in a small box a red clover plant on which is a *something* growing that is playing mischief with my clover meadow. Please state what it is. How can it be gotten rid of, and give all the necessary information to that end." The plant proved to be clover dodder, the first the writer of this bulletin had then seen from Kentucky. Another letter was received from Mr. J. C. Thompson, of Wilmore, Jessamine County, dated June 12, 1902, in which this correspondent writes:

> "I send you a curious vine that was taken from the field of Mr. L. B. Hagedorn. It seems to have no roots, but twines around the clover squeezing it to death. It starts in various places over the field in small spots, and spreads in every direction and leaves the field bare as if it had been burned. I have a field that joins it that does not seem to have any in it. The field that this was taken from was observed to have a little in it four years ago, when it was in clover. Two crops of wheat followed and then the present clover crop."

It appeared in Woodford County, at Mortonsville, also in 1902, and in 1903 was heard from at Midway. Since then it has spread steadily, though less rapidly of late because of the better condition of the seed trade and a disposition on the part of the farmers to demand better seeds.

Clover dodder has now been observed in the following counties in the State, and doubtless occurs in others:

Allen, Barren, Bourbon, Boyle, Butler, Carroll, Christian, Fayette, Gallatin, Jefferson, Jessamine, Lawrence, Mercer, McLean, Nelson, Nicholas, Oldham, Shelby, Todd, Union, Warren and Woodford.

The enactment of our seed law in the spring of 1904 provided for the inspection of clover and alfalfa seeds by the Station, and the reason for the rapid spread of the pest then became apparent to us. Thirty-seven per cent of the samples of red clover seeds examined by us during the next two years were found to have dodder seeds mixed with them, and thirty-one per cent of the alfalfa samples contained seeds of the parasite. This fact needs no comment.

The parasitic nature of dodder makes it a much more dangerous pest than an ordinary weed. It takes the life of the plant it attacks, as noted by one of the correspondents quoted above. Though produced from a seed, it soon severs its connection with the soil, and produces no roots. The color is red, or yellow, the slender stems lacking leaves and twining closely about the host plant. In midsummer numerous small whitish flowers are produced, and later these leave small capsules containing about four dull gray, roundish, or oval seeds, with a diameter of about 0.04 inch. The different dimensions of a clover seed are about as follows: Length, 0.07; width, 0.06; thickness, 0.04 inch. An alfalfa seed measures about as follows: Length, 0.09: width, 0.05; thickness, 0.04 inch. It will be seen by these measurements that clover dodder seeds can be screened out of these forage seeds. The seeds of field dodder, a much less dangerous species, average larger, and are sometimes difficult to get rid of entirely.

Several precautions should be taken to keep this pest from doing mischief on a farm.

1. Clover and alfalfa seeds should always be examined for dodder seeds before planting. They will be examined free at the Station.

2. Clover dodder attacks only plants of the clover family, hence rotation is a means of avoiding its injuries.

3. It should not be permitted to mature its seeds. If the clover is badly infested it may be best to cut early and feed in order to keep the ground free from being reseeded.

4. When only a little is present it should be cut out carefully and burned and the spots saturated with crude carbolic acid. This will keep everything from growing on these spots for a time, but this is better than having the pest everywhere established. Some years ago I found a few dodder plants on some young alfalfa in one of our experimental plots. Wherever a plant was seen the alfalfa bearing it and that for a foot about it in every direction was saturated with carbolic acid. This made some temporary

gaps in the planting, but no more dodder has been seen on the land since.

Cuscuta obtusiflora. Introduced.

Field Dodder, Love Vine (*Cuscuta arvensis*). Field dodder often occurs in clover and alfalfa fields. Its seeds are larger than those of clover dodder and hence are less easily removed. Native.

Cuscuta gronovii. A common species on low ground along streams where it becomes conspicuous in large yellow patches on herbage of various sorts.

Borage Family (Boraginaceae).

European Heliotrope (*Heliotropium europaeum*). A coarse, branched plant, with long petioled, simple, lanceolate leaves, and small white flowers in one-sided spikes. Collected at Princeton and Casky. Annual. From Europe.

Slender Heliotrope (*Heliotropium tenellum*). A tall, slender plant, with linear leaves, both stem and leaves covered with short, whitish, appressed hairs. Annual. Native.

Hound's Tongue, Dog Bur (*Cynoglossum officinale*). Occasionally this coarse downy plant gets such a foothold in neglected pasture land as to occasion some labor to get rid of it. It is most often seen growing locally along roadsides and railroads. Flower purple, leaving four bristly nutlets. Biennial. From Europe.

Wild Comfrey (*Cynoglossum virginianum*). Broader leaved than hound's tongue, and less disposed to become troublesome. Commonly in woodland. Perennial. Filson, Jackson, Pineville. Native.

Stickseed, Beggers' Ticks (*Lappula virginiana*).—A leafy stemmed weed of open woods and pastures, well known because of the round fruit which sticks to clothing by means of hooked prickles with which it is covered.

Comfrey, Healing Herb, Boneset (*Symphytum officinale*). A coarse branching plant, sometimes seen in cultivated

ground, Leaves large, lance-shaped, finely downy. From Europe.

Prickly Comfrey (*Symphytum asperrimum*). This species is everywhere rough, the hairs assuming a bristly character on the stems. Seen in cultivation, or as an escape. From Europe.

Field Scorpion Grass (*Myosotis arvensis*). A small annual, closely covered with a gray pubescence. Noted in cultivated grounds at Lexington. Probably introduced.

Corn Gromwell (*Lithospermum arvense*). A straggling gray weed, with rough stems, the narrow, pointed, sessile leaves with a close, rigid, white, pubescence, above. Flowers in the axils of leaves, white, small, leaving four, hard, brown, pointed, oval nutlets. The plants reach a height of from twelve to to eighteen inches, and are more or less branched. It is a very common pasture weed in May, and is found also in clover and alfalfa meadow. Commonly observed on waste land. Locally abundant. A bristly plant with blue flowers.

Vervain Family (Verbenaceae).

White Vervain (*Verbena urticaefolia*). An erect, branching plant, common in pastures and along roads. Leaves broad, lanceolate and sharply toothed, rough. Flowers small, white, scattered, in numerous long slender spikes. Perennial. From Tropical America.

Verbena angustifolia. Slighter than the preceding. Leave very narrow, and finely toothed. Flowers purple, or blue. Perennial. Native.

Blue Vervain (*Verbena hastata*). This weed has rather attractive blue or white flowers, fully expanded by May 24. The leaves are lanceolate, serrate, with short petioles. Perennial.

Hoary Vervain (*Verbena stricta*). A small species with broad, densely gray, pubescent leaves. Perennial. Native.

Prostrate Vervain (*Verbena bracteosa*). A low growing tufted species observed only along the Ohio River. Cloverport, Henderson.

Verbena canadensis. La Grange, Ky. Brought from farther south. Native?

Mint Family (Labiatae).

Ground Ivy (*Nepeta hederacea*). A common weed about lawns and sometimes in cultivated ground. Not a serious pest. From Europe.

Dead Nettle, Henbit (*Lamium amplexicaule*). In late fall and early spring plowed ground in Kentucky is often thickly covered by this small plant, the stems not reaching much above six inches in height. December 13, 1906, it was noted as abundant among young alfalfa at Lexington, the plants being in bloom and also bearing seeds. In early spring it covers for a time whole fields where these have not been plowed, and carpets the ground among young wheat and oats. It is a weak plant, the stems bearing kidney-shaped leaves, without petioles above, the margins cut into rounded teeth. Flowers bluish purple, in whorls in the leaf axils, 14 to 16 in a whorl, the individual flowers a little less than a half inch long. Tho abundant, it is easily suppressed. From Europe.

Dead Nettle (*Lamium purpureum*). The weed is less common than the preceding. It is much like it, but all of the leaves are with stems (petioles). From Europe.

Nightshade Family (Solanaceae).

Black Henbane, Blue Bindweed, Bittersweet (*Solanum dulcamara*). This is a vine, with smooth stems and heart-shaped leaves, some of them cut into a lobe on each side at the base. Flowers in clusters, blue or purple, producing small red, or blackish berries. It has been suspected of poisoning stock. From Europe.

Black Nightshade (*Solanum nigrum*). Many of the members of the family Solanaceae are of evil favor. Even the potato is a rank smelling poisonous plant from which solanine, a medicine and poison is secured by pharmacists. The very young tubers are well known to have an ill effect when eaten, due apparently to this same substance. Black nightshade is reported one of the worst of the group, and tho seldom eaten it is charged with having from time to time caused the death of animals.

The plant is a low-growing herb, without spines, not often above eighteen inches or two feet in height, bearing small black berries about one-fourth inch in diameter, with flat, pale yellow seeds. The berries are edible, if one desires to think so. The plant seems to be identical with Burbank's Wonderberry, and is so regarded by botanists. Grown on the Experiment Farm and in the conservatory of this Division, the wonderberry did not show characters sufficient to separate it from Black Nightshade. It is frequently observed in pastures and along roadsides in Kentucky. Native.

Horse Nettle (*Solanum carolinense*). In most Kentucky pastures a few of these prickly plants are to be seen, and when the grass becomes too closely grazed they become conspicuous, since they are untouched by animals. In cultivated ground and barnyards it often grows more rankly. The plant reaches a height of eight or ten inches, has prickly stems and leaves and purple flowers somewhat like those of the potato, and finally, toward fall, produces green, or yellowish, naked, berry-like fruit with flat seeds. It is perennial and a native.

Buffalo Bur (*Solanum rostratum*). Western plants are now brought to this State with alfalfa hay and seeds, and probably the Buffalo Bur was introduced in this way. It was common locally as early as 1902 in Bourbon, Harrison and Nicholas counties, and has since been observed in Henderson and Fayette. It was first called to my attention by Dr. C. W. Mathers, of Millersburg, Ky.

It is a densely prickly plant, the leaves deeply lobed and dissected, the flowers yellow, the fruit completely concealed by a prickly calyx, in all of which characters it differs from the common horse nettle. The plant is interesting as the original food of the Colorado potato beetle.

Ground Cherry (*Physalis pubescens*).—The ground cherries of which this and the following members of the genus Physalis are examples, may be recognized by the fruit being completely concealed by the large calyx. They are common in pastures and cultivated ground. Native.

Physalis heteroyphylla. Native.

Physalis virginiana. Native.

Physalis lanceolata. Native.

Apple of Peru (*Nicandra physalodes*). A coarse, broad-leaved annual, with pale blue flowers, opening in the afternoon, and leaving, finally, a berry enclosed in the inflated, angled divisions of the calyx. Plants have been sent me from Grayson, Carter County, Kentucky, with the statement that the weed is known as "fly poison," and that an infusion of the leaves kills the house fly quickly. Experiments made in this Laboratory have not thus far shown it to have value for this purpose. From Peru.

Matrimony Vine (*Lycium halimifolium*). Frequently observed about old premises. Sometimes escaped and growing in out-of-the-way places. From Europe.

Jimpson Weed (*Datura stramonium*). The green-stemmed Jimpson-weed is a common plant about stables and elsewhere on farms. All parts of the plant, including the seeds, are poisonous, causing symptoms like those of belladonna, namely dryness of the mouth, thirst, nausea, vertigo, delirium, convulsions, coma. Remedies are, the use of emetics and the stomach siphon. The plants should never be allowed to grow where children, or stock can reach them. They are easily destroyed with a hoe.

While the plants are to be regarded as poisonous and objectionable when growing in pastures, it must be remem-

bered that they produce substances very valuable in medicine. Jimpson weed, together with *Scopolina carniolica* and other members of the family produce the soporific, Scopolamine, used with surprising results recently in childbirth cases at the hospital at Freiburg, Baden, Germany. An introduced plant.

Purple Jimpson Weed (*Datura tatula*). This species grows somewhat taller than the other, and may at any stage be known by its purple stem. It possesses the same poisonous and other properties as its relative. From Tropical America.

Tobacco (*Nicotiana tabacum*). It is well known to chemists and pharmacists that tobacco contains in nicotine a deadly poison that in concentrated condition is not less prompt in destroying life than corrosive sublimate. Stock sometimes eat the leaves, it is said, with deadly effect.

Figwort Family (Scrophulariaceae).

Common Mullein (*Verbascum thapsus*). Common everywhere in pastures, along roadsides and on waste land. From Europe.

Woolly Mullein (*Verbascum phlomoides*). About 1888 this mullein, a native of Europe, was observed at Dickey's Mills, on Nolin River, in Edmonson County, where it was supposed to have been recently introduced with packing, or soil, about imported plants. A somewhat thorough investigation of the neighborhood showed that it was common all along the river to the northeast of this place and that it had probably been introduced along the railroad and its seeds carried down stream. It was present along the stream in Hardin, Grayson, Hart and Edmonson counties. It has not spread to other parts of the State as was anticipated at the time, and is still restricted, as far as I have learned, to the region in which it was discovered.

While it resembles the common mullein in being woolly, and bears yellow flowers much like those of the common species, the flowers are scattered on the stems, which are slender, and old plants branch at the top, finally with num-

erous flower-bearing branches, instead of a single flower-bearing axis continuous with the stem of the plant. Though commonly three or four feet high, plants in rich soil sometimes grow much taller, and one plant measured ten feet and seven inches.

Moth Mullein (*Verbascum blattaria*). A more slender weed than either of the preceding, the leaves small, not at all hairy, the flowers white, pink, or pale yellow, not crowded. Two to three feet high. Common in lawns, meadows and cultivated ground in June, July and August. From Europe.

Butter and Eggs (*Linaria vulgaris*). Most frequently observed on waste ground and commons about towns. Not troublesome. Common. From Europe.

Kenilworth Ivy (*Linaria cymbalaria*). From Europe.

Culver's Root (*Veronica virginica*). Native.

Thyme-leaved Speedwell (*Veronica serpyllifolia*). From Eastern Europe.

Neckweed (*Veronica peregrina*). From Europe.

Corn Speedwell (*Veronica arvensis*). This is another of the small weeds that, from their commonness in pastures and meadows, become noticeable in early spring. The plant is of a slight, simple growth, about three inches high in pastures, and is often seen associated with Whitlow grass and species of chickweed. It is recognizable from its heart-shaped seed capsules, about one-tenth inch long and a trifle wider, scattered along the stems. The minute seeds are mostly mature by May 15. It is not large enough to occasion serious trouble, and is quickly overshadowed by most forage plants. With others of its character, it has been brought to this country from Europe, probably among forage seeds.

Downy False Foxglove (*Gerardia flava*). Native.

Slender Gerardia (*Gerardia tenuifolia*). Native.

Broom-rape Family (Orobanchaceae).

Broom-rape of Hemp and Tobacco (*Orobanche ramosa*). In 1889 growers of hemp and tobacco observed a singular plant with whitish succulent stems, pushing up about tobacco plants and among hemp growing in the rich loose soils of Bluegrass Kentucky. Most of them had not seen the plant before, but repeated inquiries among farmers revealed a few men who declared they had observed it among hemp fifty years or more earlier. Broom-rape unquestionably first began to attract general notice about 1889. It became at this time known to botanists in the United States, and was listed in writings on the botany of the country. Whether it really did occur here much earlier need not now concern us greatly.

That it was brought to Kentucky as a seed with imported hemp seed, there can be no question. Occurring as it does throughout Europe and the East, it might easily have been brought to us from any one of a half dozen sections of the old world. But because of the fact that Kentucky hemp growers have been accustomed to get hemp seed occasionally from China, it is considered most likely broom-rape is a gift from the Chinese.

We have several native plants belonging to the same botanical family as the imported pest. All of them lack leaves. All lack the green color of ordinary plants. All are whitish, yellowish, or purplish in color. While they are without leaves, they flower and produce seeds much like ordinary weeds. But broom-rape is not a weed merely. If this were so we should have less fear of it. It is a true root parasite, becoming closely fixed to the roots of the plants it attacks, as soon as its minute seeds germinate, and deriving thereafter all of its sustenance from the plant to which it is attached.

Plants Attacked and Nature of Injury.

Most of our native broom-rapes are somewhat restricted as to the plants upon which they can prey. The beech-drops, so called, is found attached only to the roots of beech trees.

Others of the native species attack a larger number of host plants, but generally only such as belong to one or two botanical families. The broom-rape of hemp and tobacco feeds widely. Hemp, tobacco, tomato, turnip, cabbage, dwarf Essex rape, Coleus, parsnip, knot-grass (*Polygonum aviculare*), potato, sunflower, and some other less well-known plants are its prey.

It does not attack corn, wheat, oats, rye, barley, bluegrass, clovers and alfalfa. Nor does it attack any woody plant, as far as is known. It is possible, therefore, to utilize land that has become infested with broom-rape by planting in it some one of these immune crops.

Nor is tobacco as badly injured by it as hemp, partly because hemp keeps the ground shaded and moist, conditions favorable to broom-rape, and partly because cultivation of tobacco can be made to remove most of the parasites before serious mischief is done.

Thousands of dollars have been lost from its injuries to hemp. It not only reduces the weight of fiber, but greatly weakens this product. Twenty-five per cent of a crop is not an uncommon loss. I have seen plantings that would not average more than two and a half feet high, and with a large proportion of the plants dead long before cutting time.

Broom-rape grasps the roots of hemp much as does mistletoe the branches of walnut and other trees. Its seeds are extremely small, only about one ninety-sixth of an inch in diameter, and are thus not to be detected when mixed with hemp seeds except by microscopic examination. It is completely impracticable to detect them in soils.

One of the most singular things about them is their failure to germinate except when near the roots of some plant upon which they can fasten. All attempts to induce them to germinate when no roots of an appropriate plant were near have failed. Any ordinary seed, such as that of corn, wheat, beans, and the like, can be made to germinate by keeping it sufficiently moist and warm. With these conditions supplied it will germinate in pure water, or in sand, where the young plantlet can get no food and must

eventually starve. Broom-rape seeds know better, if I may be allowed to express it so. Any way, they will lie in soil for years without germinating unless hemp or some other acceptable plant sends its roots within their reach.

Ways of Spreading.

The parasite has been scattered in the vicinity of infested fields in several ways. The washing of soil constantly carcries the seeds from higher to lower levels, and in this way, it is claimed, many fields along Kentucky River have become infested. So minute a seed might be picked up by the wind with other dust particles, and no doubt it is to some extent scattered by this agency. With particles of soil it probably adheres to harrows and other tools and is thus carried out of infested fields. But its wide distribution over the globe is due to another agency. In all the years it has been known to Kentucky, it has not spread outside the section in which hemp is grown. When we think of this fact it becomes apparent that broom-rape is scattered with hemp seed or some other hemp product.

We long ago demonstrated at the Station that the seeds of broom-rape were scattered with hemp seeds. A single one of these seeds sown with hemp may produce a plant that in one season will mature at least a thousand seeds, and at this rate of multiplication it requires but a couple of seasons to stock land so thickly as to render the growing of hemp on it out of the question. This fact, that hemp seeds may, when carelessly gathered, be the source of contamination, has led to greater caution on the part of growers as to the source from which their hemp seed is obtained. When land is free from the pest it is possible by getting only clean seed, from localities in which the parasite does not grow, to guard against its introduction, except as it may be brought by one of the other agencies mentioned.

Now, if our Seed Law could be amended so as to make it a misdemeanor for any one, grower or seedman, to sell seeds with which are seeds of plants such as clover dodder and

broom-rape, the amendment will do quite as much for farmers as is done by checking the sale of adulterated seeds.

The problem of getting rid of broom-rape when once in the soil, as will be understood by any one with practical experience in such things, is an exceptionally difficult one. We have proved by experiment that the seeds retain their vitality for more than twelve years when lying in the soil. They are almost invisible, some lie near the surface, more lie from three to forty or more inches in the depths. How can you apply an herbicide that will reach them all? Many chemicals will kill seeds. Can any one of them be applied to extensive areas in such quantity as to do this without incurring expense that is prohibitive? And supposing this can be done, will the chemical leave soil in condition such that crops will grow in it.

The Use of Salt Against Broom-rape.

Common salt is well known as a means of checking the growth of weeds, and in small quantity helps the growth of plants. In 1890 salt at the rate of two tons to the acre was tried on soil containing broom-rape seeds, and hemp refused to grow in this soil for more than two months afterward. At the end of three and a half months, though several plantings of hemp seed had been made, but one enfeebled plant had appeared. When only half this quantity of salt was used a number of hemp plants were present in the soil at the end of three weeks, though they were not of very thrifty appearance. But twenty-two per cent of these plants became infested with broom-rape. These experiments were made in a greenhouse, and while they seemed unpromising, it was thought possible that in field trials soil might be disinfected of broom-rape some time before planting hemp, and thus allow the salt to become dissipated sufficiently to permit the growth of a crop.

In the spring of 1903 an opportunity presented itself for a test of this character. Four plots of land infested with broom-rape, each of one-eightieth acre, were treated with salt, while an untreated plot was left beside each for com-

parison. Two of the plots received on February 9, fifty pounds each of salt. Two others received, each, thirty-one and a fourth pounds of salt. The eight plots were planted with hemp May 19, using seed at the rate of two-thirds bushel to the acre. The stands of plants obtained in treated and untreated plots were much alike. By the middle of July broom-rape began to appear above ground in the plots. When the hemp was cut, September 11, on Plot 1, treated with salt at the rate of two tons per acre, the hemp averaged sixty-six inches high, and 521 broom-rape plants were counted in the plot. Hemp fiber was obtained from this hemp on December 30, at the rate of 720 pounds per acre.

The untreated plot beside this one produced shorter hemp, averaging only forty-nine inches, the fiber from it weighing only 500 pounds per acre, while 1080 broom-rape plants were counted in the plot at cutting time.

The second plot treated with salt at the rate of two tons per acre was some distance from the first, on land that originally was not so badly infested with broom-rape. The plants at cutting time were about sixty-nine inches high, while the untreated plot beside it produced plants averaging only sixty-three inches. Three broom-rape plants were noted in the treated plot as against fifteen in the check. This plot produced hemp fiber at the rate of 780 pounds per acre, while its check yielded only at the rate of 640 pounds.

Other plots treated with salt at the rate of one and a half tons per acre also showed an increase in the height of hemp, and a somewhat smaller number of broom-rape plants than their checks. One of them produced 900 pounds of hemp per acre as against 640 pounds produced by its check, and the plants when cut averaged more than ten inches taller.

All of these plots were again planted with hemp in 1904, without treatment. The effect of the applications was still apparent in the growth of hemp, though less decided than in 1903, and while a slight difference was estimated in favor of the treated plots in the matter of broom-rape present, it was so slight as scarcely to be worth considering.

Muriate of Potash for Broom-rape.

Side by side with these tests of salt, we tried muriate of potash on infested land, using on two plots potash at the rate of two tons per acre, and on two others at the rate of a ton and a half. Where two tons were used there was a decided increase in the height of hemp produced, and a very great reduction in the number of broom-rape plants, in one case a treated plot producing 199 broom-rape plants against 1001 produced by its check, while in another the treated plot produced seven broom-rape plants to fifteen produced in the check plot. When only a ton and a half of potash was used, the difference between treated and untreated plots, both as to height of hemp and number of broom-rape plants present was less decided.

But used at the rate of two tons per acre, muriate of potash exerts a decided injurious effect on hemp, as was shown by the yield of fiber in 1903, one treated plot yielding fiber at the rate of only 240 pounds per acre while its check yielded at the rata of 600 pounds, and this in spite of numerous broom-rape plants present in the latter. The second of these plots yielded 400 pounds per acre, as against 640 pounds from from its check.

It might be supposed that this reduction in yield would be counterbalanced the next year following, but this proved not to be the case in our plots. Both in the matter of yield of hemp and the number of broom-rape plants present, treated and untreated plots were much alike in 1904.

Unslaked Lime for Broom-rape.

In experiments made in our experimental greenhouse in 1890 unslaked lime appeared to have a very decided deterrent effect on the growth of broom-rape. Two tests, using unslaked lime at the rate of two tons per acre, gave a good growth of hemp and but one imperfect broom-rape plant. In field tests made in 1903 lime was applied to two plots at the rate of two and three-fourths tons to the acre. The number of broom-rape plants produced was decidedly less than in untreated plots, but the weight of fiber was less

than in the untreated plots. In 1904, however, the treated plots showed an increased yield over the checks.

The conclusion to be drawn from these experiments is that applications made to the soil with the object of checking the growth of broom-rape are impracticable because of the large quantities of material required and its consequent cost, but that salt and muriate of potash can be applied in moderate quantity with benefit because of the stimulating effect they have on the growth of hemp.

As already stated, the practice by which we may hope most completely to avoid injury from broom-rape is refraining from sowing on infested land, and putting some sort of check on the sale of seeds gathered from infested land. We undoubtedly received the pest in hemp seed sent us from abroad. We have ourselves sent it into other States in the same way. Every one of the weeds mentioned as being distributed in clover and grass seeds in Kentucky, excepting one of the buckhorns, came to us from abroad, and very probably as seeds mixed with grass or clover seeds. We should receive no more of these weeds, and should prevent, as far as may be, the further dissemination of those we already have. No doubt prompt burning over infested fields after hemp is cut would greatly reduce the number of broom-rape seeds, but it would involve removing the hemp at once, which growers are loath to do. Yet it would be well worth while to do so in case hemp or tobacco is to be grown again on the infested land.

Bignonia Family (Bignoniaceae).

Trumpet Flower (*Tecoma radicans*). This woody vine produces handsome orange-red trumpet-shaped flowers, and is an attractive ornamental, widely grown in this and other countries. In Kentucky it is at its best, being a native, and sometimes becomes so common and persistent as to be regarded as a weed.

Plantain Family (Plantaginaceae).

Common Plantain (*Plantago major*). I am not sure that we have this plant in Kentucky. The seeds are not often found in the many samples of forage seeds we examine. From Eastern Europe.

Common Plantain (*Plantago rugelii*). The common plantain in Kentucky. It has broad leaves, the petioles purple at the base, the capsules opening well below the middle. Seen everywhere along paths, in lawns and cultivated ground. Native.

Narrow-leaved Plantain, Buckhorn, English Plantain (*Plantago lanceolata*). Very common, the seeds constantly present among clover seeds. Buckhorn seeds are glossy brown, elongate, with rounded ends, one surface convex, the opposite channeled lengthwise of the seed. A broad, pale, median stripe extends along the convex side of fresh examples. Some old ones are uniform black. Dimensions of a seed may be 0.11x0.05x0.03 inch, or less. Troublesome in pastures, lawns and meadows, since 1898, when it was observed in Christian County. Perennial. From Europe.

Plantago purshii. Native.

Bracted Plantain, Buckhorn (*Plantago aristata*). Common in the western half of the State on poor soils. Less often seen east. To be recognized by the spur-like bracts projecting from among the flowers of the heads. Seed opaque, and with a slight narrow groove about the middle. Leaves thread-like. First observed in Shelby County in 1898. It has now been noticed in the following counties: Bracken, Christian, Clark, Daviess, Fayette, Grayson, Hart, Hickman, Henderson, Mercer, Nelson, Shelby, Todd. Native. Annual.

Plantago virginica. Native.

Plantago elongata. Native.

Madder Family (Rubiaceae).

Bedstraw, Cleavers, Goose Grass (*Galium aparine*). Bedstraw often becomes excessively common in neglected strips along fences and under some circumstances shows a disposition to take possession of cultivated ground. It is the square-stemmed reclining weed, which lops over other vegetation, the growth finally reaching a length of several feet, and with whorls of linear oblanceolate leaves, bearing microscopic hooklets on edges and surface. The flowers are minute. The fruit appears on small stems (peduncles) an inch or an inch and a half long, and consists of two globular bur-like bodies covered with small hooked spines which often attach them to clothing. As showing something of its character as a weed the following is quoted from a letter received from Henderson, May 10, 1906.

> "I am sending you a specimen of a plant which made its appearance in my strawberries last year about this time in May and soon covered the ground and absolutely choked out the berry plants. It has spread over much of my ground and kills out all other vegetation."

From another correspondent writing from Falmouth, April 26, 1911, the following was received:

> "Inclosed find a weed that is taking a field of alfalfa of a friend or mine, and at his request I am sending it to you to examine and inform me what it is. Is it an annual, perennial, or biennial? What are its habits? And how can it be eradicated?"

In my notes I wrote of it at Lexington, May 21, 1891:

> "A troublesome weed in meadows. Now in fruit. Grows to a considerable length, forming a mat which it is unpleasant to pass through."

It is chiefly troublesome, however, where it has been neglected for some time, and being an annual can be destroyed by care in keeping it from producing seeds. From Europe.

Wild Liquorice (*Galium circaezans*). Native.

Wild Liquorice (*Galium lanceolatum*). Native.

Galium trifidum. From Eastern Europe.

Galium triflorum. From Europe.

Buttonweed (*Diodia teres*). A common weed along roads and in fields at Marion, Crittenden County, and in Henderson County. Also sent me from Taylor County, where it is said cattle eat it when they can get nothing better.

Honeysuckle Family (Caprifoliaceae).

Japanese Honeysuckle (*Lonicera japonica*). This is a trailer or climber with simple opposite leaves and white, or finally, yellow, fragrant flowers. Common about old premises in Kentucky where it has at times been observed to assume the character of a weed. Introduced originally as an ornamental.

Teasel Family (Dipsacaceae).

Teasel (*Dipsacus sylvestris*). A coarse plant often four feet high and with lateral branches expanding two and a half feet, growing along roadsides and fences. Not so often seen in cultivated ground. In late summer it bears bristly heads on which are the small purple flowers. Stems and midribs of leaves of with small prickles. Leaves opposite, lanceolate and serrate below, becoming smaller, more nearly linear and simple above. Heads often three inches long and one and a fourth inch in diameter, with slender bracts at base. Biennial. From Europe.

Sunflower Family (Compositae).

Ironweed (*Vernonia fasciculata*). This is a tall perennial resembling the next in general growth, but with smaller heads of purple flowers, and narrower, smoother leaves. Heads about twenty-flowered. Leaves linear on the upper parts, sometimes scarcely serrate. Native.

Ironweed (*Vernonia altissima*). This is one of the tall weeds which appear most commonly on low ground in pastures. By the middle of July the plants are three feet high and not yet in bloom, the stems erect, nearly three-quarters

inch in diameter at base, grooved, purple and leafy from the ground, the leaves short petioled, lanceolate, finely unevenly serrate, seven inches or more in length. Flowers begin to appear in July and are a characteristic feature of pastures in late summer. The heads are small, deep purple, the flowers in a head numbering about twenty-five. Perennial. Native.

Joe-pye Weed, Trumpet Weed (*Eupatorium purpureum*). A tall native perennial of lowland pastures. Often five or six feet in height and bearing in late summer numerous small heads of pink flowers. Leaves narrowly lanceolate, simply serrate, about four in a whorl.

The following additional species of the genus are found in the State. None are to be regarded as troublesome, though ordinarily ranking as weeds: Mist flower (*E. coelestinum*), thoroughwort (*E. perfoliatum*), late-flowering thoroughwort (*E. serotinum*), upland boneset (*E. sessilifolium*), white snakeroot (*E. urticaefolium*).

Frost Flower (*Aster ericoides*). Our only really troublesome aster. It makes some return by furnishing beekeepers a good deal of fall forage. Everywhere along roadsides and in pastures. Native.

Fleabane, Daisy (*Erigeron philadelphicus*). A common native plant in pastures and lawns during April, May and early June. It is in full bloom by May 20, when the handsome heads of flowers, with rosy thread-like ray flowers and bright yellow centers present an attractive appearance. The heads expand about three-fourths inch. The leaves are lance-shaped, with slightly clasping bases. The height of about one foot and nine inches is reached, the flowers of a head in an example before me numbering twelve. The seeds, rendered bouyant by the silky threads attached to them, are widely scattered by winds and add to the difficulty of keeping it suppressed in lawns and pastures. When soil is moist, however, it is easily and completely removed by hand.

White Top (*Erigeron annuus*). No other weed in Kentucky is the cause of more complaints as a meadow pest than this one. It is generally present among timothy, and often con-

stitutes from one-fifth to one-fourth of the growth in timothy meadows in May. Pastures, if neglected, or over-grazed, may become thickly infested, and I have seen pastures belonging to a dairyman near Lexington in which the white-top was the most conspicuous plant present. There is no occasion for this, of course, if a mower is run over the land occasionally to keep the weed from seeding and the cattle are not permitted to devour the bluegrass too completely.

White-top may be seen almost anywhere in grass land and along roadsides in May and June. The flowers begin to appear in May, and are white, with yellow button-like centers, the thread-like ray flowers resembling those of the common daisy, and occasionally showing a slight trace of purple. The leaves are without stems (sessile), are remotely toothed, lance-shaped, and are covered on both sides with a fine, short, white pubescence. Plants before me measure two feet, eight inches, and are not branched. It is an introduced plant and an annual.

Horse Weed, Butter Weed (*Erigeron canadensis*). Tho the name horse weed is applied to this species, the giant ragweed (*Ambrosia trifida*) is better known under this common name because of its frequent use as a feed for horses. *Erigeron canadensis* is an erect annual, with numerous linear leaves and large numbers of small heads of flowers appearing in late summer in cultivated ground and in grass land of almost any sort. Difficult to get rid of largely because it is so very prolific. It occurs throughout the world. Often exceedingly common in Kentucky.

Ragweed (*Ambrosia bidentata*). This is not our common species, having only been observed along roadsides at Mayfield in Graves County. Native.

Horse Weed, Great Ragweed (*Ambrosia trifida*). Common on low ground where it often reaches a height of seven or eight feet. October 3, 1909, at Lexington, numerous examples were ten and eleven feet high, and one measured thirteen feet, eight inches, with the stem one and one-eighth inch in diameter at the base. Often cut for horses, and said

to be a remedy for slobbering. Sometimes cured and ground for feed, for which it seems well adapted, being rich in nitrogenous material. The ash contains a good deal of potash also, giving it value as a green fertilizer when turned under. Native.

Ragweed (*Ambrosia artemisiifolia*). This is the common species, and often takes pastures in late summer. Not as common tho as it is north of the Ohio River. Native.

Spiny Cocklebur (*Xanthium spinosum*). Correspondents sometimes send me parts of this plant from Central and Western Kentucky, supposing they have found the "Russian Thistle" or some other pest of recent introduction. It is frequent thruout the western half of the State, and is noticeable among our species of cockleburs because of its large, yellow, three-forked spines, the latter often as much as three-fourth inch in length. It is doubtful if stock eat it, but the other species are believed to have been eaten with ill effect at times. They are all troublesome weeds on bottom land, where in the fall their burs become lodged in large numbers in the manes and tails of horses, to the great discomfort of these animals.

Xanthium canadense. A common weed, sometimes giving trouble by matting the manes and tails of horses. Native.

Cocklebur (*Xanthium commune*). This differs from the preceding by having more numerous spines on the burs, the surface of the burs and base of the spines hairy. Native.

Crownbeard (*Verbesina occidentalis*). Reported troublesome in Lawrence County. Native.

Spanish Needles (*Bidens discoidea*). Native.

Beggar Ticks (*Bidens frondosa*). Common in places. The flat seeds with two, barbed spines, characteristic. Native.

Swamp Beggar Ticks (*Bidens connata*). Native.

Spanish Needles (*Bidens laevis*). At Lexington, September 25, 1904, this species was noted as covering a large tract of wet land which had been occupied by water in the spring.

The heads of flowers are rather showy, one and a fourth inch across, the ray flowers yellow, deeper yellow toward the base, rounded at the tips and short toothed. The leaves are opposite, long lanceolate, slightly joined and serrate. The stems are cylindrical, slightly grooved along one side, viscid pubescent. The seeds are flattish, four-awned, the margins minutely hooked. Native.

Spanish Needles (*Bidens bipinnata*). A common weed about cultivated ground, well known for its barbed seeds which cling to clothing. Plants in good soil two and a half to three feet high, leaves cut into many small divisions, flowers yellow; heads about one-sixth inch in diameter and nearly a half inch long. Seeds four-sided, grooved, the spines yellow, three or four. Common along fences about cultivated ground. Annual. Native.

Tickseed Sunflower (*Bidens trichosperma*). Kentucky. Gray's Manual.

Bidens aristosa. Observed in large numbers in fields and waste land about Marion, Kentucky, and other points along the Illinois Central Railroad in Western Kentucky. A rather showy plant when numerous. Native.

Sneezeweed (*Helenium nudiflorum*). Common about Paducah, Clinton and elsewhere in the western end of Kentucky. Not seen in eastern sections. Native.

Sneezeweed (*Helenium autumnale.*) This is a very common weed of the sunflower family that grows in dense masses at the edges of ponds and ditches. The flowers appear in late summer and are yellow, the ray flowers notched, the disc convex and greenish yellow. Cattle under some circumstances eat it and are killed, the poisonous properties residing, it is thought, largely in the flowers. These are believed to produce also a poisonous honey. This plant is very common in Bluegrass Kentucky. Native.

Narrow-leaved Sneezeweed (*Helenium tenuifolium*). This third sneezeweed has appeared in Southwestern Kentucky in the past fifteen years and is spreading northward and east-

ward. It has smaller heads of flowers than *H. autumnale* and may be distinguished readily by its extremely slender thread-like leaves. Its height may be eighteen inches or more. It produces a poisonous honey, and may do harm if eaten in any quantity by animals. The species is now very common in some of the southwestern counties of the State. Native.

Yarrow (*Achillea millefolium*). This introduced weed grows in tufts and patches in pastures, meadows and along roadsides. It is in flower in late May and thenceforward during the summer, becoming especially conspicuous in mid June. Its decided aromatic odor when bruised, together with its finely cut feather-like leaves and conspicuous clusters of white or pink flowers, will distinguish it from any other common Kentucky weed. It has sometimes been sent to me by correspondents who knew it under the name wild tansy.

The leaves are of a gray green color, the stems cylindrical, a little angulate and pubescent. Plants before me measure about two feet, ten inches high. But in pastures where the soil is compact the height is more often about eighteen inches. It is a perennial, but is not difficult to eradicate, the usual method being by grubbing out with a hoe.

In a British work on forage plants this species is included as having value for stock. Our animals do not eat it ordinarily, but probably browse the leaves sparingly as they do those of other weeds when grasses and clover become scarce. Yarrow is well known to the pharmacist and herbalist for its medicinal properties, more highly valued perhaps formerly than now.

Dog Fennel, May Weed (*Anthemis cotula*). Well known to everybody as the strong smelling weed of barnyards, with finely dissected leaves, the heads of flowers with bright yellow discs and white ray flowers. Annual. From Europe.

Ox-eye Daisy (*Chrysanthemum leucanthemum*). This daisy is very common and troublesome locally in pastures, and should be looked after closely with the grubbing hoe, or spud, before it has taken possession of land. Like several other weeds the

difficulty of getting rid of it grows the longer it is neglected. Superintendents of parks and cemeteries are often very much afraid of it, and sometimes forbid visitors bringing the flowers upon land of which they have charge. The flowers are very ornamental. From Europe.

Sweet Fern, Wormseed (*Artemisia annua*). Common locally along rivers and at the edges of cities elsewhere. Forming dense growths where permitted, the plants standing four or five feet high and giving off a characteristic and not unpleasant odor. From Europe.

Fire Weed, Pilewort (*Erechtites hieracifolia*). A tall native annual, sometimes observed in Kentucky in clearings, but not as common as in the northern States. Leaves oblanceolate and finely toothed. Producing numerous heads of small whitish flowers leaving finally dense bunches of white cottony material (pappus), which serve to render the seed bouyant. Observed at Lexington, August and September, and at Frankfort, in October.

Burdock (*Arctium minus*). The material in our collection seems to represent this species, yet it seems to me that I have seen, when busy with other things, the large species (*A. lappa*) with its corymbed flowers. From Europe.

Bull Thistle (*Cirsium lanceolatum*). Our common thistle. Sometimes mistaken for the Canada thistle, which never grows so tall. From Europe.

Bull Thistle (*Cirsium altissimum*). Native.

Canada Thistle (*Cirsium arvense*). None of our weeds is better known from its bad reputation, and none less known in Kentucky in actual farming experience. The Canada thistle is more often seen in newspapers than in our fields. It occurs locally in the State and sometimes produces thrifty looking plants, but for some reason disappears again, sometimes without being recognized for what it is. Our common bull thistle, the spiny cockle bur, and perhaps other plants, are sometimes mistaken for it. As its name implies, it is a northern plant, being very common in meadows of the

northern tier of states and in Canada. Its seeds frequently come to Kentucky in imported forage seeds, and this accounts for the appearance of occasional plants in our fields. Perhaps we are too far south ever to be greatly troubled with the pest.

The plant is of only moderate height, eighteen inches or two feet, commonly. The heads of purple flowers are much smaller than those of our common species, being about half an inch across when in bloom and when the cottony pappus is developed later, about three-fourths of an inch or an inch across. The leaves bear numerous slender yellow prickles. Perennial. Originally from Europe.

Scotch Thistle (*Onopordum acanthium*). At the edges of cities this striking thistle has become established in dense patches on waste ground and along railroads. Gray in general hue, the under sides of the leaves being whitish, and continuing as broad prickly wings down the stalk. Flower heads large, enclosed by spiny bracts. Perennial. From Europe.

Barnaby's Thistle (*Centaurea solstitialis*). Not common. From Europe.

Centaurea jacea. Not very common. Local. It has been accused of poisoning stock. From Europe.

Knapweed (*Centaurea nigra*). Not common. From Europe.

Chicory (*Cichorium intybus*). Becoming a common weed locally in lawns and about the edges of towns. Heads of flowers blue, about one inch across. Leaves at the base paddle-shaped, or oblanceolate, with toothed edges, becoming small and linear on the stems. In bloom from June to September. Even chicory has been mistaken for Canada thistle. A correspondent wrote of it from Grant County, July, 1907, as follows: "There is a good deal of it on my farm, and I do not see it anywhere else. There is a central stalk two to four feet high which puts out many limbs or branches. The stem is one-fourth inch or more in diameter near the ground."

In lawns it persists after being repeatedly cut with a mower, by a prostrate growth difficult to destroy with anything except a hoe or spud. The seeds are scattered with forage seeds. Introduced originally from Europe.

Dandelion (*Taraxacum officinale*). Our lawns and pastures are often thickly infested with this weed, the bright yellow flowers and globular white cottony heads of seeds presenting a sprightly appearance in early spring. It can be best managed by the use of a spud or stout bladed knife. It grows so low that frequent mowing does not have the same good effect that it does on more erect weeds. The plants must be cut below the crown of leaves in order to kill them. Spraying with iron sulfate if frequent enough can be made to prevent the development of seeds. The leaves are often gathered for greens or salad before the flowers appear. From Europe.

Red-seeded Dandelion (*Taraxacum erythrospermum*). From Europe. Not as common as the preceding. Local.

Common Sow Thistle (*Sonchus oleraceus*). From Europe.

Spiny-leaved Sow Thistle (*Sonchus asper*). From Europe.

Prickly Lettuce (*Lactuca scariola*). Several milky-juiced plants producing small heads of yellow flowers and finally setting quantities of seeds provided with cottony floats, are common about cultivated ground in Kentucky. Where neglected they gather in dense patches, the plants reaching a height of about two and a half or three feet. This species may be known by the prickly edges of its leaves which clasp the stems by ear-shaped lobes at their bases. In flower during July and August. Common everywhere. Introduced from Europe.

Narrow-leaved Wild Lettuce (*Lactuca saligna*). A small patch of this weed has recently been noted at the edge of Lexington. All of these plants had linear, tapering leaves with entire margins, their bases with acute clasping lobes. The leaves are described as sometimes pinnatifid. The small heads of flowers are pale yellow within, purple without. Biennial. From Europe.

Wild Lettuce (*Lactuca canadensis*). In a general way like the preceding species, but not prickly. Flowers yellow, the heads small. A common weed in cultivated ground and on grass land. Easily suppressed with the hoe if taken before its seeds mature. Native.

Lactuca villosa. A tall plant, with small heads of blue flowers and brown cottony pappus. In thickets at the edge of fields in the latter part of summer. Not very common. Native.

Lactuca spicata. A tall plant somewhat like the preceding, with small heads of blue flowers, but with white pappus attached to the seeds. Native. Not troublesome.

ADDENDUM.

Goosefoot Family (Chenopodiaceae).

Russian Thistle (*Salsola kali*, var. *tenuifolia*). A straggling, slender-stemmed plant, with insignificant flowers, so small, in fact, that they can hardly be recognized without a magnifier. It is very unlike the ordinary thistles, with which it has no relation. As the bulletin was being printed a specimen of this weed was received from a correspondent at Russellville, Kentucky, who stated that it appeared in a planting of alfalfa from North Dakota seed. While the pest is not as dangerous as was supposed when it first appeared in the Northwest, it is an unwelcome addition to our list of Kentucky weeds, and the manner of its introduction illustrates an imperfection of our seed law, which should be corrected by amendment.

Other members of the family are listed on page 282. They are not particularly aggressive as weeds, tho some of them are to be seen on most farms.

Numerous other weedy plants have been brought to my attention at one time and another, some of them while this bulletin was being printed, but have been omitted because not calculated to give serious trouble to the farmer. The Jewel weed (*Impatiens biflora*) and several species of Solidago, very common on damp, neglected land, are examples. They disappear without special attention being given them when land is cultivated, or receives the ordinary care characteristic of good farming.

INDEX

Amaranth Family (Amaranthaceae), 282
Anemone, Wood, 287
Angle-pod, 305
  Short's, 305
Apple of Peru, 313
Arrow-leaved Tear-thumb, 281
Avens, 292

Baneberry, White, 288
Barberry Family (Berberidaceae), 288
Beaver Poison, 301
Bedstraw, 324
Beggar Ticks, 309, 328
  Swamp, 328
Bignonia Family (Bignoniaceae), 322
Bindweed, Black, 281
  Blue, 311
  Field, 306
  Hedge, 305
  Small, 306
Bittersweet, 297, 311
Black Locust, 260, 262, 293
Black Mustard, 291
Bladder Campion, 286
Bladder Pod, Short's, 289
Blue Bindweed, 311
Boneset, 309
Borage Family (Boraginaceae), 309
Bouncing Bet 286
Broom-rape, 316
Broom-rape Family (Orobanchaceae), 316
Broom Sedge, 271
Buckeye, Ohio, 298
  Red, 298
  Sweet, 298
Buckhorn, 323
Buffalo Bur, 312
Bugbane, 288
Bull Thistle, 331
Burdock, 331
Butter and Eggs, 315
Butterfly Weed, 304
Butter Weed, 327
Buttonweed, 325

Calico Bush, 302
Campion, Bladder, 286
  White, 285
Canada Thistle, 331
Canary Grass, Reed, 273
Carrion Flower, 278
Carpet Weed, 283
Carrot, 302
Castor-oil Plant, 295
Cat Brier, 278
Catchfly, Night-flowering, 286
  Sleepy, 285
Cheat, 275
Cheeses, 298
Cherry, Wild Black, 260, 262, 292
Chickweed, 283
  Common, 283
  Great, 283
  Indian, 283
  Mouse-ear, 284
Chicory, 332
Cinquefoil, Rough, 292
Clearweed, 279
Cleavers, 324
Climbing False Buckwheat, 281
Clover Family (Leguminosae), 292
Cockle, Corn, 284
  White, 285
Cocklebur, 328
  Spiny, 328
Coffee Tree, Kentucky, 292
Cohosh, 288
  Black, 288
Comfrey, 309
  Prickly, 309
Corn Cockle, 284
Cowbane, 301
Crab Grass, 272
Crane's Bill, 294
  Long-stalked, 294
Cress, Mouse-ear, 292
Croton capitatus, 295
Crowfoot Family (Ranunculaceae), 287
Crowfoot, Small-flowered, 287
Crown Beard, 328
Culver's Root, 315
Cypress Vine, 305

Daisy, 326
Ox-eye, 330
Dandelion, 333
Red-seeded, 333
Dead Nettle, 311
Deptford Pink, 287
Devil's Vine, 305
Dill, 302
Dock Family (Polygonaceae), 280
Dock, Bitter, 280
Curled, 280
Pale, 280
Sour, 280
Yellow, 280
Dodder, Alfalfa, 306
Clover, 306
Field, 309
Dogbane Family (Apocynaceae), 303
Dogbane, 303
Dog Bur, 309
Dog Fennel, 330
Dropseed, 274

English Plantain, 323
Ergot, 265
Euphorbia, 295
Evening Primrose Family (Onagraceae), 299
Evening Primrose, 299
Cut-leaved, 300
White, 300

False Buckwheat, Climbing, 281
Field Garlic, 276
Field Sorrel, 280
Figwort Family (Scrophulariaceae), 314
Fleabane, 326
Fireweed, 331
Fool's Parsley, 301
Foxglove, Downy False, 315
Foxtail, 273
Frenchweed, 289
Frost Flower, 326.

Geranium Family (Geraniaceae), 294
Gerardia, Slender, 313
Goosefoot Family (Chenopodiaceae), 282, 355
Goose Grass, 274, 324
Grass Family (Graminiae), 271
Great Laurel, 302
Great Ragweed, 327
Green Brier, 278
Green Foxtail, 273
Gromwell, Corn, 310
Ground Cherry, 313
Ground Ivy, 311

Harbinger of Spring, 300
Healing Herb, 309
Hedge Bindweed, 305
Hedge Mustard, 291
Hedge Pink, 286
Heliotrope, European, 309
Slender, 309
Hemlock, 300
Hemlock Parsley, 302
Henbane, Black, 311
Henbit, 311
Honewort, 301
Honeysuckle Family (Caprifoliaceae), 325
Honeysuckle, Japanese, 325
Horse Chestnut, 298
Horse Nettle, 312
Horse Weed, 327
Hound's Tongue, 309

Indian Chickweed Family (Aizoaceae), 283
Indian Chickweed, 283
Indian Hemp, 303
Ironweed, 325
Indian Strawberry, 292

Jerusalem Oak, 282
Jimpson Weed, Purple, 313
White, 260, 313
Joe-Pye Weed, 326
Johnson Grass, 272

Kenilworth Ivy, 315
Kentucky Coffee Tree, 292
Knapweed, 332
Knot Grass, 281

Lady's Slipper, 278
Lady's Thumb, 281
Lambkill, 302
Lamb's Quarters, 282
Large Periwinkle, 303
Larkspur, 287
Laurel Family (Lauraceae), 288, (Ericaceae), 302

Laurel, Mountain, 302
Lily Family (Liliaceae) 276
Lily-of-the-Valley, 277

Locust, Black, 293
Love Vine, 309

Madder Family (Rubiaceae) 324
Mallow Family (Malvaceae) 298
Mallow, Common, 298
Mandrake, 288
Matrimony Vine, 313
May Apple, 288
May Weed, 230
May Pops, 299
Meadow Parsnip, 302
Mexican Tea, 282
Mild Water Pepper, 281
Milk Purslane, 295
Milkweed Family (Asclepiadaceae) 304
Milkweed, Common, 260, 262, 268, 304
  Green, 305
  Purple, 304
  Swamp, 304
Mint Family (Labiatae), 311
Molds, 263
Morning Glory Family (Convolvulaceae) 305
Morning Glory, Common, 305
  Ivy-leaved, 305
  Small, 305
  Small Red, 305
Mountain Laurel, 302
Mouse-ear Cress, 292
Mullein, Common, 314
  Moth, 315
  Woolly, 314
Mustard Family (Cruciferae) 288
Mustard, Black, 291
  Hedge, 291
Myrtle, 303

Nettle Family (Urticaceae) 279
Nettle, 279
Neckweed, 315
Nightshade Family (Solanaceae) 311
Nightshade, Black, 312
Nut Grass, 275

Old Witch Grass, 273
Olive Family (Oleaceae) 303
Orchid Family (Orchidaceae) 278
Orpine Family (Crassulaceae)
Ox-eye Daisy, 330

Parsley Family, (Umbelliferae) 300
Parsley, Fool's, 301
  Hemlock, 302
Parsnip, Meadow, 302
  Wild, 302
Passion Flower Family (Passifloraceae) 299
Passion Flower, 299
  Small, 299
Pellitory, 280
Pennywort, 300
Peppergrass, 290
Periwinkle, 303
  Large, 303
Pigeon Grass, 273
Pigweed, 282
  Purple, 282
Pilewort, 331
Pink Family (Caryophyllaceae) 283
Plantain Family (Plantaginaceae) 323
Plantain, Bracted, 323
  Common, 323
  English, 323
  Narrow-leaved, 323
Pleurisy root, 304
Poison Elder, 296
Poison Ivy, 297
Poison Hemlock, 300
Pokeweed Family (Phytolaccaceae) 282
Poke Root, 260, 282
Potato Vine, Wild, 305
Prickly Comfrey, 309
Prickly Lettuce, 333
Primrose Family, Evening, (Primulaceae) 299
Primrose, Cut-leaved Evening, 300
  Evening, 299
  White Evening, 300
Prince's Feathers, 281
Privet, 303
Purple Pigweed, 282
Purslane, 287
Pussley, 287

Quack Grass, 275
Queen Anne's Lace, 302

Ragweed, 327, 328
  Great, 327
Rattle Box, 293
Rattlesnake Master, 300
Reed Canary Grass, 273
Rhododendron, 302.

Richweed, 279
Rose Bay, 302
Rose Family (Rosaceae), 292
Rough Cinquefoil, 292
Rush Family (Juncaceae), 276
Russian Thistle, 334
Rutland Beauty, 305

Sand Vine, 305
Sandwort, Thyme-leaved, 283
Sassafras, 288
Saw Brier, 278
Scorpion Grass, Field, 310
Scotch Thistle, 332
Scouring Rush Family (Equisetaceae), 270
Scouring Rush, 270
Sedge Family (Cyperaceae), 275
Sheep Sorrel, 280, 294
Shepherd's Purse, 291
Short's Angle-pod, 305
Short's Bladder-pod, 294
Sida, 298
Silkweed, 304
Slender Gerardia, 215
Smartweed, 281
Snakeroot, 300
  Black, 288
Sneezeweed, 300, 329
  Narrow-leaved, 329
Snow-on-the Mountain, 295
Soapwort, 286
Sorrel Family (Oxalidaceae), 294
Sorrel, Field, 294
Sorrel, Great, 294
  Lady's, 294
  Sheep's, 294
  Wood, 294
  Yellow, 294
Sow Thistle, Common, 333
  Spiny-leaved, 333
Spanish Needles, 328, 329
Speedwell, Corn, 315
  Thyme-leaved, 315
Spotted Hemlock, 300
Spurge Family (Euphorbiaceae), 295
Staff Tree Family (Celastraceae), 297
Staff Tree 297
Stagger Weed, 287,
Star-of-Bethlehem, 277
Stickseed, 309
Stink Grass, 274
Stinkweed, 289
Strawberry, Indian, 292
Sumach Family (Anacardiaceae) 296
Sundrops, 300
Sunflower Family (Compositae) 325
Sweet Cicely, 300
Sweet Fern. 331

Tall Red-top, 274
Tear-Thumb, Arrow-leaved) 281
Teasel, 325
Teasel, Family (Dipsacaceae) 325
Thistle, Barnaby's, 332
  Bull, 331
  Canada, 331
  Russian, 335
  Scotch, 332
Thorny Amaranth, 282
Three-seeded Mercury, 295
Thyme-leaved Speedwell, 315
Tickseed Sunflower, 329
Tobacco, 313
Trumpet Flower, 322
Trumpet Weed, 326
Tumble Weed, 282

Velvet Leaf, 298
Verbena Family (Verbenaceae) 310
Vervain, Blue, 310
  Hoary, 310
  Prostrate, 311
  White, 310

Water Hemlock, 301
Water Pepper, Mild, 281
Water Smartweed, 281
Waxwork, 297
Weak Nettle, 297
White Baneberry, 288
White Campion, 285
White Cockle, 285
White-Top, 326
Whitlow Grass, 288
Wild Comfrey, 309
Wild Cotton, 304
Wild Leek, 276
Wild Lettuce, 334
  Narrow-leaved, 333
Wild Liquorice, 324
Wild Onion, 276
Wild Parsnip, 302
Wild Potato Vine, 305
Wild Radish, 291
Witch Grass, Old, 273
Wormseed, 331

Yard Grass, 274
Yard Rush, 276
Yarrow, 330



FIG. 14. Yard Rush (Juncus tenuis).

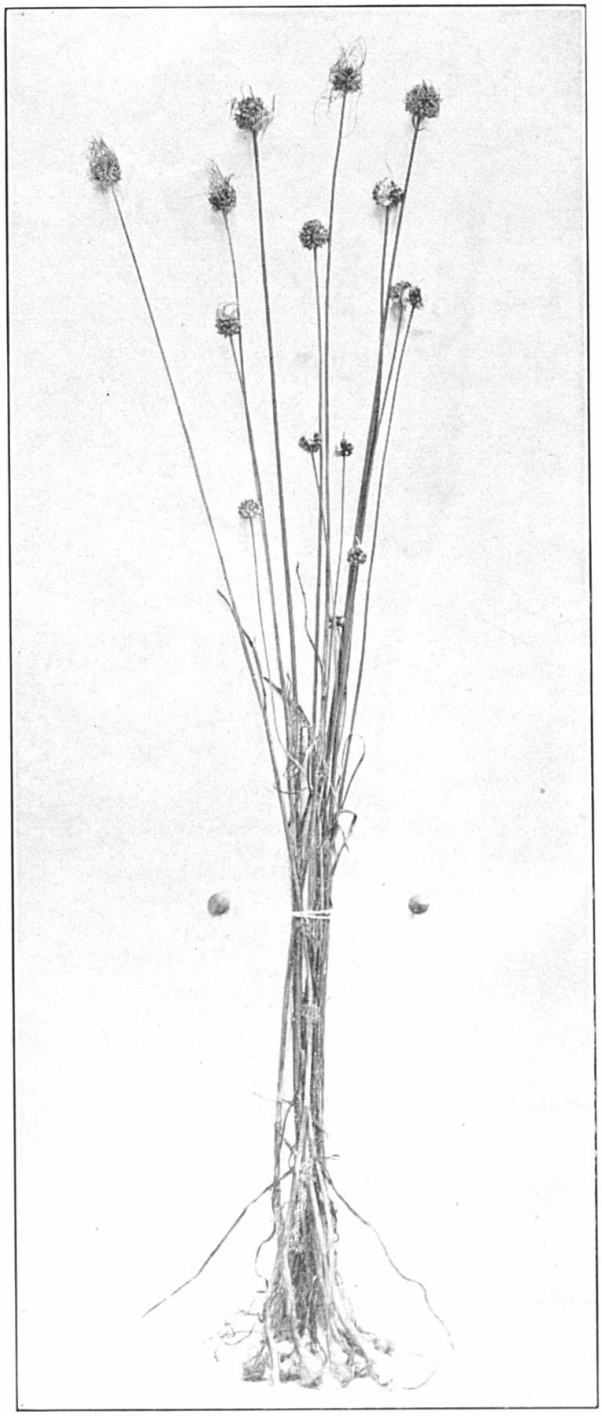


FIG. 15. Wild Onion (Allium vineale). Reduced.
Photographed by H. Garman.



FIG. 16. Wild Onion Tops. Natural size. Photographed by H. Garman.

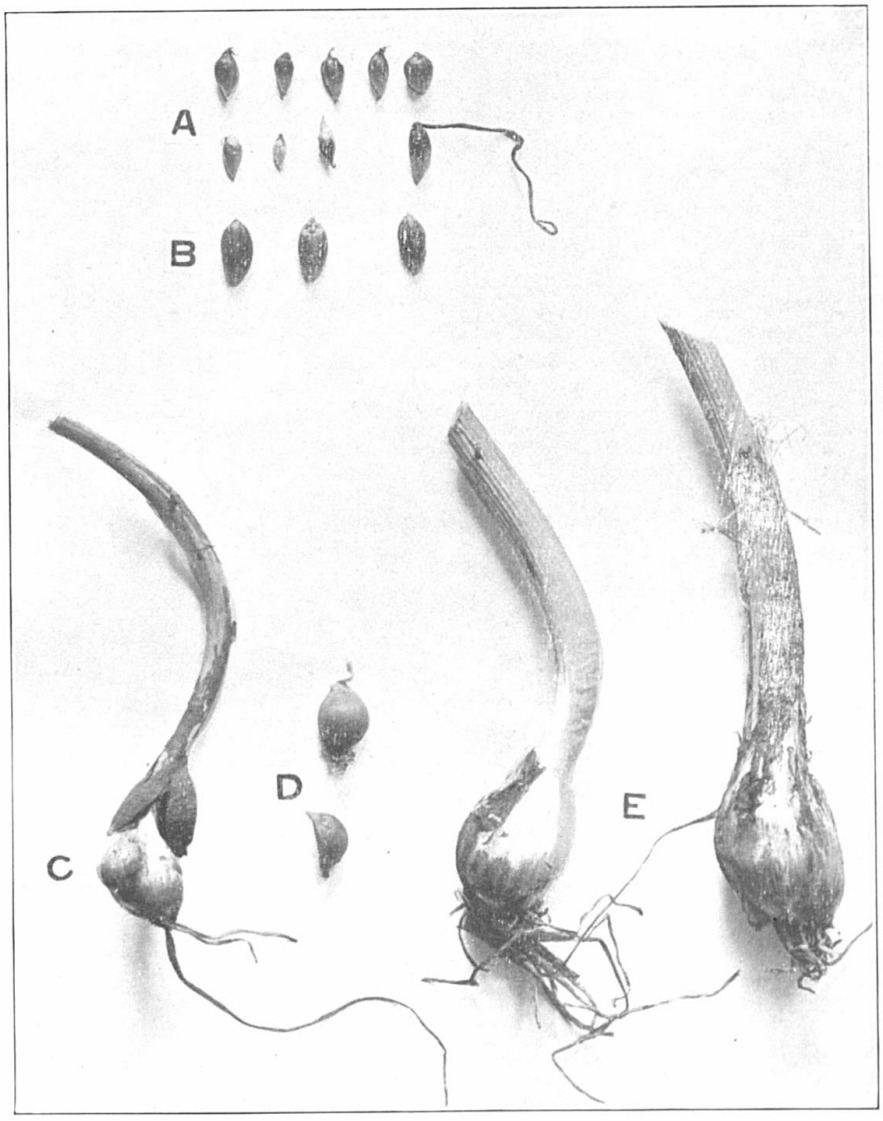


FIG. 17. Wild Onion. A, Bulblets from tops. B, Grains of wheat, for comparison. C, Showing bulbs developed in the soil. D, Two of these bulbs. E, The bulbs of old plants. Natural size. Photographed by H. Garman.



FIG. 18. Star of Bethlehem, before flowering. Natural size. Photographed by E. C. Vaughn.



FIG. 19. Sour Dock or Field Sorrel (Rumex acetosella).



FIG. 20. Sour Dock or Field Sorrel (Rumex acetosella) growing among red clover. It is sometimes charged with destroying other plants by rendering soil acid. Photographed by H. Garman.

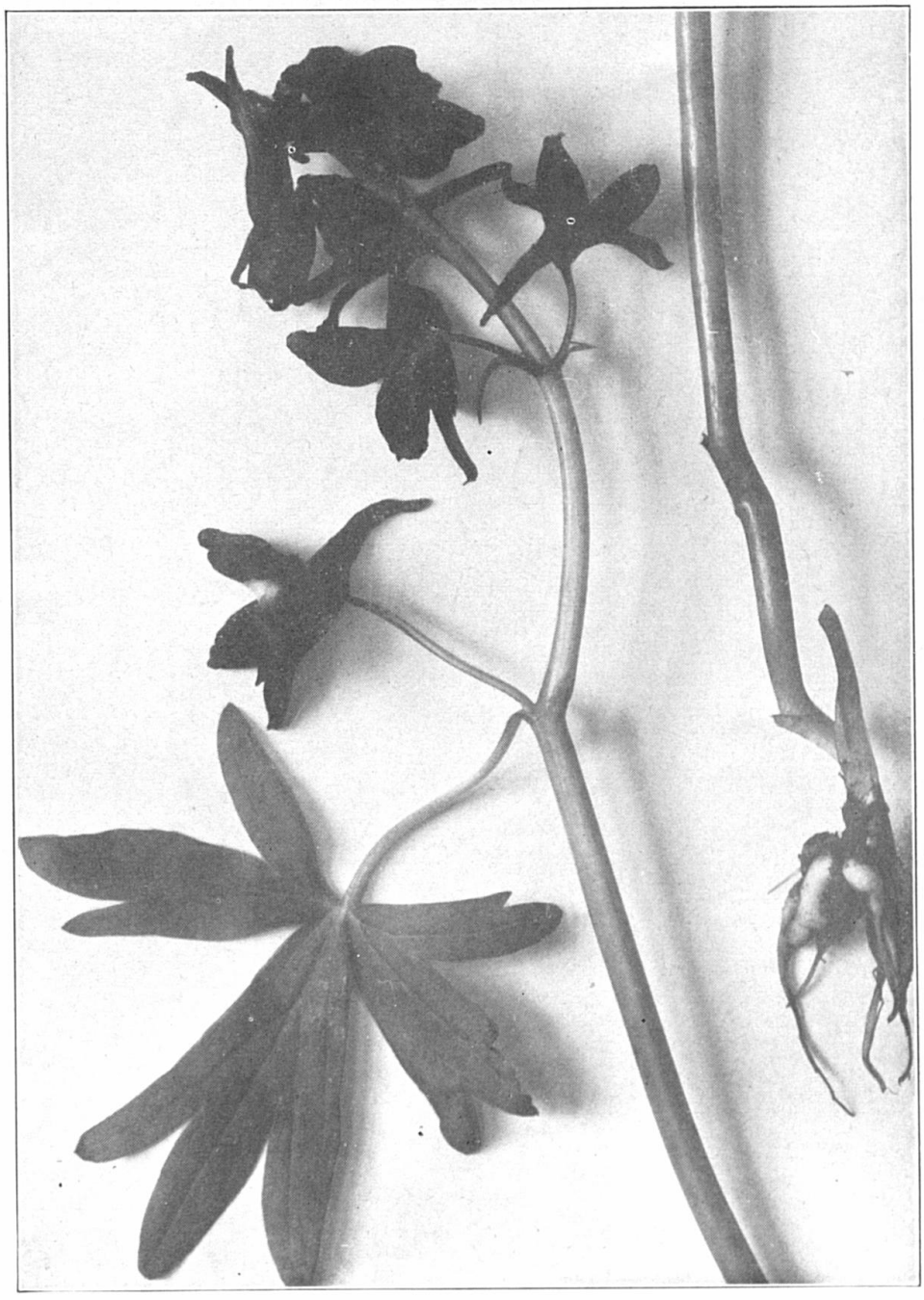


FIG. 21. Larkspur (Delphinium tricorne). Natural size. A poisonous plant.



FIG. 22. Larkspur (Delphinium tricorne). Reduced. Showing both purple and whitish flowers.

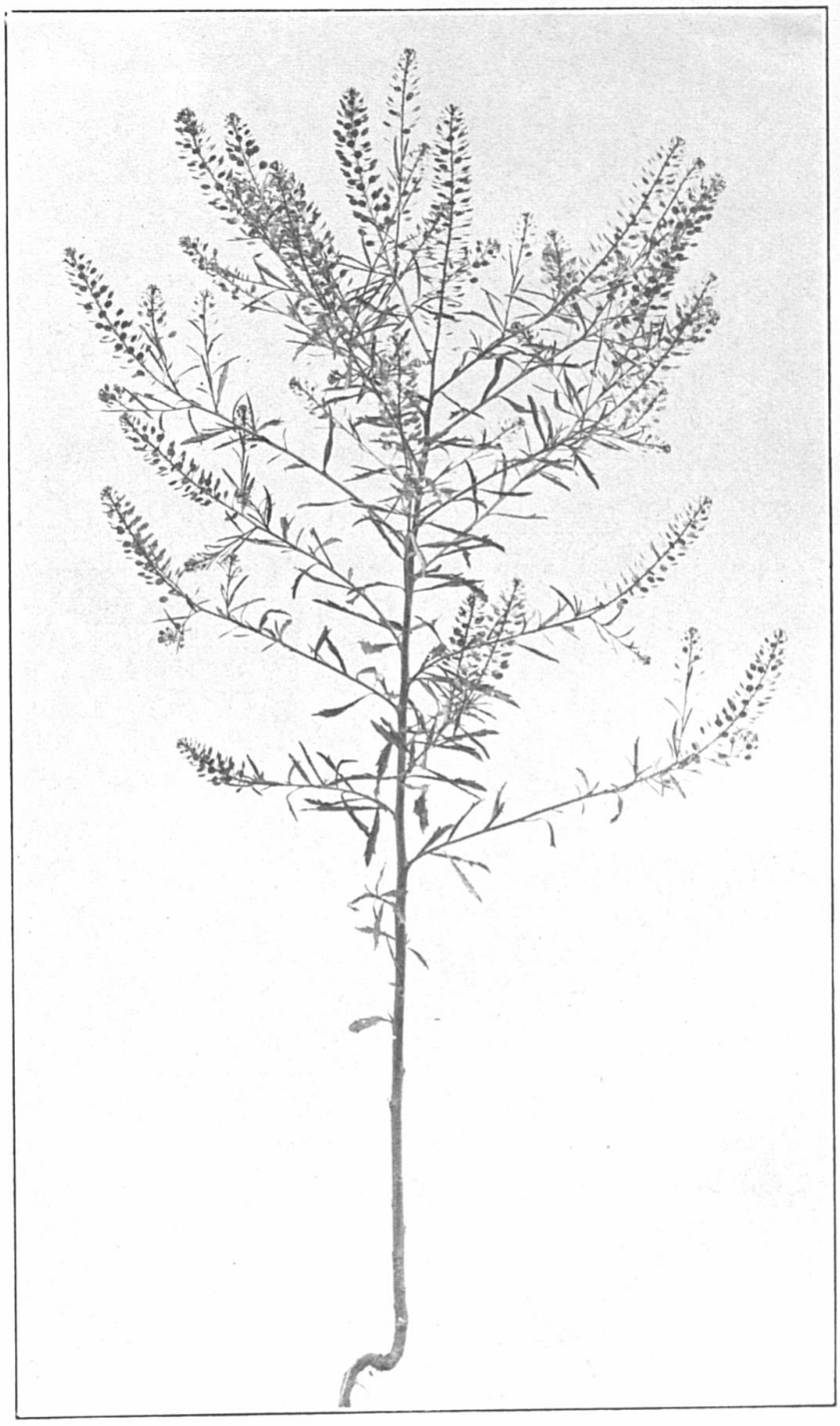


FIG. 23. Pepper Grass (Lepidium virginicum).

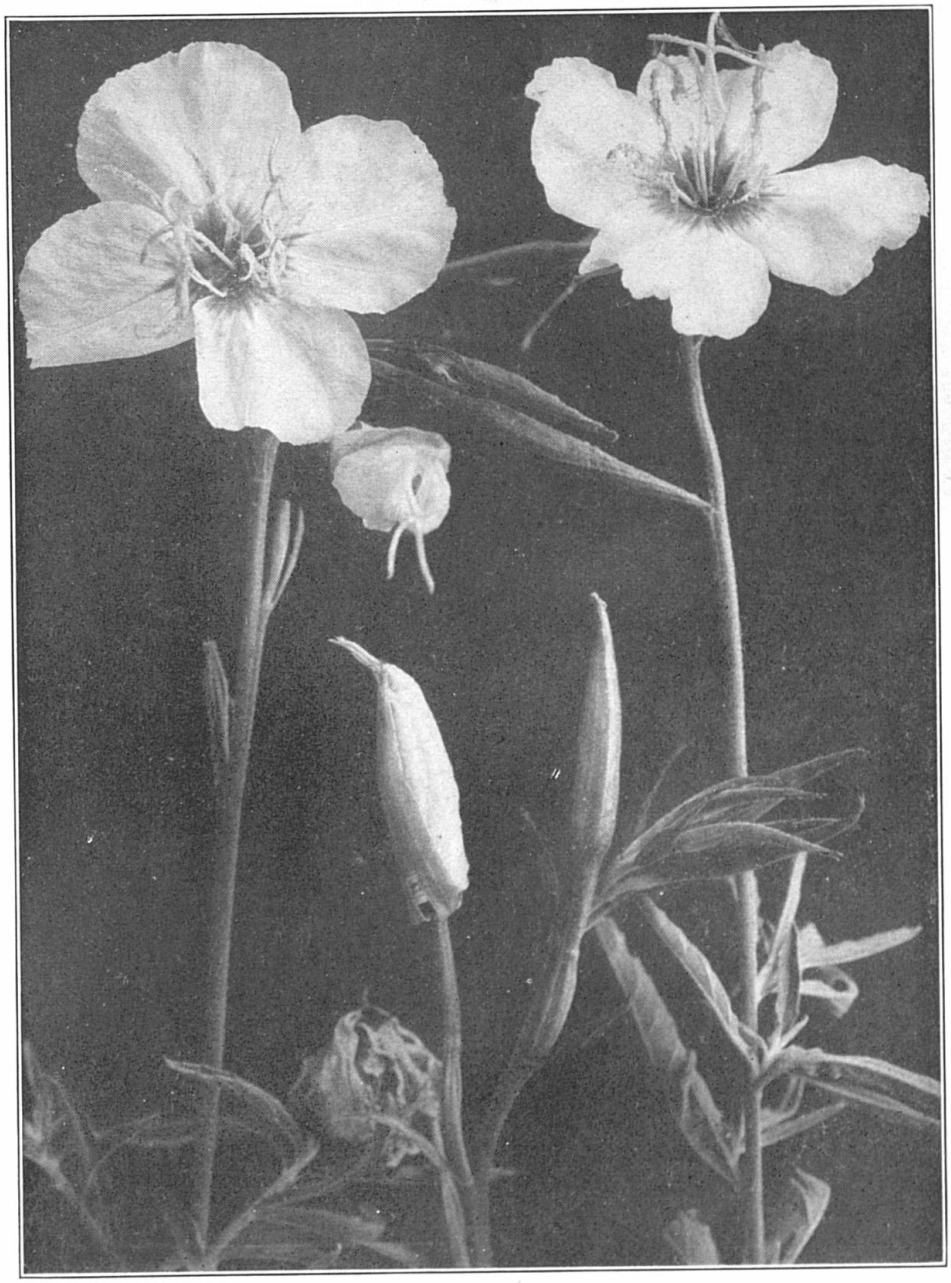


FIG. 24. White Evening Primrose (Oenothera speciosa). Natural size. Photographed by H. Garman.



FIG. 25. Poison Hemlock (Conium maculatum).

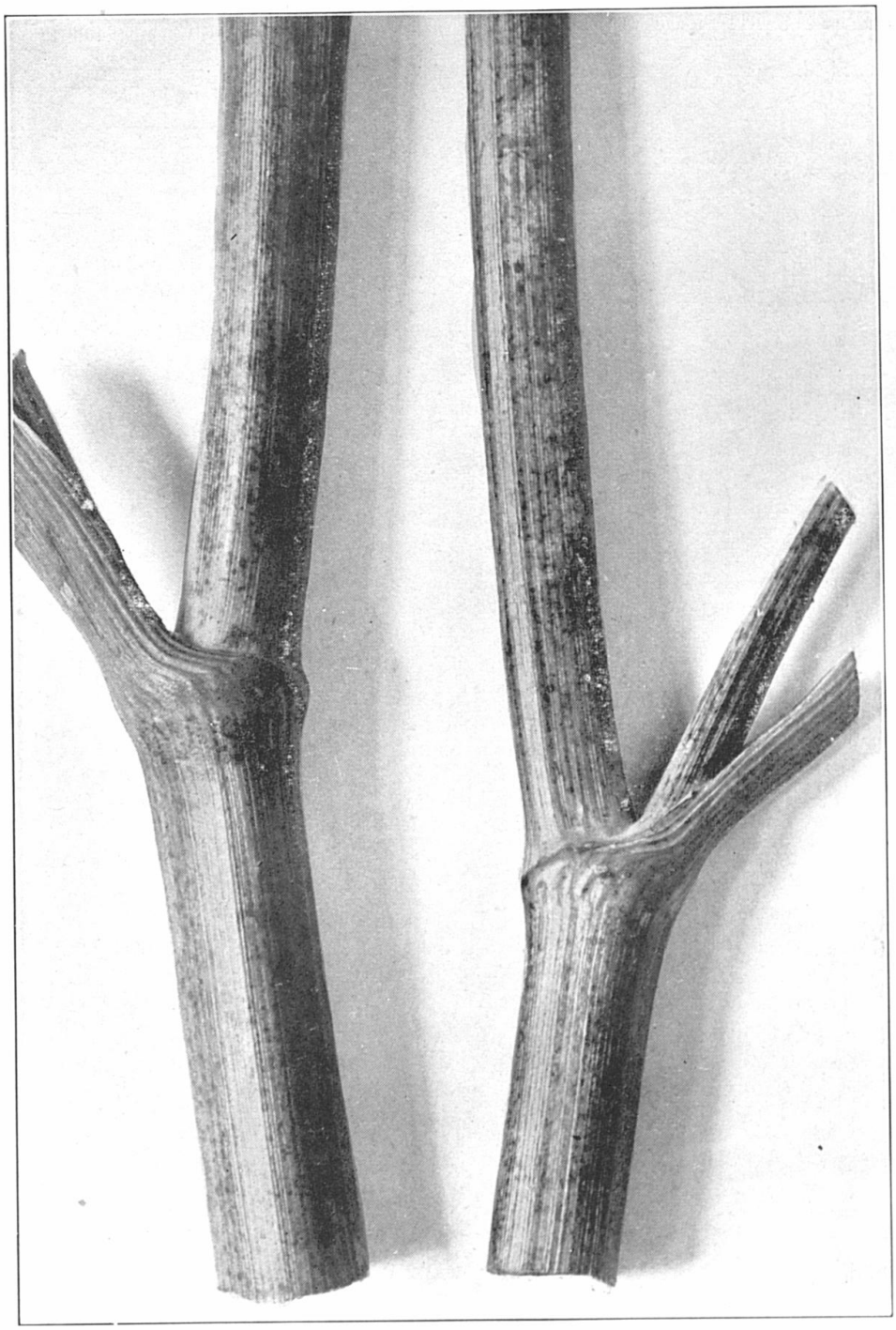


FIG. 26. Poison Hemlock (Conium maculatum). Showing the purple dotted stems. Natural size. Photographed by E. C. Vaughn.

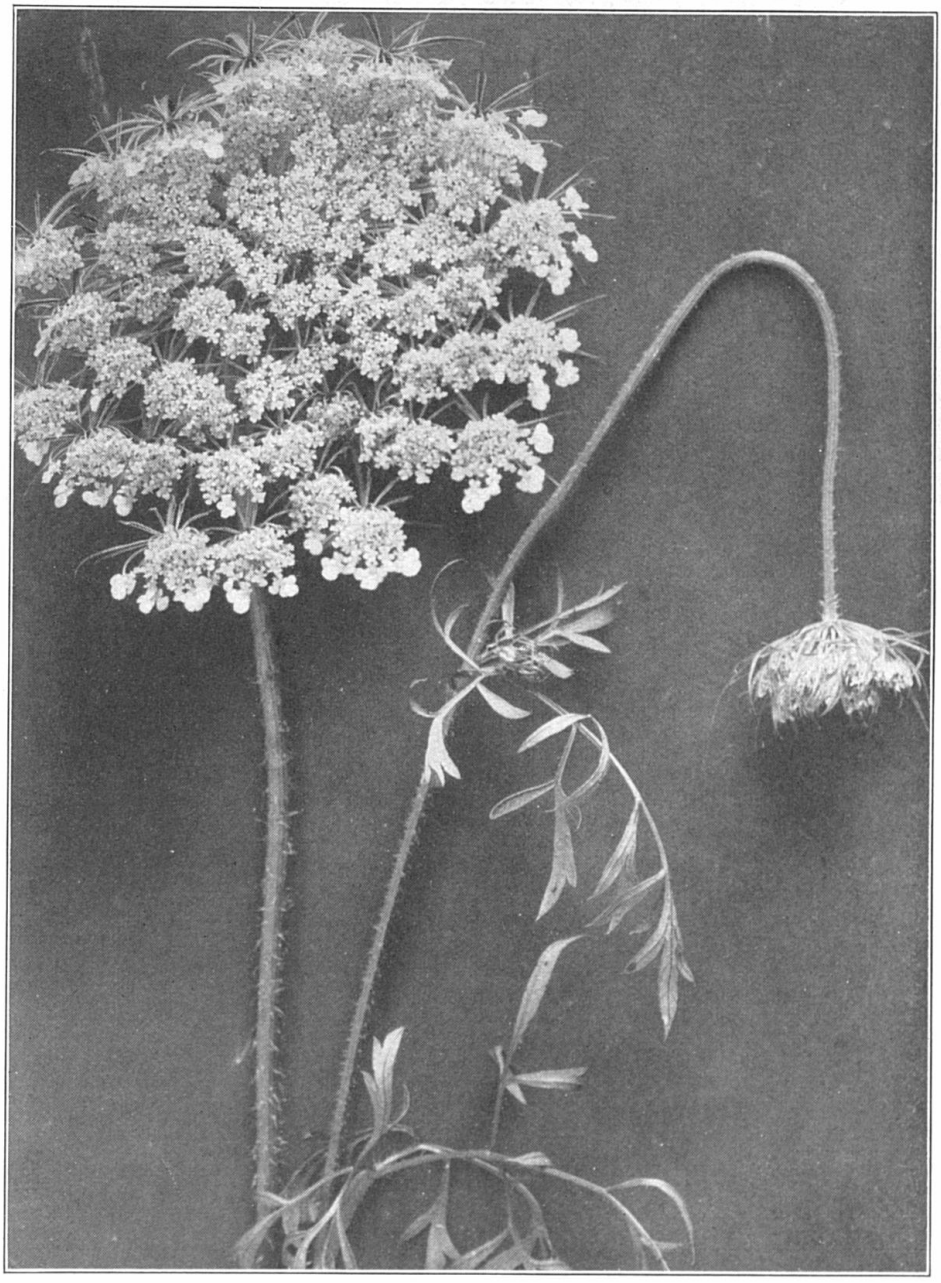


FIG. 27. Queen Anne's Lace, Wild Carrot (Daucus carota).

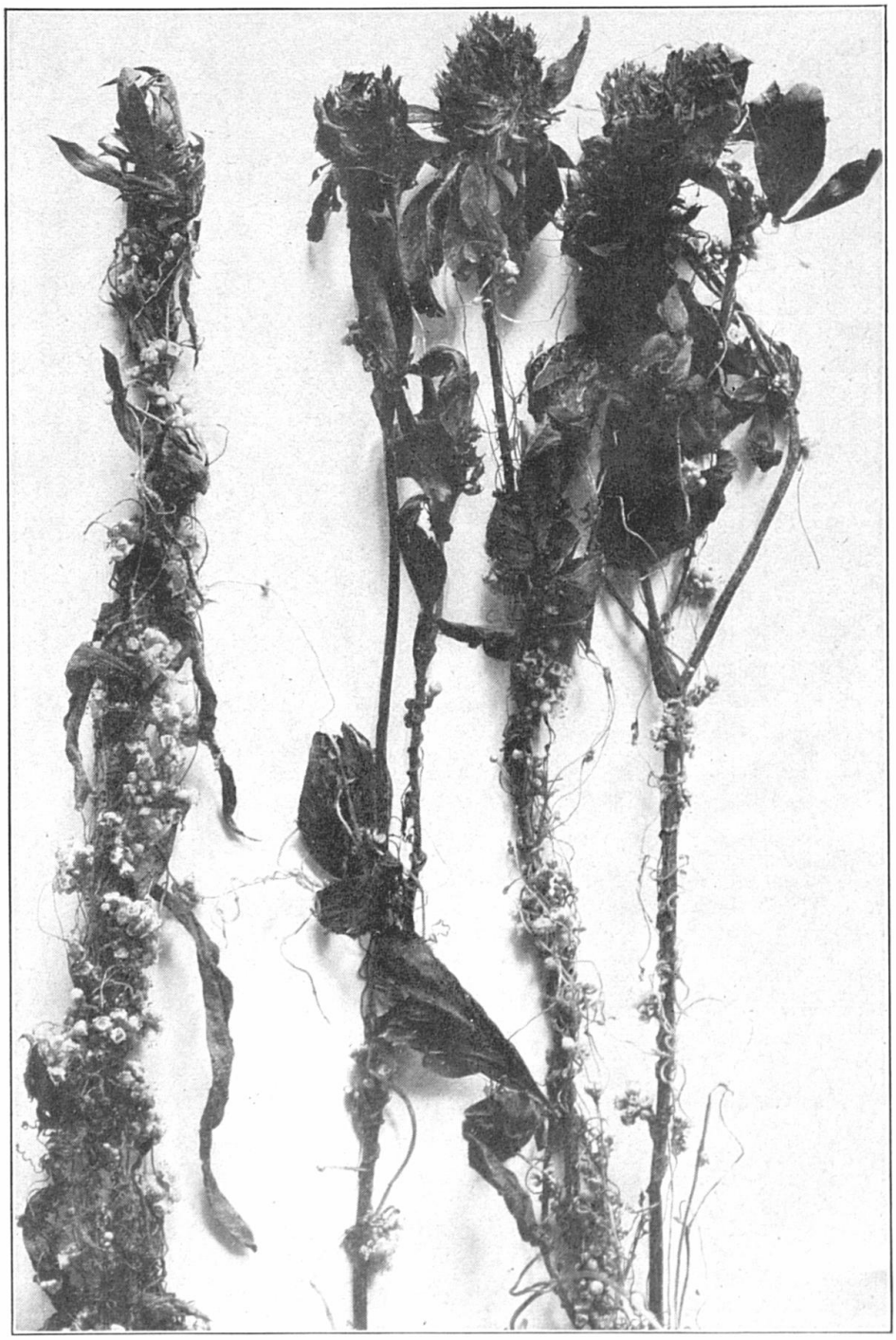


FIG. 28. Clover Dodder. Natural size. Photographed by H. Garman.

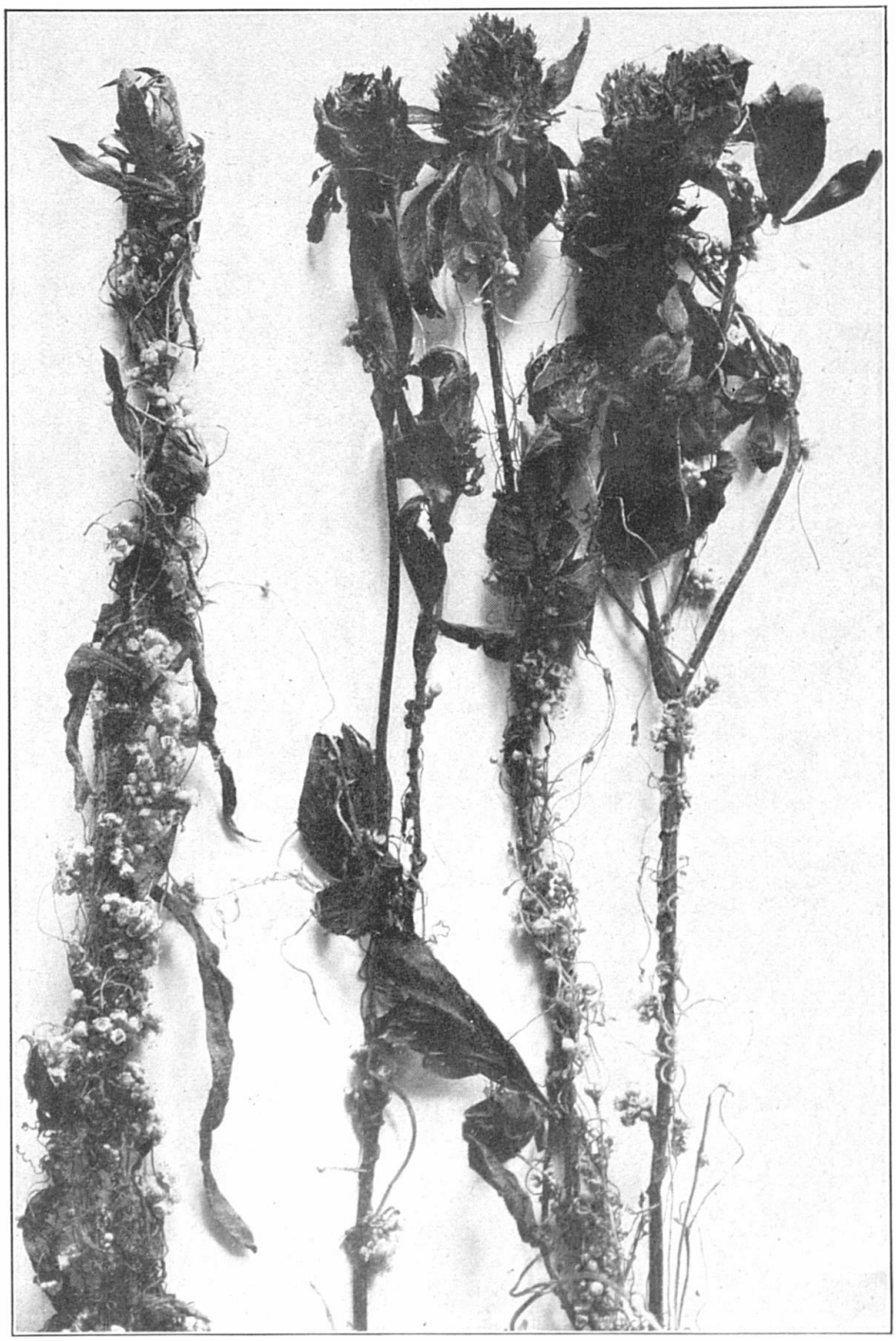


FIG. 28. Clover Dodder. Natural size. Photographed by H. Garman.



FIG. 29. Clover Dodder. The flowers magnified to three diameters. Photographed by H. Garman.



FIG. 30. Broom-rape (Orobanche ramosa), growing on hemp.

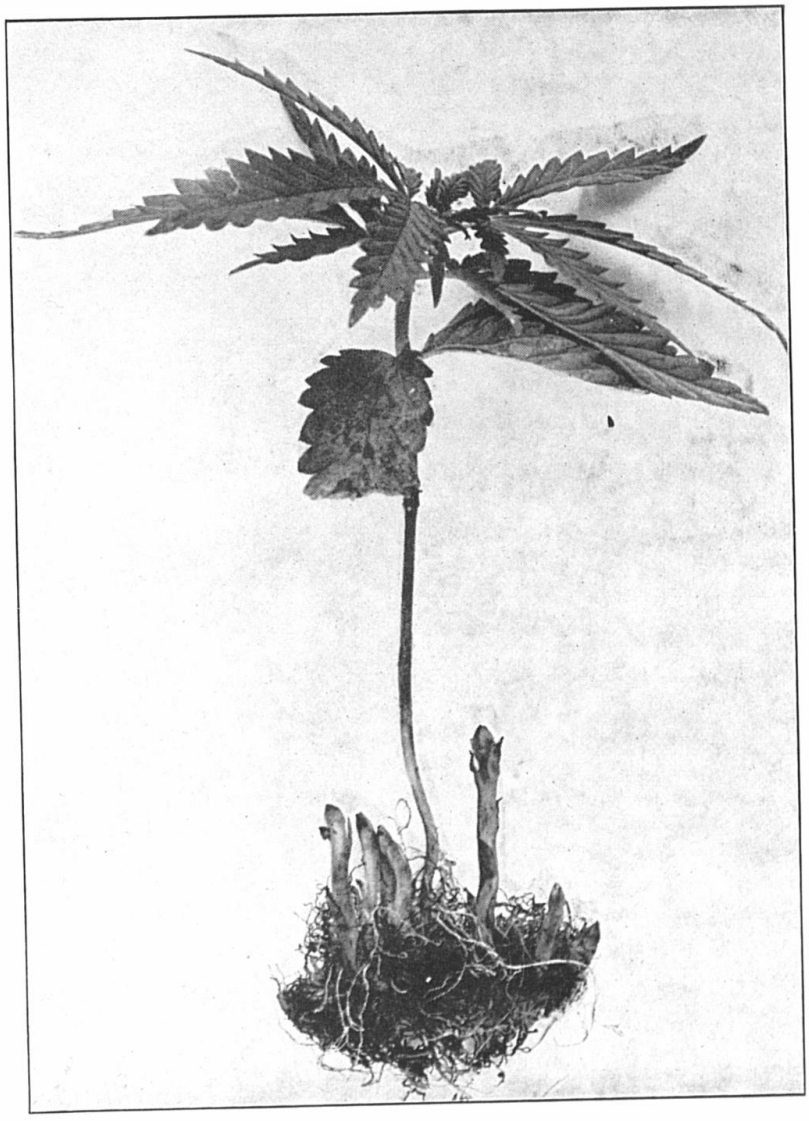


FIG. 31. Young Broom-rape attached to Hemp.

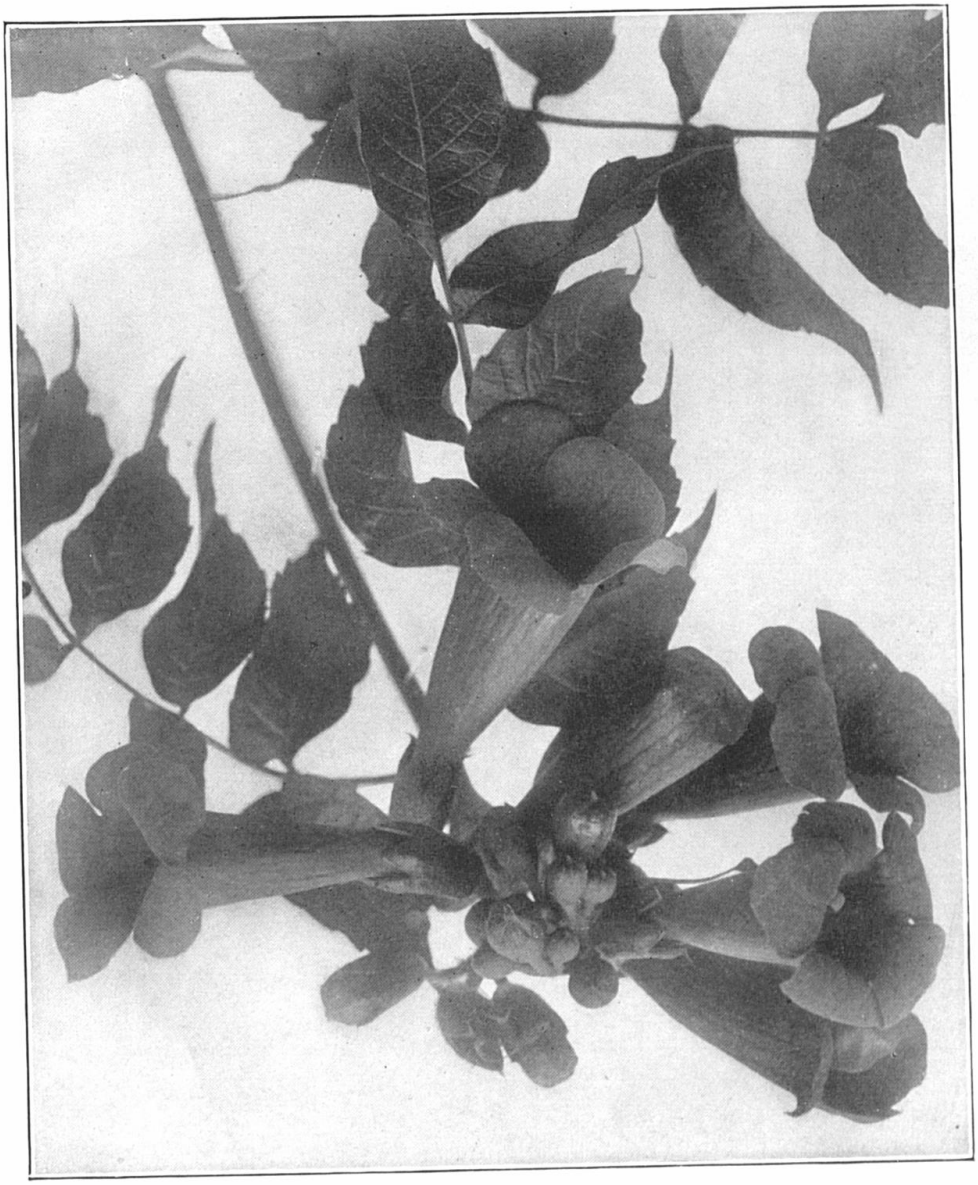


FIG. 32. The Trumpet Creeper.

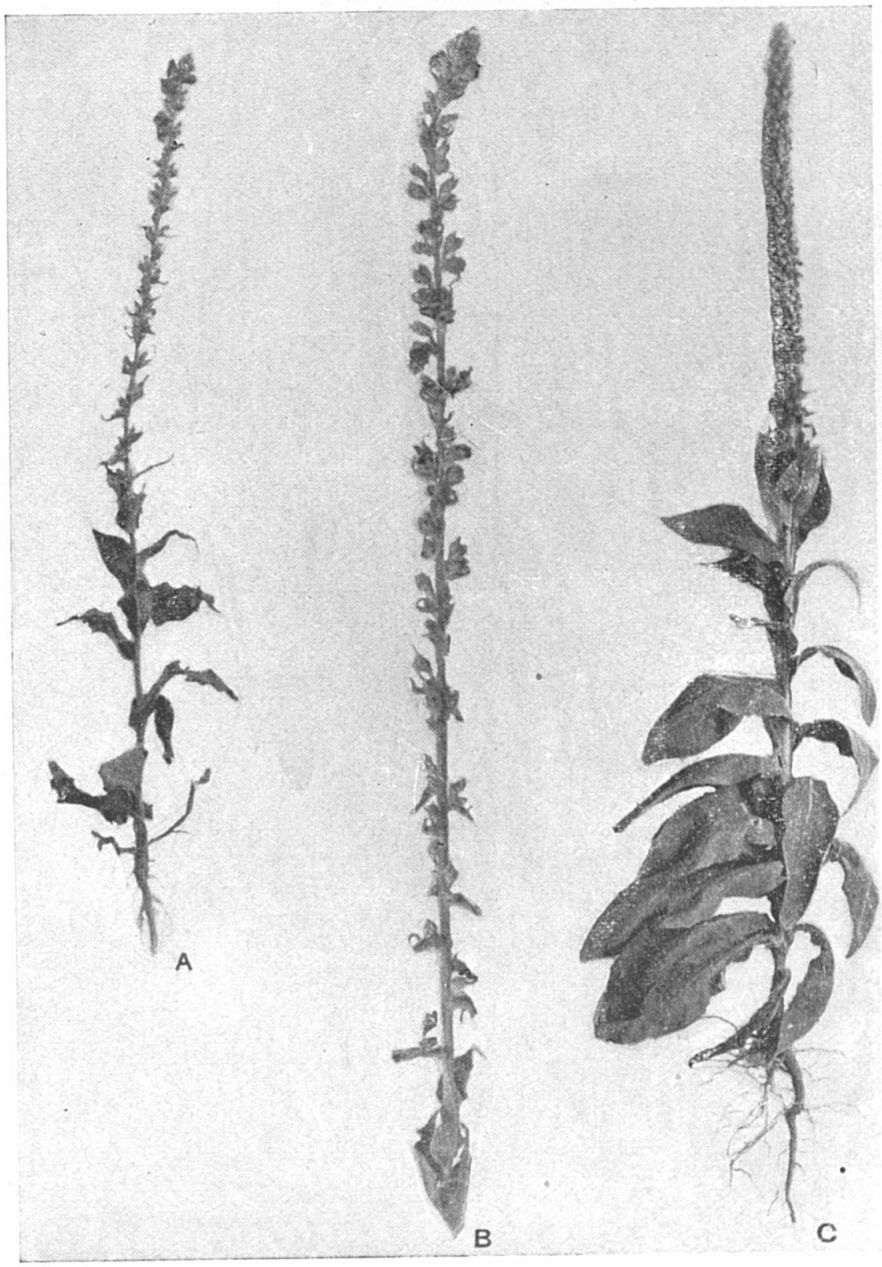


FIG. 33. A and B, Young Woolly Mullein Verbascum phlomoides); C, Common Mullein (Verbascum thapsus).

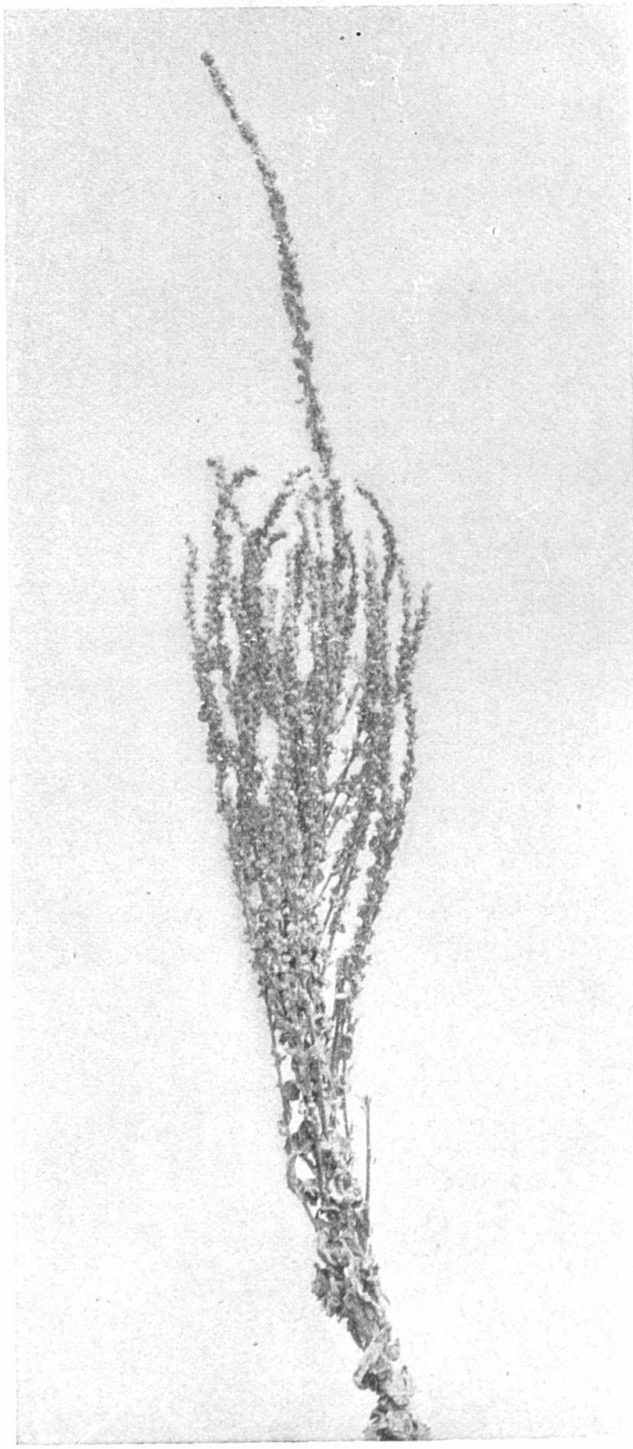


FIG. 34. The Woolly Mullein (Verbascum phlomoides). The top of an old plant.



FIG. 35. Narrow-leaved Plantain (Plantago lanceolata). Reduced.



FIG. 36. Braeted Plantain (Plantago aristata). Natural size.

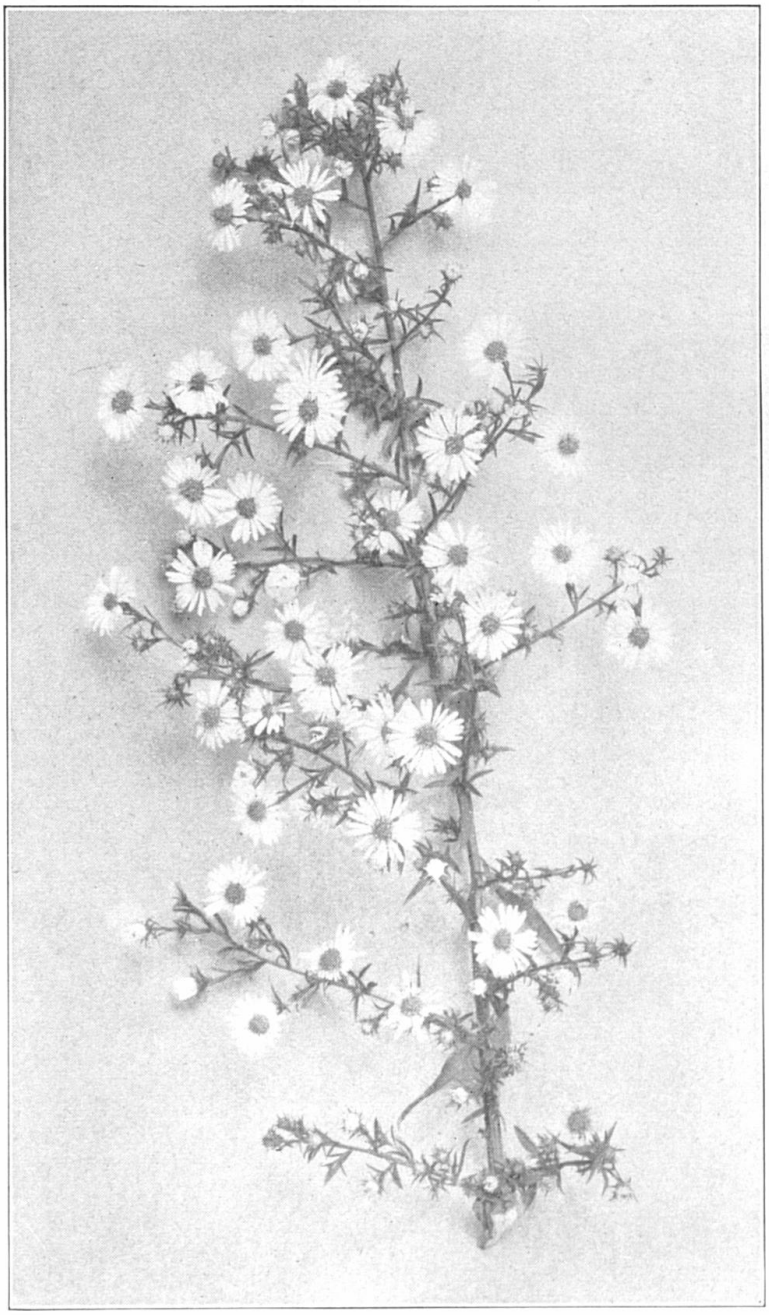


FIG. 37. Frost Flower (Aster ericoides). Photographed by H. Garman.



FIG. 38. White-top (Erigeren annuus). Centers of flowers yellow and made too dark by camera.

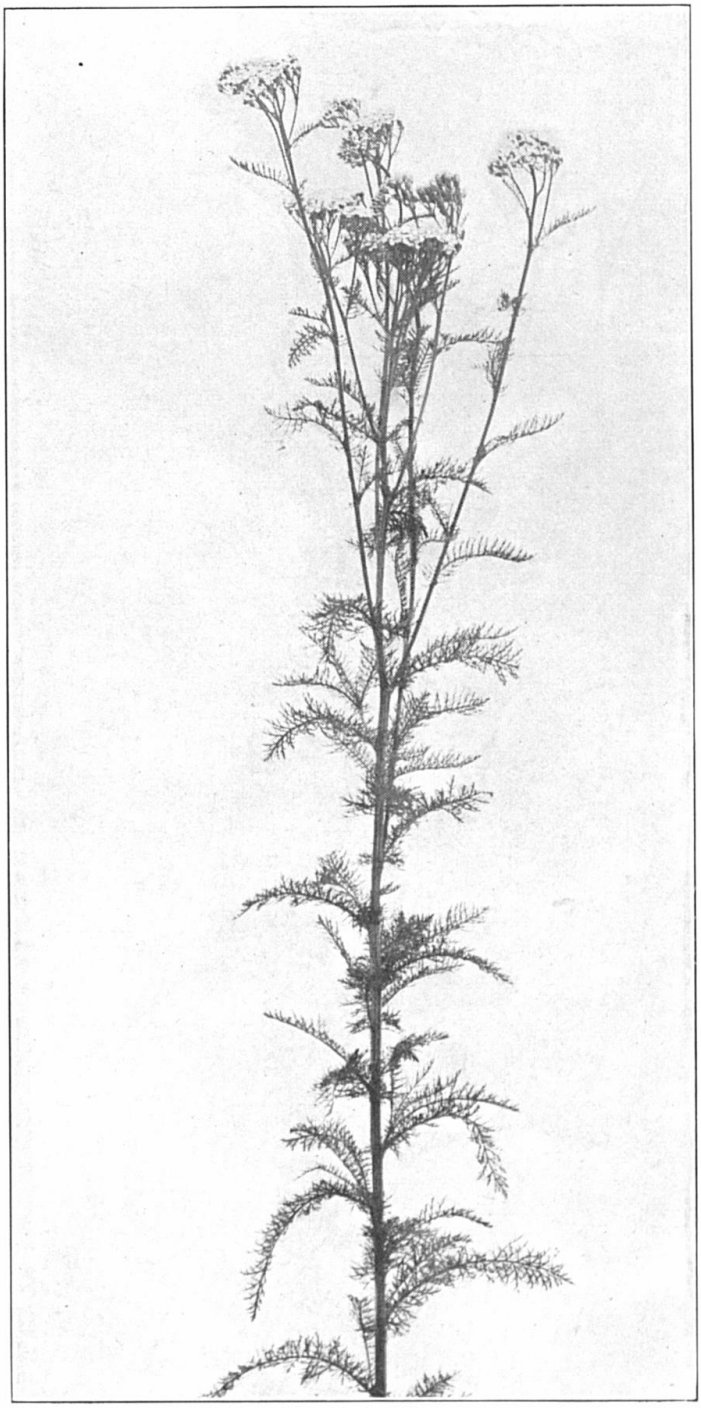


FIG. 39. Yarrow (Achillea millefolium).



FIG. 40. A Bluegrass pasture with patches of Yarrow in bloom. The scattered tall weeds not in bloom are Iron Weed (Vernonia altissima). Photographed by E. C. Vaughn.



FIG. 41. Ox-eye Daisy (Chysanthemum leucanthemum). Natural size. Photographed by H. Garman. The centers of flowers yellow; made too dark by the camera.

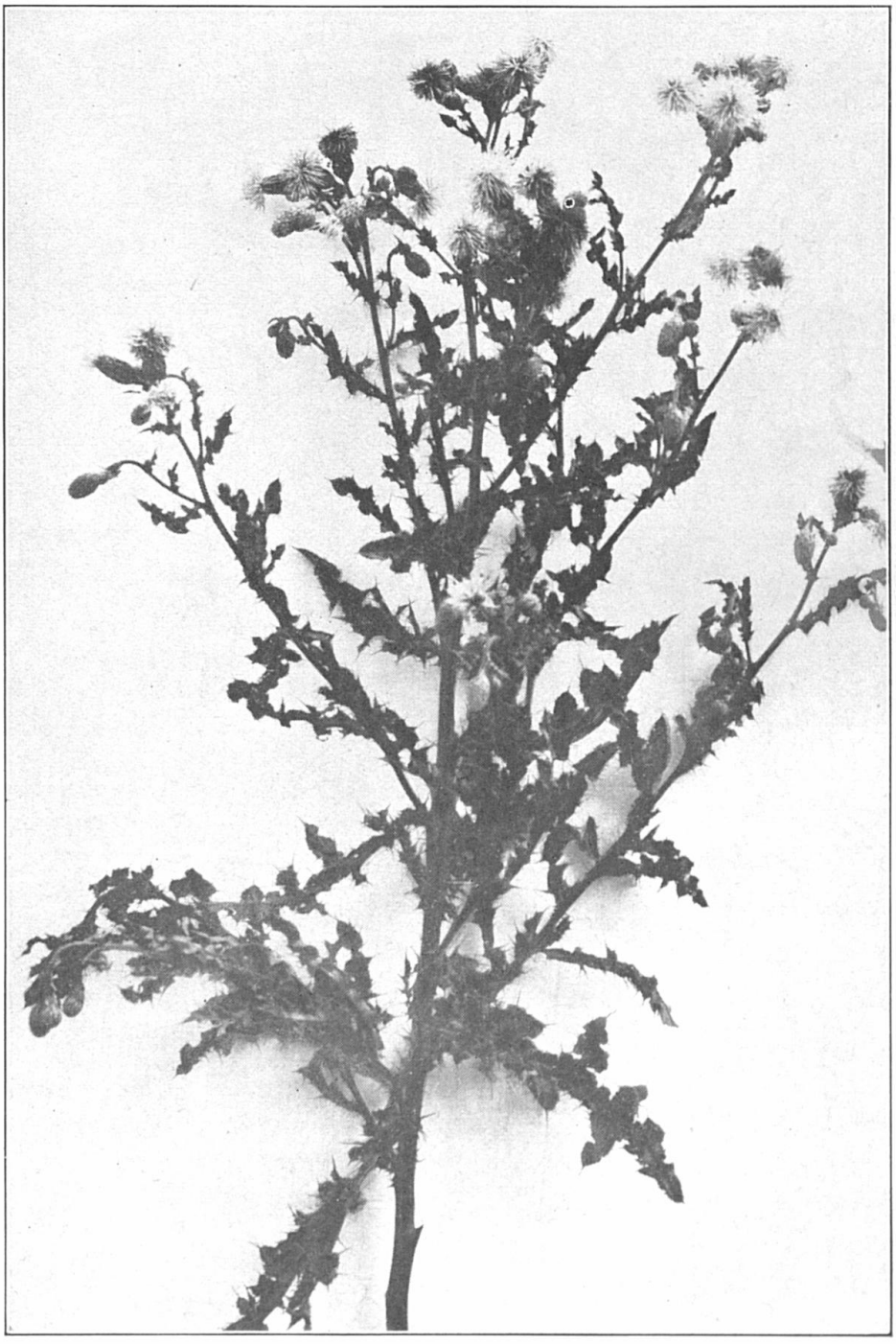


FIG. 42. Canada Thistle (Cirsium arvense). Reduced.

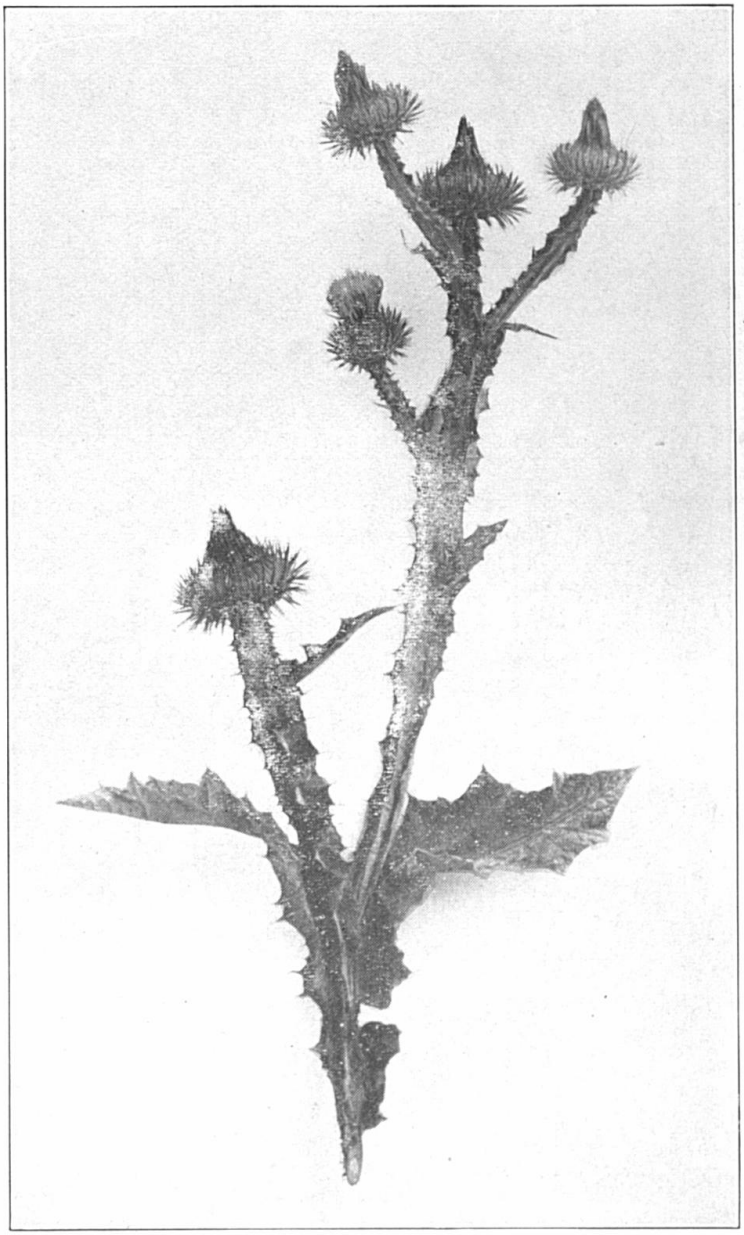


FIG. 43. Scotch Thistle (Onopordum acanthium). Reduced.

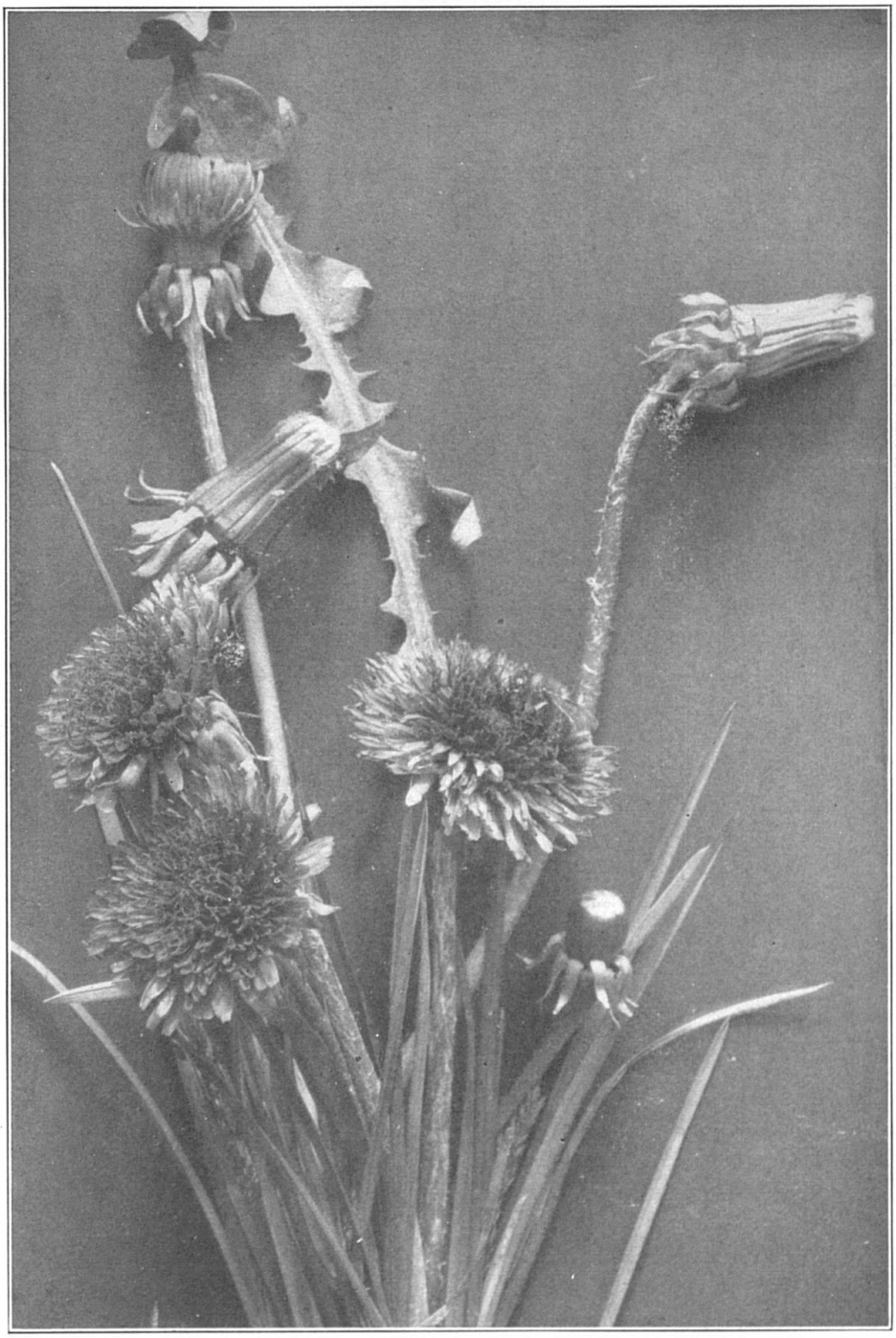


FIG. 44. Common Dandelion. Photographed by H. Garman.



FIG. 45. Dandelions in Grassland. Photographed by H. Garman.

Kentucky
Agricultural Experiment Station
State University, Lexington, Kentucky

BULLETIN NO. 184

Six Different Species of Nodule Bacteria

BY

H. GARMAN and MARY DIDLAKE.



STATE UNIVERSITY PRESS
LEXINGTON, KY.
August, 1914
(341)

KENTUCKY AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

RICHARD C. STOLL, Chairman, Lexington, Ky.
CHARLES B. NICHOLS, Lexington, Ky.
LEWIS L. WALKER, Lancaster, Ky.
HENRY S. BARKER, President of the University.
THE DIRECTOR, Secretary, ex-officio.

JOSEPH H. KASTLE, Director.

STATION COUNCIL

THE DIRECTOR

A. M. PETER
H. E. CURTIS
H. GARMAN
C. W. MATHEWS
R. M. ALLEN
J. D. TURNER
E. S. GOOD
GEORGE ROBERTS
J. J. HOOPER

DEPARTMENTAL ORGANIZATION

ADMINISTRATION

THE DIRECTOR, Head.
H. E. CURTIS, Bursar.
HYWEL DAVIES, Purchasing Agent.
O. L. GINOCHIO, Secretary to Director.
ADDIE LEE DEAN, Librarian.
ANNA WALLIS, Clerk.
CORNELIA C. PAGE, Clerk.

AGRONOMY.

GEORGE ROBERTS, Agronomist, Head.
E. J. KINNEY, Assistant Agronomist.
S. C. JONES, Soil Survey.
A. E. EWAN, Supt. Experiment Fields.
JESSIE F. CASWALL, Clerk.

ANIMAL HUSBANDRY

(Beef Cattle, Sheep and Swine)

E. S. GOOD, Head.
ROBERT GRAHAM, Veterinary Science, In Charge Hog Cholera Serum Production.
E. W. MUMMA, Asst. In Charge Hog Cholera Serum Production.
O. S. CRISLER, Hog Cholera Serum.
R. L. PONTIUS, Hog Cholera Serum.
W. V. SMITH, Asst. in Animal Husbandry.
M. G. GINOCHIO, Clerk.
C. B. WILSON, Hog Cholera Serum.
LAWRENCE GINOCHIO, Clerk.
E. J. GOTT, Hog Cholera Serum.

ANIMAL HUSBANDRY

(Dairy Cattle, Horses and Poultry)

J. J. HOOPER, Head.
W. S. ANDERSON, Asst. Horse Husb'd.
J. W. NUTTER, Supt. Dairy Farm.
W. D. NICHOLLS, Asst. Dairying.
D. D. SLADE, Supt. Poultry Farm.
P. E. BACON, Elmendorf Milk Records.
F. WALLACE UTTERBACK, Clerk.

CHEMISTRY

A. M. PETER, Chief Chemist, Head.
S. D. AVERITT, Chemist.
J. S. McHARGUE, Asst. Chemist.
R. PFANSTIEL, Asst. Chemist.
ETHEL V. T. CASWALL, Clerk.

ENTOMOLOGY AND BOTANY

H. GARMAN, Entomologist and Botanist, Head.
MARY L. DIDLAKE, Laboratory Asst.
E. C. VAUGHN, Asst. in Seed Inspection and Plant Breeding.
H. H. JEWETT, Research Asst. Entom.
H. R. NISWONGER, Asst. in Field Work and Nursery Inspection.
LOUISE BEWLAY, Clerk.

FEED

J. D. TURNER, Head.
H. D. SPEARS, Chemist.
E. H. NOLLAU, Asst. Chemist.
ELMER INGRAM, Chief Inspector.
ROGER W. JONES, Inspector.
FANNY C. ROGERS, Clerk.

FERTILIZER

H. E. CURTIS. Chemist, Head.
B. D. WILSON, Assistant Chemist.
WM. RODES, Assistant Chemist.
ELMER INGRAM, Inspector.
R. W. JONES, Inspector.
ANNA WALLIS, Clerk.

FOOD AND DRUGS

R. M. ALLEN, Head.
J. O. LaBACH, Chief Chemist.
L. A. BROWN, Chemist, Drugs.
J. W. McFARLIN, Chief Food Inspector.
W. R. PINNELL, Bacteriologist.
C. S. PORTER, Inspector, Drugs.
WALTER SCHEPPELMAN, Inspector, Bakery Sanitation.
E. F. WORTHINGTON, Inspector, Dairy Sanitation.
W. G. TERRELL, Inspector, Foods.
LILLIE LISTON, Chief Clerk.
LENA LISTON, Clerk.

HORTICULTURE

CLARENCE W. MATHEWS, Head.
F. W. HOFMANN, Asst. in Horticulture.
G. B. WURTZ, Consulting Meteorologist.
MURIEL CASWALL, Clerk.

RESEARCH

THE DIRECTOR, Head.
H. GARMAN, Entomologist and Botanist.
D. J. HEALY, Bacteriologist.
E. S. GOOD, Animal Husbandry.
O. M. SHEDD, Chemist.
MARY L. DIDLAKE, Asst. Entomologist and Botanist.
G. D. BUCKNER, Chemist.
H. H. JEWETT, Research Asst. in Entom.

Notice

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Director.

BULLETIN NO. 184

SIX DIFFERENT SPECIES OF NODULE BACTERIA

By H. GARMAN AND MARY DIDLAKE.

Since 1901 the senior author of this paper has given attention to the nodula bacteria as his other duties permitted, sometimes by experiments in the field, again by the study of the nodules and their organisms with the microscope, later, when a conservatory became available, by experiments on growing plants under glass. The difficulties in preventing contamination of both treated and untreated plants early impressed him as rendering results secured in this way very unsatisfactory, and he began to cast about for means of preventing, or avoiding, the difficulty so that tests of the transference of an organism from one plant to another might be made with something like the certainty attained in other manipulations familar to those working with bacteria.

Our first experiments were made on plants growing in flower pots which had been soaked in bluestone solution and containing soil sterilized by dry heat, or by steam, carefully fenced with glass and watered with distilled water. Some fairly good results were secured, but still contamination of checks and the possibility of contamination often rendered a whole experiment of doubtful value. It was then decided to use bottles filled with distilled, or reservoir water, with a nitrogen-free chemical fertilizer added, the whole being sterilized in an autoclav. This also had its difficulties, coming partly from the necessity of cutting the stoppers to let

the plants protrude; and while results were better than those secured in other ways, frequent contaminations occurred.

After experimenting with various media and chemical fertilizers it was finally decided to use agar in six-inch test tubes and twelve-inch cylinders, and in 1908 we planned a series of tests including at first alfalfa and sweet clover (*Melilotus alba*), but extended as the work continued to the other most commonly grown leguminous plants. The first suggestions of the feasibility of making tests so controlled of the transference of nodule bacteria from plant species to plant species came from the observation that the nodules appear on certain plants as soon as these begin to grow and shortly after the seed leaves are exhausted. These at any rate it was thought could be grown in the tubes and cylinders long enough to get results. It was found that even the large seeded plants like the garden pea and cowpea could also be grown for a long time in tubes, and they have been thus tested, tho the results have not always been as satisfactory as those obtained in working with the clovers and alfalfa.

The tubes to be used and the cotton plugs were sterilized in the usual way in a hot air sterilizer, and the tubes were then filled about one-third full of agar made with distilled water only and 0.65 per cent of agar (one-half of the quantity ordinarily used for agar media). After sterilization of the tube and its contents in an autoclav part of a pure culture obtained from a nodule was introduced and a few seeds were placed on the surface of the agar.

Clover and alfalfa managed thus grow very well and soon produce nodules when treated with appropriate cultures, making it unnecessary to remove the cotton plugs after the seeds are introduced. The larger plants find the tubes less congenial and, requiring a longer time to produce nodules, must be helped past the plugs before the experiment terminates.

It has been a part of our plan to use for each test fifteen tubes and lots of treated plants together with fifteen other

tubes containing untreated plants. Usually with clovers and alfalfa six seeds were put in each tube; with soy beans, cowpeas, etc., only one. If all of the fifteen lots agree in producing nodules, or in not producing them, while the check lots remain uncontaminated, it affords pretty good proof as to the possibility of transferring the particular organism tested. Coupled with such tests others are frequently made to determine the quality of the culture employed—to determine if it will certainly produce nodules on any species. For example, if it produces nodules on every treated plant of the sort from which it was originally taken, its failure, if failure there is, to produce nodules on other plants can not be charged to its lack of viability.

One disturbing chance of contamination comes from the difficulty of sterilizing the seeds introduced. Seeds of such plants as red clover and alfalfa make little difficulty of this sort. Those of the larger plants, garden pea, soy bean, and the like, have made some trouble because of the very great difficulty of sterilizing them so that all molds are removed. Yet the results obtained with these plants and presented below are believed to be thoroly established.

Various methods of disinfecting the seeds have been tried: Soaking them in very hot water, in formalin (one part to 240 of water), in corrosive sublimate (one part in 1000 of water), and lime chloride. After treatment the chemicals had to be removed by thoro rinsing in sterilized distilled water. But in spite of all precautions molds occasionally marred results during the summer months, especially with the larger seeds, peas, beans, etc. During the winter simply rubbing the seeds with a clean cloth and dropping them directly into the tubes sometimes gave good results and no contamination, while with clover and alfalfa even this precaution could often be dispensed with, seeds right from a package being dropped into the tubes.

The medium commonly used for the isolation and culture of the nodule organisms has been made from an infusion of the roots of legumes (usually soy beans) with ½ per cent. sugar, ¼ per cent. asparagin and 1¼ per cent. agar. All the species tested grew freely upon this

medium, the soy bean organism, strange to say, and the cowpea, giving more scanty growth than the others.

It has been claimed that cultures on a nitrogen-free medium become "nitrogen hungry," are more virulent and active in producing nodules than others. For several years we have employed such an agar made according to a formula given in Bulletin 71, p. 27, of the Bureau of Plant Industry, and containing 1 per cent. agar, 1 per cent. maltose, 1/10 per cent. monobasic potassium phosphate, 2/100 per cent. magnesium sulphate, to 100 c.c. distilled water. Repeated tests, details of which will appear below, have not shown this medium to have any advantage over the other. Soy bean and cowpea cultures grow on it more freely and alfalfa less freely; but nodule producing power does not seem to be increased by its use.

Other tests have been made to determine at what age cultures are most virulent, but those grown artificially for over a year produce nodules about equally well with those newly isolated.

In the series of test-tube experiments the common method of inoculation has been to melt up the agar and as it cools insert a loop of the culture, shake well and allow to harden again. The method of mixing the culture in water and moistening the seeds with it, as commonly recommended to farmers, gave equally good results, while a combination of both methods slightly increased the number of nodules produced. In the series of experiments with plants in bottles of water the method of allowing the plant to develop a few days and then touching the roots with a loop of the culture gave satisfactory inoculation.

In one experiment with soy beans the seeds were divided into three lots; one soaked in the culture ten minutes and spread out to dry; one soaked an hour and then spread out to dry; and the third soaked over night. Of the first lot 9.09 per cent. had nodules; of the second 88.88 per cent.; of the third lot 100 per cent. had nodules. The checks showed no nodules.

As to the length of time seed should be left dry after treatment, our experience indicates that the sooner they are planted, the better. To test the question soy beans were soaked in the culture for an hour, then spread out to dry. Some were planted after one night, some after four days, some after a week, two weeks, three weeks. As a result, those dried over night had 77.77 per cent. with nodules; four days, 47.14 per cent. with nodules; one week, 15.39 per cent; two weeks, 14.28 per cent.; three weeks, no nodules. The check plant in the lot kept dry a week had one nodule; the rest were all free from nodules.

Another experiment, using a piece of cloth which, soaked in the culture, might, it was believed, be more easily mailed to farmers, showed conclusively that much better results are obtained by inoculation with the culture direct; tho where the cloth was kept dry only twenty-four hours, every plant but one treated from it showed some nodules.



FIG. 1. A, Fifteen test tubes of red clover inoculated with white clover nodule bacteria. B, Fifteen tubes of red clover, not inoculated (checks). Started July 16, 1909. Photographed November 19. Reduced.

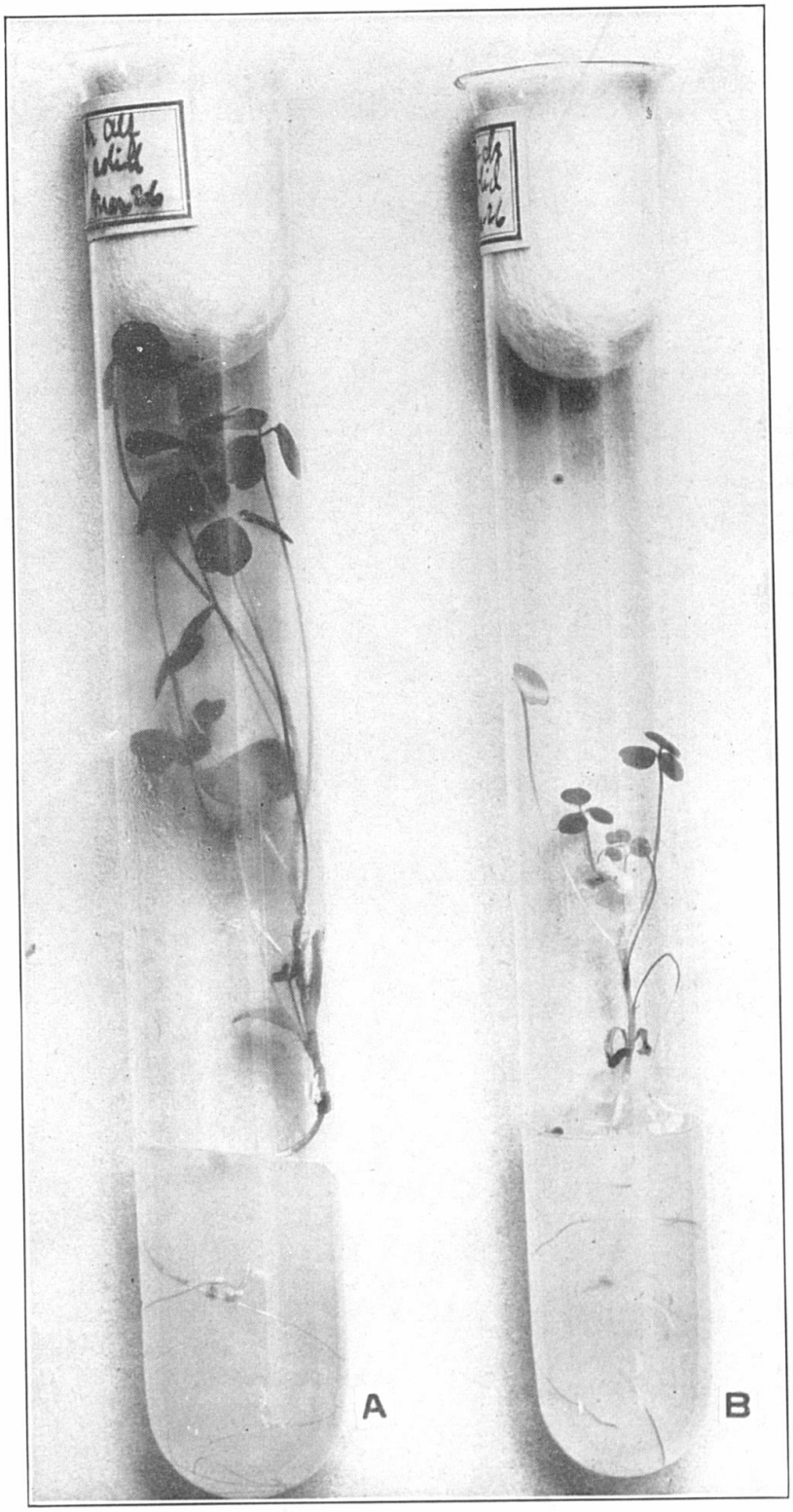


FIG. 2. A, An alfalfa plant inoculated with an alfalfa nodule bacteria culture. B, A check plant. Started March 26, 1909. Photographed June 4. Natural size.

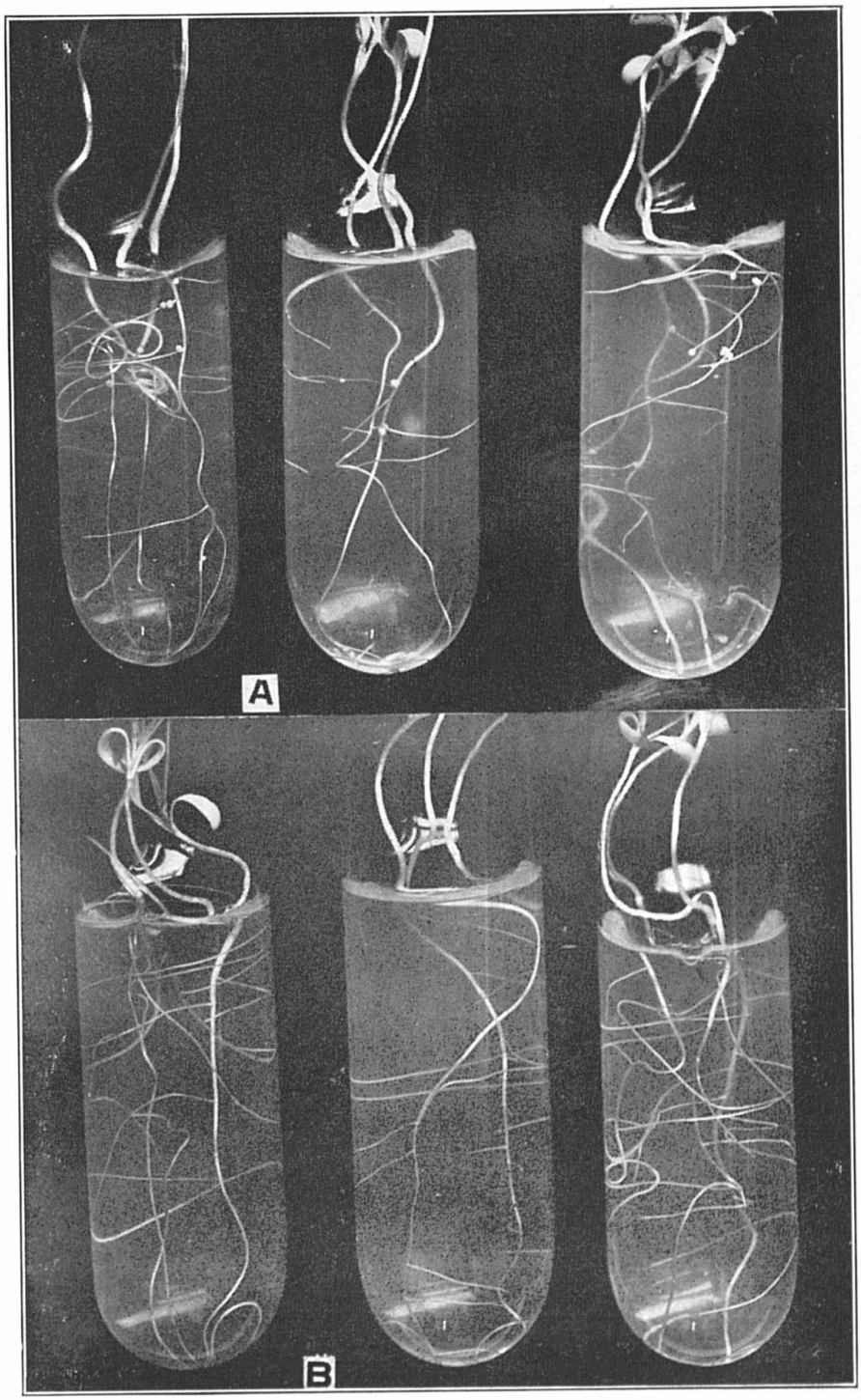


FIG. 3. A, Three tubes of nodule bearing alfalfa, inoculated with sweet clover nodule bacteria, B, Three check tubes of same, without nodules. Started April 29, 1909. Photographed June 9. Natural size.

By the many tests made, as above outlined, we have succeeded in proving to our own satisfaction that the bacteria producing nodules on the roots of the commonly grown leguminous plants (1) are of several different species, (2) which have no relation with each other so far as any published evidence shows; (4) that a species may produce nodules on but one plant or on several; and that (4) in the latter case these different plants may not be members of one genus, tho they commonly are.

Observations made in this laboratory imply, too, that (5) an organism which does not naturally produce nodules on a plant can not be induced to adapt itself to this new host. The vetch organism after being cultivated for a year artificially on a medium made from an infusion of the roots of soy bean would not at the end of this time produce nodules on the soy bean, while still producing them abundantly on its own host plant, the vetch.

Thousands of treated plants have been grown since the tests were begun, and an equal number of check lots have been grown for comparison. The data upon which our conclusions rest is given in part at the end of this paper.

The Alfalfa Nodule Organism.

It has long been claimed that the organism causing nodules on the roots of alfalfa was the same as that producing nodules on *Melilotus alba*. This seemed to us unlikely at the outset, considering that the plants belong to different botanical genera. The tests made in this country, as far as known to us, were field tests where all the conditions could not be known and controlled. Yet it has proved true that the organism taken from nodules on the roots of alfalfa produce nodules in our tubes on the roots of sweet clover, and true also that the organism from sweet clover causes nodules on alfalfa. Repeated tests, with checks, have shown it to be a matter of no consequence as to which plant the bacteria come from; they are just as effective on the other as are bacteria from nodules on its own roots.

The nodule organism of alfalfa and sweet clover has been proved to be identical also with that producing nodules on two other forage plants of the genus Medicago, namely *M. lupulina*, the trefoil or black medick of botanies, and *M. denticulata*, bur clover. By test tube cultures it has been transferred back and forth on these different plants until we feel satisfied in asserting that there is no necessity in practical work for keeping separate cultures for each plant, and should not hesitate when supplying cultures to farmers of Kentucky for field use on alfalfa to make use of cultures obtained from any one of the plants named.

But these bacteria do not produce nodules on the roots of any species of Trifolium, of Vicia, Pisum, Vigna, Glycine, or Phaseolus.

The Clover Nodule Organism.

All of the species of Trifolium are affected by a single nodule organism species. It does not matter at all which species the culture is made from, it will produce nodules on the roots of any other member of the genus. This is a matter of some importance to those engaged in manufacturing cultures for sale. We do not hesitate to send out to our farmers in Kentucky, for example, cultures made from alsike clover if cultures are wanted for use on red, white or crimson clover. The cultures made from these latter show a similar capacity to produce nodules on alsike and upon each other. The proof of this has been in our possession for some time and is conclusive as to the identity of the organisms of this group of plants.

Here again the bacteria from the roots will not produce, under any conditions with which we are familiar, nodules on the roots of alfalfa, sweet clover, garden peas, field peas, cowpeas, garden beans, or soy beans. Tests of the cultures on plants of the species from which they were originally made have been employed as a means of showing whether or not in the case of non-transference the bacteria were active. The results secured are conclusive to the effect that

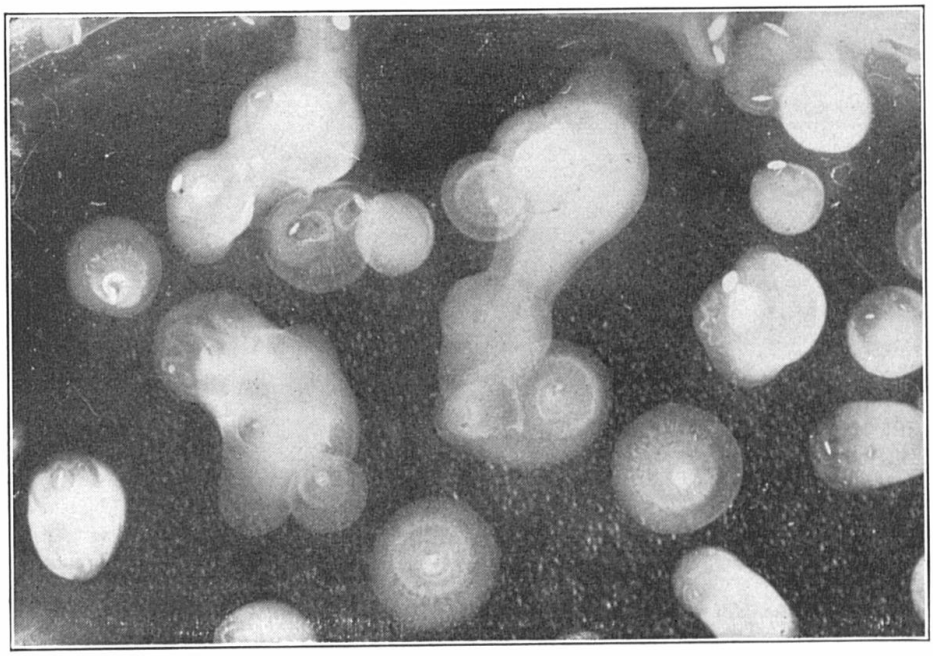


FIG. 4. Colonies of red clover nodule bacteria from a Petri dish culture. Reproduced from a photograph. (X 2)

the clover nodule organism is a species, restricted, as far as there is any proof of value, to plants of the genus Trifolium.

The Vetch and Garden Pea Nodule Organism.

This seems to be a third species distinct in its physiological characters from the two preceding. The cultures made in the Division have been secured from *Vicia villosa*, and do not produce nodules on red clover, crimson clover, nor on alfalfa; neither do the organisms obtained from the clover and alfalfa produce nodules on plants of these genera. The organism does not produce nodules on cowpea, soy bean, or common bean; nor do the organisms from these plants produce nodules on the hairy vetch.

The organisms on *Vicia villosa* and on spring vetch (*V. sativa*) are identical, as has been proved in this laboratory by transference from the former to the latter, ten of fourteen (One of the tubes was broken by accident.) treated lots of plants bearing nodules, while none of the checks bore nodules.

A single test of the possibility of transferring the organism of garden pea nodules to the spring vetch (*Vicia sativa*) gave satisfactory evidence that the two plants bear but one organism. The results of the test will be found among the data given below.

The artificial cultures of the two organisms and their microscopical appearances show resemblances which support the belief that they are identical.

The Cowpea Nodule Organism.

It appears now to be certain that the cowpea organism is distinct among those studied here, and that it does not produce nodules on any other familiar agricultural species. It has proved very commonly, and is perhaps invariably, present wherever cowpeas have been grown in the State, not, it is believed, because it is always present in soil, but because it is generally conveyed on the seeds themselves.

We have not succeeded in conveying it to clovers, alfalfa,

or vetches, and it seems to be equally refractory when applied to more closely related plants like garden beans and peas. We believe it to be a distinct nodule producing species.

The Soy Bean Nodule Organism.

Our experiments indicate that in the soy bean nodule bacteria we have still another very distinct species not transferable to cowpeas, garden beans, or garden peas. Fine growths of soy beans without a trace of nodules were at one time produced in our plots, implying that the organism is not generally present. Of late it seems to be more common and plantings are often with nodules when planted on land in which they have not been grown before. It is undoubtedly conveyed to new localities on the seeds, even when these have not been inoculated.

The Garden Bean Nodule Organism.

It has been a matter of surprise to us that the organism on the roots of common garden beans is distinct from those on the roots of cowpeas and soybeans, especially after having obtained convincing evidence of the identity of those on the roots of species of Medicago and Melilotus. Yet the fact seems to be, judging by our tests, that the common bean of our gardens is infested with an organism distinct from all of the others here designated. Fifteen tubes containing plants started May 11, 1909, and inoculated with a pure soy bean culture, bore no nodules when examined June 22. The fifteen checks were also free from nodules. The same result was secured from a test of fifteen lots with as many checks, started September 30, 1910, and examined November 1. The same result was secured also June 22, 1909, with garden bean treated with a cowpea culture.

Tests of Transference of Nodule Bacteria.

Most of the plants were grown on sterilized agar in six-inch test-tubes about one inch in diameter, plugged with cotton. Each experiment involved 15 tubes, treated with a

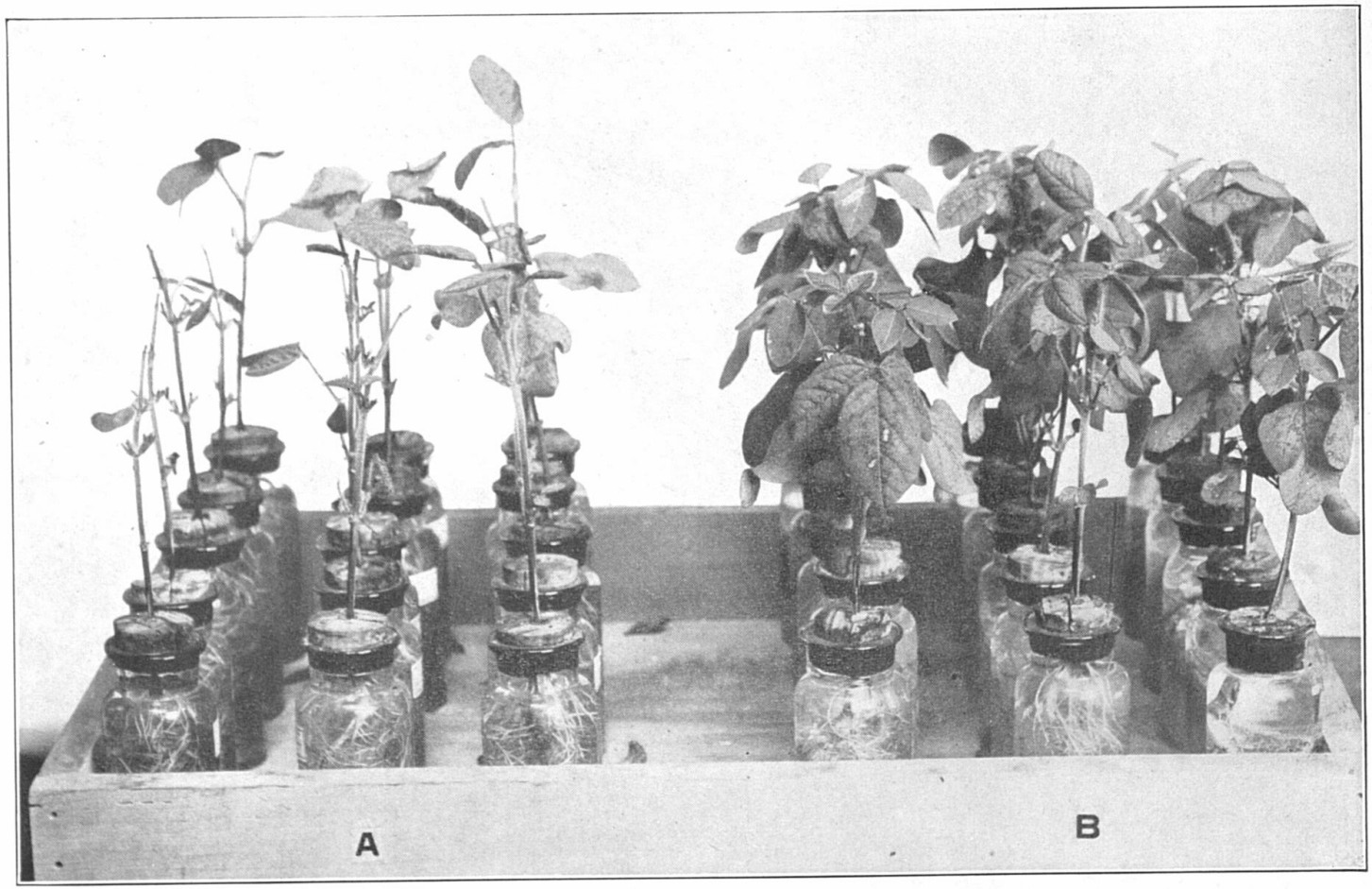


FIG. 5. A, Soy bean checks grown in bottles of sterilized water. B, Soy beans inoculated with soy bean nodule bacteria. Photographed February 10, 1909. Reduced.

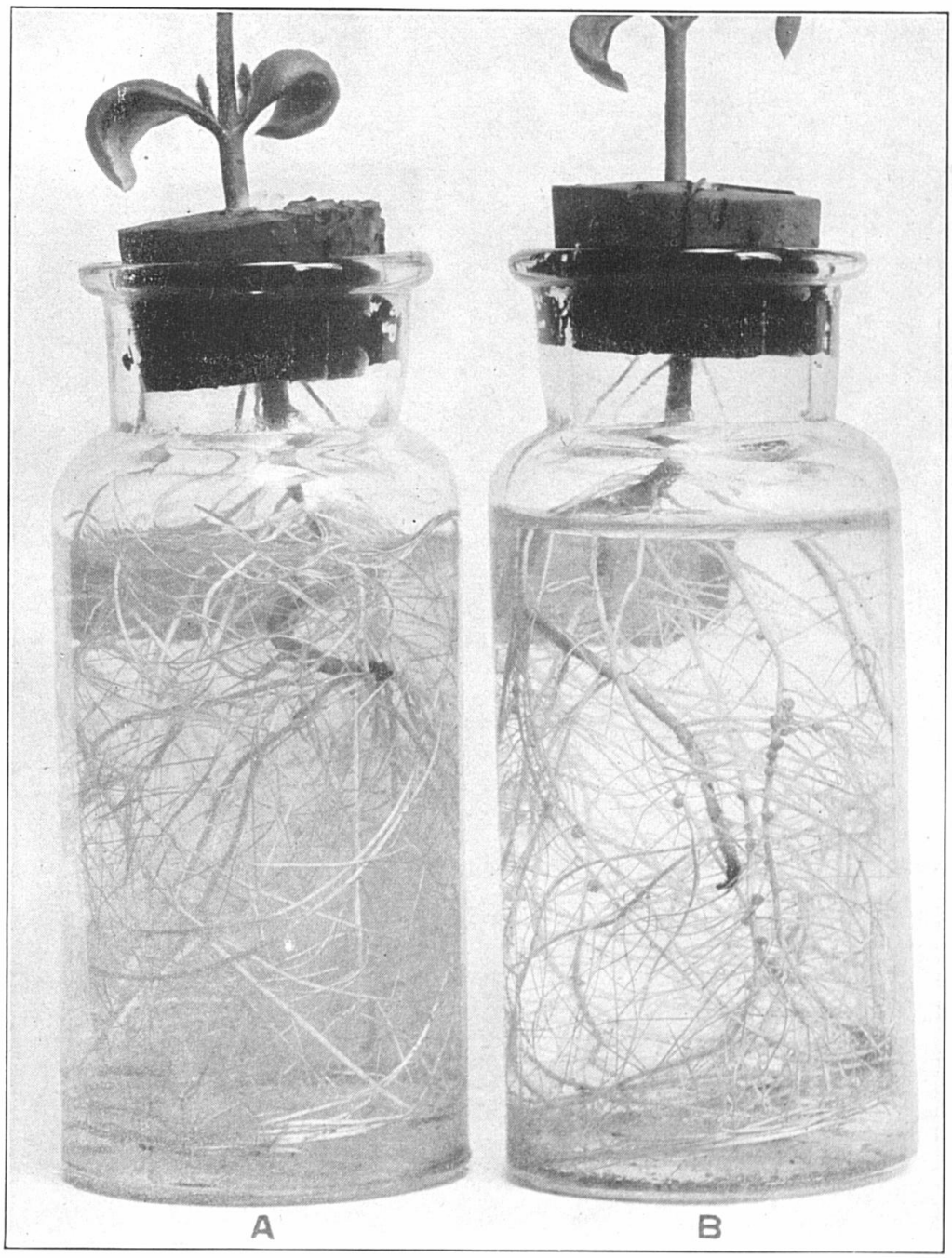


FIG. 6. A, One of the check bottles shown in Fig. 5. B, One of the treated bottles showing nodules. Natural size.

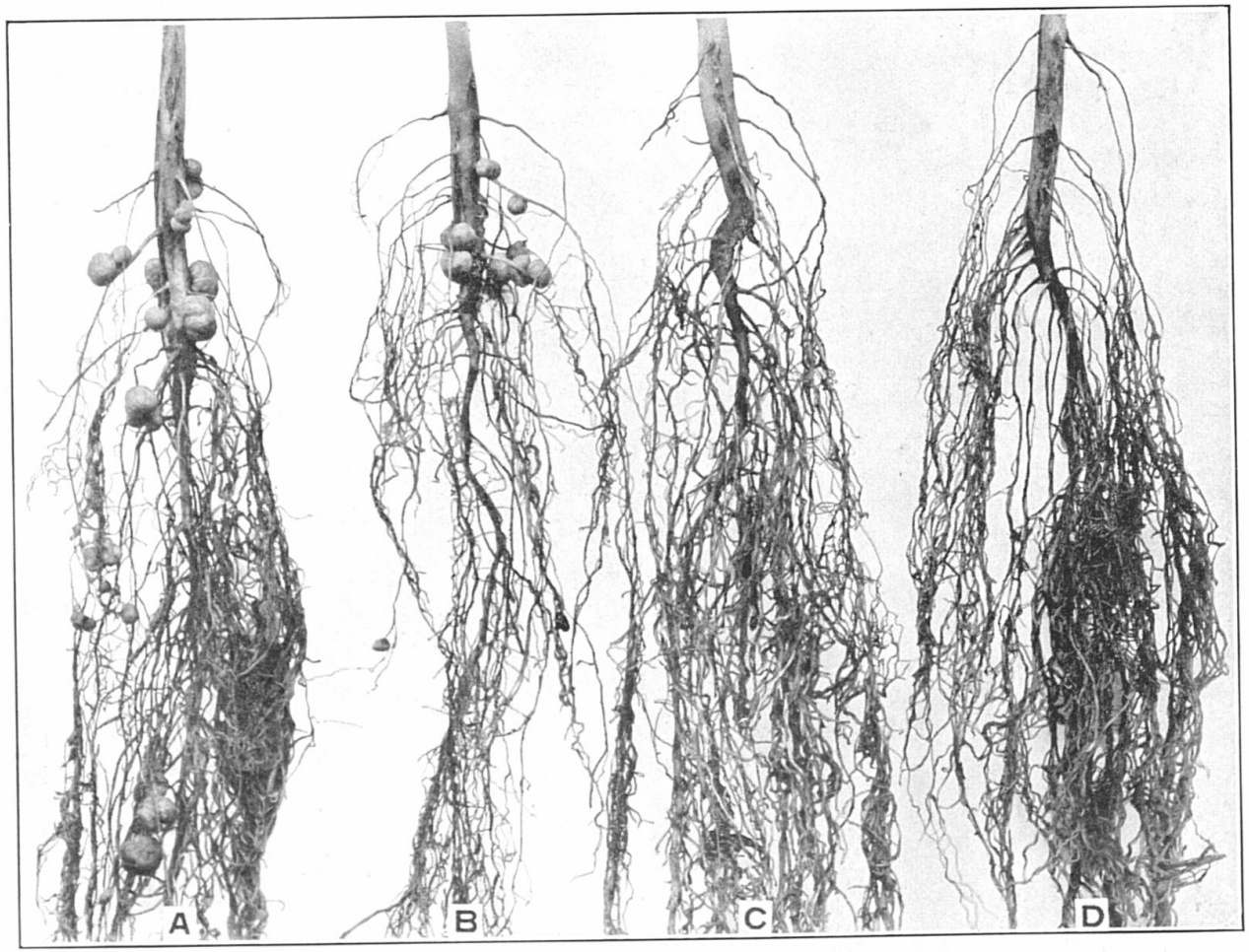


FIG. 7. A. Soy bean plant bearing nodules, from seed soaked in soy bean bacterial culture over night. B, Plant from seed soaked one hour. C, Plant from seed soaked ten minutes. D, Check plant. Photographed April 7, 1903 Reduced.

culture, and 15 checks. With alfalfa, sweet clover, black medick, bur clover, red, white, crimson and alsike clover, six seeds were ordinarily used in every tube and as a rule all grew well. With the vetches four seeds were put in each tube. With soy beans, cowpeas, garden beans and garden peas we usually started two seeds in a tube, removing with sterile, platinum-tipped forceps the one which was most backward in germinating. With the larger plants the cotton plug had to be slipped in against the stem below the leaves, allowing the plant to grow sometimes a foot or more outside the tube; and as the roots exhausted the moisture it had to be replaced with sterilized distilled water. The smaller plants, alfalfa and clovers, completed satisfactory growth and nodule production without the removal of the cotton plug after the seed were dropped in, growing to a height of only two or three inches. Nodules usually began to appear in two weeks, on red clover sometimes in only seven to ten days, the clear white agar medium allowing them to be easily seen with a hand lens from their very start.

It is impossible to explain the difficulty we have experienced in securing nodules by these methods on ordinary garden beans and peas. Soy beans and cowpeas readily produced nodules when grown in these test tubes and treated with the right cultures. It was thought that perhaps the seed coats contained some substance antagonistic to the nodule organisms, so experiments were tried in which the seeds were soaked in sterile water, the seed coats being then removed and the plants introduced into agar tubes treated with the culture, but no nodules resulted; with others the seeds were germinated and well started in one set of tubes, then transferred to another lot and the roots of each touched with a loop of the culture, but still with no success. Of course there was always the possibility of the pure culture not being the right organism, but it was usually isolated from large, juicy nodules with small chance of contamination, and we felt more sure of it than of many isolated from the smaller nodules of the clovers. One experiment was tried in which the crushed nodules themselves were used to inoculate the

agar instead of an intermediate pure culture, but the peas then used also failed to produce nodules.

About ten different experiments were started with the object of learning if cultures grown on a nitrogen-free medium produced more nodules than those grown on the agar medium made from an infusion of the roots of legumes. Results were slightly in favor of the former, but with such small advantage that either medium is considered satisfactory. The tests were made with red clover, crimson clover, alfalfa, vetch, soy bean and cowpea, and a count of the nodules on each plant of each experiment resulted in an average of about 7¾ nodules to each plant treated with the culture grown on the nitrogen-free medium, and 6⅘ nodules to a plant where the other culture was used.

It has been thought that the use of a small quantity of barium carbonate in the tubes with the plants would help keep down the growth of molds and promote nodule production, but this was tried in eleven different tests with red clover, crimson clover, alfalfa, vetch, soy bean, cowpea, bean and pea, and no advantage resulted.

In the earlier experiments with plants grown in pots of sterilized soil, in those grown in bottles of water, as also later with those started in test tubes of agar, we usually found little difference in the plants in favor of the inoculated lots; in fact the checks frequently started off rather better than the treated; but as evidenced by our illustrations the plants with good nodules persisted longer, showed more vigor in resisting decay and retaining their leaves than the checks. These last remarks apply, however, to media in which there is a deficiency of nitrogen other than that derived from the nodules.

In one experiment with soy beans treated with a soy bean culture, grown in bottles, started February 23 and finished April 30, 1909, all the treated plants had nodules and none of the checks. The following notes apply to the condition of the two lots of plants: March 13, nodules on all the treated lot, checks look equally green and vigorous. April 3, treated lot decidedly greener than the checks, but no

larger. April 8 and 14, difference still more noticeable. April 17, some checks dying and dropping leaves. April 22, treated lot still green and leafy, taking up water quickly, twelve with seed pods; checks, nearly all the leaves fallen, four with seed pods.

Another test of soy beans treated with a soy bean culture, was started April 12, finished June 11, 1909. By May 22, eleven of the treated lot had nodules, two others were dead; checks, no nodules; both lots sickly, leaves falling, checks rather the better of the two. By June 11 checks had good roots, but no tops, every leaf gone; of the treated lot four still had good green leaves and pods and three others had some leaves.

In similar tests of cowpeas the treated lots with nodules, after a month's growth were greener and continued putting out new leaves when the checks were dying and losing their leaves.

Alfalfa treated with alfalfa culture.
Started April 14; finished, May 12, 1909.
Results: Treated lot, 13 with nodules; checks, no nodules.

Alfalfa treated with sweet clover culture.
Started, April 29, finished May 12, 1909.
Results: Treated lot, all 15 with nodules; checks, no nodules. Kept until July 6 and there were still no nodules on any checks and those on the treated lot were much larger and more numerous.

Alfalfa treated with black medick culture.
Started, November 6, finished, December 21, 1912.
Results: Treated lot, all 15 with good nodules; checks, no nodules.

Alfalfa treated with bur clover culture.
Started, October 24, finished December 19, 1913.
Results: Treated lot, 6 with uodules; checks, no nodules.

Alfalfa treated with red clover culture.
Started, July 8, finished, October 4, 1909.
Results: Treated lot, no nodules; checks, no nodules. Started off quickly and developed abundant roots.

Started, March 18, finished, May 6, 1913.
Results: Treated lot, no nodules; checks, no nodules. Culture used had been grown on nitrogen-free medium but proved no more effective in producing nodules on a different host plant than any other.

Alfalfa treated with white clover culture.
Started, July 14, finished October 4, 1909.
Results: Treated lot, no nodules; checks, no nodules.

Alfalfa treated with crimson clover culture.
Started, November 7, finished, December 13, 1911.
Results: Treated lot, no nodules; checks, no nodules. Healthy plants, good roots. Culture newly isolated and tested on red clover and on crimson clover with positive results.

Alfalfa treated with vetch culture.
Started, February 2, finished, March 9, 1911.
Results: Treated lot, no nodules; checks, no nodules. At the same time to prove ths activity of the vetch organism and the capacity of the alfalfa plants to produce nodules under similar conditions, we started four tubes of vetch treated with vetch culture, and all produced nodules; also four tubes of alfalfa treated with alfalfa culture, and all of these had good nodules.

Alfalfa treated with soy bean culture.
Started, February 4, finished, March 10, 1910.
Results: Treated lot, no nodules; checks, no nodules. All germinated well and had fine, long, straight roots.

Alfalfa treated with cowpea culture.
Started, May 17, finished, June 17, 1910.
Results: Treated lot, no nodules; checks, no nodules. Good plants and vigorous roots.

Sweet clover treated with sweet clover culture.
Started, April 29, finished, June 4, 1909.
Results: Treated lot, 12 with nodules; checks, no nodules. The three tubes without nodules had plants not well developed.

Sweet clover treated with alfalfa culture.
Started, May 15, finished, June 1, 1909.
Results: Treated lot, all 15 with nodules; checks, no nodules.

Sweet clover treated with black medick culture.
Started, November 8, 1912; finished, January 2, 1913.
Results: Treated iot, 9 with nodules; checks, no nodules. Plants rather poor, with small development of roots.

Started, January 15, finished, March 4, 1913.
Results: Treated lot, 12 with nodules; checks, no nodules. Good growth of plants and roots, nodules mostly near base of stem.

Sweet clover treated with red clover culture.
Started, December 22, 1909; finished, February 5, 1910.

Results: Treated lot, no nodules; checks, no nodules. Among the treated lot, in four tubes the plants either did not germinate or were sickly and died; among the checks six tubes of plants failed to develop well.

Started, March 14, finished, April 14, 1910.

Results: Treated lot, no nodules; checks, no nodules. Seeds germinated poorly, plants frail, but some with long roots.

Sweet clover treated with white clover culture.

Started October 15, finished, December 3, 1909.

Results: Treated lot, no nodules; checks, no nodules. The sweet clover seed we could obtain did not germinate well and not all the various transfers were undertaken on this account.

Black medick treated with black medick culture.

Started, November 11, finished, December 27, 1913.

Results: Treated lot, 14 with nodules (Plants in the 15th tube died.); checks, no nodules.

Black medick treated with alfalfa culture.

Started, November 11, 1913, finished, January 2, 1913.

Results: Treated lot, 9 with nodules; checks, no nodules.

Black medick treated with sweet clover culture.

Started, November 11, 1912, finished, January 2, 1913.

Results: Treated lot, 6 with nodules; checks, no nodules.

Black medick treated with red clover culture.

Started, April 10, finished, May 22, 1913.

Results: Treated lot, no nodules; checks, no nodules.

Bur clover treated with bur clover culture.

Started, March 7, finished, April 14, 1913.

Results: Treated lot, 9 with nodules (Plants in one tube dead.); checks, no nodules.

Red clover treated with red clover culture.

Started, June 9, finished, July 12, 1909.

Results: Treated lot, 13 with nodules; checks, no nodules.

Red clover treated with white clover culture.

Started, July 16, finished, October 4, 1909.

Results: Treated lot, all 15 with nodules; checks, no nodules.

Red clover treated with alsike clover culture.

Started, March 9, finished, March 28, 1910.

Results: Treated lot, all 15 with good nodules; checks, no nodules.

Red clover treated with crimson clover culture.
Started, October 19, finished, November 20, 1011.
Results: Treated lot, all 15 with nodules; checks, no nodules. Good plants and roots.

Red clover treated with alfalfa culture.
Started, June 9, finished, July 12, 1914.
Results: Treated lot, no nodules; checks, no nodules.

Red clover treated with sweet clover culture.
Started, October 13, finished, December 3, 1909.
Results: Treated lot, no nodules; checks, no nodules.

Started, March 21, finished, May 6, 1913.
Results: Treated lot, no nodules; checks, no nodules. Culture used had been grown on nitrogen-free medium, but proved no more effective in producing nodules on another host plant than any other.

Red clover treated with black medick culture.
Started, November 8, finished, December 27, 1912.
Results: Treated lot, no nodules; checks, no nodules.

Red clover treated with bur clover culture.
Started, October 27, finished, December 19, 1013.
Results: Treated let, no nodules; checks, no nodules.

Red clover treated with vetch culture.
Started, February 2, finished, March 9, 1911.
Results: Treated lot, no nodules; checks, no nodules. At the same time 4 tubes of red clover treated with red clover culture and vetch treated with vetch culture, all had good nodules.

Red clover treated with soy bean culture.
Started, January 25, finished, March 10, 1910.
Results: Treated lot, no nodules; checks, no nodules.

Red clover treated with cowpea culture.
Started, September 30, finished, October 30, 1910.
Results: Treated lot, no nodules; checks, no nodules.

White clover treated with white clover culture.
Started, July 14, finished, October 4, 1909.
Results: Treated lot, 13 with nodules; checks, no nodules. Plants did not start off well, roots a long time getting any growth; in the two treated tubes that had no nodules, the plants scarcely started, were moldy and with little roots.

White clover treated with red clover culture.
Started, July 28, finished, October 4, 1909.
Results: Treated lot, all 15 with nodules; checks, no nodules.

White clover treated with alsike clover culture.
Started, March 10, finished, March 30, 1910.
Results: Treated lot, all 15 with nodules; checks, no nodules. Good growth of roots and nodules abundant.

White clover treated with alfalfa culture.
Started, July 16, finished, October 4, 1909.
Results: Treated lot, no nodules; checks, no nodules.

White clover treated with sweet clover culture.
Started, July 28, finished, October 4, 1909.
Results: Treated lot, no nodules; checks, no nodules.

Alsike clover treated with alsike clover culture.
Started, February 4, finished, March 10, 1910.
Results: Treated lot, all 15 with nodules; checks, no nodules. All the plants made a poor start and had very scanty roots.

Alsike clover treated with red clover culture.
Started, October 13, finished, December 3, 1909.
Results: Treated lot, 14 with nodules; checks, no nodules.

Alsike clover treated with white clover culture.
Started, February 8, finished, March 10, 1910.
Results: Treated lot, all 15 with nodules; checks, no nodules. All the plants with very good roots and nodules.

Crimson clover treated with crimson clover culture.
Started, October 19, finished, November 20, 1911.
Results: Treated lot, all 15 with nodules; checks, no nodules. Good plants and roots, nodules developed promptly.

Crimson clover treated with red clover culture.
Started, November 7, finished, December 13, 1911.
Results: Treated lot, all 15 with nodules; checks, no nodules. The culture used had been isolated over a year, but had been recently tested and gave nodules on red clover.

Crimson clover treated with alfalfa culture.
Started, January 31, finished, March 2, 1912.
Results: Treated, no nodules; checks, no nodules. Good, healthy plants.

Crimson clover treated with vetch culture.
Started, January 18, finished, February 19, 1912.
Results: Treated lot, no nodules; checks, no nodules. Plants made poor growth, but some had good roots.

Crimson clover treated with soy bean culture.
Started, March 6, finished, April 9, 1912.
Results: Treated lot, no nodules; checks, no nodules. Plants made poor growth, but some had goods roots.

Crimson slover treated with cowpea culture.
Started, February 29, finished, April 9, 1912.
Results: Treated, no nodules; checks, no nodules. Plants made poor growth, but some had good roots.

Vetch treated with vetch culture.
Started, February 2, finished, March 20, 1911.
Results: Treated lot, 13 with nodules. The two tubes without nodules had plants which hardly made any start; checks, two with nodules, small but unmistakable.

Spring vetch treated with hairy vetch culture.
Started, May 4, finished, June 3, 1912.
Results: Treated lot, 10 with nodules (1 tube broken); checks, no nodules.

Vetch treated with alfalfa culture.
Started, December 21, 1911; finished, January 22, 1912.
Results: Treated lot, no nodules; checks, no nodules. Good plants and roots, but some moldy.

Vetch treated with red clover culture.
Started, March 28, finished, May 9, 1911.
Results: Treated lot, one nodule; checks, one nodule. At same time tried four tubes of vetch treated with vetch culture, and four of red clover treated with red clover, and all had good nodules.

Vetch treated with crimson clover culture.
Started, January 18, finished, February 19, 1912.
Results: Treated lot, no nodules; checks, no nodules. Plants rather poor and moldy. some with good roots.

Vetch treated with cowpea culture.
Started, March 6, finished April 9, 1912.
Results: Treated lot, no nodules; checks, no nodules. Plants fairly good. Culture recently tested on cowpea with positive results.

Vetch treated with garden bean culture.
Started, March 12, finished, April 14, 1913.
Results: Treated lot, no nodules; checks, no nodules.

Vetch treated with garden pea culture.

Started, February 1, finished, March 4, 1913.

Results: Treated lot, all 15 with nodules; checks, no nodules. A very satisfactory lot, good plants and nodules.

Soy beans treated with soy bean culture.

Started, June 9, finished, July 9, 1910.

Results: Treated lot, 12 with nodules; checks, no nodules.

Started, September 27, finished, October 27, 1910.

Results: Treated lot, all 15 with nodules by October 14; checks, no nodules. Fine growth of roots and numerous nodules.

Started. June 2, finished, June 28, 1912.

Results: Treated lot, all with good nodules even on some moldy stubby roots; checks, no nodules.

Soy bean treated with cowpea culture.

Started, May 9, finished, June 4, 1910.

Results: Treated lot, no nodules; checks, no nodules.

Started, June 27, finished, August 15, 1910.

Results: Treated lot, no nodules; checks, no nodules. Tops all dead, but good roots.

Started, September 9, finished, October 14, 1910.

Results: Treated lot, one plant with one nodule; checks, no nodules. Large healthy plants and roots. At the same time 15 tubes of cowpea treated with the same cowpea culture, all had nodules.

Started, November 29, 1911; finished, January 2, 1912.

Results: Treated lot, no nodules; checks, no nodules.

Soy bean treated with alfalfa culture.

Started, March 4, finished, April 12, 1910.

Results: Treated lot, no nodules; checks, no nodules.

Soy bean treated with red clover culture.

Started, March 17, finished, April 14, 1910.

Results: Treated lot, no nodules; checks, no nodules. Plants grew well and had fine roots.

Soy bean treated with crimson clover culture.

Started, January 23, finished, February 23, 1912.

Results: Treated lot, no nodules; checks, no nodules. Plants good and clean, very few moldy, roots fine. The culture used had been grown for a long time on a medium made from an infusion of soy bean roots, but evidently the organism can not be induced to acquire a new taste or to adopt a new host.

Soy bean treated with vetch culture.

Started, January 23, finished February 23, 1912.

Results: Treated lot, no nodules; checks, no nodules. Good, clean plants and fine roots. Another proof that individual species of root-nodule bacteria do not adapt themselves to a new host plant. The vetch culture had been grown for a year or more on a medium made from an infusion of the roots of soy beans.

Soy bean treated with garden bean culture.

Started, July 1, finished, Aug. 13, 1910.

Results: Treated lot, no nodules; checks, no nodules. Roots good, but tops dying.

Started, January 7, finished, February 7, 1911.

Results: Treated lot, no nodules; checks, no nodules. Good, healthy plants.

Soy bean treated with garden pea culture.

Started, May 17, finished, June 17, 1910.

Results: Treated lot, no nodules; checks, no nodules. Good plants.

Started, March 28, finished, May 9, 1911.

Results: Treated lot, no nodules; checks, no nodules.

Cowpea treated with cowpea culture.

Started, June 10, finished, July 22, 1909.

Results: Treated lot, 10 with nodules (Plants died in two cylinders). Tall cylinders used instead of test tubes. Checks, no nodules. Many of the plants moldy. Plants with the most nodules seemed to grow most vigorously and exhaust the supply of agar most completely.

Started, June 27, finished, August 15, 1910.

Results: Treated lot, 14 with nodules; checks, no nodules. Good roots, but tops diseased.

Started, September 9, finished, October 14, 1910.

Results: Treated lot, all 15 with nodules; checks, no nodules. Healthy plants, good roots; those with nodules had only about one to each plant.

Cowpea treated with soy bean culture.

Started, October 29, 1909; finished, January 19, 1910.

Results: Treated lot, no nodules; checks, no nodules. Used tall cylinders instead of test-tubes. Many moldy, but with roots well developed.

Started, February 2, finished, March 17, 1910.

Results: Treated lot, no nodules; checks, no nodules. Used tall cylinders instead of test-tubes. All started off clean and germinated well, finally more or less moldy but with good root development.

Started, April 19, finished, May 19, 1910.
Results: Treated lot, no nodules; checks, no nodules.

Started, June 9, finished, July 9, 1910.
Results: Treated lot, all 15 with nodules; checks, no nodules.

Started, September 27, finished, October 27, 1910.
Results: Treated lot, no nodules; checks, no nodules. Good, clean roots and healthy tops. Culture newly isolated and exactly the same that produced nodules on all 15 soy bean plants treated with it.

Started, November 16, 1911, finished, January 2, 1912.
Results: Treated lot, no nodules; checks, no nodules. Plants vigorous and roots good. At same time soy bean treated with this soy bean culture gave 13 out of 15 with fine nodules.

Cowpea treated with alfalfa culture.
Started, March 15, finished, April 14, 1910.
Results: Treated lot, no nodules; checks, no nodules. Plants grew well.

Cowpea treated with red clover culture.
Started, March 15, finished, April 14, 1910.
Results: Treated lot, no nodules; checks, no nodules. Tops of plants good and healthy, roots with some molds.

Cowpea treated with crimson clover culture.
Started, January 31, finished, March 2, 1912.
Results: Treated lot, no nodules; checks, no nodules. Good, healthy plants in general, but three checks and one treated thrown out because too moldy.

Cowpea treated with vetch culture.
Started, February 29, finished, April 9, 1912.
Results: Treated lot, no nodules; checks, no nodules. Plants did not do well. Many moldy.

Cowpea treated with garden bean culture.
Started, June 28, finished, August 13, 1910.
Results: Treated lot, no nodules; checks, no nodules. Good roots, tops dying. At same time 6 beans treated with bean culture gave only one with numerous nodules

Started, January 7, finished, February 9, 1911.
Results: Treated lot, no nodules; checks, no nodules. Good healthy plants.

Cowpea treated with garden pea culture.
Started, March 28, finished, May 9, 1911.
Results: Treated lot, no nodules; checks, no nodules.

Garden bean treated with garden bean culture.

Started January 7, finished, February 8, 1911.

Results: Treated lot, 8 with small nodules, one or two to a plant; checks, one with numerous nodules.

Started, November 29, 1911; finished, January 2, 1912.

Results: Treated lot, no nodules; checks, no nodules.

Started, September 19, finished, November 19, 1912.

Results: Treated lot, no nodules; checks, no nodules. Good growth of plants, some going so far as to produce flowers and even pods.

Garden bean treated with soy bean culture.

Started, April 21, finished, May 21, 1919.

Results: Treated lot, no nodules; checks, no nodules.

Started September 30, finished, October 30, 1910.

Results: Treated lot, no nodules; checks, no nodules. Plants with good roots. Culture newly isolated and successfully tested on soy beans.

Garden bean treated with cowpea culture.

Started, July 1, finished, August 13, 1910.

Results: Treated lot, no nodules; checks, no nodules. Only ten of the treated and eleven checks grew to some size with good roots; others died and were thrown out. At the same time the cowpea culture was tested on cowpea plants and 14 out of 15 had nodules.

Garden pea treated with garden pea culture.

Started, November 9, finished, December 20, 1911.

Results: Treated lot, no nodules; checks, no nodules. Good growth of plants and roots.

Started, November 14, finished, December 20, 1911.

Results. Treated lot, no nodules; checks, no nodules. Good growth of plants and roots.

Started, February 19, finished April 8, 1912.

Results. Treated lot, no nodules; checks, no nodules.

Started, September 20, finished, November 19, 1912.

Results: Treated lot, no nodules; checks, no nodules.

Started, January 15, finished, March 6, 1913.

Results: Treatep lot, only one plant with three small nodules; checks, no nodules. Many plants moldy and had to be thrown out.

Started, January 21, finished, March 6, 1913.

Results: Treated lot, no nodules; checks, no nodules.

Started, January 27, finished, March 4, 1913.
Results: Treated lot, one plant with one rather large noduie; checks, no nodules. Plants moldy and poor growth.

Started, March 18, finishud, May 6, 1913.
Results: Treated lot, no nodules; checks, no nodules.

Garden pea treated with vetch culture:
Started, February 4, finished, March 18, 1913.
Results: Treated lot, no nodules; checks, no nodules. Very good growth of plants, some moldy.

Started, March 21, finished, May 6, 1913.
Results: Treated lot, no nodules; checks, no nodules. Many plants moldy.

Garden pea treated with soy bean culture.
Started, September 30, finished, October 30, 1910.
Results: Treated lot, no nodules; checks, no nodules.

Canada field pea treated with soy bean culture.
Started, April 7, finished, May 7, 1910.
Results: Treated lot, no nodules; checks, no nodules. Good plants and roots.

Canada field pea treated with cowpea culture.
Started, April 7, finished, May 7, 1910.
Results: Treated lot, no nodules; checks, no nodules. Good plants and roots.

Kentucky
Agricultural Experiment Station
State University, Lexington, Kentucky

BULLETIN NO. 185

Concentrated Commercial Feeding Stuffs

BY

J. D. TURNER and H. D. SPEARS



STATE UNIVERSITY PRESS
LEXINGTON, KY.
September, 1914.
(365)

KENTUCKY AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

RICHARD C. STOLL, Chairman, Lexington, Ky.
CHARLES B. NICHOLS, Lexington, Ky.
LEWIS L. WALKER, Lancaster, Ky.
HENRY S. BARKER, President of the University.
THE DIRECTOR, Secretary, ex-officio.

JOSEPH H. KASTLE, Director.

STATION COUNCIL

THE DIRECTOR

A. M. PETER
H. E. CURTIS
H. GARMAN
C. W. MATHEWS
R. M. ALLEN
J. D. TURNER
E. S. GOOD
GEORGE ROBERTS
J. J. HOOPER

DEPARTMENTAL ORGANIZATION

ADMINISTRATION

THE DIRECTOR, Head.
H. E. CURTIS, Bursar.
HYWEL DAVIES, Purchasing Agent.
O. L. GINOCHIO, Secretary to Director.
ADDIE LEE DEAN, Librarian.
ANNA WALLIS, Clerk.
CORNELIA C. PAGE, Clerk.

AGRICULTURAL EXTENSION

F. MUTCHLER, Superintendent.
T. R. BRYANT, Asst. Superintendent.
J. H. CARMODY, Horticulture.
H. B. HENDRICK, Agronomy.
C. D. BOHANNAN, Rural Economics.
W. D. NICHOLLS, Dairying.
H. W. RICKEY, Poultry. (In Cooperation with U. S. Dept. of Agriculture.)
T. E. STOKES, Animal Husbandry. (In Cooperation with U. S. Dept. of Agriculture.)
MARY E. SWEENY, Home Economics.
AUBYN CHINN, Cookery and Dietetics.
RUBY M. BUCKMAN, Sewing and Household Arts.
ANNA BERRY JONES, Clerk.
MARGARET RYAN, Clerk.

AGRONOMY.

GEORGE ROBERTS, Agronomist, Head.
E. J. KINNEY, Assistant Agronomist.
S. C. JONES, Soil Survey.
A. E. EWAN, Supt. Experiment Fields.
JESSIE F. CASWALL, Clerk.

ANIMAL HUSBANDRY

(Beef Cattle, Sheep and Swine)

E. S. GOOD, Head.
ROBERT GRAHAM, Veterinary Science, In Charge Hog Cholera Serum Production.
E. W. MUMMA, Asst. In Charge Hog Cholera Serum Production.
O. S. CRISLER, Hog Cholera Serum.
R. L. PONTIUS, Hog Cholera Serum.
W. V. SMITH, Asst. in Animal Husbandry.
M. J. SMITH, Asst. in Animal Husbandry.
M. G. GINOCHIO, Clerk.
E. J. GOTT, Hog Cholera Serum.
A. L. BRUECKNER, Hog Cholera Serum.
LUCY K. HUTCHCRAFT, Clerk.

ANIMAL HUSBANDRY

(Dairy Cattle, Horses and Poultry)

J. J. HOOPER, Head.
W. S. ANDERSON, Asst. Horse Husb'd.
J. W. NUTTER, Supt. Dairy Farm.
W. D. NICHOLLS, Asst. Dairying.
D. D. SLADE, Supt. Poultry Farm.
P. E. RACON, Elmendorf Milk Records.
ED. HUSTON, Asst. in Dairying.
F. WALLACE UTTERBACK, Clerk.

CHEMISTRY

A. M. PETER, Chief Chemist, Head.
S. D. AVERITT, Chemist.
J. S. McHARGUE, Asst. Chemist.
R. PFANSTIEL, Asst. Chemist.
ETHEL V. T. CASWALL, Clerk.

ENTOMOLOGY AND BOTANY

H. GARMAN, Entomologist and Botanist, Head.
MARY L. DIDLAKE, Laboratory Asst.
E. C. VAUGHN, Asst. in Seed Inspection and Plant Breeding.
H. H. JEWETT, Research Asst. Entom.
H. R. NISWONGER, Asst. in Field Work and Nursery Inspection.
LOUISE BEWLAY, Clerk.

FEED

J. D. TURNER, Head.
H. D. SPEARS, Chemist.
E. H. NOLLAU, Asst. Chemist.
ELMER INGRAM, Chief Inspector.
ROGER W. JONES, Inspector.
FANNY C. ROGERS, Clerk.

FERTILIZER

H. E. CURTIS, Chemist, Head.
WM. RODES, Assistant Chemist.
ELMER INGRAM, Inspector.
R. W. JONES, Inspector.
ANNA WALLIS, Clerk.

FOOD AND DRUGS

R. M. ALLEN, Head.
J. O. LaBACH, Chief Chemist.
L. A. BROWN, Chemist, Drugs.
J. W. McFARLIN, Chief Food Inspector.
W. R. PINNELL, Bacteriologist.
C. S. PORTER, Inspector, Drugs.
WALTER SCHEPPELMAN, Inspector, Bakery Sanitation.
E. F. WORTHINGTON, Inspector, Dairy Sanitation.
W. G. TERRELL, Inspector, Foods.
LILLIE LISTON, Chief Clerk.
LENA LISTON, Clerk.

HORTICULTURE

CLARENCE W. MATHEWS, Head.
F. W. HOFMANN, Asst. in Horticulture.
G. B. WURTZ, Consulting Meteorologist.
MURIEL CASWALL, Clerk.

RESEARCH

THE DIRECTOR, Head.
H. GARMAN, Entomologist and Botanist.
D. J. HEALY, Bacteriologist.
E. S. GOOD, Animal Husbandry.
O. M. SHEDD, Chemist.
MARY L. DIDLAKE, Asst. Entomologist and Botanist.
G. D. BUCKNER, Chemist.
H. H. JEWETT, Research Asst. in Entom.

Notice

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Director.

BULLETIN NO. 185

CONCENTRATED COMMERCIAL FEEDING STUFFS.

By J. D. Turner and H. D. Spears.

The benefits resulting from the commercial feeding stuffs law to the consumers and honest manufacturers doing business in Kentucky are so generally understood and recognized that practically all feeds manufactured or sold in the State are put out in accordance with the requirements of the law.

Notwithstanding the great demand for feeds in Kentucky the last year, on account of the drought, fewer violations than ever before during the same period were found. The feeds found on the market were usually up to standard and guaranty made by the manufacturer.

For the period covered by this bulletin, 972 inspectors', 43 consumers', 378 dealers' and 90 miscellaneous samples were analyzed chemically and microscopically and the results reported to all parties concerned. Besides these analyses, 342 purity examinations were made of samples collected by our inspectors and samples sent in by consumers and parties interested, making a total of 1825 samples. A report of the inspectors' samples is given in another section of this bulletin.

In compiling this report, the purpose is to give those interested in commercial feeding stuffs sufficient and definite information which will assist: First, the feeder in purchasing the feeds that are most economical and suitable for his wants; Second, the manufacturer in compounding his feeds so that they will comply with the provisions of the law and at the same time give the feeder what he wants and needs;

and, Third, the dealer to handle only feeds that are properly registered and labeled and put out by reputable and responsible manufacturers. A digest of the law, rulings, et cetera, have been published in previous bulletins and information on these subjects will be furnished on request.

The Purchasing of Feeding Stuffs.

The chief economic problem confronting the feeder of live stock is what to feed and how to feed it in order to obtain the most satisfactory results at the least possible cost. One of the most important questions, then, to the feeder is how to buy his feeds, or the materials to make up his rations.

Those who feed intelligently are usually feeders who use large quantities of commercial feeds and buy only high class materials at close prices. However, the small feeders usually lack the knowledge of the physiological requirements of animals performing the different grades of labor, and, in consequence of this fact, there is frequently an enormous waste in various ways. Therefore, one fact of great importance in economical feeding that a feeder must keep in mind is that the amount, kind and character of the feed an animal requires depends entirely upon the use to which that animal is going to put the food.

Commercial feeding stuffs are usually purchased for the purpose of supplementing the feed materials raised on the farm and especially so where corn, oats, timothy hay and like materials are the only crops. If alfalfa, cow peas, soy beans and other similar crops can be raised and used on the farms in Kentucky, little, if any, concentrates are needed, as these materials are rich in protein and will supply sufficient nourishment.

The amount of protein will serve only as a guide in selecting a feeding stuff, as the consumer should base his final conclusion on the amount of digestible nutrients the feed contains. Feeds are rarely offered for sale in the State that are not regularly registered and labeled in accordance with the requirements of the law, and in most instances the feeds run well up to guaranty. Consumers should distinguish

between total and digestible nutrients and give special attention to the materials used in making the feeds and the guaranteed analysis as well.

The value of a feeding stuff depends upon that portion of the nutrient which the animal can, under ordinary conditions, digest and take into its system for building up the growth, keeping up the heat and energy and repairing the natural waste of the body. It frequently happens that animals receive more food than is necessary. An excessive amount of food not only overtaxes the digestive organs and consequently invites disease, but is an absolute waste as well. On the other hand, an insufficient amount causes loss by producing debility through want of necessary nutrition, and hence the inability to perform the desired amount of work. Also, if the food is not properly balanced one set of tissues of the body will receive an abundance of food and be properly nourished while others, and perhaps the more important ones, will not receive a sufficient amount, and thus loss is caused by destroying the equilibrium of the nutrients demanded by the animal system for its proper maintenance.

System of Tagging.

In addition to printing the guaranty on the official tag, the department issues tags in three colors, namely: Black, red and yellow. This is done in order to classify the feeds relative to their general make-up and assist the trade as far possible to recognize at a glance at the tag the general character of the feed. This, in connection with the guaranty printed on the tag, will put the purchaser on guard and give reasonable warning and an opportunity to make whatever investigation he desires before purchasing.

The color design is: First, a manila tag printed in black ink represents a straight feeding stuff, or a feeding stuff made from the products and by-products of one kind of grain or plant only, such as wheat, or corn, or cotton seed, et cetera. Second, a manila tag printed in red ink indicates that the feeding stuff is made of the products or by-products of two or more grains or plants, such as corn and wheat, or

corn, wheat and oats, et cetera. Third, a yellow tag printed in black ink represents a feeding stuff as containing a material of little or no feeding value, or a material not classed as a concentrate, such as oat hulls, cob meal, flax refuse, cotton seed hulls, et cetera.

Chemical Analyses of Feeds.

The chemical analysis of a feeding stuff consists in determining the following constituents: Moisture, Protein, Fat, Nitrogen-free extract, Fiber and Ash. The Nitrogen-free extract and the Fiber constitute the "Carbohydrates" which are sometimes reported in the various statements of analysis. There are a few constituents included in the Nitrogen-free extract, such as pentosans, dextrin, et cetera, which are occasionally determined, but they are of little importance and will not be mentioned further. The methods used herein are those adopted by the Association of Official Agricultural Chemists. Wherever the terms protein, fat and fiber, et cetera, are used, unless otherwise stated, they refer to crude protein, crude fat and crude fiber.

Moisture in a feeding stuff is the water it contains and it varies in amount from a few to as much as ninety per cent, depending on the kind, age or state of greenness, and whether stored in a dry or damp place. In grains and dried or cured fodders, hays, et cetera, it is estimated at from 8 to 15 per cent of the weight; in the grasses and other green foods, it may run as high as 85 per cent; while in roots, such as turnips, stock beets, carrots, et cetera, 90 per cent of the weight may be reached. Some feeding stuffs such as distillers' dried grains and brewers' dried grains have gone through a process of drying by artificial heat, thus greatly reducing their water content, and the amount they hold depends on the length of time they are allowed to remain in the dryer and the temperature of the same. When exposed to moist air, these artificially dried feeds will take up water again, the quantity absorbed depending upon atmospheric conditions and the extent of exposure.

Protein is the nitrogenous constituent of a feeding stuff,

containing about 16 per cent of the element nitrogen. The percentage of protein is obtained by simply multiplying the per cent of nitrogen found in analysis by the factor 6.25. The amount of crude protein in feeding stuffs varies from a few to about 50 per cent and even higher than this, the highly concentrated materials being meat scraps, blood meal, feeding tankage, cotton seed meal, et cetera.

Besides occurring in feeding stuffs, protein exists in nearly all natural foods, both animal and vegetable. Gluten of wheat, the albumen or white of eggs, the lean part of beef, the curd of milk and the fibrin of the blood are well known forms of protein.

Crude fat is the name given to that portion of a feed which is extracted with ether or similar solvents. The terms "Ether Extract" or "Fat" are often used in reporting analyses instead of crude fat. This constituent consists chiefly of fats and oils, also containing other substances as wax, resins and chlorophyll or coloring matter, which are soluble in ether. The percentage of crude fat in feeding stuffs varies from about 1 to 15 per cent.

Nitrogen-free extract is a general term given to those bodies contained in a feed other than water, protein, fat, fiber and ash. Its percentage is determined by subtracting the sum of the percentages of these constituents from 100. In most feeding stuffs, the nitrogen-free extract consists chiefly of starch. Sugars, gums and pentosans (an insoluble carbohydrate of little importance) are usually present in smaller amounts which vary according to the kind of feed. In grains, the nitrogen-free extract runs from 50 to 75 per cent, and is almost wholly starch, while in the hulls and chaff of grain and roughages the amount is considerably less.

Crude fiber is the woody part or structural material. It is composed largely of cellulose. It is insoluble in weak acid and alkali and is therefore but slightly digested. It is lowest in amount in hulled corn, which contains about 1 or 2 per cent, and highest in the husk of grains or hulls, such as cotton seed hulls, which contain about 45 per cent and in corn cob which contains about 30 per cent.

Ash is the mineral constituent and consists principally of phosphate and carbonate of calcium and potassium.

Carbohydrates are the nitrogen-free extract and fiber together, though the term is often wrongly used as synonymous with nitrogen-free extract.

Functions of Nutrients.

When coal is burned in an engine, heat and energy are produced. The same is true when food is consumed in the body. It is oxydized or "burned" and produces heat and energy for the body to carry on its functions. Besides producing heat and energy for the animal body, food also furnishes the material necessary for its maintenance, growth, and repair for the natural waste. The principal constituents of food value in a feeding stuff are protein, fat, nitrogen-free extract, fiber and ash. They are called nutrients because they perform the function of building up and maintaining the animal body, each having certain duties to perform.

Water, though essential to life is not mentioned as one of the nutrients in a feeding stuff because its commercial value is practically nothing. The value of a feed is based upon the dry matter, or what is termed water-free content. Therefore, the presence of water affects the value of a feed negatively by adding weight without any value, the weight in water taking the place of food material. An excessive amount of water in a feed lowers the keeping quality. The functions of the various organs of the animal body can not be maintained without water, which in the animal body acts as a solvent carrying the digested and assimilated food to the parts where needed.

The nutrients may be described as follows:

Protein is the most important as well as the most costly nutrient in a feed and the value of a feed depends very largely on the amount of this constituent it contains. Protein supplies the nitrogenous material which is essential to the building up of the various tissues and secretions of the body. This constituent produces flesh, muscle, ligaments, glanular secretions, tissues, milk, blood, tendons, hair,

hoofs, hide, and is found in all portions of the animal body which have strength, including the bones which contain about 25 or 30 per cent. Under certain conditions, as in starvation, protein may serve as a source of heat and energy, and it may be used to form fat, thereby taking the place of the nutrients fat and carbohydrates. No other nutrient can be used to perform the proper office of protein, however, due to the fact that no others contain nitrogen.

Fat ranks next to protein in the valuation of the nutrients. It is used to produce heat and energy, and while carbohydrates are also used, fat is 2¼ times as valuable for the same purpose. Fat also serves as a protection to the protein compounds of the body against destruction and as a protection for the other tissues.

Nitrogen-free extract is also of importance as a source of heat and energy. While it does not have as great a power in this respect as fat, it is present in such large quantities in feeding stuffs that it serves an important part. The members of this group, however, differ in nutritive value on account of the wide variance of their digestibility. The starches and sugars are readily soluble and almost completely digested, while pentosans and other less well known substances are digested with much more difficulty and far less completely. It is therefore desirable in selecting a feeding stuff that starches and sugars should constitute the principal part of the nitrogen-free extract, other things being equal. Nitrogen-free extract is converted into fats in the animal body and stored as such in the fatty tissues. Along with fats it is consumed by the body, thereby giving out heat, muscular and intellectual energy. The amount of fats and carbohydrates assimilated over and above that used immediately by the body for heat and energy is the amount stored up as fat in the tissues.

Fiber, the woody portion or structural material of plants, is not so valuable a nutrient as nitrogen-free extract. Like pentosans, it is not very soluble and is one of the slightly digestible carbohydrates. It is contained in large proportions in materials used as roughage and it is only for this

purpose that it may be considered valuable. It is not well to use a too concentrated feed, and hence a feeding stuff containing a large per cent of protein and fat is fed with fodder, hay, et cetera, which contain a large per cent of crude fiber. When fed in this way, the animal derives a greater benefit from the nutrient. Fiber, though, is nearly inert and as a rule a feeding stuff containing a large per cent of fiber is considered low grade.

Ash or mineral matter found in feeds is the amount of inorganic material taken from the soil and stored by the plant during its period of growth. It forms the bony structure and is found in the various tissues and secretions of the animal body. Calcium, potassium and phosphorus are the most important of these constituents.

Definitions and Descriptions of Feeding Materials.

The definitions given in this Bulletin are the official definitions of the Association of Feed Control Officials and will be considered standard by this department. The percentages of digestible nutrients used in the discussions of the various feeds are taken from Henry's compilations.

From Alfalfa.

Alfalfa Hay is possibly of wider use than any other roughage. It is not a good feed for road horses, being too laxative and causing the animals to sweat too freely. However, it can be used with all classes of horses to some extent if used correctly, but better with those doing slow, steady work. Alfalfa is an excellent material for fattening cattle and reduces the quantity of concentrates required to produce a given gain. For the dairy cow there is no better feed, for alfalfa hay is not only rich in crude protein but in mineral matter as well. As a feed for sheep, alfalfa leads the roughages. It can be used to a limited extent for fattening hogs and is largely employed in maintaining stock hogs through the winter. With a fair understanding of the composition and nature of alfalfa hay, a feeder can use it in feeding all farm animals with economy and satisfaction.

Alfalfa meal is the entire alfalfa hay ground, and does not contain an admixture of ground alfalfa straw or other foreign materials.

Six samples were analyzed with an average of 17% protein, 2.14% fat and 31.38% fiber. Three samples fell below guaranty in protein and fat. However, the guaranty in each case was rather high—too high, perhaps, since the percentages found in these samples are above the average analysis of alfalfa found on the market. Alfalfa has an average digestibility of 72% protein, 43% fat and 47% fiber.

The average price paid per ton was $33.75—the highest price being $35 and the lowest $33.

Animal Products.

The slaughter houses now furnish to the feeder large quantities of by-products, such as blood meal, digester tankage, meat meal, et cetera. These products are very rich in protein. Owing to their highly concentrated form and the high prices which such feeds command, the feeder should always understand their nature and how to compound them with other materials in order to get the best results.

Blood Meal is ground dried blood.

This is the richest of the animal products and is particularly useful in feeding young pigs and calves.

One sample of blood meal was taken, which fell two points below guaranty in protein. No price was obtained. The average digestibility of blood meal is 84%.

Cracklings are the residue after partially extracting the fats and oils from the animal tissue. If they bear a name descriptive of their kind, composition or origin, they must correspond thereto.

No samples of cracklings were obtained on the Kentucky market.

Digester Tankage is the residue from animal tissue exclusive of hoof and horn, specially prepared for feeding purposes by tanking under live steam, drying under high heat, and suitable grinding. If it contains any considerable

amount of bone, it must be designated *Digester Meat and Bone Tankage.*

Tankage is very rich in protein and has a digestibility of 93%. It is excellent for feeding hogs and is a good material to include in the ration of horses run down.

Two samples were analyzed with an average of 58.75% protein and 12.32% fat. No price was obtained on this product.

Meat Scrap and *Meat Meal* are the ground residues from animal tissue exclusive of hoof and bone. If they contain any considerable amount of bone, they must be designated *Meat* and *Bone Scrap,* or *Meat* and *Bone Meal.* If they bear a name descriptive of their kind, composition or origin, they must correspond thereto.

The average digestibility of meat scrap is 93% protein and 98% fat. No samples of these products were obtained for analysis.

From Barley.

Malt Sprouts are the sprouts of the barley grain. If the sprouts are derived from any other malted cereal, the source must be designated.

Malt sprouts have an average of 26.3% protein, 1.6% fat and 11.6% fiber, with an average digestibility of 77% protein, 90% fat and 83% fiber. No samples were collected for analysis.

From Beets.

Dried Beet Pulp is a by-product obtained in the manufacture of beet sugar, and consists of the dried residue after the extraction of most of the sugar from the beets.

Two samples were analyzed with an average of 9.44% protein, .74% fat and 20.08% fiber. Beet pulp has a digestibility of 51% protein and 72% fiber. The price paid for one lot of beet pulp was $32, which seems to be far in excess of the value of this material.

From Buckwheat.

Buckwheat is rarely used for feeding stock, though it has a fair feeding value, running somewhat lower in its nutri-

ents than most of the cereals. It has an average composition of 10.50% protein, 2.40% fat and 11.7% fiber.

Buckwheat Shorts or *Buckwheat Middlings* are that portion of the buckwheat grain immediately inside the hull after separation from the flour.

No samples of these products were obtained for analysis.

From Corn.

Corn is the great energizing, heat-giving, fat-furnishing food for the animals of the farm. However, not being rich in protein and mineral matter, it fails to furnish the nutrients in proper proportion for building up the bone and muscle. These deficiencies are easily supplied in other feeds. It is rich in starch and oil and its function is to produce heat, energy and fat.

Analyses of ninety-two samples of Kentucky corn gave an average of 9.42% protein, 4.83% fat and 1.88% fiber. There are a number of by-products of this cereal which make good feeds.

Corn Bran is the outer coating of the corn kernel.

The average analysis reported in previous bulletins on corn bran was 10.54% protein, 7.93% fat and 11.90% fiber, and the average price paid was $19.50. Very few data were obtained on this material as the bulk of it is sold for mixing purposes. It has no ready sale as a distinct feed on account of its low feeding value.

Corn Chop is a term commonly applied to cracked or crushed corn, but more generally used to cover that portion of cracked corn after the finer particles have been sifted out and to which corn bran may or may not have been added.

Fifteen samples of corn chop were analyzed, with an average of 9.20% protein, 4% fat, and 1.75% fiber. Only four samples fell below guaranty in fat. Seven of the samples analyzed were cracked corn. The average price paid per ton was $37.55, the highest being $50 and the lowest $27. The price paid for this product is often excessive.

Cracked or Crushed Corn is what the term implies—the whole grain cracked or crushed, from which nothing has

been taken and to which nothing has been added. *Sifted Cracked Corn* is the material left after the small particles have been sifted out.

Twenty-three samples of cracked and sifted cracked corn were analyzed with an average of 9.16% protein, 4.08% fat and 1.79% fiber. The average digestibility is 76% protein, 86% fat and 58% fiber. One sample ran below guaranty in protein and only one below in fat.

The average price paid per ton for cracked corn was $37.55, the highest being $50 and the lowest $27. The price paid in most instances seems to be excessive, the same being true in the case of corn chop.

Corn Feed Meal is the sifting obtained in the manufacture of (sifted) cracked corn and table meal made from the whole grain.

Eleven samples of corn feed meal were analyzed with an average of 9.06% protein, 3.29% fat and 1.72% fiber. All the samples ran well up to guaranty in protein, but five were deficient in fat. One sample contained an excess of corn bran. Sixty-six per cent of the protein in corn feed meal is digestible, and 91% of the fat.

The average price paid for corn feed meal was $28 per ton, the highest being $29 and the lowest $26.

Corn Germ Meal is a product in the manufacture of starch, glucose, and other corn products, and is the germ layer from which a part of the corn oil has been extracted.

Two samples were analyzed with an average of 18.56% protein, 7.52% fat and 4.08% fiber. One sample fell below guaranty in fat. This material has a digestibility of 73% protein and 96% fat.

Corn Gluten Feed is that portion of commercial shelled corn that remains after the separation of the larger part of the starch and the germ by the processes employed in the manufacture of corn starch and glucose. It may or may not contain corn solubles.

This material has an average of 25.4% protein, 3.4% fat and 6.5% fiber, with an average digestibility of 85% protein,

82% fat and 76% fiber. The average price paid was $36 per ton.

Corn Gluten Meal is that part of commercial shelled corn that remains after the separation of the larger part of the starch, the germ and the bran by the processes employed in the manufacture of corn starch and glucose. It may or may not contain corn solubles.

This product averages 34.5% protein, 3.65% fat and 1.85% fiber, the average digestibility being 88% protein and 93% fat. The average price paid per ton was $40.

Grits are the hard flinty portions of Indian corn without hulls and germ.

No samples were obtained for analysis.

Hominy Meal, Hominy Feed or *Hominy Chop* is a mixture of the bran coating, the germ and a part of the starchy portion of the corn kernel obtained in the manufacture of hominy grits for human consumption.

Nine samples were analyzed with an average of 10.80% protein, 7.82% fat and 4.50% fiber. Hominy Meal, Feed and Chop have an average digestibility of 65% protein, 92% fat and 67% fiber. The average price paid per ton was $30.17, the highest price being $34 and the lowest $23.

From Cotton Seed.

Cotton Seed Meal is a product of the cotton seed only, composed principally of the kernel with such portion of the hull as is necessary in the manufacture of oil, provided that nothing shall be recognized as cotton seed meal that does not conform to the foregoing definition and that does not contain at least thirty-six (36) per cent of protein.

Cotton seed meal is rich in protein and fat and is classed as one of the richest feeds in these nutrients. It has an average digestibility of 83% protein, 94% fat and 35% fiber.

Choice Cotton Seed Meal must be finely ground, not necessarily bolted, perfectly sound and sweet in odor, yellow, free from excess of lint and must contain at least forty-one (41) per cent of protein.

Sixty-nine samples of choice cotton seed meal were analyzed with an average of 41.62% protein, 7.82% fat and 9.82% fiber. Thirteen samples fell below guaranty in protein and three in fat. The average price paid per ton was $32.16, the highest being $40 and the lowest $27.40.

Prime Cotton Seed Meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color, yellow, not brown or reddish, free from excess of lint, and must contain at least thirty-eight and six-tenths (38.6) per cent of protein.

Sixteen samples were analyzed with an average of 40.22% protein, 7.73% fat and 10.34% fiber. The prime meals averaged up well, as did the choice meals, both grades averaging above their guaranty, and in no instance did the analysis in the prime meals fall below guaranty in protein, and very few fell below in fat. On the whole, both the choice and prime meals were equal to and even better than their guaranties.

Good Cotton Seed Meal must be finely ground, not necessarily bolted, of sweet odor, reasonably bright in color and must contain at least thirty-six (36) per cent of protein.

No samples of this class of meal were found. However, one or two samples guaranteed to be choice meal should have been classed under this head.

Cold Pressed Cotton Seed is the product resulting from subjecting the whole undecorticated cotton seed to the cold pressure process for the extraction of oil and includes the entire cotton seed less the oil extracted. When Cold Pressed Cotton Seed is subjected to grinding, it shall be designated "*Ground Cold Pressed Cotton Seed.*"

No samples of this material were found on the Kentucky market.

Cotton Seed Feed is a mixture of cotton seed meal and cotton seed hulls containing less than thirty-six (36) per cent of protein.

Four samples were obtained for analysis, two of which fell below guaranty in fat and all of which ran above guaranty in fiber. The average price paid per ton for this material was $29 as against $32.16 for choice meal. On the basis of

protein content, if choice cotton seed meal is worth $32.16 per ton, cotton seed feed guaranteed at 20% protein should not be worth more than $16 per ton, not taking into consideration the freight on this material and the handling of the hulls.

From Flax.

Flax Plant By-Product is that portion of the flax plant remaining after the separation of the seed, the baste fiber and a portion of the shives, and consists of flax shives, flax pods, broken and immature flax seeds and the corticle tissue of the stem.

No samples were obtained for analysis.

Linseed Meal is the ground residue after extraction of part of the oil from ground flax seed.

There are two kinds of linseed meal on the market, known as *"Old Process"* and *"New Process"* meals, produced by the two methods used in extracting the oil. When the crushed seeds are heated and subjected to hydraulic pressure, the residue consists of cakes which are ground and placed on the market as "Old Process" meal. When the oil is obtained by the use of a solvent, the ground residue is known as "New Process" meal. On account of a more perfect extraction of the oil by the new process, the "Old Process" meal is richer in fat, but poorer in protein.

Eight samples were taken for analysis which resulted in an average of 33.65% protein, 7.59% fat and 8.26% fiber. Almost all equaled or exceeded their guaranty in protein and fat.

This material has an average digestibility of 86% protein, 89% fat and from 60 to 70% fiber. The average price paid per ton was $39.11, the highest price being $47 and the lowest $35.

From Oats.

The production of oats is not large in Kentucky as compared with some of the other States. Next to corn, oats are the most extensively grown cereal in America. Oats are the safest of all feeds for horses and are excellent for dairy

cows. They are not good for fattening stock but are splendid for growing animals and breeding swine.

Oats have an average composition of 11.4% protein, 4.8% fat and 10.8% fiber with an average digestibility of 77% protein, 89% fat and 31% fiber.

There are a number of by-products obtained at the oatmeal factories and grain elevators, the value of which depends upon the proportion of the oat grain or kernel to the hull and other waste. Often light weight oats of low feeding value are mixed with corn and the ground or chopped product put on the marked as corn and oat chop or C. & O. chop. Large quantities of oat hulls are put out by the oatmeal factories and, as the modern machinery can so completely separate the hulls from the kernels, the chaff-like material which is left has very little feeding value. None of the oat by-products were found in an unmixed state on the Kentucky market, but were found in mixed feeds, usually molasses feeds which are imported into the State.

Oat Groats are the kernels of the oat berry with the hulls removed.

Oat Hulls are the outer chaffy coverings of the oat grain.

Oat Middlings are the floury portion of the groat obtained in the milling of rolled oats.

Clipped Oat By-Product is the resultant by-product obtained in the manufacture of clipped oats. It may contain light, chaffy material broken from the ends of the hulls, empty hulls, light immature oats and dust. It must not contain an excessive amount of oat hulls.

Rolled Oats are found on the market in very limited quantity. Two samples were analyzed with an average of 12.91% protein, 4.66% fat and 10.50% fiber. The average price per ton was $31.50, the highest being $33 and the lowest $30.

Oat Shorts are the covering of the oat grain lying immediately inside the hull, being a fuzzy material carrying with it considerable portions of the fine floury part of the groat obtained in the milling of rolled oats.

From Rice.

The production of rice in this country is limited to the Southern States, principally to Louisiana and Texas. Rice is rather low in crude protein and fat and is grown strictly for human food, yet the by-products have value and are used for feeding domestic animals.

Rice has an average analysis of 7.50% protein, 0.50% fat and 0.25% fiber, with an average digestibility of 86% protein and 90% fat.

Rice Bran is the cuticle beneath the hull.

Rice Polish is the finely powdered material obtained in polishing the kernel.

Rice Hulls are the outer chaffy coverings of the rice grain.

From Rye.

The sample of rye feed obtained for analysis was the whole grain ground up. It had a guaranty of 17.56% protein, 3.06% fat and 4.60% fiber, while it analyzed only 11.31% protein, 1.83% fat and 2.28% fiber. The average price paid per ton for this feed in Kentucky is $30.33, the highest being $36.00 and the lowest $27.00.

From Wheat.

In the extent of the growth of cereals in America, wheat ranks third. As compared with corn, wheat is richer in protein but contains much less fat. Analyses of thirty-three samples of Kentucky wheat gave an average of 11.79% protein, 1.97% fat and 1.87% fiber. Wheat has an average digestibility of 74% protein and 71% fat.

Wheat is not now used to any considerable extent for feeding purposes, being used principally in making food for human consumption, and the by-products obtained therefrom for feeds for animals. The by-products from the wheat milling industry make excellent feeds and form a large part of the legitimate feeds found on the Kentucky market.

Wheat Bran is the coarse outer coating of the wheat

berry, obtained in the usual commercial milling processes from wheat that has been cleaned and scoured.

Wheat Bran with Mill Run Screenings is pure wheat bran plus the screenings which were separated from the wheat used in preparing said bran.

Wheat Bran with Screenings not exceeding Mill Run is either wheat bran with the whole mill run of screenings or wheat bran with a portion of the mill run of screenings: Provided, that such portion is not an inferior portion thereof.

Wheat bran is comparatively rich in digestible protein and fat, light and chaffy, rather high in fiber, and rich in mineral matter except lime. Bran supplies an abundance of phosphorus which is so essential in milk and bones, though it is lacking in lime which is needed in still larger amount. Horses fed heavily on bran sometimes suffer from what is called "Bran disease," which seriously affects their bones. However, lime may be supplied in an inorganic form such as wood ashes, burned lime, et cetera, or by feeding the lime-laden plants such as the legumes.

In order to feed bran economically and advantageously, one must know its properties. Bran should be mixed with other concentrates to give bulk or lighten the ration while improving its nutritive qualities. On account of its laxative effect it cannot be fed extensively to horses. It is an excellent feed for the dairy cow, giving bulk to the ration and providing the crude protein and phosphorus so vital to the formation of milk. It is very satisfactory for feeding breeding sheep and lambs. It is not a good feed for pigs, though considered valuable in preparing a ration for breeding swine and stock hogs when they can not get legume pasture or hay, and likewise for the female farm animal to bear her young.

Fifty-six samples of bran were analyzed, some of which contained screenings and were so registered. The average analysis of all samples of bran, including those containing screenings, was 15.62% protein, 4.22% fat and 8.47% fiber. Bran has an average digestibility of 77% protein, 63% fat

and 41% fiber. The average price paid per ton was $27.98, the highest price being $33 and the lowest $21.

Wheat White Middlings or *White Middlings* are that part of the offal of wheat intermediate between shorts or standard middlings and red dog.

Shipstuff or *Mixed Wheat Feed* is a mixture of the products other than the flour obtained from the milling of the wheat berry.

Shipstuff forms a combination which can be fed to almost every class of animals with safe and good results. It is rich in digestible protein and fat and mineral matter except lime. In this combination the laxative effect found in the bran is reduced, the heavy and pasty nature of the shorts and middlings overcome, the mineral matter found in both bran and shorts maintained, and the digestible protein and fat kept up to a high standard.

One hundred and forty-four samples of shipstuff or mixed wheat feed were analyzed, with an average of 15.62% protein, 4.27% fat and 7.17% fiber. Shipstuff has an average digestibility of 78% protein, 87% fat and 62% fiber.

The average price paid per ton for shipstuff was $30.06, the highest price being $38 and the lowest $24.

Shorts or *Standard Middlings* are the fine particles of the outer and inner bran separated from the bran and white middlings.

Shorts and Middlings are used by many as interchangeable terms. They make an excellent feed for swine of all ages. They should be mixed and fed with other materials as corn meal, barley meal, ground oats, et cetera. When properly mixed with other materials, they form a good combination for the dairy cow, since they are rich in protein and phosphorus. They should never be fed alone to horses on account of being heavy and pasty, and are liable to cause colic. Like bran, they are deficient in lime and this must be supplied by other ingredients which go to make up the ration.

Forty-two samples of shorts or standard middlings were analyzed with an average of 16.56% protein, 4.74% fat and

5.14% fiber. This material has an average digestibility of 77% protein, 88% fat and 30% fiber.

The average price paid per ton was $33.13, the highest being $45 and the lowest $24.

Red Dog is a low grade wheat flour containing the finer particles of bran.

This material is rich in digestible protein and fat and has a high feeding value, especially for young pigs, calves and milk cows.

No samples were collected for analysis.

Miscellaneous.

Brewers' Dried Grains are the properly dried residue from cereals obtained in the manufacture of beer.

Four samples were analyzed and gave an average of 30.79% protein, 7.16% fat and 14.09% fiber. Brewers' Dried Grains have an average digestibility of 80% protein, 90% fat and 50% fiber.

The average price paid per ton was $32.

Distillers' Dried Grains are the dried residue from cereals obtained in the manufacture of alcohol and distilled liquors. The product shall bear the designation indicating the cereal predominating.

Five samples were analyzed with an average of 25.59% protein, 10.48% fat and 10.92% fiber. The average grade of distillers' dried grains found on the market was not up to standard. Distillers' grains are rich in digestible protein and fat and are one of the best concentrates. These grains have an average digestibility of 73% protein, 95% fat and 95% fiber.

The average price paid per ton was $30.20, the highest price being $32 and the lowest $23.

Screenings are the smaller imperfect grains, weed seeds and other foreign material having feeding value, separated in cleaning the grain.

No samples of screenings were taken for analysis. Very few screenings are imported into Kentucky except as one of

the ingredients in mixed feeds. The wheat screenings are run into the wheat by-products and sold as such.

Mixed Feeds.

Under this heading are included the "Mixed feeds" made from the wheat by-products, a small percentage of corn bran and in most cases wheat screenings. These feeds vary somewhat in composition and value, depending on the amount of corn bran and screenings used. The bulk of the feed sold in Kentucky is from this group.

Three hundred and ten samples were analyzed with an average of 15% protein, 4.56% fat and 7.07% fiber.

The average price per ton was $29.74, the highest price being $45 and the lowest $24. In many instances the price paid was in excess of the value of the feed.

Miscellaneous Mixed Feeds or Proprietary Horse, Dairy and Stock Feeds.

In grouping this class of feeds, no division has been made of the molasses feeds from the others coming in the group, as most of these feeds contained molasses in varying proportions. Special attention is called to the fact that many of the feeds in this class are made from the best materials obtainable and show care and intelligence in the way they are compounded, but on the other hand many are ordinary mixtures of low grade materials and are often sold at excessively high prices. Many of the brands are sold under fancy and catchy names and names that are not descriptive of the materials used. Molasses is added to many ostensibly to give palatability and in many cases, no doubt, to cover up the inferior materials used in the mixture. The feeder should bear in mind that the names and selling prices usually bear no relation to the composition, and that there is no mystery in the compounding of these feeds.

The use of low grade feeds often results in hardship for the animals to which they are fed and to the owners of such animals as well.

Miscellaneous Mixed Feeds.

The miscellaneous mixed feeds are classified into two groups. First: Those feeds made up from the various concentrates found on the market and a combination of grains. Second: Those feeds containing a material or materials of little or no feeding value, and not classified as a concentrate.

One hundred and fifteen samples of Group No. 1 were analyzed. These feeds varied widely in composition and feeding value. The prices paid for these feeds were excessive in many cases and were in no wise an indicator of their feeding value. However, most of these feeds equalled or exceeded their guaranty and in many cases the prices were based on the merit of the feed.

Sixty-four samples of Group No. 2 were analyzed. These feeds varied greatly in composition and value. The prices varied from $45 to $26 and in some cases the lowest grade feeds were sold for the highest price. Most of these feeds contained a large amount of fibrous material such as cob meal, oat hulls, screenings, cotton seed hulls, et cetera, and a sufficient amount of some material high in protein to bring up the average to a certain percentage. The percentage of digestible protein in high fiber feeds is usually much smaller than in the low fiber feeds, and they furnish feed material at a much higher price than it can be bought in the ordinary standard grains and their by-products.

Many of these feeds contain material, though low in feeding value, yet of sufficient amount of nutrients to justify their use and conservation, but a number of them contain materials ranging from worthless to dangerous.

Chicken Feeds.

Thirty-two samples of chicken feed were analyzed, most of which came up to guaranty in both protein and fat, but varied from their guaranty a good deal in ingredients. A number contained grain screenings with a large percent of weed seeds present, though in less amounts than in previous inspections covered by reports.

The average price paid per ton was $42.64, the highest price paid being $50 and the lowest $33. The prices paid for a good many of these feeds are out of proportion to their value.

To give a better idea of the relative food value of the common feeding stuffs the following tables are added showing the average composition and digestibility of the common materials.

AVERAGE COMPOSITION OF FEEDING STUFFS—PER CENT.

(Henry's, Jordan's and Lindsay's Compilations.)

	Dry Matter	Water	Ash	Protein	Carbohydrates Fat	Fiber	N-F Extract
Corn	89.4	10.6	1.5	10.3	5.0	2.2	70.4
Corn Meal	85.0	15.0	1.4	9.2	3.8	1.9	68.7
Corn Bran	90.6	9.4	1.2	11.2	6.2	11.9	60.1
Corn Chops	87.2	12.3	1.5	9.8	4.4	2.0	69.5
Hominy Meal	90.4	9.6	2.7	10.5	8.0	4.9	64.3
Gluten Feed	90.8	9.2	2.0	25.0	3.5	6.8	53.5
Corn and Cob Meal	84.9	15.1	1.5	8.5	3.5	6.6	64.8
Corn Cob	89.3	10.7	1.4	2.4	0.5	30.1	54.9
Oats	89.6	10.4	3.2	11.4	4.8	10.8	59.4
Oat Middlings	91.2	8.8	4.5	16.2	6.9	7.1	56.5
Oat Feed	93.0	7.0	5.3	8.0	2 9	21.5	55.3
Wheat	89.5	10.5	1.8	11.9	2.1	1.8	71.9
Wheat Bran	88 1	11.9	5.8	15.4	4.0	9.0	53.9
Wheat Middlings (shorts)	88.8	11.2	4.4	16.9	5.1	6.2	56.2
Flour Middlings	90.0	10.0	3.2	19.2	4.8	3.2	59.6
Shipstuff	89.1	10.9	5.6	16.3	4.6	7.5	55.1
Rye	91.3	8.7	2.1	11.3	1.9	1.5	74.5
Rye Feed (shorts & bran)	87.8	12.4	3.2	15.7	3.1	4.1	61.5
Barley	89.2	10.8	2.5	12.0	1.8	4.2	68.7
Buckwheat	86.6	13.4	2.0	10.8	2.4	11 7	59.7
Buckwheat Feed	88.4	11.6	3.9	18 3	4.9	19.2	42.1
Brewers Dried Grains	91.3	8.7	3.7	25.0	6 7	13.6	42.3
Distillers Dried Grains	92.4	7.6	2.0	31.2	12.2	11.6	35.4
Malt Sprouts	90.5	9.5	6.1	26.3	1.6	11 6	44.9
Flax Seed	90.8	9 2	4.3	22.6	33.7	7.1	23.2
Linseed Meal (O. process)	90.2	9.8	5 5	33.9	7.8	7.3	35.7
Linseed Meal (N. process)	91.0	9.0	5.5	37.5	2.0	8.9	36.4
Cotton Seed	89.7	10.3	3.5	18.4	19.9	23.2	24.7
Cotton Seed Meal	93.0	7.0	6.6	45.3	10.2	6.3	24.6
Rice	87.6	12.4	0.4	7.4	0:4	0.2	79.2
Rice Bran	90.3	9.7	9.7	11.9	10.1	12.0	46.6
Rice Meal	89.8	10.2	8.1	12.0	13.1	5.4	51.2
Rice Polish	39.2	10.8	4.8	11.9	7 2	3.3	62.3
Alfalfa Hay	91.6	8.4	7.4	14.3	2.2	25.0	42.7
Dried Beet Pulp	91.6	8.4	4.5	8.1	0.7	17.5	60.8
Meat Scraps	89.3	10.7	4.1	71.2	13 7	----	0.3
Molasses Feed	89.6	10.4	6.5	17.1	2.9	11.9	51.2
Mixed Feed (shipstuff 80%, corn bran 20%)	89.6	10.4	4.13	14.6	5.18	8.97	56.76

Average Digestible Nutrients of Feeds—Per Cent.

(Henry's, Jordan's and Lindsay's Compilations.)

	Dry Matter	Protein	Fat	Fiber	Carbohydrates N. Free Extract
Corn	81.35	7.83	4.30	1.28	65.47
Corn Meal	74.8	6.07	3.46	----	63.29
Corn Bran	63.42	6.05	4.74	6.78	45.68
Corn Chops	78.00	6.95	3.88	1.25	64.38
Hominy Meal	74.13	6.83	7.36	3.28	57.23
Gluten Feed	79.0	21.25	2.87	5.17	47.62
Corn and Cob Meal	67.07	4.42	2.94	2.97	57.02
Corn Cob	52.67	0.4	0.25	19.57	32.94
Oats	62.72	8.78	4.27	3.35	45.74
Oat Middlings	82.08	13.12	6.49	3.48	54.24
Oat Feed	37.20	5.20	2.61	1.88	23.23
Wheat	-----	10.2	1.7		69.2
Wheat Bran	58.15	11.86	2 5	3.69	38.27
Wheat middlings (Shorts)	-----	13.0	4.5	1.86	43.84
Flour Middlings	73.8	16.9	4.1	1.15	52.45
Shipstuff	65.04	12.7	4.0	4.65	42.43
Rye	-----	9.5	1.2		69.4
Rye Feed (Shorts & Bran)	72.0	12.6	2.8	----	53.12
Barley	76.71	8.4	1.6	2.10	63.2
Buckwheat	61.49	8.1	2.4	2.81	45.37
Buckwheat Feed	-----	15.6	4.4		38.2
Brewers' Dried Grain	56.61	20.00	6.0	6.8	25.38
Distillers' Dried Grains	73.00	22.78	11.6	11.02	28.67
Malt Sprouts	70.59	20.3	1.4	9.63	36.37
Flax Seed	69.92	20.6	29 0	4.26	12.76
Linseed Meal (old process)	71.26	30.2	6.9	4.16	27.85
Linseed Meal (new process)	74.62	31.5	2.4	6.59	29.12
Cotton Seed	59.2	12.5	17.3	17.63	12.35
Cotton Seed Meal	71.61	37.6	9.6	2.21	19.19
Rice	85.85	6.4	0.4	----	79.2
Rice Bran	55.99	7.6	7.3	2.52	36.35
Rice Meal	66.4	57.4	11.9	----	47.10
Rice Polish	74.0	47.9	5.3	0.73	57.94
Alfalfa Hay	-----	10.44	0.31	10.0	29.89
Dried Beet Pulp	70.53	4.1	----	12.6	52.29
Meat Scraps	83.05	66.2	13.4	----	----
Molasses Feed	64.51	10.8	2.2	6.55	41.47
Mixed Feed (Shipstuff 80%, Corn Bran 20%)	64.5	10.48	4.24	5.36	43.51

Analyses.

The analyses given in the following tables represent the various kinds of feeds found on the Kentucky market by our inspectors. For convenience, the analyses of feeds of the same class are grouped together.

The definitions of terms of different materials used as feeds and in compounding the various mixed feeds are given on another page of this bulletin.

Explanation of Tables.

Table I.

In this table are classed all straight feeds, or feeds made from one grain or cereal only. The grains or cereals from which these feeds are made are given in alphabetical order and the names of the products of each grain or cereal are given in alphabetical order also.

Table II.

Table II contains a class of feeds composed of wheat and corn and their by-products, with usually from 1 to 10% of wheat screenings. The feeds in this class are composed almost wholly of wheat, but where corn product appears, corn bran is the principal ingredient and varies from a mere trace to 20 or 30%.

Brewers' and Distillers' dried grains are included in Table II as mixed feeds.

Table III.

In this table are included all feeds termed "Poultry feeds." Most of the chicken feeds came up to guaranty in protein and fat, but varied from guaranty a good deal in the ingredients. A number contained screenings with a large per cent of weed seeds present.

Table IV.

In this table are grouped the miscellaneous feeds. These feeds are made up of the various concentrates found on the market and a combination of grains.

In the table of analyses the manufacturer's guaranty is printed in bold face figures.

TABLE 1.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
	Alfalfa.				
588-12	Pioneer Alfalfa Meal	Kornfalfa Feed Milling Co., Kansas City, Mo.	17.38 **12.00**	2.08 **1.50**	------ **35.00**
592-11	Lucerne Alfalfa Meal	M. C. Peters Mill Co. Omaha, Neb.	15.75 **12.00**	1.69 **0.50**	31.65 **33.00**
753-12	Alfalfa Meal	W. H. Small & Co. Evansville, Ind.	16.88 **20.06**	2.40 **2.96**	------ **32.00**
753-12	Alfalfa Meal	W. H. Small & Co. Evansville, Ind.	18.16 **20.06**	2.26 **2.96**	------ **32.00**
753-12	Alfalfa Meal	W. H. Small & Co. Evansville, Ind.	17.94 **20.06**	2.24 **2.96**	25.95 **32.00**
711-11	Atlas Alfalfa Meal	Southern Seed Co. Louisville, Ky.	15.69 **15.00**	2.20 **1.75**	31.60 ------
	Animal Products.				
764-12	Blood Meal	Armour Fertilizer Works Chicago, Ill.	78.00 **80.00**	------ ------	------ **1.50**
976-13	Swift's Digester Tankage	Swift & Co. Chicago, Ill.	57.41 **60.00**	11.25 **8.00**	2.22 **3.00**
259-14	Swift's Digester Tankage	Swift & Co. Chicago, Ill.	60.09 **60.00**	13.40 **8.00**	1.68 **3.00**
	Beet Pulp.				
1058-11	Dried Beet Pulp	W. H. Small & Co. Evansville, Ind.	9.60 **8.00**	1.03 **0.50**	20.08 **20.00**
752-12	Dried Beet Pulp	W. H. Small & Co. Evansville, Ind.	9.28 **8.00**	0.45 **0.50**	------ **20.00**
	Corn Bran.				
991-12	Corn Bran	J. R. Shaw & Co. Jetts, Ky.	10.06 **9.00**	6.91 **5.00**	------ ------
	Corn Chop.				
417-12	Corn Chop	Ashland Milling Co. Ashland, Ky.	9.13 **8.50**	4.31 **3.52**	------ ------
511-12	Corn Chop	James Cate & Son Co. Hopkinsville, Ky.	8.91 **8.19**	3.52 **4.11**	------ ------
511-12	Corn Chop	James Cate & Son Co. Hopkinsville, Ky.	8.31 **8.19**	3.53 **4.11**	------ ------
216-11	Pure Chops	Crown Roller Mills Co. Morganfield, Ky.	8.72 **8.50**	4.21 **4.50**	1.78 ------
551-12	Corn Chop	Dixon Milling Co. Dixon, Ky.	8.63 **8.59**	4.05 **3.75**	------ ------
551-12	Corn Chop	Dixon Milling Co. Dixon, Ky.	8.91 **8.59**	3.98 **3.75**	1.90 ------
1006-12	Quail Chop	Madisonville Milling Co. Madisonville, Ky.	8.88 **8.25**	4.19 **3.93**	------ ------
799-13	Quail Chop	Madisonville Milling Co. Madisonville, Ky.	8.78 **8.25**	4.08 **3.93**	1.65 ------

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED	REMARKS—VARIANCE FROM GUARANTY
588-12	H. G. Brooks & Co. Louisville, Ky.	Alfalfa Hay	
592-11	W. E. Ellis Hartford, Ky.	Alfalfa Hay	
753-12	Clarence Howard Russellville, Ky.	Alfalfa Hay	Below guaranty in both protein and fat.
753-12	Park City Feed Store Bowling Green, Ky.	Alfalfa Hay	Below guaranty in both protein and fat.
753-12	L. E. Chapman Owensboro, Ky.	Alfalfa Hay	Below guaranty in both protein and fat.
711-11	H. G. Brooks & Co. Louisville, Ky.	Alfalfa Hay	
764-12	W. H. Luesing Louisville, Ky.	Dried Blood	Below guaranty in protein.
976-13	F. W. Alvis Bowling Green, Ky.	Meat Residues	Below guaranty in protein.
359-14	Schramme & Smith Shelbyville, Ky.	Meat Residues	
1058-11	Barnett Feed & Commission Co., Henderson, Ky.	Dried Beet Pulp.	
752-12	Henderson Feed & Commission Co., Henderson, Ky.	Dried Beet Pulp.	
991-12	Manufacturer's Warehouse	Corn	
417-12	Bush & Bush Ashland, Ky.	Corn	Sample is cracked corn.
511-12	Forbes Manufacturing Co. Hopkinsville, Ky.	Shelled Corn	Sample is composed of corn, cob and shucks. Below guaranty in fat.
511-12	Forbes Manufacturing Co. Hopkinsville, Ky.	Shelled Corn	Sample is cracked corn. Below guaranty in fat.
216-11	Manufacturer's Warehouse	Shelled Corn	
551-12	Manufacturer's Warehouse	Corn	
551-12	Manufacturer's Warehouse	Corn	
1006-12	St. Bernard Mining Co. Earlington, Ky.	Corn	
799-13	Manufacturer's Warehouse	Cracked Corn	

TABLE I.—STRAIGHT FEEDS

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
122-12	Corn Chop	Ohio Valley Mill & Supply Co., Ashland, Ky.	8.53 **8.75**	3.00 **3.63**	------ ------
278-10	Corn Chop	Peerless Roller Mills. Beech Grove, Ky.	9.88 **8.40**	3.60 **4.00**	1.68 ------
99-13	Corn Chop	R. C. Poage Milling Co. Ashland, Ky.	9.25 **8.31**	4.55 **3.85**	------ ------
115-14	Corn Chop	R. C. Poage Milling Co. Ashland, Ky.	9.00 **8.30**	3.85 **3.50**	1.85 **2.00**
929-12	Corn Chop	Sturgis Milling Co. Sturgis, Ky.	8.88 **8.50**	4.22 **4.10**	1.73 ------
35-13	Corn Chop	C. B. Travis Hickman, Ky.	9.47 **8.81**	4.29 **4.33**	1.70 ------
518-12	Corn Chop	H. D. Tutt & Son Salem, Ky.	8.75 **8.69**	3.62 **3.78**	------ ------
	Cracked Corn.				
454-13	Red River Cracked Corn	Geo. P. Burke. Rosslyn, Ky.	8.41 **8.19**	4.23 **4.00**	1.47 ------
104-13	Cracked Corn	Jas. Cate & Son Co. Hopkinsville, Ky.	8.85 **8.19**	4.15 **4.11**	------ ------
863-12	"Crescent" Cracked Corn	Crescent Milling Co. Cynthiana, Ky.	9.88 **8.69**	3.58 **4.01**	------ ------
387-13	Cracked Corn	Dawson Milling Co. Dawson Springs, Ky.	8.47 **8.80**	4.05 **4.00**	1.95 ------
759-12	Cracked Corn	Dickinson Bros. Glasgow, Ky.	10.13 **8.50**	4.10 **4.00**	------ ------
1014-13	Cracked Corn	Dickinson Bros. Glasgow, Ky.	9.06 **8.50**	3.70 **4.00**	1.85 ------
114-13	Sifted Cracked Corn	The Early & Daniel Co. Cincinnati, Ohio.	8 88 **8.60**	4.04 **4.00**	1.35 **7.00**
474-12	Cracked Corn	Henry Fruechtenicht. Louisville, Ky.	9.10 **8.50**	4.48 **4.25**	------ ------
455-14	Cracked Corn	The Goldcamp Mill Co. Ironton, Ohio.	9.28 **8.60**	4.04 **3.93**	1.78 **1.68**
76-13	Cracked Corn	Greenup Milling Co. Greenup, Ky.	8.69 **8.59**	4.58 **3.75**	1.90 ------
606-13	Cracked Corn	Gwinn Bros. & Co. Huntington, W. Va.	9.38 **8.19**	3.15 **4.29**	1.63 ------
1081-12	Cracked Corn	Hall Brothers. Morehead, Ky.	9.56 **7.72**	4.13 **4.02**	1.75 ------
1120-13	"Purity" Cracked Corn	Ohio Valley Mill & Supply Co., Ashland, Ky.	8.85 **9 16**	4.08 **4.39**	2.05 ------
122-14	"Purity" Cracked Corn	Ohio Valley Mill & Supply Co., Ashland, Ky.	8.81 **9.16**	4.06 **4.39**	1.80 **1.80**
1143-12	Cracked Corn	Paris Milling Co. Paris, Ky.	8.53 **8.65**	3.83 **3.75**	1.75 ------
403-13	Cracked Corn	F. Raidt Milling Co. Louisville, Ky.	8.63 **8.68**	4.88 **3.85**	------ ------
403-13	Cracked Corn	F. Raidt Milling Co. Louisville, Ky.	9.25 **8.68**	4.07 **3.85**	1.95 ------

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED	REMARKS—VARIANCE FROM GUARANTY
122-12	G. W. Vance, Prestonsburg, Ky.	Corn	Sample is cracked corn. Below guaranty in fat.
278-10	Manufacturer's Warehouse	Corn	Sample is cracked corn.
99-13	Williams Feed & Transfer Co., Pikeville, Ky.	Corn Bran, Cracked Corn	
115-14	E. R. Coleman, Olive Hill, Ky.	Corn Bran, Cracked Corn	
929-12	Manufacturer's Warehouse	Corn	Sample is cracked corn.
35-13	Hickman Joint Stock Co., Hickman, Ky.	Corn	Sample is cracked corn.
518-12	Manufacturer's Warehouse	Corn	Sample is cracked corn.
454-13	Mountain Central R. R. Co., Campton Junction, Ky.	Shelled Corn	
104-13	Forbes Manufacturing Co., Hopkinsville, Ky.	Shelled Corn	Sample is corn chop, containing small amount of cob.
863-12	Manufacturer's Warehouse	Corn	
387-13	Louis Igleheart, Dawson Springs, Ky.	Shelled Corn	
759-12	Manufacturer's Warehouse	Corn	
1014-13	Manufacturer's Warehouse	Corn	
114-13	W. R. Henderson, Vanceburg, Ky.	Sifted Cracked Corn	
474-12	H. G. Brooks & Co., Louisville, Ky.	Corn	Sample is sifted cracked corn.
455-14	Spurlock Mercantile Co., Middle Creek, Ky.	Shelled Corn	
76-13	N. D. Tabor, Olive Hill, Ky.	Corn	
606-13	R. Blankenship, Louisa, Ky.	Corn	Below guaranty in fat.
1081-12	F. P. Blair, Morehead, Ky.	Corn	
1120-13	Bush & Bush, Ashland, Ky.	Shelled Corn	
-------	F. P. Blair, Morehead, Ky.	Shelled Corn	
1143-12	Ky. Block Cannel Coal Co., Cannel City, Ky.	Pure Corn	
403-13	L. M. Nuchols, Louisville, Ky.	Corn	
403-13	H. G. Brooks & Co., Louisville, Ky.	Corn	

TABLE I.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
992-12	Cracked Corn	J. R. Shaw & Co.	9.66	3.92	------
		Jetts, Ky.	**8.69**	**3.78**	------
669-13	Crushed Corn	W. H. Small & Co.	9.91	4.00	1.68
		Evansville, Ind.	**8.00**	**4.00**	**2.00**
231-12	Smith's Pure Cracked Corn	H. C. Smith & Sons.	8.94	3.93	------
		Harrodsburg, Ky.	**9.40**	**4.80**	------
757-12	Cracked Corn	Star Milling Co.	9.38	4.53	1.93
		Nicholasville, Ky.	**8.05**	**4.17**	------
609-12	"Noxall" Cracked Corn	Tranchant & Finnell,	9.47	4.30	2.08
		Osborne, Ohio.	**8.65**	**4.12**	**2.50**
684-12	Cracked Corn	Woolcott Bros. Flour Mills.	10.50	3.89	------
		Lexington, Ky.	**8.65**	**3.75**	------
	Corn Feed Meal.				
215-12	Corn Feed Meal	Cincinnati Grain Co.	8.16	3.05	------
		Cincinnati, Ohio.	**8.50**	**4.25**	------
215-12	Corn Feed Meal	Cincinnati Grain Co.	8.13	3.40	------
		Covington, Ky.	**8.50**	**4.25**	------
215-12	Corn Feed Meal	Cincinnati Grain Co.	9.00	3.60	------
		Covington, Ky.	**8.50**	**9.25**	------
255-13	Corn Feed Meal	Cincinnati Grain Co.	8.94	3.64	1.52
		Covington, Ky.	**8.50**	**4.25**	------
725-12	Feed Meal	C. P. Dodd & Co.	8.75	4.03	------
		Louisville, Ky.	**8.50**	**4.20**	------
580-13	Dorsel's Corn Meal	The Dorsel Company.	8.91	3.09	1.65
		Newport, Ky.	**9.06**	**4.16**	------
490-12	Yellow Corn Meal	The Early & Daniel Co.	9.78	3.13	------
		Cincinnati, Ohio.	**8.43**	**4.29**	**2.00**
175-13	Corn Feed Meal	Edinger & Co.	9.91	4.35	------
		Louisville, Ky.	**8.76**	**3.98**	------
483-12	Feed Meal	Edinger & Co.	10.31	3.45	------
		Louisville, Ky.	**8.76**	**3.98**	------
32-11	Feed Meal	F. Raidt Milling Co.	8.75	4.08	------
		Louisville, Ky.	**8.31**	**3.85**	------
156-12	Feed Meal	F. Raidt Milling Co.	9.10	3.65	------
		Louisville, Ky.	**8.31**	**3.85**	------
	Corn Germ Meal.				
80-13	Homcoline	American Hominy Co.	18.63	8.67	4.08
		Indianapolis, Ind.	**17.00**	**5 00**	**7.00**
1261-12	Maizina Germ Oil Meal	American Maize Oil Refining	18.50	6.37	------
		Co., Indianapolis, Ind.	**18.00**	**8.00**	**4.50**
	Hominy Feed.				
81-13	That Good Feed	American Hominy Co.	10.69	6.83	5.63
		Indianapolis, Ind.	**14.37**	**6.71**	**7.00**
171-12	Hominy Feed	Chas. Broeker & Co.	11.38	9.53	------
		Owensboro, Ky.	**10.00**	**10.00**	------
211-12	Hominy Feed	Cincinnati Grain Co.	10.31	7.21	------
		Covington, Ky.	**10.19**	**8.00**	------

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY
992-12	Manufacturers' Warehouse	Corn	
669-13	Clarence Howard, Russellville, Ky.	Corn	
231-12	Manufacturers' Warehouse	Corn	Below guaranty in both protein and fat.
757-12	C. S. Evans & Co., Nicholasville, Ky.	Corn	
609-12	Qualls & Dennes, Olive Hill, Ky.	Corn	
684-12	Mountain Central R. R. Co., McCormack, Ky.	Corn	
215-12	H. Dieters, Covington, Ky.	Yellow Corn	Below guaranty in fat. Excess of corn bran.
215-12	Frank Steenken, Covington, Ky.	Yellow Corn	Below guaranty in fat.
215-12	Clem Schulte, Latonia, Ky.	Yellow Corn	Below guaranty in fat.
255-13	Frank M. Steenken, Covington, Ky.	Corn	Below guaranty in fat.
725-12	H. E. Eilers, Louisville, Ky.	Corn	
580-13	Mrs. Young & Sons, Fort Thomas, Ky.	Corn	
490-12	Bud Hamilton, Latonia, Ky.	Corn	Below guaranty in fat.
175-13	H. J. Greive, Louisville, Ky.	Corn	Contains small amount of corn cob and oat hulls.
483-12	A. G. Bauer, Louisville, Ky.	Corn	Below guaranty in fat.
32-11	L. M. Nuckols, Louisville, Ky.	Corn	
156-12	D. Zehnder, St. Matthews, Ky.	Corn	
80-13	R. B. Hayes & Co., Hodgenville, Ky.	White Corn	
1261-12	McAfee & Schramme, Shelbyville, Ky.	Ground Hominy Hearts	Below guaranty in fat.
81-13	R. B. Hayes & Co., Hodgenville, Ky.	White Corn	Below guaranty in protein.
171-12	Rogers & Hughes Co., Central City, Ky	White Corn	
211-12	H. Kollman, Latonia, Ky.	Corn	Below guaranty in fat.

TABLE I.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
110-12	Hominy Meal	The Early & Daniel Co.	10.94	6.99	------
		Covington, Ky.	**9.86**	**8.22**	------
1-13	Hominy Feed	J. H. Fedders & Sons.	11.19	9.00	4.40
		Covington, Ky.	**10.25**	**7.75**	------
1467-13	"Calumet White Hominy Feed"	O. L. Hunter & Co.	11.50	8.80	4.43
		Chicago, Ill.	**9.30**	**7.10**	**10.00**
653-13	Hominy Feed	George Keller.	10.53	8.04	5.18
		Newport, Ky.	**9.25**	**6.50**	------
558-13	Hominy Feed	Perin Bros.	10.81	7.02	3.56
		Cincinnati, Ohio.	**10.69**	**9.15**	------
603-9	Oriental Feed	Standard Hay & Grain Co.	9.85	6.98	3.83
		Cincinnati, Ohio.	**10.00**	**8.21**	------
	Choice Cotton Seed Meal.				
107-14	Cotton Seed Meal	Blue Grass Commission Co.	37.19	6.83	16.13
		Lexington, Ky.	**41.00**	**8.00**	**9.00**
662-10	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	39.13	7.18	12.18
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
130-12	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	41.22	7.53	10.55
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
130-12	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	40.81	7.47	9.70
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
130-12	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	42.53	7.58	8.88
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
130-12	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	42.06	7.53	9.20
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
130-12	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	39.38	7.28	9.38
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
130-12	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	40.06	7.51	------
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
25-13	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	42.50	8.05	8.65
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
25-13	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	43.50	10.03	8.05
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
25-13	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	42.38	7.04	9.83
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
25-13	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	42.53	7.78	8.10
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
25-13	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	41.69	8.85	8.18
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
25-13	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	41.88	7.93	10.03
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
25-13	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	41.63	8.40	7.46
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
25-13	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	41.94	8.95	8.20
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
25-13	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	40.25	7.30	10.55
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**
25-13	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co.	40.60	9.64	8.30
		Memphis, Tenn.	**41.00**	**6.00**	**10.00**

Analyses of Inspectors' Samples.

Reg. No.	Sample taken from	Ingredients guaranteed	Remarks—Variance from guaranty
110-12	John Winger. Latonia, Ky.	Corn	Below guaranty in fat.
1-13	Joe List. Covington, Ky.	Corn	
1467-13	Riedling & Bro. Louisville, Ky.	White Corn	
653-13	George Weymann. Newport, Ky.	Corn	Below guaranty in fat.
558-13	Diers & Best. Walton, Ky.	Corn	Below guaranty in fat.
	August Kramer. Ft. Thomas, Ky.	Corn	
107-14	W. Z. Thompson. Georgetown, Ky.	Cotton Seed	Large amt. of lint present. Below guaranty in both protein and fat, and too high in fiber.
662-10	J. E. Combs. Greenville, Ky.	Decorticated Cotton Seed.	Hulls and lint present. Below guaranty in protein.
130-12	C. R. Barnes. Bardstown, Ky.	Decorticated Cotton Seed.	
130-12	L. E. Chapman. Owensboro, Ky	Decorticated Cotton Seed.	
130-12	Martin Hodgkin Coal & Sup'y Co., Winchester, Ky.	Decorticated Cotton Seed.	
130-12	E. T. Ford. Cave City, Ky.	Decorticated Cotton Seed.	
130-12	Robertson & Bro. Finchville, Ky.	Decorticated Cotton Seed.	Considerable hulls present. Below guaranty in prot.
130-12	J. S. Vaughn. Franklin, Ky.	Decorticated Cotton Seed.	Below guaranty in prot.
25-13	Shelby Jett. Kirksville, Ky.	Decorticated Cotton Seed.	
25-13	Simon Weil & Son. Lexington, Ky.	Decorticated Cotton Seed.	
25-13	Chas. W. Caldwell. Danville, Ky.	Decorticated Cotton Seed.	
25-13	J. C. Caldwell. Danville, Ky.	Decorticated Cotton Seed.	
25-13	Simon Weil & Son Lexington, Ky.	Decorticated Cotton Seed.	
25-13	J. H. Ditto. Vine Grove, Ky.	Decorticated Cotton Seed.	Considerable amount of hulls present.
25-13	Arthur Maddox. Cave City, Ky.	Decorticated Cotton Seed.	
25-13	W. T. Robinson. Danville, Ky.	Decorticated Cotton Seed.	
25-13	C. H. Jett. Richmond, Ky.	Decorticated Cotton Seed.	Below guaranty in protein.
25-13	C. E. Duff. Mt. Sterling, Ky.	Decorticated Cotton Seed.	

TABLE I.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
25-13	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co. Memphis, Tenn.	43.63	7.40	8.33
			41.00	**6.00**	**10.00**
25-13	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co. Memphis, Tenn.	41.56	7.10	10.33
			41.00	**6.00**	**10.00**
25-13	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co. Memphis, Tenn.	44.47	8.48	7.18
			41.00	**6.00**	**10.00**
25-13	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co. Memphis, Tenn.	41.50	7.94	8.93
			41.00	**6.00**	**10.00**
662-14	"Owl Brand" High Grade Cotton Seed Meal.	F. W. Brode & Co. Memphis, Tenn.	41.56	7.68	8.60
			41.00	**6.00**	**10.00**
131-12	Golden Yellow Brand Cotton Seed Meal.	Brownsville Cotton Oil & Ice Co., Brownsville, Tenn.	40.19	7.03	9.03
			41.00	**6.00**	**10.00**
1144-11	Cotton Seed Meal	Brownsville Cotton Oil & Ice Co., Brownsville, Tenn.	40.41	7.41	------
			41.00	**6.00**	**10.00**
163-12	Burnett's Best Cotton Seed Meal	William A. Burnett. Louisville, Ky.	41.31	7.31	9.63
			41.00	**6.00**	**10.00**
448-13	Burnett's Choice Cotton Seed Meal.	The William A. Burnett Co. Louisville, Ky.	43.50	7.00	8.08
			41.00	**6.00**	**10.00**
448-13	Burnett's Choice Cotton Seed Meal.	The William A. Burnett Co. Louisville, Ky.	40.31	6.97	11.80
			41.00	**6.00**	**10.00**
448-13	Burnett's Choice Cotton Seed Meal.	The William A. Burnett Co. Louisville, Ky.	40.25	8.80	9.58
			41.00	**6.00**	**10.00**
448-13	Burnett's Choice Cotton Seed Meal.	The William A. Burnett Co. Louisville, Ky.	40.19	7.35	11.48
			41.00	**6.00**	**10.00**
448-13	Burnett's Choice Cotton Seed Meal.	The William A. Burnett Co. Louisville, Ky.	41.94	7.88	10.65
			41.00	**6.00**	**10.00**
448-13	Burnett's Choice Cotton Seed Meal.	The William A. Burnett Co. Louisville, Ky.	40.50	7.37	11.98
			41.00	**6.00**	**10.00**
448-13	Burnett's Choice Cotton Seed Meal.	The William A. Burnett Co. Louisville, Ky.	39.60	7.28	13.18
			41.00	**6.00**	**10.00**
448-13	Burnett's Choice Cotton Seed Meal.	The William A. Burnett Co. Louisville, Ky.	40.75	7.63	9.60
			41.00	**6.00**	**10.00**
448-13	Burnett's Choice Cotton Seed Meal.	The William A. Burnett Co. Louisville, Ky.	40.03	7.58	9.83
			41.00	**6.00**	**10.00**
1483-13	Eagle Brand Choice Cotton Seed Meal.	The Cottonseed Products Co., Louisville, Ky.	39.94	7.10	12.28
			41.00	**6.00**	**10.00**
1483-13	Eagle Brand Choice Cotton Seed Meal.	The Cottonseed Products Co., Louisville, Ky.	40.47	7.33	11.45
			41.00	**6.00**	**10.00**
472-14	Eagle Brand Choice Cotton Seed Meal.	The Cottonseed Products Co., Louisville, Ky.	38.16	7.25	12.73
			41.00	**6.00**	**10.00**
472-14	Eagle Brand Choice Cotton Seed Meal.	The Cottonseed Products Co., Louisville, Ky.	40.81	8.08	10.13
			41.00	**6.00**	**10.00**
472-14	Eagle Brand Choice Cotton Seed Meal.	The Cottonseed Products Co., Louisville, Ky.	38.38	7.32	13.13
			41.00	**6.00**	**10.00**
1065-13	"De Soto" Brand Choice Cotton Seed Meal.	De Soto Oil Co. Memphis, Tenn.	42.81	8.22	7.55
			41.00	**6.50**	**10.00**
113-12	Cotton Seed Meal	The Early & Daniel Co. Covington, Ky.	41.94	8.41	------
			41.41	**6.94**	------
1398-12	Choice Cotton Seed Meal	Henry Fruechtenicht, Louisville, Ky.	41.38	6 89	10.15
			41.00	**6.00**	**10.00**

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED	REMARKS—VARIANCE FROM GUARANTY
25-13	Sterling Hinkson, Lair, Ky.	Decorticated Cotton Seed.	
25-13	Eminence Milling Co., Eminence, Ky.	Decorticated Cotton Seed.	
25-13	Rogers & Thomas, Leitchfield, Ky.	Decorticated Cotton Seed.	
25-13	Dickinson Bros., Glasgow, Ky.	Decorticated Cotton Seed.	
662-14	J. K. Smith, Eminence, Ky.	Decorticated Cotton Seed.	
131-12	W. J. Kirk, Madisonville, Ky.	Cotton Seed	Below guaranty in protein.
1144-11	Duncan & Bro., La Grange, Ky.	Cotton Seed	Below guaranty in protein.
163-12	F. W. Alvis, Bowling Green, Ky.	Decorticated Cotton Seed.	Below guaranty in protein.
448-13	F. W. Alvis, Bowling Green, Ky.	Cotton Seed	
448-13	I. F. Tabb, Mt. Sterling, Ky.	Cotton Seed	Below guaranty in protein.
448-13	Lovell & Luckett, Greenville, Ky.	Cotton Seed	Below guaranty in protein.
448-13	S. English Anderson, Mt. Sterling, Ky.	Cotton Seed	Below guaranty in protein.
448-13	C. E. Duff, Mt. Sterling, Ky.	Cotton Seed	
448-13	W. T. Barn, Lawrenceburg, Ky.	Cotton Seed	Below guaranty in protein.
448-13	Ripy & Hawkins, Lawrenceburg, Ky.	Cotton Seed	Below guaranty in protein.
448-13	W. R. Rasdall, Smith's Grove, Ky.	Cotton Seed	
448-13	Tatum-Embry & Co., Louisville, Ky.	Cotton Seed	Below guaranty in protein.
1483-13	W. O. & P. E. Brock, Winchester, Ky.	Decorticated Cotton Seed.	Below guaranty in protein. Too high in fiber.
1483-13	R. P. Taylor, Winchester, Ky.	Decorticated Cotton Seed.	Below guaranty in protein.
472-14	Simon Weil & Son, Lexington, Ky.	Decorticated Cotton Seed	Sample contains hulls. Below guaranty in protein.
472-14	Simon Weil & Son, Lexington, Ky.	Decorticated Cotton Seed.	
472-14	Simon Weil & Son, Lexington, Ky.	Decorticated Cotton Seed.	Sample contains hulls. Below guaranty in protein.
1065-13	R. B. Hutchcraft, Paris, Ky.	Cotton Seed	
113-12	Bud Hamilton, Latonia, Ky.	Cotton Seed	
1398-12	Wm. P. Miller, Louisville, Ky.	Decorticated Cotton Seed	

TABLE I.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
302-13	Choice Cotton Seed Meal	H. P. Hawkins & Son, Paducah, Ky.	41.38	7.36	
			41.00	**7.00**	**10.50**
37-13	"Dixie" Brand Choice Cotton Seed Meal.	Humphreys-Godwin Co. Memphis, Tenn.	41.35	9.24	8.53
			41.00	**6.00**	**10.00**
862-12	Imperial Cotto Brand Cotton Seed Meal	Imperial Cotto Milling Co. Chicago, Ill.	39.25	8.00	10.58
			41.00	**9.00**	**9.00**
862-12	Imperial Cotto Brand Cotton Seed Meal.	Imperial Cotto Milling Co. Chicago, Ill.	39.88	6.75	10.53
			41.00	**9.00**	**9.00**
862-12	Imperial Cotto Brand Cotton Seed Meal.	Imperial Cotto Milling Co. Chicago, Ill.	39.94	7.30	10.00
			41.00	**9.00**	**9.00**
862-12	Imperial Cotto Brand Cotton Seed Meal.	Imperial Cotto Milling Co. Chicago, Ill.	41.28	9.41	8.98
			41.00	**9.00**	**9.00**
529-13	Imperial Cotto Brand Cotton Seed Meal.	Imperial Cotto Milling Co. Chicago, Ill.	42.00	9.23	9.35
			41.00	**8.00**	**9.00**
107-14	Imperial Cotto Brand Cotton Seed Meal.	Imperial Cotto Milling Co. Chicago, Ill.	44.25	8.80	8.03
			41.00	**8.00**	**9.00**
107-14	Imperial Cotto Brand Cotton Seed Meal.	Imperial Cotto Milling Co. Chicogo, Ill.	42.16	9.33	10 00
			41.00	**8.00**	**9.00**
107-14	Imperial Cotto Brand Cotton Seed Meal.	Imperial Cotto Milling Co. Chicago, Ill.	42.06	8.23	8.43
			41.00	**8.00**	**9.00**
107-14	Imperial Cotto Brand Cotton Seed Meal.	Imperial Cotto Milling Co. Chicago, Ill.	40.19	8.63	10.43
			41.00	**8.00**	**9.00**
305-13	Choice Cotton Seed Meal	W. B. Johnson & Co. Memphis, Tenn.	41.44	7.45	10.08
			41.00	**7.00**	**10.00**
305-13	Choice Cotton Seed Meal	W. B. Johnson & Co. Memphis, Tenn.	42.50	7.70	9.98
			41.00	**7.00**	**10.00**
1394-13	Canary Choice Cotton Seed Meal	Lanier Brothers Nashville, Tenn.	41.00	7.67	10.08
			41.00	**6.00**	**10.00**
1394-13	Canary Choice Cotton Seed Meal	Lanier Brothers Nashville, Tenn.	41.41	8.15	9.33
			41.00	**6.00**	**10.00**
518-11	Louisville Brand Cotton Seed Meal.	Louisville Cottonseed Products Co., Louisville, Ky:	39.63	8.15	11.65
			41.00	**6.00**	**10.00**
472-14	"Eagle Brand" Cotton Seed Meal.	Louisville Cottonseed Products Co., Louisville, Ky.	40.16	7.67	11.95
			41.00	**6.00**	**10.00**
1008-12	Cotton Seed Meal	R. H. Menefee & Co. Louisville, Ky.	41.81	7.08	9.63
			41.00	**6.00**	**10.00**
414-13	Crown Brand Cotton Seed Meal	Ohio Valley Seed Co Evansville, Ind.	39.31	7.08	13.88
			41.00	**7.00**	**10.00**
1357-12	Phoenix Cotton Seed Meal	Phoenix Cotton Oil Co. Dyersburg, Tenn.	41.69	7.11	9.43
			41.00	**7.00**	**10.00**
1357-12	Phoenix Cotton Seed Meal	Phoenix Cotton Oil Co. Dyersburg, Tenn.	40.75	7.84	10.18
			41.00	**7.00**	**10.00**
727-14	Phoenix Choice Cotton Seed Meal	Phoenix Cotton Oil Co. Dyersburg, Tenn.	39.94	7.25	11.05
			41.00	**7.00**	**10.00**
727-14	Phoenix Choice Cotton Seed Meal	Phoenix Cotton Oil Co. Dyersburg, Tenn.	42.00	7.93	9.40
			41.00	**7.00**	**10.00**
704-11	Atlas Cotton Seed Meal	Southern Seed Co. Louisville, Ky.	37.56	7.79	10.23
			41.00	**6.00**	**9.00**
189-12	Choice Cotton Seed Meal	Tennessee Cotton Oil Co. Memphis, Tenn.	40.69	7.97	10.40
			41.00	**6.00**	**10.00**
189-12	Choice Cotton Seed Meal	Tennessee Cotton Oil Co. Memphis, Tenn.	40.19	7.80	9.58
			41.00	**6.00**	**10.00**

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED	REMARKS—VARIANCE FROM GUARANTY
302-13	E. O. Thompson, Paducah, Ky.	Cotton Seed	Sample contains cotton seed hulls.
37-13	W. M. Matheny, Stanford, Ky.	Cotton Seed	
862-12	Park City Feed Store, Bowling Green, Ky.	Cotton Seed	Below guaranty in both protein and fat and above in fiber.
862-12	Cecelian Milling Co., Cecelian, Ky.	Cotton Seed	Below guaranty in prot. and fat and above in fiber. Sample contains cotton seed hulls.
862-12	Elizabethtown Milling Co., Elizabethtown, Ky.	Cotton Seed	Below guaranty in both protein and fat and above in fiber.
862-12	Elmendorf Coal & Feed Yards, Lexington, Ky.	Cotton Seed	Sample contains considerable amt. of lint. Above guaranty in fiber.
529-13	Bedford & Tuttle, Winchester, Ky.	Cotton Seed	
107-14	W. O. & P. E. Brock, Winchester, Ky.	Cotton Seed	
107-14	W. M. Scobee, Winchester, Ky.	Cotton Seed	Above guaranty in fiber.
107-14	R. B. Hayes & Co., Hodgenville, Ky.	Cotton Seed	Hulls present. Below guaranty in protein and above in fiber.
107-14	Elizabethtown Milling Co., Elizabethtown, Ky.	Cotton Seed	
305.13	Dickinson Brothers, Glasgow, Ky.	Decorticated Cotton Seed	Considerable lint present.
305-13	Latonia Hay & Grain Co., Covington, Ky.	Decorticated Cotton Seed	
1394-13	C. S. Brent & Co., Lexington, Ky.	Decorticated Cotton Seed	
1394-13	R. S. Arnold, Richmond, Ky.	Decorticated Cotton Seed	
518-11	Brock & Allen, Winchester, Ky.	Decorticated Cotton Seed	Sample contains lint. Below in protein and too high in fiber.
472-14	A. G. Bauer, Louisville, Ky.	Decorticated Cotton Seed	Below guaranty in protein and too high in fiber.
1008-12	J. H. Fehrman, Paris, Ky.	Cotton Seed	
414-13	Weaverton Feed Co., Henderson, Ky.	Decorticated Cotton Seed	Below guaranty in protein and too high in fiber.
1357-12	Hodgkin Brothers, Winchester, Ky.	Decorticated Cotton Seed	
1357-12	Leitchfield Milling Co., Leitchfield, Ky.	Decorticated Cotton Seed	
727-14	W. M. McKinney, Paducah, Ky.	Decorticated Cotton Seed	Below guaranty in protein and above in fiber.
727-14	M. J. Yopp Seed Co., Paducah, Ky.	Decorticated Cotton Seed	
704-11	W. E. Ellis, Hartford, Ky.	Cotton Seed	Below guaranty in protein and above in fiber.
189-12	Clarence Wilson, Lexington, Ky.	Cotton Seed	
189-12	S. C. Evans & Co., Nicholasville, Ky.	Cotton Seed	Below guaranty in protein.

TABLE I.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER.	Analysis.		
			Prot.	Fat.	Fiber.
	Prime Cotton Seed Meal.				
942-12	"Dove Brand" Cotton Seed Meal	F. W. Brode & Co., Memphis, Tenn.	44.88	7.08	9.99
			38.63	**6.00**	**10.00**
52-13	Buckeye Prime Cotton Seed Meal	Buckeye Cotton Oil Co. Cincinnati, O.	38.25	7.63	11.80
			38.62	**6.50**	**12.00**
52-13	Buckeye Prime Cotton Seed Meal	Buckeye Cotton Oil Co. Cincinnati, O.	40.31	7.70	11.10
			38.62	**6.50**	**12.00**
52-13	Buckeye Prime Cotton Seed Meal	Buckeye Cotton Oil Co. Cincinnati, O.	38.75	6.58	13.08
			38.62	**6.50**	**12.00**
52-13	Buckeye Prime Cotton Seed Meal	Buckeye Cotton Oil Co. Cincinnati, O.	38.19	6.65	12.73
			38.62	**6.50**	**12.00**
610-12	Prime Cotton Seed Meal	Lake County Manufacturing Co., Tiptonville, Tenn.	41.31	8.10	8.89
			38.60	**7.00**	**10.00**
1420-13	Prime Cotton Seed Meal	Lake County Manufacturing Co., Tiptonville, Tenn.	40.53	8.93	8.90
			38.60	**7.00**	**10.00**
239-12	Prime Cotton Seed Meal	Phoenix Cotton Oil Co. Dyersburg, Tenn.	40.56	7.30	11.38
			38.62	**10.50**	**7.50**
239-12	Prime Cotton Seed Meal	Phoenix Cotton Oil Co. Dyersburg, Tenn.	39.38	6.61	8.27
			38.62	**10.50**	**7.50**
1388-13	Phoenix Prime Cotton Seed Meal	Phoenix Cotton Oil Co. Dyersburg, Tenn.	42.75	7.80	9.00
			38.62	**7.00**	**10.00**
535-14	Phoenix Prime Cotton Seed Meal	Phoenix Cotton Oil Co. Dyersburg, Tenn.	42.88	7.89	9.35
			38.62	**7.00**	**10.00**
535-14	Phoenix Prime Cotton Seed Meal	Phoenix Cotton Oil Co. Dyersburg, Tenn.	41.97	7.58	9.40
			38.62	**7.00**	**10.00**
1307-13	Prime Cotton Seed Meal	Tennessee Cotton Oil Co. Memphis, Tenn.	40.56	8.60	9.90
			38.62	**8.00**	**14.00**
4-14	Prime Cotton Seed Meal	Tennessee Cotton Oil Co. Memphis. Tenn.	39.81	9.32	10.13
			32.62	**8.00**	**14.00**
4-14	Prime Cotton Seed Meal	Tennessee Cotton Oil Co. Memphis, Tenn.	38.72	7.73	9.98
			38.62	**8.00**	**14.00**
4-14	Prime Cotton Seed Meal	Tennessee Cotton Oil Co. Memphis, Tenn.	38.60	8.35	11.48
			38.62	**8.00**	**14.00**
	Cotton Seed Feed.				
581-12	"Creamo Brand" Cotton Seed Feed	Tennessee Fiber Co. Memphis, Tenn.	20.56	4.18	23.15
			20.00	**5.00**	**20.00**
581-12	"Creamo Brand" Cotton Seed Feed	Tennessee Fiber Co. Memphis, Tenn.	23.50	4.42	21.55
			20.00	**5.00**	**20.00**
702-13	"Creamo Brand" Cotton Seed Feed	Tennessee Fiber Co. Memphis, Tenn.	22.28	4.90	23.10
			20.00	**4.50**	**22.00**
702-13	"Creamo Brand" Cotton Seed Feed	Tennessee Fiber Co. Memphis, Tenn.	23.19	4.90	22.58
			20.00	**4.50**	**22.00**
	Oil Meal.				
468-8	Linseed Oil Meal	American Linseed Co. Cincinnati, O.	35.94	7.42	8.13
			32.36	**5.00**	**11.00**
608-11	Oil Meal	The Dorsel Co. Newport, Ky.	33.03	7.15	9.10
			32.00	**6.39**	------

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
942-12	Dickinson Bros. Glasgow, Ky.	Decorticated Cotton Seed.	
52-13	E. F. Spears & Sons Paris, Ky.	Cotton Seed.	
52-13	E. F. Spears & Sons Paris, Ky.	Cotton Seed.	
52-13	Park City Feed Store Bowling Green, Ky.	Cotton Seed.	Sample contains large amount of lint.
52-13	R. B. Hutchcraft Paris, Ky.	Cotton Seed.	
610-I2	W. S. Ellison Hickman, Ky.	Decorticated Cotton Seed.	Sample is choice meal.
1420-13	W. T. Grissom Hickman, Ky.	Decorticated Cotton Seed.	
239-12	John A. Latta Water Valley, Ky.	Cotton Seed	Below guaranty in fat and above in fiber.
239-12	W. A. Terry Fulton, Ky.	Cotton Seed	Below guaranty in fat and above in fiber.
1388-13	Illinois Coal & Feed Co. Paducah, Ky.	Cotton Seed	Sample is choice meal.
535-14	E. M. Gish Central City, Ky.	Cotton Seed	Sample is choice meal.
535-14	Charles Noonon Fulton, Ky.	Cotton Seed	Sample is choice meal.
1307-13	S. C. Evans & Co. Nicholasville, Ky.	Cotton Seed	
4-14	Jonas & Sim Weil Lexington, Ky,	Cotton Seed	
4-14	Jonas & Sim Weil Lexington, Ky.	Cotton Seed	
4-14	Jonas & Sim Weil Lexington, Ky.	Cotton Seed	
581-12	S. C. Jennings Co. Madisonville, Ky.	Choice Cotton Seed Meal, Cotton Seed Hulls 50%.	Below guaranty in fat and contains excess of fiber.
581-12	Bowling Green Milling Co. Bowling Green, Ky.	Choice Cotton Seed Meal, Cotton Seed Hulls 50%.	
702-13	Forbes Manufacturing Co. Hopkinsville, Ky.	Choice Cotton Seed Meal, Cotton Seed Hulls 50%.	
702-13	W. E. Ellis Hartford, Ky.	Choice Cotton Seed Meal, Cotton Seed Hulls 50%.	
468-8	Staggs Bros. Vanceburg, Ky.	Flax Seed	
608-11	Fred Schuerman Newport, Ky.	Flax Seed	

TABLE I.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED.	MANUFACTURER.	Analysis. Prot.	Fat.	Fiber.
402-14	"We Kno" Oil Meal	Oscar Farmer & Sons. Louisville, Ky.	33.31 **32.81**	8.08 **7.83**	8.33 **9.00**
439-13	"We Kno" Oil Meal	Oscar Farmer & Sons Louisville, Ky.	37.13 **32.81**	6.21 **7.83**	7.80 **9.00**
1080-11	Old Process Oil Meal	The Guy G. Major Co. Toledo, Ohio.	30.31 **30.00**	7.75 **5.00**	8.88 **10.00**
358-13	Old Process Oil Meal	Metzger Seed & Oil Co. Toledo, Ohio,	34.63 **30.00**	6.35 **5.00**	8.45 **10.00**
1029-10	Oil Meal	Reidling & Bro. Louisville, Ky.	33.56 **36.38**	7.50 **5.74**	------ ------
1215-I1	Old Process Linseed Ground Cake	W. H. Small & Co. Evansville, Ind.	31.31 **32.00**	10.13 **6.00**	8.23 ------
	Rolled Oats.				
733-12	Dodd's Rolled Oats	C. P. Dodd & Co. Louisville, Ky.	13.19 **12.00**	5.10 **4.20**	------ ------
95-13	Dodd's Rolled Oats	C. P. Dodd & Co. Louisville, Ky.	12.63 **12.00**	4.23 **4.20**	10.50 ------
	Rye Feed.				
1441-13	Rye Feed	Nordmeyer & Berding. Covington, Ky.	11.31 **17.56**	1.83 **3.06**	2.28 **4.60**
	Wheat Bran.				
393-13	Wheat Bran	Acme Milling Co. Hopkinsville, Ky.	14.31 **14.50**	4.20 **4.00**	10.63 **9.50**
393-13	Wheat Bran	Acme Milling Co. Hopkinsville, Ky.	15.50 **14.50**	3.48 **4.00**	------ **9.50**
584-8	Wheat Bran	Adams Bros. Cobb, Ky.	13.75 **15.72**	4.15 **4.62**	4.40 ------
50-12	Bran	The Ansted & Burk Co. Springfield, Ohio.	14.66 **14.00**	4.38 **3.00**	10.63 **11.50**
401-13	Ballard's Bran	Ballard & Ballard Co. Louisville, Ky.	15.19 **14.50**	4.25 **4.10**	9.42 **9.00**
44-13	Eclipse Bran	Binns Milling Co. Herndon, Ky.	16.69 **15.25**	4.98 **4.10**	7.93 ------
10-12	Bran	C. H. Brown. Island, Ky.	16.38 **15.25**	3.93 **4.07**	6.43 ------
-------	Lyon Bran	Buffalo Roller Mills. Buffalo, Ky.	14.81 **15.12**	4.27 **3.92**	------ ------
809-11	Bran	Clarkson Milling Co. Clarkson, Ky.	15.94 **14.84**	4.27 **5.18**	------ ------
751-12	Wheat Bran	College Mill Co. Franklin, Ky.	15.81 **15.56**	4.70 **4.68**	------ **7.50**
751-12	Wheat Bran	College Mill Co. Franklin, Ky.	15.47 **15.56**	4.25 **4.68**	------ **7.50**
831-13	Wheat Bran	College Mill Co. Franklin, Ky.	14.00 **15.56**	4.48 **4.60**	8.03 **7.50**
1145-13	Wheat Bran	H. C. Crouse. Hardin, Ky.	15.91 **15.70**	3.75 **4.07**	6.50 **9.12**

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
402-14	Ehrler Bros. Louisville, Ky.	Flax Seed	
439-13	Eminence Milling Co. Eminence, Ky.	Flax Seed	Below guaranty in fat.
1080-11	E. M. Gish Central City, Ky.	Flax Seed	
358-13	Hiner & Gardner Vanceburg, Ky.	Flax Seed	
1029-10	H. G. Brooks & Co. Louisville, Ky.	Flax Seed	Below guaranty in protein.
1215-11	Weaverton Feed Co. Henderson, Ky.	Flax Seed	Below guaranty in protein.
733-12	H. G. Brooks & Co. Louisville, Ky.	Oats	
95-13	Henry Stanton Louisville, Ky.	Oats	
1441-13	Galloway Grocery Co. Pineville, Ky.	Rye	Below guaranty in both protein and fat.
393-13	F. A. Yost Co. Hopkinsville, Ky.	Wheat	Small per cent of screenings present.
393-13	George Bradley. Hopkinsville, Ky.	Wheat	Below guaranty in fat.
584-8	Manufacturer's Warehouse.	Wheat	Below guaranty in both protein and fat.
50-12	J. F. Thompson. Berry, Ky.	Wheat	Sample contains wheat screenings.
401-13	Henry S. Beyes. Louisville, Ky.	Wheat	
44-13	Forbes Mfg. Co. Hopkinsville. Ky.	Wheat	
10-12	Manufacturer's Warehouse	Wheat	
-------	Manufacturer's Warehouse	Wheat	
809-11	Manufacturer's Warehouse	Wheat	Below guaranty in fat.
751-12	S. F. Clark. Auburn, Ky.	Wheat	Sample is shipstuff.
751-12	Hurt & Co. Auburn, Ky.	Wheat	Sample is shipstuff.
831-13	Manufacturer's Warehouse	Wheat	Shipstuff containing small per cent of screenings. Below guaranty in protein.
1145-13	Manufacturer's Warehouse	Wheat	Sample is shipstuff.

TABLE I.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
92-6	Bran	Eagle Milling Co.	14.85	3.73	------
		Eagle Mills, Ky.	**15.00**	**4.50**	------
975-13	Bran	Eagle Roller Mills Co.	16.50	5.22	------
		New Ulm, Minn.	**15.60**	**3.70**	**12.24**
958-13	Pure Wheat Bran and Screenings	Eagle Roller Mills Co.	16.81	4.67	------
		New Ulm, Minn.	**14.00**	**3.00**	------
182-12	Bran	Eberts & Bro.	14.91	3.56	------
		Louisville, Ky.	**14.12**	**3.95**	**8.00**
1186-12	Moo Bran	Equity Mills	15.38	3.60	------
		Morgantown, Ky.	**15.70**	**4.07**	------
1175-12	Wheat Bran	Exchange Milling Co.	15.31	2.94	------
		Sturgis, Ky.	**15.20**	**4.00**	------
880-13	Wheat Bran and Wheat Screenings	Exchange Milling Co.	15.44	4.18	6.10
		Sturgis, Ky.	**15.17**	**4.07**	------
1102-13	Wheat Bran	Farmers' Milling Co.	15.94	4.20	7.38
		Beaver Dam, Ky.	**13.88**	**3.44**	------
694-13	Pure Bran	Henry Fruechtenicht	15.75	4.90	------
		Louisville, Ky.	**14.50**	**4.00**	**9.50**
10-12	Bran	Martin Gish	15.28	3.63	------
		Bremen, Ky.	**15.25**	**4.07**	------
1132-11	Wheat Bran	Grimes Milling Co.	14.06	3.53	------
		Leavenworth, Ind.	**14.00**	**3.50**	------
1121-13	Wheat Bran and Screenings	Kansas Flour Mills Co.	15.28	4.15	10.25
		Kansas City, Mo.	**14.70**	**4.45**	**10.00**
1052-13	Bran and Screenings	The Kaw Milling Co.	15.53	4.33	9.07
		Topeka, Kansas	**17.00**	**4.05**	**9.63**
295-8	Wheat Bran	W. C. Kendall	15.85	3.69	------
		Berry, Ky.	**16.18**	**3.85**	------
295-8	Wheat Bran	W. C. Kendall	15.69	4.96	7.40
		Berry, Ky.	**16.18**	**3.85**	------
721-12	Bran	Leitchfield Milling Co.	16.13	4.43	9.28
		Leitchfield, Ky.	**15.00**	**4.23**	------
30-13	Bran	Lycan Brothers	16.00	3.80	------
		Lafayette, Ky.	**13.93**	**4.03**	------
549-10	Bran	Marion Milling Co.	16.19	4.73	------
		Marion, Ky.	**15.30**	**4.20**	------
496-13	Wheat Bran and Screenings	McKenzie Milling Co.	16.44	4.20	9.50
		McKenzie, Tenn.	**15.81**	**4.32**	**6.67**
1111-12	Wheat Bran	J. Hill Morgan	16.85	4.05	------
		Gracey, Ky.	**15.75**	**3.26**	------
1384-13	Noblesville Wheat Bran and Screenings	Noblesville Milling Co.	16.56	4.33	9.30
		Noblesville, Ind.	**14.00**	**3.70**	**8.00**
526-12	Bran	Nordmeyer & Berding	17.13	3.88	------
		Covington, Ky.	**14.19**	**3.65**	------
526-12	Bran	Nordmeyer & Berding	15.13	3.73	8.75
		Covington, Ky.	**14.19**	**3.65**	------
566-12	Wheat Bran	Orndorff, Russell & Co.	14.88	4.90	------
		Adairville, Ky.	**15.06**	**4.89**	------
531-13	Wheat Bran	Orndorff, Russell & Co.	14.81	4.80	6.00
		Adairville, Ky.	**15.06**	**4.89**	------
805-8	Wheat Bran	J. H. Roark	15.94	3.98	------
		Price's Mill, Ky.	**15.00**	**4.00**	------

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No,	NAME OF FEED	INGREDIENTS GUARANTEED,	REMARKS—VARIANCE FROM GUARANTY.
92-6	Manufacturer's Warehouse	Wheat	
975-13	Rogers & Hughes Co. Central City, Ky.	Wheat	
958-13	Rogers & Hughes Co. Central City, Ky.	Wheat, Ground Screenings 4%	
182-12	F. A. Ratterman. Louisville, Ky.	Wheat	
1186-12	Manufacturer's Warehouse	Wheat	Sample is shipstuff.
1175-12	C. E. Bradburn. Sturgis, Ky.	Wheat	Screenings and Corn Bran. Below guaranty in fat.
880-13	Manufacturer's Warehouse	Wheat Bran, Ground Wheat Screenings 4%	
1102-13	Manufacturer's Warehouse	Wheat	
694-13	H. J. Grieve. Louisville, Ky.	Wheat	
10-12	Manufacturer's Warehouse	Wheat	Sample is Shipstuff.
1132-11	Wm. P. Miller. Louisville, Ky.	Wheat	Shipstuff containing small per cent of corn bran and screenings.
1121-13	Thomas and Parker. Murray, Ky.	Wheat Bran, Ground Wheat Screenings 10%	
1052-13	A. B. Beale & Son. Murray, Ky.	Wheat Bran, Unground Wheat Screenings 1%	Below guaranty in protein.
295-8	Manufacturer's Warehouse	Wheat	Below guaranty in protein.
295-8	Manufacturer's Warehouse	Wheat	Below guaranty in protein.
721-12	Manufacturer's Warehouse	Wheat	
30-13	George Bradley. Hopkinsville, Ky.	Wheet	
549-10	Manufacturer's Warehouse	Wheat, Wheat Screenings 2%.	
496-13	Nat Gibbs & Son. Murray, Ky.	Wheat Bran, Unground Wheat Screenings 1%	More than one per cent screenings present.
1111-12	Julian Atwood. Cadiz, Ky.	Wheat	
1384-13	J. W. Webb & Son. Vanceburg, Ky.	Wheat Bran, Ground Wheat Screenings 7%	
526-12	Ben Fryer & Son. Butler, Ky.	Wheat	Sample is shipstuff.
526-12	H. Riesenberg. Newport, Ky.	Wheat	
566-12	Manufacturer's Warehouse	Wheat	Sample is shipstuff.
531-13	Manufacturer's Warehouse	Wheat	Sample is shipstuff.
805-8	Manufacturer's Warehouse	Wheat	

TABLE I.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis. Prot.	Fat.	Fiber.
805-8	Wheat Bran	J. H. Roark	14.78	4.28	5.95
		Price's Mill, Ky.	**15.00**	**4.00**	------
83-14	Cream Bran	Roszell Bros.	16.85	4.38	9.10
		Lexington, Ky.	**14.50**	**4.10**	**9.00**
749-12	Wheat Bran	Russellville Milling Co.	16.72	3.70	------
		Russellville, Ky.	**15.70**	**4.07**	------
1171-13	Wheat Bran	Russellville Milling Co.,	14.44	4.33	5.73
		Russellville, Ky.	**15.70**	**4.07**	------
1268-12	Wheat Bran and Screenings	D. E. Stahl & Son	16.38	4.38	------
		Barlow, Ky.	**12.35**	**4.03**	------
239-11	Bran	Standard Hay & Grain Co.	17.75	4.35	------
		Cincinnati, Ohio.	**15.12**	**4.55**	------
1244-12	Pure Winter Wheat Bran	Stanard-Tilton Co.	18.72	4.28	------
		St. Louis, Mo.	**14.50**	**4.00**	**9.50**
1244-12	Pure Winter Wheat Bran	Stanard-Tilton Co.	17.66	4.62	------
		St. Louis, Mo.	**14.50**	**4.00**	**9.50**
620-10	"Starbran"	Star & Crescent Milling Co.	16.44	5.53	------
		Chicago, Ill.	**14.50**	**4.00**	**11.00**
554-13	Wheat Bran	R. W. Thompson	15.85	3.83	4.70
		Water Valley, Ky.	**15.88**	**4.72**	------
953-12	Bran	Trimble Milling Co.	14.75	3.54	------
		Milton, Ky.	**14.06**	**5.83**	------
1015-11	Bran	The Van Leunen Co.	15.68	3.50	------
		Covington, Ky.	**14.19**	**3.65**	------
134-13	Pure Bran	Washburn-Crosby Mill'g Co.	15.31	5.13	------
		Louisville, Ky.	**14.50**	**4.00**	**9.50**
394-12	Wheat Bran	V. C. Wells	15.85	4.11	5.87
		Viola, Ky.	**15.20**	**4.07**	------
558-10	Wheat Bran	Wheelersburg Milling Co.	14.38	4.63	9.05
		Wheelersburg, Ohio.	**15.14**	**4.29**	------
1325-12	Bran	The Williamson Milling Co.	17.56	4.48	8.98
		Clay Center, Kan.	**15.50**	**3.50**	**12.00**
251-13	Bran	Ziliak & Schafer Milling Co.	15.41	3.60	9.25
		Evansville, Ind.	**14.50**	**2.65**	------
	Shorts or Standard Middlings.				
218-14	Acme Middlings and Screenings	Acme-Evans Co.	15.19	3.58	4.58
		Indianapolis, Ind.	**16.50**	**4.50**	**8.00**
239-14	Pure Winter Wheat Shorts	Akin-Erskine Milling Co.	15.72	4.08	5.98
		Evansville, Ind.	**16.30**	**4.50**	**3.90**
329-13	Trojan Middlings	The Allen & Wheeler Co.	16.88	4.97	5.93
		Troy, Ohio.	**15.00**	**4.00**	**6.00**
191-13	William Tell Middlings	The Ansted & Burk Co.	16.85	5.11	6.30
		Springfield, Ohio.	**14.50**	**4.00**	**7.50**
191-13	William Tell Middlings	The Ansted & Burk Co.	16.31	4.78	6.38
		Springfield, Ohio.	**14.50**	**4.00**	**7.00**
1195-13	Shorts	Arlington Roller Mills Co.	17.35	5.78	3.50
		Arlington, Ky.	**16.13**	**4.75**	**6.50**

Analyses of Inspectors' Samples.

Reg. No.	Sample taken from	Ingredients guaranteed.	Remarks—Variance from guaranty.
805-8	Manufacturer's Warehouse	Wheat	Sample is shipstuff.
83-14	J. H. Hanley & Bro. Lexington, Ky.	Wheat	
749-12	Manufacturer's Warehouse	Wheat	Sample is shipstuff.
1171-13	Manufacturer's Warehouse	Wheat	Sample is Shipstuff. Below in protein.
1268-12	A. T. Whitnel La Center, Ky.	Wheat	Sample is shipstuff and corn bran.
239-11	Kenton Hay & Grain Co. Latonia, Ky.	Wheat	
1244-12	Chris. Miller's Sons Louisville, Ky.	Wheat	
1244-12	Lamb & Perry Princeton, Ky.	Wheat	
620-10	H. G. Holcamp Louisville, Ky.	Wheat	
554-13	Manufacturer's Warehouse	Wheat	Below guaranty in fat.
953-12	Manufacturer's Warehouse	Wheat products	Sample contains screenings
1015-11	Manufacturer's Warehouse	Wheat product	
134-13	Conrad J. Clausen Louisville, Ky.	Wheat bran	
394-12	Morgan Bros. Viola, Ky.	Wheat	Sample is shipstuff.
558-10	J. W. Webb & Son Vanceburg, Ky.	Wheat	Sample contains corn bran. Below guaranty in protein.
1325-12	R. K. M. Flour Co., Inc. Livingston, Ky.	Wheat	
251-13	W. E. Ellis Hartford, Ky.	Wheat	
218-14	Tabor & James Olive Hill, Ky.	Wheat middlings, ground wheat screenings 10%.	Below guaranty in both protein and fat.
239-14	Bush & Bush Ashland, Ky.	Wheat shorts	Below guaranty in both protein and fat and above in fiber.
329-13	J. W. Creech E. Bernstadt, Ky.	Wheat	
191-13	W. H. Fischer Flemingsburg, Ky.	Wheat	
191-13	J. F. Thompson Berry, Ky.	Wheat	
1195-13	Manufacturer's Warehouse	Wheat	

TABLE I.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
630-13	Middlings	Ashland Milling Co.	16.31	4.63	5.03
		Ashland, Ky.	**16.81**	**4.07**	------
73-13	Shorts	The Auburn Mills	16.94	4.83	------
		Auburn, Ky.	**16.03**	**3.98**	------
802-14	Middlings and Screenings	E. I. Bailey	17.06	6.15	6.18
		Cleveland, Ohio	**14.69**	**3.13**	**5.97**
1063-13	Kentucky Farm Feed	Ballard & Ballard Co.	15.00	3.75	------
		Louisville, Ky.	**15.69**	**4.26**	**6.87**
1063-13	Kentucky Farm Feed	Ballard & Ballard Co.	16.13	4.40	6.15
		Louisville, Ky.	**15.69**	**4.26**	**6.87**
479-13	Middlings	Bergenroth Brothers	17.13	4.85	------
		Troy, Ind.	**16.00**	**4.00**	**8.00**
479-13	Middlings	Bergenroth Brothers	15.72	4.80	4.40
		Troy, Ind.	**16.00**	**4.00**	**8.00**
------	Middlings	Big Sandy Milling Co.	17.19	3.76	2.93
		Louisa, Ky.	**15.31**	**3.85**	------
776-8	Shorts	J. V. Bumpus	16.22	5.20	4.50
		West Louisville, Ky.	**16.03**	**4.18**	------
690-14	Wheat Middlings	Cincinnati Grain Co.	15.10	4.35	6.45
		Covington, Ky.	**15.75**	**4.25**	**6.00**
511-13	Wheat Middlings	The Dewey Bros. Co.	18.63	4.73	5.53
		Blanchester, Ohio	**15.00**	**4.00**	**6.00**
41-14	Wheat Middlings and Screenings	B. A. Eckhart Milling Co.	16.44	4.60	6.73
		Chicago, Ill.	**14.00**	**4.00**	**8.00**
596-12	Shorts	Elizabethtown Milling Co.	14.97	4.38	4.03
		Elizabethtown, Ky.	**14.97**	**4.47**	------
1156-12	Middlings	R. L. Galloway	15.31	3.71	------
		Falmouth, Ky.	**15.75**	**4.25**	------
604-13	Middlings	Gwinn Bros. Milling Co.	14.00	4.78	5.90
		Huntington, W. Va.	**13.91**	**3.61**	**4.21**
543-13	Pure Wheat Middlings & Screenings	Igleheart Brothers	18.06	5.85	------
		Evansville, Ind.	**16.67**	**5.53**	**6.24**
543-13	Pure Wheat Middlings & Screenings	Igleheart Brothers	16.19	5.54	6.03
		Evansville, Ind,	**16.67**	**5.53**	**6.24**
56-11	Middlings	George Keller	17.50	5.00	------
		Newport, Ky.	**15.97**	**4.55**	------
296-8	Wheat Middlings	W. C. Kendall	14.94	3.32	------
		Berry, Ky.	**12.97**	**2.57**	------
485-13	Middlings	D. A. Leffingwell & Co.	18.19	5.65	7.35
		Ashland, Ky.	**15.00**	**4.00**	**6.00**
73-14	Middlings	McWhorter & Wells	16.25	5.50	5.06
		Springfield, Ky.	**16.00**	**4.25**	**6.01**
1004-13	Middlings	Millersburg Mills	14.63	3.95	4.95
		Millersburg, Ky.	**15.75**	**4.46**	------
1385-13	Noblesville Middlings & Screenings	Noblesville Milling Co.	17.00	4.95	6.15
		Noblesville, Ind.	**15.00**	**4.00**	**7.00**
525-12	Middlings	Nordmeyer & Berding	18.00	4.69	5.00
		Covington, Ky.	**14.63**	**4.60**	------
102-13	Middlings	R. C. Poage Milling Co.	14.25	3.53	4.63
		Ashland, Ky.	**16.75**	**4.41**	------
1358-13	Standard Middlings	R. C. Poage Milling Co.	16.69	5.71	10.23
		Ashland, Ky.	**15.00**	**4.00**	**6.00**

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
630-13	The Isaac Richmond Co. Prestonsburg, Ky.	Wheat	
73-12	J. P. Summers. Smith's Grove, Ky.	Wheat	
802-14	J. S. Tabor. Olive Hill, Ky.	Middlings, Ground Wheat Screenings 15%.	
1063-13	W. H. Luesing. Louisville, Ky.	Stand'd Wheat Middlings Wheat Screenings 4½%.	Below in both protein and fat.
1063-13	The Corbin Feed Store Corbin, Ky.	Stand'd Wheat Middlings Wheat Screenings 4½%.	
479-13	Geo W. Newman. Hawesville, Ky.	Wheat	
479-13	J. H. Brown. Cloverport, Ky.	Wheat	
-------	Manufacturer's Warehouse	Wheat	
776-8	Manufacturer's Warehouse	Wheat	
690-14	A. Pliemann. Ft. Thomas, Ky.	Wheat	Below guaranty in protein.
511-13	Consolidated Coal Co. Jenkins, Ky.	Wheat	
41-14	Dorsey Bros. & Fisher. Carlisle, Ky.	Wheat Middlings, Ground Wheat Screenings 5%.	
596-12	Manufacturer's Warehouse	Wheat	
1156-12	Manufacturer's Warehouse	Wheat	Below guaranty in fat.
604-13	Noah Vanhoose & Co. Paintsville, Ky.	Wheat	Sample contains corn bran.
543-13	E. & L. Cohen. Greenville, Ky.	Wheat Middlings, Ground Wheat Screenings 10%.	
543-13	The Auburn Mills. Auburn, Ky.	Wheat Middlings, Ground Wheat Screenings 10%.	
56-11	Ruef Bros. Covington, Ky.	Wheat	
296-8	Manufacturer's Warehouse	Wheat	
485-13	Catlettsburg Feed & Produce Co., Catlettsburg, Ky.	Wheat	
73-14	Manufacturer's Warehouse	Wheat	
1004-13	Manufacturer's Warehouse	Wheat Bran, Middlings	Sample is shipstuff. Below guar. in both protein and fat
1385-13	J. W. Webb & Son. Vanceburg, Ky.	Wheat Middlings, Ground Wheat Screenings 7%.	
525-12	H. Riesenberg. Newport, Ky.	Wheat	
102-13	J. S. Tabor. Olive Hill, Ky.	Wheat	Below guaranty in both protein and fat.
1358-13	J. S. Tabor. Olive Hill, Ky.	Wheat	

TABLE I.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis. Prot.	Fat.	Fiber.
238-11	Middlings	Standard Hay & Grain Co.	18.91	4.20	------
		Cincinnati, Ohio.	**14.87**	**4.10**	------
1245-12	Pure Winter Wheat Shorts	Stanard-Tilton Milling Co.	18.25	4.80	------
		St. Louis, Mo.	**15.00**	**4.00**	**6.00**
746-11	Steven's Middlings	J. S. Stevens & Co.	16.35	4.04	4.30
		Ashland, Ky.	**16.06**	**5.86**	------
577-13	Middlings	Tell City Flour Mills	16.10	4.30	------
		Tell City, Ind.	**14.75**	**4.50**	**8.00**
546-13	Middlings	Tell City Flour Mills	17.44	5.05	7.30
		Tell City, Ind.	**14.50**	**4.00**	**8.00**
1013-11	Middlings	The Van Leunen Co.	18.56	5.10	------
		Covington, Ky.	**15.81**	**4.65**	------
146-13	Anchor Wheat Middlings	A. Waller & Co.	18.03	6.15	3.75
		Corydon, Ky.	**16.00**	**4.00**	**6.00**
218-12	Pure Shorts	Washburn-Crosby Milling	17.31	4.48	------
		Co., Louisville, Ky.	**15.00**	**4.00**	**7.00**
I35-13	Pure Shorts	Washburn-Crosby Milling	16.50	5.28	------
		Co., Louisville, Ky.	**15.00**	**4.00**	**7.00**
135-13	Pure Shorts	Washburn-Crosby Milling	16.25	5.13	------
		Co., Louisville, Ky.	**15.00**	**4.00**	**7.00**
	Shipstuff or Mixed Wheat Feed.				
394-13	Shipstuff	The Acme Milling Co.	15.69	4.15	------
		Hopkinsville, Ky.	**15.00**	**4.25**	**8.50**
141-13	Acme Feed	Acme-Evans Co.	16.06	4.59	8.64
		Indianapolis, Ind.	**16.50**	**4.00**	**9.00**
141-13	Acme Feed	Acme-Evans Co.	15.75	4.40	8.15
		Indianapolis, Ind.	**16.50**	**4.00**	**9.00**
18-12	Shipstuff	Adams & Langford	15.16	4.15	------
		Harrodsburg, Ky.	**15.60**	**4.42**	------
18-12	Shipstuff	Adams & Langford	16.31	4.14	5.85
		Harrodsburg, Ky.	**15.60**	**4.42**	------
240-14	Mixed Wheat Feed & Screenings	Akin-Erskine Milling Co.	14.75	4.10	7.48
		Evansville, Ind.	**16.72**	**4.01**	**8.20**
385-9	Shipstuff	Albright & Sons	15.78	4.78	5.83
		Elgin, Ky.	**15.50**	**4.00**	------
54-12	Trojan Mixed Wheat Feed	The Allen & Wheeler Co.	15.38	3.88	------
		Troy, Ohio.	**14.50**	**4.00**	**8.00**
328-13	Trojan Mixed Wheat Feed	The Allen & Wheeler Co.	16.50	4.80	8.15
		Troy, Ohio.	**14.50**	**4.00**	**8.00**
190-13	William Tell Mixed Wheat Feed	The Ansted & Burk Co.	16.25	4.48	8.10
		Springfield, Ohio.	**14.50**	**3.50**	**11.50**
190-13	William Tell Mixed Wheat Feed	The Ansted & Burk Co.	15.97	4.00	7.58
		Springfield, Ohio.	**14.50**	**3.50**	**11.50**
190-13	William Tell Mixed Wheat Feed	The Ansted & Burk Co.	15.88	4.65	8.28
		Springfield, Ohio.	**14.50**	**3.50**	**11.50**
1107-13	Shipstuff	Augusta Milling Co.	15.75	4.83	8.68
		Augusta, Ky.	**15.31**	**3.45**	------
1107-13	Shipstuff	Augusta Milling Co.	16.13	3.58	5.40
		Augusta, Ky.	**15.31**	**3.45**	------
1107-13	Shipstuff	Augusta Milling Co.	15.85	4.55	8.35
		Augusta, Ky.	**15.31**	**3.45**	------

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
238-11	Kenton Hay & Grain Co. ---- Latonia, Ky.	Wheat ----------	Sample contains screenings.
1245-12	Lamb & Perry ---------- Princeton, Ky.	Wheat ----------	
746-11	Manufacturer's Warehouse--	Wheat ----------	Below guaranty in fat.
577-13	W. C. Kelly ---------- Hawesville, Ky.	Wheat ----------	
546-13	A. D. Ashcraft---------- Irvington, Ky.	Wheat ----------	
1013-11	Manufacturer's Warehouse--	Wheat ----------	
146-13	Manufacturer's Warehouse--	Wheat ----------	
218-12	W. H. Luesing & Co. -------- Louisville, Ky.	Wheat ----------	
135-13	W. H. Luesing & Co. -------- Louisville, Ky.	Wheat ----------	
135-13	Conrad J. Clausen---------- Louisville, Ky.	Wheat ----------	
394-13	Forbes Manufacturing Co. -- Hopkinsville, Ky.	Wheat Bran, Shorts ---	
141-13	Skillman Feed Co ---------- Owensboro, Ky.	Wheat Bran, Middlings, Ground wheat scgs. 1%.	
141-13	D. C. Edwards ---------- London, Ky.	Wheat Bran, Middlings, Ground wheat scgs. 1%.	Below guaranty in protein.
18-12	Manufacturer's Warehouse--	Wheat Bran, Shorts---	Sample contains corn bran and corn cockle.
18-12	Manufacturer's Warehouse--	Wheat Bran, Shorts---	Sample contains small amount of corn bran.
240-14	Bush & Bush---------- Ashland, Ky	Wheat Bran, Shorts, Ground wheat scgs. 1%.	Below guaranty in protein.
385-9	Manufacturer's Warehouse--	Wheat ----------	Sample contains cockle bran.
54-12	Harlan Wholesale Grocery Co. Harlan, Ky.	Wheat Bran, Wheat Middlings	
328-13	J. W. Creech---------- East Bernstadt, Ky.	Wheat Bran, Middlings	
190-13	W. H. Fischer ---------- Flemingsburg, Ky.	Wheat Bran, Middlings	
190-13	J. F. Thompson ---------- Berry, Ky.	Wheat Bran, Middlings	Sample contains wheat screenings.
190-13	J. C. Everett & Co. --------- Maysville, Ky.	Wheat Bran, Middlings	
1107-13	Manufacturer's Warehouse--	Wheat Bran, Middlings	
1107-13	Manufacturer's Warehouse--	Wheat Bran, Middlings	
1107-13	Mrs. O. P. Miller---------- California, Ky.	Wheat Bran, Middlings	

TABLE I.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
1339-13	Bran and Shipstuff	Baldwin & Austin. Rumsey, Ky.	15.16 **15.13**	3.80 **4.15**	6.31 **8.50**
1278-12	Bran and Shipstuff	Baldwin & Austin. Rumsey, Ky.	15.56 **16.25**	3.55 **4.15**	------ ------
485-14	Ballard's Mixed Wheat Feed and Screenings.	Ballard & Ballard Co. Louisville, Ky.	15.63 **15.09**	4.83 **4.17**	7.50 **7.98**
410-13	Wheat Bran, Shipstuff and Screenings.	Beaver Dam Milling Co. Beaver Dam, Ky.	15.25 **15.62**	3.94 **3.50**	------ ------
140-12	Mt. Carmel Mixed Feed	Bernet, Craft & Kauffman. St. Louis, Mo.	16.69 **14.30**	4.31 **3.55**	------ **9.50**
1373-12	Shipstuff	Big Clifty Milling Co. Big Clifty, Ky.	15.28 **15.45**	3.98 **4.13**	------ ------
186-11	Bull's Eye Mixed Feed	Blish Milling Co. Seymour, Ind.	16.47 **16.00**	4.20 **4.50**	------ **9.10**
913-13	Mixed Wheat Feed and Screenings.	Blish Milling Co. Seymour, Ind.	15.75 **16.00**	4.55 **4.50**	8.33 **8.90**
913-13	Mixed Wheat Feed and Screenings.	Blish Milling Co. Seymour, Ind.	15.63 **16.00**	4.46 **4.50**	8.05 **8.90**
507-12	Pure Wheat Mill Feed and Screenings.	Bloomfield Mill Co. Bloomfield. Ky.	14.94 **16.13**	3.80 **4.33**	------ ------
507-12	Pure Wheat Mill Feed and Screenings.	Bloomfield Mill Co. Bloomfield, Ky.	15.72 **16.13**	4.58 **4.33**	------ ------
138-13	Shipstuff	Blue Grass Milling Co. Campbellsburg, Ky.	15.10 **15.75**	4.00 **4.46**	------ ------
138-13	Shipstuff	Blue Grass Milling Co. Campbellsburg, Ky.	14.38 **15.75**	3.84 **4.46**	6.23 ------
642-13	Shipstuff	V. A. Brock. Sparta, Ky.	13.25 **15.75**	3.08 **4.46**	4.98 ------
1184-12	Shipstuff	Brodhead Roller Mills. Brodhead, Ky.	14.53 **15.87**	3.41 **4.16**	------ ------
421-12	Shipstuff	J. V. Bumpus. West Louisville, Ky.	15.68 **16.03**	4.40 **4.13**	------ ------
668-12	Mixed Wheat Feed	Ashton Bryant. Calhoun, Ky.	15.41 **15.50**	4.67 **4.00**	6.30 ------
668-12	Mixed Wheat Feed	Ashton Bryant. Calhoun, Ky.	16.31 **15.50**	3.80 **4.00**	------ ------
175-12	Shipstuff	Cadick Milling Co. Grand View, Ind.	16.56 **16.44**	6.14 **4.15**	3.38 ------
488-13	Climax	Calhoun Milling Co. Calhoun, Ky.	14.85 **15.02**	3.33 **4.10**	6.41 ------
989-13	Shipstuff	Carlisle Milling Co. Carlisle, Ky.	15.53 **14.41**	4.23 **4.34**	7.20 ------
1174-11	Mixed Wheat Feed	R. A. Carr. Maysville, Ky.	15.50 **16.75**	5.06 **4.74**	7.05 ------
1377-12	Shipstuff	Climax Milling Co. Cynthiana, Ky.	16.75 **16.37**	4.43 **3.83**	6.58 ------
415-14	Mixed Wheat Feed and Screenings.	The Colton Bros. Co. Bellefontaine, O.	15.75 **14.50**	4.58 **4.00**	7.93 **8.00**
25-12	Famous Feed	Corydon Milling Co. Corydon, Ky.	15.81 **16.37**	3.58 **4.90**	------ **8.50**
1346-13	Famous Feed	Corydon Milling Co. Corydon, Ky.	15.35 **15.00**	4.13 **4.00**	7.35 **8.00**

Analyses of Inspectors' Samples.

Reg. No,	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
1339-13	Manufacturer's Warehouse	Wheat Bran, Shipstuff	
1278-12	Manufacturer's Warehouse	Wheat Bran, Shipstuff	
485-14	L. A. Duty. Pikeville, Ky.	Wheat Bran, Wheat Middlings, Ground Wheat Screenings 2¼%	
410-13	J. F. Casebier. Beaver Dam, Ky.	Wheat Bran, Shipstuff, Ground Wheat Screenings 9½%.	Sample contains corn bran.
140-12	Consolidated Coal & Mining Co., Erlanger, Ky.	Wheat Bran, Shorts	
1373-12	Manufacturer's Warehouse	Wheat Bran, Shorts	
186-11	Croley Hardware & Grocery Co., Barbourville, Ky.	Wheat	
913-13	T. A. Porter & Co. London, Ky.	Wheat Bran, Middlings, Ground Wheat Screenings 3%.	
913-13	Wm. P. Miller. Louisville, Ky.	Wheat Bran, Middlings, Ground Wheat Screenings 3%	
507-12	Hart Wallace. Shelbyville, Ky.	Wheat Bran, Wheat Middlings, Wheat Screenings 5%.	Below guaranty in both protein and fat.
507-12	Schramme & Smith. Shelbyville, Ky.	Wheat Bran, Wheat Middlings, Wheat Screenings 5%.	
138-13	Manufacturer's Warehouse	Wheat Bran, Shorts	Below guaranty in both protein and fat.
138-13	Manufacturer's Warehouse	Wheat Bran, Shorts	Below guaranty in both protein and fat.
642-13	Manufacturer's Warehouse	Bran, Middlings, Wheat Germ.	Below guaranty in both protein and fat.
1184-12	Manufacturer's Warehouse	Wheat Bran, Middlings	Below guaranty in both protein and fat.
421-12	Manufacturer's Warehouse	Wheat Bran, Middlings, Shorts.	
668-12	Manufacturer's Warehouse	Wheat Bran, Shorts	
668-12	Manufacturer's Warehouse	Wheat Bran, Shorts	
175-12	J. W. Fontaine. Brandenburg, Ky.	Wheat Bran, Middlings	Sample is shorts.
488-13	Manufacturer's Warehouse	Wheat Bran, Shorts, Unground Wheat Screenings 5%.	Below guaranty in fat.
989-13	Manufacturer's Warehouse	Wheat Bran, Shorts	
1174-11	Manufacturer's Warehouse	Wheat	Below guaranty in fat.
1377-12	Manufacturer's Warehouse	Wheat Bran, Shipstuff	
415-14	Caudill, Blair & Co. Morehead, Ky.	Wheat, Ground Wheat Screenings 5%.	
25-12	Manufacturer's Warehouse	Wheat Bran, Shipstuff, Ground Screenings 3%.	Below guaranty in both protein and fat.
1346-13	Manufacturer's Warehouse	Wheat Bran, Middlings, Shipstuff, Low Grade Flour, Ground Wheat Screenings 5%	

TABLE I.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
367-13	Shipstuff	Crescent Roller Mills	15.38	5.28	7.05
		Taylorsville, Ky.	**15.62**	**3.50**	------
237-13	Mixed Wheat Feed	Doe Run & Brandenburg	15.31	4.43	7.53
		Mill Co., Brandenburg, Ky.	**16.00**	**4.50**	------
1179-13	Shipstuff	Drakesboro Milling Co.	14.56	4.24	6.72
		Drakesboro, Ky.	**15.03**	**4.13**	------
237-13	Mixed Wheat Feed	Doe Run & Brandenburg	15.53	4.70	------
		Mill Co., Brandenburg, Ky.	**16.00**	**4.50**	------
91-6	Shipstuff	Eagle Milling Co.	17.25	5.67	------
		Eagle Mills, Ky.	**16.00**	**4.50**	------
10-13	Shipstuff and Screenings	Eagle Roller Mills	15.13	4.56	8.45
		Lawrenceburg, Ky.	**15.50**	**4.20**	**7.00**
335-13	Mixed Wheat Feed	Eberts & Bro.	15.50	4.47	8.00
		Louisville, Ky.	**15.16**	**4.50**	**6.50**
1060-13	Mixed Wheat Feed & Screenings	B. A. Eckhardt Milling Co.	17.19	4.76	------
		Chicago, Ill.	**15.00**	**4.00**	**6.00**
1429-13	Mixed Wheat Feed & Screenings	B. A. Eckhardt Milling Co.	16.63	5.14	9.18
		Chicago, Ill.	**14.00**	**4.00**	**11.00**
43-14	Mixed Wheat Feed & Screenings	B A. Eckhardt Milling Co.	15.44	4.58	8.60
		Chicago, Ill.	**14.00**	**4.00**	**11.00**
129-12	Mixed Wheat Feed	Farmers & Merchants Mill-	15.19	3.68	------
		ing Co., Brooksville, Ky.	**15.75**	**4.25**	------
267-13	Mixed Wheat Feed	Farmers & Merchants Mill-	15.13	5.05	6.25
		ing Co., Brooksville, Ky.	**15.75**	**4.25**	------
2-12	Shipstuff	Farris Bros.	16.69	4.32	------
		Cave City, Ky.	**16.18**	**3.90**	------
3-13	Mixed Wheat Feed	J. H. Fedders & Sons	16.75	4.44	8.53
		Covington, Ky.	**15.12**	**4.27**	------
1484-12	Shipstuff	Fleanor & Howard	14.13	3.35	5.65
		Morgantown, Ky.	**15.75**	**4.09**	**7.50**
405-13	Shipstuff	J. W. Ford	14.25	3.55	5.80
		Hartford, Ky.	**16.00**	**4.50**	------
842-12	Shipstuff	Frankfort Roller Mills Co.	15.03	3.43	------
		Frankfort, Ky.	**16.03**	**4.13**	------
1079-13	Garland Mixed Wheat Feed	Garland Milling Co.	15.25	4.58	7.43
		Greensburg, Ky.	**16.00**	**4.00**	**9.00**
339-12	Mixed Wheat Feed	Garrard Milling Co.	14.78	4.05	------
		Lancaster, Ky.	**14.50**	**4.38**	------
1109-12	Shipstuff	Germantown Milling Co.	15.88	3.95	------
		Germantown, Ky.	**15.75**	**4.25**	------
1109-12	Shipstuff	Germantown Milling Co.	15.44	4.65	6.69
		Germantown, Ky.	**15.75**	**4.25**	------
998-9	Wheat Feed	Ghent Milling Co.	15.50	6.00	------
		Ghent, Ky.	**16.00**	**3.90**	------
1225-11	Shipstuff	D. W. Gish	15.68	4.75	------
		Sacramento, Ky.	**15.81**	**4.83**	------
766-11	Glencoe Feed	Glencoe Milling Co.	15.50	3.25	------
		Glencoe, Ky.	**15.50**	**4.25**	------
1110-11	Shipstuff	Goodpaster & Scott	14.63	3.97	5.20
		Sherburne, Ky.	**15.50**	**4.20**	------
1110-11	Shipstuff	Goodpaster & Scott	14.60	3.70	5.63
		Sherburne, Ky.	**15.50**	**4.20**	------

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
367-13	Manufacturer's Warehouse	Wheat Bran, Shorts	
237-13	Manufacturer's Warehouse	Wheat Bran, Shorts	Sample contains cockle bran. Below guaranty in protein.
1179-13	Manufacturer's Warehouse	Wheat Bran, Shorts	Sample contains screenings and bran. Below guaranty in protein.
237-13	Manufacturer's Warehouse	Wheat Bran, Shorts	
91-6	Manufacturer's Warehouse	Wheat	
10-13	Manufacturer's Warehouse	Wheat Bran, Middlings, Shorts Ground Wheat Screenings 5%	
335-13	Schrieber Bros. Louisville, Ky.	Wheat Bran, Shipstuff	Sample contains screenings.
1060-13	Rogers & Hughes Co. Central City, Ky.	Wheat Bran, Ground Wheat Screenings 4%	
1429-13	W. J. Lindsey Campbellsville, Ky.	Wheat Bran, Middlings, Ground Wheat Screenings 5%	
43-14	Dorsey Bros. & Fischer Carlisle, Ky.	Wheat Bran, Middlings, Ground Wheat Screenings 5%	
129-12	Manufacturer's Warehouse	Wheat Bran, Middlings	Sample contains screenings. Below guaranty in both protein and fat.
267-13	Manufacturer's Warehouse	Wheat Bran, Middlings, Unground Wheat Screenings 4%	Below guaranty in protein.
2-12	E. T. Ford Cave City, Ky.	Wheat Bran, Middlings	
3-13	Henry Tecker Covington, Ky.	Wheat Bran, Middlings	Sample contains screenings
1484-12	Manufacturer's Warehouse	Wheat Bran, Shorts	Below guaranty in both protein and fat.
405-13	Manufacturer's Warehouse	Wheat Bran, Shorts	Below guaranty in both protein and fat.
842-12	Manufacturer's Warehouse	Wheat Bran, Middlings	Below guaranty in both protein and fat.
1079-13	Sparks & Brown London, Ky.	Wheat Bran, Wheat Middlings Ground Wheat Screenings 5%	Below guaranty in protein.
339-12	E. S. Cockrell Livingston, Ky.	Wheat Bran, Shorts, Ground Wheat Screenings 3%	
1109-12	Manufacturer's Warehouse	Wheat Bran, Shorts, Middlings	
1109-12	Manufacturer's Warehouse	Wheat Bran, Shorts, Middlings	
998-9	Manufacturer's Warehouse	Wheat	
1225-11	Manufacturer's Warehouse	Wheat Bran, Middlings	
766-11	Manufacturer's Warehouse	Wheat	Below guaranty in fat.
1110-11	Manufacturer's Warehouse	Wheat	Below guaranty in protein.
1110-11	I. F. Tabb Mt. Sterling, Ky.	Wheat Bran, Middlings	Below guaranty in both protein and fat.

TABLE I.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
77-13	Mixed Wheat Feed	Greenup Milling Co.	13.88	3.73	7.33
		Greenup, Ky.	**15.50**	**4.20**	
605-13	Mixed Wheat Feed	Gwinn Bros. Milling Co.	14.91	4.70	
		Huntington, W. Va.	**13.78**	**3.96**	**7.64**
605-13	Mixed Wheat Feed	Gwinn Bros. Milling Co.	13.81	3.83	5.00
		Huntington, W. Va.	**13.78**	**3.96**	**7.64**
945-11	Bran and Shipstuff	Hartford Mill Co.	15.06	4.10	
		Hartford, Ky.	**14.68**	**3.20**	
1099-12	Shipstuff	Holmes & Boyd	16.22	4.05	6.88
		Sedalia, Ky.	**14.93**	**3.96**	
1176-13	Bran and Shorts	J. M. Johnson & Son	16.06	3.76	5.83
		Benton, Ky.	**15.06**	**3.93**	**8.50**
1225-11	Shipstuff	Jones & Woodburn	15.06	4.00	5.90
		Sacramento, Ky.	**15.81**	**4.83**	
302-8	Shipstuff	Keeling & Carey	15.06	4.38	
		Tatham Springs, Ky,	**15.31**	**4.09**	
857-13	Mixed Wheat Feed	The Kenton Hay & Grain Co.	16.63	4.43	8.35
		Latonia, Ky.	**15.31**	**4.23**	
478-12	Bran, Shipstuff and Screenings	Kevil Milling Co.	16.06	4.15	
		Kevil, Ky.	**16.00**	**4.00**	
1190-11	Shipstuff	T. W. Knox	14.53	4.78	6.73
		Boyd, Ky.	**15.00**	**2.92**	
577-13	Snowflake Mixed Wheat Feed	Lawrenceburg Roller Mills	16.22	4.45	7.95
		Co., Lawrenceburg, Ind.	**15.20**	**4.30**	**8.00**
1457-13	Shipstuff	Lee & Acton	16.03	4.38	6.85
		Eubank, Ky.	**15.50**	**3.83**	**7.50**
722-12	Shipstuff	Leitchfield Milling Co.	17.66	5.63	5.13
		Leitchfield, Ky.	**16.18**	**5.63**	
514-12	Thoroughbred Feed	Lexington Roller Mills Co.	15.94	4.10	
		Lexington, Ky.	**16.38**	**4.15**	
519-13	Thoroughbred Feed	Lexington Roller Mills Co.	15.91	4.45	7.30
		Lexington, Ky.	**16.38**	**4.15**	**7.09**
465-12	Mixed Wheat Feed	Louisville Cereal Mill Co.	18.81	4.60	
		Louisville, Ky.	**14.00**	**4.00**	**7.50**
50-14	Shipstuff	Mayhew Milling Co.	15.63	4.35	6.28
		Owensboro, Ky.	**16.00**	**4.05**	**6.20**
1247-13	Shipstuff	McDaniel & Armes	14.56	4.08	5.43
		Olaton, Ky.	**15.65**	**4.01**	
1152-13	Mixed Wheat Feed	McQuady Milling Co.	15.38	3.98	5.26
		McQuady, Ky.	**16.00**	**4.00**	
620-12	Cream Mixed Wheat Feed	R. H. Menefee & Co.	16.31	4.08	
		Louisville, Ky.	**15.80**	**4.70**	
348-13	Cream Mixed Wheat Feed	R. H. Menefee & Co.	15.63	4.33	8.38
		Louisville, Ky.	**16.00**	**4.50**	**8.90**
877-9	Shipstuff	Milford Mills	15.56	4.23	
		Milford, Ky.	**15.50**	**4.20**	
877-9	Shipstuff	Milford Mills	13.06	3.60	4.23
		Milford, Ky.	**15.50**	**4.20**	
1178-12	Shipstuff	T. J. Miller	15.13	3.52	
		Willisburg, Ky.	**15.50**	**4.00**	
947-9	Shipstuff	Moss Milling Co.	15.06	4.50	6.68
		Greensburg, Ky.	**15.75**	**4.46**	

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
77-13	D. J. Burchett, Jr. Louisa, Ky.	Wheat Bran, Shorts	Below guaranty in protein.
605-13	H. H. Fitzpatrick Prestonburg, Ky.	Wheat Bran, Middlings	
605-13	Noah Vanhoose & Co. Paintsville, Ky.	Wheat Bran, Middlings	
945-11	Manufacturer's Warehouse	Wheat	
1099-12	Manufacturer's Warehouse	Wheat Bran, Middlings	Sample contains screenings.
1176-13	Manufacturer's Warehouse	Bran, Shorts	
1225-11	Manufacturer's Warehouse	Wheat Bran, Middlings	Below guaranty in protein.
302-8	Manufacturer's Warehouse	Wheat	Small per ct. of corn cockle and screenings present.
857-13	August Kramer Ft. Thomas. Ky.	Wheat Bran, Shorts	
478-12	Manufacturer's Warehouse	Wheat Bran. Shipstuff, Wheat Screenings 5%	
1190-11	Manufacturer's Warehouse	Wheat Bran, Middlings	
577-13	J. C. Everett & Co. Maysville. Ky.	Wheat Bran, Middlings	
1457-13	Manufacturer's Warehouse	Wheat Bran, Shorts	
722-12	Manufacturer's Warehouse	Wheat Bran, Shorts	
514-12	Floyd Day & Co. Jackson, Ky.	Wheat Bran, Wheat Middlings.	
519-13	Kentucky Block Cannel Coal Co., Cannel City, Ky.	Wheat Bran, Wheat Middlings.	
465-12	Wm. P. Miller Louisville, Ky.	Wheat Bran, Middlings	Sample contains weed seeds and screenings.
50-14	L. E. Chapman Owensboro, Ky.	Wheat Bran, Shorts	
1247-13	B. F. Wallace Fordsville, Ky.	Wheat Bran, Middlings	Below guaranty in protein. Contains corn bran.
1152-13	J. H. Roberts Fordsville, Ky.	Wheat Bran, Shipstuff	Below guaranty in protein.
620-12	Henry S. Beyer Louisville, Ky.	Wheat Bran, Wheat Middlings.	Below guaranty in protein.
348-13	B. W. Wright Frankfort, Ky	Wheat Bran, Wheat Middlings.	
877-9	Manufacturer's Warehouse	Wheat	
877-9	Manufacturer's Warehouse	Wheat	Below guaranty in both protein and fat.
1178-12	Manufacturer's Warehouse	Wheat Bran, Middlings	
947-9	Manufacturer's Warehouse	Wheat	Below guaranty in protein.

TABLE I.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot	Fat	Fiber
360-13	Shipstuff	Murray Milling Co.	14.97	4.60	7.44
		Murray, Ky.	**15.00**	**4.00**	------
1383-13	Noblesville Mixed Wheat Feed	Noblesville Milling Co.	16.63	4.69	7.73
		Noblesville, Ind.	**16.00**	**4.00**	**8.00**
881-12	Shipstuff	Nolin Milling Co.	15.94	4.30	------
		Nolin, Ky.	**15.00**	**4.50**	------
455-13	Shipstuff	Nolin Milling Co.	14.66	5.04	8.28
		Nolin, Ky.	**15.00**	**4.50**	------
455-13	Shipstuff	Nolin Milling Co.	16.31	4.46	6.70
		Nolin, Ky.	**15.00**	**4.50**	------
497-14	Mixed Wheat Feed	Nordmeyer & Berding	15.81	4.20	7.33
		Covington, Ky.	**15.93**	**4.13**	**8.25**
943-13	Midget Mill Feed	Parks & Abrams.	14.69	5.60	7.13
		Richmond, Ky.	**13.56**	**3.64**	------
586-11	Mixed Feed	I. E. Payne.	13.13	2.48	4.30
		Eubank, Ky.	**13.38**	**2.05**	------
1154-13	Shipstuff	I. E. Payne.	15.13	3.79	5.33
		Eubank, Ky.	**14.97**	**3.56**	------
1387-13	Mixed Wheat Feed	W. A. Peay	14.94	4.05	6.70
		Livermore, Ky.	**15.50**	**4.00**	------
1180-12	Ideal Wheat Feed	T. S. Penn	16.25	4.50	------
		Kevil, Ky.	**15.66**	**4.57**	------
1143-13	Ideal Wheat Feed	T. S. Penn.	16.72	4.77	7.50
		Kevil, Ky.	**16.25**	**4.50**	**7.50**
909-11	Mixed Feed	Perin Bros.	16.19	4.27	7.00
		Cincinnati, Ohio.	**15.38**	**4.09**	------
644-10	Shipstuff	Philpot Mills.	17.06	4.28	------
		Philpot, Ky.	**16.00**	**4.50**	------
804-14	Shipstuff	Rapier Grain & Seed Co.	15.81	4.43	7.98
		Owensboro, Ky.	**16.91**	**4.76**	**7.73**
87-8	Mixed Feed	John Riddle & Sons	14.56	3.83	7.38
		Walnut Grove, Ky.	**14.75**	**4.19**	------
942-12	Mixed Wheat Feed	Riedling & Bro.	18.35	4.29	------
		Louisville, Ky.	**14.50**	**4.00**	------
1173-13	Shipstuff	J. M. Riley.	15.56	4.08	6.95
		Williamstown, Ky.	**15.31**	**3.82**	------
1144-13	Peerless Feed	L. W. Riley & Son.	15.78	4.30	6.95
		Mayfield, Ky.	**16.18**	**4.08**	------
1137-11	Shipstuff	W. T. Ritter.	14.75	3.30	------
		London, Ky.	**16.03**	**4.13**	------
921-12	Shipstuff	W. T. Ritter.	14.16	3.25	------
		London, Ky.	**16.03**	**4.13**	------
18-11	Shipstuff	Robertson Milling Co.	15.28	2.85	------
		Cynthiana, Ky.	**15.81**	**3.80**	------
661-12	Shipstuff	Rocky Hill Roller Mills	17.25	4.50	------
		Rocky Hill Station, Ky.	**15.03**	**4.56**	------
367-12	Shipstuff	W. O. Rouse & Co.	16.35	3.42	------
		Walton, Ky.	**15.12**	**3.77**	------
273-9	Shipstuff	Sardis Milling Co.	15.88	4.18	7.98
		Sardis, Ky.	**15.00**	**4.00**	------
564-12	Bostain's Shipstuff and Screenings	Sharpsburg Roller Mills.	14.38	3.43	------
		Sharpsburg, Ky.	**14.63**	**3.91**	------

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED	REMARKS—VARIANCE FROM GUARANTY
360-13	Manufacturer's Warehouse	Wheat bran, Middlings	
1383-13	J. W. Webb & Son. Vanceburg, Ky.	Wheat Bran, Middlings, Ground Wheat Screenings 7%.	
881-12	Watkins & Co. Elizabethtown, Ky.	Wheat Bran, Shorts	
455-13	Watkins & Co. Elizabethtown, Ky.	Wheat Bran, Shorts	
455-13	Pineville Feed & Grain Co. Pineville, Ky.	Wheat Bran, Shorts	
497-14	Ben Fryer & Son. Butler, Ky.	Wheat Bran, Middlings	Contains large per cent of corn bran.
943-13	C. A. Flanery. Richmond, Ky.	Wheat Bran, Shorts	Sample contains corn bran.
586-11	Manufacturer's Warehouse	Wheat Bran, Wheat Middlings, Wheat Screenings 51%,	
1154-13	Manufacturer's Warehouse	Wheat Bran, Wheat Middlings.	
1387-13	Manufacturer's Warehouse	Wheat Bran, Shorts	Below guaranty in protein.
1180-12	Manufacturer's Warehouse	Wheat	
1143-13	Manufacturer's Warehouse	Wheat Bran, Middlings	
909-11	Diers & Best. Walton, Ky.	Wheat	
644-10	Manufacturer's Warehouse	Wheat	
804-14	C. B. Carden. Fordsville, Ky.	Wheat	Sample contains screenings. Below guaranty in protein.
87-8	Manufacturer's Warehouse	Wheat Bran, Shorts	Sample contains cockle bran.
942-12	W. W. Shadburne. Louisville, Ky.	Wheat Bran, Middlings	
1173-13	Manufacturer's Warehouse	Wheat Bran, Middlings	
1144-13	Manufacturer's Warehouse	Wheat Bran, Middlings	
1138-11	Manufacturer's Warehouse	Wheat Bran, Middlings	Below guaranty in both protein and fat.
921-12	Manufacturer's Warehouse	Wheat Bran, Middlings	Below guaranty in both protein and fat.
18-11	Manufacturer's Warehouse	Wheat	Below guaranty in both protein and fat.
861-12	Manufacturer's Warehouse	Wheat	
367-12	Manufacturer's Warehouse	Wheat Bran, Shorts	
273-9	Manufacturer's Warehouse	Wheat	
564-12	I. F. Tabb. Mt. Sterling, Ky.	Wheat Bran, Middlings, Wheat Screenings 10%	

TABLE I.—STRAIGHT FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
686-12	Shipstuff	J. A. Shaver	15.47	4.26	7.08
		Greenville, Ky.	**15.75**	**4.46**	------
759-10	Shipstuff	L. G. Shehan	15.50	4.85	6.35
		Bardstown, Ky.	**15.36**	**4.36**	------
404-11	"Dewey"	Lee B. Smith	16.25	3.70	------
		Poindexter, Ky.	**16.49**	**4.46**	------
851-14	"Try Me" Mixed Wheat Feed	Sparks Milling Co.	14.75	4.45	8.73
		Alton, Ill.	**15.00**	**3.75**	**10.00**
927-12	Shipstuff and Screenings	Sturgis Milling Co.	15.81	4.34	------
		Sturgis, Ky.	**16.00**	**4.25**	------
939-13	Shipstuff and Screenings	Sturgis Milling Co.	15.47	4.45	7.43
		Sturgis, Ky.	**16.00**	**4.25**	------
1105-12	Shipstuff	J. H. Tate & Co.	15.75	3.61	------
		Monticello, Ky.	**13.03**	**3.04**	------
1054-13	Wheat Bran and Shipstuff	Adam Temple & Son	15.41	4.93	7.38
		Maxon Mills, Ky.	**15.69**	**4.37**	------
355-13	Shipstuff	Trenton Milling Co.	15.81	4.15	------
		Trenton, Ky.	**15.41**	**4.32**	------
355-13	Shipstuff	Trenton Milling Co.	15.88	5.23	7.65
		Trenton, Ky.	**15.41**	**4.32**	------
952-12	Shipstuff	Trimble Milling Co.	16.75	4.34	------
		Milton, Ky.	**15.60**	**4.72**	------
1359-13	Shipstuff	Trimble Milling Co.	15.06	4.45	5.81
		Milton, Ky.	**15.20**	**4.72**	**8.50**
1052-12	Mixed Wheat Feed	Union Grain & Hay Co.	15.66	4.48	------
		Cincinnati, Ohio	**15.94**	**4.09**	------
316-13	Shipstuff	Valley Oak Roller Mills	16.56	5.01	7.33
		Valley Oak, Ky.	**15 65**	**4.13**	------
1177-13	Shipstuff and Screenings	Wallis & Brodbent	15.50	3.90	5.93
		Gracey, Ky.	**15.70**	**4.07**	**9.50**
663-13	Shipstuff	Walton Roller Mill Co.	15.88	4.48	7.50
		Walton, Ky.	**15.12**	**3.77**	------
397-12	Country Wheat Bran, Shipstuff and Screenings	A. Waller & Co.	15.56	4.85	6.17
		Corydon, Ky.	**14.50**	**4.00**	**8.00**
145-13	Country Wheat Bran, Shipstuff and Screenings	A. Waller & Co.	15.75	4.05	------
		Corydon, Ky.	**14.50**	**4.00**	**8.00**
145-13	Country Wheat Bran, Shipstuff and Screenings	A. Waller & Co.	14.56	3.88	8.43
		Corydon, Ky.	**14.50**	**4.00**	**8.00**
921-11	Shipstuff	M. C. Wells & Co.	15.13	3.83	------
		Mt. Olivet, Ky.	**16.00**	**3.70**	------
648-13	Shipstuff	M. C. Wells & Co.	15.31	4.45	6.15
		Mt. Olivet, Ky.	**15.00**	**3.70**	------
650-8	Shipstuff	J. H. Wilhite & Co.	16.31	3.59	------
		Utica, Ky.	**16.09**	**4.35**	------
650-8	Shipstuff	J. H. Wilhite & Co.	16.25	4.38	7.40
		Utica, Ky	**16.09**	**4.35**	------
499-13	Mixed Wheat Feed and Screenings	Willis & Lafont	16.18	4.50	7.69
		Metropolis, Ill.	**14.69**	**4.18**	------
876-9	Shipstuff	Wilson Milling Co.	16.94	4.93	6.01
		Greensburg, Ky.	**16.00**	**4.50**	------
821-12	Mixed Feed	Woodburn Milling Co.	16.25	5.30	------
		Woodburn, Ky.	**15.68**	**4.85**	------

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED	REMARKS—VARIANCE FROM GUARANTY
686-12	Manufacturer's Warehouse	Wheat Bran, Shorts	
759-10	Manufacturer's Warehouse	Wheat	
404-11	M. A. McBryde. Falmouth, Ky.	Wheat Bran, Shorts	Below guaranty in fat.
851-14	J. C. Everett & Co. Maysville, Ky.	Wheat Bran, Middlings, Ground Wheat Screenings 2%	
927-12	Geo. A. Reasor. Clay, Ky.	Low Grade Flour, Wheat Bran. Wheat Screenings 2%.	
939-13	Manufacturer's Warehouse	Low Grade Flour, Wheat Bran, Unground Wheat Screenings 2%	
1105-12	Geo. P. Taylor Burnside, Ky.	Wheat Bran, Middlings	
1054-13	T. J. Wood Lone Oak, Ky.	Wheat Bran, Shipstuff.	
355-13	Manufacturer's Warehouse	Wheat Bran, Middlings	Sample contains cracked corn.
355-13	Manufacturer's Warehouse	Wheat Bran, Middlings	
952-12	Manufacturer's Warehouse	Wheat	
1359-13	C. S. Griffith Carrollton, Ky.	Wheat Bran, Middlings	
1052-12	J. S. Smith Butler, Ky.	Wheat Bran, Middlings	
316-13	Manufacturer's Warehouse	Wheat Bran, Shorts	Sample contains large per cent of corn bran.
1177-13	Julian Atwood. Cadiz, Ky.	Shipstuff, Ground Wheat Screenings 5%.	
663-13	Manufacturer's Warehouse	Wheat Bran, Shorts	
397-12	Pfeffer & Abell. Uniontown, Ky.	Wheat Bran, Shipstuff, Wheat Screenings 4%.	Sample contains corn bran
145-13	Henderson Feed & Commission Co., Henderson, Ky.	Wheat Bran, Shipstuff, Wheat Screenings 4%.	Sample contains corn bran
145-13	Dixon Grocery Co. Dixon, Ky.	Wheat Bran, Shipstuff, Wheat Screenings 4%.	
921-11	Manufacturer's Warehouse	Soft Winter Wheat	Sample contains corn cockle. Below guaranty in protein.
648-13	Manufacturer's Warehouse	Wheat Bran, Middlings	
650-8	Manufacturer's Warehouse	Wheat	Below guaranty in fat.
650-8	Manufacturer's Warehouse	Wheat	
499-13	W. W. McElrath. Murray, Ky.	Wheat Bran, Middlings, Ground Wheat Screenings 8%	Sample contains cockle.
876-9	Manufacturer's Warehouse	Wheat	
821-12	F. W. Alvis. Bowling Green, Ky.	Wheat Bran, Shorts	

TABLE II.—MIXED FEEDS, COMPOSED OF WHEAT AND CORN PRODUCTS, AND DISTILLERS' AND BREWERS' GRAINS.

Reg. No.	NAME OF FEED	MANUFACTURER.	Analysis.		
			Prot.	Fat.	Fiber.
	Mixed Feed (Wheat and Corn).				
19-12	Mixed Feed	Adams & Langford	13.78	4.91	
		Harrodsburg, Ky.	**12.65**	**5.20**	
1170-13	Mixed Feed	Adams & Langford	15.94	4.36	7.28
		Harrodsburg, Ky.	**12.65**	**5.20**	
76-12	Anderson & Spilman Feed	Anderson & Spilman Co.	13.56	3.86	
		Danville, Ky.	**12.60**	**5.10**	**4.96**
770-13	Anderson & Spilman Feed	Anderson & Spilman Co.	14.91	3.68	5.53
		Danville, Ky	**12.60**	**5.10**	**4.96**
1194-13	Mixed Feed	Arlington Roller Mills	14.00	4.05	8.15
		Arlington, Ky.	**13.50**	**4.44**	**9.10**
1194-13	Mixed Feed	Arlington Roller Mills	13.50	4.13	8.00
		Arlington, Ky.	**13.50**	**4.44**	**9.10**
416-12	Mill Run	Ashland Milling Co.	14.06	5.21	
		Ashland, Ky.	**13.00**	**4.00**	
632-13	Mill Run	Ashland Milling Co.	14.81	5.02	8.00
		Ashland, Ky.	**13.00**	**4.00**	
1052-11	Mixed Feed	J. B. Bates	15.81	3.18	
		McQuady, Ky.	**14.78**	**3.63**	
164-12	Mixed Mill Feed	J. H. Baughman & Co.	14.56	4.61	
		Stanford, Ky.	**14.43**	**4.73**	
164-12	Mixed Mill Feed	J. H. Baughman & Co.	14.44	4.35	
		Stanford, Ky.	**14.43**	**4.73**	
363-13	Mixed Mill Feed	J. H. Baughman & Co.	15.16	4.95	6.70
		Stanford, Ky.	**14.43**	**4.73**	
1162-13	Mixed Feed	Beaver Creek Milling Co.	14.60	3.78	6.30
		Glasgow, Ky.	**14.20**	**4.20**	**8.40**
412-13	Mill Feed	Beaver Dam Milling Co.	14.69	5.13	5.80
		Beaver Dam, Ky.	**15.08**	**4.30**	
86-12	Mixed Feed	Berea Roller Mills	13.50	4.87	
		Berea, Ky.	**14.00**	**4.50**	
86-12	Mixed Feed	Berea Roller Mills	14.22	5.73	
		Berea, Ky.	**14.00**	**4.50**	
101-12	Mixed Feed	Bergenroth Bros.	16.19	3.75	
		Troy, Ind.	**14.00**	**4.00**	**8.00**
720-11	Mixed Feed	Bergenroth Bros.	15.47	4.86	
		Troy, Ind.	**14.00**	**4.00**	**8.00**
720-11	Mixed Feed	Bergenroth Bros.	16.69	4.42	8.25
		Troy, Ind.	**14.00**	**4.00**	**8.00**
999-11	Mill Run	Big Sandy Milling Co.	16.25	3.99	6.93
		Louisa, Ky.	**13.59**	**4.57**	
120-12	Eclipse Feed	Binns Milling Co.	17.75	5.05	
		Herndon, Ky.	**13.80**	**4.60**	
116-12	Mill Run Brans	Bowling Green Milling Co.	14.44	4.50	
		Bowling Green, Ky.	**14.00**	**4.50**	
552-13	Mixed Feed	Bowling Green Milling Co.	14.38	3.77	
		Bowling Green, Ky	**15.19**	**4.17**	
552-13	Mixed Feed	Bowling Green Milling Co.	15.03	4.86	7.10
		Bowling Green, Ky.	**15.19**	**4.17**	

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED	REMARKS—VARIANCE FROM GUARANTY
19-12	Manufacturer's Warehouse	Wheat bran, Shorts, Corn bran, Corn hearts	
1170-13	Manufacturer's Warehouse	Wheat bran, Shorts, Corn bran, Corn hearts	No corn hearts present. Below guaranty in fat.
76-12	Danville Ice & Coal Co. Danville, Ky.	Wheat bran, Wheat middlings. Wheat scgs. 10%, Low grade flour, Corn bran	Sample contains cockle. Below guaranty in fat.
770-13	Manufacturer's Warehouse	Wheat bran, Wht midl'gs, Low grade flour, Corn bran, Gr'd and ungr'd Wht scgs. 1%	Contains corn cockle. Below guaranty in fat.
1194-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Unground wheat screenings 3%	
1194-13	T. C. Rutherford Bardwell, Ky.	Wheat bran, Corn bran, Unground wheat screenings 3%	
416-12	H. H. Fitzpatrick Prestonsburg, Ky.	Corn bran, Wheat bran, Middlings	Sample contains screenings.
632-13	The Isaac Richmond Co. Prestonsburg, Ky.	Middlings, Wheat bran, Corn bran	
1052-11	Manufacturer's Warehouse	Wheat bran, Corn Bran, Wheat screenings 12%	
164-12	Vick H. Neal Eubank, Ky.	Wheat bran, Shorts, Corn bran, Wheat screenings 5%	
164-12	W. R. Gibson & Co. Barbourville, Ky.	Wheat bran, Shorts, Corn bran, Wheat screenings 5%	
363-13	J. W. Acey Stanford' Ky.	Wheat bran, Shorts, Corn bran	Sample contains cockle.
1162-13	W. P. Cartwright Glasgow, Ky.	Shipstuff 80%, Corn bran 20%	Below guaranty in fat.
412-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Shipstuff, Ground wheat screenings 9%	
86-12	N. J. Coyle Berea, Ky.	Shipstuff, Corn bran	Below guaranty in protein.
------	Manufacturer's Warehouse	Shipstuff, Corn bran	
101-12	Geo. W. Newman Hawesville, Ky.	Wheat bran, Wheat Middlings, Corn bran, Wheat screenings 3%	
720-11	Geo. W. Newman Hawesville, Ky.	Wheat bran, Middlings, Corn bran, Wheat screenings 3%	
720-11	Quiggins & Beavin Cloverport, Ky.	Wheat bran, Middlings, Corn bran, Wheat screenings 3%	
999-11	Manufacturer's Warehouse	Shipstuff, Corn bran, Corn meal	Below guaranty in fat.
120-12	Forbes Mfg. Co. Hopkinsville, Ky.	Wheat bran, Corn bran	Sample is Shipstuff.
116-12	Central Coal & Feed Co. Middlesboro, Ky.	Wheat bran, Corn bran, Wheat screenings 5%	
552-13	Elizabethtown Milling Co., Elizabethtown, Ky.	Wheat bran, Shorts, Corn bran, Ground wheat screenings 5%	Below guaranty in both protein and fat.
552-13	Phelps Bros. Bowling Green, Ky.	Wheat bran, Shorts, Corn bran, Ground wheat screenings 5%	

TABLE II.—MIXED FEEDS, COMPOSED OF WHEAT AND CORN PRODUCTS, AND DISTILLERS' AND BREWERS' GRAINS.

Reg. No.	NAME OF FEED.	MANUFACTURER	Analysis.		
			Prot.	Fat.	Fiber.
593-13	Mixed Feed	Bransford Mills	15.88	3.68	------
		Owensboro, Ky.	**15.00**	**4.00**	------
593-13	Mixed Feed	Bransford Mills	14.38	3.92	------
		Owensboro, Ky.	**15.00**	**4.00**	------
593-13	Mixed Feed	Bransford Mills	16.63	4.28	6.65
		Owensboro, Ky.	**15.00**	**4.00**	------
326-14	Mixed Feed	Bransford Mills	14.56	4.78	7.08
		Owensboro, Ky.	**15.00**	**4.00**	**6.00**
1354-12	Brano	R. Brett.	16.25	5.15	------
		Mayfield, Ky.	**14.00**	**4.60**	------
1354-12	Brano	R. Brett.	15.00	5.65	------
		Mayfield, Ky.	**14.00**	**4.60**	------
688-13	Brano	L. Brewer	16.03	4.45	7.88
		Mayfield, Ky.	**15.00**	**5.00**	------
83-12	XX Mixed Feed	Chas. Broeker & Co.	13.22	7.09	------
		Owensboro, Ky.	**13.00**	**4.00**	------
63-13	XX Mixed Feed	Chas. Broeker & Co.	13.25	6.78	------
		Owensboro, Ky.	**13.00**	**4.00**	------
1182-12	Mixed Feed	Brookport Milling Co.	14 69	4.95	------
		Brookport, Ill.	**14.44**	**4.61**	------
370-13	Mixed Feed	Browder Milling Co.	15.47	4.53	6.63
		Fulton, Ky.	**16.28**	**4.68**	. . .
658-14	Mixed Feed	Browder Milling Co.	15.16	3.88	6.21
		Fulton, Ky.	**16.28**	**4.68**	------
26-12	Famous XX Feed	Corydon Milling Co.	14 81	3.43	------
		Corydon, Ky.	**14.70**	**4.60**	**9.50**
990-12	Mixed Feed	E. L. Buckley.	17.31	4.79	------
		Allensville, Ky.	**15.31**	**5.07**	------
366-13	Mixed Feed	E. L. Buckley.	14.63	5.43	8.20
		Allensville, Ky.	**15.31**	**5.07**	------
1361-13	Mixed Feed	J. V. Bumpus	15.78	4.30	7.73
		W. Louisville, Ky.	**15.44**	**4.42**	**9.22**
637-13	Rich Feed	Burkholder Bros.	16.31	4.20	7.59
		Crofton, Ky.	**13.25**	**4.19**	**10.50**
537-12	Mixed Feed	Burnam & Riddleberger	15.94	4.29	------
		Paint Lick, Ky.	**14.60**	**4.60**	------
547-12	Mixed Feed	Burnam & Rucker	15.41	4.75	------
		Paint Lick, Ky.	**14.60**	**4.60**	------
547-12	Mixed Feed	Burnam & Rucker	15.06	4.13	6.48
		Paint Lick, Ky.	**14.60**	**4 60**	------
343-13	Mixed Feed	Burnside Roller Mills Co.	15.03	4.37	7.63
		Burnside, Ky.	**14.44**	**5.47**	**7.43**
760-13	Mixed Feed	Cadick Milling Co.	15.63	4.68	------
		Grand View, Ind.	**14.93**	**4.19**	**5.00**
760-13	Mixed Feed	Cadick Milling Co.	15.16	4.54	8.25
		Grand View, Ind.	**14.93**	**4.19**	**5.00**
291-12	Hope Mills Mill Feed	J. Andrew Cain	15.44	3.85	------
		Versailles, Ky.	**15.25**	**4.25**	--- --
1216-12	Mixed Feed	Campbell & Vaught.	15.81	4.33	------
		Somerset, Ky.	**13.19**	**4.83**	------

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED	REMARKS—VARIANCE FROM GUARANTY
593-13	Owensboro Feed & Seed Co., Owensboro, Ky.	Wheat bran, Corn bran, Shorts, Screenings 2%	Sample contains more than 2% screenings.
593-13	Owensboro Feed & Seed Co., Owensboro, Ky.	Wheat bran, Corn bran, Shorts, Screenings 2%	Below guaranty in protein.
593-13	L. E. Chapman Owensboro, Ky.	Wheat bran, Corn bran, Shorts, Screenings 2%	
326-14	C. B. Carden Fordsville, Ky.	Wheat bran, Corn bran, Shorts, Ground wheat screenings 2%	
1354-12	Manufacturer's Warehouse	Wheat bran, Corn bran	
1354-12	Wolf & Reynolds Mayfield, Ky.	Wheat bran, Corn bran	
-------	Manufacturer's Warehouse	Wheat bran, Corn bran	Below guaranty in fat.
83-12	Wallace Bros. Greenville, Ky.	Shipstuff, Wheat bran, Hominy feed, Ground wheat screenings 1%	
63-13	E. M. Gish Central City, Ky.	Shipstuff, Wheat bran, Hominy feed, Ground wheat screenings 1%	
1182-13	T. J. Ward Lone Oak, Ky.	Wheat bran, Shipstuff, Corn bran	
370-13	Chas. Noonon Fulton, Ky.	Wheat, Corn bran, Middlings, Ground wheat screenings 7½%	Below guaranty in protein.
658-14	J. T. Moss Jordon, Ky.	Wheat, Corn, bran, Middlings, Ground wheat screenings 7½%	No corn bran present. Below in protein and fat.
-------	Manufacturer's Warehouse	Wheat bran, Corn bran, Shipstuff, Ground screenings 3%	Below guaranty in fat.
990-12	The Buck & Small Co. Guthrie, Ky.	Wheat bran, Corn bran	
366-13	L. B. Downer Guthrie, Ky.	Wheat bran, Middlings, Corn bran	Below guaranty in protein.
1361-13	Manufacturer's Warehouse	Wheat bran, Middlings, Corn bran, Ground wheat screenings 1%	
637-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Ground wheat screenings 5%	
547-12	Manufacturer's Warehouse	Wheat bran, Corn bran, Shipstuff	
547-12	Manufacturer's Warehouse	Wheat bran, Corn bran	
547-12	Manufacturer's Warehouse	Wheat bran, Corn bran, Shipstuff	
343-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Ground wheat screenings 1%	Below guaranty in fat.
760-13	Frank Wessel Louisville, Ky.	Wheat bran, Corn bran, Middlings	
760-13	H. J. Greive Louisville, Ky.	Wheat bran, Corn bran, Middlings	Above guaranty in fiber.
291-12	James N. Benton Irvine, Ky.	Wheat shorts, Wheat bran, Wheat middlings, Wheat screenings 6%, Corn bran	Below guaranty in fat.
1216-12	Manufacturer's Warehouse	Wheat bran, Corn bran, Shorts	Below guaranty in fat.

TABLE II.—MIXED FEEDS, COMPOSED OF WHEAT AND CORN PRODUCTS, AND DISTILLERS' AND BREWERS' GRAINS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
525-13	Mixed Feed	Cannelton Flour Mills	14.03	3.86	------
		Cannelton, Ind.	**14.43**	**3.45**	------
525-13	Mixed Feed	Cannelton Flour Mills	13.97	3.70	6.96
		Cannelton, Ind.	**14.43**	**3.45**	------
895-13	Cameron's Feedstuff	Carrollton Roller Mills	14.75	5.16	7.25
		Carrollton, Ky.	**14.25**	**3.60**	------
65-12	Mixed Feed	James Cate & Son Co.	15 81	4.38	------
		Hopkinsville, Ky.	**12.87**	**4.62**	------
103-13	Mixed Feed	James Cate & Son Co.	13.94	4.23	8.88
		Hopkinsville, Ky.	**12.87**	**4.62**	------
645-13	Mixed Feed	Cave Milling Co.	15.75	4.45	------
		Bowling Green, Ky.	**13.03**	**3.50**	------
840-13	Mixed Feed	Cayce Milling Co.	15.16	4.53	7.50
		Cayce, Ky.	**15.20**	**4.07**	------
285-12	Mixed Feed	Cecilian Milling Co.	15 88	4.28	------
		Cecilian, Ky.	**14.37**	**4.15**	------
399-12	Mixed Feed	Clark & Clark	16.13	4 83	------
		Franklin, Ky.	**15.62**	**4.94**	**5.14**
1138-13	Peerless Feed	Clay Milling Co.	14.94	3.58	5.05
		Clay, Ky.	**14.00**	**3.00**	------
1210-12	Mixed Feed	Clell Coleman & Sons	14.06	3.89	------
		Burgin, Ky.	**13.12**	**4.35**	------
609-13	Burgin Feed	Clell Coleman & Sons	15.13	4.38	8.00
		Burgin, Ky.	**13.20**	**4.35**	------
745-13	Famous XX Feed	Corydon Milling Co.	15.53	4.11	7.75
		Corydon, Ky.	**14.70**	**4.60**	**9.50**
8-14	Famous XX Feed	Corydon Milling Co.	12.06	4.33	4.13
		Corydon, Ky.	**14.70**	**4.60**	**9.50**
199-12	Crescent	Crescent Milling Co.	16.00	3.73	------
		Cynthiana, Ky.	**15.64**	**4.18**	------
1337-13	Crescent	Crescent Milling Co.	15.53	4.61	6.95
		Cynthiana, Ky.	**15.06**	**4.67**	**8.93**
283-12	Mixed Feed	Crider Roller Mills	15.75	3.45	------
		Crider, Ky.	**13.56**	**3.76**	------
1129-13	Mixed Feed	Crider Roller Mills	16.44	4.56	6.75
		Crider, Ky.	**13.56**	**3.76**	------
198-12	Mixed Feed	Crown Jewel Milling Co.	16.19	3.75	------
		Cynthiana, Ky.	**16.06**	**4.52**	------
1318-13	Mixed Feed	Crown Jewel Milling Co.	15.16	4.40	6.75
		Cynthiana, Ky.	**15.94**	**4.12**	**7.14**
162-12	Crystal Flake Mixed Feed	Crown Roller Mills	13.66	4.50	------
		Morganfield, Ky.	**12.50**	**4.50**	------
162-12	Crystal Flake Mixed Feed	Crown Roller Mills	14.50	4.03	------
		Morganfield, Ky.	**12.50**	**4.50**	------
1029-13	Crystal Flake Mixed Feed	Crown Roller Mills	13.38	5.95	------
		Morganfield, Ky.	**12.50**	**4.50**	------
72-13	Damon's Brans	C. D. Damon	16.38	4.25	------
		Elkton, Ky.	**13.00**	**3.00**	------
72-13	Damon's Brans	C. D. Damon	13.66	5.47	5.83
		Elkton, Ky.	**13 00**	**3.00**	------

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED	REMARKS—VARIANCE FROM GUARANTY
525-13	J. W. Quisenbury ----- Hawesville, Ky.	Shipstuff, Corn bran, Wheat bran, Ground wheat screenings 5%	No corn bran present.
525-12	J. H. Brown ---------- Cloverport, Ky.	Shipstuff, Corn bran, Wheat bran, Ground wheat screenings 5%	
895-13	Manufacturer's Warehouse	Wheat bran, Corn bran ---------	
65-12	Forbes Mfg. Co. ------ Hopkinsville, Ky.	Wheat bran, Corn bran, Shorts--	
103-13	Forbes Mfg. Co ------ Hopkinsville, Ky.	Wheat bran, Corn bran, Shorts--	
-------	Manufacturer's Warehouse	Wheat bran, Corn bran, Wheat screenings 10%	
840-13	West Hickman Supply Co., Hickman, Ky.	Wheat bran, Corn bran ---------	Sample is shipstuff.
285-12	Davis & Williams------ Elizabethtown, Ky.	Wheat bran, Corn, Corn bran----	Sample is shipstuff.
399-12	Manufacturer's Warehouse	Wheat bran, Corn bran----------	
1138-13	Manufacturer's Warehouse	Wheat bran, Corn bran----------	Sample is shipstuff.
1210-12	Cogar Grain & Coal Co, Harrodsburg, Ky.	Wheat bran, Corn bran----------	Sample contains corn cockle. Below in fat.
609-13	Manufacturer's Warehouse	Wheat, corn, Corn bran, Ground wheat screenings 25%	Cockle and unground screenings present.
745-13	Manufacturer's Warehouse	Wheat bran, Shipstuff, Corn bran, Ground wheat screenings 5%	
8-14	J. H. Harmon --------- Henderson, Ky.	Wheat bran, Wheat middlings, Corn bran, Ground wheat screenings 5%	Below guaranty in protein.
199-12	Manufacturer's Warehouse	Wheat bran, Corn bran----------	
1337-13	Manufacturer's Warehouse	Wheat bran, Corn bran----------	
283-12	Manufacturer's Warehouse	Wheat bran, Corn bran----------	
1129-13	Manufacturer's Warehouse	Wheat bran, Corn bran----------	Shipstuff, containing screenings and large amt. corn cockle.
198-12	Manufacturer's Warehouse	Wheat bran, Middlings, Corn bran	Below guaranty in fat.
1318-13	Manufacturer's Warehouse	Wheat bran, Middlings, Corn bran	Below guaranty in protein.
162-12	W. J. Kirk ---------- Madisonville, Ky.	Wheat bran, Corn bran, Wheat and corn screenings 5%	
162-12	Manufacturer's Warehouse	Wheat bran, Corn bran, Wheat and corn screenings 5%	
1029-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Unground wheat screenings 5%	
72-13	Manufacturer's Warehouse	Corn bran, Wheat bran----------	
72-13	Manufacturer's Warehouse	Corn bran, Wheat bran----------	

TABLE II.—MIXED FEEDS, COMPOSED OF WHEAT AND CORN PRODUCTS, AND DISTILLERS' AND BREWERS' GRAINS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
667-8	Mixed Feed	J. W. Davis	15.31	4.25	------
		Elkton, Ky.	**15.78**	**4.83**	------
667-8	Mixed Feed	J. W. Davis	12.75	6.58	5.88
		Elkton, Ky.	**15.78**	**4.83**	------
388-13	Mixed Feed	Dawson Milling Co.	16.13	4.32	------
		Dawson Springs, Ky.	**11.25**	**4.97**	------
911-10	Mixed Feed	Dempsey Bros.	15.00	4.25	------
		Shawneetown, Ill.	**15.18**	**5.34**	------
706-13	Williams' Feed	A. Dewey	14.06	3.68	6.00
		Sanders, Ky.	**15.28**	**3.29**	------
340-12	Mixed Feed	Dixon Milling Co.	14.85	4.22	5.10
		Dixon, Ky.	**14.43**	**3.82**	------
1193-12	Dorsel's Special Feed	The Dorsel Co.	15.94	3.93	------
		Newport, Ky.	**13.56**	**3.99**	------
582-13	Dorsel's Special Feed	The Dorsel Co.	14.10	3.24	3.33
		Newport, Ky.	**13.56**	**3.99**	------
584-13	Dorsel's Mixed Feed	The Dorsel Co.	14.81	3.70	8.73
		Newport, Ky.	**14.97**	**4.56**	------
1180-13	Mixed Feed	Drakesboro Milling Co.	13 38	4.65	------
		Drakesboro, Ky.	**15.44**	**3.85**	------
341-12	Dukedom Brans	Dukedom Roller Mills Co.	15.97	4.18	7.38
		Dukedom, Tenn.	**14.12**	**5.73**	**9.50**
1164-12	Mixed Feed	Dunmor Roller Mills	16.31	3.93	------
		Dunmor, Ky.	**13.88**	**4.30**	------
359-13	Mixed Feed	Dunmor Roller Mills	15.19	3.70	6.33
		Dunmor, Ky.	**13.88**	**4.30**	------
1170-12	Mixed Feed	H. A. Deutschke	15.50	4.55	------
		Stepensport, Ky.	**14.00**	**3.93**	------
349-12	Mixed Feed	Eagle Mills	15.47	3.85	------
		Franklin, Ky.	**15.18**	**5.10**	------
249-13	Mixed Feed	Eagle Mills	14.81	4.33	7.73
		Franklin, Ky.	**15.18**	**5.10**	------
184-12	Eberts Mixed Feed	Eberts & Bro.	16.25	3.75	------
		Jeffersonville, Ind.	**16.00**	**4.30**	**8.00**
484-12	Creamo Mixed Feed	Edinger & Co.	16.13	4.00	------
		Louisville, Ky.	**15.50**	**4.25**	------
1001-13	Mixed Feed	Elizabethtown Milling Co.	14.31	4.35	6.80
		Elizabethtown, Ky.	**14.80**	**4.48**	**6.78**
350-12	Mixed Feed	T. M. Ellis & Co.	15.56	4.73	------
		Russellville, Ky.	**15.00**	**4.60**	------
350-12	Mixed Feed	T. M. Ellis & Co.	15.88	4.11	------
		Russellville, Ky.	**15.00**	**4.60**	------
523-13	Mixed Feed	T. M. Ellis & Co.	15.16	4.30	------
		Russellville, Ky.	**15 00**	**4.60**	------
523-13	Mixed Feed	T. M. Ellis & Co.	15.56	4.95	6.23
		Russellville, Ky.	**15.00**	**4.60**	------
422-10	Leader Mixed Feed	Eminence Milling Co.	15.81	5.32	------
		Eminence, Ky.	**13.75**	**4.25**	------
1319-13	Leader Mixed Feed	Eminence Milling Co.	14.63	4.80	6.85
		Eminence, Ky.	**14.25**	**4.35**	**8.08**

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY
667-8	Manufacturer's Warehouse	Wheat, corn	
667-8	Manufacturer's Warehouse	Wheat, corn	Below guaranty in protein.
388-13	Louis Igleheart, Dawson Springs, Ky.	Wheat bran, Corn bran, Unground wheat screenings 3%	Below guaranty in fat.
911-10	R. N. Knight, Tolu, Ky.	Wheat bran, Shipstuff, Corn bran, Wheat screenings 1%	Below guaranty in fat.
706-13	Manufacturer's Warehouse	Wheat bran, Middlings, Corn bran	Below guaranty in protein.
340-12	Manufacturer's Warehouse	Shipstuff, Corn bran	Contains screenings and low grade flour.
1193-12	John Kruchten, Dayton, Ky.	Wheat Middlings, Fine corn bran	
582-13	J. M. McArthur, California, Ky.	Wheat Middlings, Fine corn bran	No corn bran present. Below guaranty in fat.
584-13	R. L. Galloway, Falmouth, Ky.	Wheat bran, Corn bran	Below guaranty in fat.
1180-13	Manufacturer's Warehouse	Wheat bran, Shorts, Corn bran, Ground wheat screenings 2%	Below guaranty in protein.
341-12	Chas. Noonon, Fulton, Ky.	Wheat bran, Corn bran	Below guaranty in fat.
1164-12	Manufacturer's Warehouse	Wheat bran, Corn bran, Wheat screenings 5%	
359-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Ground wheat screenings 5%	No corn bran present.
1170-12	Manufacturer's Warehouse	Middlings, Wheat bran, Shipstuff, Corn bran, Wheat screenings 4%	
349-12	Manufacturer's Warehouse	Wheat bran, Corn bran	Below guaranty in fat.
249-13	Manufacturer's Warehouse	Wheat bran, Corn bran	Below guaranty in fat.
184-12	F. A. Ratterman, Louisville, Ky.	Wheat bran, Shipstuff, Corn bran, wheat screenings 3%	No corn bran present.
484-12	Schreiber Bros., Louisville, Ky.	Wheat bran, Corn bran, Wheat screenings 2%	Sample is shipstuff.
1001-13	Manufacturer's Warehouse	Wheat bran, Corn bran	
350-12	Clarence Howard, Russellville, Ky.	Wheat bran, Corn bran, screenings 2%	
350-12	Clarence Howard, Russellville, Ky.	Wheat bran, corn bran, screenings 2%	Sample is shipstuff.
523-13	Clarence Howard, Russellville, Ky.	Wheat bran, Corn bran, Ground wheat screenings 2%	
523-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Ground wheat screenings 2%	
422-10	Manufacturer's Warehouse	Shipstuff, Corn bran 10%, Wheat screenings 5%	
1319-13	Manufacturer's Warehouse	Shipstuff, Corn bran 5%, Unground screenings 5%	

TABLE II.—MIXED FEEDS, COMPOSED OF WHEAT AND CORN PRODUCTS, AND DISTILLERS' AND BREWERS' GRAINS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
634-12	Mixed Feed	W. M. Farless	16.56	4.43	------
		Henderson, Ky.	**15.00**	**4.00**	------
344-13	Mixed Feed	W. M Farless	15.06	5.05	------
		Henderson, Ky.	**15.00**	**4.00**	------
344-13	Mixed Feed	W. M. Farless	15.10	5.23	8.00
		Henderson, Ky.	**15.00**	**4.00**	------
72-12	"We-Kno" Mixed Feed	Oscar Farmer & Sons	15.63	3.93	------
		Louisville, Ky.	**14.00**	**4.10**	------
438-13	"We-Kno" Mixed Feed	Oscar Farmer & Sons	15.13	4.18	8.93
		Louisville, Ky.	**14.00**	**4.10**	------
1007-13	Mill Feed	Farmers' Union Mills	13.22	3.78	8.70
		Versailles, Ky.	**14.97**	**3.88**	------
1292-12	Mixed Feed	John W. Fry	15.44	4.59	7.15
		Melber, Ky.	**14.44**	**4.61**	------
1155-12	Mixed Feed	R. L. Galloway	16.53	4.23	------
		Falmouth, Ky.	**15.00**	**4.00**	------
755-13	Mixed Feed	R. L. Galloway	15.91	4.63	9.14
		Falmouth, Ky.	**15.00**	**4.00**	**8.00**
339-12	Mixed Feed	Garrard Milling Co	14.69	4.38	------
		Lancaster, Ky.	**14.50**	**4.38**	------
603-12	Mixed Feed	Glasgow Milling Co.	16.88	4.26	------
		Glasgow, Ky.	**15.50**	**4.25**	------
973-13	Mixed Feed	Glasgow Milling Co.	15.53	4.93	7.05
		Glasgow, Ky.	**15.50**	**4.25**	------
99-12	Glass's High Grade Feed	Glass Milling Co.	14.38	3.78	------
		Wilmore, Ky.	**16.32**	**4.25**	**7.44**
573-13	Glass's High Grade Feed	Glass Milling Co.	15.85	4.68	6.75
		Wilmore, Ky.	**16.32**	**4.25**	**7.44**
533-13	Mixed Feed	The Goldcamp Mill Co.	14.31	5.19	------
		Ironton, Ohio.	**13.63**	**7.31**	------
533-13	Mixed Feed	The Goldcamp Mill Co.	16.25	5.13	7.50
		Ironton, Ohio.	**13.63**	**7.31**	------
533-13	Mixed Feed	The Goldcamp Mill Co.	14.31	5.68	7.13
		Ironton, Ohio.	**13.63**	**7.31**	------
456-14	Mixed Feed	The Goldcamp Mill Co.	13.81	6.15	7.28
		Ironton, Ohio.	**14.00**	**4.25**	**8.50**
679-12	Dairy Feed	The Goldcamp Mill Co.	15.19	3.58	------
		Ironton, Ohio	**13.63**	**2.99**	------
74-13	Dairy Feed	Greenup Milling Co.	13.47	5.08	5.50
		Greenup, Ky.	**13.63**	**2.99**	------
45-12	Mixed Feed	Gordonsville Milling Co.	15.06	3.90	------
		Gordonsville, Ky.	**16.10**	**4.68**	------
534-11	Mixed Feed	Guthrie Milling Co.	14.88	3.98	------
		Guthrie, Ky.	**13.81**	**4.08**	**9.00**
737-13	Mixed Feed	Guthrie Milling Co.	14.44	4.23	6.13
		Guthrie, Ky.	**12.50**	**3.99**	**9.00**
563-13	H. R. M. Feed	Hanson Roller Mills Co.	13.06	3.56	7.13
		Hanson, Ky.	**14.75**	**4.31**	------
533-12	H. R. M. Feed	Hanson Roller Mills Co.	15.00	3 75	------
		Hanson, Ky.	**14.75**	**4.31**	------

Analyses of Inspectors' Samples.

Reg. No,	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
634-12	Henderson Feed & Com. Co., Henderson, Ky.	Shipstuff, Corn bran 5%, unground Screenings 5%	
344-13	A. T. Coleman Henderson, Ky.	Wheat bran, Corn bran Ground wheat screenings 2%	Sample contains cockle bran.
344-13	A. T. Coleman Henderson, Ky.	Wheat bran, Corn bran, Ground wheat screenings 2%	
72-12	H. J. Greive Louisville, Ky.	Wheat bran, Wheat screenings 2%, Corn bran 1%	
438-13	Frank Birchler Louisville, Ky.	Wheat bran, Ground Wheat screenings 2%, Corn bran 1%	No corn bran present.
1007-13	C. S. Sebree Georgetown, Ky.	Shipstuff, Corn bran 5%, Ground wheat screenings 5%	More than 5% corn bran, contains cockle bran; below in prot.
1292-12	Manufacturers' Warehouse	Shipstuff, Corn bran, wheat screenings 5%	
1155-12	Manufacturers' Warehouse	Wheat bran, Corn bran 5%, Wheat screenings 3%	
755-13	Manufacturers' Warehouse	Shipstuff, Corn bran 5%, Ground wheat screenings 2%	
339-12	Hudson & Hughes Lancaster, Ky.	Wheat bran, Shorts, Corn bran, Ground wheat screenings 3%	
603-12	Dicky & Co. Glasgow, Ky.	Wheat bran, Corn bran, Shorts	No corn bran present.
973-13	Manufacturers' Warehouse	Wheat bran, Corn bran	
99-12	Manufacturer's Warehouse	Wheat bran, Corn bran, Shipstuff	Below guaranty in prot. Contains corn cockle.
573-13	J. D. Hughes Lumber Co., High Bridge, Ky.	Wheat bran, Corn bran, Shipstuff	Sample is shipstuff.
533-13	J. L. Preston Paintsville, Ky.	Middlings, Bran, Corn bran	Below guaranty in fat.
533-13	Shelby Coal Co., Shelby, Ky.	Middlings, Bran, Corn bran	Below guaranty in fat.
533-12	Jno. Jeems Louisa, Ky.	Middlings, Bran, Corn bran	Containsscreen'gs&corncockle Below guaranty in fat.
456-14	Spurlock Mercantile Co. Middle Creek, Ky.	Wheat bran, Wheat Middlings, Corn bran	
679-12	Jno. Jeems Louisa, Ky.	Wheat bran, Wheat Middlings, Corn grits, Corn bran	
74-13	Press Childers & Son, W. Van Lear, Ky.	Wheat bran, Middlings, Corn grits, Corn bran	
45-12	Manufacturer's Warehouse	Wheat bran, Corn bran	Below guaranty in both protein and fat.
534-11	Clarence Howard Russellville, Ky.	Wheat bran, Corn bran, Wheat screenings 2%	
737-13	Clarence Howard Russellville, Ky.	Wheat bran, Corn bran, Unground wheat screenings 2%	
563-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Ground wheat screenings 4%	Below guaranty in both protein and fat.
533-12	Manufacturer's Warehouse	Wheat bran, Corn bran, Unground wheat screenings 4%	Below guaranty in fat.

TABLE II.—MIXED FEEDS, COMPOSED OF WHEAT AND CORN PRODUCTS, AND DISTILLERS' AND BREWERS' GRAINS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
120-12	Mixed Feed	Hardinsburg Mill & Elevator Co., Hardinsburg, Ky.	14.91	4.22	------
			14.34	**4.11**	------
793-13	Mixed Feed	Hardinsburg Mill & Elevator Co., Hardinsburg, Ky,	14.81	3.73	6.20
			14.34	**4.61**	------
793-13	Mixed Feed	Hardinsburg Mill & Elevator Co., Hardinsburg, Ky.	13.94	4.20	5.58
			14.34	**4.61**	------
494-13	Mixed Feed	Harlan Lowe Milling Co. Bardwell, Ky.	15.41	4.20	7.78
			14.22	**4.43**	**4.80**
725-11	Milburn Feed	O. T. Helfer Milburn, Ky.	15.94	6.52	------
			12.81	**4.03**	------
362-12	Mixed Feed	Herren & Cundiff Bros. Liberty, Ky.	14.25	3.88	------
			13.81	**4.73**	------
659-12	"Lincoln"	Hodgenville Roller Mills Hodgenville, Ky.	15.31	4.35	------
			15.50	**3.99**	------
589-13	"Lincoln"	Hodgenville Roller Mills Hodgenville, Ky.	15.00	4.98	6.85
			15.50	**3.99**	------
1262-12	Happy Home Mixed Feed	Home Milling Co. Greenville, Ky.	14.25	4.85	------
			15.25	**5.20**	------
1262-12	Happy Home Mixed Feed	Home Milling Co. Greenville, Ky.	14.85	4.47	------
			15.25	**5.20**	------
1115-13	Happy Home Mixed Feed	Home Milling Co. Greenville, Ky.	15.91	4.73	7.39
			14.22	**5.14**	------
43-12	Star and Crescent	Hopkinsville Milling Co. Hopkinsville. Ky.	14.94	4.33	------
			13.25	**4.68**	**9.50**
471-13	Star and Crescent	Hopkinsville Milling Co. Hopkinsville, Ky.	15.10	5.00	8.10
			13.25	**4.68**	**9.52**
86-13	Mixed Feed	Horse Cave Mills Horse Cave, Ky.	14.85	5.08	7.33
			14.87	**3.78**	------
159-12	Mixed Feed	Horse Cave Mills Horse Cave, Ky.	16.47	4.23	------
			14.87	**3.78**	------
------	Mixed Feed	Jenkins-Ryan Milling Co. Adairville, Ky.	14.50	4.48	6.40
			14.50	**4.00**	------
669-12	Mixed Feed	Jenkins-Ryan Milling Co. Adairville, Ky.	14.35	3.38	------
			15.78	**4.75**	------
719-12	Mixed Feed	Johns Bros. Milling Co. Henshaw, Ky.	16.13	5.23	------
			12.56	**4.15**	------
719-12	Mixed Feed	Johns Bros. Milling Co. Henshaw, Ky.	15.60	4.73	7.58
			12.56	**4.15**	------
1178-12	Shipstuff and Corn Bran	Keen & Smith Burkesville, Ky.	16.69	4.87	------
			16.53	**5.16**	------
33-12	Lyon Feed	Keith Bros. Buffalo, Ky	15.91	4.70	------
			15.19	**5.09**	------
828-12	Feed Stuff	D. V. Kennedy & Co. Stanford, Ky.	14.06	3.35	------
			12.12	**4.06**	------
97-12	Mixed Feed	R. U. Kevil & Sons Princeton, Ky.	15.25	4.07	------
			15.00	**4.00**	**7.00**
671-13	Mixed Feed	R. U. Kevil & Sons Princeton, Ky.	15.91	4.38	7.50
			15.00	**4.00**	**7.00**
716-12	Mixed Feed	R. U. Kevil & Sons Mayfield, Ky.	15.63	4.88	------
			14.50	**4.95**	**7.87**

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
120-12	J. H. Roberts ---------- Fordsville, Ky.	Wheat bran, Corn bran, Wheat screenings 1%	
793-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Ground wheat screenings	Below guaranty in fat.
793-13	J. H. Roberts ---------- Fordsville, Ky.	Wheat bran, Corn bran, Ground wheat screenings 1%	
494-13	Ballard Mercantile Co.- Wickliffe, Ky.	Wheat bran, Middlings, Corn bran, Unground wheat screenings 5%	Higher than guaranty in fiber.
725-11	Manufacturer's Warehouse	Wheat bran, Corn bran, Wheat screenings 15%	
362-12	The Gayert & Vogel Co Junction City, Ky.	Wheat bran, Corn bran, Wheat screenings 5%	Below guaranty in fat.
659-12	Watkins & Co. -------- Elizabethton, Ky.	Wheat bran, Corn bran, Shorts--	
589-13	Manufacturer's Warehouse	Wheat bran, Corn bran ----------	Sample in shipstuff. Below guarnty in protein.
1262-12	E. A. & L. Cohen ----- Greenville. Ky.	Wheat bran, Corn bran, Cheat --	Below guaranty in protein.
1262-12	Greenville Hdw. & Grocery Co., Greenville, Ky.	Wheat bran, Corn bran, Cheat --	Below guaranty in fat.
1115-13	H. C. Wilkinson & Co. Greenville, Ky.	Wheat bran, Corn bran, Cheat --	Sample is shipstuff and screenings.
43-12	C. R. Clark & Co. ----- Hopkinsville, Ky.	Wheat bran, Corn bran, Wheat screenings 10%	
471-13	N. B. Wilson---------- Hopkinsville, Ky.	Wheat bran, Corn bran, Unground wheat screenings 10%	
86-13	Hagan, Clark & Yates- Elizabethtown, Ky.	Wheat bran, Shorts, Corn bran--	No corn bran present.
159-12	Dickinson Bros. ------- Glasgow, Ky.	Wheat bran, Shorts, Corn bran--	
------	G. B. Cooper ---------- Adairville, Ky.	Wheat bran, Corn bran, Shorts, Unground wheat screenings 1½%	Sample is shipstuff.
669-12	B. S. Cooper ---------- Adairville, Ky.	Wheat bran, Corn bran, Shorts, Unground wheat screenings 1½%	Below guaranty in both protein and fat.
719-12	Manufacturer's Warehouse	Wheat bran, Corn bran, Wheat screenings 12%	
719-12	Manufacturer's Warehouse	Wheat bran, Corn bran, Wheat screenings 12%	
1178-12	George P. Taylor & Co. Burnside, Ky.	Wheat, Corn and wheat screenings 2%	
33-12	Manufacturer's Warehouse	Wheat bran, Corn bran, Shorts--	
828-12	Manufacturer's Warehouse	Wheat bran, Middlings, Corn bran, Corn meal	
97-12	Smith & Newson ------ Princeton. Ky.	Wheat bran, Shipstuff, Corn bran	Sample contains screenings.
671-13	Smith & Newson ------ Princeton, Ky.	Wheat bran, Corn bran----------	Sample is shipstuff and screenings.
716-12	A. J. Wheeler-------- Mayfield, Ky.	Wheat bran, Corn bran, Screenings 2%	

TABLE II.—MIXED FEEDS, COMPOSED OF WHEAT AND CORN PRODUCTS, AND DISTILLERS' AND BREWERS' GRAINS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
389-13	Mixed Feed	R. U. Kevil & Sons, Mayfield, Ky.	15.66	4.60	7.25
			14.50	**4.95**	**7.87**
671-13	Mixed Feed	R. U. Kevil & Sons, Mayfield, Ky.	14.81	4.56	7.09
			15.81	**4.00**	**7.00**
36-12	Mixed Feed	Kuttawa Milling Co., Kuttawa, Ky.	14.75	5.93	------
			13.90	**3.52**	------
105-13	Mixed Feed	Kattawa Milling Co., Kuttawa, Ky.	13.19	4.59	4.53
			13.90	**3.52**	------
504-12	Mixed Feed	Lancaster Elevator & Flour Mills, Lancaster, Ky.	16.00	4.88	------
			16.00	**5.38**	------
504-12	Mixed Feed	Lancaster Elevator & Flour Mills, Lancaster, Ky.	16.75	4.13	------
			16.00	**5.38**	------
504-12	Mixed Feed	Lancaster Elevator & Flour Mills, Lancaster, Ky.	14.94	4.29	------
			16.00	**5.38**	------
298-13	Mixed Feed	Lancaster Elevator & Flour Mills, Lancaster, Ky.	16.63	5.03	6.60
			16.00	**5.38**	------
487-13	Mill Feed	D. A. Leffingwell & Co., Ashland, Ky.	16.31	5.18	7.70
			12.94	**4.65**	------
1037-13	Eureka	Leitchfield Milling Co., Leitchfield, Ky.	14.63	5.15	6.00
			13.50	**6.70**	**10.00**
839-12	Mixed Feed	Lewisburg Milling Co., Lewisburg, Ky.	15.06	3.48	------
			15.25	**4.10**	**8.50**
985-13	Mixed Feed	Lewisburg Milling Co., Lewisburg, Ky.	15.19	4.94	6.38
			15.25	**4.10**	**8.50**
662-12	Farmers' Choice	Lewisport Mill Co., Lewisport, Ky.	14.44	5.08	------
			14.00	**4 25**	------
662-12	Farmers' Choice	Lewisport Mill Co., Lewisport, Ky.	16.44	4.33	------
			14.00	**4.25**	------
658-13	Farmers' Choice	Lewisport Mill Co, Lewisport, Ky.	14.88	4.74	6.98
			14.00	**4.25**	------
923-14	Farmers' Choice	Lewisport Mill Co., Lewisport, Ky.	15.00	4.54	6.95
			14.00	**4.25**	**9.50**
663-12	Mixed Feed	Lewisport Mill Co., Lewisport, Ky.	15.00	3.91	------
			13.70	**3.85**	------
1011-12	Lone Mountain Mill Feed	Lone Mountain Mill Co., Lone Mountain, Tenn.	15.00	4.67	------
			15.06	**4.00**	**7.00**
42-13	Nonesuch Feed	Louisville Cereal Mill Co., Louisville, Ky.	11.50	8.13	7.35
			11.00	**7 80**	**6.60**
42-13	Nonesuch Feed	Louisville Cereal Mill Co., Louisville, Ky.	11.31	9.28	------
			11.00	**7.80**	**6.50**
42-13	Nonesuch Feed	Louisville Cereal Mill Co., Louisville, Ky.	10.66	7.55	7.23
			11.00	**7.80**	**6.50**
42-13	Nonesuch Feed	Louisville Cereal Mill Co., Louisville, Ky.	12.10	9.13	5.43
			11.00	**7.80**	**6.50**
612-12	Mixed Brans	Lycan Bros., Lafayette, Ky.	14.00	6.49	------
			14.75	**5.15**	------
1038-12	Cracker Jack Mixed Feed	Lewis & Adcock, Knoxville, Tenn.	12.13	2.93	5.19
			10.00	**4.00**	**6.50**
749-13	Mixed Feed	Lynn Milling Co., Hodgenville, Ky.	13.00	3.58	------
			14.00	**4.00**	------

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED	REMARKS—VARIANCE FROM GUARANTY
389-13	Stubblefield & Jones ___ Mayfield, Ky.	Wheat bran, Corn bran, Shipstuff, Ground Wheat Screenings 2%	
671-13	A. Koltinsky _____ Princeton, Ky.	Wheat bran, Corn bran_____	
36-12	Manufacturer's Warehouse.	Shipstuff, Corn bran_____	
105-13	Manufacturer's Warehouse.	Shipstuff, Corn bran_____	Below guaranty in protein.
504-12	Hudson & Davis _____ Danville, Ky.	Wheat bran, Corn bran _____	Below guaranty in fat.
504-12	G. B. Skinner _____ Woodbine, Ky.	Wheat bran, Corn bran _____	Below guaranty in fat.
504-12	Smith, Riley & Co. ____ Barbourville, Ky.	Wheat bran, Corn bran_____	Below guaranty in both protein and fat.
298-13	Hudson & Hughes _____ Lancaster, Ky.	Wheat bran, Corn bran_____	
487-13	Catlettsburg Feed& Pro. Co., Catlettsburg, Ky.	Middlings, Wheat bran, Corn bran.	
1037-13	Manufacturer's Warehouse.	Wheat bran, Corn bran_____	Below guaranty in fat.
839-12	Manufacturer's Warehouse.	Shipstuff, Corn bran, Wheat screenings 10 %.	Below guaranty in fat.
985-13	Manufacturer's Warehouse.	Shipstuff, Corn bran, Ground Wheat screenings 10 %	
662-12	A. D. Ashcraft_____ Irvington, Ky.	Shipstuff, Corn bran, Screenings 1 %.	
662-12	C. B. Carden & Co. ____ Fordsville, Ky.	Shipstuff, Corn bran, Screenings 1 %.	
658-13	Manufacturer's Warehouse.	Shipstuff, Corn bran, Ground Wheat screenings 1 %	Sample in shipstuff.
923-14	J. H. Roberts _____ Fordsville, Ky.	Shipstuff, Corn bran, Ground Wheat screenings 1 %.	
663-12	D. Zehnder_____ St. Matthews, Ky.	Wheat bran, Corn bran, Wheat screenings 5 %.	
1011-12	Magic City Grocery Co. Middlesboro, Ky.	Wheat bran, Wheat shorts, Corn bran, Wheat screenings 8 %.	
42-13	T. A. Porter & Co. _____ London, Ky.	Wheat bran. Hominy meal _____	
42-13	Pineville Feed & Grain Co., Pineville, Ky.	Hominy meal, Wheat bran _____	High in fiber.
42-13	Pineville Feed & Grain Co., Pineville, Ky.	Hominy meal, Wheat bran _____	
42-13	The White Grocery Co. _ Williamsburg, Ky.	Hominy meal, Wheat bran _____	
612-12	Geo. Bradley _____ Hopkinsville, Ky.	Wheat bran, Corn bran_____	Below guaranty in protein.
1038-12	Jellico Grocery Co. ____ Middlesboro, Ky.	Wheat bran, Corn meal, Hominy feed, Corn bran.	Contains oats and screenings. Below guaranty in fat.
749-13	Manufacturer's Warehouse.	Wheat bran, Corn bran_____	

TABLE II.—MIXED FEEDS, COMPOSED OF WHEAT AND CORN PRODUCTS, AND DISTILLERS' AND BREWERS' GRAINS.

Reg .No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
46-12	Mill Feed	Madison Milling Co.	16.69	5.63	------
		Richmond, Ky.	**14.00**	**5.25**	------
595-13	Mill Feed	Madison Milling Co.	17.03	4.60	6.25
		Richmond, Ky.	**14.00**	**4.25**	------
1007-12	"Bob White"	Madisonville Milling Co.	13.88	5.99	------
		Madisonville, Ky.	**12.98**	**3.77**	------
798-13	"Bob White "	Madisonville Milling Co.	15.53	4.23	7.60
		Madisonville, Ky.	**12.98**	**3.77**	------
897-12	Feeders' Favorite Mixed Feed	Marion Milling Co.	15.81	5.29	------
		Marion, Ky.	**14.40**	**4.60**	------
1140-13	Feeders' Favorite Mixed Feed	Marion Milling Co.	15.81	4.95	6.85
		Marion, Ky.	**14.44**	**4.60**	------
899-12	Mixed Feed	J. A. McAlister	16.38	3.88	------
		Stanley, Ky.	**14.68**	**4.95**	------
899-12	Mixed Feed	J. A. McAlister	15.38	4.55	7.30
		Stanley, Ky.	**14.68**	**4.95**	------
986-13	Mixed Feed	McKinney Milling Co.	15.13	4.60	6.58
		McKinney, Ky.	**15.63**	**3.59**	------
1376-12	Mixed Feed	McQuady Milling Co.	15.28	3.87	5.38
		McQuady, Ky.	**14.50**	**4.25**	------
69-13	Mixed Brans	McWhorter & Wells	14.75	3.96	10.48
		Springfield, Ky.	**13.41**	**3.30**	------
1158-12	Mixed Feed	Miller Milling Co.	16.00	3.68	------
		Utica, Ky.	**14.65**	**3.85**	------
1158-12	Mixed Feed	Miller Milling Co.	15.69	4.29	7.23
		Utica, Ky.	**14.65**	**3.85**	------
793-14	Mixed Feed	Mitchell-Taylor Milling Co.	14.25	4.08	6.60
		Nicholasville, Ky.	**15.00**	**3.50**	**8.25**
650-12	Mixed Feed	Model Roller Mills	14.06	3.98	------
		Smith's Grove, Ky.	**13.81**	**5.13**	------
15-13	Mixed Feed	Model Roller Mills	12.13	3.70	------
		Smith's Grove, Ky.	**13.81**	**5.13**	------
15-13	Mixed Feed	Model Roller Mills	14.47	4.20	6.48
		Smith's Grove, Ky.	**13.81**	**5.13**	------
40-13	Mixed Feed	Monarch Milling Co.	16.88	5.31	9.60
		Mt. Sterling, Ky.	**14.76**	**4.15**	------
833-12	White Rose Mixed Feed	Morganfield Roller Mills	15.50	5.19	------
		Morganfield, Ky.	**12.50**	**4.50**	------
833-12	White Rose Mixed Feed	Morganfield Roller Mills	15.44	4.33	------
		Morganfield, Ky.	**12.50**	**4.50**	------
869-13	White Rose Mixed Feed	Morganfield Roller Mills	16.97	4.33	------
		Morganfield, Ky.	**12.50**	**4.50**	------
893-12	Fine Feed	Mountain City Mill Co.	13.56	4.13	------
		Chattanooga, Tenn.	**12.50**	**5.50**	**8.50**
893-12	Fine Feed	Mountain City Mill Co.	13.56	5.55	------
		Chattanooga, Tenn.	**12.50**	**5.50**	**8.50**
689-13	Fine Feed	Mountain City Mill Co.	13.53	4.88	6.00
		Chattanooga, Tenn.	**12.50**	**5.50**	**8.50**
794-13	Mixed Brans	W. N. Neville	15.03	4.40	7.68
		Arlington, Ky.	**15.43**	**3.50**	------

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
46-12	Thomas Jameson & Co. Beattyville, Ky.	Wheat bran, Corn bran, Wheat screenings 5%	Sample is shipstuff, containing corn cockle.
595-13	O. W. Witt & Co. Irvine, Ky.	Wheat bran, Corn bran, Ground wheat screenings 5%	
1007-12	P. R. Cabell Madisonville, Ky.	Shipstuff, Corn bran, Wheat bran, Cheat 5%	
798-13	Manufacturer's Warehouse	Shipstuff, Corn bran, Wheat bran, Cheat	No corn bran present.
897-12	Manufacturer's Warehouse	Bran, Shipstuff, Corn bran, Screenings 2%	
1140-13	Morris & Son Marion, Ky.	Bran, Shipstuff, Corn bran, Unground wheat screenings 2%	
899-12	J. George & Son Spottsville, Ky.	Wheat bran, Middlings, Shipstuff, Corn grits	Below guaranty in fat.
899-12	Manufacturer's Warehouse	Wheat bran, Middlings, Shipstuff, Corn grits	No corn grits present.
986-13	Manufacturer's Warehouse	Wheat bran, Corn bran	Below in protein.
1376-12	Manufacturer's Warehouse	Wheat bran, Shipstuff, Corn bran	Below guaranty in fat.
69-13	Manufacturer's Warehouse	Wheat bran, Corn bran	No corn bran present.
1158-12	Manufacturer's Warehouse	Wheat bran, Middlings, Corn bran	
1158-12	Manufacturer's Warehouse	Wheat bran, Middlings, Corn bran	
793-14	M. F. Dixon Irvine, Ky.	Wheat bran, Corn bran, Ground wheat screenings 5%	Below guaranty in protein.
650-12	Martin & Ford Glasgow Junction, Ky.	Wheat bran, Corn bran, Wheat screenings 3%	Below guaranty in fat.
15-13	R. S. Martin Bowling Green, Ky.	Wheat bran, Corn bran, Wheat screenings 3%	Below guaranty in fat.
15-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Unground wheat screenings 3%	Below guaranty in fat.
40-13	Manufacturer's Warehouse	Wheat bran, Middlings, Corn bran	
833-12	Walker Bros. Morganfield, Ky.	Wheat bran, Corn bran	
833-12	Manufacturer's Warehouse	Wheat bran, Corn bran	
869-13	Walker Bros. Morganfield, Ky.	Wheat bran, Corn bran, Unground wheat screenings 3%	Sample is shipstuff.
893-12	The Jellico Grocery Co. Middlesboro, Ky.	Wht shorts, Mid'gs, Red Dog flour, Ground scr'gs 2%, Corn bran, Corn meal, Hominy f'd	Below guaranty in fat.
893-12	Delaney & White Williamsburg, Ky.	Wht shorts, Mid'gs, Red Dog flour, Ground scr'gs 2%, Corn bran, Corn meal, Hominy f'd	
689-13	Hodges Bros. Pineville, Ky.	Corn bran, C'n hearts, C'n meal, Wht shorts, Wheat mid'gs, Wht bran, Gr. wht scr'gs 2%	Below guaranty in fat.
794-13	L. B. Reno Wickliffe, Ky.	Wheat bran, Corn bran, Ground wheat screenings 1%	

TABLE II.—MIXED FEEDS, COMPOSED OF WHEAT AND CORN PRODUCTS, AND DISTILLERS' AND BREWERS' GRAINS.

Reg. No.	NAME OF FEED	MANUFACTURER.	Analysis.		
			Prot.	Fat.	Fiber.
883-12	Mixed Feed	New Haven Mill Co.	15.00	4.13	------
		New Haven, Ky.	**15.25**	**4.25**	------
537-13	Mixed Feed	New Haven Mill Co.	14.88	5.60	6.68
		New Haven, Ky.	**15.25**	**4.25**	------
396-12	Ideal Feed	E. F. Ogden	15.38	3.74	------
		Slaughtersville, Ky.	**13.00**	**4.00**	**12.00**
1372-13	Ideal Feed	E. F. Ogden	14.60	3.52	7.20
		Slaughtersville, Ky	**13.00**	**4.00**	**12.00**
726-13	Mill Feed	Ohio Valley Mill & Supply Co., Ashland, Ky.	13.19	5.35	8.90
			14.75	**6.00**	------
615-14	Mixed Feed	Owensboro Milling Co.	15.00	4.28	6.38
		Owensboro, Ky.	**15.85**	**4.13**	**8.25**
432-13	Mixed Feed	Paducah Milling Co.	15.00	5.00	------
		Paducah, Ky.	**15.00**	**4.35**	------
432-13	Mixed Feed	Paducah Milling Co.	16.63	3.88	------
		Paducah, Ky.	**15.00**	**4.35**	------
432-13	Mixed Feed	Paducah Milling Co.	16.35	4.67	8.30
		Paducah, Ky.	**15.00**	**4.35**	------
38-14	Mixed Feed	Paducah Milling Co.	12.72	4.18	4.95
		Paducah, Ky.	**5.00**	**4.35**	**8.50**
512-12	Mixed Feed	Paris Milling Co.	16.19	4.34	------
		Paris, Ky.	**15.50**	**4.00**	------
1126-13	Mixed Feed	Paris Milling Co.	16.06	4.91	7.80
		Paris, Ky.	**15.50**	**4.00**	**10.00**
1126-13	Mixed Feed	Paris Milling Co.	14.50	5.49	7.33
		Paris, Ky.	**15.50**	**4.00**	**10.00**
139-13	Mixed Feed	Park City Milling Co.	16.00	4.40	------
		Bowling Green, Ky.	**15.19**	**4.17**	------
139-13	Mixed Feed	Park City Milling Co.	16.00	4.75	------
		Bowling Green, Ky.	**15.19**	**4.17**	------
139-13	Mixed Feed	Park City Milling Co.	14.16	4.83	6.60
		Bowling Green, Ky.	**15.19**	**4.17**	------
943-13	Midget Mill Feed	Parks & Abrams	14.19	3.75	6.08
		Richmond, Ky.	**13.56**	**3.64**	------
819-12	Mixed Feed	Parrish & Hankins	14.69	3.85	------
		Providence, Ky.	**13.18**	**5.35**	------
510-13	Mixed Feed	Parrish & Hankins	15.19	3.88	6.63
		Providence, Ky.	**13.18**	**5.34**	------
153-12	Mill Run	The Patton Milling Co.	14.50	5.92	------
		Catlettsburg, Ky.	**13.75**	**3.50**	------
657-13	Mill Run	The Patton Milling Co.	15.44	5.70	------
		Catlettsburg, Ky.	**13.75**	**3.50**	------
657-13	Mill Run	The Patton Milling Co.	16.56	4.63	8.35
		Catlettsburg, Ky.	**13.75**	**3.50**	------
689-11	Mixed Feed	Peerless Roller Mills	15.75	3.75	------
		Beech Grove, Ky.	**14.81**	**3.40**	------
689-11	Mixed Feed	Peerless Roller Mills	15.75	4.33	7.23
		Beech Grove, Ky.	**14.81**	**3.40**	**9.50**
583-12	Mixed Feed	Pembroke Roller Mills Co.	15.81	4.63	------
		Pembroke, Ky.	**13.44**	**5.13**	------

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED	REMARKS—VARIANCE FROM GUARANTY
883-12	C. R. Barnes ---------- Bardstown, Ky.	Wheat bran, Shorts, Corn bran--	
537-13	Manufacturer's Warehouse	Wheat bran, Shorts, Corn bran--	
396-12	Manufacturer's Warehouse	Wheat bran, Corn bran, Shipstuff, Screenings 2%	
1372-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Shipstuff, Ground wheat screenings 2%	Contains more than 2% screenings.
726-13	Shouse & Kircheval---- Salt Lick, Ky.	Middlings, Wheat bran, Corn bran	Below guaranty in both protein and fat.
615-14	J. H. Roberts ---------- Fordsville, Ky.	Wheat bran, Shipstuff, Corn bran, Ground wheat screenings 1%	Below in protein.
432-13	R. D. Robinson-------- Mayfield, Ky.	Wheat bran. Corn bran----------	Shipstuff and corn meal.
432-13	H. Gallman---------- Paducah, Ky.	Wheat bran, Corn bran----------	Sample contains weed seeds, screenings.
432-13	W. W. McElrath ------ Murray, Ky.	Wheat bran, Corn bran----------	No corn bran present.
38-14	Charles Broyles ------- Paducah, Ky.	Wheat bran, Corn bran----------	Below in both protein and fat.
512-12	Ky. Block Cannel Coal Co., Cannel City, Ky.	Wheat bran, Wheat shorts, Wheat middlings, Corn bran 5%	
1126-13	Millersburg Coal & Lumber Co., Millersburg, Ky.	Wheat bran, Wheat shorts, Wheat middlings, Corn bran 5%	No corn bran present.
1126-13	James A. Wallace----- Irvine, Ky.	Wheat bran, Wheat shorts, Wheat middlings, Corn bran 5%	Below guaranty in protein.
139-13	Park City Feed Store-- Bowling Green, Ky.	Wheat bran, Corn bran, Wheat screenings 5%	
139-13	Park City Feed Store-- Bowling Green, Ky.	Wheat bran, Shorts, Corn bran, Ground wheat screenings 5%	
139-13	Phelps Bros. ---------- Bowling Green, Ky.	Wheat bran, Shorts, Corn bran, Ground wheat screenings 5%	
943-13	C. A. Flanery --------- Richmond, Ky.	Wheat bran, Shorts, Corn bran--	
819-12	Manufacturer's Warehouse	Wheat bran, Corn bran, Wheat screenings 5%	Below guaranty in fat.
510-13	Sugg & Co.---------- Providence, Ky.	Wheat bran, Corn bran, Ground wheat screenings 5%	Below guaranty in fat.
153-12	D. J. Burchett & Co. -- Louisa, Ky.	Middlings, Wheat bran, Corn bran	Contains oat hulls, screenings. wild buckwheat, weed seeds.
657-13	Spurlock Mercantile Co. Middle Creek, Ky.	Middlings, Whaat bran, Corn bran	Sample contains screenings (buckwheat, cheat, etc.)
657-13	The Z. Meek Co. ------ Catlettsburg, Ky.	Middlings, Wheat bran, Corn bran	Sample is wheat bran.
689-11	Manufacturer's Warehouse	Bran, Corn bran, Shipstuff, Wheat screenings 1%	
689-11	Manufacturer's Warehouse	Bran, Corn bran, Unground wheat screenings 1%	
583-12	Rose & Couch --------- Pembroke, Ky.	Wheat bran, Corn bran ---------	Below guaranty in fat.

TABLE II—MIXED FEEDS, COMPOSED OF WHEAT AND CORN PRODUCTS, AND DISTILLERS' AND BREWERS' GRAINS.

Reg. No.	NAME OF FEED.	MANUFACTURER	Analysis.		
			Prot.	Fat.	Fiber.
583-12	Mixed Feed	Pembroke Roller Mills Co., Pembroke, Ky.	15.78	4.90	------
			13.44	**5.13**	------
701-13	Mill Feed	Pembroke Roller Mills Co., Pembroke, Ky.	14 44	5.40	7.88
			15.44	**4.42**	**9.22**
934-9	Mixed Feed	People's Roller Mills, Newtown, Ky.	14.53	3.66	------
			15.19	**6.03**	------
381-12	Ideal Mill Feed	R. C. Poage Milling Co., Ashland, Ky.	13.81	6.31	------
			12.94	**4.65**	------
101-13	Ideal Mill Feed	R. C. Poage Milling Co., Ashland, Ky.	14.69	4.13	------
			12.94	**4.65**	------
101-13	Ideal Mill Feed	R. C. Poage Milling Co., Ashland, Ky.	14.75	5.20	------
			12.94	**4.65**	------
101-13	Ideal Mill Feed	R. C. Poage Milling Co., Ashland, Ky.	14.38	4.23	6.45
			12 94	**4.65**	------
545-12	Mixed Feed	Poole Milling Co., Poole, Ky.	15.68	3.35	------
			15.56	**4.13**	------
18-13	Mixed Feed	Poole Milling Co., Poole, Ky.	15.00	3.43	7.43
			14.50	**4.00**	------
667-12	Mixed Feed	R. L. Potts & Son White's Station, Ky.	15.00	4.74	------
			12.00	**3.00**	------
667-12	Mixed Feed	R. L. Potts & Son, White's Station, Ky.	16.53	3.37	------
			12.00	**3.00**	------
1266-12	Mixed Feed	J. C. Poynter, Bowling Green, Ky.	16.31	4.38	------
			13.68	**5.02**	------
591-13	Mixed Feed	J. E. Poynter & Co., Bowling Green, Ky.	14.09	4.98	6.88
			13.68	**5.02**	------
433-13	Mixed Feed	W. G. Prewitt, Perryville, Ky.	16.56	4.65	6.50
			14.50	**3.40**	------
408-13	Cream Patent Feed	J. B. Ramsey, Sebree, Ky.	15.68	3.88	------
			15.43	**4.28**	------
924-12	Peerless Feed	Red Cross Milling Co., Clay, Ky	14.69	3.83	------
			14.00	**3.00**	------
902-13	Mixed Feed	Riedling & Bro., Louisville, Ky.	15.50	4.50	8.79
			14.93	**4.19**	------
713-11	Dairy No. I Feed	J. M. Riley, Williamstown, Ky.	12.41	4.48	4.85
			12.00	**3.90**	------
1255-12	Mixed Feed	Rineyville Roller Mills, Rineyville, Ky.	14.06	4.73	8.28
			13.06	**4.92**	------
837-12	Kopp's Mixed Feed	Rockport Milling Co., Rockport, Ind.	14.13	4.23	------
			12.60	**4.10**	------
616-13	Mixed Feed	Rockport Milling Co., Rockport, Ind.	14.44	4.20	8.03
			14.75	**3.75**	------
717-13	Mixed Feed	Sadieville Milling Co., Sadieville, Ky.	15.50	4.13	6.57
			15.66	**4.13**	------
561-12	White Swan Mixed Feed	T. A. Sandefur, Henderson, Ky.	16.25	3.65	------
			15.25	**3.89**	------
746-13	White Swan Mixed Feed	T. A. Sandefur, Henderson, Ky.	14.60	3.84	------
			15.25	**3.89**	------
746-13	White Swan Mixed Feed	T. A. Sandefur, Henderson, Ky.	14.49	4.47	8.20
			15.25	**3.89**	------

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
------	J. H. Rose & Co. ------ Pembroke, Ky.	Wheat bran, Corn bran----------	
701-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Ground wheat screenings 2%	Below guaranty in protein.
934-9	G. M. Taylor ---------- Georgetown, Ky.	Wheat bran, Middlings, Corn bran	Below in protein and fat.
381-12	Big Sandy Milling Co.. Louisa, Ky.	Middlings, Wheat bran, Corn bran	
101-13	J. H. Campbell-------- Salt Lick, Ky.	Middlings, Wheat bran, Corn bran	Below guaranty in fat.
101-13	Morrell Supply Co. ---- Prestonburg, Ky.	Middlings, Wheat bran, Corn bran	
101-13	Bush & Bush ---------- Ashland, Ky.	Middlings, Wheat bran, Corn bran	
543-12	C. M. Cox---------- Sebree, Ky.	Wheat bran, Corn bran, Shipstuff	No corn bran present. Below guaranty in fat.
18-13	C. M. Cox---------- Sebree, Ky.	Wheat bran, Corn bran, Shipstuff	Below in fat.
667-12	Henderson & Doan ---- Berea, Ky.	Shipstuff, Wheat bran, Corn bran, Wheat screenings 20%	
667-12	W. O. Moore---------- Berea, Ky,	Shipstuff, Wheat bran, Corn bran, Wheat screenings 20%	Sample in shipstuff.
------	F. W. Alvis ---------- Bowling Green, Ky.	Wheat bran, Corn bran----------	Below guaranty in fat.
------	F. W. Alvis ---------- Bowling Green, Ky.	Wheat bran, Corn bran----------	
433-13	Danville Ice & Coal Co. Danville, Ky.	Wheat bran, Shipstuff, Corn bran	No corn bran present, but contains cockle.
408-13	A. J. Arnold ---------- Slaughtersville, Ky.	Wheat bran, Corn bran, Wheat screenings 5%	
924-12	Manufacturer's Warehouse	Wheat bran, Corn bran----------	
902-13	George Miners -------- Louisville, Ky.	Wheat bran, Corn bran, Shipstuff	
713-11	Manufacturer's Warehouse	Shipstuff, Feed meal ----------	
1255-12	Manufacturer's Warehouse	Wheat bran, Shorts, Corn bran--	
837-12	Owensboro Feed & Seed Co,, Owensboro, Ky.	Wheat bran, Middlings, Feed meal, Wheat screenings 3%	
616-13	Samuel Quick & Co.--- Louisville. Ky.	Wheat bran, Wheat Middlings, Corn bran, Unground wheat screenings 3%	
717-13	Manufacturer's Warehouse	Wheat bran, Corn bran----------	
561-12	Barnett Feed & Com. Co. Henderson, Ky.	Wheat bran, Corn bran, Wheat screenings 10%	
746-13	Barnett Feed & Com. Co. Henderson, Ky.	Wheat bran, Corn bran, Unground wheat screenings 4%	Below guaranty in protein.
746-13	Barnett Feed & Com. Co. Henderson, Ky.	Wheat bran, Corn bran, Unground wheat screenings 4%	

TABLE II.—MIXED FEEDS, COMPOSED OF WHEAT AND CORN PRODUCTS, AND DISTILLERS' AND BREWERS' GRAINS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis.		
			Prot.	Fat.	Fiber.
746-13	White Swan Mixed Feed	T. A. Sanderfur	14.69	3.77	9.25
		Henderson, Ky.	**15.25**	**3.89**	------
1196-11	Empress	Scobee & Guest	14.13	4.39	------
		Bagdad, Ky.	**15.35**	**5.60**	------
801-13	Mixed Feed	Scottsville Milling Co.	13.38	4.43	------
		Scottsville, Ky.	**15.62**	**4.50**	------
408-13	Cream Patent Feed	Sebree Light & Milling Co.	15.47	4.20	------
		Sebree, Ky.	**15.43**	**4.28**	------
565-12	Bostain's Feed	Sharpsburg Roller Mills	14.00	4.33	------
		Sharpsburg, Ky.	**14.31**	**4.98**	------
549-13	Mixed Feed	Shelby City Roller Mills	14.06	4.43	4.50
		Shelby City, Ky.	**14.00**	**4.73**	------
618-13	Mixed Feed	Simpson Co. Mills	15.13	5.12	6.90
		Franklin, Ky.	**15.62**	**4.94**	**5.14**
744-12	Mixed Feed	Smithfield Milling Co.	15.56	4.28	------
		Smithfield, Ky.	**15.00**	**4.50**	------
693-13	Mixed Feed	Smithfield Milling Co.	15.06	4.90	6.93
		Smithfield, Ky.	**15.00**	**4.50**	------
230-12	Smith's I. X. L. Mixed Feed	H. C. Smith & Son	15.13	4.30	------
		Harrodsburg, Ky.	**15.68**	**4.62**	------
940-12	Cow Feed	J. Allen Smith & Co.	16.13	4.18	------
		Knoxville, Tenn.	**14.50**	**4.00**	**8.00**
574-13	So-Mil-Co Mixed Feed	Somerset Milling Co.	12.88	4.40	4.30
		Somerset, Ky.	**14.44**	**5.00**	**7.00**
779-12	Mixed Feed	Southern Star Roller Mills	15.81	3.30	------
		Perryville, Ky.	**14.50**	**3.40**	------
531-12	Mixed Feed	E. F. Spears & Sons	16.25	4.25	------
		Paris, Ky.	**14.50**	**4.50**	**7.50**
1013-13	Mixed Feed	E. F. Spears & Sons	15.50	5.30	8.15
		Paris, Ky.	**14.50**	**4.60**	**7.50**
1296-13	Mixed Feed	Squires & Miller	14.97	3.58	6.78
		Cloverport, Ky.	**15.06**	**5.18**	**9.00**
562-13	Wheat and Corn Bran	D. E. Stahl & Son	13.78	4.13	6.80
		Barlow, Ky.	**14.00**	**4.00**	------
522-12	"Jersey"	Standard Roller Mill Co.	16.06	4.23	------
		Cerulean, Ky.	**15.00**	**4.00**	------
528-13	"Jersey"	Standard Roller Mill Co.	16.94	5.63	2.00
		Cerulean, Ky.	**15.00**	**4.00**	------
528-13	"Jersey"	Standard Roller Mill Co.	14.25	4.88	9.53
		Cerulean, Ky.	**15.00**	**4.00**	------
1345-12	Empress Feed	Star Milling Co.	14.38	3.90	6.33
		Bagdad, Ky.	**15.63**	**4.06**	------
346-13	Mixed Feed	Star Milling Co.	16.53	4.92	7.30
		Clinton, Ky.	**13.75**	**4.25**	------
307-12	Tip Top Feed	Star Milling Co.	14.88	4.33	------
		Nicholasville, Ky.	**14.41**	**3.71**	**7.54**
353-13	Tip Top Feed	Star Milling Co.	15.56	4.34	7.95
		Nicholasville, Ky.	**14.41**	**3.71**	**7.54**
928-12	Mixed Feed	Sturgis Milling Co.	15.75	4.13	------
		Sturgis, Ky.	**14.00**	**4.25**	------

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
746-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Unground wheat screenings 4%	Below guaranty in protein.
1196-11	McAfee & Schramme Shelbyville, Ky.	Wheat bran, Wheat middlings, Corn bran 10%	Below guaranty in both protein and fat.
801-13	J. W. Patton Scottsville, Ky.	Wheat bran, Wheat Shorts, Corn bran	Below guaranty in rpotein.
408-13	W. J. Kirk Madisonville, Ky.	Wheat bran, Corn bran, Ground wheat screenings 5%	Sample contains corn cockle.
565-12	I. F. Tabb Mt. Sterling, Ky.	Shipstuff, Corn bran, Wheat screenings 10%	
549-13	H. C. Catron Junction City, Ky.	Wheat bran, Shorts, Corn bran	
618-13	Manufacturer's Warehouse	Wheat bran, Corn bran	
744-12	Duncan & Co. LaGrange, Ky.	Wheat bran, Corn bran, Wheat screenings 2%	
693-13	Manufacturer's Warehouse	Wheat bran, Corn bran 3%, Ground wheat screenings 2%	
230-12	Manufacturer's Warehouse	Wheat bran, Corn bran, Shorts	Sample contains cockle. Below in protein.
940-12	The H. T. Hackney Co. Inc., Middlesboro, Ky.	Wheat bran, Wheat Shorts, Corn meal, Corn bran, Wheat scr'gs 1%	
574-13	Mrs. Carrie Albertson Somerset, Ky.	Wheat bran, Wheat middlings, Corn bran, Ground wheat scgs 2%	Below guaranty in protein and fat.
779-12	J. A. Oliver Livingston, Ky.	Wheat bran, Shipstuff, Corn bran	No corn bran present.
531-12	Swan-Dav Lumber Co. Clay City, Ky.	Wheat bran, Wheat shorts, Wheat middlings, Corn bran 5%, Wheat screenings 3%	No corn bran present.
1013-13	J. F. Griffing Mt. Vernon, Ky.	Wheat bran, Wheat Shorts, Wheat middlings Corn bran 5%, Wheat screenings 3%	
1296-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Shorts	Below guaranty in fat.
562-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Unground wheat screenings 5%	
522-12	Manufacturer's Warehouse	Wheat bran, Corn bran, Screenings 1%	
528-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Unground screenings 1%	Sample is fine middlings.
528-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Unground screenings 1%	Below guaranty in protein.
1345-12	Manufacturer's Warehouse	Wheat bran, Corn bran 10%, Ground screenings 10%	Below guaranty in protein.
346-13	Manufacturer's Warehouse	Wheat bran, Low grade flour, Corn bran, Unground wheat screenings 7%	
307-12	Manufacturer's Warehouse	Wheat bran, Shorts, Middlings, Corn bran, Wheat screenings 3%	Sample contains corn cockle.
353-13	R. A. Dodd Wilmore, Ky.	Wheat bran, Shorts, Middlings, Corn bran, Ground wheat sceenings 3%	
928-12	Manufacturer's Warehouse	Low grade flour, Wheat bran, Screenings 2%, Corn bran 10%	

TABLE II.—MIXED FEEDS, COMPOSED OF WHEAT AND CORN PRODUCTS, AND DISTILLERS' AND BREWERS' GRAINS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
940-13	Mixed Feed	Sturgis Milling Co.	15.31	4.05	6.73
		Sturgis, Ky.	**14.00**	**4.25**	------
578-12	Mixed Feed	Tell City Flouring Mills	14.72	4.17	------
		Tell City, Ind.	**14.00**	**4.00**	**9.00**
578-12	Mixed Feed	Tell City Flouring Mills	14.38	5.75	------
		Tell City, Ind.	**14.00**	**4.00**	**9.00**
457-13	Mixed Feed	Tell City Flouring Mills	16.10	4.50	8.43
		Tell City, Ind.	**14.00**	**4.00**	**9.00**
31-12	Belle Brans	J. W. Thompson	14.63	4.45	------
		Madisonville, Ky.	**14.75**	**4.25**	------
891-13	Belle Brans	J. W. Thompson	14.69	5.37	7.75
		Madisonville, Ky.	**14.75**	**4.29**	------
898-13	Camp's No. 2 White Middlings and Corn Bran	The Toledo Grain & Milling Co., Toledo, Ohio	15.56	5.10	6.20
			12.00	**4.00**	**6.00**
357-13	Cow Feed	Trenton Milling Co.	15.68	4.38	------
		Trenton, Ky.	**13.91**	**4.77**	------
1193-13	Mixed Feed	Trenton Milling Co.	15.47	4.97	7.95
		Trenton, Ky.	**13.56**	**4.78**	**8.75**
20-12	Mixed Feed	H. D. Tutt & Son	15.81	5.76	------
		Salem, Ky.	**15.93**	**4.03**	------
743-12	Mixed Feed	Uniontown Roller Mill Co.	16.13	5.28	------
		Uniontown, Ky.	**15.00**	**4.00**	------
743-12	Mixed Feed	Uniontown Roller Mill Co.	17.25	4.20	------
		Uniontown, Ky.	**15.00**	**4.00**	------
596-13	Mixed Feed	Uniontown Roller Mill Co.	13.66	4.50	8.15
		Uniontown, Ky.	**15.00**	**4.00**	------
478-13	Mixed Feed	VanArsdall & Graves	15.85	4.42	6.48
		Harrodsburg, Ky.	**15.68**	**4.62**	------
495-13	Mixed Feed	T. S. Vickers	14.81	3.90	7.35
		Hamlettsburg, Ill.	**14.02**	**3.49**	------
975-12	Concentrated Feed Stuff	Vine Grove Roller Mills Co.	16.31	4.39	------
		Vine Grove, Ky.	**15.94**	**4.84**	------
408-13	Cream Patent Feed	G. H. Warren & Son	15.00	4.08	7.83
		Sebree, Ky.	**15.43**	**4.28**	------
517-13	Cream Feed	Phil J. Weisenberger	14.22	4.50	8.20
		Midway, Ky.	**14.71**	**5.16**	------
613-12	National	A. P. White & Co.	16.00	4.20	------
		Cadiz, Ky.	**15.37**	**5.01**	**7.30**
397-13	National	A. P. White & Co.	13.91	3.51	------
		Cadiz, Ky.	**15.37**	**5.01**	**7.30**
237-12	Mixed Feed	Winchester Roller Mills	15.88	3.86	------
		Winchester, Ky.	**15.50**	**3.73**	------
692-13	Mixed Feed	Winchester Roller Mills	15.63	4.58	------
		Winchester, Ky.	**15.50**	**3.73**	------
692-13	Mixed Feed	Winchester Roller Mills	14.97	4.57	6.65
		Winchester, Ky.	**15.50**	**3.73**	------
692-13	Mixed Feed	Winchester Roller Mills	15.63	4.78	7.09
		Winchester, Ky.	**15.50**	**3.73**	------
119-12	Wolcott's Feed	J. F. Wolcott & Co.	15.50	4.25	7.25
		S. Carrollton, Ky.	**15.19**	**4.86**	------

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
940-13	Manufacturer's Warehouse	Low grade flour, Wheat bran, Unground wheat screenings 2%, Corn bran 10%	
578-12	W. C. Kelly, Hawesville, Ky.	Middlings, Shipstuff, Bran, Corn bran, Screenings 4%	
578-12	W. C. Kelly, Hawesville, Ky.	Middlings, Shipstuff, Bran, Corn bran, Screenings 4%	
457-13	A. D. Ashcraft, Irvington, Ky.	Middlings, Shipstuff, Bran, Corn bran, Screenings 4%	
31-12	P. R. Cabell, Madisonville, Ky.	Wheat bran, Corn bran	
891-13	Manufacturer's Warehouse	Wheat bran, Corn bran	
898-13	Consolidated Coal Co., Jenkins, Ky.	Wheat middlings, Fine white corn meal	
357-13	Manufacturer's Warehouse	Ground corn, Wheat bran, Middlings	
1193-13	Manufacturer's Warehouse	Wheat bran, Middlings, Corn bran	
20-12	Manufacturer's Warehouse	Wheat bran, Corn bran, Wheat screenings 2%	
743-12	W. J Kirk, Madisonville, Ky.	Shipstuff, Wheat bran, Corn bran, Wheat screenings 4%	
743-12	Pfeffer & Abell, Uniontown, Ky.	Shipstuff, Wheat bran, Corn bran, Wheat screenings 4%	
596-13	Manufacturer's Warehouse	Shipstuff, Wheat bran, Corn bran, Unground wheat screenings 5%,	Below guaranty in protein.
478-13	Manufacturer's Warehouse	Wheat bran, Corn bran, Shorts	No corn bran present.
495-13	L. N. Overby & Co., Murray, Ky.	Wheat bran, Corn bran, Shorts, Unground wheat screenings 6%	
975-12	Manufacturer's Warehouse	Wheat bran, Corn bran	
408-13	A. J. Arnold, Slaughtersville, Ky.	Wheat bran, Corn bran, Ground wheat screenings 5%	
517-13	Manufacturer's Warehouse	Wheat bran, Corn bran	Below guaranty in both protein and fat.
613-12	Julian Atwood, Cadiz, Ky.	Wheat bran, Corn bran	Below guaranty in fat.
397-13	Chappell & Cowherd, Cadiz, Ky.	Wheat bran, Corn bran	Below guaranty in both protein and fat.
237-12	R. J. Matthews, McCormick, Ky.	Shipstuff, Corn bran	No corn bran present.
692-13	W. R. Razor, Salt Lick, Ky.	Shipstuff, Corn bran	
692-13	Day Lumber & Coal Co. Clay City, Ky.	Shipstuff, Corn bran	No corn bran present. Below guaranty in protein.
692-13	Manufacturer's Warehouse	Shipstuff, Corn bran	No corn bran present.
119-12	Continental Feed Co., Drakesboro, Ky.	Wheat bran, Shipstuff, Corn bran, Screenings 5%	

TABLE II.—MIXED FEEDS, COMPOSED OF WHEAT AND CORN PRODUCTS, AND DISTILLERS' AND BREWERS' GRAINS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
979-12	Model Feed	R. H. Wolfe & Son, Georgetown, Ky.	15.97	4.83	------
			15.69	**4.56**	------
680-13	Model Feed	R. H. Wolfe & Son, Georgetown, Ky.	14.38	4.43	8.95
			15.69	**4.56**	------
545-13	Mixed Feed	Woodburn Milling Co., Woodburn, Ky.	15.94	4.30	------
			15.78	**4.85**	------
540-13	Mixed Feed	Woodburn Milling Co., Woodburn, Ky.	14.03	5.01	7.45
			15.18	**4.85**	------
307-13	Woolcott's Mixed Feed	Woolcott Flour Mills, Lexington, Ky.	16.44	4.89	7.78
			15.50	**3.73**	------
32-14	Woolcott's Mixed Feed	Woolcott Flour Mills, Lexington, Ky.	14.50	4.33	6.55
			15.50	**3.73**	**7.78**
598-12	Bonanza	J. W. Zaring Grain & Mill Co., Richmond, Ky.	13.50	6.08	------
			14.00	**3.75**	------
598-12	Bonanza	J. W. Zaring Grain & Mill Co., Richmond, Ky.	14.22	6.33	------
			14.00	**3.75**	------
598-12	Bonanza	J. W. Zaring Grain & Mill Co., Richmond, Ky.	13.66	6.18	------
			14.00	**3.75**	------
144-13	Bonanza	J. W. Zaring Grain & Mill Co., Richmond, Ky.	14.94	7.13	6.50
			14.00	**3.75**	------
	Brewers' Dried Grains.				
1222-13	Dry Malt	Falls City Brewing Co., Louisville, Ky.	28.88	8.11	14.30
			27.00	**7.00**	**17.00**
543-12	Brewers' Dried Grains	Lexington Brewing Co., Lexington, Ky,	29.78	6.90	------
			26.44	**6.66**	**14.19**
975-14	Brewers' Dried Grains	Lexington Brewing Co, Lexington, Ky.	31.69	7.68	13.83
			26.44	**6.66**	**14.19**
990-11	Brewers' Dried Grains	West Louisville Brewing Co. Louisville, Ky.	32.81	5.95	------
			35.19	**9.31**	------
	Distillers' Dried Grains.				
1042-10	Three D. Grains	The Dewey Bros. Co. Blanchester, Ohio	16.31	7.08	14.83
			18.00	**4.00**	**17.00**
1319-12	Eagle Three D. Grains	The Dewey Bros. Co. Blanchester, Ohio	31.69	10.35	------
			30.00	**10.00**	**13.00**
633-12	Distillers' Dried Grains	Ben Fryer & Son, Butler, Ky.	28.16	11.73	8.23
			24.50	**9.54**	**10.24**
458-13	Argo Dairy Feed	S. J. Greenbaum Co. Midway, Ky.	26.60	11.20	9.50
			26.00	**9.00**	**11.00**
458-13	Argo Dairy Feed	S. J. Greenbaum Co. Midway, Ky.	25.19	12.07	9.05
			26.00	**9.00**	**11.00**

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
979-12	Manufacturer's Warehouse	Shipstuff, Corn bran	
680-13	Manufacturer's Warehouse	Shipstuff, Corn bran	Below guaranty in protein.
545-13	W. F. Toops & Son, Bowling Green, Ky.	Wheat bran, Corn bran, Shorts	
540-13	W. A. Cassaday, Bowling Green, Ky.	Wheat bran, Corn bran	
307-13	Mountain Central R. R. Co., Campton Jc., Ky.	Wheat bran, Corn bran, Shorts, Middlings, Ground wheat scrgs. 2%	
32-14	Shouse & Kercheval, Salt Lick, Ky.	Wheat bran, Middlings, Shorts, Corn bran	Below guaranty in protein.
598-12	D. C. Wiggins, Richmond, Ky.	Wheat middlings, Wheat bran, Corn bran, Wheat screenings 25%	Below guaranty in protein.
598-12	C. B. Burke, Beattyville, Ky.	Wheat middlings, Wheat bran, Corn bran, Wheat screenings 25%	Sample contains corn cockle.
598-12	Pineville Feed & Grain Co., Pineville, Ky.	Wheat middlings, Wheat bran, Corn bran, Wheat screenings 25%	
144-13	Cole, Hughes & Co., Barbourville, Ky.	Wheat middlings, Wheat bran, Corn bran, Ground wheat scseenings 25%	
1222-13	G. F. Gauman, Louisville, Ky.	Barley malt, Rice	
543-12	Clarence Wilson, Lexington, Ky.	Barley malt, Indian rice, Refined grits	
975-14	David Cahill, Lexington, Ky.	Barley malt, Indian rice, Refined grits	
990-11	Mahoney & Luckhardt Louisville, Ky.	Malt, Corn grits	Below guaranty in both protein and fat.
1042-10	J. C. Everett & Co., Maysville, Ky.	Distillers' Dried Grains	Below guaranty in protein.
1319-12	J. C. Everett & Co., Maysville, Ky.	Corn, Oats, Barley, Malt	
633-12	Manufacturer's Warehouse	Corn, Rye, Barley	Below guaranty in protein.
458-13	Ben Fryer & Son, Butler, Ky.	Corn, Malt, Rye, Ground screenings 5%	
458-13	J. C. Everett & Co., Maysville, Ky.	Corn, Malt, Rye, Ground screenings 5%	Below guaranty in protein.

TABLE III—POULTRY FEEDS

Reg. No.	NAME OF FEED.	MANUFACTURER	Analysis.		
			Prot.	Fat.	Fiber.
708-13	Allneeda Poultry Feed	Allneeda Mills Co.	10.94	3.81	3.25
		E. St. Louis, Ill.	**10.00**	**4.00**	**5.00**
1171-12	Buckeye Scratch Feed	H. G. Brooks & Co.	10.31	3.33	2.98
		Louisville, Ky.	**10.56**	**2.89**	------
1259-12	Rex Chicken Feed	Cogar Grain & Coal Co.	8.94	2.43	------
		Harrodsburg, Ky.	**9.38**	**2.77**	------
1041-11	Corno Hen Feed	Corno Mills Co.	10.85	3.25	------
		St. Louis, Mo.	**10.00**	**3.50**	**5.00**
1309-12	Cu-Tu-No Chicken Feed	Curry, Tunis & Norwood	11.38	3.25	------
		Lexington, Ky.	**10.00**	**3.00**	**6.00**
3-11	Aunt Patsy's Poultry Feed	C. A. Dammann & Co.	15.31	4.94	9.18
		Memphis, Tenn.	**17.09**	**5.44**	**7.28**
351-8	Scratching Food	Darling & Co.	12.47	3.37	------
		Chicago, Ill.	**15.00**	**3.00**	------
839-14	Shamrock Chick Feed	John De Wine Company	12.41	7.83	4.88
		Yellow Springs, O.	**10.15**	**3.08**	**3.85**
838-14	Shamrock Scratch Feed	John De Wine Company	11.31	2.93	3.98
		Yellow Springs, O.	**11.17**	**3.08**	**2.46**
726-12	Dodd's Choice Chicken Feed	C. P. Dodd & Co.	11.06	3.01	------
		Louisville, Ky.	**10.35**	**3.28**	------
438-12	Good Luck Mill Feed	Good Luck Mills	10.38	3.07	------
		St. Louis, Mo.	**10.00**	**3.60**	**6.00**
1150-12	Nonesuch Poultry Feed	Louisville Cereal Mill Co.	11.00	2.79	2.25
		Louisville, Ky.	**10.97**	**3.28**	------
1077-13	Nonesuch Poultry Feed	Louisville Cereal Mill Co.	10.75	3.23	2.25
		Louisville, Ky.	**10.97**	**3.28**	------
1011-13	Eadan Scratch Feed	Early & Daniel Co.	11.31	3.38	2.30
		Cincinnati, Ohio.	**10 00**	**2.50**	**5.00**
120-13	Tuxedo Scratch Feed (no grit)	Early & Daniel Co.	11.13	3.25	3.03
		Cincinnati, Ohio.	**10.00**	**2.50**	**5.00**
1020-10	Red Comb Poultry Feed	Edwards & Loomis Co.	11.03	2.63	3.12
		Chicago, Ill.	**10.00**	**2.50**	**5.00**
1295-12	Red Comb Scratch Feed	Edwards & Loomis Co.	11.63	3.47	2.74
		Chicago, Ill.	**10.00**	**2.50**	**5.00**
1020-13	Bell Grain, Seed & Screenings	J. Chas. McCullough Seed Co., Cincinnati, O.	12.63	3.68	7.55
			10.00	**3.00**	**11.00**
1020-13	Bell Grain, Seed & Screenings	J. Chas. McCullough Seed Co., Cincinnati, O.	11.38	2.80	6.78
			10.00	**3.00**	**11.00**
720-13	Rex Chicken Feed	Paducah Milling Co.	11.31	3.00	2.34
		Paducah, Ky.	**11.66**	**3.13**	------
248-12	Quaker Scratching Grains	Quaker Oats Co.	12.44	3.10	------
		Chicago, Ill.	**10.00**	**2.50**	**5.00**
240-12	Schumacker Little Chick Feed (with grit).	Quaker Oats Co.	10.81	2.98	------
		Chicago, Ill.	**10.00**	**2.50**	**5.00**

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY
708-13	R. D. Robertson, Mayfield, Ky.	Corn, Oats, Kafir corn, Wheat, Sunflower seed	Sample contains barley and weed seeds.
1071-13	Manufacturer's Warehouse	Sunflower seed, Charcoal 1%, Oyster shell 1%, Cracked corn, Wheat, Oats, Kafir corn	
1259-12	Manufacturer's Warehouse	Corn, Barley, Oats, Wheat, Mica grit 9%	
1041-11	Forbes Mfg. Co., Hopkinsville, Ky.	Corn, Milo maize, Kafir corn, Sunflower seed	
1309-12	Manufacturer's Warehouse	Wheat, Corn, Oats, Barley, Kafir corn, Milo maize, Sunflower seed, Peas, Beans, Charcoal, Millet, Rape, Buckwheat	Sample does not contain peas, beans, millet, rape or buckwht, Other ingredients as guar'teed
3-11	Riedling Bros., Louisville, Ky.	Wheat bran, Corn bran, Corn meal, Alfalfa meal, Oyster shells 6½%, Beef meal, Corn chop, White shorts	Contains large per cent of oats. Below guaranty in protein and fat and above in fiber.
351-8	St. Bernard Mining Co. Earlington, Ky.	Corn, Wheat, Barley, Oats, Buckwheat, Kafir corn. Sunflower seed, Oat cake, Grit 3%, Crushed shells 4%, Charcoal 25%	Below guaranty in protein.
839-14	J. J. Willinbrink, Bellevue, Ky.	Cracked corn, Cracked wheat, Weed seeds 10%, Grit 6%	More than 10% weed seeds present.
838-14	J. J. Willinbrink, Bellevue, Ky.	Cracked corn, Wheat, Kafir corn, Weed seeds 5%, Grit 6%	Contains barley, buckwht and oats, besides ingredients grt'd
726-12	M. T. Cain, Central City, Ky.	Corn, Wheat, Kafir corn, Sunflower seed, Charcoal	Sample contains large per cent of oats.
438-12	B. W. Wright, Frankfort, Ky.	Wheat, Corn, Millet, Kafir corn, Milo maize, Grit 5%, Various grain screenings 10%	
1150-12	Schramme & Smith, Shelbyville, Ky.	Wheat, Cracked corn, Oats, Kafir corn, Barley, Sunflower seed	Below guaranty in fat.
1077-13	Geo. H. Ratterman & Co., Louisville, Ky.	Wheat, Cracked corn, Oats, Kafir corn, Barley, Sunflower seed	
1011-13	Fayette Coal, Grain & Feed Co., Lexington, Ky	Corn, Wheat, Oats, Buckwheat, Kafir, Sunflower seed, Rye, Barley	
120-13	F. Besse & Son, Bellevue, Ky.	Cracked corn, Wheat, Oats, Sunflower seed, Barley, Buckwheat, Kafir	No buckwht or kafir corn present. Cont's corn cockle & cheat
1020-10	Catlettsburg Feed & Produce Co., Catlettsburg, Ky,	Wheat, Cracked corn, Kafir corn, Barley, Oats, Sunflower seed, Buckwheat, Grit 3%, Shells 3%, Charcoal 1%	
1295-12	H. Riesenburg & Co., Newport, Ky.	Wht, Cracked corn, Kafir corn, Barley, Oats, Sunflower seed, Buckwheat, Charcoal 1%	
1020-13	W. R. Henderson, Vanceburg, Ky.	Corn, Wheat, Rye, Oats, Barley, Buckwheat. Kafir corn, Sunflower seed, Weed seeds and screenings 15%, Limestone grit 10%	
1020-13	Catlettsburg Feed & Produce Co., Catlettsburg, Ky.	Corn, Wheat, Rye, Oats, Barley, Buckwheat, Kafir corn, Cane seed, Millet seed, Sunflower seed, Weed seeds and screenings 15%, Limestone grit 10%	
720-13	Broach & Jones, Murray, Ky.	Cracked corn, Wheat, Wheat screenings 50%	
248-12	Smith & Newson, Princeton, Ky.	Wheat, Kafir corn, Barley, Corn, Buckwht, Sunfl'er seed, Charcoal	Besides ingredients guaranteed, contains oats, milo maize and weed seeds.
240-12	E. L. Martin & Co., Lexington, Ky.	Wheat, Kafir corn, Millet, Cracked corn, Oat groats, Pigeon grass, Charc'l, Marble grit 6%	

TABLE III.—POULTRY FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER.	Analysis.		
			Prot.	Fat.	Fiber.
223-13	Daisy Hen Feed with grit	Quaker Oats Co.	9.75	3.31	2.49
		Chicago, Ill.	**10.00**	**2.50**	**5.00**
1163-13	Blue Hen Scratch Feed	Rapier Sugar Feed Co.	11.94	3.68	3.50
		Owensboro, Ky.	**10.00**	**3.00**	**5.00**
1338-12	Tip Top Chicken Feed	J. A. Shaver	11.75	3.35	3.65
		Greenville, Ky.	**11.10**	**3.00**	------
1181-12	Eclipse Poultry Feed	W. H. Small & Co.	11.13	3.19	------
		Evansville, Ind.	**8.53**	**2.14**	------
1001-12	Atlas Scratch Feed	Southern Seed Co.	10.91	3.20	------
		Louisville, Ky.	**10.00**	**3.00**	**6.00**
147-13	Atlas Scratch Feed	Southern Seed Co.	11.00	3.56	2.40
		Louisville, Ky.	**10.00**	**3.00**	**6.00**
1118-12	Sterling Poultry Feed	I. F. Tabb	10.38	3.38	------
		Mt. Sterling, Ky.	**9.56**	**3.29**	------
649-13	Egg Scratch	The Van Leunen Co.	10.13	3.45	3.30
		Covington, Ky.	**10.00**	**3.83**	------
822-13	Virginia Poultry Feed	Virginia-Carolina Feed Co.	11.53	3.69	------
		St. Louis. Mo.	**10.00**	**4.00**	**5.00**

TABLE IV.—MISCELLANEOUS MIXED FEEDS.

770-12	Jersey Sugar Feed	Allneeda Mills Co.	10.52	1.94	
		E. St. Louis, Ill.	**10.40**	**1.80**	**27.60**
712-13	Allneeda Horse and Mule Feed	Allneeda Mills Co.	9.53	2.84	11.13
		E. St. Louis, Ill.	**10.00**	**3.50**	**12.00**
712-13	Allneeda Horse and Mule Feed	Allneeda Mills Co.	11.53	2.69	11.85
		E. St. Louis, Ill.	**10.00**	**3.50**	**12.00**
203-14	Allneeda Horse and Mule Feed	Allneeda Mills Co.	10.94	2.45	11.78
		E. St. Louis, Ill.	**9.00**	**2.00**	**12.00**
707-13	Butterfat Dairy Feed	Allneeda Mills Co.	9.51	1.40	9.94
		E. St. Louis, Ill.	**16.00**	**4.50**	**12.00**
707-13	Butterfat Dairy Feed	Allneeda Mills Co.	13.72	3.50	10.28
		E. St. Louis, Ill.	**16.00**	**4.50**	**12.00**
714-13	Dexter Horse and Mule Feed	Allneeda Mills Co.	8.71	2.60	8.22
		E. St. Louis, Mo.	**10.00**	**3.25**	**12.00**
204-14	Virginia Horse and Mule Feed	Allneeda Mills Co.	10.25	2.30	11.18
		E. St. Louis, Ill.	**9.00**	**2.00**	**12.00**
589-14	XX Good Feed and Molasses	Allneeda Mills Co.	11.13	2.95	10.03
		E. St. Louis, Ill.	**9.00**	**1.50**	**12.00**
23-10	Sucrene Horse and Mule Feed	American Milling Co.	10.81	3.30	10.89
		Chicago, Ill.	**10.00**	**3.50**	**12.00**

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
223-13	Geo. W. Riedling ----- Louisville, Ky.	Wheat, Kafir corn, Cracked corn, Buckwht, Sunflower seed, Ground oyster shells 3%, Marble grit 3%	Besides ingredients guaran'd, sample contains barley, oats and wild buckwheat.
1163-13	Rogers Hughes Co. ---- Central City, Ky.	Corn, Wheat, Kafir corn, Sunflower seed, Buckwheat, Shells 5%.	Sample contains wild buckwheat and other weed seeds, oats and charcoal besides ingredients guaranteed.
1338-12	Manufacturer's Warehouse.	Wheat, Cracked corn, Millet, Sunflower seed, Oats.	
1181-12	St. Bernard Mining Co. Earlington, Ky.	Wheat, Kafir, Sunflower seed, Corn, Oyster Shells 10%.	
1001-12	Bedford & Tuttle ------ Winchester, Ky.	Wheat, Corn, Oats, Barley, Kafir corn, Milo maize. Sunflower seed, Peas, Beans, Charcoal, Millet, Rape, Buckwheat.	Sample does not contain peas, beans, millet, rape or buckwheat. Other ingredients as guaranteed.
147-13	Cooper & Craycroft --- Vine Grove, Ky.	Wheat, Corn, Oats, Barley, Kafir corn, Milo maize, Sunflower seed, Charcoal.	No charcoal present.
1118-12	Manufacturer's Warehouse.	Corn, Wheat, Oats, Sorghum, Kafir corn. Sunflower seed, Bone grit 5%.	
649-13	Manufacturer's Warehouse.	Kafir corn, Sunflower seed, Wheat, Cracked corn, Buckwheat, Oats, Mica grit 3%, Charcoal.	Sample contains a large per cent of sorghum. No buckwheat present.
822-13	Riedling Bros. ---------- Louisville, Ky,	Corn, Oats, Kafir corn, Wheat, Sunflower seed.	Found flax, wild buckwheat and mustard besides ingredients guaranteed.

Analyses of Inspectors' Samples.

770-12	C. K. Bell ---------- Paducah, Ky.	Alfalfa Meal, Molasses	
712-13	Chris Miller's Sons ---- Louisville, Ky.	Corn, Oats, Alfalfa, Molasses, Ground wheat	Below guaranty in protein.
712-13	R. D. Robertson ------ Mayfield, Ky.	Corn, Oats, Alfalfa, Molasses, Ground wheat, Salt 1%	Below guaranty in fat.
203-14	Henderson Feed & Com. Co., Henderson, Ky.	Corn, Oats, Alfalfa, Molasses, Salt 1%	
707-13	Chris Miller's Sons ---- Louisville, Ky.	Cotton seed meal, Brewers' grains, Alfalfa, Molasses, Ground wheat & Oat Screenings 15%, Salt 1%	Did not find cotton seed meal. Below guaranty in both protein and fat.
707-13	M. Woosley & Sons---- Elizabethtown, Ky.	Cotton seed meal, Brewers' grains, Alfalfa, Molasses, Ground wheat and Oat screenings 15%, Salt 1%	No cotton seed meal present. Below guaranty in both protein and fat.
714-13	Chris Miller's Sons ---- Louisville, Ky.	Corn, Oats, Alfalfa, Molasses, Ground wheat & Oat screenings10%, Salt 1%	Below guaranty in both protein and fat.
204-14	E. L. Malloy Grain Co. Paducah, Ky.	Corn, Oats, Alfalfa, Molasses, Salt 1%	
589-14	Weaverton Feed Co. --- Henderson, Ky.	Cracked corn, Whole oats, Ground alfalfa, Molasses, Ground grain screenings 15%, Salt 1%	
23-10	Dodson & Denton ------ Paris, Ky.	Corn, Oats, Barley, Wheat, Grain screenings 15%, Molasses, Salt ½ of 1%	No wheat present.

TABLE IV.—MISCELLANEOUS MIXED FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
501-13	Sucrene Horse and Mule Feed	American Milling Co. Peoria, Ill.	10.23 **10.00**	3.42 **2.50**	9.15 **12.00**
501-13	Sucrene Horse and Mule Feed	American Milling Co. Peoria, Ill.	10.25 **10.00**	3.09 **2.50**	11.55 **12.00**
502-13	Sucrene Alfalfa Horse and Mule Feed	American Milling Co. Peoria, Ill.	11.13 **11.00**	3.11 **2.05**	13.56 **12.00**
1497-13	Peerless Cow Feed	The J. S. Ashbrook Co. Mattoon, Ill.	16.63 **14.00**	5.75 **3.00**	10.68 **12.00**
1005-12	Auburn Mills Dairy Feed	The Auburn Mills Auburn, Ky.	23.10 **19.03**	4.83 **5.65**	------ ------
1410-13	Perfection Horse Feed	Beaver Dam Milling Co. Beaver Dam, Ky.	13.56 **12.50**	5.38 **4.25**	9.65 **10.48**
818-12	Ubico Union Grains	J. W. Biles Co. Cincinnati, Ohio.	25.28 **24.00**	7.50 **7.00**	10.36 **9.00**
142-12	Peerless Cow Feed	Blue Grass Commission Co. Lexington, Ky.	20.88 **19.50**	5.43 **5.45**	------ ------
239-13	Peerless Cow Feed	Blue Grass Commission Co. Lexington, Ky.	21.06 **19.50**	5.40 **5.45**	7.53 ------
266-14	Peerless Cow Feed	Blue Grass Commission Co. Lexington, Ky.	20.38 **19.50**	4.90 **5.45**	6.20 **7.60**
143-12	Monarch Horse Feed	Blue Grass Commission Co. Lexington, Ky.	10.69 **10.87**	3.74 **3.77**	------ ------
568-12	Alfalfa and Chop Feed	A. H. Bowman & Co. Louisville, Ky.	13.69 **13.75**	3.54 **3.47**	------ ------
1012-13	Jewel Alfalfa Horse Feed	Bradley Bros. Paducah, Ky.	11.97 **11.69**	2.98 **3.12**	10.58 ------
1012-13	Jewel Alfalfa Horse Feed	Bradley Bros. Paducah, Ky.	11.63 **11.69**	2.78 **3.12**	7.78 ------
193-12	Callahan's Columbia Crushed Feed	Callahan & Sons Louisville, Ky.	11.44 **10.15**	3.93 **3.48**	------ ------
193-12	Callahan's Columbia Crushed Feed	Callahan & Sons Louisville, Ky.	11.69 **10.15**	3.81 **3.48**	------ ------
495-14	Graino Mash Feed	Conrad J. Clausen Louisville, Ky.	26.10 **24.50**	4.40 **5.13**	8.65 **7.65**
465-13	Dixie Horse and Mule Feed	Dixie Mills Co., E. St. Louis, Ill.	9.25 **10.00**	5.29 **3.00**	9.25 **12.00**
465-13	Dixie Horse and Mule Feed	Dixie Mills Co., E. St. Louis, Ill.	10.31 **10.00**	3.05 **3.00**	11.93 **12.00**
124-14	Dixie Horse and Mule Feed	Dixie Mills Co., E. St. Louis, Ill.	11.19 **10.00**	2.99 **2.50**	11.60 **12.00**
731-12	Crushed Feed	C. P. Dodd & Co., Louisville, Ky.	10.75 **12.06**	4.10 **4.83**	------ ------
478-14	Crushed Feed	C. P. Dodd & Co., Louisville, Ky.	10.97 **12.06**	3.88 **4.83**	4.83 **6.50**
1045-12	Dodd's Molasses Feed	C. P. Dodd & Co., Louisville, Ky.	12.06 **11.63**	4.05 **3.63**	------ ------

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED	REMARKS—VARIANCE FROM GUARANTY
501-13	Dodson & Denton, Paris, Ky.	Recleaned grain screenings 30%, Molasses, Cracked corn, Linseed meal, Rolled oats, Salt	
501-13	J. F. Griffin, Mt. Vernon, Ky.	Molasses, Cracked corn, Linseed meal, Rolled oats, Salt, Recleaned grain screenings 30%	
502-13	W. E. Ellis, Hartford, Ky.	Molasses, Alfalfa, Crushed corn, Linseed meal, Rolled oats, Rolled barley, Recleaned grain screenings 20%, Salt	
1497-13	J. H. Harmon, Henderson, Ky.	Corn, Wheat bran, Cotton seed meal, Alfalfa meal, Rice bran, Ground flax seed, Ground flax screenings 3%, Molasses	
1005-12	Auburn Mills Store, Auburn, Ky.	Wheat bran, Corn bran, Cotton seed meal	Below guaranty in fat.
1410-13	James Taylor, Beaver Dam, Ky.	Oats, Wheat bran, Shipstuff, Corn bran, Ground wheat screenings 1%	Sample contains oat hulls.
818-12	Hart Wallace, Shelbyville, Ky.	Distillers' dried grains, Choice Cotton seed meal, Old process linseed meal, White wheat middlings, Winter wheat bran, hominy meal, ¾% table salt	
142-12	Floyd Day & Co., Jackson, Ky.	Cotton seed meal, Shipstuff, Corn, Oats, Barley	
239-13	Mountain Cent. R. R. Co., Campton Junct., Ky.	Cotton seed meal, Shipstuff, Corn, Oats, Barley	
266-14	Burnett & Drake, Beattyville, Ky.	Cotton seed meal, Shipstuff, Corn, Oats, Barley	Below guaranty in fat.
143-12	Lex. Omnibus & Tran Co, Lexington, Ky.	Corn, Oats, Barley, Bran	
568-12	Manufacturer's Warehouse	Alfalfa, Corn, Oats, Shorts	
1012-13	T. J. Wood, Lone Oak, Ky.	Alfalfa, Syrup, Corn, Oats	
1012-13	Illinois Coal & Feed Co., Paducah, Ky.	Alfalfa, Syrup, Corn, Oats	
193-12	Louisv. Hay & Grain Co, Louisville, Ky.	Corn, Oats, Bran	
193-12	W. E. Hess, Louisville, Ky.	Corn, Oats, Bran	
495-14	Manufacturer's Warehouse	Dandy middlings, Bran, Feed meal, Alfalfa meal, Beef scraps, Gluten meal, Oil meal, Ground oats	Below guaranty in fat.
465-13	W. W. Shadburne, Louisville, Ky.	Ground alfalfa, Ground oats, Ground corn, Cotton seed meal, Molasses	Below guaranty in protein.
465-13	C. W. Hill & Bro., Morgantown, Ky.	Ground alfalfa, Ground corn, Oats, Cotton seed meal, Molasses	
124-14	J. H. Harmon, Henderson, Ky.	Ground alfalfa, Corn, Oats, Cotton seed meal, Sugar cane molasses	
731-12	Wm. Norton's Son, Louisville, Ky.	Corn, Oats, Wheat	Below guaranty in both protein and fat.
478-14	Henry Stanton, Louisville, Ky.	Corn, Oats, Wheat bran	Below guaranty in both protein and fat.
1045-12	F. A. Ratterman & Co., Louisville, Ky.	Molasses, Alfalfa, Corn, Oats, Wheat bran	

TABLE IV.—MISCELLANEOUS MIXED FEEDS.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
93-13	Dodd's Molasses Feed	C. P. Dodd & Co.	11.19	4.14	------
		Louisville, Ky.	**11.63**	**3.63**	------
93-13	Dodd's Molasses Feed	C. P. Dodd & Co.	10.66	3.45	------
		Louisville, Ky.	**11.63**	**3.63**	------
93-13	Dodd's Molasses Feed	C. P. Dodd & Co.	11.56	3.33	10.40
		Louisville, Ky.	**11.60**	**3.63**	------
105-12	Cerealia Chop	The Early & Daniel Co.	13.81	3.83	------
		Covington, Ky.	**12.53**	**4.29**	------
893-13	Cerealia Sweets for the Dairy	The Early & Daniel Co.	17.31	3.17	7.62
		Covington, Ky.	**18.00**	**4.50**	------
936-13	Ceralia Sweets for the Dairy	The Early & Daniel Co.	15.06	3.45	6.33
		Cincinnati, Ohio.	**18.00**	**4.50**	**8.00**
965-13	Tuxedo Chop	The Early & Daniel Co.	13.12	4.25	9.93
		Covington, Ky.	**12.50**	**4.00**	**10.00**
935-13	Tuxedo Chop	The Early & Daniel Co.	12.03	3.58	8.60
		Cincinnati, Ohio.	**12.50**	**4.00**	**10 00**
104-12	Alfalfa Cerealia	The Early & Daniel Co.	23.38	5.25	11.24
		Covington, Ky.	**23.00**	**5.08**	**10.00**
110-13	Alfalfa Cerealia	The Early & Daniel Co.	24.44	4.50	11.83
		Cincinnati, Ohio.	**23.00**	**5.08**	**10.00**
79-13	Arrowfalfa	Edinger & Co.	10.60	3.49	------
		Louisville, Ky.	**11.06**	**4.18**	------
480-12	E-Co-Falfa Feed	Edinger & Co.	12.22	3.18	------
		Louisville, Ky.	**12.50**	**3.74**	------
702-14	Arrowfalfa Horse & Mule Feed	Edinger & Co.	11.80	2.00	13.44
		Louisville, Ky.	**11.00**	**3.50**	**13.00**
1473-13	Reliable Horse Feed	Excelsior Feed Milling Co.	11.19	2.97	10.23
		St. Joseph, Mo.	**10.00**	**3.50**	**15.00**
14-13	Ferger's Nutritia Horse Feed	The Ferger Grain Co.	7.97	2.88	7.06
		Cincinnati, Ohio.	**12.00**	**4.00**	**10.00**
471-12	Blue Grass Horse Feed	Henry Fruechtenicht	11.31	3.30	------
		Louisville, Ky.	**10.00**	**2.40**	------
424-13	Good Luck Molasses Feed	Good Luck Mills	11.53	2.60	10.30
		St. Louis, Mo.	**9.00**	**1.50**	**12.50**
644-14	Acme Mill Feed	Greenup Milling Co.	12.75	2.85	3.30
		Greenup, Ky.	**12.19**	**2.60**	**2.90**
858-14	Kingfalfa Horse Feed	Howard H. Hanks Co.	11.88	2.58	11.28
		Chicago, Ill.	**9.00**	**2.00**	**15.00**
778-13	Golden Grain and Alfalfa Feed	H. P. Hawkins	10.53	3.10	------
		Paducah, Ky.	**10.33**	**3.05**	**9.78**
299-13	Golden Grain Feed	H. P. Hawkins & Son	11.03	2.48	8.24
		Paducah, Ky.	**10.33**	**3.05**	**9.78**
299-13	Golden Grain Feed	H. P. Hawkins & Son	11.69	2.44	11.80
		Paducah, Ky.	**10.33**	**3.05**	**9.78**

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED	REMARKS—VARIANCE FROM GUARANTY
93-13	Henry Stanton ..... Louisville, Ky.	Molasses, Alfalfa, Corn, Oats, Wheat bran.	
93-13	F. A. Ratterman ..... Louisville, Ky.	Molasses, Alfalfa, Corn, Oats, Wheat bran.	Below guaranty in protein.
93-13	Henry Stanton ..... Louisville, Ky.	Molasses, Alfalfa, Corn, Oats, Wheat bran.	Sample contains barley.
105-12	The Consolidated Coal & MiningCo., Erlanger, Ky.	Wheat, Oats, Yellow corn, Oil Meal, Bran, Alfalfa meal.	Below guaranty in fat.
893-13	Fred Turner ..... Butler, Ky.	Corn meal, Cotton Seed meal, Molasses, Brewers' grains, Distillers' dried grains, Cotton Seed meal.	Below guaranty in both protein and fat.
936-13	Bedford & Tuttle ..... Winchester, Ky.	Brewers' grains, Distillers' grains, Cotton Seed meal, Corn meal, Malt sprouts, Molasses.	Sample contains weed seeds. Below guaranty in both protein and fat.
965-13	W. J. Sutton ..... Newport, Ky.	Corn, Oats, Alfalfa meal, Brewers' grains, Molasses.	Sample contains weed seeds. Below guaranty in both protein and fat.
935-13	Pineville Feed & Grain Co., Pineville, Ky.	Corn, Oats, Alfalfa meal, Brewers' Grain, Molasses.	
104-12	Bud Hamilton ..... Latonia, Ky.	Alfalfa, Flax seed, Cotton Seed meal, Wheat bran, Wheat middlings, Corn, Distillers' dried grains, Malt sprouts, Brewers' grains.	
110-13	W. R. Henderson ..... Vanceburg, Ky.	Alfalfa meal, Oil meal, Cotton Seed meal, Wheat bran, Wheat middlings, Corn, Distillers' dried grains, Malt sprouts.	Below in protein and fat and high in fiber.
79-13	Schreiber Bros. ..... Louisville, Ky	Alfalfa, Corn, Oats, Molasses ...	Below guaranty in both protein and fat.
480-12	Geo. H. Ratterman & Co., Louisville, Ky.	Corn, Oats, Alfalfa, Wheat bran.	Sample contains corn branand weed seeds. No wheat bran present. Below guarantyin fat
702-14	Frank Birchler ..... Louisville, Ky.	Oats, Corn, Barley, Alfalfa, Molasses.	Below guaranty in fat.
1473-13	The White Grocery Co. Williamsburg, Ky.	Alfalfa meal, Corn chop, Oats, Molasses, Salt 1%.	Below guaranty in fat.
14-12	W. J. Sutton ..... Newport, Ky.	Oats, Cracked corn, Wheat bran, Alfalfa meal, Cotton Seed meal, Molasses.	Below guaranty in both protein and fat. No cotton seed meal present.
471-12	Mahoney & Luckhardt Louisville, Ky.	Corn, Oats, Alfalfa, Molasses.	
424-13	George A. Reasor ..... Clay, Ky.	Cracked corn, Whole oats, Ground alfalfa, Molasses.	
644-14	John Jeems ..... Louisa, Ky.	Wheat bran, Middlings, Rye, Corn.	
858-14	Park City Feed Store .. Bowling Green, Ky.	Alfalfa meal, Cracked corn, Oats, Molasses.	
778-12	Kennedy & Buey ..... Murray, Ky.	Corn, Oats, Alfalfa, Molasses ...	
299-13	W. W. McElrath ..... Murray, Ky.	Corn, Oats, Alfalfa, Molasses ...	Below guaranty in fat.
299-13	G. F. Phillips ..... Paducah, Ky.	Corn, Oats, Alfalfa, Molasses ..	Below in fat and high in fiber.

TABLE IV.—MISCELLANEOUS MIXED FEEDS

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
1190-13	Hess's Crushed Feed	W. E. Hess & Co.	11.81	4.67	15.33
		Louisville, Ky.	**11.88**	**5.59**	**8.04**
1374-13	Hess's Molasses Crushed Feed	W. E. Hess & Co.	11.75	2.75	10.60
		Louisville, Ky.	**12.25**	**2.75**	**12.00**
1374-13	Hess's Molasses Crushed Feed	W. E. Hess & Co.	12.06	2.51	13.08
		Louisville, Ky.	**12.25**	**2.75**	**12.00**
414-13	Star Molasses Feed	Illinois Feed Mills	10.55	2.16	10.32
		St. Louis, Mo.	**9.00**	**1.50**	**12.00**
414-13	Star Molasses Feed	Illinois Feed Mills	10.41	2.43	10.08
		St. Louis, Mo.	**9.00**	**1.50**	**12.50**
414-13	Star Molasses Feed	Illinois Feed Mills	10.28	2.70	10.28
		St. Louis, Mo.	**9.00**	**1.50**	**12.50**
919-13	Kay Molasses Feed	Kornfalfa Feed Milling Co.	11.94	1.40	13.43
		Kansas City, Mo.	**8.00**	**1.50**	**17.00**
586-12	Kornfalfa Kandy Feed	Kornfalfa Feed Milling Co.	10.81	3.20	10.95
		Kansas City, Mo.	**9.00**	**2.50**	**12.00**
917-13	Kornfalfa Feed	Kornfalfa Feed Milling Co.	10.81	3.23	13.98
		Kansas City, Mo.	**10.00**	**3.50**	**12.00**
917-13	Kornfalfa Feed	Kornfalfa Feed Milling Co.	11.88	3.23	13.35
		Kansas City, Mo.	**10.00**	**3.50**	**12.00**
127-13	Old Process Laxo Cake Meal	Laxo Cake Meal Co.	26.53	9.93	10.58
		Chicago, Ill.	**25.00**	**6.00**	**11.00**
127-13	Old Process Laxo Cake Meal	Laxo Cake Meal Co.	26.25	8.75	10.33
		Chicago, Ill.	**25.00**	**6.00**	**11.00**
410-12	Old Process Laxo Cake Meal	Laxo Cake Meal Co.	27.38	8.30	9.78
		Chicago, Ill.	**25.00**	**8.00**	**11.00**
410-12	Old Process Laxo Cake Meal	Laxo Cake Meal Co.	24.38	9.09	9.23
		Chicago, Ill.	**25.00**	**8.00**	**11.00**
751-13	Dezarn's Gold Medal Cattle Feed	Lynn Milling Co.	12.25	4.65	------
		Hodgenville, Ky.	**12.72**	**4.59**	------
1290-12	Dezarn's Gold Medal Cattle Feed	Lynn Milling Co.	11.85	4.30	------
		Hodgenville, Ky.	**12.72**	**4.59**	------
710-14	McQuady Stock Feed	McQuady Milling Co.	13.25	3.52	3.13
		McQuady, Ky.	**14.16**	**3.58**	**4.40**
1228-11	Matzos Sweepings	Wm. Miller	9.75	1.86	0.45
		Newport, Ky.	**10.10**	**1.39**	------
1080-12	Green Meadow Dairy Feed	Omaha Alfalfa Milling Co.	13.38	1.15	------
		Omaha, Neb.	**11.00**	**1.00**	**25.00**
1080-12	Green Meadow Dairy Feed	Omaha Alfalfa Milling Co.	13.27	1.10	18.97
		Omaha, Neb.	**11.00**	**1.00**	**25.00**
700-12	Perfection Horse Feed	Omaha Alfalfa Milling Co.	10.60	2.20	12.48
		Omaha, Neb.	**10.50**	**2.00**	**12.00**
700-12	Perfection Horse Feed	Omaha Alfalfa Milling Co.	11.67	2.26	10.20
		Omaha, Neb.	**10.50**	**2.00**	**12.00**
431-13	Green Meadow Corn, Oats and Alfalfa Feed.	Paducah Milling Co,	10.88	2.63	8.74
		Paducah, Ky.	**10.22**	**3.30**	------
431-13	Green Meadow Corn, Oats and Alfalfa Feed.	Paducah Milling Co.	10.75	3.00	8.20
		Paducah, Ky.	**10.22**	**3.20**	------

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
1190-13	Manufacturer's Warehouse	Corn, Oats, Bran, Salt 2%	Below guaranty in fat.
1374-13	Manufacturer's Warehouse	Alfalfa, Molasses, Bran, Corn, Oats	Below guaranty in protein.
1374-13	Manufacturer's Warehouse	Alfalfa, Molasses, Bran, Corn, Oats	High in fiber.
414-13	Smith Bros. Owensboro, Ky.	Cracked corn, Whole oats, Ground alfalfa, Molasses	
414-13	Weaverton Feed Co. Henderson, Ky.	Cracked corn, Whole oats, Ground alfalfa, Molasses	
414-13	Weaverton Feed Co. Henderson, Ky.	Cracked corn, Whole oats, Ground alfalfa, Molasses	
919-13	A. Schneider's Sons Louisville, Ky.	Corn, Oats, Alfalfa, Molasses	
586-12	Benj J. Brumleve Louisville, Ky.	Corn, Oats, Alfalfa, Molasses, ½ of 1% salt	
917-13	L. M. Nuckols Louisville, Ky.	Corn, Oats, Alfalfa	
917-13	Conrad J. Clausen Louisville, Ky.	Corn, Oats, Alfalfa	
127-13	Schramme & Smith Shelbyville, Ky.	Flaxseed, Field and weed seeds, (Buckwheat, Foxtail, Mustard, Pigweed, Bindweed, etc.) 15%	
127-13	Frank Birchler Louisville, Ky.	Flaxseed, Field and weed seeds, (Buckwheat, Foxtail, Mustard, Pigweed, Bindweed, etc.) 15%	
410-12	W. H. Luesing Louisville, Ky.	Flaxseed, Field and weed seeds, (Buckwheat, Foxtail, Mustard, Pigweed, Bindweed, etc.) 15%	
410-12	Chris Miller's Sons Louisville, Ky.	Flaxseed, Field and weed seeds, (Buckwheat, Foxtail, Mustard, Pigweed, Bindweed, etc.) 15%	Below guaranty in protein.
751-13	Manufacturer's Warehouse	Corn, Cotton seed meal, Middlings, Wheat bran	
1290-12	Manufacturer's Warehouse	Corn, Cotton seed meal, Middlings, Wheat bran	Below guaranty in protein.
710-14	J. H. Roberts Fordsville, Ky.	Corn, Rye, Oats, Bran, Cotton seed meal	Below guaranty in protein.
1228-11	Frank Huntemann Newport, Ky.	Refuse from bakery	
1080-12	Mike Bohan Earlington, Ky.	Alfalfa meal, Molasses	
1080-12	Skillman Feed Co. Owensboro, Ky.	Alfalfa meal, Molasses	
700-12	Byrnes & Pettit Lexington, Ky.	Corn, Oats, Alfalfa meal, Molasses	
700-12	Skillman Feed Co. Owensboro, Ky.	Corn, Oats, Alfalfa meal, Molasses	
431-13	Broach & Bell Murray, Ky.	Corn, Oats, Alfalfa, Molasses	Below guaranty in fat.
431-13	E. K. Bonds Paducah, Ky.	Corn, Oats, Alfalfa, Molasses	Sample contains whole wheat.

TABLE IV.—MISCELLANEOUS MIXED FEEDS

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
37-14	Green Meadow Corn, Oats and Alfalfa Feed	Paducah Milling Co. Paducah, Ky.	10.91	3.34	7.70
			10.22	**3.20**	**10.00**
37-14	Green Meadow Corn, Oats and Alfalfa Feed	Paducah Milling Co. Paducah, Ky.	10.47	2.55	8.05
			10.22	**3.20**	**10.00**
214-10	June Pasture Dairy Feed	M. C. Peters Mill Co. Omaha, Neb.	11.70	1.02	------
			10.00	**0.50**	**26.00**
214-10	June Pasture Dairy Feed	M. C. Peters Mill Co. Omaha, Neb.	13.19	1.55	18.65
			10.00	**0.50**	**26.00**
703-12	Peters Arab Horse Feed	M. C. Peters Mill Co. Omaha, Neb.	11.13	2.50	9.55
			9.00	**2.00**	**15.00**
703-12	Peters Arab Horse Feed	M. C. Peters Mill Co. Omaha, Neb.	11.25	2.64	------
			9.00	**2.00**	**15.00**
703-12	Peters Arab Horse Feed	M. C. Peters Mill Co. Omaha, Neb.	10.97	2.42	7.78
			9.00	**2.00**	**15.00**
773-13	Peters Arab Horse Feed	M. C. Peters Mill Co. Omaha, Neb.	11.31	2.83	9.18
			9.00	**2.00**	**15.00**
773-13	Peters Arab Horse Feed	M. C. Peters Mill Co. Omaha, Neb.	10.94	2.60	9.83
			9.00	**2.00**	**15.00**
777-13	Peters King Corn Sugar Feed	M. C. Peters Mill Co. Omaha, Neb.	11.63	1.43	12.03
			9.00	**1.50**	**18.00**
850-14	Purina Sweet Feed	Purina Mills, Branch, Ralston Purina Co., St. Louis, Mo.	12.31	1.85	16.55
			10.30	**1.20**	**18.00**
589-14	XX Good Luck Feed and Molasses	Purina Mills, Branch, Ralston Purina Co., St. Louis, Mo.	10.63	2.53	10.70
			9.00	**1.50**	**12.00**
1221-11	Blue Ribbon Dairy Feed	Quaker Oats Co. Chicago, Ill.	27.63	4.77	10.24
			25.00	**4.00**	**9.00**
436-12	Purina Molasses Feed	Ralston Purina Co. St. Louis, Mo.	10.41	2.38	------
			10.00	**2.50**	**12.00**
21-13	Purina Molasses Feed	Ralston Purina Co. St. Louis, Mo.	11.47	1.80	------
			9.00	**1.50**	**12.00**
21-13	Purina Molasses Feed	Ralston Purina Co. St. Louis, Mo.	10.22	2.80	------
			9.00	**1.50**	**12.00**
21-13	Purina Molasses Feed	Ralston Purina Co. St. Louis, Mo.	11.31	2.60	11.98
			9.00	**1.50**	**12.00**
308-14	Purina Feed with Molasses	Purina Mills, Branch, Ralston Purina Co., St. Louis, Mo.	10.41	3.05	9.40
			9.30	**1.70**	**11.70**
1166-13	Rapier's Otene Horse and Mule Feed	Rapier Sugar Feed Co. Owensboro, Ky.	10.16	4.08	8.83
			10.00	**2.50**	**12.00**
1166-13	Rapier's Otene Horse and Mule Feed	Rapier Sugar Feed Co. Owensboro, Ky.	11.56	5.70	9.00
			10.00	**2.50**	**12.00**
1166-13	Rapier's Otene Horse and Mule Feed	Rapier Sugar Feed Co. Owensboro, Ky.	9.13	3.50	9.93
			10.00	**2.50**	**12.00**
1073-12	Mill Feed	Robinson-Danforth Co. St. Louis, Mo.	12.50	3.20	------
			11 00	**3.60**	**4.00**
422-13	Winner Molasses Feed	Robinson-Danforth Co. St. Louis, Mo.	11.38	2.60	10.85
			9.00	**1.50**	**12.50**
271-12	Rex Crushed Feed	Roszell Bros. Lexington, Ky.	10.06	4.53	------
			10.06	**3.95**	------

Analyses of Inspectors' Samples.

Reg No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED	REMARKS—VARIANCE FROM GUARANTY
37-14	T. H. O'Brien, Dawson Springs, Ky.	Corn, Oats, Alfalfa, Molasses	
37-14	Sears Grocery Co., Paducah, Ky.	Corn, Oats, Alfalfa, Molasses	Below guaranty in fat
214-10	J. F. Casebier, Beaver Dam, Ky.	Alfalfa, Syrup	
214-10	W. E. Ellis, Hartford, Ky.	Alfalfa, Syrup	
703-12	Louisville Hay & Grain Co., Louisville, Ky.	Corn, Oats, Alfalfa, Molasses	
703-12	Jellico Grocery Co., Middlesboro, Ky.	Corn, Oats, Alfalfa, Molasses	
703-12	Charles Noonon, Fulton, Ky.	Cracked corn, Whole oats, Alfalfa, Molasses	
773-13	T. H. O'Brien, Dawson Springs, Ky.	Cracked corn, Whole oats, Alfalfa, Molasses	
773-13	L. E. Chapman, Owensboro, Ky.	Cracked Corn, Whole oats, Alfalfa, Molasses	
777-13	H. E. Eilers & Sons, Louisville, Ky.	Cracked corn, Whole oats, Alfalfa, Molasses	
850-14	Ruef Bros., Covington, Ky.	Ground alfalfa, Molasses, Ground wheat screenings 20%	
589-14	W. T. Grissom, Providence, Ky.	Cracked corn, Whole oats, Ground alfalfa, Molasses, Ground grain screenings 15%, Salt 1%	
1221-11	Bain Holeman, Providence, Ky.	Molasses, Wheat bran, Hominy feed, Malt sprouts, Cotton seed meal, Oat middlings	
436-12	H. Wright & Son, Frankfort, Ky.	Corn, Oats, Ground alfalfa, Molasses	
21-13	Park City Feed Store, Bowling Green, Ky.	Cracked corn, Whole oats, Ground alfalfa, Molasses	
21-13	H. E. Eilers & Sons, Louisville, Ky.	Cracked corn, Whole oats, Ground alfalfa, Molasses	
21-13	L. L. Roberts, Dawson Springs, Ky.	Cracked corn, Whole oats, Ground alfalfa, Molasses	
308-14	W. R. Skillman & Co., Owensboro, Ky.	Cracked corn, Whole oats, Ground alfalfa, Molasses, Salt 1%	
1166-13	Weaverton Feed Co., Henderson, Ky.	Ground recleaned grain screenings 30%, Molasses, Cracked corn, Linseed meal, Rolled oats, Salt 1%	
1166-13	D. C. Edwards, London, Ky.	Ground recleaned grain screenings 30%, Molasses, Cracked corn, Linseed meal, Rolled oats, Salt 1%	
1166-13	R. B. Hayes & Co., Hodgenville, Ky.	Ground recleaned grain screenings 30%, Molasses, Cracked corn, Linseed meal, Rolled oats, Salt 1%	Below guaranty in protein.
1073-12	Park City Feed Store, Bowling Green, Ky.	Wheat, Corn, Oats, Barley, Kafir corn, Milo maize, Sunflower seeds, Various grain screenings 10%	
422-13	W. J. Kirk, Madisonville, Ky.	Cracked corn, Whole oats, Ground alfalfa, Molasses	
271-12	Lexington Brewing Co. Lexington, Ky.	Corn, Oats, Bran	

TABLE IV.—MISCELLANEOUS MIXED FEEDS

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
1455-13	Double "S" Crushed Feed	A. Schneiders' Sons Co.	13.81	5.33	9.70
		Louisville, Ky.	**12.19**	**4.03**	**10.38**
955-13	Double "S" Crushed Feed	A. Schneiders' Sons Co.	11.97	3.85	8.48
		Louisville, Ky.	**11.35**	**4.22**	------
542-12	Perfection Horse Feed	W. H. Small & Co.	12.25	2.88	------
		Evansville, Ind.	**10.50**	**3.00**	**12.00**
1325-12	Green Meadow Dairy Feed	W. H. Small & Co.	13.94	0. 8	------
		Evansville, Ind.	**11.00**	**1.00**	------
1116-12	Atlas Molasses Feed	Southern Seed Co.	17.25	4.04	12.18
		Louisville, Ky.	**12.00**	**3.00**	**12.00**
1161-12	Atlas Horse and Mule Feed	Southern Seed Co.	10.28	3.43	10.60
		Louisville, Ky.	**10.00**	**2.50**	**12.00**
1161-12	Atlas Horse and Mule Feed	Southern Seed Co	10.50	2.98	8.37
		Louisville, Ky.	**10.00**	**2.50**	**12.00**
508-14	Atlas Dairy Feed	Southern Seed Co.	19.13	4.20	16.00
		Louisville, Ky.	**18.00**	**4.00**	**12.00**
1119-12	Germ Food	Wm. J. Sutton	12.63	7.75	6.08
		Newport, Ky.	**12.25**	**7 70**	**7.35**

TABLE V.—MISCELLANEOUS MIXED FEEDS CONTAINING A MATERIAL OF LITTLE OR NO FEEDING VALUE.

871-13	Cyclone Cotton Seed Feed	American Cotton Hull &	21.06	4.23	25.83
		Fiber Co., Memphis, Tenn.	**20.00**	**3.00**	**23.00**
225-12	Sucrene Dairy Feed	American Milling Co.	16.50	4.96	12.13
		Chicago, Ill.	**16.50**	**3.50**	**12.00**
225-12	Sucrene Dairy Feed	American Milling Co.	17.10	4.66	11.28
		Chicago, Ill.	**16.50**	**3.50**	**12.00**
500-13	Sucrene Dairy Feed	American Milling Co.	17.53	5.52	12.99
		Chicago, Ill	**16.50**	**3.50**	**12.00**
500-13	Sucrene Dairy Feed	American Milling Co.	17.38	5.57	13.25
		Chicago, Ill,	**16.50**	**3.50**	**12.00**
500-13	Sucrene Dairy Feed	American Milling Co.	17.00	5.42	12.63
		Chicago, Ill.	**16.50**	**3.50**	**12.00**
500-13	Sucrene Dairy Feed	American Milling Co.	14.81	4.43	12.17
		Chicago, Ill.	**16.50**	**3.50**	**12.00**
193-12	Pure Ear Crush	Burkholder Bros.	8.13	3.90	------
		Crofton, Ky.	**8.13**	**4.10**	------
751-8	Cotton Seed Feed Meal	Cincinnati Grain Co.	24.69	5.83	20.80
		Covington, Ky.	**22.00**	**5.00**	------

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED	REMARKS—VARIANCE FROM GUARANTY
1455-13	Manufacturers Warehouse	Corn, Oats, Wheat. Alfalfa meal, Brewers' dried grains, Condition powders	
995-13	H. G. Holcamp, Louisville, Ky.	Oats, Corn, Wheat, Alfalfa meal, Condition powders	
542-12	J. W. Davis, Elkton, Ky.	Corn, Oats, Alfalfa, Molasses	
1325-12	J. W. Pursley, Cadiz, Ky.	Alfalfa meal, Molasses	
1116-12	J. H. Brown, Cloverport, Ky.	Alfalfa, Corn, Oats, Cotton seed meal, Distillers' dried grains, Hominy meal, Wheat bran, Middlings, Molasses, ½ of 1% salt	
1161-12	Lexington Steam Laundry, Lexington, Ky.	Alfalfa, Corn, Oats, Cotton seed meal, Wheat bran, Middlings, Hominy meal, Molasses, Salt ½ of 1%	
1161-12	Rout & Cleveland, Versailles, Ky.	Alfalfa, Corn, Oats, Cotton seed meal. Wheat bran, Middlings, Hominy meal, Molasses. Salt ½ of 1%	
508-14	R. B. Hayes & Co. Hodgenville, Ky,	Corn meal, Brewers' grains, Distillers' dried grains, Cotton seed meal, Alfalfa, Molasses, Wheat bran, Salt ½ of 1%	
1119-12	Herm Feldman, Newport, Ky.	Corn, Barley	

Analyses of Inspectors' Samples.

871-13	Hobdy & Read, Scottsville, Ky.	Cotton seed meal, Cotton seed hulls 50%	
225-12	George Bradley, Hopkinsville, Ky.	Cotton seed meal, Gluten feed, Molasses. Oat clippings 20%, Ground and bolted grain screenings 35%, Salt ½ of 1%	
225-12	Dodson & Denton, Paris, Ky.	Cotton seed meal, Gluten feed, Molasses, Oat clippings 20%, Ground and bolted grain screenings 35%, Salt ½ of 1%	No gluten feed present.
500-13	Clarence Howard, Russellville, Ky.	Molasses, Cotton seed meal, Gluten feed, Ground and bolted grain screenings 35%, Clipped oat by-prod. 20%, Salt, Linseed meal	
500-13	Dodson & Denton, Paris, Ky.	Molasses, Cotton seed meal, Gluten feed, Ground and bolted grain screenings 35%, Clipped oat by-prod. 20%. Salt, Linseed meal	
500-13	J. F. Griffin, Mt. Vernon, Ky.	Molasses, Cotton seed meal, Gluten feed, Ground and bolted grain screenings 35%, Clipped oat by-prod. 20%. Linseed meal, Salt	
500-13	G. C. Shaw, Frankfort, Ky.	Molasses, Cotton 'seed' meal, Gluten feed, Ground and bolted grain screenings 35%, Clipped oat by-prod. 20%, Linseed meal, Salt	
193-12	Manufacturers' Warehouse	Corn, Cob 20%	
751-8	Manufacturers' Warehouse	Cotton seed meal, Cotton seed hulls 50%	

TABLE V.—MISCELLANEOUS MIXED FEEDS CONTAINING A MATERIAL OF LITTLE OR NO FEEDING VALUE.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
1469-13	Holstein Feed	Cincinnati Grain Co.	11.94	4.05	18.45
		Cincinnati, Ohio	**12.00**	**3.00**	**16.00**
270-11	Creamo Dairy Feed	Corno Mills Co.	16.81	4.35	18.76
		St. Louis, Mo.	**14 50**	**5.00**	**19.50**
270-11	Creamo Dairy Feed	Corno Mills Co.	16.75	3.95	19.33
		St. Louis, Mo.	**14.50**	**5.00**	**19.50**
332-12	Corno Horse and Mule Feed	Corno Mills Co.	11.94	3.44	14.50
		St. Louis, Mo.	**10.00**	**3.50**	**12.00**
332-12	Corno Horse and Mule Feed	Corno Mills Co.	11.63	3.48	------
		St. Louis, Mo.	**10.00**	**3.50**	**12.00**
332-12	Corno Horse and Mule Feed	Corno Mills Co.	9.88	3.59	13.62
		St. Louis, Mo.	**10.00**	**3.50**	**12.00**
269-11	Corno Horse and Mule Feed	Corno Mills Co.	10.50	3.55	14.88
		St. Louis, Mo.	**10.00**	**3.50**	**12.00**
186-10	Crushed Feed	J. W. Davis	14.44	4.75	------
		Elkton, Ky.	**7.81**	**4.26**	------
186-10	Crushed Feed	J. W. Davis	8.88	4.17	------
		Elkton, Ky.	**7.81**	**4.26**	------
702-13	"Cremo Brand" Cotton Seed Feed	Fern Fiber Co.	23.16	4.45	22.05
		Memphis, Tenn.	**20.00**	**4.50**	**22.00**
90-13	Sterling Feed	Indiana Milling Co.	11.81	4.13	14.85
		Terre Haute, Ind.	**9.35**	**3.02**	**14.91**
469-14	Holstein Feed	Indiana Milling Co.	11.63	3.95	18.00
		Terre Haute, Ind.	**11.00**	**3.00**	**16.00**
809-12	International Horse and Mule Feed	International Sugar Feed No. 2 Co., Memphis, Tenn.	13.31	4.57	9.45
			12.50	**3.50**	**12.00**
513-12	Mixed Feed	J. M. Johnson & Son	13.06	3.91	------
		Benton, Ky.	**12.75**	**4.31**	------
320-9	Magic City Mill Mixed Feed	Middlesboro Supply Co.	13.31	4.98	------
		Middlesboro, Ky.	**12.56**	**4.20**	------
1402-13	Sweet Molasco Cow Feed	National Oats Co.	16.94	6.52	17.45
		St. Louis, Mo.	**15.00**	**6.00**	**14.00**
1355-13	Molasco Sweet Feed	National Oats Co.	11.81	3.10	12.68
		St. Louis, Mo.	**10.00**	**3.25**	**13.00**
777-11	Pawnee Feed	National Oats Co.	7.72	3.35	15.45
		St. Louis, Mo.	**8.25**	**3.50**	**12.00**
629-12	Imperial Feed	Newport Mill Co.	11.56	3.80	------
		Loudon, Tenn.	**13.00**	**4.00**	**8.00**
629-12	Imperial Feed	Newport Mill Co.	12.81	4.57	11.68
		Loudon, Tenn.	**13.00**	**4.00**	**8.00**
153-13	Imperial Feed	Newport Mill Co.	11.28	4.10	9.43
		Loudon, Tenn.	**13.00**	**4.00**	**8.00**
408-12	Alcorn	The Oatequal Co.	9.75	2.13	13.26
		Columbus, Ohio	**10.00**	**3.00**	**14.00**
612-14	Golden Egg Dry Mash	Ohio Valley Seed Co.	14.25	3.30	7.85
		Evansville, Ind.	**14.00**	**3.50**	**6.00**

Analyses of Inspectors' Samples.

Reg. No,	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
1469-13	M. A. McBryde, Falmouth, Ky.	Wheat bran, Cob meal 25%	Above guaranty in fiber.
270-11	S. E Welch, Berea, Ky.	Ground alfalfa, Cotton seed meal, Hominy feed, Oat middlings and oat hulls 15%	Below guaranty in fat.
270-11	S. E. Welch, Berea, Ky.	Ground alfalfa, Cotton seed meal, Hominy feed, Oat middlings and oat hulls 15%	Below guaranty in fat.
332-12	Geo. H. Ratterman & Co. Louisville, Ky.	Ground corn, Ground alfalfa, Hominy feed, Cotton seed meal, Oat mid's and oat hulls 15%	Above guaranty in fiber.
332-12	B. T. Gosney, Campton, Ky.	Ground corn, Ground alfalfa, Hominy feed, Cotton seed meal, Oat mid's and oat hulls 15%	
332-12	Geo. H. Ratterman & Co. Louisville, Ky.	Ground corn, Ground alfalfa, Hominy feed, Cotton seed meal, Oat mid's and oat hulls 15%	Above guaranty in fiber.
269-11	E. K. Bonds, Paducah, Ky.	Ground corn, Ground alfalfa, Hominy feed, Cotton seed meal, Oat mid's and oat hulls 15%	Above guaranty in fiber.
186-10	Manufacturer's Warehouse	Corn, Cob 16%, Corn bran 20%	
186-10	Manufacturer's Warehouse	Corn, Cob 16%, Corn bran 20%	
702-13	Summer's Coal & Grocery Co., Smith's Grove, Ky.	Choice cotton seed meal, Cotton seed hulls 50%	
------	J. S. Cox, Somerset, Ky.	Wheat bran, Ground corn, Cob meal 30%	
469-14	Hiner & Gardner, Vanceburg, Ky.	Wheat bran, Cob meal 25%	
809-12	Rose & Couch, Pembroke, Ky.	Corn, Alfalfa, Wheat, Oats, Barley, Cotton seed meal, Molasses, Salt, Flax screenings 25%, Oat clips 15%	
513-12	W. W. McElrath, Murray, Ky.	Wheat bran 25%, Shorts 25%, Crushed corn 20%, Crushed cob 5%, Corn bran 25%	
320-9	Manufacturer's Warehouse	Corn cob 14%, Bran, Shorts, Cotton seed meal	
1402-13	E. K. Bonds, Paducah, Ky.	Ground alfalfa, Cotton seed meal, Ground grain screenings 25%, Molasses, Oat middlings, Oat shorts and oat hulls 17½%	Above guaranty in fiber.
1255-13	E. K. Bonds, Paducah, Ky.	Whole oats, Ground corn, Ground alfalfa, Cotton seed meal, Molasses, Oat hulls and oat middlings 25%	
777-11	E. K. Bonds, Paducah, Ky.	Ground corn, Hominy feed, Oat middlings, Oat shorts and oat hulls 45%	Below guaranty in protein and above in fiber.
629-12	Jellico Grocery Co. Middlesboro, Ky.	Wheat bran, Corn bran, Wheat shorts, Corn meal, Corn screenings 10%, Wheat screenings 19%, Cob 6%	Below guaranty in protein.
629-12	The H. T. Hackney Co. Middlesboro, Ky.	Wheat bran, Corn bran, Wheat shorts, Corn meal, Corn screenings 10%, Wheat screenings 10%, Cob 6%	Above guaranty in fiber.
153-13	S. Owsley & Son, Middlesboro, Ky.	Wheat bran, Corn bran, Wheat shorts, Corn meal, Corn screenings 10%, Wheat screenings 10%, Cob 6%	Below guaranty in protein and above in fiber.
408-12	Roark & Meng, Franklin, Ky.	Oats, Corn, Molasses, Alfalfa, Brewers. grains, Oat mid's, Oat shorts. Oat hulls 10%	Below guaranty in protein and fat.
612-14	Henderson Feed & Com. Co., Henderson, Ky.	Wheat bran, [Shorts, Corn meal, Linseed meal, Alfalfa meal, Meat scraps, Charcoal, Gluten feed, Gluten meal, Heneta (sodium, lime, silica and phosphorus comp'ds, 16%	

TABLE V.—MISCELLANEOUS MIXED FEEDS CONTAINING A MATERIAL OF LITTLE OR NO FEEDING VALUE.

Reg. No.	NAME OF FEED.	MANUFACTURER	Analysis. Prot.	Fat.	Fiber.
1153-12	Crushed Ear Corn	S. M. Overby & Co. Murray, Ky.	9.38 **8.00**	3.76 **3.25**	6.03 ------
1144-12	Sugaration	G. E. Patterson & Co. Memphis, Tenn.	12.50 **11.65**	3.39 **3.50**	9.62 **11.04**
1146-12	Katleat	G. E. Patterson & Co. Memphis, Tenn.	16.56 **15.00**	4.29 **3.50**	10.75 **12.00**
849-14	Protena Dairy Feed	Purina Mills, Branch, Ralston Purina Co., St. Louis, Mo.	17.13 **16.50**	3.98 **3.50**	13.60 **12.00**
253-12	Green Cross Horse Feed	The Quaker Oats Co. Chicago, Ill.	11.94 **10.00**	2.88 **3.25**	9.53 **10.50**
253-12	Green Cross Horse Feed	The Quaker Oats Co. Chicago, Ill.	12.06 **10.00**	3.04 **3.25**	10.45 **10.50**
253-12	Green Cross Horse Feed	The Quaker Oats Co. Chicago, Ill.	11.91 **10.00**	3.75 **3.25**	8.83 **10.50**
222-13	Green Cross Horse Feed	The Quaker Oats Co. Chicago, Ill.	11.38 **10.00**	2.21 **3.00**	12.25 **10.00**
1221-11	Blue Ribbon Dairy Feed	The Quaker Oats Co. Chicago, Ill.	30.97 **25.00**	4.37 **4.00**	11.28 **9.00**
877-13	Schumacher Stock Feed	The Quaker Oats Co. Chicago, Ill.	11.94 **10.00**	5.23 **3 25**	9.80 **10.00**
1167-13	Rapier's Creamo Dairy Feed	Rapier Sugar Feed Co. Owensboro, Ky.	17.19 **16.50**	5.55 **3.50**	10.73 **12.00**
1167-13	Rapier's Creamo Dairy Feed	Rapier Sugar Feed Co. Owensboro, Ky.	16.19 **16.50**	4.80 **3.50**	11.58 **12.00**
1167-13	Rapier's Creamo Dairy Feed	Rapier Sugar Feed Co. Owensboro, Ky.	14.56 **16.50**	4.25 **3.50**	11.33 **12.00**
1167-13	Rapier's Creamo Dairy Feed	Rapier Sugar Feed Co. Owensboro, Ky.	16.06 **16.50**	4.18 **3.50**	12.28 **12.00**
1168-13	Rapier's Mixing Feed	Rapier Sugar Feed Co. Owensboro, Ky.	11.41 **12.00**	3.25 **2.50**	13.05 **12.00**
1299-12	Economy Horse and Mule Feed	Southern Seed Co. Louisville, Ky.	12.06 **9.00**	3.30 **2.00**	11.80 **12.00**
597-13	Economy Horse and Mule Feed	Southern Seed Co. Louisville, Ky.	10.13 **9.00**	2.88 **2.50**	8.55 **12.00**
678-14	Economy Horse and Mule Feed	Southern Seed Co. Louisville, Ky.	9.53 **9.00**	3.10 **2.50**	8.75 **12.00**

ANALYSES OF INSPECTORS' SAMPLES.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
1153-12	Manufacturers' Warehouse	Corn, Cob 20%	
1144-12	McAfee & Schramme Shelbyville, Ky.	Corn, Oats, Cotton seed meal Alfalfa, Molasses, Rice straw 14%	
1146-12	McAfee & Schramme Shelbyville, Ky.	Corn, Alfalfa, Cotton seed meal. Molasses, Rice straw 15%	
849-14	C. M. Black Paducah, Ky.	Cotton seed meal, Brewers' dried grains, Molasses, Salt, Clipped oat by-product 20%, Ground wheat screenings 25%	Above guaranty in fiber.
253-12	Frank Birchler Louisville, Ky.	Alfalfa, Corn, Oats, Cotton seed meal, Oat meal mill by-products (oat middlings, oat hulls, oat shorts) 10%, Molasses	
253-12	Barnett Feed & Com. Co., Henderson, Ky.	Alfalfa, Corn, Oats, Cotton seed meal. Oat meal mill by-products (oat middlings, oat hulls, oat shorts) 10%, Molasses	
253-12	A. Schneider's Sons Louisville, Ky.	Alfalfa, Corn, Oats, Cotton seed meal, Oat meal mill by-products (oat middlings, oat hulls, oat shorts) 10%, Molasses	Sample contains barley.
222-13	Wm. P. Miller Louisville, Ky.	Alfalfa meal, Ground corn, Oats, Cotton seed meal, Molasses, Oat middlings, Oat shorts, Oat hulls 8%	Above guaranty in fiber.
1221-11	J. B. Taylor & Sons Lewisport, Ky.	Molasses, Wheat bran, Hominy feed, Malt sprouts, Cotton seed meal, Oat middlings, Oat shorts, Oat hulls 15%	
877-13	Crescent Milling Co. Cynthiana, Ky.	Ground corn, Hominy feed, Ground barley, Wheat flour, Wheat middlings, Cotton seed meal, Ground puffed rice, Ground puffed wheat. Oat middlings, Oat shorts and Oat hulls 28%, ½ of 1% salt	
1167-13	Cole Hughes & Co. Barbourville, Ky.	Molasses, Cotton seed meal, Gluten feed, Ground and bolted grain scrgs 35%, Clipped oat by-product 20%. Linseed meal. Salt 1%	
1167-13	R. A. Dodd Wilmore, Ky.	Molasses, Cotton seed meal, Gluten feed, Ground and bolted grain scrgs 35%, Clipped oat by-product 20%. Linseed meal, Salt 1%	
1167-13	Weaverton Feed Co. Henderson, Ky.	Molasses, Cotton seed meal, Gluten feed, Ground and bolted grain scrgs 35%, Clipped oat by-product 20%, Linseed meal, Salt 1%	Below guaranty in protein.
1167-13	R. B. Hayes & Co. Hodgenville, Ky.	Molasses, Cotton seed meal, Gluten feed, Ground and bolted grain scrgs 35%, Clipped oat by-product 20%, Linseed meal, Salt 1%	
1168-13	C. B. Carden Fordsville, Ky.	Ground and bolted grain screenings 45%, Clipped oat by-product 30%, Molasses, Linseed meal, Gluten feed, Salt ½ of 1%	Above guaranty in fiber.
1299-12	R. B. Hayes & Co. Hodgenville, Ky.	Corn, Oats, Alfalfa, Clover, Oat clippings 15%, Wheat bran, Molasses, ½ of 1% salt	
597-13	Magic City Coal & Feed Co., Middlesboro, Ky.	Corn, Oats. Alfalfa, Clover, Clipped oat by-products 15%, Wheat bran, Molasses, ½ of 1% salt	
678-14	J. A. Shaver Greenville, Ky,	Corn, Oats, Alfalfa, Clover, Clipped oat by-product 15%, Wheat bran, Molasses, ½ of 1% salt	

TABLE V.—MISCELLANEOUS MIXED FEEDS CONTAINING A MATERIAL OF LITTLE OR NO FEEDING VALUE.

Reg. No.	NAME OF FEED	MANUFACTURER	Analysis		
			Prot.	Fat	Fiber
678-14	Economy Horse and Mule Feed	Southern Seed Co. Louisville, Ky.	9.13 **9.00**	2.90 **2.50**	8.80 **12.00**
1298-12	Economy Dairy Feed	Southern Seed Co. Louisville, Ky.	19.63 **16.00**	4.35 **3.00**	11.48 **12.00**
599-13	Economy Dairy Feed	Southern Seed Co. Louisville, Ky.	17.00 **16.00**	3.54 **3.00**	14.28 **12.00**
679-14	Economy Dairy Feed	Southern Seed Co. Louisville, Ky.	18.00 **16.00**	3.90 **3.00**	14.28 **12.00**
17-12	Wabash Feed	Wabash Elevator Co. Uniontown, Ky.	14.13 **10.87**	3.44 **4.41**	------ ------
17-12	Wabash Feed	Wabash Elevator Co. Uniontown, Ky.	12.63 **10.87**	3.08 **4.41**	------ ------
978-12	Blue Grass Mixed Feed	A. Waller & Co. Henderson, Ky.	10.88 **10.00**	2.68 **2.00**	16.15 **17.00**
978-12	Blue Grass Mixed Feed	A. Waller & Co. Henderson, Ky.	10.31 **10.00**	2.48 **2.00**	16.16 **17.00**
978-12	Blue Grass Mixed Feed	A. Waller & Co. Henderson, Ky.	10.53 **10.00**	2.75 **2.00**	15.05 **17.00**
16-13	Blue Grass Feed	A. Waller & Co. Henderson, Ky.	9.78 **10.00**	2.75 **2.00**	17.35 **17.00**
16-13	Blue Grass Feed	A. Waller & Co. Henderson, Ky.	10.31 **10.00**	2.80 **2.00**	15.10 **17.00**
16-13	Blue Grass Feed	A. Waller & Co. Henderson, Ky.	10.81 **10.00**	2.83 **2.00**	16.58 **17.00**
16-13	Blue Grass Feed	A. Waller & Co. Henderson, Ky.	10.50 **10.00**	2.90 **2.00**	16.98 **17.00**

Analyses of Inspectors' Samples.

Reg. No.	SAMPLE TAKEN FROM	INGREDIENTS GUARANTEED.	REMARKS—VARIANCE FROM GUARANTY.
678-14	J. H. Roberts ---------- Fordsville, Ky.	Corn, Oats, Alfalfa, Clover, Wheat bran, Molasses, ½ of 1% salt, Clipped oat by-product 15%	
1298-12	Magic City Coal & Feed Co., Middlesboro, Ky.	Corn meal, Hominy feed, Wheat bran, Middlings, Alfalfa, Clover, Cotton seed meal, Oat clippings 20%, Molasses, ½ of 1% salt, Distrillers' dried grains	
599-13	J. A. Shaver ---------- Greenville, Ky.	Corn meal, Hominy meal, Wheat bran, Middlings, Alfalfa, Clover, Cotton seed meal, Clipped oat by-product 20%, Molasses, Salt ½ of 1%	Too high in fiber.
679-14	J. H. Roberts ---------- Fordsville, Ky.	Corn meal, Brewers' grains. Wheat bran, Distillers' dried grains, Alfalfa, Clover, Cotton seed meal, Molasses, ½ of 1% salt, Clipped oat by-product 15%	Above guaranty in fiber.
17-12	Manufacturers' Warehouse	Corn, Cob 50% ----------	Below guaranty in fat, corn of poor quality.
17-12	Manufacturers' Warehouse	Corn, Cob 50% ----------	Below guaranty in fat, corn of poor quality.
978-12	R. P. Poynter & Sons - Horse Cave, Ky.	Corn, Cob 25%, Wheat bran, Wheat middlings	
978-12	Dickinson Bros. ------ Glasgow, Ky.	Corn, Cob 25%, Wheat bran, Wheat middlings	
978-12	H. Gallman ---------- Paducah, Ky.	Corn, Cob 25%, Wheat bran, Wheat middlings	
16-13	Phelps Bros. ---------- Bowling Green, Ky.	Corn, Cob 25%, Wheat bran, Wheat middlings	
16-13	Illinois Coal & Feed Co.. Paducah, Ky.	Corn, Cob 25%, Wheat bran, Wheat middlings	
16-13	Keith Bros. ---------- Buffalo, Ky.	Corn, Cob 25%, Wheat bran, Wheat middlings	
16-13	Sears Grocery Co. ---- Paducah, Ky.	Corn, Cob 25%, Wheat bran, Wheat middlings	

Kentucky
Agricultural Experiment Station
State University, Lexington, Kentucky

BULLETIN NO. 186

Experiments With the Sharples Mechanical Milker

BY

J. J. HOOPER and J. W. NUTTER.



STATE UNIVERSITY PRESS
LEXINGTON, KY.
December, 1914.
(473)

KENTUCKY AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

RICHARD C. STOLL, Chairman, Lexington, Ky.
CHARLES B. NICHOLS, Lexington, Ky.
LEWIS L. WALKER, Lancaster, Ky.
HENRY S. BARKER, President of the University.
THE DIRECTOR, Secretary, ex-officio.

JOSEPH H. KASTLE, Director.

STATION COUNCIL

THE DIRECTOR.

A. M. PETER
H. E. CURTIS
H. GARMAN
C. W. MATHEWS
R. M. ALLEN
J. D. TURNER
E. S. GOOD
GEORGE ROBERTS
J. J. HOOPER

DEPARTMENTAL ORGANIZATION

ADMINISTRATION

THE DIRECTOR, Head.
H. E. CURTIS, Bursar.
HYWEL DAVIES, Purchasing Agent.
O. L. GINOCHIO, Secretary to Director.
ADDIE LEE DEAN, Librarian.
ANNA WALLIS, Clerk.
CORNELIA C. PAGE, Clerk.

AGRICULTURAL EXTENSION

F. MUTCHLER, Superintendent.
T. R. BRYANT, Asst. Superintendent.
J. H. CARMODY, Horticulture.
H. B. HENDRICK, Agronomy.
C. D. BOHANNAN, Rural Economics.
W. D. NICHOLLS, Dairying.
H. W. RICKEY, Poultry. (In Cooperation with U. S. Dept. of Agriculture.)
T. E. STOKES, Animal Husbandry. (In Cooperation with U. S. Dept. of Agriculture.)
MARY E. SWEENY, Home Economics.
AUBYN CHINN, Cookery and Dietetics.
RUBY M. BUCKMAN, Sewing and Household Arts.
ANNA BERRY JONES, Clerk.
MARGARET RYAN, Clerk.

AGRONOMY

GEORGE ROBERTS, Agronomist, Head.
E. J. KINNEY, Assistant Agronomist.
P. E. KARRAKER, Soil Survey.
A. E. EWAN, Supt. Experiment Fields.
JESSIE F. CASWALL, Clerk.

ANIMAL HUSBANDRY

(Beef Cattle, Sheep and Swine)

E. S. GOOD, Head.
ROBERT GRAHAM, Veterinary Science, In Charge Hog Cholera Serum Production.
E. W. MUMMA, Asst. In Charge Hog Cholera Serum Production.
O. S. CRISLER, Hog Cholera Serum.
R. L. PONTIUS, Hog Cholera Serum.
W. V. SMITH, Asst. in Animal Husbandry.
M. J. SMITH, Asst. in Animal Husbandry.
M. G. GINOCHIO, Clerk.
E. J. GOTT, Hog Cholera Serum.
A. L. BRUECKNER, Hog Cholera Serum.
LUCY K. HUTCHCRAFT, Clerk.

ANIMAL HUSBANDRY

(Dairy Cattle, Horses and Poultry.)

J. J. HOOPER, Head.
W. S. ANDERSON, Asst. Horse Husb'd.
J. W. NUTTER, Supt. Dairy Farm.
W. D. NICHOLLS, Asst. Dairying.
D. D. SLADE, Supt. Poultry Farm.
P. E. BACON, Elmendorf Milk Records.
ED HUSTON, Asst. in Dairying.
F. WALLACE UTTERBACK, Clerk.

CHEMISTRY

A. M. PETER, Chief Chemist, Head.
S. D. AVERITT, Chemist.
J. S. McHARGUE, Asst. Chemist.
R. PFANSTIEL, Asst. Chemist.
ETHEL V. T. CASWALL, Clerk.

ENTOMOLOGY AND BOTANY

H. GARMAN, Entomologist and Botanist, Head.
MARY L. DIDLAKE, Laboratory Asst.
E. C. VAUGHN, Asst. in Seed Inspection and Plant Breeding.
H. H. JEWETT, Research Asst. Entom.
H. R. NISWONGER, Asst. in Field Work and Nursery Inspection.
LOUISE BEWLAY, Clerk.

FEED

J. D. TURNER, Head.
H. D. SPEARS, Chemist.
E. H. NOLLAU, Asst. Chemist.
ELMER INGRAM, Chief Inspector.
ROGER W. JONES, Inspector.
FANNY C. ROGERS, Clerk.

FERTILIZER

H. E. CURTIS, Chemist, Head.
WM. RODES, Assistant Chemist.
ELMER INGRAM, Inspector.
R. W. JONES, Inspector.
ANNA WALLIS, Clerk.

FOOD AND DRUGS

R. M. ALLEN, Head.
J. O. LaBACH, Chief Chemist.
L. A. BROWN, Chemist, Drugs.
J. W. McFARLIN, Chief Food Inspector.
W. R. PINNELL, Bacteriologist.
C. S. PORTER, Inspector, Drugs.
WALTER SCHEPPELMAN, Inspector, Bakery Sanitation.
E. F. WORTHINGTON, Inspector, Dairy Sanitation.
W. G. TERRELL, Inspector, Foods.
LILLIE LISTON, Chief Clerk.
LENA LISTON, Clerk.

HORTICULTURE

CLARENCE W. MATHEWS, Head.
F. W. HOFFMAN, Asst. in Horticulture.
G. R. WURTZ, Consulting Meteorologist.
MURIEL CASWALL, Clerk.

RESEARCH

THE DIRECTOR, Head.
H. GARMAN, Entomologist and Botanist.
D. J. HEALY, Bacteriologist.
E. S. GOOD, Animal Husbandry.
O. M. SHEDD, Chemist.
MARY L. DIDLAKE, Asst. Entomologist and Botanist.
G. D. BUCKNER, Chemist.
H. H. JEWETT, Research Asst. in Entom.

Notice

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Director.

BULLETIN No. 186.

EXPERIMENTS WITH THE SHARPLES MECHANICAL MILKER.

By J. J. Hooper and J. W. Nutter.

The purpose of this bulletin is to furnish information regarding experiments carried out with a Sharples Mechanical Milker during the past year at the Kentucky Agricultural Experiment Station. The work is not completed, but it is now deemed advisable to print the mass of important data included in this publication.

The work may be divided into the following headings:

(1). Cost of the Machine and Cost of Operation.
(2). Effect of Machine Milking on Milk Yield of Cows.
(3). Time Saved Through the Use of the Machine. Time Required for Machine to Milk a Cow. Amount of Strippings Secured.
(4). Method of Cleaning the Parts of the Milking Machine.
(5). Bacteriological Tests of Samples of Milk Produced with the Machine.

Mechanical milkers have been offered for sale for many years in this country and abroad. As early as 1868 an attractive, extensive, and most convincing advertisement of a mechanical milker appeared in one of the leading American farm papers. That machine was declared to be a "sure cure for aching hands and kicking cows." However, for

various reasons, such machines did not find a place on practical dairy farms until very recently.

(1). Cost of Machine and Cost of Operating It.

In May, 1913, this Experiment Station purchased a Mechanical Milker from the Sharples Separator Company, of West Chester, Pennsylvania. Since May 12, 1913, this machine has

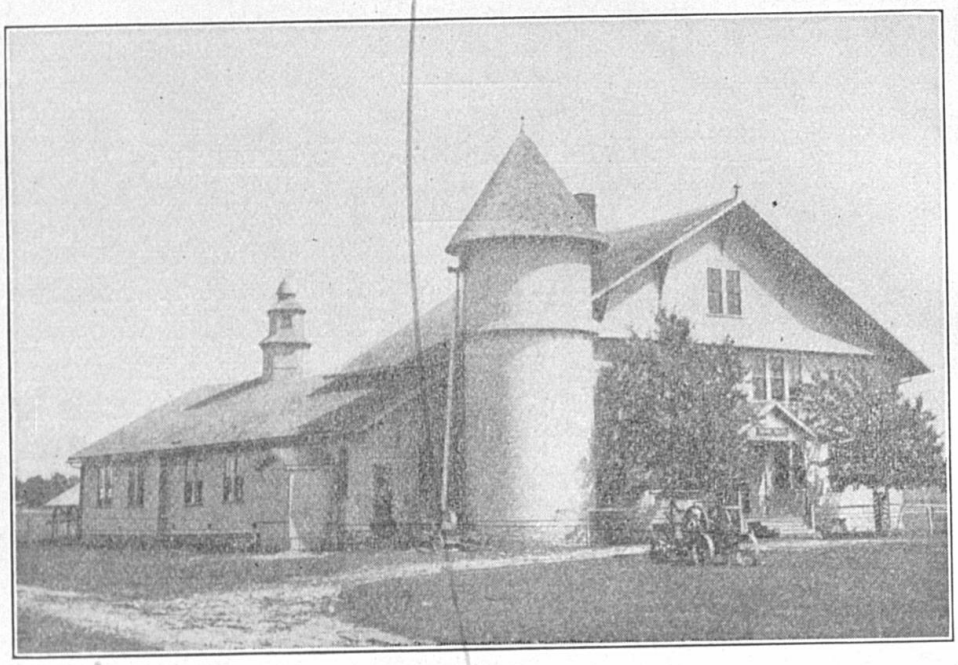


FIG. 1. The Dairy Barn at the Kentucky Agricultural Experiment Station

been under daily observation at the Experiment Station dairy barn. Notes included in this bulletin cover the period from May 12, 1913, to July 1st, 1914. In March, 1914, the Elmendorf Farm, located near Lexington, purchased a similar machine, and through the kindness of Manager C. H. Berryman, of that farm, we are privileged to quote a mass of valuable data gathered there.

Cost of The Sharples Mechanical Milker Operated at the Kentucky Agricultural Experiment Station.

Four pulsators, rubber tubing and machine milk buckets	$400.00*
Iron piping which carries pressure and vacuum through barn	33.00
Pump and equipment	125.00
Two extra milk buckets for the machine	10.00
Total cost	$568.00

Possibly the greatest objection to the machine lies in its cost.

Ease of Operation and Effect of Machine Milking on the Udders. At this Station very little difficulty has been experienced in the operation of the machine. Probably any farmer of average mechanical ingenuity could operate the machine, after he had received instruction by an expert from the factory.

During the first few days that the machine was operated here some trouble was experienced. The pressure levers on the pulsators were not operated as they should have been. As a result there was but slight upward pressure in the teat cups, the upward squeeze was feeble, and the teats of several cows became inflamed. At this time an expert from the factory explained the operation carefully, and since then no further difficulty has been experienced.

An electric motor furnishes power for the machine. An occasional thunder shower burns out a fuse which causes a temporary delay. Otherwise the machine has been operated every day since its installation except when stopped for experimental purposes.

Cost of Repairs. From time to time experts from the factory have visited the dairy and have assisted in minor alterations. This has been done free of cost. The only parts of the machine that have been replaced during the

*Special buckets that are constructed of rust proof metal have been substituted for the tin plated buckets formerly used, and the cost of the machine and its parts have advanced since the machine was installed at this dairy. For instance, the pulsator, rubber tubing and milk bucket (a unit) sell now for $110, while the unit cost this Station a year ago $100. The pump and equipment now cost $160.

year have been the rubber tubes which are washed frequently. The parts that have been replaced are as follows:

4 two-foot milk tubes, $1.00 each	$ 4.00
24 teat cup inflations, 50 cents each	12.00
12 seven-inch rubber pressure tubes, 28 cents each	3.36
12 four and three-quarter inch vacuum tubes, at 18 cents each	2.16
Total cost of replaced parts	$21.52

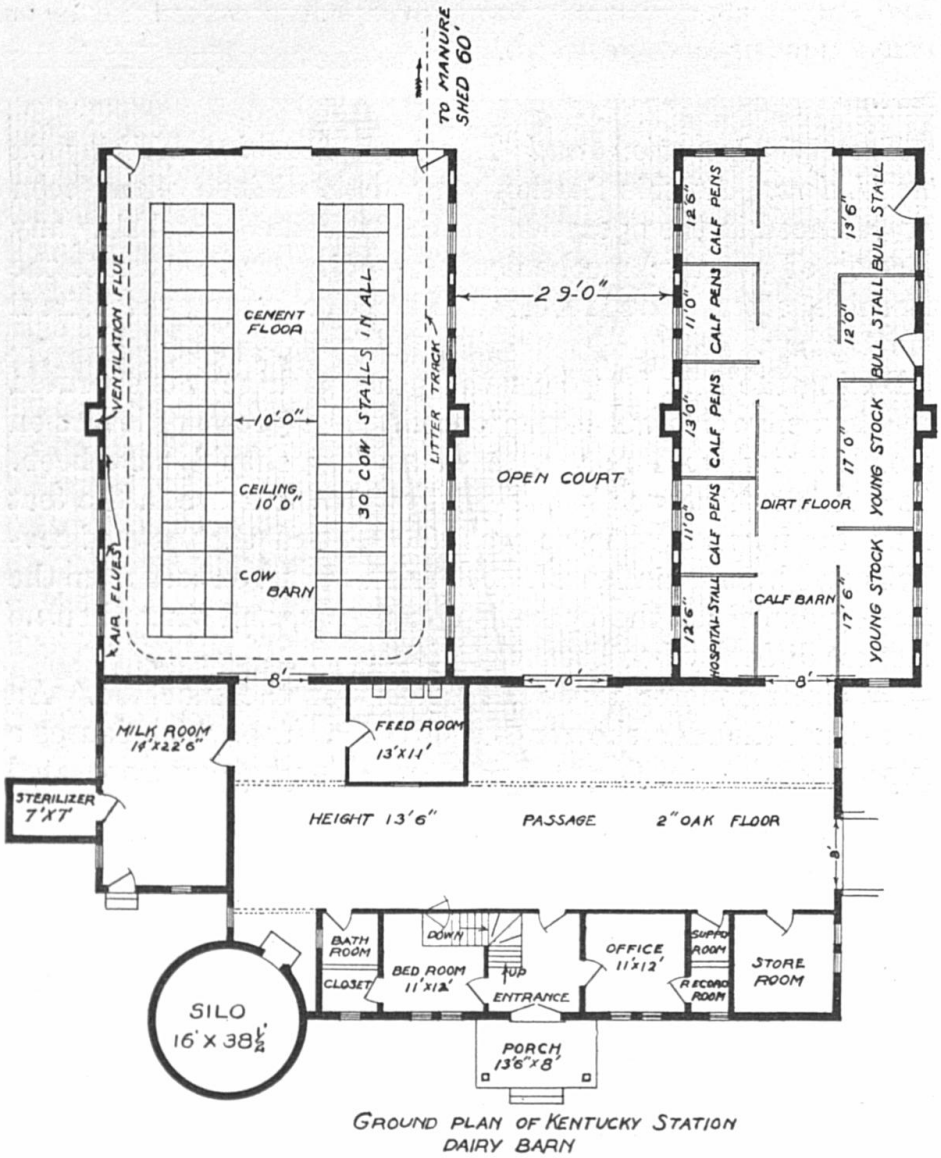


FIG 2.. Floor plan of dairy barn at Kentucky Agricultural Experiment Station.

Cost of Power. A two-horse power motor, connected with the city electric current, supplies power for the machine. Numerous observations indicate that one kilowat of electricity is used during each milking, or two kilowats each day. The cost is six and a half cents per kilowat or thirteen cents a day. This aggregates about $3.90 a month. A small gasoline engine could furnish the power but it would not be as convenient or as dependable.

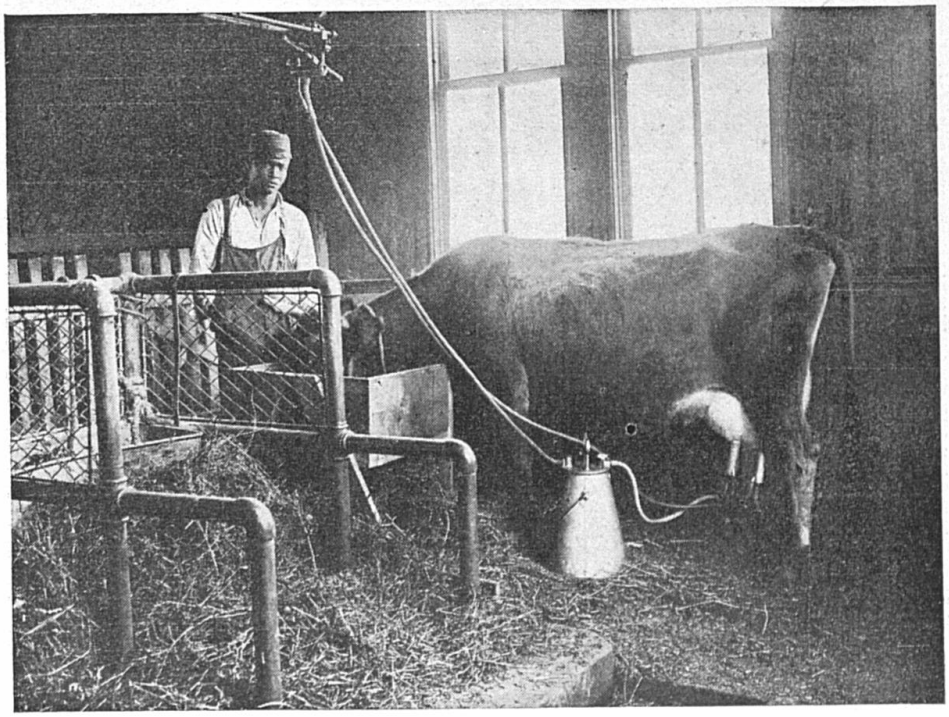


FIG. 3. Milking a cow with the milking machine at Kentucky Agricultural Experiment Station Dairy.

(2). Effect of Machine on Milk Yield of Cows.

The effect of machine milking on the milk yield of the cows has been a paramount issue whenever the mechanical milker has been mentioned. Most dairymen believe that the machine will cause a decrease in milk production, and many dairymen who have fine, high testing cows have failed to take kindly to the machine for this reason.

After carefully tabulating the milk yield of each cow for

thirty days before the machine was used, and for thirty days after its use was begun, we can state definitely that there was no appreciable or permanent decrease in milk production during the short period when the cows were becoming accustomed to the mechanical milker. It should be stated, however that the cows were carefully handled by quiet and careful milkmen with whom the cows were familiar.

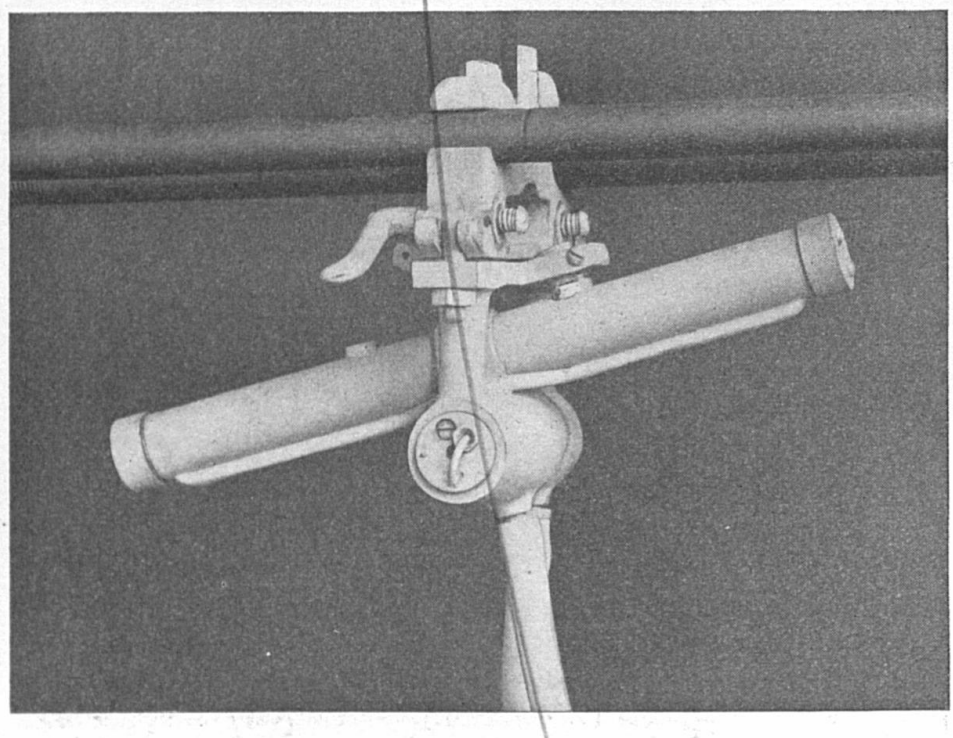


FIG. 4. The Pulsator. This device controls the pulsation in the teat cups

Milk Records for Four Months. A Sharples Mechanical Milker was installed at the Elmendorf Farm in March 1914. Through the co-operation of Mr. J. B. McNulty, Superintendent of the dairy at that farm, we are privileged to quote some interesting data secured there.

In explanation of the following table it should be stated that fifty cows were under observation. Twenty-five were hand milked during the four months reported upon, while

twenty-five were subjected to machine milking for three months out of the four. The first lot of cows were used as a check upon the latter lot.

Table One—Milk Production of Twenty-five Cows Milked by Hand, Compared With Twenty-five Milked With the Machine.

	February	March	April	May
	Hand Milked	Machine Milked		
	lbs.	lbs.	lbs.	lbs,
Twenty-five cows	416.3	364.3	391.6	372.4
Per cent of decrease compared with February		12.49%	+5.9%	10.5%
Per cent of decrease comparing each month with preceding month		12.49%	+7.49%	4.9%
	February	March	April	May
	Hand Milked all the Time.			
	lbs.	lbs.	lbs,	lbs.
Twenty-five cows	607.4	513.7	497.5	494.9
Per cent of decrease compared with February		15.4%	18.09%	18.05%
Per cent of decrease comparing each month with preceding month		15.4%	3.15%	.52%

In explanation of the above table it should be stated that the twenty-five cows that were milked with the machine had decreased 10.5 per cent in their milk yield in May as compared with their production in February, while twenty-five other cows during the same period when milked by hand decreased 18.5 per cent. The machine milked cows produced less milk during March than during April.

Effect of Discontinuing Machine Milking for a Few Days. After the machine had been used at this Station for seven months, it was discontinued for two weeks and the cows during that period were milked by hand. The purpose at that time was to determine whether the cows would respond to hand milking and produce more milk. In the following table the initials designating the name of each cow are given. Some few of the cows gained slightly in milk yield while the milk was drawn by hand, but most of the cows showed a slight decrease. The slight decrease of 3.3 per cent in milk yield is to be expected because the weather was colder during the second period than during the first, and the cows were advancing in their lactation periods.

However, it seemed evident that the cows were producing about all the milk that they would have produced had they been hand milked during the preceding period. At least they did not respond with a larger milk yield when hand milked.

Table Two—Milk Produced When Cows Are Milked by Hand and With the Machine.

NAME OF COW.	Machine Milking 14 Days Preceding December 16, 1913. Total for 14 days. Pounds Milk.	Hand Milking 14 Days Subsequent to December 16, 1913. Total for 14 days. Pounds Milk.
B. L. D.	122.5	97.8
F. L.	246.4	235.9
E.	176.7	173.2
L. D. H.	148.7	132.9
O. J.	135.8	126.9
D. D. N. III S.	483.7	480.2
V. A.	87.5	70.7
B. T.	143.0	134.5
C. M.	337.5	314.8
B. H.	252.3	267.4
J. B. V.	133.4	121.7
L. L.	91.7	82.5
E. C.	200.6	200.0
E. A.	268.6	229.6
M. L.	142.7	143.6
I. G. D.	219.3	207.9
D. N. D.	549.7	548.0
L. T.	91.4	77.9
L. V.	111.7	107.5
Jr. De K. B.	447.3	455.9
B. T. B.	207.1	210.8
A. H.	122.1	106.1
I. L. M.	126.4	111.0
L. V.	201.7	199.7
L. E.	124.9	119.2
B. L. L.	194.6	201.5
B. J.	234.4	231.7
D. O. II.	497.9	509.1
Total milk for 14 days	6,099.6	5898.0
Per cent. of decrease during hand milking		3.3%

It was believed by the writers that the mechanical milker was causing a decrease in milk flow from one of the cows in the Station barn. To test this matter, in November, after she had been milked with the machine for six months, hand milking was begun with her. The milk yielded for twenty-one days while the machine was used in drawing the milk

amounted to 38.3 pounds daily, while she averaged 37 pounds daily for the next period of twenty-one days when hand milked. It is thought that this decrease is due to advancing lactation and colder weather. She was again placed in the line of cows milked with the machine.

Official Records Made by Cows Milked With the Mechanical Milker. Since the machine was installed three cows owned by the Kentucky Agricultural Experiment Station have made official register of merit records. These cows have been milked along with the others, and no especial attention has

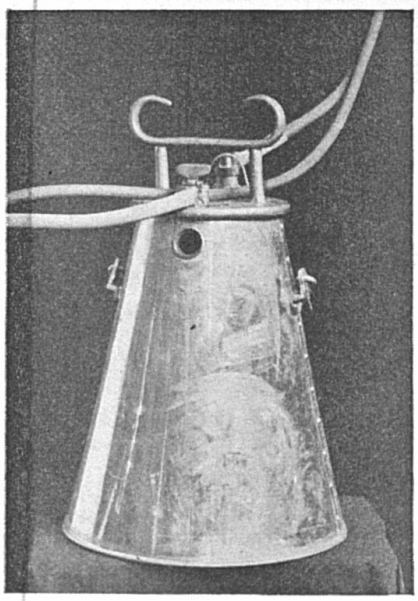


FIG. 5. The Bucket.

been given them. All of the cows are stripped by hand after the machine has completed its work. The strippings reported in this bulletin amount ordinarily to less than a pint of milk, but it would be highly detrimental to leave this milk in the udder. The tests made by the cows are as follows:

Eminent's Countess (5-year-old Jersey) 31-day test, 1110 pounds milk, 57 pounds butter fat.

Baronetti's Tera B. (2 years and one month old, Jersey) test for one year, 6,586 pounds milk, 368 pounds butter fat.

Baronetti's Lady Dean (2 years and one month old, Jersey), test for one year, 4,856 pounds milk, 291 pounds butter fat.

Will Machine Milking Cause a Rapid Loss of Milk and a Short Lactation Period.

Some dairymen have expressed the opinion that the milking machine will cause cows to go dry. In order that this matter may be definitely decided something must be determined as to the proper rate of decrease to anticipate as an average. For information in this regard we turn to Research Bulletin 26 from the Wisconsin Agricultural Experiment

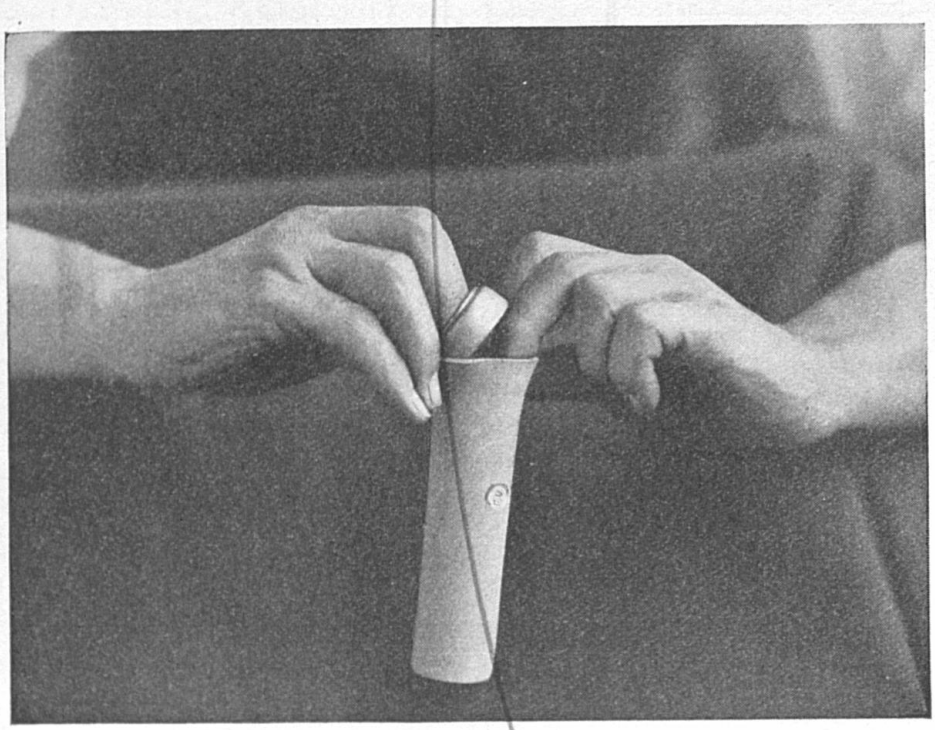


FIG. 6. Inserting top metal ring into rubber inflation which is placed inside the teat cup.

Station. Three hundred and twenty-three dairy cows were under the observation of Prof. F. W. Woll, of that Station, for a year. Careful records were kept relating to the rapidity with which these cows lost in milk yield during each month. Prof. Woll reports in Bulletin 26, that there was an average loss of about 5 per cent each month in milk until the eighth month when the loss became somewhat greater. He

presents the following figures: Percentage loss of milk second month compared with first, 5 per cent; third compared with second, 7 per cent; fourth compared with third, 6 per cent; fifth, 5 per cent; sixth, 5 per cent; seventh, 6 per cent; eighth, 10 per cent; ninth, 13 per cent; tenth, 20 per cent; eleventh, 13 per cent; twelfth, 16 per cent.

A table is presented below to indicate the behavior of the cows at the Kentucky Experiment Station when milked with

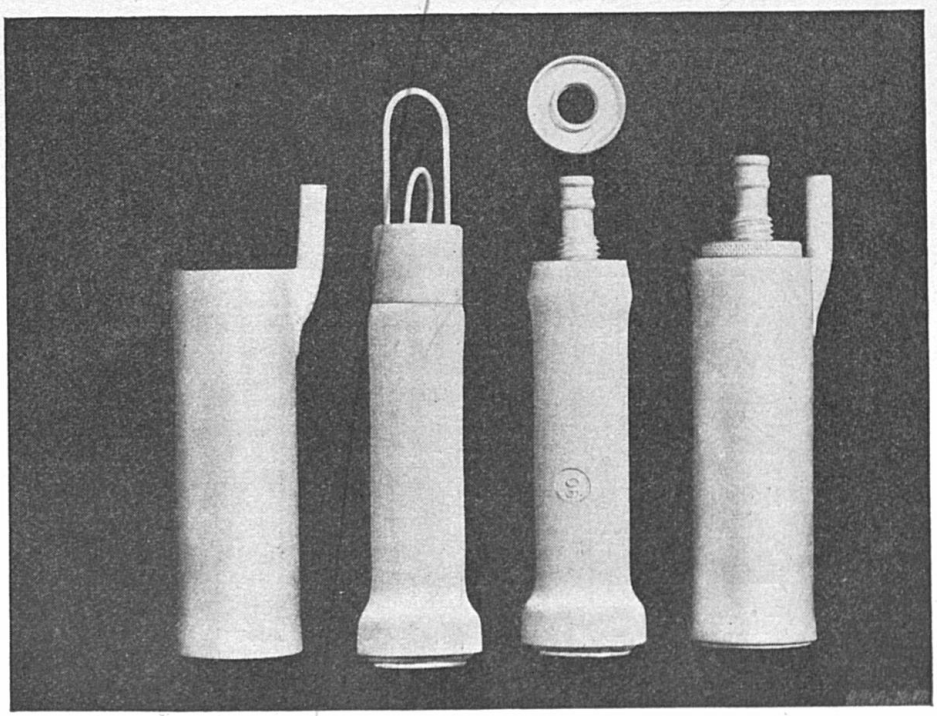


FIG. 7. Parts of a teat cup.

the machine. Some of the cows calved before the machine was installed and consequently were milked by hand for several months. The star in each case indicates when the cows were started on machine milking. The table indicates the amount of milk yielded by each cow during each thirty-day period, together with the percentage of loss in milk produced during each succeeding thirty days.

Table Three—FIGURES SHOW THE PERCENTAGE OF DECREASE IN

The (*) star indicates the date that each cow started on the machine.

COW	First	Second	Third	Fourth	Fifth	Sixth
				PERIODS OF		
Baronetti's Lady Dean	*728.5	546.3	489.6	424.5	387.3	355.1
		25%	10.4%	13.3%	8.8%	8.5%
Baronetti's Tera B.	*840.4	769.9	758.1	649.3	561.7	509.6
		8.4%	1.6%	14.4%	13.5%	9.3%
Belle Holstein	1130.1	*1409.0	1254.1	1128.4	950.4	823.9
		+24.6%	11%	10%	15.8%	13.4%
Countess McEachen	*992.3	931.0	761.0	687.1	677.0	559.3
		6.2%	18.3%	9.8%	1.5%	17.4%
Dora Olin 2d	*1148.1	868.9	1093.4	1055.0	926.7	823.1
		24.4%	+25.8%	2.6%	12.2%	11.2%
Dora Wilson	*734.9	754.4	747.8	735.9	837.9	750.5
		+2.6%	1%	1.5%	+13.8%	10.5%
Elva A.	*723.5	671.2	590.3	497.1	477.9	435.8
		7.3%	12.1%	15.8%	3.9%	8.9%
Eminent's Countess	1101.3	*1041.7	899.5	771.3	669.6	514.5
		5.5%	13.7%	13.2%	13.2%	23.2%
Ethel's Lady	623.8	611.5	638.5	732.1	*713.9	675.9
		1.9%	+4.1%	+14.6%	1%	5.4%
Fannie Lovel	457.0	537.9	605.5	613.6	*575.8	561.6
		+17.7%	+12.5%	+1.3%	6.2%	2.5%
Isabelle's Little May	738.5	877.6	874.1	*717.1	763.7	683.0
		+18.8%	.3%	18%	+6.5%	10.6%
Isabella's Golden Dollie	*891.6	764.7	643.7	587.2	513.9	437.6
		14.3%	15.9%	8.8%	12.5%	14.9%
June Beauty's Val	*820.8	754.1	687.3	623.4	533.9	447.6
		8.2%	8.9%	9.3%	14.4%	16.2%
Lad's Valentine	777.5	*700.2	694.0	579.2	468.9	425.8
		9%	.9%	16.9%	19.1%	9.2%
Lad's Villa	809.2	*822.7	766.8	694.0	574.2	457.3
		+1.6%	6.8%	9.5%	17.3%	20.2%
Lady Dean H.	804.2	*732.3	624.8	599.4	523.4	419.0
		9%	14.7%	4.1%	12.8%	20%
Lady Lafferty	*688.0	667.2	638.5	547.7	not dry	---
		3.1%	4.3%	14.3%	---	---
Avg. % decr'se each month	---	3.40%	4.55%	8.56%	8.20%	12.60%
Wisconsin estimate	---	5.00%	7.00%	6.00%	5.00%	5.00%

MILK YIELD FOR EACH PERIOD OF THIRTY DAYS.

Figures indicate milk yielded and percentage of decrease.

THIRTY DAYS.

Seventh	Eighth	Ninth	Tenth	Eleventh	Twelfth	Total Milk
315.2	239.3	26.2				3512.0
11.3%	24.1%					
474.4	461.3	455.0	386.9	278.0	42.1	6186.7
7%	2.8%	1.4%	15%	28.1%		
740.3	628.4	557.9	390.6	145.2		9212.4
10.2%	15.2%	11.3%	30%			
586.2	536.0	568.2				6866.3 still mlk'g
+4.8%	8.6%	6%				
885.0	770.7	730.9				8337.8 " "
+7.5%	13%	5.2%				
						4561.4 " "
						4857.0 " "
483.5	479.5	497.2				
+10.9%	.9%	+3.6%				
460.6	451.9	408.2	327.4			6646.0
10.6%	1.9%	9.7%	19.8%			
698.5	576.2	487.7	433.8	274.7	49.4	6516.0
+3.3%	13.6%	15.4%	11.1%	36.7%		
509.3	378.5	338.8	271.6	128.7	21.5	4999.8
9.4%	25.7%	10.5%	19.9%	52.6%		
553.1	445.2	372.7	312.7	262.5	216.9	6817.1 still mlk'g
19.1%	19.6%	16.3%	16.2%	16.1%	17.4%	
399.4	336.1	361.8	380.1	401.5		5618.1 " "
8.8%	15.8%	+7.6%	+5%	+5.6%		
366.7	282.9	212.6				4329.1
18.1%	22.9%	24.9%				
293.1	284.1	235.4	204.9	183.1	187.4	5033.6
31.2%	3.1%	17.2%	13%	10.7%	+2.3%	
429.6	432.3	410.9	369.4			5721.4 still mlk'g
6.1%	+.6%	5%	10.1%			
338.1	257.0	294.8	281.5	247.2	245.4	5367.1 " "
19.4%	24%	14.8%	4.6%	12.2%	.8%	
						2541.4 " "
8.30%	12.70%	9.00%	13.47%	21.50%	5.30%	----------
6.00%	10.00%	13.00%	20.00%	13.00%	16.00%	----------

For instance, refer to cow B. L. D., line one. She was started on the machine as soon as she freshened. Her milk yield decreased 25 per cent during the second thirty days. Refer to line three, cow B. H. She freshened a month before the machine was installed and was hand-milked, therefore, the first month. She produced 1130.1 pounds milk the first thirty days, and 1409 pounds the second thirty days, an increase of 24.6 per cent.

Particular attention is called to the two bottom lines of the table. The average percentage of decrease of the cows milked with the machine at this Station is compared with statistics from the Wisconsin bulletin referred to above. It will be observed that the rate of decrease in milk yield is about the same in the two lines.

Unquestionably there are occasional instances where cows will not progress well when machine milked, and no doubt there are other cases in which the cows do better when the milk is drawn with the machine than when they are hand-milked.

(3). Time Saved Through the Use of the Machine.

Time Required to Milk a Cow. It is customary at the Station barn for each dairyman to operate two units. A unit consists of the parts required to milk a cow, and includes a pulsator, a bucket, rubber tubing and a set of teat cups. Each man milks two cows simultaneously, and he observes each cow as she is being milked. It is a simple matter to tell when a cow has been milked. As the milk leaves the rubber tube that leads from the teat cups it pours over a glass in the side of the bucket. When the milk stops running over this glass the cow has been finished. The teat cups are then removed and the last milk is drawn by hand. The time required for each unit to do its work is reported in the following table:

Table Four—Time Required to Milk a Cow With One Unit.

May	20	4.28 minutes
"	22	3.89 "
"	22	4.06 "
"	24	4.05 "
"	25	3.50 "
June	7	4.20 "
Average of seventy-one milkings		3.99 minutes

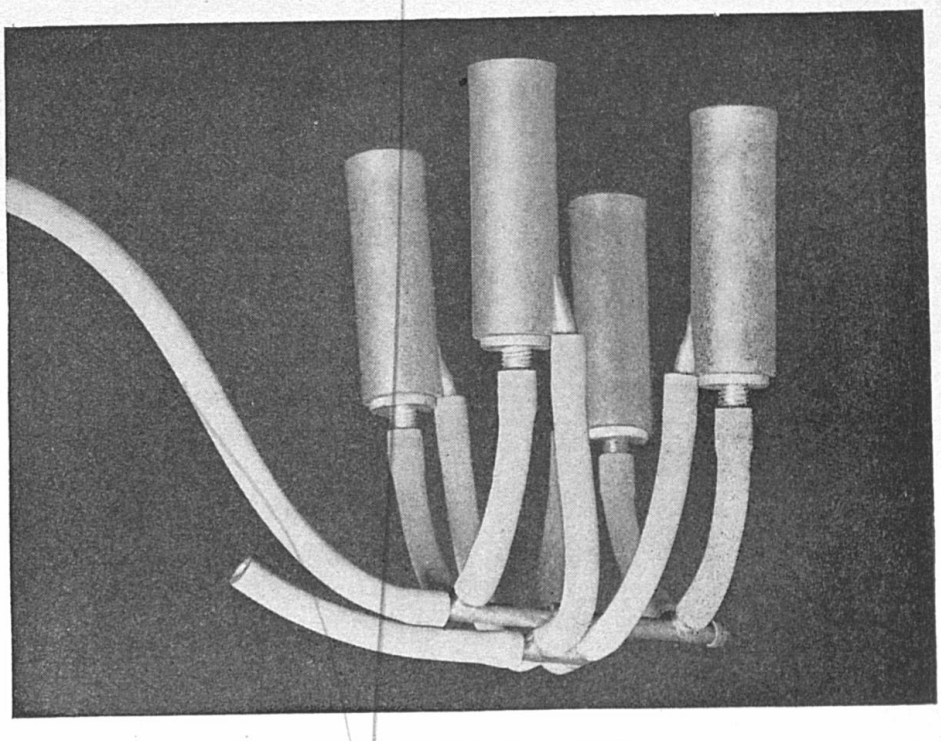


FIG. 8. The "claw" assembled.

Many cows were included during the observations on the different days reported above. In all, seventy-one milkings are included in these figures.

In explanation of these figures it should be stated that the machine will not draw the milk from a cow much faster than a quick hand-milker could. But each man may operate two or three units and thereby milk that number of cows simultaneously. The rate of milking with the machine is maintained during an entire milking, while a man would decrease in speed after having milked several cows.

To still further facilitate matters at this Station two extra machine milk buckets are used. When a cow is milked, and the strippings have been added, the bucket is taken to the milk room where the weight of the milk is recorded. But during this time the machine unit is not idle, because an extra bucket is attached to the set of teat cups and the machine is immediately started on another cow before the milkman starts on his trip to the milk room. While he is gone, therefore, the unit milks a cow. We soon found a need for extra buckets, caused by our system of keeping daily milk records on each cow.

The cows at the Station barn are arranged in two lines of sixteen cows each. Of the sixteen cows on a side, fourteen are machine milked. During the many different milkings the two men who operate the four units have been observed to determine the time required to milk each line with two units and three buckets. Five different men have been assigned the task of milking fourteen cows. E. H. averaged 3.1 minutes per cow; G. C. (colored) 3.35; G. T. (colored) 3.; J. W. W. 3.06; E. B. (colored) 3; or an average of 3.1 minutes per cow. In other words, two of these men operating four units can milk the twenty-eight cows, strip them, feed and carry the milk to the dairy room, in 43.4 minutes. The average of many observations made in connection with hand milking indicates that this same operation, performed by two men, required one hour and twenty minutes. Of course there is some extra work after the milking is done due to extra buckets, rubber tubing, etc., which must be washed. A bright student milked the twenty-eight cows, stripped them, fed the cows and carried the milk from each cow to the milk room, in one hour and fourteen minutes on four different afternoons. He operated three units and five buckets. However, such work is entirely too fast to expect in daily routine.

At the Elmendorf Farm, Mr. J. B. McNulty, Superintendent of the dairy, states that up until March, when all milking was done by hand, two milkmen with a boy to carry the milk to the dairy room, required three hours to milk fifty

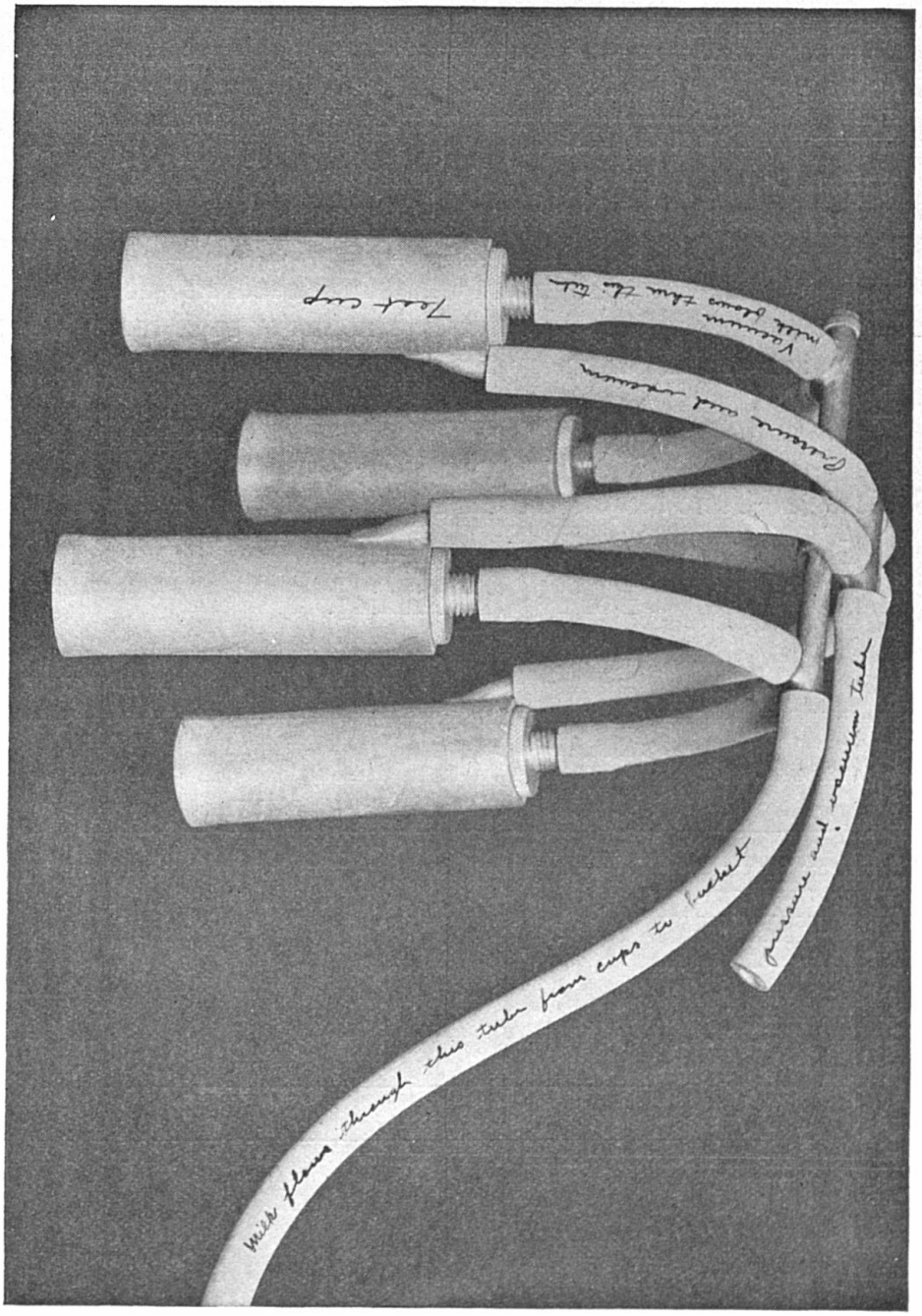


FIG. 9. Showing method by which pressure and vacuum are transmitted to the cups and teats.

cows. By a method that is being tried now, two men operating three units of the mechanical milker, are milking fifty cows in one hour and forty-five minutes, and the boy is not used. The same milkers, for a time, with the boy, operated two units each (four units in all) and milked the cows in one hour and fifteen minutes.

The following tables present figures secured at the dairy barn operated by this Experiment Station, and they indicate the time consumed by a unit in milking a cow, the time to strip by hand, the amount of strippings secured after the machine has milked a cow, and the amount of milk that was produced at each milking by the cows under test.

Table Five—Time Required for Each Unit to Milk a Cow, Time to Strip, Weight of Strippings, and Total Milk Produced During One Milking.

Notes Made May 20, 1913.

NAME OF COW.	Time Consumed by a unit in Milking a Cow. Minutes.	Time to Strip. Minutes.	Weight of Strippings. Pounds.	Milk Produced with Strippings Added. Pounds.
B. L. D.	5.0	1.0	1.6	10.3
F. L.	4.0	1.0	0.5	5.2
V. A.	6.0	0.5	0.1	9.0
O. J.	5.5	0.5	0.1	6.5
V. M.	4.0	0.25	0.2	5.4
B. H.	3.0	0.5	0.1	17.2
L. L.	3.0	0.25	0.9	7.5
E. I. Q.	4.5	0.5	0.3	15.6
M. L.	3.5	0.5	0.1	8.4
Averages	4.28	0.55	0.43	9.45

Notes Made May 22, 1913.

NAME OF COW.	Time Consumed by a Unit in Milking a Cow. Minutes.	Time to Strip. Minutes.	Weight of Strippings. Pounds.	Milk Produced with Strippings Added. Pounds.
I. G. D.	3.5	0.5	1.3	5.1
V. V.	3.0	1.0	1.4	8.6
L. T.	4.0	1.5	0.7	8.5
L. H.	3.0	1.5	0.8	8.5
L. V.	4.0	1.0	0.7	13.0
M. K.	5.5	0.75	0.7	10.2
B. T. B.	5.0	1.0	0.4	13.5
J. B. V.	4.5	0.75	0.4	9.9
A. H.	3.5	0.5	0.3	10.2
I. L. M.	3.5	1.0	0.2	16.4
E. L.	3.0	0.75	0.9	12.4
H. V.	4.0	0.75	0.1	10.2
L. V.	4.0	0.5	1.8	18.0
D. W.	4.0	----------	0.4	16.5
Averages	3.89	0.89	0.72	11.5

Notes Made May 22, 1913.

NAME OF COW.	Time Consumed by a Unit in Milking a Cow. Minutes.	Time to Strip. Minutes.	Milk Produced with Strippings Added. Pounds.
B. L. D.	4.5	1.0	10.0
E.	5.0	0.75	7.0
F. L.	3.5	0.75	7.8
L. D. H.	3.0	1.0	12.8
O. J.	3.0	1.0	5.5
V. A.	5.0	0.25	9.4
C. M.	3.0	0.5	6.8
B. T.	3.0	0.75	7.2
B. H.	4.0	1.0	18.8
J. B. V.	6.0	3.0	8.4
E C.	6.0	0.25	16.9
L. L.	4.0	0.25	7.8
F. I. Q.	3.0	1.0	18.3
E. A.	5.0	0.25	4.8
M. L.	3.0	0.5	10.2
Averages	4.06	0.81	10.1

Notes Made May 24, 1913.

NAME OF COW.	Time Consumed by a Unit in Milking a Cow. Minutes.	Time to Strip. Minutes.	Weight of Strippings. Pounds.	Milk Produced with Strippings Added. Pounds.
B. L. D.	5.0	1.0	0.6	8.8
F. L.	4.25	1.25	1.1	6.6
E.	5.0	0.5	0.2	4.9
L. D. H.	4.5	2.0	4.2	11.0
O. J.	6.0	0.5	0.3	6.4
V. A.	4.0	0.25	0.4	9.3
B. T.	3.5	1.0	0.6	7.8
C. M.	3.0	1.0	0.8	0.5
B. H.	5.0	1.25	1.3	19.4
J. B. V.	6.5	1.25	0.2	11.0
L. L.	2.5	0.5	0.4	6.6
E. C.	3.0	0.5	0.5	14.8
E. A.	3.0	0.25	0.25	4.0
M. L.	3.0	0.5	0.4	9.4
F. I. Q.	2.5	2.0	2.9	13.6
Averages	4.05	0.91	0.94	8.9

Notes Made May 25, 1913.

NAME OF COW.	Time Consumed by a Unit in Milking a Cow. Minutes.	Time to Strip. Minutes.	Weight of Strippings. Pounds.	Milk Produced with Strippings Added. Pounds.
I. G. D.	2.0	1.5	2.6	4.2
V. B.	4.0	1.25	1.0	8.3
L. T.	3.5	1.25	1.2	8.2
L. H.	4.0	0.75	1.4	8.1
L. V.	4.5	1.0	1.8	14.4
M. K.	4.0	1.25	1.9	10.1
B. T. B.	4.0	0.75	1.2	14.9
J. B. P.	3.0	0.75	0.9	8.5
A. H.	3.5	0.5	0.8	9.9
I. L. M.	3.0	1.0	0.8	14.6
E. L.	3.5	1.25	1.3	9.4
H. V.	2.5	1.0	0.8	10.2
L. V.	3.5	1.0	0.9	15.0
D. W.	4.0	2.0	3.8	16.3
Averages	3.5	1.09	1.46	10.9

Notes Made June 7, 1913.

NAME OF COW.	Time Consumed by a Unit in Milking a Cow. Minutes.	Time to Strip. Minutes.	Weight of Strippings. Pounds.	Milk Produced with Strippings Added. Pounds.
D. C.	4.0	1.0	1.3	21.4
B. H.	5.0	1.33	1.7	26.3
J. B. V.	4.0	0.25	0.4	13.4
E. C.	4.0	0.5	0.8	16.0
Averages	4.2	0.77	1.05	19.27
General Averages	3.99	0.83	0.92	11.67

(4). Method of Cleaning the Parts of the Milking Machine.

Method of Taking Care of Rubber Parts that Come in Contact With the Milk. It is absolutely necessary that the rubber tubes which come in contact with the milk be thoroughly cleaned each day. We have seen teat cups encased in white casein which had accumulated during several weeks use. If the tubes are permitted to become foul they contaminate every ounce of milk that passes through them. It is not sufficient to rinse them with warm water. They must be cleaned with washing powder and water after each milking. A long brush is furnished with the machine, and it should be used once a day in cleaning the tubes.

At this Station the rubber tubes and milk buckets are cleaned after each milking, as indicated in the outline given below, and between milkings, the claws (teat cups and attached rubbers) are submerged in a ten per cent solution of lime water. Large jars are used to contain this solution. The lime water serves to prevent the cups and tubes from becoming contaminated, and the rubber parts are kept soft and pliable.

During the first few days that the machine was experimented with at this Station the rubber parts were subjected to live steam, for the purpose of killing all bacteria. A neighboring dairyman even went so far as to place the teat cups and tubes from his machine in a steam sterilizer. It

soon became evident that the rubber would not stand exposure to such heat without rapidly deteriorating. Now the rubber parts are not steamed, but the buckets with their tops are so sterilized each day.

The parts used in milking which are washed every day include four sets of teat cups, rubber tubes and six buckets. The daily routine is as follows:

3 p. m. Teat cups, metal buckets and tops washed with clean water and buckets and tops steamed. Time consumed	10 minutes.
4 p. m. Cows are milked at this time.	
5 p. m. Teat cups washed with warm water to which washing powder has been added, and thoroughly brushed. Buckets and tops steamed. Time consumed	30 minutes.
5 a. m. Teat cups, tubes and metal buckets washed in hot water. Time consumed	10 minutes.
5:15 a. m. Cows are milked at this time.	
6 a. m. Teat cups, tubes and buckets washed in warm water to which washing powder has been added. Time consumed	10 minutes.
9 a. m. Claws disassembled; that is, the rubber tubes are taken from the teat cups and long brushes are used in thoroughly washing them. A liberal amount of washing powder is used. The inflations are not removed from the teat cups. Once every two weeks a dull knife is used to scrape the lime deposited on the inside of the rubber teat cup inflations. Time consumed	15 minutes.
Total time consumed in washing parts each day	75 minutes.

Antiseptic Solutions. In the interim between milkings the rubber tubes that come in contact with the milk are submerged in an antiseptic solution. Various solutions have been suggested for this purpose, some of which have proven satisfactory, some have been found worthless and some are too expensive.

Early in these tests it was found that ordinary air-slaked lime would not furnish a satisfactory solution, because it would not kill the bacteria. It is necessary that the solution in which the rubber parts are soaked should kill bacteria with which it comes in contact. It is advisable to submerge

the rubber in some solution to keep it soft, but clear water will not answer the purpose because it quickly becomes contaminated. Strong salt brine was used for a time, but the bacteriological tests reported below indicated that it was not satisfactory. Sal soda was suggested and tried with negative results in so far as bacteria are concerned. A solution was made by mixing 5 per cent sal soda by weight with 95 per cent water. Subsequently lump lime was secured and

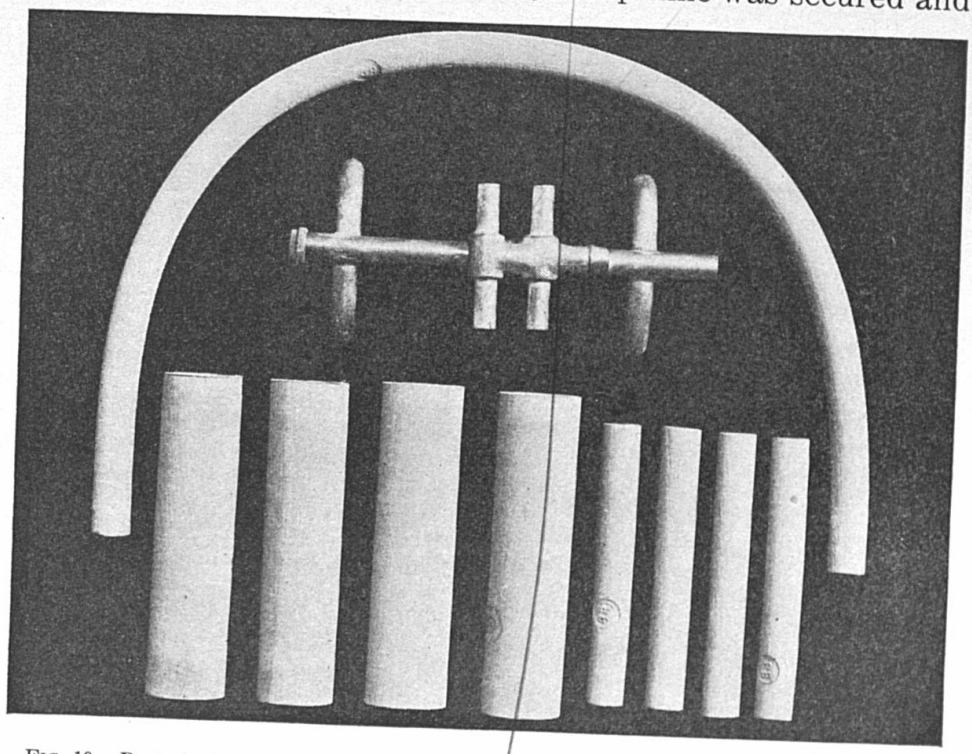


FIG. 10. Parts included in a milking claw for one unit. These convey the milk from the teats to the milk bucket, and require cleaning after each milking.

mixed with clear water in the proportion of 10 pounds of unslaked lime and 90 pounds of water, and this solution has proven satisfactory and cheap, but it is essential that lump lime, not lime dust, be used in making such solutions. The greatest objection to the lime solution is that the lime deposits on the rubber inflations inside the teat cups and after several months these rubber parts become hard and unyielding. This deposit should be scraped from the inflations once every two weeks.

FIG. 11. Diagram illustrating the principle upon which the Sharples Mechanical Milker operates. The pump transmits both vacuum and pressure to the pulsator through two lines of pipe. The vacuum is passed through the bucket to the inside of the teat cup which causes the teat to be drained of its milk. Immediately following this the tube marked A and B transmits compressed air between the metal wall and the rubber inflation, which causes the rubber inflation or diaphragm to collapse causing an upward massaging of the teat.

The teat cups and short rubber tubing which are attached to the claw are submerged in the solution.

The following bacteriological tests of solutions in which these parts had been submerged were made by Dr. D. J. Healy and by Dr. W. R. Pinnell, both bacteriologists of this Station. Their further work in this bulletin is reported in subsequent pages. Tests on such solutions are also reported from the work done at Elmendorf by Mr. J. P. La Master, bacteriologist at that farm. Especially interesting is the fact that the lime solution seems to retain its antiseptic properties for several weeks.

Table Six—Bacteriological Tests of Solutions in Which Rubber Parts had Been Submerged.

(Note: Tests made by Dr. Healy are marked H. Those made by Dr. Pinnell are marked P.)

Date.	Solution.	Bacteria per cubic centimeter.	Remarks.
1913.			
June 4.	H. Strong brine used three days	119,000	Apparently, strong brine will not serve the purpose.
June 9.	H. Strong brine used three days	300	
June 11.	H Clear water used one day	198,500	Water becomes contaminated.
June 21.	P. 10% lime solution used two days	100	Quick lime was mixed with soft water.
June 21.	P. 10% solution of sal soda, used two days	49,500	Evidently sal soda will not prove satisfactory.
June 21.	P. Water from the faucet	40	The supply of water at this dairy is very pure.
June 7.	P. Faucet water	210	
June 7.	P. Sample 5% lime solution used two days	4	
July 16.	P. Sample 5% lime solution used seven days	4	
July 16.	P. Sample 10% lime solution used seven days	1	
July 21.	P. Sample 10% solution 2 weeks old	10	
July 21.	P. Sample 5% lime water used two weeks	60	
Sept. 11.	P. Sample 10% lime water	114	

Table Seven—Bacteriological Tests of 10% Lime Water.

Made by J. P. LaMaster.

March 11,	after 4 days' use	40 bacteria per c. c.
March 14,	after 7 days' use	30 bacteria per c. c.
March 24,	after 10 days' use	1 bacteria per c. c.
April 6,	after 11 days' use	1 bacteria per c. c.
April 16,	after 21 days' use	0 bacteria per c. c.
April 29,	after 35 days' use	0 bacteria per c. c.
May 1,	after 1 day's use	130 bacteria per c. c.
May 7,	after 7 days' use	10 bacteria per c. c.
May 23,	after 23 days' use	0 bacteria per c. c.
May 30,	after 7 days' use	65 bacteria per c. c.
June 1,	after 9 days' use	0 bacteria per c. c.
June 3,	after 2 days' use	100 bacteria per c. c.
June 6,	after 5 days' use	0 bacteria per c. c.
June 11,	after 10 days' use	0 bacteria per c. c.
June 18,	after 18 days' use	0 bacteria per c. c.
June 24,	after 23 days' use	0 bacteria per c. c.

(5) Bacteriological Tests of Samples of Milk Produced With the Machine.

Several hundred bacteriological tests are reported in this bulletin of milk samples produced with the milking machine. Some of these samples were taken from the buckets immediately after the cows had been milked, and other samples were taken after the cows had been stripped and the strippings had been added to the contents of the buckets. These tests were made by Dr. D. J. Healy, Bacteriologist of the Kentucky Agricultural Experiment Station; by Dr. W. R. Pinnell, Bacteriologist of the Pure Food Department of this Station; by Miss Josephine Lisle, Bacteriologist of the Board of Health of Lexington, and by Mr. J. P. LaMaster, Bacteriologist of Elmendorf Farm.

This mechanical milker differs in an important essential from most machines of this kind. No air from the stable is permitted to contaminate the milk. The teat is enclosed in a rubber inflation that works by an upward and downward squeeze, but outside air is not drawn into the milk bucket during the operation of milking. Only one size of teat

cup is required, and therefore it is not necessary to change the parts often. This eliminates needless handling and contamination of teat cups.

A careful operator can secure remarkably low bacterial counts in machine milking, perhaps no lower than he could secure by hand milking, but certainly he can produce clean milk with the machine if he is careful. The operator should carefully wash the udders and teats of each cow, and just before milking he should again wipe the teats with a damp cloth. He should establish a vacuum in the bucket and carefully attach the teat cups, being especially watchful to see that each teat is fitted straight into its cup, so there will be no pinching or doubling of the teats. If the cups are carelessly attached and fall to the floor, a very large number of bacteria and much dirt may be sucked into the milk bucket. While they are off, the teat cups in this case act as a vacuum cleaner. The tests at this Station indicate that dampening the teats just before applying the cups softens them and causes the cups to hang on securely.

To ascertain if it is possible to contaminate the milk by introducing water into the vacuum pipe that extends in front of the cow stalls, the writers poured four gallons of water into the vacuum relief valve, which is on the end of the vacuum pipe. This water was rapidly sucked into the pipe, carried the full length of the barn and evidently deposited in the bottom of the vacuum tank. Not a drop of water could be found in the milk buckets, although purposely two pulsators had been set to working along the pipe through which the water passed. Evidently nothing can contaminate the milk in the buckets during the operation of milking unless the cups fall to the floor.

In all experiments quoted in this bulletin, the strippings were drawn by hand into ordinary small topped milk pails. In most cases the strippings were poured into the machine bucket and mixed with the cow's milk before samples of milk were taken for bacteriological tests. However, in the first table quoted below, in many cases, samples for bacteriological tests were secured before the strippings were added.

Table Eight—Bacteriological Tests Made of Milk Produced With Sharples Mechanical Milker. Bacteria Per Cubic Centimeter.

(Note: All counts in this table were made by Dr. D. J. Healy.)

Date.	Place.	Milk from Bucket.	Milk with Strippings Added.	Samples of Milk After Cooled and Bottled.
May 13, 1913	Station	1650		
May 13, "	"	1550		
May 14, "	"		150	
May 14, "	"			2350
May 12, "	"		7300	
May 14, "	"			350
May 19, "	"		36500	
May 19, "	"		1300	
May 13, "	"			9000
May 13, "	"			5600
May 14, "	"			14400
May 14, "	"			2150
May 12, "	"			7300
May 19, "	"	950	350	
May 19, "	"			7350
May 20, "	"			4350
May 21, "	"		12500	
May 21, "	"		350	
May 21, "	"			1400
May 21, "	"	600		
May 21, "	"			650
May 21, "	"			7150
May 22, "	"			62500
May 22, "	"			22800
May 23, "	"			8500
May 23, "	"			2350
May 24, "	"		6700	
May 24, "	"		600	
May 24, "	"			11200
May 26, "	"	9100		
May 26, "	"	500		
May 26, "	"			5300
May 27, "	"			2900
May 28, "	"			2000
May 28, "	"		600	
May 28, "	"		300	
May 28, "	"		71000	
May 29, "	"	5800		
May 29, "	"	750		
May 29, "	"			4800
May 29, "	"			3850

Bacteriological Tests Made of Milk Produced With Sharples Mechanical Milker.

Bacteria Per Cubic Centimeter.—(Continued.)

(Note: All counts in this table were made by Dr. D. J. Healy.)

Date.	Place.	Milk from Bucket.	Milk with Strippings Added.	Samples of Milk After Cooled and Bottled.
May 30, 1913	Station		1900	
May 30, "	"		1850	
May 30, "	"			3900
May 30, "	"		216000	
May 30, "	"		6200	
June 2, "	"	3700		
June 2, "	"	1000		
June 2, "	"			4840
June 4, "	"			54500
June 4, "	"		4050	
June 4, "	"			1490
June 5, "	"		700	
June 5, "	"		35700	
June 6, "	"			66500
June 6, "	"			700
June 8, "	"			41600
June 8, "	"	490		
June 9, "	"		200	
June 9, "	"		560	
June 9, "	"		1410	
June 9, "	"		41500	
June 9, "	"	100		
June 10, "	"		350	
June 10, "	"		2650	
June 10, "	"			4850
June 10, "	"	1290		
June 10, "	"	1340		
June 10, "	"	130		
June 10, "	"	360		
June 11, "	"	100		
June 11, "	"	1840		
June 11, "	"			1910
June 11, "	"		300	
June 11, "	"		50	
June 11, "	"	40000		
June 12, "	"		1250	
June 12, "	"		400	
June 12, "	"		3850	
June 12, "	"			7900
June 12, "	"		140	
June 12, "	"		4900	

Bacteriological Tests Made of Milk Produced With Sharples Mechanical Milker. Bacteria Per Cubic Centimeter.—(Continued.)

(Note: All counts in this table were made by Dr. D. J. Healy.)

Date.	Place.	Milk from Bucket.	Milk with Strippings Added.	Samples of Milk After Cooled and Bottled.
June 12, 1913	Station		540	
June 12, "	"			43000
June 13, "	"		3200	
June 13, "	"		3880	
June 13, "	"	4920		
June 13, "	"			3850
June 13, "	"		1700	
June 13, "	"	640		
June 14, "	"		320	
June 14, "	"		1170	
June 14, "	"		4220	
June 14, "	"			1500
Total bacteria		76810	476640	424790
Aver. bacteria		3657.6	12221.5	12136.86
Total bacteria in three columns		978,240		
Average bacteria, per test, on all counts		10,297		
Number of counts		21	39	35
Number of counts or tests in three columns		95		

Table Nine—Tests on Average Milk From Station Dairy.

Reported by Dr. D. J. Healy.

Bottles of milk are delivered to the laboratory of Dr. Healy frequently. Almost all of the milk at the Station dairy is drawn with the machine. This milk represents that sent to patrons in the city each day.

DATE	TEST
June 16, 1913	48500 bacteria per cubic centimeter
June 18, 1913	2000 " " "
June 19, 1913	3700 " " "
June 20, 1913	3500 " " "
June 23, 1913	2500 " " "
October 28, 1913	1400 " " "
October 29, 1913	1200 " " "
October 30, 1913	96000 " " "
October 31, 1913	1000 " " "
November, 1913	5200* " " "
December, 1913	5700* " " "
January, 1914	800* " " "
February, 1914	700* " " "
March, 1914	400* " " "
April, 1914	850* " " "
May, 1914	2400* " " "
June, 1914	4700* " " "
Average	10620 bacteria per cubic centimeter

Hand versus Machine Milk.

After the machine had been in use at the Station barn for a year it was tested in comparison with hand milking according to the following manner. Two cows were milked on July 8, 1914, by hand and two with the machine. Samples of this milk were sent to Dr. Healy for test.

The following table is self-explanatory:

COW	Machine Milked	Hand Milked
1	1100 bacteria	
2		5750 bacteria per c. c.
3	700 bacteria	
4		1100 bacteria per c. c.

*The bacteriological tests for November, December, January, February, March, April, May and June, are averages for the month; that is a test was made each day during this time, and all of these counts were averaged.

Bacteriological Tests Reported by the Lexington Board of Health on Samples of Milk From the Experiment Station Dairy.

An inspector from the City Board of Health takes from each milk wagon samples of milk at frequent intervals during each month. These samples are tested by Miss Josephine Lisle, Bacteriologist of that office, and the tests are published in the local newspapers. Frequently the Station has headed the list with the lowest bacterial count received by any dairy supplying Lexington patrons with milk.

For the tests given in the following table, the bottles of milk were taken from the delivery wagon as it was enroute to the customers. Most of the milk was drawn with the mechanical milker. Two hundred quarts of milk were drawn with the machine and twenty quarts were milked by hand each day. All of this milk was more or less mixed, and therefore the tests reported in this table were made of the milk mixed in the above proportion.

Table Ten—Monthly Reports.

MONTH	Bacteria per Cubic Centimeter	REMARKS
April, 1913	433	This was the month preceding the installation of the mechanical milker. Sediment test reported 99% perfect.
May, 1913	1500	
June, 1913	4550	Sediment test 100%, indicating there was no dirt in the milk.
July, 1913	3800	
August, 1913	8100	Lowest count given any dairy supplying Lexington.
September, 1913	93000	First count this month was 13,600. Two other counts were made on milk that was drawn by hand.
October, 1913	6375	
November, 1913	2500	
December, 1913	1600	
January, 1914	450	All milk drawn by hand this month.
February, 1914	340	
March, 1914	520	
April, 1914	140	
May, 1914	3000	
June, 1914	1000	Lowest of any dairy supplying Lexington.
Average	8487	

Tests Made at Elmendorf.

Mr. J. P. LaMaster, Bacteriologist of the Elmendorf Farm, tested samples of milk from fifty-seven different cows. The samples of milk were taken from the milking machine buckets after the strippings had been added.

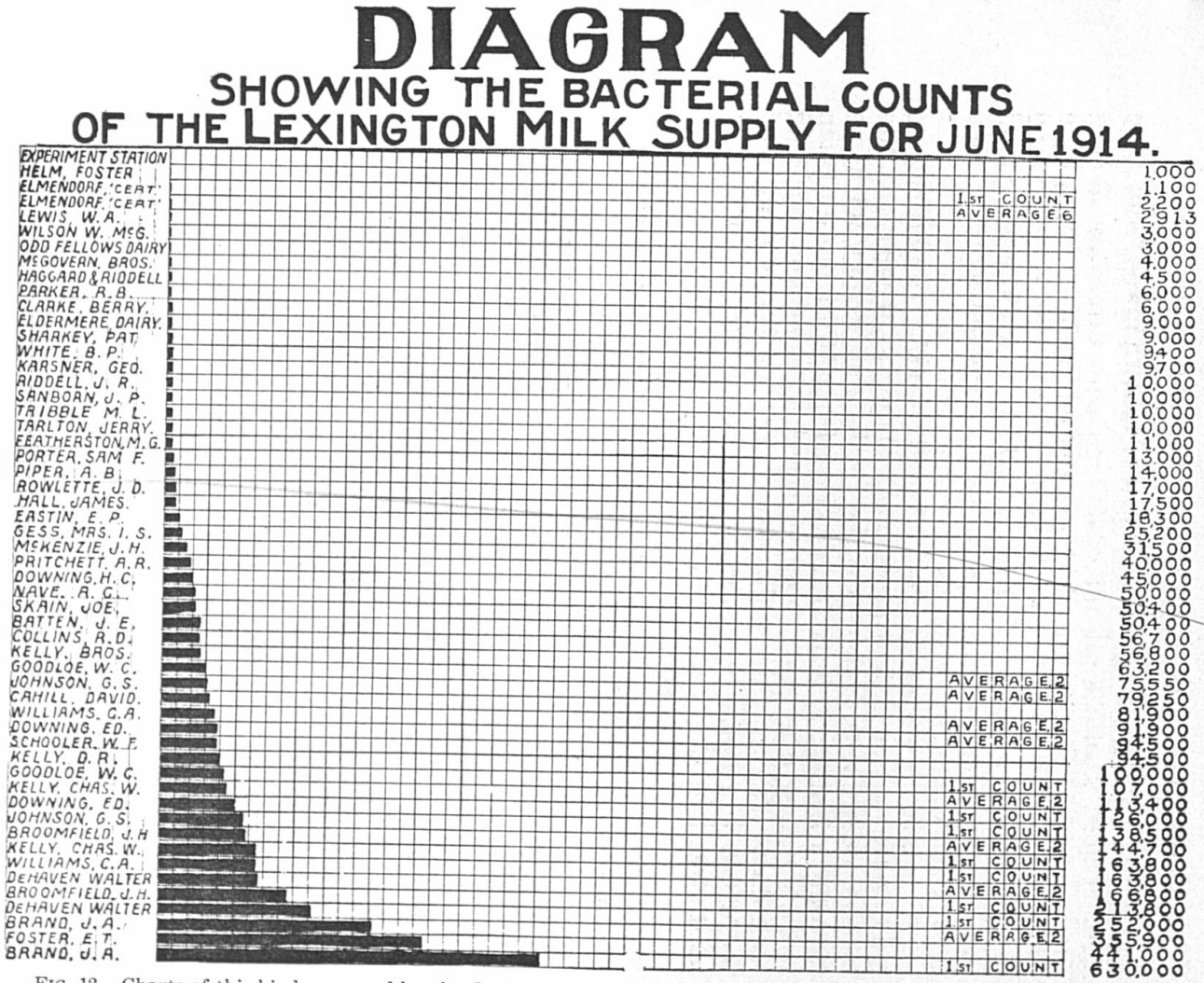


FIG. 12. Charts of this kind prepared by the Lexington Board of Health are printed in the local daily papers on the first of each month. The figures indicate the number of bacteria per cubic centimeter in samples taken from the wagons of the various dairymen supplying this city with milk. This chart is one-fourth as large as those that appear in the daily papers.

Table Eleven—Bacteriological Tests of Milk Drawn With the Machine From Many Different Cows.

The samples were taken from the machine buckets after the strippings drawn by hand had been added to the contents of milking machine buckets. Results reported by Mr. J. P. LaMaster.

No. of Cow.	March Bac. per c. c.	April Bac. per c. c.	May Bac. per c. c.	Average Bac. per c.c.
14	4000; 150	500	3200	1962.5
1564	2900; 500	450	3600	1862.5
1689	1100			1100.0
389	1900; 6800; 550			
	16500	4100	1900	5291.6
1165	26800; 94500			60500.0
2017	1400: 17200	1050		6550.0
	100; 450			
1685	2100	900	750	860.3
139	2800; 7300	550	1000	2912.5
1449	1100; 550	2300	1000	1237.5
559	1700; 1300	2150	1600	1687.5
1655	4000 4400	8600	3100	5000.0
	4900;			
1562	3000; 3000	1450; 1350	700	1900.0
1740	8400	850	2000	3750.0
10	500	2150	2000	1550.0
284	2200			2200.0
65	750	1650	2500	1633.3
33	150; 2800	200	1700	1212.5
1390	2200	3700	950	2283.3
47	1100	1350	1050	1166.6
2013	3500	950	1200	1883.3
304	1300	600		950.0
1698	2000	800	1200	1333.3
1448	1450	600		1025.0
1696	1050	400	1500	983.3
1686	900	300	25000; 2600	7200.0
2187	1300	1900	2800	2000.0
1760	2300	700	3000	2000.0
2056	500	850	850	733.3
1083	3000	1500	2900	2466.6
1484	150	1400	600	716.6
1697	300	350	1400	683.3
1400	700	550	1700	983.3
1561	2000	800	1800	1533.3
1913	600	1000	2100	1233.3
1695	500	950	500	650.0
1656	28000; 6100			
	24000	2500		15,150.0
2180	500	250	1150	633.3
1559	2700	3000	950	2216.6

Bacteriological Tests of Milk Drawn With the Machine from Many Different Cows.—(Continued.)

No. of Cow.	March Bac. per c. c.	April Bac. per c. c.	May Bac. per c. c.	Average Bac. per c. c.
1676	500	----------	----------	500.0
306	1100	650	1200	983.3
339	1300	1550	3500	2116.6
400	11000; 1200	5400	12500; 6000	7220.0
2178	450	----------	----------	450.0
81	5000	2500	750	2750.0
1871	5000	600	1400	2333.3
2021	3500	2650	1800	2650.0
63	1800	2000; 3350	2900	2512.5
1302	2100	650	2300	1683.3
95	8000; 3400	900	7900; 2900	4620.0
2093	1000	----------	7000	4000.0
1389	1700	1000	350	1017.0
435	20000; 4300	100	1300	6425.0
308	----------	1800; 300	1150	1083.3
209	----------	1000	1400	1200.0
310	----------	1500; 1250	1800	1517.0
28	----------	900	500	700.0
340	----------	----------	400	400.0
Average of all above tests				3389.3

Number of cows tested, 57.
Number counts made, 178.

The samples reported above were taken directly from the milking machine bucket, just after each cow was milked and the strippings added. Incidentally, attention is called to cows numbered 389 and 1165 which were found to produce milk with high counts. It seems that some cows produce milk that contains a large number of bacteria, but ordinarily the milk is almost free from bacteria as it comes from a healthy udder. It is well to draw a stream of milk from each teat before the cups are applied, and this first milk should be discarded as it is full of bacteria.

At Elmendorf, Mr. LaMaster secured the following exten sive data regarding milk drawn with the machine. An eight gallon milk can was kept in the center of the dairy barn. As each cow was milked her milk was poured into the can. As each can was filled it was immediately sent to the milk

room to be cooled. The strippings from each cow were added to the milk produced by each cow before the milk was poured into the eight gallon can. As each can was filled Mr. LaMaster secured a sample of the milk for bacteriological test. In all he secured samples from two hundred and twenty different cans during a period of three months. Everything that touched the milk had been sterilized, including strainers, milk cans, etc. In averaging all of these tests it was found that the milk contained only 4624 bacteria per cubic centimeter, and only fourteen samples exceeded the ten thousand limit permitted for certified milk.

Result of Using Uncleaned Machine. As has been stated above, the teat cups, rubber tubing and machine milk buckets must be scrupulously cleaned each day or the milk will be contaminated. To test this the washing was dispensed with for two days, but the cups were soaked in a proper lime solution. Fifty cows were milked each day, and samples of milk were taken direct from the machine milk buckets before the strippings had been added. During the two days that the washing was neglected the average bacterial count amounted to 10,748 bacteria per cubic centimeter, while for the next two days, when the parts had been carefully cleaned, the bacterial count averaged 2654 bacteria.

It is unnecessary to comment upon the necessity for washing the rubber tubing and teat cups. If they become contaminated, then every ounce of milk that passes through them will become contaminated. Some dairymen only rinse the cups and tubes by sucking a bucketful of water through the cups and into the machine bucket after the milking has been finished on the herd. This is pure carelessness and will lead speedily to a high count. Vigilance is the price of cleanliness when operating a mechanical milker. A conscientious dairyman need have no trouble in keeping the bacterial count low, and a careless dairyman will meet with difficulty whether he employs hand or machine milking.

Kentucky
Agricultural Experiment Station
State University, Lexington, Kentucky

BULLETIN NO. 187

The Life-history and Habits of the Corn-ear Worm (*Chloridea obsoleta*)

BY

H. GARMAN and H. H. JEWETT.



STATE UNIVERSITY PRESS
LEXINGTON, KY.
December, 1914.
(511)

KENTUCKY AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

RICHARD C. STOLL, Chairman, Lexington, Ky.
CHARLES B. NICHOLS, Lexington, Ky.
LEWIS L. WALKER, Lancaster, Ky.
HENRY S. BARKER, President of the University.
THE DIRECTOR, Secretary, ex-officio.

JOSEPH H. KASTLE, Director.

STATION COUNCIL

THE DIRECTOR.

A. M. PETER
H. E. CURTIS
H. GARMAN
C. W. MATHEWS
R. M. ALLEN
J. D. TURNER
E. S. GOOD
GEORGE ROBERTS
J. J. HOOPER

DEPARTMENTAL ORGANIZATION

ADMINISTRATION

THE DIRECTOR, Head.
H. E. CURTIS, Bursar.
HYWEL DAVIES, Purchasing Agent.
O. L. GINOCHIO, Secretary to Director.
ADDIE LEE DEAN, Librarian.
ANNA WALLIS, Clerk.
CORNELIA C. PAGE, Clerk.

AGRICULTURAL EXTENSION

F. MUTCHLER, Superintendent.
T. R. BRYANT, Asst. Superintendent.
J. H. CARMODY, Horticulture.
H. B. HENDRICK, Agronomy.
C. D. BOHANNAN, Rural Economics.
W. D. NICHOLLS, Dairying.
H. W. RICKEY, Poultry. (In Cooperation with U. S. Dept. of Agriculture.)
T. E. STOKES, Animal Husbandry. (In Cooperation with U. S. Dept. of Agriculture.)
MARY E. SWEENY, Home Economics.
AUBYN CHINN, Cookery and Dietetics.
RUBY M. BUCKMAN, Sewing and Household Arts.
ANNA BERRY JONES, Clerk.
MARGARET RYAN, Clerk.

AGRONOMY

GEORGE ROBERTS, Agronomist, Head.
E. J. KINNEY, Assistant Agronomist.
P. E. KARRAKER, Soil Survey.
A. E. EWAN, Supt. Experiment Fields.
JESSIE F. CASWALL, Clerk.

ANIMAL HUSBANDRY

(Beef Cattle, Sheep and Swine)

E. S. GOOD, Head.
ROBERT GRAHAM, Veterinary Science, In Charge Hog Cholera Serum Production.
E. W. MUMMA, Asst. In Charge Hog Cholera Serum Production.
O. S. CRISLER, Hog Cholera Serum.
R. L. PONTIUS, Hog Cholera Serum.
W. V. SMITH, Asst. in Animal Husbandry.
M. J. SMITH, Asst. in Animal Husbandry.
M. G. GINOCHIO, Clerk.
E. J. GOTT, Hog Cholera Serum.
A. L. BRUECKNER, Hog Cholera Serum.
LUCY K. HUTCHCRAFT, Clerk.

ANIMAL HUSBANDRY

(Dairy Cattle, Horses and Poultry.)

J. J. HOOPER, Head.
W. S. ANDERSON, Asst. Horse Husb'd.
J. W. NUTTER, Supt. Dairy Farm.
W. D. NICHOLLS, Asst. Dairying.
D. D. SLADE, Supt. Poultry Farm.
P. E. BACON, Elmendorf Milk Records.
ED HUSTON, Asst. in Dairying.
F. WALLACE UTTERBACK, Clerk.

CHEMISTRY

A. M. PETER, Chief Chemist, Head.
S. D. AVERITT, Chemist.
J. S. McHARGUE, Asst. Chemist.
R. PFANSTIEL, Asst. Chemist.
ETHEL V. T. CASWALL, Clerk.

ENTOMOLOGY AND BOTANY

H. GARMAN, Entomologist and Botanist, Head.
MARY L. DIDLAKE, Laboratory Asst.
E. C. VAUGHN, Asst. in Seed Inspection and Plant Breeding.
H. H. JEWETT, Research Asst. Entom.
H. R. NISWONGER, Asst. in Field Work and Nursery Inspection.
LOUISE BEWLAY, Clerk.

FEED

J. D. TURNER, Head.
H. D. SPEARS, Chemist.
E. H. NOLLAU, Asst. Chemist.
ELMER INGRAM, Chief Inspector.
ROGER W. JONES, Inspector.
FANNY C. ROGERS, Clerk.

FERTILIZER

H. E. CURTIS, Chemist, Head.
WM. RODES, Assistant Chemist.
ELMER INGRAM, Inspector.
R. W. JONES, Inspector.
ANNA WALLIS, Clerk.

FOOD AND DRUGS

R. M. ALLEN, Head.
J. O. LaBACH, Chief Chemist.
L. A. BROWN, Chemist, Drugs.
J. W. McFARLIN, Chief Food Inspector.
W. R. PINNELL, Bacteriologist.
C. S. PORTER, Inspector, Drugs.
WALTER SCHEPPELMAN, Inspector, Bakery Sanitation.
E. F. WORTHINGTON, Inspector, Dairy Sanitation.
W. G. TERRELL, Inspector, Foods.
LILLIE LISTON, Chief Clerk.
LENA LISTON, Clerk.

HORTICULTURE

CLARENCE W. MATHEWS, Head.
F. W. HOFFMAN, Asst. in Horticulture.
G. B. WURTZ, Consulting Meteorologist.
MURIEL CASWALL, Clerk.

RESEARCH

THE DIRECTOR, Head.
H. GARMAN, Entomologist and Botanist.
D. J. HEALY, Bacteriologist.
E. S. GOOD, Animal Husbandry.
O. M. SHEDD, Chemist.
MARY L. DIDLAKE, Asst. Entomologist and Botanist.
G. D. BUCKNER, Chemist.
H. H. JEWETT, Research Asst. in Entom.

Notice

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Director.

BULLETIN NO. 187

THE LIFE-HISTORY AND HABITS OF THE CORN-EAR WORM (*Chloridea obsoleta*)

By H. Garman and H. H. Jewett.

Since July, 1889, the senior author of this account has observed this insect and its injuries in Kentucky, more or less continuously, as other duties permitted. It was common at that time and has remained so until now, with some periods of little injury and others of very general and severe loss to the crop. Records made by me September 7, 1889, and subsequently will serve very well to give an idea of a common condition of the crop, especially near cities where truck farming is practised and numerous plantings of table corn and tomatoes give the insect an exceptional food supply during the whole summer season.

My first record reads: Sept. 7, 1889.—"Larvae very abundant everywhere on corn. Adult moths found to-day lurking in hollows formed by blades of young late-planted corn." The next entry, of September 14, 1889, reads: "Corn very badly injured by this insect. On the Experiment Farm I believe 95 per cent of the ears are affected. A count of fifty ears as I came to them gave only two which were probably not infested. Most of the ears showed a hole at the side. Some young larvae just hatched, others nearly grown. Some moths in the field." A third record, dated September 25 of the same year, reads: "In young late-planted corn the larvae are working down among the central blades. Result

of work like that of stalk-borer (*Papaipema nitela*) in spring—a riddling of the blades with rather large holes. One imago observed in this field."

September 24, 1891, corn was again noted as badly injured, in some cases three or four worms, when they were small, being found on a single ear and most of the ears affected. This continued until the middle of October. On October 26, all those collected had pupated. Some evidence of a bacterial disease among the larvae was observed, and cultures were made of bacteria obtained from the fluids. An interesting feature of the habits of the insect was noted October 13, when larvae of various sizes were found feeding on the green seed pods of the weed known as velvet leaf (*Abutilon avicennae*).

In 1893 it was observed working on tobacco and has since then been found constantly present when tobacco is grown next to corn, and especially when there is a rank growth of leaves after the tobacco crop is removed.

On October 5, 1895, two living worms about two-thirds grown were found on an ear of corn brought from the Farm. On November 1, both had pupated, and on December 3, 1895, both had emerged. This acceleration of the development is a constant feature, however, of the worms kept indoors if the rooms are heated. Two of the pupae, secured in 1891, yielded adults February 18, 1892, and another yielded one on March 3. These instances of early maturity are interesting as showing that the insect is controlled in this matter by its environment, and if the proper temperature and food are provided it goes forward with its changes steadily, yielding, as will appear later, a brood of adults per month, approximately, during the summer season.

October 6, 1894, the worms were noted as still common in the ends of corn ears, tho the grain was very hard. Various sizes were noted, from those less than a half inch long to those fully grown and ready to pupate.

October 12, 1896, it was noted that tobacco suckers, which grow up after the crop is harvested, were frequented by the corn worm larvae, probably in some cases driven to this food

from ripening corn, but sometimes no doubt they were resorted to by the laying females in the absence of other food.

October 3, 1900, the pods of tobacco of some experimental plantings of southern varieties were found badly infested with the worms, which were eating into the sides and feeding with part of the body exposed.

On October 30, 1903, corn planted July 10, at Lexington, was noted as 100 per cent infested, most of the brood having at this date left the ears. During this season the insect was observed continuously from July until frosts stopped its depredations. A larva obtained July 21 had changed to a pupa July 28 and yielded an adult August 18. Other rearings made at this time gave a larval period of about fifteen days and a pupal period of about sixteen or seventeen. Seven plots of corn planted by the Division were observed closely with reference to the injuries. They were planted, respectively, May 13, May 29, June 12, June 26, July 10, July 24 and August 7. When examined for corn worm injury September 22 the first two plantings were found to have been badly injured but no worms were present. Those planted June 13 to July 10 were infested with larvae of various sizes. The plot of July 24 with tassels and silks just appearing bore numerous larvae feeding on the tassels, and some moths were observed resting on tassels and blades. The last planting (August 7) then about three feet high furnished but one larva, found working among the central leaves.

Three plots of tomatoes were planted between corn plots, but during the season only a half dozen larvae were taken from them, while the corn was badly infested. Our observations made at this time indicate that tomatoes are not the favorite food, but that the worms feed upon them when corn becomes too ripe or none is to be found, as is true in the early part of the season.

As showing the lateness with which the adult insects may come out of the ground an observation made in 1904 may be given here: On August 23 twelve larvae from experimental

plots were placed in a cage and kept under out-of-door conditions. They had produced nine pupae on the 25th, and from these five adults had emerged on September 23, and on the 24th some of them had placed eggs on the ears of corn provided as food.

A good deal of attention was given during the summer of 1904 to the injury by the corn-ear worm, with a view to learning whether or not it varied with season, time of planting corn, or with variety. Our results indicated that there was little difference with respect to variety, that the insects liked one sort about as well as another, preferring at the time of placing their eggs, however, corn that was succulent and on which the silk was fresh. The following records of four plots planted by the Division may be of some interest, as throwing light on this phase of the subject. The results indicate that corn planted very early may escape severe injury by the silk drying up before the moths are about in large numbers, possibly to some extent also because the grain is farther along and less acceptable to the moths as food for their young. The variety used was in each of the four plots, Iowa Silver Mine. They were all examined for corn worm injury, October 29.

Plot 182.

Planted May 14.
Greatest injury August 10 to 25, with some larvae present September 26.
Perfect ears, 33.8 per cent.
Slightly injured, 30 per cent.
Moderately injured, 20.2 per cent.
Severely injured, 16 per cent.

Plot 197.

Planted May 28.
Worms numerous August 10 to 31, with a few present October 8.
Perfect ears, 11.3 per cent.
Slightly injured, 30 per cent.
Moderately injured, 25.3 per cent.
Severely injured, 33.4 per cent.

Plot 195.

Planted June 11.
Greatest injury August 10, some larvae present October 8.
Perfect ears, 11.3 per cent.
Slightly injured, 30 per cent.
Moderately injured, 25.3 per cent.
Severely injured, 33.4 per cent.

Plot 184.

Planted June 25.
Greatest injury from September 12 to October 5.
Injury had begun August 25, when silks were just appearing.
Perfect ears, 5.4 per cent.
Slightly injured, 16.2 per cent.
Moderately injured, 27 per cent.
Severely injured, 51.4 per cent.

Records from three other plots of as many different varieties of sweet corn, planted August 16, follow:

Plot 187.

Variety, Peep o' Day.
Larvae most numerous Oct. 8-29, over 85 per cent of them being less than $\frac{1}{4}$ inch long on the first date and 86 per cent over $\frac{1}{4}$ inch on the last. The last examination was made after a severe frost (Oct. 26) when the worms were found eating any part of the plant still succulent.

Plot 175 A.

Variety, Crosby's Extra Early.
Larvae numerous tho silks had not yet been produced.
Mostly one-half to one inch long.

Plot 175 B.

Variety without name (Seed from New Jersey Experiment Station).
In full silk October 22, when badly infested. Numerous well grown worms present on ears, tassels and blades Oct. 29 after a severe frost.

Attention is directed to the four plots of Iowa Silver Mine as showing an increase in the injury from corn worms as the season advanced. While a third of the ears was not injured

at all, and 16 per cent were injured badly, the percentage of uninjured ears gradually fell, and of the badly injured ones rose, until in the last planting (June 25) only 5.4 per cent of the ears were free from injury and 51.4 per cent were badly damaged. This increase of injury goes of course with the increase in the numbers of insects abroad with each brood developing. In the fall there is likely to be a cutting off of the last brood from frost and from the attacks of insect enemies, so that the number pupating may be small, and it may be much reduced if very early frosts occur. This feature of the insect's economy suggests the possibility of avoiding the worst mischief by early planting, coupled with other precautions which will be mentioned later.

The three plots of table corn (Nos. 187, 175A, and 175B) were planted to get information as to the fall history and hibernation of the insects. The plants were infested probably not less than 95 per cent, and as the planting was all done August 16 the insects pertained wholly to the last or fourth brood. Some of the plants were infested before ears developed, and as already noted, the worms were more disposed to live exposed on the tassels and blades than they were in midsummer. By the 23rd of September some of the adults had emerged. The rest of the pupae were carried thru the winter and emerged in the spring of 1905.

While the moths generally remain concealed and are unrecognized by farmers, they sometimes, when very common, fly about actively in the sunshine, visiting and feeding greedily on the nectar of flowers, as on July 19, 1890, when they were observed to be common about the flowers of bouncing Bet (*Saponaria officinalis*) growing wild along the pikes of Bluegrass Kentucky, and on August 4 of the same season, on some late blooming white clover. On July 18, 1890, the moths appeared suddenly in numbers on the sirup used on the trunks of trees as a bait to attract night flying moths of other sorts, and remained common until July 25.

On June 24, 1893, the moth was noted by me about corn not yet in tassel, and also about petunias near corn.

On another occasion the moths were observed to be very common among cowpeas growing near corn, and in the plots in midsummer have been noted from time to time about the blossoms of sweet clover (*Melilotus alba*).

These miscellaneous observations, together with dates of collecting the moths recorded on pinned and mounted specimens, give a general view of the insect, its habits and injuries but lack some details that could only be secured by giving it more continuous and concentrated attention.

Summary of Observations Made Previous to 1907.

The adult insects observed about corn and flowers in June, 1893, probably represented the winter brood (the 4th), and those found so common about sugary baits and bouncing Bet in July, the first. Others noted about cowpea and sweet clover undoubtedly represented the third, and those pupae secured by rearing in the fall, the fourth or hibernating brood. The relations of these facts were not made absolutely plain until the successive broods were carried thru from the egg to maturity, as has been done in the Division for several years past.

Other facts of importance definitely determined by these early observations were:

(1) The corn-ear worm larva feeds constantly on tobacco, both leaves and seed pods.

(2) It feeds on the weed, velvet leaf (*Abutilon avicennae*).

(3) It feeds on the fruit and leaves of the tomato, but eats it as a second choice, preferring corn.

(4) It feeds at times on horse nettle (*Solanum carolinense*).

(5) The moth feeds greedily on baits consisting of sweets of various sorts, in the evening, and is a common visitor to flowers in the daytime.

(6) The moth is not commonly drawn to light. In 1893 some careful tests of electric light lantern traps were made, with special reference to the codling moth, but in the vicinity of growing corn. Not a single corn worm moth was captured.

(7) The injury begins on tomatoes and table corn in June, and ends on late corn and tobacco suckers with some individuals resorting to the seeds of weeds.

(8) The injury gradually increases in severity with the advance of the season.

(9) The late brood (4th) may be greatly reduced from the effect of frost and the attacks of enemies, this feature accounting for the occasional years, sometimes noted, of reduced injury by the corn-ear worm.

Recent Studies of the Corn-ear Worm Made in this Division.

At different dates in 1907, plantings of several widely different varieties of corn, some field corn, others table varieties, were made with a view to learning the preferences of the insect, if any, and to determine if possible when corn is most subject to injury. The results of an examination of each ear are given below:

STOWELL EVERGREEN.

(A well known sweet corn of our gardens)

Plot	Date planted	Yield-lbs.	Per cent injured.	Per cent destroyed.	Harvested.
83 –1/80 A.	May 13	75.75	45	3	Oct. 12
102 –1/80 A.	" 27	96.00	80	10	" 23
109 –1/80 A.	June 12	81.00	85	5	" 12
122 –1/80 A.	" 25	94.00	93	12	" 23
135a–1/320A.	July 8	18.50	100	27	Nov. 2
135b–1/320A.	" 22	15.00	81	34	" 2

EARLY RED CORY.

(A table corn)

85 –1/80 A.	May 13	34.50	82	20	Oct. 23
98 –1/80 A.	" 27	35.50	50	5	" 12
111 –1/80 A.	June 12	58.00	30	3	" 23
124 –1/80 A.	" 25	46.50	45	1	" 12
137a–1/320A.	July 8	3.75	90	7	Nov. 2
137b–1/320A.	" 22	6.75	100	15	" 2
137c–1/320A.	Aug. 5	-----	---	--	--------

IOWA GOLD MINE.

(A field corn)

Plot.	Date planted.	Yield-lbs.	Per cent injured.	Per cent destroyed.	Harvested.
87 –1/80 A.	May 13	84.75	33	1	Oct. 12
100 –1/80 A.	" 27	93.50	35	1	" 12
113 –1/80 A.	June 12	93.25	63	7	" 23
139a–1/320A.	July 8	16.75	92	11	Nov. 2
139b–1/320A.	" 22	11.50	97	43	" 2

BOONE COUNTY WHITE.

(A late field corn, popular in Kentucky)

170 –1/20 A.	May 13	361.00	58	6	Oct. 12
171 –1/20 A.	" 13	427.00	44	3	" 12
204 –1/20 A.	" 13	324.50	56	4	" 23
209 –1/20 A.	" 13	198.00	86	4	" 23
211 –1/20 A.	" 13	204.75	77	6	" 23
91 –1/80 A.	" 14	89.50	56	4	" 23
104 –1/80 A.	" 27	85.50	54	5	" 23
117 –1/80 A.	June 12	62.50	86	5	" 23
130 –1/80 A.	" 25	80.00	90	5	Nov. 2
143a–1/320A.	July 8	17.50	90	10	" 2
143b–1/320A.	" 22	4.50	70	8	" 2

LITTLE WILLIS.

(A hard white field corn of Kentucky origin)

93 –1/80 A.	May 14	97.50	40	6.5	Oct. 23
106 –1/80 A.	" 27	72.50	51	1	" 23
119 –1/80 A.	June 12	64.00	84	8	" 23
132 –1/80 A.	" 25	65.00	84	3	Nov. 2
145a1/320 A.	July 8	11.50	71	7	" 2
145b1/320 A.	" 22	2.00	12	1	" 2

WHITE FLINT.

89 –1/80 A	May 13	67.75	50	3	Oct. 23
102 –1/80 A.	" 27	71.50	50	10	" 23
115 –1/80 A.	June 12	69.50	80	4	" 23
128 –1/80 A.	" 25	86.00	80	5	" 23
141a–1/320A.	July 8	14.00	90	16	Nov. 2
141b–1/320A.	" 22	8.00	89	38	" 2

In a general way these results corroborate those secured from an examination of plots of corn in 1904. They show an increase in the injury with the advance of the season, the

early plantings, without regard for variety, generally showing less injury than those planted later. An apparent exception to the injury of first plantings being slight, is shown by plot 75, in Early Red Cory. Eighty-two per cent of injured ears is high for a planting made May 13, and was probably a result of some peculiarity of situation and preceding crop, not, however, noted at the time. Yet even this variety shows the same increase as the others when the first planting is omitted, the last of all (July 22) being injured to the extent of 100 per cent of the ears produced.

A falling off in the injury of some of the late planted, late maturing varieties, such as the Little Willis, was due in part to the imperfect growth of the plants and the undeveloped condition of the ears when the season closed.

In the percentage of ears actually destroyed, Stowell Evergreen led, with White Flint next, and Iowa Gold Mine, third. The plantings suffering most in this way, i. e., having most ears actually destroyed, were those of July 22, Stowell Evergreen of this date suffering a loss of 34, Iowa Gold Mine, of 43, and White Flint, of 38 per cent.

The fact is worth noting here that the best total weights of corn were secured from plantings made from May 13 to June 12, excepting the quick-maturing varieties such as Stowell Evergreen and Early Red Cory, which yielded well when planted as late as June 25.

We began our observations on the insects themselves in 1907, with what seemed to be the belated second brood of the season, individuals of the first one, beginning in June, having been very rare. Sirup baits constantly used with a view to showing when the moths were abroad in the field failed to attract a single one. Electric lanterns of excellent quality also failed to attract the moths tho kept in some cases in the midst of corn. Larvae of the second brood were secured in August, and on the 12th to the 19th of the month left the corn for pupation. Adults from these pupae emerged in early September (August 28 to September 9) in confined examples, and on the 11th eggs were found attached to the silks. Larvae hatched from some of these eggs Sep-

tember 14, and pupated October 17. Adults of one or another brood were abroad during all this period, apparently. On September 11 eggs were found attached to silks. On October 9 some Little Willis corn planted August 5, was found to have eggs on every ear, sometimes six or eight on the silks, occasionally one at the edge of the husks. They were noted as abundant again on the 19th and 22nd. On the 24th they were noted as hatching, and individuals of the brood were confined and followed to maturity. An example of a series kept under observation at this time will give an idea of their rate of development, the conditions being kept as nearly as possible like those out-of-doors.

Larva No. 11, November 9: Five millimeters long. Pallid; head, neckplate, jointed legs, sides of fleshy legs, caudal plate, black. November 11: Feeding well; perhaps 6 millimeters long. November 14: Ready to moult. November 16: Has moulted. Head distinctly dotted. Neck plate black, but with white markings more prevalent than usual. Lateral pale stripe conspicuous. Spiracles dark at centers. November 20: Moulted. Blackish; the darkest of the larvae under observation at present. November 27: Restless. Not eating, probably ready to pupate. November 28: Has gone into ground for pupation. June 16, 1908: Adult emerged, a perfect female.

This larva and others reared do not represent indoor conditions alone. On the 14th of November ears of late planted Boone County White were still infested with worms, slowly maturing because of the cold and probably at times torpid, but some had cut thro the husks and gone into the soil for pupation. Others died before pupation as a result of the cold weather.

Tho our rearings were not sufficiently numerous to enable us to get mated examples of the adults and thus secure fertile eggs, they give a pretty definite idea of the late summer and fall history of the insect when taken with the out-of-door observations and collections. The brood first observed (the second) became mature, as stated, in late August and early September, the eggs having been secured on

the 11th. Larvae of this brood (the third) pupated October 17, and some adults (4th brood) appear to have emerged by the last of the month or in early November, laying the eggs found abundant during the greater part of November and producing in one of our rearings, a moth June 16, 1908. Others emerged much earlier, tho kept in a basement room.

Some examinations of pupae in soil were made from time to time to learn how widely the larvae roamed after leaving corn and to determine the exact situations in which they pupated. They were not found far away from the corn and in no case had a larva pupated at more than four inches depth. In confinement they frequently pupated one or two inches below the surface, and sometimes during the summer among rubbish on the surface.

Our reared pupae, kept over winter, began to emerge in 1908, February 14, when a female came forth from a pupa kept in the basement of the Station Building. This was probably an accelerated individual which would have emerged in November of 1907 if cold weather had not set in to prevent. As will be noted in what follows, rearings kept in the basement of the insectary emerged in a good many cases at that time.

The normal emergence, corresponding with that which took place out-of-doors, began with an individual found October 22, 1907, which produced a moth June 16, 1908. Corn at this date was mostly up but rather backward; some was not yet planted. Adults were still emerging from the same batch of pupa, June 27. An adult came forth July 2; another, July 3, from a pupa found October 22, 1907; a third, July 10, from a pupa found November 24, 1907. At the latter date larvae in the field pertaining to the first brood of the season were nearly ready to pupate, and doubtless were from eggs of some early appearing moths of the same brood as those coming out July 10. Larvae taken from sweet corn were sent me about this time (July 6) from Louisville, by Mr. Kinney, then assistant in the Division, and were from a half to an inch in length.

On the 12th of July larvae went into the ground for pupa-

tion, and on the 27th an adult emerged. Adults continued to come out until August 10. Scattered eggs were found on corn silks in the experiment plots July 31 and were present during the early part of August. Five adults confined in cages with corn, August 4 and 5, had on the 8th produced numerous pale olive-green eggs attached to the wire gauze forming the walls of the cages. They were laid on the night of the 7th. On the 9th adults confined in Stender dishes in the Laboratory had laid during the previous night numerous eggs on bits of corn blades. Eggs of this batch were noted as hatching August 15, the young very active, creeping by a looping motion and suspending themselves by a thread when disturbed. The worms of the brood were ready to pupate August 21 to August 27. On the 28th some of them had gone into the ground for pupation and at the same date a few eggs were found on corn in the field, showing that some moths were abroad. The bulk of the brood, however, was ready to pupate at this time, and the moths then laying in the field were doubtless the result of the overlapping in the life-histories of different individuals of broods, already noted. Individuals hatched August 15 and going into the soil August 28, emerged as adults September 11. One came forth September 17, and from this time until frost, eggs were to be found on corn in the field. The young were noted as being numerous again from September 28 to October 5. On October 8 to 12th larvae were nearly ready to pupate and continued until about November 6 in late plantings of corn, tho by November 7 most of the larvae were noted as having pupated. An adult emerged November 8 from a pupa found in September. Another adult came forth November 19 from a larva that pupated October 19. A larva was kept in the Laboratory until December 3 when it was ready to pupate, but died before this condition was assumed.

The following records of individuals kept in the Insectary are additional to the observations recorded above. One hundred and sixty-five moths were secured by rearing, out of two hundred and eighty-three larvae kept in rearing cages.

	Egg laid.	Egg hatched.	Ready to pupate.	Adult emerged.
1.	Sep. 7	Sep. 11	Sep. 22	July 7, 1909
2.	" 7	" 11	" 25	" 2, 1909
3.	" 7	" 11	" 24	" 20, 1909
4.	" 1	" 11	" 22	" 6, 1909
5.	" 7	" 11	" 22	Nov. 21, 1908
6.	" 4	" 11	" 22	" 21, 1908
7.	" 4	" 11	" 22	July 2, 1909
8.	" 7	" 11	" 24	" 10, 1909
9.	" 7	" 11	" 25	" 4, 1909
10.	" 7	" 11	" 25	" 12, 1909
11.	" 7	" 11	" 25	" 7, 1909
12.	" 7	" 11	" 25	Nov. 17, 1908
13.	" 7	" 11	" 24	" 17, 1908
14.	" 7	" 11	" 23	July 2, 1909
15.	" 7	" 11	" 24	" 8, 1909
16.	" 7	" 11	" 25	" 16, 1909
17.	" 8	" 12	" 25	" 4, 1909
18.	" 8	" 12	" 24	" 12, 1909
19.	" 8	" 12	" 25	" 8, 1909
20.	" 8	" 12	" 25	" 20, 1909
21.	" 8	" 12	" 23	" 10, 1909
22.	" 8	" 12	" 23	" 14, 1909
23.	" 8	" 12	" 25	" 8, 1909
24.	" 8	" 12	" 24	" 12, 1909
25.	" 7	" 11	" 22	" 12, 1909
26.	" 8	" 12	" 25	" 12, 1909
27.	" 8	" 12	" 23	Nov. 15, 1908
28.	" 8	" 12	" 25	July 1, 1909
29.	" 8	" 12	" 25	" 4, 1909
30.	" 8	" 12	" 25	" 7, 1909
31.	" 8	" 12	" 25	" 6, 1909
32.	" 8	" 12	" 25	" 13, 1909
33.	" 8	" 12	" 23	" 17, 1909
34.	" 8	" 12	" 25	" 6, 1909
35.	" 8	" 12	" 25	" 12, 1909
36.	" 8	" 12	" 25	" 13, 1909
37.	" 8	" 12	" 25	" 7, 1909
38.	" 8	" 12	" 25	" 4, 1909
39.	" 8	" 12	" 25	" 5, 1909
40.	" 8	" 12	" 25	" 15, 1909
41.	" 8	" 12	" 25	" 19, 1909
42.	" 10	" 14	" 25	" 7, 1909
43.	" 10	" 14	" 26	" 19, 1909
44.	" 10	" 14	" 25	" 14, 1909

	Egg laid.	Egg hatched.	Ready to pupate.	Adult emerged.
45.	Sep. 10	Sep. 14	Sep. 25	July 15, 1909
46.	" 10	" 14	" 25	Nov. 15, 1908
47.	" 10	" 14	" 25	July 24, 1909
48.	" 10	" 14	" 25	" 25, 1909
49.	" 10	" 14	" 25	" 19, 1909
50.	" 10	" 14	" 25	" 12, 1909
51.	" 10	" 14	" 25	" 10, 1909
52.	" 10	" 14	" 26	" 14, 1909
53.	" 10	" 14	" 27	" 31, 1909
54.	" 10	" 14	" 26	" 28, 1909
55.	" 10	" 14	" 24*	" 23, 1909
56.	" 10	" 14	" 25	" 31, 1909
57.	" 10	" 14	" 26	" 17, 1909
58.	" 10	" 14	" 27	" 14, 1909
59.	" 10	" 14	" 25	" 19, 1909
60.	" 10	" 14	" 27	Aug. 1, 1909
61.	" 10	" 14	" 26	Nov. 17, 1908
62.	" 10	" 14	" 26	July 17, 1909
63.	" 10	" 14	" 25	" 24, 1909
64.	" 10	" 14	" 26	" 14, 1909
65.	" 10	" 14	" 26	" 8, 1909
66.	" 10	" 14	" 25	" 12, 1909
67.	" 10	" 14	" 27	" 8, 1909
68.	" 10	" 14	" 26	" 4, 1909
69.	" 10	" 14	" 26	" 10, 1909
70.	" 10	" 14	" 26	" 13, 1909
71.	" 10	" 14	" 25	" 1, 1909
72.	" 10	" 14	" 26	" 12, 1909
73.	" 10	" 14	" 25	Nov. 15, 1908†
74.	" 10	" 14	" 26	July 9, 1909
75.	" 10	" 14	" 25	Nov. 10, 1908
76.	" 10	" 14	" 26	July 2, 1909
77.	" 10	" 14	" 25	" 20, 1909
78.	" 11	" 15	" 27	" 12, 1909
79.	" 11	" 15	" 25	Nov. 20, 1908
80.	" 11	" 15	" 27	July 5, 1909
81.	" 11	" 15	" 26	" 7, 1909
82.	" 11	" 15	" 27	" 9, 1909
83.	" 11	" 15	" 26	" 14, 1909
84.	" 11	" 15	" 27	" 6, 1909
85.	" 11	" 15	" 27	" 7, 1909

*Noted by Mr. Kinney as maturing in 10 days, but lying in soil 4 days before pupating, September 28.

†Dead when noted, had been out several days.

	Egg laid.	Egg hatched.	Ready to pupate.	Adult emerged.
86.	Sep. 11	Sep. 15	Sep. 28	Nov. 22, 1908
87.	" 11	" 15	" 27	July 3, 1909
88.	" 11	" 15	" 28	" 10, 1909
89.	" 11	" 15	" 28	" 5, 1909
90.	" 11	" 15	" 28	Nov. 23, 1908
91.	" 11	" 15	" 27	Aug. 14, 1909
92.	" 11	" 15	" 27	July 4, 1909
93.	" 11	" 15	" 28	" 6, 1909
94.	" 11	" 15	" 27	" 6, 1909
95.	" 11	" 15	" 27	" 8, 1909
96.	" 11	" 15	" 28	" 4, 1909
97.	" 11	" 15	" 29	" 4, 1909
98.	" 11	" 15	" 28	" 4, 1909
99.	" 11	" 15	" 27	" 13, 1909
100.	" 11	" 15	" 28	Aug. 12, 1909
101.	" 11	" 15	" 27	July 5, 1909
102.	" 11	" 15	" 28	" 9, 1909
103.	" 11	" 15	" 28	" 5, 1909
104.	" 11	" 15	" 28	" 12, 1909
105.	" 11	" 15	" 28	" 6, 1909
106.	" 11	" 15	" 27	" 6, 1909
107.	" 11	" 15	" 27	" 6, 1909
108.	" 11	" 15	" 27	" 21, 1909
109.	" 11	" 15	" 29	" 6, 1909
110.	" 11	" 15	" 27	" 13, 1909
111.	" 11	" 15	" 29	" 10, 1909
112.	" 11	" 15	" 29	" 4, 1909
113.	" 11	" 15	" 27	" 1, 1909
114.	" 11	" 15	" 28	" 5, 1909
115.	" 11	" 15	" 26	" 6, 1909
116.	" 11	" 15	" 27	" 9, 1909
117.	" 11	" 15	" 27	" 7, 1909
118.	" 11	" 15	" 27	" 8, 1909
119.	" 11	" 15	" 29	" 6, 1909
120.	" 11	" 15	" 27	Aug. 8, 1909
121.	" 11	" 15	" 30	July 7, 1909
122.	" 11	" 15	" 27	" 1, 1909
123.	" 11	" 15	" 26	" 10, 1909
124.	" 11	" 15	" 27	" 13, 1909
125.	" 11	" 15	" 28	" 10, 1909
126.	" 11	" 15	" 28	" 10, 1909
127.	" 11	" 15	" 28	" 10, 1909
128.	" 11	" 15	" 27	Aug. 5, 1909
129.	" 11	" 15	" 27	July 12, 1909

	Egg laid.	Egg hatched.	Ready to pupate.	Adult emerged.
130.	Sep. 11	Sep. 15	Sep. 29	July 7, 1909
131.	" 11	" 15	" 27	" 10, 1909
132.	" 11	" 15	" 27	" 10, 1909
133.	" 11	" 15	" 28	" 16, 1909
134.	" 11	" 15	" 29	Aug. 4, 1909
135.	" 11	" 15	" 27	July 9, 1909
136.	" 11	" 15	" 27	" 1, 1909
137.	" 11	" 15	" 27	" 10, 1909
138.	" 11	" 15	" 28	" 8, 1909
139.	" 11	" 15	" 28	" 7, 1909
140.	" 11	" 15	" 28	" 7, 1909
141.	" 11	" 15	" 27	" 16, 1909
142.	" 11	" 15	" 27	" 8, 1909
143.	" 11	" 15	" 27	" 4, 1909
144.	" 11	" 15	" 28	" 4, 1909
145.	" 11	" 15	" 27	" 9, 1909
146.	" 11	" 15	" 27	" 12, 1909
147.	" 11	" 15	" 26	" 16, 1909
148.	" 11	" 15	" 28	" 9, 1909
149.	" 11	" 15	" 29	" 12, 1909
150.	" 11	" 15	" 28	" 13, 1909
151.	" 11	" 15	" 29	" 6, 1909
152.	" 11	" 15	" 26	Sep. 28, 1908
153.	" 11	" 15	" 27	July 3, 1909
154.	" 11	" 15	" 27	" 10, 1909
155.	" 11	" 15	" 27	" 8, 1909
156.	" 11	" 15	" 28	" 27, 1909
157.	" 11	" 15	" 27	" 6, 1909
158.	" 11	" 15	" 27	" 7, 1909
159.	" 11	" 15	" 27	" 6, 1909
160.	" 11	" 15	" 28	" 6, 1909
161.	" 11	" 15	" 27	" 10, 1909
162.	" 11	" 15	" 27	" 14, 1909
163.	" 11	" 15	" 27	" 8, 1909
164.	" 11	" 15	" 27	" 9, 1909
165.	" 11	" 15	" 29	" 7, 1909

It had become very evident to me at the beginning of 1909 that the rate of development of the corn-ear worm was influenced very decidedly by temperature and food conditions. Rearings showed that the time required for complete develment from egg to adult was just about one month and three or four days. If, therefore, the insects come forth as adults in the middle of June, as some of them undoubtedly do,

there is opportunity for the production of a brood by the 20th of July, another by the 25th of August, a third by the 30th of September, and a fourth by the middle of October, allowing a longer period for the latest brood, a result of the retarding influence of cool weather. So long as the corn is not actually frosted the worms do very well, protected as they are by the husks, and our studies show that they may develop to maturity in the fall and that these late individuals lay numerous fertile eggs on such corn as they can find in a suitable condition for food.

But the number of broods seems liable to be reduced by cold both in the spring and fall in Eastern Kentucky. In the southern part of the State and in Western Kentucky they have an earlier start and the fall weather often permits a somewhat longer time for the maturing of late fall broods. In the southwestern part of the State particularly, scattered observations made for a number of years indicated the development of a brood by the twentieth of July. On the fifteenth of this month early corn observed in Todd County was found to have been deserted by larvae. Corn examined in Warren, Logan, Trigg and other counties of the same general region from July 10 to July 18 showed eggs to be numerous about corn-ears while at the same time grown larvae had left the ears for pupation. It is not impossible from what we have learned that both the eggs and grown larvae were produced by moths of the hibernating brood of pupae. Moths from such pupae come forth from March until August. It is this unevenness in time of emergence that accounts for the confusing overlapping of broods noted every season; but it does not invalidate the conclusion we have reached that four annual broods may develop. The fact is patent that the corn-ear worm begins its injuries in the spring as soon as it finds suitable food and continues producing broods at the rate of about one a month until severe frosts destroy its food again in the fall.

The first eggs were found in 1909 at Lexington, out-of-doors, on June 28 on some Early Adams table corn. Larvae were found on the corn at the same time, and had been observed

on the 25th. An example confined in the Insectary went into the sand July 2, was a pupa July 3, and yielded an adult on the night of July 14. This example simply illustrates what occurs here every season, and probably what occurs in Southern Kentucky somewhat earlier, if we may judge by the observations thus far made.

Rearings in Insectary in 1909.

The first brood reared is not to be understood as the first produced during the season, for I had myself secured an adult moth on July 14, as noted above, from eggs laid in June, but unquestionably shows the number produced from parent moths emerging from hibernating pupae somewhat late in the season. In their case as in these rearings there is little chance for the development of more than three broods before cold weather comes on.

First Brood Reared.

July 5, 1909, two individuals, emerging from pupae kept over winter, were mated in a cage where they were provided with corn growing in a flower pot. Eggs were found on the wire gauze of the cage July 7 and both moths were dead on the 10th. Most of the eggs hatched on the 12th and 13th, the total number hatching being about 125.

The history of the mated moths is as follows: (1) Egg laid September 11, 1908. Hatched, September 15. Ready to pupate September 27. Adult, a female, emerged July 4, 1909. (2) Egg laid September 11, 1908. Hatched September 15. Ready to pupate September 28. Adult, a male, emerged July 5, 1909.

The individuals reared from these moths gave the following record:

	Egg laid.	Egg hatched.	Ready to pupate.	Adult emerged.
1.	July 7	July 12	July 29	Aug. 10
2.	" 7	" 12	" 24	" 9
3.	" 7	" 12	" 24	" 9
4.	" 7	" 12	" 26	" 10
5.	" 7	" 12	" 26	" 10
6.	" 7	" 12	" 24	" 9

	Egg laid.	Egg hatched.	Ready to pupate.	Adult emerged.
7.	July 7	July 12	July 26	Aug. 9
8.	" 7	" 12	" 24	" 9
9.	" 7	" 12	" 24	" 9
10.	" 7	" 12	" 28	" 11
11.	" 7	" 12	" 26	" 10
12.	" 7	" 12	" 29	" 12
13.	" 7	" 12	" 28	" 9
14.	" 7	" 12	" 26	" 10
15.	" 7	" 12	" 26	" 9
16.	" 7	" 12	" 24	" 9
17.	" 7	" 12	" 26	" 10
18.	" 7	" 12	" 24	" 9
19.	" 7	" 12	" 27	" 12
20.	" 7	" 12	" 26	" 10
21.	" 7	" 12	" 26	" 11
22.	" 7	" 12	" 28	" 12
23.	" 7	" 12	" 29	" 12
24.	" 7	" 12	" 29	" 12
25.	" 7	" 12	" 28	" 12
26.	" 7	" 12	" 24	" 9
27.	" 7	" 12	" 26	" 10
28.	" 7	" 12	" 28	" 12
29.	" 7	" 12	" 29	" 13
30.	" 7	" 12	" 27	" 10
31.	" 7	" 12	" 26	" 13
32.	" 7	" 12	" 24	" 9
33.	" 7	" 12	" 29	" 12
34.	" 7	" 12	" 29	" 12
35.	" 7	" 12	" 24	Died as a pupa

The individuals recorded below were secured from eggs produced by adults mated July 24-27, the eggs being laid on the latter date. The history of the moths from which the series started is as follows:

(1) Egg laid September 10, 1908. Hatched September 14. Ready to pupate September 25. Adult, a female, emerged July 24, 1909.

(2) Egg laid September 10, 1908. Hatched September 14. Ready to pupate September 25. Adult, a male, emerged July 24, 1909.

	Egg laid.	Egg hatched.	Ready to pupate.	Adult emerged.
36.	July 27	Aug. 1	Aug. 14	Sep. 2
34.	" 27	" 1	" 13	" 1
38.	" 27	" 1	" 16	Aug. 29
39.	" 27	" 1	" 14	Sep. 1
40.	" 27	" 1	" 14	" 1
41.	" 27	" 1	" 13	Aug. 29
42.	" 27	" 1	" 14	" 29
43.	" 27	" 1	" 13	" 29
44.	" 27	" 1	" 15	Sep. 2
45.	" 27	" 1	" 14	Aug. 30
46.	" 27	" 1	" 14	" 30
47.	" 27	" 1	" 14	Died as a pupa
48.	" 27	" 1	" 14	Sep. 1
49.	" 27	" 1	" 13	Aug. 29
50.	" 27	" 1	" 13	" 31
51.	" 27	" 1	" 14	" 31
52.	" 27	" 1	" 14	" 31
53.	" 27	" 1	" 14	" 31
54.	" 27	" 1	" 13	" 29
55.	" 27	" 1	" 14	Sep. 2
56.	" 27	" 1	" 14	" 1
57.	" 27	" 1	" 15	" 3
58.	" 27	" 1	" 14	Aug 30
59.	" 27	" 1	" 14	" 31
60.	" 27	" 1	" 15	" 31
61.	" 27	" 1	" 15	" 29
62.	" 27	" 1	" 14	Sep. 1
63.	" 27	" 1	" 14	Aug. 29
64.	" 27	" 1	" 14	" 30
65.	" 27	" 1	" 14	Sep. 2

Second Brood Reared.

This brood was reared from moths of the first brood carried thru their transformations in the Insectary.

Moth No. 1 emerged August 10 and was mated with No. 7, which emerged August 9. Larvae No. 66 to 115, inclusive, were produced from the eggs of this mating.

Moth No. 11, emerging August 10 was mated with No. 30 emerging August 10, and the eggs secured from them are represented by numbers 116 to 165, inclusive, below.

	Egg laid.	Egg hatched.	Ready to pupate.	Adult emerged.
66.	Aug. 12	Aug. 17	Aug. 29	Sep. 21
67.	" 12	" 17	" 29	" 17
68.	" 12	" 17	" 29	" 20
69.	" 12	" 17	" 30	" 17
70.	" 12	" 17	" 30	" 21
71.	" 12	" 17	" 29	" 21
72.	" 12	" 17	" 30	" 20
73.	" 12	" 17	" 30	" 20
74.	" 12	" 17	" 30	" 20
75.	" 12	" 17	" 31	------
76.	" 12	" 17	" 31	------
77.	" 12	" 17	" 30	------
78.	" 12	" 17	" 30	------
79.	" 12	" 17	" 30	Sep. 21
80.	" 12	" 17	" 31	" 22
81.	" 12	" 17	" 31	------
82.	" 12	" 17	" 31	------
83.	" 12	" 17	" 31	------
84.	" 12	" 17	" 31	Sep. 18
85.	" 12	" 17	" 31	------
86.	" 12	" 17	" 31	------
87.	" 12	" 17	" 29	Sep. 18
88.	" 12	" 17	" 31	Oct. 4
89.	" 12	" 17	" 31	------
90.	" 12	" 17	" 30	------
91.	" 12	" 17	" 31	Sep. 22
92.	" 12	" 17	Sep. 5 (pupated)	" 18
93.	" 12	" 17	Aug. 30	------
94.	" 12	" 17	" 31	------
95.	" 12	" 17	" 30	Sep. 22
96.	" 12	" 17	" 30	" 20
97.	" 12	" 17	" 30	" 22
98.	" 12	" 17	Sep. 1	------
99.	" 12	" 17	" 2	------
100.	" 12	" 17	Aug. 31	------
101.	" 12	" 17	" 31	------
102.	" 12	" 17	" 31	------
103.	" 12	" 17	" 31	------
104.	" 12	" 17	" 29	Sep. 21
105.	" 12	" 17	" 31	------
106.	" 12	" 17	" 31	------
107.	" 12	" 17	" 31	------
108.	" 12	" 17	" 30	Sep. 20
109.	" 12	" 17	Sep. 1	------

	Egg laid.	Egg hatched.	Ready to pupate.	Adult emerged.
110.	Aug. 12	Aug. 17	Aug. 30	Sep. 21
111.	" 12	" 17	" 30	" 21
112.	" 12	" 17	" 29	-------
113.	" 12	" 17	" 30	-------
114.	" 12	" 17	" 29	Sep. 19
115.	" 12	" 17	" 31	-------
116.	" 12	" 17	" 31	Sep. 20
117.	" 12	" 17	Sep. 1	" 19
118.	" 12	" 17	Aug. 30	-------
119.	" 12	" 17	" 30	-------
120.	" 12	" 17	" 29	-------
121.	" 12	" 17	" 31	-------
122.	" 12	" 17	" 30	Sep. 21
123.	" 12	" 17	" 29	-------
124.	" 12	" 17	" 30	Sep. 22
125.	" 12	" 17	" 30	" 21
126.	" 12	" 17	" 30	-------
127.	" 12	" 17	" 29	-------
128.	" 12	" 17	" 29	-------
129.	" 12	" 17	" 30	Sep. 20
130.	" 12	" 17	" 30	-------
131.	" 12	" 17	" 31	Sep. 20
132.	" 12	" 17	" 30	" 21
133.	" 12	" 17	" 30	-------
134.	" 12	" 17	" 29	Sep. 18
135.	" 12	" 17	" 30	-------
136.	" 12	" 17	" 30	-------
137.	" 12	" 17	Sep. 2	-------
138.	" 12	" 17	" 1	-------
139.	" 12	" 17	Aug. 31	-------
140.	" 12	" 17	" 30	-------
141.	" 12	" 17	" 30	-------
142.	" 12	" 17	" 29	-------
143.	" 12	" 17	" 29	-------
144.	" 12	" 17	" 30	-------
145.	" 12	" 17	" 30	-------
146.	" 12	" 17	" 29	-------
147.	" 12	" 17	" 29	Sep. 18
148.	" 12	" 17	" 30	-------
149.	" 12	" 17	" 29	Sep. 19
150.	" 12	" 17	" 31	" 19
151.	" 12	" 17	" 31	-------
152.	" 12	" 17	" 31	-------
153.	" 12	" 17	" 31	-------
154.	" 12	" 17	" 31	Sep. 21

	Egg laid,	Egg hatched.	Ready to pupate.	Adult emerged.
155.	Aug. 12	Aug. 17	Aug. 30	- ------
156.	" 12	" 17	" 31	--- ----
157.	" 12	" 17	" 30	- ------
158.	" 12	" 17	" 30	- ------
159.	" 12	" 17	Sep. 1	- ------
160.	" 12	" 17	" 2	- ------
161.	" 12	" 17	Aug. 31	- ------
162.	" 12	" 17	" 30	Sep. 20
163.	" 12	" 17	" 30	- ------
164.	" 12	" 17	" 29	- ------
165.	" 12	" 17	" 30	- ------

Third Brood Reared.

A large percentage of the preceding brood failed to emerge, and some difficulty was encountered in getting individuals to mate. The weather was rather cool and this retarded the development of the eggs.

Moth No. 67, emerging Sep. 17, was mated with No. 149, emerging Sep. 19, and produced eggs Sep. 21. Moth No. 84, emerging Sep. 18, was mated with No. 87, emerging Sep. 18, and produced eggs Sep. 22. The young did not thrive as did those reared in midsummer, and some failed to pupate, as noted below:

	Egg laid.	Egg hatched.	Ready to pupate.	Adult emerged.
166.	Sep. 21	Sep. 28	Nov. 2	- ------
167.	" 21	" 28	Oct. 25	- ------
168.	" 21	" 28	" 23	- ------
169.	" 21	" 28	" 27	- ------
170.	" 21	" 28	" 23	- ------
171.	" 21	" 28	Larva died	- ------
172.	" 21	" 28	Oct. 25	- ------
173.	" 21	" 28	" 21	- ------
174.	" 21	" 28	" 21	- ------
175.	" 21	" 28	" 22	- ------
176.	" 21	" 28	" 23	- ------
177.	" 21	" 28	Nov. 1	- ------
178.	" 21	" 28	" 3	- ------
179.	" 21	" 28	Oct. 25	- ------
180.	" 21	" 28	Larva died	- ------
181.	" 21	" 28	Oct. 25	--- ...
182.	" 21	" 28	" 24	- ------
183.	" 21	" 28	" 22	- ------

	Egg laid.	Egg hatched.	Ready to pupate.	Adult emerged.
184.	Sep. 21	Sep. 28	Larva died	-------
185.	" 21	" 28	Oct. 26	-------
186.	" 21	" 28	" 22	-------
187.	" 21	" 28	" 23	-------
188.	" 21	" 28	" 29	-------
189.	" 21	" 28	" 30	-------
190.	" 21	" 28	Nov. 1	-------
191.	" 21	" 28	Oct. 28	-------
192.	" 21	" 28	Larva died	-------
193.	" 21	" 28	Oct. 24	-------
194.	" 21	" 28	Larva died	-------
195.	" 21	" 28	Oct. 26	-------
196.	" 21	" 28	Nov. 1	-------
197.	" 21	" 28	Oct. 30	-------
198.	" 21	" 28	" 28	-------
199.	" 21	" 28	Larva died	-------
200.	" 21	" 28	Oct. 30	-------
201.	" 21	" 28	" 30	-------
202.	" 21	" 28	" 28	-------
203.	" 21	" 28	Larva died	-------
204.	" 21	" 28	" "	-------
205.	" 22	" 30	Oct. 25	-------
206.	" 22	" 30	Nov. 1	-------
207.	" 22	" 30	Oct. 27	-------
208.	" 22	" 30	" 25	-------
209.	" 22	" 30	Larva died	-------
210.	" 22	" 30	Oct. 30	-------
211.	" 22	" 30	Larva died	-------
212.	" 22	" 30	Oct. 25	-------
213.	" 22	" 30	Larva died	-------
214.	" 22	" 30	Nov. 1	-------
215.	" 22	" 30	Larva died	-------
216.	" 22	" 30	Oct. 24	-------
217.	" 22	" 30	" 26	-------
218.	" 22	" 30	Larva died	-------
219.	" 22	" 30	Nov. 1	-------
220.	" 22	" 30	Oct. 28	-------
221.	" 22	" 30	" 30	-------
222.	" 22	" 30	Nov. 2	-------
223.	" 22	" 30	Larva died	-------
224.	" 22	" 30	" "	-------
225.	" 22	" 30	Oct. 27	-------
226.	" 22	" 30	Nov. 2	-------
227.	" 22	" 30	" 1	-------
228.	" 22	" 30	Oct. 23	-------

	Egg laid.	Egg hatched.	Ready to pupate.	Adult emerged.
229.	Sep. 22	Sep. 30	Oct. 30	------
230.	" 22	" 30	Nov. 1	------
231.	" 22	" 30	Oct. 30	------
232.	" 22	" 30	" 28	------
233.	" 22	" 30	" 24	------
234.	" 22	" 30	" 24	------
235.	" 22	" 30	Nov. 1	------
236.	" 22	" 30	Oct. 25	------
237.	" 22	" 30	" 25	------
238.	" 22	" 30	" 31	------
239.	" 22	" 30	Larva died	------
240.	" 22	" 30	Oct. 26	------
241.	" 22	" 30	" 28	------
242.	" 22	" 30	" 31	------
243.	" 22	" 30	" 26	------
244.	" 22	" 30	" 23	------
245.	" 22	" 30	Larva died	------
246.	" 22	" 30	Oct. 28	------
247.	" 22	" 30	" 31	------
248.	" 22	" 30	" 29	------
249.	" 22	" 30	Larva died	------
250.	" 22	" 30	" "	------
251.	" 22	" 30	" "	------
252.	" 22	" 30	" "	------
253.	" 22	" 30	" "	------
254.	" 22	" 30	Oct. 28	------
255.	" 22	" 30	" 27	------
256.	" 22	" 30	" 25	------
257.	" 22	" 30	Larva died	------
258.	" 22	" 30	" "	------
259.	" 22	" 30	" "	------
260.	" 22	" 30	Oct. 24	------
261.	" 22	" 30	" 28	------
262.	" 22	" 30	" 28	------
263.	" 22	" 30	" 27	------
264.	" 22	" 30	" 28	------
265.	" 22	" 30	" 25	------
266.	" 22	" 30	Larva died	------
267.	" 22	" 30	Oct. 28	------
268.	" 22	" 30	" 27	------
269.	" 22	" 30	" 24	------
270.	" 22	" 30	" 26	------

During the season of 1910 the worms were rare owing to the late broods having been caught by frost before pupation.

Enough went thru the winter, however, to stock the corn fields, and they began their depredations at the usual time, tho in very small numbers.

A larva was secured by Mr. E. C. Vaughn of the Division on June 13 from corn planted for experiment. It was carried thru to maturity giving the following record:

Molted, June 16; molted, June 21; pupated, June 26; adult emerged, July 11.

They were observed during the season to mature at the same rate as during the preceding seasons, with the same overlapping of broods. They were found to be rather scarce in Breckinridge, Bullitt, Gallatin, Hardin, Hickman, Henderson, Lincoln, Logan, Madison, Mason, McCracken, Meade, Montgomery and Warren counties.

Eggs were secured at Louisville July 7 and hatched July 9. A larva of this brood, reared to maturity on green tomatoes, pupated during the night of July 27 exposed on the surface of sand in the Stender dish employed for rearing, and the adult emerged in the night of August 7.

The latest brood observed was represented by an individual secured as a larva September 17. It pupated October 7 and emerged November 1, 1910. Another individual secured on the same date and pupating September 17, wintered as a pupa, but emerged March 30, 1911, having been kept in a Stender dish in the Laboratory.

Taking the average period of a brood as about 32 days, from egg-laying to egg-laying, and beginning with the brood represented by the example secured June 13 and emerging July 11, ending with that reared in September and October, it appears that three broods developed as follows:

Brood 1: Egg, about June 10; pupa, June 26; adult, July 11.
Brood 2: Egg, July 13; pupa, July 28; adult Aug. 12.
Brood 3: Egg, Aug. 14; pupa, Aug. 29; adult, Sep. 12.
Brood 4: Egg, Nov. 3. Brood imperfect owing to frost.

In 1911 the adult corn-ear moth began to appear in the field in June and July. Eggs were collected from growing corn June 16 and recently hatched larvæ, June 18. To

determine the limits of broods as they developed in the field the small series given below were reared:

First Brood Reared.

	Egg hatched.	Larva pupated.	Adult emerged.
1.	June 20, 10:00 A.M.	July 2, 4 P.M.	July 16, 6 P.M.
2.	" 20, 10:15 A.M.	" 2, 2 P.M.	" 17, 5 P.M.
3.	" 20, 9:15 A.M.	" 3, 9 A.M.	" 17, 5 P.M.
4.	" 19, 2:00 P.M.	" 2, 11 A.M.	" 16, 4 P.M.

Average larval period: 12 days, 13.6 hours.
Average pupal period: 14 days, 10.5 hours.

Second Brood Reared.

	Egg hatched.	Larva pupated.	Adult emerged.
1.	July 25, 10:00 A.M.	Aug. 7, 9:00 A.M.	Aug. 20, 4:00 P.M.
2.	" 25, 9:45 A.M.	" 8, 1:30 P.M.	" 21, 3:15 P.M.
3.	" 25, 8:30 A.M.	" 7, 12:30 P.M.	" 22, 11:15 A.M.
4.	" 25, 9:30 A.M.	" 8, 10:30 A.M.	" 22, 3:15 P.M.
5.	" 25, 10:00 A.M.	" 8, 11:30 A.M.	" 22, 4:30 P.M.

Average larval period: 13 days, 14.4 hours.
Average pupal period: 13 days, 22.5 hours.

Further rearings are given below merely as rendering more complete, information secured during other seasons:

	Egg hatched.	Ready for pupation.	Adult emerged.
1.	July 25	Aug. 8	Aug. 28
2.	" 25	" 8	" 28
3.	" 25	" 8	" 22
4.	" 25	" 8	" 29
5.	" 25	" 9	" 19
6.	" 25	" 9	" 28
7.	" 25	" 9	" 23
8.	" 23	" 4	" 23
9.	" 23	" 4	" 18
10.	" 23	" 8	" 22
11.	" 23	" 9	" 24
12.	" 23	" 7	" 24
13.	" 29	" 13	" 27
14.	" 29	" 13	" 26
15.	" 29	" 13	" 30
16.	" 29	" 14	" 29
17.	" 29	" 12	" 27

Third Brood Reared.*

	Egg hatched.		Ready for pupation.		Adult emerged.
1.	Aug.	6	Aug.	18	---- ---
2.	"	6	"	19	---- ---
3.	"	6	"	18	---- ---
4.	"	6	"	19	---- ---
5.	"	6	"	18	---- ---
6.	"	6	"	18	---- ---
7.	"	6	"	19	---- ---
8.	"	6	"	18	---- ---
9.	"	6	"	19	---- ---
10.	"	6	"	18	---- ---
11.	Sep.	4	Sep.	15	---- ---
12.	"	4	"	16	---- ---
13.	"	4	"	17	---- ---
14.	"	4	"	16	---- ---
15.	"	4	"	14	---- ---

Eggs Collected During 1911.

As showing something of the times when the adult moths were most active in egg-laying the following records made during the season are added. They were not especially common in June, became very common in the latter part of July, and again in the latter part of August and in early September; the numbers remained high until after the middle of September, and then gradually declined.

June	16	25 collected	Aug.	20	185 collected
"	17	18 "	"	22	285 "
"	18	20 "	"	23	295 "
"	19	14 "	"	26	248 "
"	20	24 "	"	29	289 "
"	21	13 "	"	30	196 "
"	22	10 "	Sep.	1	321 "
July	15	28 "	"	3	276 "
"	16	40 "	"	6	190 "
"	17	60 "	"	12	65 "
"	18	95 "	"	14	156 "
"	19	50 "	"	16	103 "
"	20	80 "	"	18	165 "
"	21	103 "	"	20	180 "
"	22	90 "	"	22	108 "

*This brood was due as adults in September and early October, but was not followed to maturity.

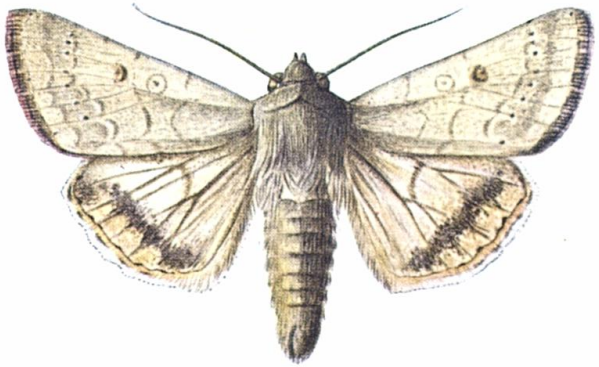
July	24	70 collected	Sep.	23	120 collected
"	25	110 "	"	24	70 "
"	28	155 "	"	26	40 "
"	29	215 "	"	27	90 "
Aug.	3	120 "	"	29	85 "
"	4	80 "	"	30	80 "
"	5	158 "	Oct.	2	40 "
"	15	70 "	"	3	10 "
"	18	75 "	"	4	23 "
"	19	310 "	"	5	60 "

Attention was given during 1912 to the parasites and other enemies of the corn worm; but the broods were looked after also with a view to completing data with which I was not fully satisfied. Pupae kept over winter and collected in the field November 1, 1911, emerged in the Insectary from June 17 to 25. Another small lot collected November 3, 1911, and kept in the window, emerged as follows:

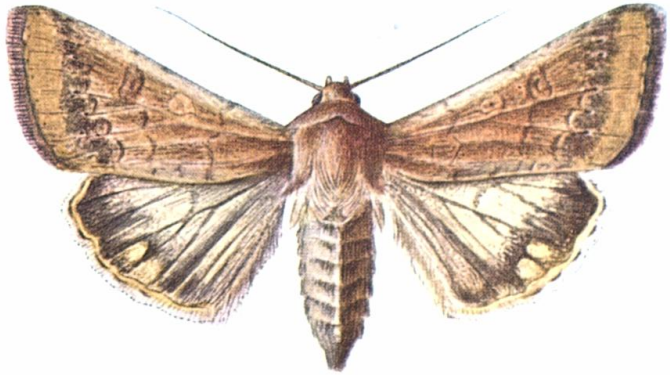
1. June 6, P. M.
2. " 1, A. M.
3. " 8, P. M.
4. " 1, A. M.
5. " 1, A. M.
6. " 8, A. M.

The following additional records of individuals pupating in the fall of 1911 and emerging in the spring are of interest, together with those already given, as showing how the period of hibernation of many individuals is extended into the summer months, tho pupation begins at about the same time as with others which emerge in June.

	Ready for pupation.	Adult emerged.
1.	Oct. 11, 1911	July 16, 1912
2.	" 11, 1911	" 14, 1912
3.	" 11, 1911	" 19, 1912
4.	" 11, 1911	" 20, 1912
5.	" 11, 1911	" 19, 1912
6.	" 11, 1911	" 18, 1912
7.	" 11, 1911	" 1, 1912
8.	" 7, 1911	June 24, 1912
9.	" 7, 1911	" 21, 1812



A



B

PLATE I. COLOR VARIATIONS OF IMAGO. x 1.52

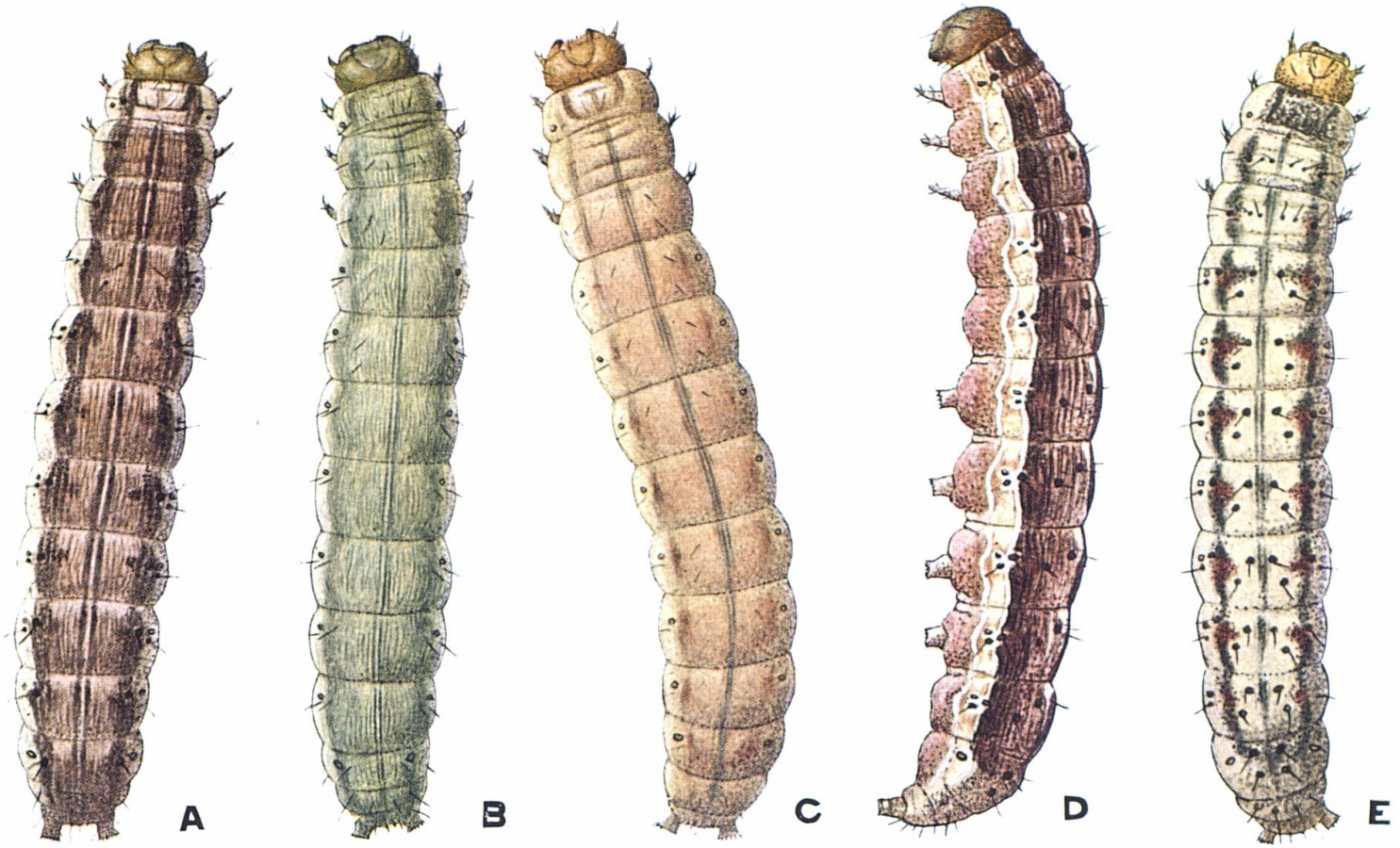


PLATE II. COLOR VARIATIONS OF LARVA. x 2.14

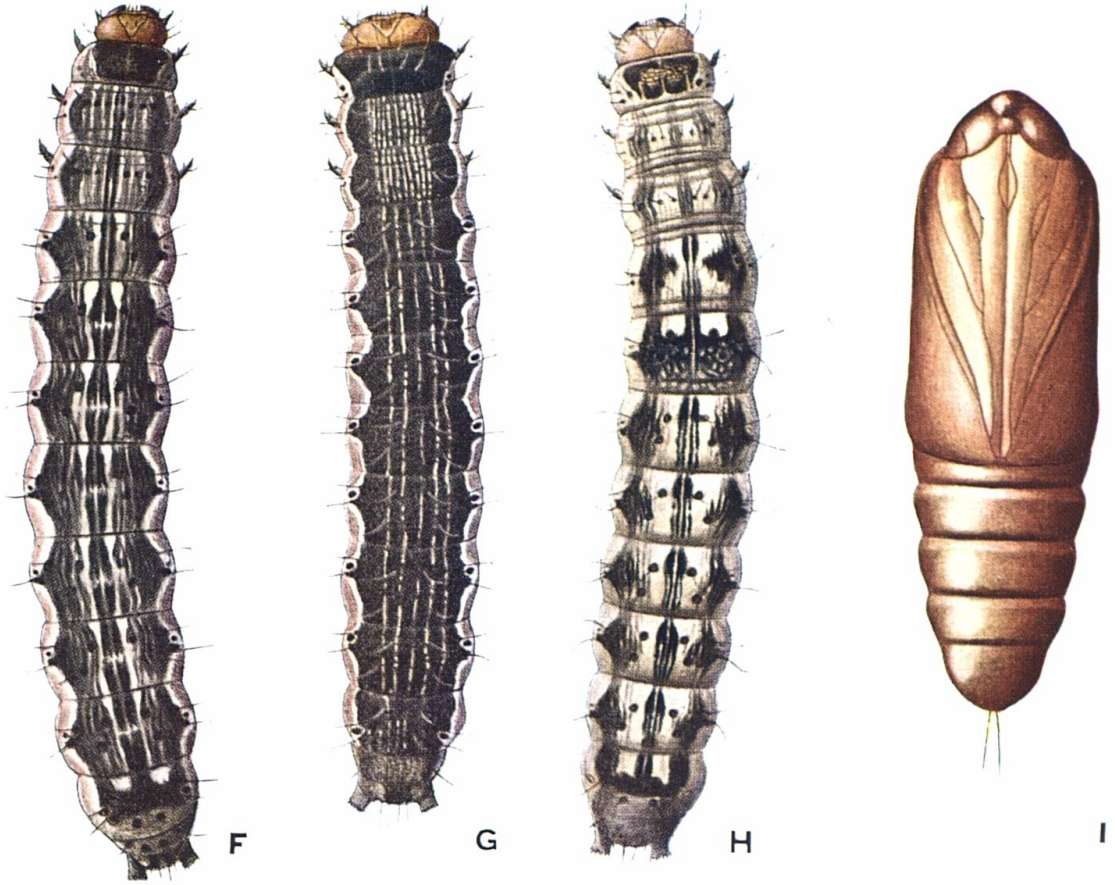


PLATE III. F, G, H, COLOR VARIATIONS OF LARVA, x 2.14;
G, JUST MOLTED; I, PUPA. x 3.83

	Ready for pupation.		Adult emerged.	
10.	" 1,	"	July 1,	"
11.	" 8,	"	" 8,	"
12.	" 8,	"	June 25,	"
13.	" 9,	"	July 22,	"
14.	" 9,	"	June 29,	"
15.	" 9,	"	Died	
16.	" 9,	"	Died	
17.	Nov. 2,	"	July 14,	"
18.	" 2,	"	Died	
19.	" 2,	"	July 15,	"
20.	Sep. 20,	"	" 17,	"
21.	" 20,	"	" 14,	"
22.	" 20,	"	" 17,	"
23.	" 20,	"	" 15,	"
24.	" 20,	"	Died	
25.	" 20,	"	July 11,	"
26.	" 20,	"	" 15,	"
27.	" 20,	"	" 15,	"
28.	" 20,	"	" 14,	"
29.	" 23,	"	" 14,	"
30.	" 23,	"	" 17,	"
31.	" 23,	"	" 17,	"
32.	" 23,	"	" 17,	"
33.	" 23,	"	" 17.	"
34.	" 23,	"	" 14,	"
35.	" 23,	"	" 15,	"
36.	" 23,	"	" 14,	"
37.	" 16,	"	June 29,	"
38.	" 16,	"	July 1,	"
39.	" 16,	"	" 1,	"
40.	" 16,	"	" 2,	"
41.	" 16,	"	June 20,	"
42.	" 15,	"	" 29,	"
43.	" 15,	"	Died	
44.	Nov. 15,	"	June 30,	"
45.	" 15,	"	" 29,	"
46.	" 15,	"	July 24,	"
47.	" 15,	"	" 6,	"
48.	" 15,	"	" 5,	"

The egg, larval and pupal periods are shown more exactly than in preceding figures in the tables following. The data are from rearings made in the Insectary by Mr. Jewett in 1911.

First Brood Reared.

	Egg period		Larval period*		Pupal period	
	Days	Hours	Days	Hours	Days	Hours
1.	4	4	13	2	16	16
2.	3	18	13	6.5	15	2.5
3.	4	18	16	5.5	12	6
4.	3	19	17	0	13	2
5.	3	7	13	6	14	0
6.	4	13	15	5	14	1
7.	4	17	13	1.5	16	23
8.	4	0	13	4	16	21
9.	4	17	14	5.5	15	0.5
10.	3	15.5	14	1	14	0
Av.	4	3.25	14	6.1	14	19.2

Second Brood Reared.

	Egg period		Larval period		Pupal period	
	Days	Hours	Days	Hours	Days	Hours
1.	3	23	15	3.5	15	11
2.	3	22.5	14	14	16	1
3.	3	22	15	17	15	23
4.	3	4	15	23	16	15
5.	2	22	16	7	16	11
6.	3	17	13	2	15	17
7.	3	15	15	16	17	15
8.	3	15	15	23	16	23
9.	3	23	13	18	16	13
10.	3	22	14	18	14	11
Av.	3	13.75	15	2.15	16	4.4

Third Brood Reared.

	Egg period		Larval period		Pupal period	
	Days	Hours	Days	Hours	Days	Hours
1.	2	22	11	20	----	----
2.	3	1	14	3	----	----
3.	2	21	12	19	----	----
4.	2	23	12	6	----	----
5.	2	21	11	21	----	----
6.	2	20	13	21	----	----
7.	2	23	12	18	----	----
8.	3	1	11	2	----	----
9.	2	21	13	7	----	----
10.	2	23	12	2	----	----
Av.	2	22.4	12	14.3	----	----

*By this is meant the time from hatching of the egg until the larva goes into the soil. It is not practicable in all cases to determine how long a larva requires to pupate after it makes its cell.

The Corn-ear Worm in 1913.

The broods of worms coincide in the main in both Eastern and Western Kentucky, but the more southern climate of the western region has an accelerating influence on the development, judging by a comparison between records made in 1913 at Hickman and at Lexington during the same periods. Thus what is to be regarded as the fourth brood started at Hickman from eggs laid during the latter part of August and early September, while at Lexington eggs of this brood were most numerous from the middle of September to the first of October. The larvae from these eggs pupated from October 17 to 30 at Lexington, and from October 13 to 18 at Hickman.

The periods passed in the different stages are practically the same. From hatching to the emergence of the adult the time is commonly from about 28½ to 30 days. The following rearings are taken from a series carried thru in the Insectary in late summer and fall.

Third Brood, Lexington, Ky.

Fed on Corn—Mr. Niswonger's rearing.

Egg secured.	Egg hatched.	Larval period.	Approximate pupal period.	Adult emerged.
Aug. 16	Aug. 17	Aug. 17—Aug. 31	Aug. 31—Sep. 9	Sep. 9
" 18	" 20	" 20—Sep. 6	Sep. 6— " 16	" 16
" 18	" 21	" 21— " 4	" 4— " 15	" 15
" 18	" 21	" 21— " 4	" 4— " 17	" 17
" 18	" 19	" 19—Died		
" 18	" 21	" 21—Sep. 3	Sep. 3—Sep. 13	Sep. 13
" 18	" 19	" 19— " 2	" 2— " 15	" 15
" 18	" 19	" 19— " 3	" 3— " 12	" 12
" 18	" 20	" 20— " 3	" 3— " 11	" 11
" 18	" 20	" 20— " 3	" 3—Died	
" 18	" 21	" 21— " 4	" 4—Sep, 17	Sep. 17
" 18	" 21	" 21— " 5	" 5— " 18	" 18
" 19	" 21	" 21—Died		
" 19	" 21	" 21—Sep. 6	Sep. 6—Sep. 20	Sep. 20
" 19	" 21	" 21— " 5	" 5—Died	
" 19	" 21	" 21— " 5	" 5—Sep. 19	Sep. 19

Fourth Brood, Lexington, Ky.

Fed on Corn—Mr. Niswonger's rearing.

Egg secured,	Egg hatched.	Larval period.	Entered soil.
Sep. 18	Sep. 24	Sep. 24—Oct. 17	Oct. 17
" 18	" 25	" 25 " 17	" 17
" 18	" 25	" 25 " 21	" 21
" 18	" 25	" 25 " 23	" 23
" 20	" 25	" 25 " 17	" 17
" 20	" 24	" 24—Died	------
" 20	" 24	" 24—Oct. 23	Oct. 23
" 20	" 25	" 25 " 21	" 21
" 20	" 28	" 28 " 28	" 28
" 22	Oct. 1	Oct. 1 " 30	" 30
" 22	" 2	" 2 " 29	" 29
" 27	" 2	" 2 " 30	" 30

Specimens emerging in the spring of 1914, and from material kept over winter by Mr. Niswonger, are labeled as follows:

Pupated,	Sep.	20, 1913	Emerged,	June	5, 1914
"	"	20, "	"	"	2, "
"	"	27, "	"	"	4, "
"	"	27, "	"	"	4, "
"	"	27, "	"	May	30, "
"	"	29, "	"	June	2, "
"	"	30, "	"	"	5, "
"	Oct.	3, "	"	May	30, "
"	"	3, "	"	"	29, "
"	"	3, "	"	"	29, "
"	"	6, "	"	"	30, "
"	"	6, "	"	June	3, "
"	"	8, "	"	"	1, "
"	"	8, "	"	May	30, "
"	"	8, "	"	June	4, "
"	"	10, "	"	"	2, "
"	"	10, "	"	"	3, "

The period during which the pupa remained in the ground thus ranged from about seven months and twenty-two days to eight months and fifteen days.

The Corn-ear Worm at Hickman, Ky., in 1913.

In 1913 Mr. Jewett was stationed at Hickman, in Fulton County, Kentucky, the only region in which cotton is

still grown in the State, with instructions to gather as much information as possible concerning the extent of injury done by the ear-worm to this plant, and also with reference to its life-history. Beginning in July, Mr. Jewett continued his observations at Hickman and in its vicinity until the middle of October, when the last brood of worms was entering the ground for pupation.

The region about Hickman in which cotton is grown is flat bottom land, the soil good, and much like that employed for this crop farther south. The elevation above sea level is less than 500 feet, giving the region a climate decidedly more southern in its general features than that of the country about Lexington, where the elevation above sea level is about 1000 feet, and the climate somewhat like that of regions a hundred miles farther north.

The first brood was completed at Hickman at the time the observations began, and eggs for the second brood were found July 12. From this date until September 19, the eggs observed and collected varied in numbers with the numbers of adults abroad, the maximum being reached when the bulk of the brood was mature, then gradually diminishing again, and as another brood of adults appeared increasing to another maximum. The time of greatest activity in egg-laying for the brood (2nd) first observed, thus appears to have been about July 22, and continued with a gradual decline until about the 26th of the month, after which the numbers laid were very few. Eggs were found thruout the month of August but in small numbers at first, a maximum being reached about the 28th. In September the eggs were common during the first two weeks, these being probably from the brood noted as active in August, but possibly some of them from another brood, since scattering accelerated individuals of the brood ordinarily hibernating, emerge in the fall of the year.

A more exact idea of the periods of abundance of eggs in the field is given by some data taken from an examination of the silk of twenty-five corn plants at Hickman, as follows:

No. eggs collected		No. eggs collected		No. eggs collected	
July	12—10	Aug.	3— 5	Sep.	1—24
"	14—15	"	5—11	"	3—18
"	16—15	"	7— 8	"	5—31
"	18—19	"	9—10	"	7—10
"	20—32	"	11—26	"	9—15
"	22—35	"	13—17	"	11—12
"	24—21	"	15—34	"	17— 8
"	26—13	"	19—26	"	19— 5
"	25— 4	"	21—33		
"	30— 5	"	23—34		
		"	25—57		
		"	27—50		
		"	29—32		

Larvae were collected on sweet corn at Hickman July 8, but were scarce and well grown, being, it was assumed, a remnant of a first brood. Until July 15 some of these larvae were observed. Afterward the young larvae of the second brood appeared in the corn fields and thereafter larvae, pupae, eggs and adults were to be observed in larger or smaller numbers at almost any time. Some records made by Mr. Jewett are given below and are from rearings with corn as the food plant.

Brood 2, Hickman, Ky.

Fed on corn.

Egg secured	Hatched	Larval period.	Approximate pupal period.	Adult emerged
July 14	July 16	July 16—July 28	July 28—Aug. 12	Aug. 12
" 14	" 16	" 16— " 29	" 29— " 10	" 10
" 14	" 15	" 15— " 28	" 28 — " 12	" 12
" 14	" 17	" 17— " 29	" 29— " 14	" 14
" 14	" 16	" 16— " 30	" 30— " 16	" 16
" 14	" 16	" 16— " 29	" 29— " 14	" 14
" 14	" 16	" 16— " 27	" 27— " 10	" 10
" 14	" 16	" 16— " 27	" 27— " 10	" 10
" 14	" 16	" 16— " 28	" 28— " 12	" 12
" 14	" 15	" 15— " 27	" 27— " 11	" 11
" 14	" 15	" 15— " 28	" 28— " 12	" 12
" 14	" 16	" 16— " 28	" 28— " 13	" 13

The range of the larval period was thus from 11 to 14 days, with an average for the twelve individuals of 12⅓ days. The range of the pupal period is from 12 to 17 days,

with an average of 15⅓. The total period from the hatching of the egg ranges from 25 to 32 days, with an average of 27⅔.

A second lot of larvae reared at Hickman and regarded as pertaining to the second brood was produced from eggs secured in the field July 24. It was fed on corn. Its history is given in the following table.

Brood 2, Hickman, Ky.

Egg secured.	Hatched.	Larval period.	Approximate pupal period.	Adult emerged.
July 22	July 24	July 24—Aug. 6	Aug. 6—Aug. 21	Aug. 21
" 22	" 24	" 24— " 7	" 7— " 22	" 22
" 22	" 24	" 24— " 8	" 8— " 25	" 25
" 22	" 25	" 25— " 8	" 8— " 25	" 25
" 22	" 24	" 25— " 8	" 8— " 25	" 25
" 22	" 24	" 24— " 6	" 6— " 24	" 24
" 22	" 24	" 24— " 7	" 7— " 24	" 24
" 22	" 24	" 24— " 6	" 6— " 20	" 20
" 22	" 24	" 24— " 6	" 6— " 23	" 23
" 22	" 24	" 24— " 7	" 7— " 25	" 25
" 22	" 24	" 24— " 6	" 6— " 24	" 24

The periods for this lot average a little longer than for the preceding: The larval period ranges from 14 to 16 days, and averages 14⅞₁₁ days; the pupal period ranges from 14 to 18 days, with an average of 16⅞₁₁ days; while the total life period from hatching ranges from 28 to 33 days, and averages 31¾₁₁ days.

Brood 3, Hickman, Ky.

Fed on corn.

Egg secured.	Hatched.	Larval period.	Approximate pupal period.	Adult emerged.
Aug. 14	Aug. 17	Aug. 17—Aug. 31	Aug. 31—Sep. 17	Sep. 17
" 14	" 17	" 17— " 31	" 31— " 16	" 16
" 14	" 17	" 17— " 29	" 29— " 22	" 22
" 14	" 17	" 17— " 29	" 29— " 16	" 16
" 14	" 17	" 17— " 29	" 29— " 16	" 16
" 14	" 17	" 17— " 27	" 27— " 16	" 16
" 14	" 17	" 17— " 27	" 27— " 16	" 16
" 15	" 18	" 18— " 30	" 30— " 19	" 19

The larval period of the above lot ranges from 11 to 15 days, averaging 13 days; the pupal period ranges from 17 to 25 days and averages 20⅜ days; the total period ranges from 32 to 38 days and averages 33⅜ days.

Brood 3, Hickman, Ky.

Fed on corn.

Egg laid.	Egg hatched.	Larval period.	Approximate pupal period.	Adult emerged
Aug. 25	Aug. 28	Aug. 28—Sep. 11	Sep. 11—Oct. 13	Oct. 13
" 25	" 28	" 28— " 12	" 12—	No adult
" 25	" 28	" 28— " 12	" 12—Oct. 12	Oct. 12
" 25	" 28	" 28— " 14	" 14—	No adult
" 25	" 28	" 28— " 12	" 12—	" "
" 25	" 28	" 28— " 12	" 12—Oct. 10	Oct. 10
" 25	" 28	" 28— " 12	" 12—	No adult
" 25	" 28	" 28— " 13	" 13—	" "
" 25	" 28	" 28— " 16	" 16—	" "
" 25	" 28	" 28— " 17	" 17—	" "

The delayed development of this brood became more apparent than in the other lot from eggs secured August 14 and 15. These eggs were laid August 25 and seven out of ten did not emerge in 1913. The three that did emerge had a longer total period than any other lot yielding adults in the fall. The range of larval period for the three is from 15 to 16 days, with an average of 15⅔ days; the range of pupal period is 28 to 32 days, with an average of 30 days; the total period ranges from 44 to 47 days, and averages 45⅔ days.

Brood 4, Hickman, Ky.

Fed on corn.

Egg secured.	Egg hatched.	Larval period.	Pupal period began.
Sep. 20	Sep. 23	Sep. 23—Oct. 18	Oct. 18
" 20	" 24	" 24 " 20	" 20
" 20	" 24	" 24 " 15	" 15
" 20	" 24	" 24 " 16	" 16
" 20	" 24	" 24 " 14	" 14
" 20	" 24	" 24 " 13	" 13
" 20	" 24	" 24 " 16	" 16
" 20	" 23	" 23 " 18	" 18
" 20	" 24	" 24 " 17	" 17
" 20	" 24	" 24 " 15	" 15
" 20	" 24	" 24 " 14	" 14

The above brood was not carried thru the winter. But other larvæ from the same locality emerged in the spring at about the same time as those reared at Lexington.

It was partly with the object of having the insect studied as a boll worm on cotton that I had Mr. Jewett stationed at Hickman, and observations on this feature of its injuries are presented below. It seems that it did not develop as rapidly in the bolls of cotton as it did in corn, possibly because the food is less succulent. Mr. Jewett thinks it prefers corn and feeds upon this food when it can, resorting to cotton as a second choice. Whether this is true or not, the insects confined with cotton bolls did not make as rapid growth as those fed on corn and reached maturity on an average about three days later.

Something of the same retarding effect may be observed in larvae fed on old dry corn as compared with those fed on young corn: the former do not feed as freely and grow more slowly, sometimes when corn becomes very hard deserting the ears and feeding on tobacco or other more succulent food near by.

Brood 2, Hickman, Ky.

Fed on cotton bolls.

Egg secured.	Hatched.	Larval period.	Approximate pupal period.	Adult emerged.
July 16	July 18	July 18—July 31	July 31—Aug. 15	Aug. 15
" 16	" 18	" 18— " 30	" 30— " 15	" 15
" 16	" 18	" 18— " 30	" 30— " 15	" 15
" 16	" 18	" 18— " 31	" 31— " 16	" 16
" 16	" 18	" 18— " 31	" 31— " 17	" 17
" 16	" 18	" 18— " 31	" 31— " 17	" 17
" 16	" 19	" 19—Aug. 1	Aug. 1 — " 17	" 17
" 16	" 19	" 19— " 1	" 1 — " 16	" 16
" 16	" 18	" 18— " 2	" 2 — " 18	" 18
" 16	" 19	" 19 — " 2	" 2 — " 17	" 17
" 16	" 19	" 19— " 3	" 3 — " 20	" 20
" 16	" 18	" 18—July 31	July 31— " 17	" 17

Brood No. 3, Hickman, Ky.

Fed on cotton bolls.

Egg secured.	Hatched.	Larval period.	Approximate pupal period.	Adult emerged.
Aug. 18	Aug. 21	Aug. 21—Sep. 2	Sep. 2—Sep. 18	Sep. 18
" 18	" 21	" 21— " 3	" 3— " 20	" 20
" 18	" 21	" 21— " 3	" 3— " 20	" 20
" 18	" 21	" 21— " 4	" 4— " 22	" 22
" 18	" 21	" 21— " 2	" 2— " 20	" 20
" 18	" 22	" 22— " 5	" 5— ------	--------
" 18	" 22	" 22— " 4	" 4—Sep. 21	Sep. 21
" 18	" 21	" 21— " 2	" 2— " 22	" 22
" 18	" 21	" 21— " 3	" 3— " 21	" 21
" 18	" 22	" 22— " 4	" 4— " 24	" 24

While some individuals pupating in September and October remain in the ground nearly nine months, most of them emerge at the end of about eight months, and a few may emerge in about seven months and twenty-five days. This was true of individuals brought from Hickman by Mr. Jewett. The average time spent in the ground is about eight months and five days. All of those brought from Hickman that emerged at all, emerged from June 1 to June 15, 1914.

The Periods in the Life of the Larva.

The life-history of the insect has been presented by the preceding pages. It remains to give a more exact account of the periods, especially of the larva, tho it must be premised in doing so that these stages, or instars as they are sometimes called, are of more interest from the point of view of the entomologist than from that of the practical man.

As soon as the young larva cuts it way thru the egg-shell it proceeds to make a meal on the shell and sometimes completely devours it before it begins to feed on the corn silks or blades. It is whitish in general color, with a disproportionately large black head, and moves restlessly about with a decided looping motion, letting itself down quickly with a silken thread spun from its lower lip, when disturbed.

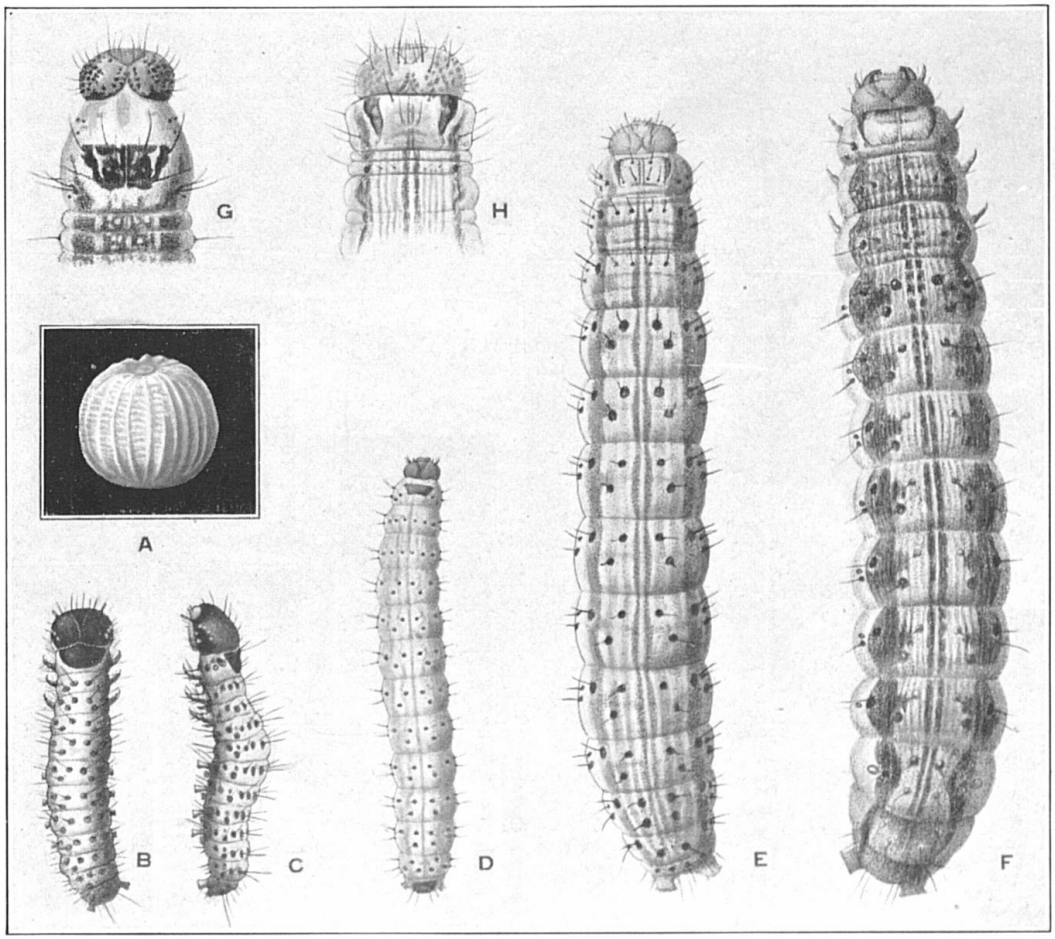


FIG. 1. A, EGG, x 28; B AND C, RECENTLY HATCHED LARVAE, x 28; D, LARVA AFTER THIRD MOLT, x 4; E, LARVA AFTER FOURTH MOLT, x 4.5; F, FULLY GROWN LARVA, x 2.33; G, HEAD AND SWOLLEN FIRST SOMITE OF A LARVA AS THEY APPEAR JUST BEFORE A MOLT, x 3.5; H, THE SAME IMMEDIATELY AFTER A MOLT, x 3.5.

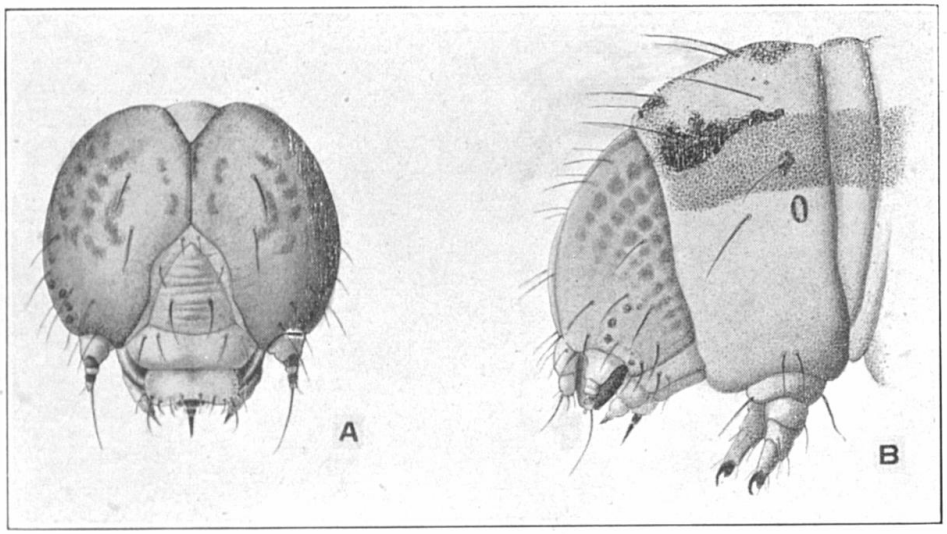


FIG. 2. A, FRONT VIEW OF HEAD OF LARVA, x 9; B, SIDE VIEW OF SAME AND FIRST SOMITE, x 9.

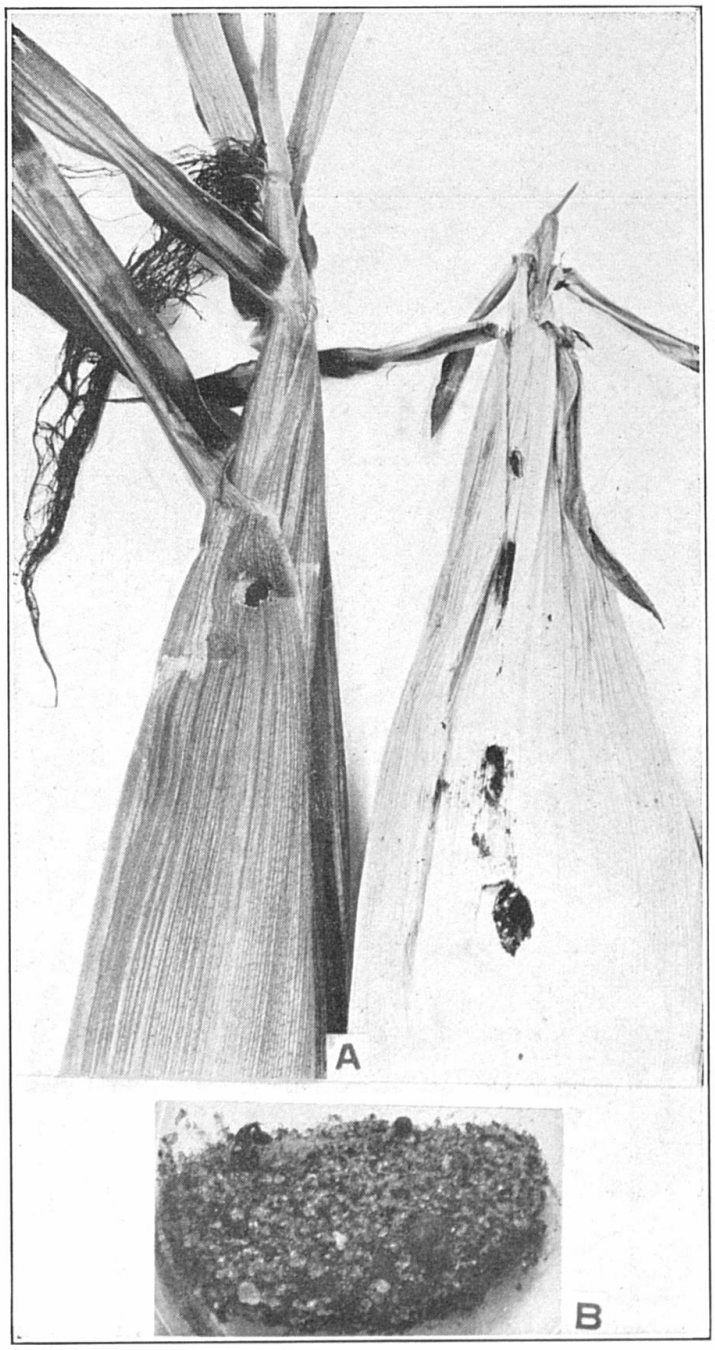


FIG. 3. A, TWO TIPS OF CORN EARS WITH HOLES MADE BY EMERGING LARVAE, REDUCED; B, EARTHEN CELL IN WHICH LARVA PUPATES, NATURAL SIZE.

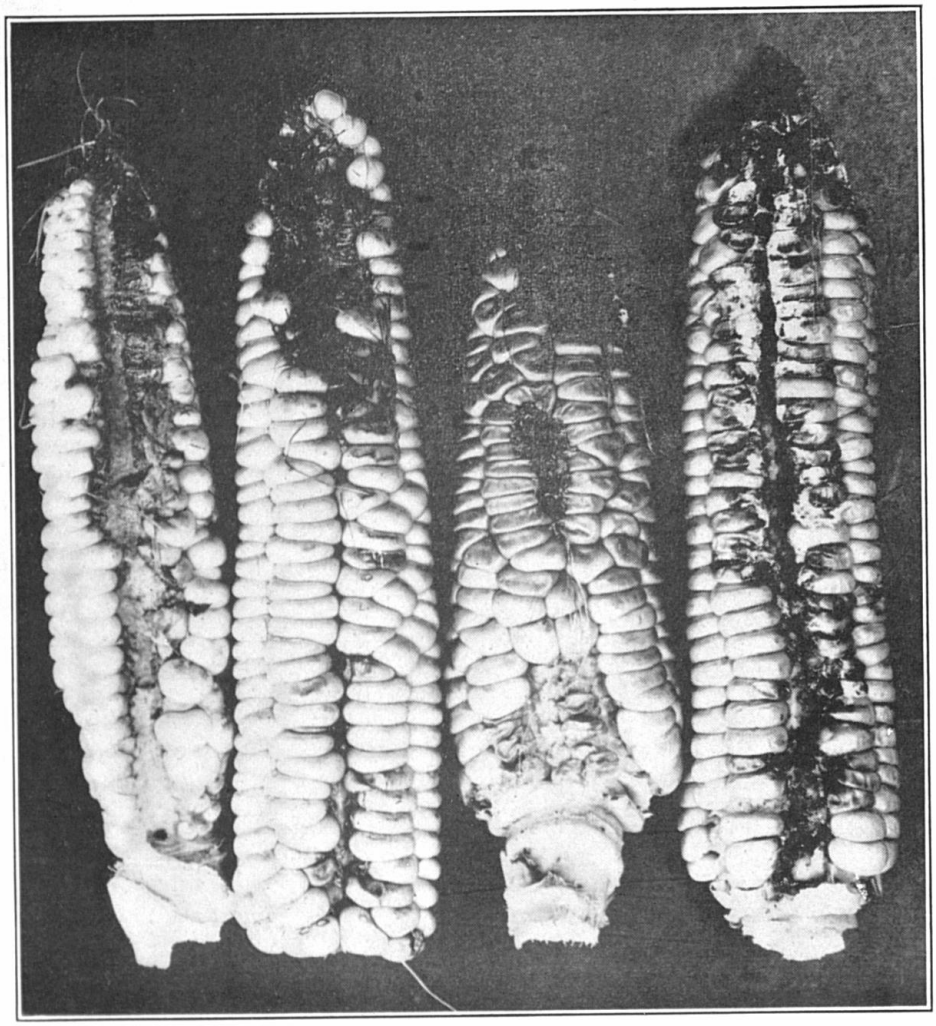


FIG. 4. EARS OF TABLE CORN INJURED BY THE CORN-EAR WORM. REDUCED.

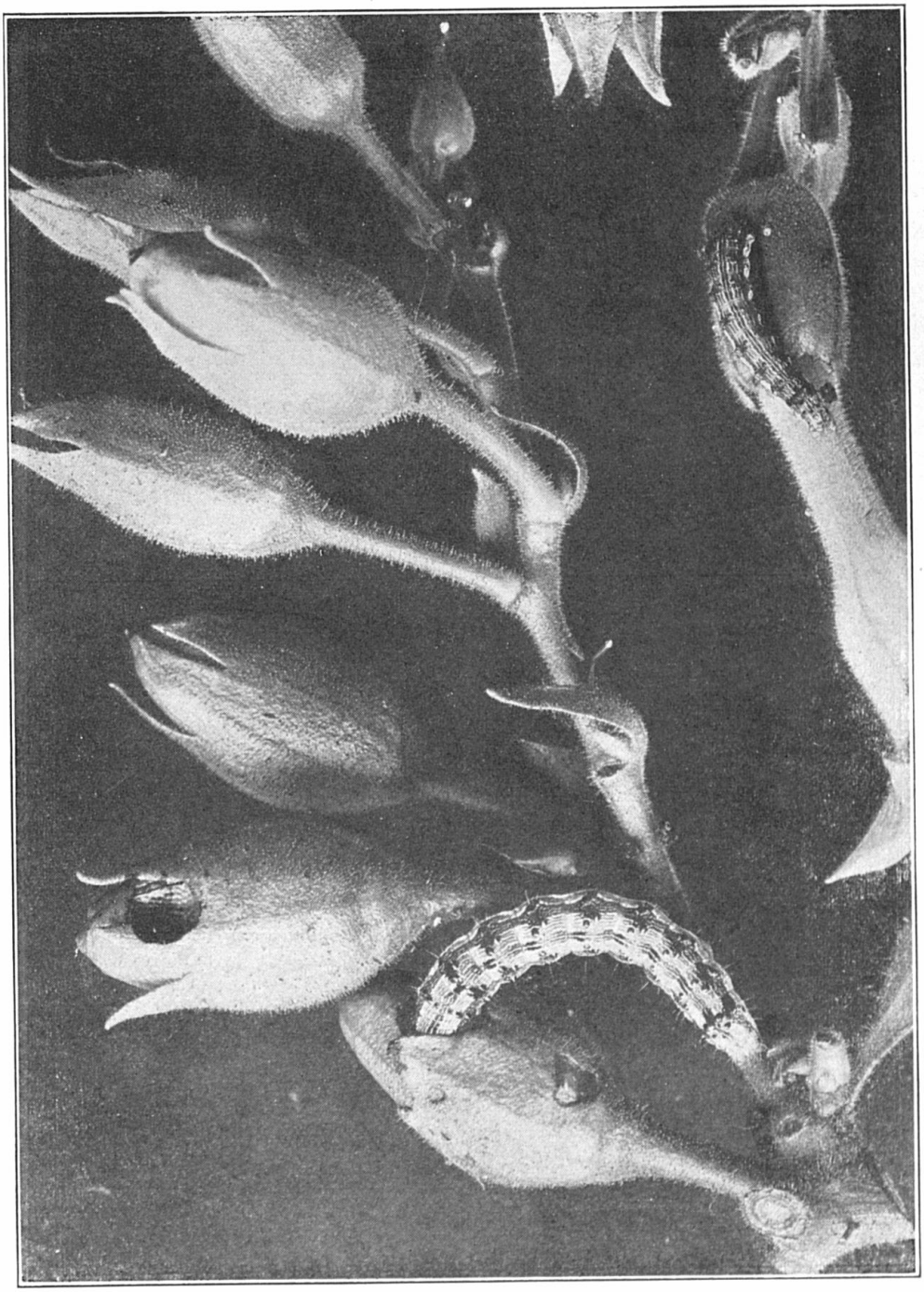


FIG. 5. TOBACCO SEED PODS INJURED BY CORN-EAR WORMS. X 1.65.

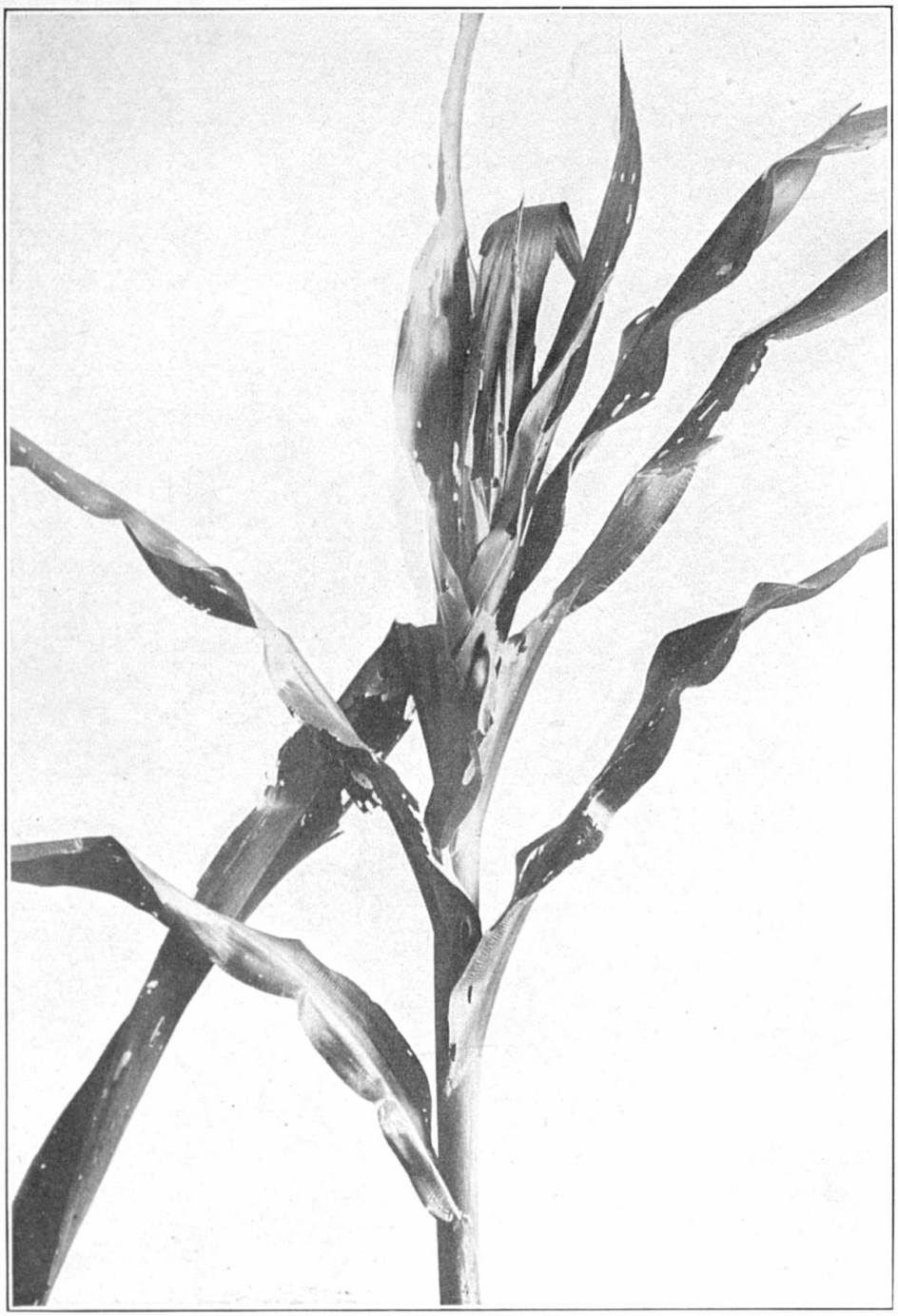


FIG. 6. A YOUNG CORN PLANT INJURED BY THE CORN-EAR WORM. REDUCED.

In about four days it spins a slight web of silk on some convenient surface, fastens its claws in it and remains inactive, the region just behind the head swelling gradually and finally the skin breaking so as to release the crust of the head and allow the skin of the rest of the body, a mere pellicle, to be cast off. This is the first molt and first period or instar.

From time to time afterward, as it grows, it frees itself from the skin taking a rest and securing itself temporarily to a slight web each time. Six molts, making six periods or instars in its life, occur, the size increasing each time and the colors changing, the insect becoming less active as its tissues become loaded with fat, until the last period, when it again becomes restless, roams continually about its quarters in confinement, if not furnished with soil in which to pupate. In the field at this time it simply cuts a round hole thru the husks of the ear, drops to the ground and enters it, where at a depth of 3 or 4 inches a cell is made and the sixth molt takes place. Some records of the periods in the lives of individual larvae are given below.

1. Hatched Oct. 5, 1908; Oct. 9, molted last night; Oct. 12, ready to molt again, inactive, the body behind the head swollen; Oct. 13, molted last night; Oct. 16, molted last night; Oct. 19, Molted last night; Oct. 23, molted (5th time) last night; Oct. 31, restless, went into sand for pupation when this was provided. Died without pupating.

2. Hatched Oct. 5; molted, Oct. 9, 13, 15, 18 and 21; Oct. 25, went into sand for pupation; Dec. 13, adult emerged.

These periods will be found to vary, of course, with the weather and condition of the food supply. Thus the periods recorded above are longer than they are in the summer broods, and more uneven as a rule, warm weather hurrying them, while cooler weather retards the changes. In 1910 Mr. Jewett determined some periods of larvae of the first and second broods, as follows:

First Brood.

1st period, 2 days, 15 hrs.; 2d period, 2 days, 12 hrs.; 3d period, 2 days, 2 hrs.; 4th period, 2 days, 10 hrs.; 5th

period, 2 days, 14 hrs.; 6th period, 3 days, 14 hrs. This is an average from ten worms.

Second Brood.

1st period, 2 days, 22 hrs.; 2d period, 2 days, 21 hrs.; 3d period, 2 days, 12 hrs.; 4th period, 2 days, 15 hrs.; 5th period, 3 days, 22 hrs.; 6th period, 3 days, 12 hrs. This also is an average of the periods of ten larvae.

I wished to secure still more exact data on the periods and asked Mr. Niswonger to carry thru a series for the purpose in the fall of 1913. His records are given on pages 556 to 563, inclusive.

Pupation in the Field.

The apparent scarcity of pupae in fields in which the corn-ear worm had done injury during the season led me to look

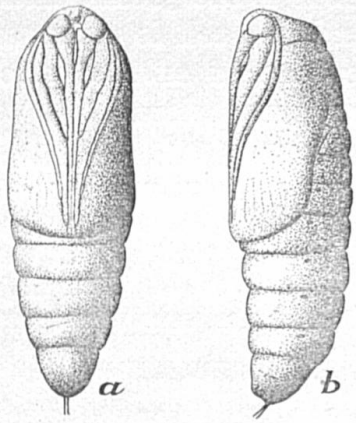


FIG. 7. a, Ventral view of pupa; b, side view. x2.

somewhat carefully into the matter, since the place of hibernation is of importance from the practical point of view. Examinations made at different times during the past ten years showed that the numbers to be found in infested corn fields varied a good deal. When the early broods are pupating there is no great difficulty in finding the pupae in the soil close to the corn, as was done by Professor G. H. French years ago. A scarcity of pupae in the fall might be due, it was learned by repeated observations, to the time of ripening of the corn. If it ripens early the insects produce no late

brood on it, and consequently the hibernating pupae must be looked for elsewhere.

Since this study was undertaken, plantings of corn have been made in the plots belonging to the Division at regular intervals during the summer. And with fresh corn available at all times the insect has not been compelled to wander away to find suitable food for its young. Wherever the late broods mature, there they enter the soil for pupation. The larvae do not wander as far away from the corn as I at first thought probable, and it may be said that pupation and hibernation of the late brood takes place in cornfields, tobacco fields, tomato patches etc., wherever, in fact, the late brood finds suitable food. The fact points to a remedy for the injuries that should, if generally employed, prove decidedly effective in diminishing the injuries in a locality, namely, winter plowing and harrowing to break up the earthen cells and expose the helpless pupae to the weather and to their enemies.

Larvae ready to pupate do not creep down the stalks. Twenty well grown larvae were placed on corn in the plots in 1911 and the stalks were banded with "tangle foot" at the base. Not a single worm passed over the trap, and all had left the corn and entered the soil on August 7. In the Insectary several larvae feeding in corn-ears were observed to drop. On Sep. 7 a larva was noted as coming out of an ear at 6 o'clock P. M. It remained out until 6:30 then reentered and remained until 11 o'clock, when it again emerged, fixed itself to the outside of the husk, raised the front part of its body, remaining in this position for an hour, then dropped.

On September 19, another larva was observed to come out of an ear at 4 P. M. rather hurriedly and dropped at once. On the floor of the Insectary this larva crept a distance of twelve feet in twenty-two minutes, and would probably have crept much farther in its endeavor to get to soil.

Two additional cases were observed in the Insectary September 22. One of the larvae emerged at 12:40, P. M., crept around the ear, elevating the forward part of the body frequently, finally elevating its head and falling from the ear.

Collected.	Hatched.	Length in mm.	1st molt.	Length.	2nd molt.	Length.	3rd molt.	Length.	4th molt.	Length.
8/16	A.M. 8/17	1.5	P.M. 8/19	4.	P.M. 8/21	7.5	A.M. 8/23	12.	A.M. 8/25	16.
8/18	" 8/20	1.3	" 8/23	4.5	A.M. 8/26	7.	" 8/28	10.	" 8/30	20.
8/18	P.M. 8/21	1.2	" 8/24	4.5	" 8/26	7.	" 8/28	9.5	" 8/31	18.
8/18	" 8/21	1.6	" 8/24	3.5	" 8/26	8.	" 8/28	15.	" 8/30	19.
8/18	" 8/19	1.5	A.M. 8/22	4.	" 8/25	10.	" 8/27	14.	" 8/28	20.
8/18	" 8/21	1.4	P.M. 8/24	4.5	" 8/26	8.	P.M. 8/28	11.	" 8/30	17.
8/18	A.M. 8/19	1.4	" 8/20	5.	" 8/23	7.5	A.M. 8/25	13.	" 8/26	19.
8/18	" 8/19	1.5	" 8/21	3.5	P.M. 8/24	9.	" 8/26	10.	" 8/29	17.
8/18	" 8/20	1.6	A.M. 8/23	5.	A.M. 8/25	7.	" 8/27	10.5	" 8/29	18.
8/18	" 8/20	1.5	P.M. 8/22	4.	" 8/24	7.5	" 8/27	11.	" 8/28	20.
8/18	" 8/21	1.2	" 8/24	5.	" 8/26	8.	P.M. 8/28	11.	P.M. 8/29	17.
8/18	" 8/21	1.3	" 8/24	4.	" 8/26	8.	A.M. 8/28	13.	" 8/29	18.
8/19	" 8/21	1.5	A.M. 8/25	3.5	" 8/27	7.	" 8/29	12.	" 8/30	16.
8/19	" 8/21	1.5	" 8/25	4.	" 8/27	7.5	" 8/29	10.5	A.M. 8/31	19.
8/19	" 8/21	1.4	" 8/25	4.5	" 8/26	6.5	" 8/28	11.	" 8/30	16.
8/19	P.M. 8/21	1.5	" 8/25	4.5	" 8/26	7.	P.M. 8/27	10.	" 8/30	18.
8/19	A.M. 8/21	1.4	" 8/24	5.	" 8/27	6.5	A.M. 8/28	12.	P.M. 8/30	20.
8/19	P.M. 8/21	1.3	P.M. 8/24	4.5	" 8/26	7.5	P.M. 8/28	14.	A.M. 8/30	21.
8/19	A.M. 8/22	1.6	" 8/24	4.5	" 8/26	7.	A.M. 8/28	11.	" 8/30	21.
8/19	P.M. 8/21	1.4	A.M. 8/24	4.	" 8/26	6.5	" 8/29	14.	" 8/30	20.
8/19	" 8/21	1.5	" 8/25	4.	" 8/26	7.	" 8/29	12.	" 8/31	21.
8/19	" 8/21	1.3	" 8/25	4.5	" 8/26	8.	" 8/28	10.	" 8/30	19.
8/21	A.M. 8/22	1.2	" 8/25	4.	" 8/27	6.	" 8/29	15.	" 8/31	17.
8/21	P.M. 8/21	1.4	" 8/24	5.	" 8/26	7.5	" 8/27	11.	" 8/29	20.
8/21	A.M. 8/23	1.5	" 8/26	3.5	P.M. 8/28	6.5	P.M. 8/31	13.	" 9/2	17.
8/21	" 8/23	1.6	P.M. 8/26	4.	A.M. 8/28	7.	A.M. 8/29	11.	" 8/31	18.
8/21	" 8/23	1.4	A.M. 8/25	4.5	" 8/28	8.	" 8/29	10.	" 8/31	20.
8/21	" 8/23	1.5	P.M. 8/25	4.	" 8/27	8.	" 8/29	13.	" 8/31	18.
8/21	" 8/23	1.5	" 8/26	4.	" 8/28	6.5	" 8/29	10.	" 8/31	16.
8/21	" 8/23	1.6	" 8/26	3.	" 8/28	6.	" 8/29	10.	" 8/30	18.
8/21	" 8/23	1.4	A.M. 8/27	5.	P.M. 8/28	8.	" 8/30	12.	" 8/31	17.
8/21	" 8/23	1.3	" 8/26	3.5	A.M. 8/28	7.5	" 8/29	12.	" 8/31	21.
8/21	" 8/23	1.6	" 8/26	4.	P.M. 8/27	6.5	" 8/29	11.	" 8/31	16.
8/21	" 8/23	1.5	" 8/26	5.	A.M. 8/28	7.	" 8/29	12.	" 8/31	18.
8/21	" 8/22	1.5	" 8/25	4.	" 8/28	6.5	P.M. 8/29	10.	" 8/31	16.
8/21	" 8/23	1.2	" 8/25	4.5	" 8/28	7.5	" 8/29	13.	" 8/31	19.
Av.		1.43		4.26		7.12		11.62		18.36

CORN-EAR WORM, 1913.

5th molt.	Length.	Length before entering ground.	Entered soil.	Made cell.	Pupated.	Emerged.	Total, days
A.M. 8/27	21.	28.	A.M. 8/29	8/30	A.M. 8/31	A.M. 9/9	24.
" 9/1	29.	39.	" 9/3	9/3	P.M. 9/6	" 9/16	29.
Dead							
A.M. 9/1	32.	37.	P.M. 9/2	9/3	P.M. 9/4	P.M. 9/15	28.
" 8/30	30.	40.	" 9/1	9/2	" 9/4	A.M. 9/17	30.
" 9/1	25.	38.	" 9/4	9/5	Larva	dead in cell	
" 8/28	23.	35.	A.M. 8/31	9/1	A.M. 9/3	A.M. 9/13	26.
" 8/31	25.	40.	" 9/2	9/2	P.M. 9/2	" 9/15	28.
" 8/31	22.	38.	" 9/2	9/2	" 9/3	" 9/12	25.
" 8/31	32.	40.	" 9/1	9/2	A.M. 9/3	" 9/11	24.
" 8/31	21.	37.	P.M. 9/1	9/2	P.M. 9/3	Pupa dead	
" 8/31	28.	39.	" 9/2	9/3	A.M. 9/4	A.M. 9/17	30.
" 9/1	30.	38.	" 9/3	9/4	" 9/5	P.M. 9/18	30.
P.M. 9/2	27.	40.	" 9/5	9/6	Pupa	dead	
" 9/2	32.	39.	" 9/4	9/5	P.M. 9/6	A.M. 9/20	32.
A.M. 9/1	30.	39.	" 9/2	9/3	A.M. 9/5	Pupa dead	
P.M. 9/1	24.	38.	A.M. 9/4	9/4	P.M. 9/5	A.M. 9/19	31.
" 9/1	29.	40.	P.M. 9/2	9/3	A.M. 9/4	" 9/17	29.
" 9/1	23.	37.	A.M. 9/3	9/3	P.M. 9/5	" 9/15	27.
" 9/1	27.	39.	P.M. 9/5	9/6	" 9/6	" 9/23	35.
Absent	------	35.	" 9/2	9/3	A.M. 9/5	P.M. 9/18	30.
A.M. 9/1	33.	40.	" 9/2	9/3	Did not	pupate	
P.M. 9/1	22.	38.	A.M. 9/3	9/4	P.M. 9/5	A.M. 9/20	30.
A.M. 9/1	31.	40.	P.M. 9/2	9/3	" 9/4	" 9/25	35.
" 9/4	30.	40.	A.M. 9/6	9/7	A.M. 9/9	Pupa died	
" 9/1	24.	39.	P.M. 9/5	9/6	" 9/7	A.M. 9/17	27.
P.M. 9/1	29.	38.	" 9/3	9/4	" 9/6	" 9/24	34.
Absent	------	37.	" 9/4	9/5	" 9/7	P.M. 9/23	33.
P.M. 9/2	28.	36.	A.M. 9/4	9/4	P.M. 9/5	A.M. 9/19	29.
A.M. 9/1	26.	39.	P.M. 9/3	9/4	A.M. 9/6	" 9/25	35.
" 9/1	29.	38.	" 9/3	9/4	P.M. 9/5	P.M. 9/19	29.
" 9/2	28.	37.	A.M. 9/4	9/4	A.M. 9/6	A.M. 9/23	33.
" 9/2	20.	38.	" 9/4	9/5	" 9/6	" 9/17	27.
P.M. 9/1	20.	35.	" 9/3	9/5	" 9/6	" 9/19	29.
A.M. 9/2	19.	40.	P.M. 9/4	9/5	" 9/7	" 9/26	36.
P.M. 9/1	23.	33.	" 9/2	9/3	" 9/5	" 9/21	31.
----------	26.69	38.11	----------	------	----------	----------	30.2

LIFE PERIODS OF THE CORN-EAR

Collected.	Hatched.	Length in mm.	1st molt.	Length.	2nd molt.	Length.	3rd molt.	Length.	4th molt.	Length.
8/23	A. M. 8/23	1.2	A. M. 8/25	4.	A. M. 8/28	7.	P. M. 8/29	13.	A. M. 8/30	16.
8/23	" 8/26	1.5	P. M. 8/30	4.5	" 9/1	8.	" 9/2	14.	" 9/5	18.
8/23	" 8/2.	1.3	A. M. 8/30	5.	" 9/1	8.	A. M. 9/2	11.	" 9/4	18.
8/23	" 8/27	1.5	" 8/31	4.5	" 9/1	7.5	P. M 9/2	12.	" 9/5	22.
8/23	" 8/27	1.4	" 8/30	6.	" 9/1	8.	" 9/2	10.	" 9/4	17.
8/23	" 8/27	1.6	" 8/30	5.	" 8/31	7.	A. M. 9/2	12.	" 9/3	20.
8/23	" 8/27	1.6	P. M. 8/29	4.5	" 8/31	6.5	P. M. 9/1	11.	" 9/2	17.
8/23	" 8/27	1.3	A. M. 8/30	4.	" 9/1	7.	A. M. 9/2	12.	" 9/3	16.
8/25	" 8/28	1.4	" 8/30	3.5	" 8/31	8.	" 9/2	10.	" 9/4	15.
8/25	" 8/28	1.5	" 8/30	3.	" 9/2	7.5	" 9/3	12.	" 9/5	16.
8/25	P. M. 8/27	1.5	" 8/30	4.	" 8/31	8.5	" 9/2	13.	" 9/4	17.
8/25	A. M. 8/28	1.2	" 8/30	4.	" 9/1	7.5	" 9/3	13.	" 9/5	19.
8/25	" 8/28	1.4	" 8/30	4.5	P. M. 9/1	7.	" 9/3	11.	" 9/5	16.
8/25	P. M. 8/27	1.4	" 8/30	4.	A. M. 8/31	7.	P. M. 9/2	12.	" 9/3	15.
8/26	A. M. 8/29	1.4	" 9/1	4.5	P. M. 9/2	6.5	A. M. 9/4	16.	P. M. 9/5	20.
8/26	" 8/29	1.5	" 8/31	4.	A. M. 9/3	7.	" 9/4	10.	A. M. 9/5	15.
8/26	" 8/29	1.4	P. M. 8/31	5.	P. M. 9/2	8.	" 9/3	12.	" 9/6	19.
8/26	" 8/29	1.5	A. M. 9/1	4.5	" 9/2	7.	" 9/3	17.	Dead.	---
8/26	" 8/28	1.5	" 8/31	4.	A. M. 9/2	8.	" 9/3	11.	A. M. 9/5	16.
8/28	" 8/31	1.5	" 9/3	4.5	P. M. 9/4	7.	" 9/6	14.	P. M. 9/7	17.
8/28	" 8/31	1.2	" 9/3	4.	A. M. 9/4	6.	" 9/6	10.	A. M. 9/7	16.
8/28	" 8/31	1.4	" 9/3	4.5	" 9/4	7.	" 9/5	10.	" 9/7	15.
8/28	" 8/31	1.5	" 9/3	4.5	" 9/5	7.	" 9/9	16.	---	---
8/29	" 9/1	1.3	" 9/3	3.5	" 9/5	7.5	" 9/6	13.	" 9/8	18.
8/29	" 9/1	1.4	" 9/3	4.	P. M. 9/4	7.	P. M. 9/5	10.	" 9/7	16.
8/29	" 9/1	1.5	" 9/3	5.	A. M. 9/4	7.	A. M. 9/6	12.	" 9/8	16.
9/2	" 9/4	1.5	" 9/6	3.5	" 9/7	6.5	P. M. 9/8	11.	" 9/10	17.
9/2	" 9/4	1.6	" 9/5	3.5	" 9/7	7.	" 9/9	12.	" 9/11	18.
9/2	" 9/5	1.3	" 9/7	4.5	" 9/9	8.	A. M. 9/11	11.	P. M. 9/12	16.
9/2	" 9/4	1.5	" 9/6	4.	" 9/7	6.5	" 9/9	9.	" 9/10	15.
9/2	" 9/4	1.4	" 9/6	4.	" 9/7	7.	" 9/9	12.	A. M. 9/11	16.
9/3	" 9/5	1.5	" 9/7	5.	" 9/9	7.5	" 9/11	11.	P. M. 9/13	19.
9/3	P. M. 9/5	1.3	" 9/7	3.5	" 9/9	6.	" 9/11	11.	" 9/13	16.
9/3	A. M. 9/5	1.2	" 9/7	4.	" 9/9	6.	" 9/11	12.	" 9/13	17.
9/3	P. M. 9/5	1.4	P. M. 9/8	4.	P. M. 9/10	8.	P. M. 9/12	11.	A. M. 9/14	17.
Av.	---	1.4	---	4.24	---	7.45	---	11.94	---	17.

WORM, 1913 (Con.)

5th molt.	Length.	Length before entering ground.	Entered ground.	Made cell.	Pupated.	Emerged.	Total, days.
A.M. 9/1	20.	39.	A.M. 9/2	9/3	A.M. 9/4	A.M. 9/21	29.
P.M. 9/6	36.	----	P.M. 9/7	9/8	" 9/10	" 10/2	40.
" 9/5	28.	40.	A.M. 9/7	9/8	" 9/9	" 9/27	35.
Absent	----	28.	" 9/8	9/9	" 9/10	Pupa dead	
A.M. 9/6	23.	37.	" 9/10	9/12	P.M. 9/11	----------	------
" 9/5	27.	39.	" 9/6	9/8	" 9/9	A.M. 9/27	35.
" 9/4	21.	34.	" 9/6	9/7	A.M. 9/9	" 9/26	34.
" 9/5	19.	38.	" 9/7	9/8	" 9/9	" 9/30	38.
" 9/5	18.	33.	" 9/7	9/8	P.M. 9/9	" 10/3	39.
" 9/6	21.	36.	" 9/8	9/8	" 9/9	" 9/27	33.
" 9/6	22.	30.	P.M. 9/7	9/8	A.M. 9/9	" 9/30	35.
P.M. 9/6	24.	38.	" 9/8	9/9	" 9/10	" 10/1	36.
A.M. 9/7	23.	40.	" 9/9	9/10	" 9/12	" 10/6	42.
" 9/5	20.	36.	" 9/6	----	" 9/7	P.M. 9/23	29.
----------	----	29.	A.M. 9/7	9/7	P.M. 9/10	----------	------
A.M. 9/7	19.	28.	" 9/8	9/9	A.M. 9/12	----------	------
" 9/7	27.	38.	" 9/8	9/10	" 9/12	A.M. 10/7	42.
----------	----	----	----------	----	----------	----------	------
P.M. 9/7	22.	34.	A.M. 9/7	9/9	A.M. 9/10	A.M. 10/6	41.
" 9/9	22.	38.	P.M. 9/11	9/12	" 9/15	" 10/17	50.
" 9/9	25.	40.	A.M. 9/13	9/15	" 9/17		
" 9/8	20	28.	P.M. 9/11	9/12	" 9/14		
----------	----	34.	" 9/11	9/12	" 9/16		
P.M. 9/9	23.	39.	" 9/12	9/13	" 9/18		
A.M. 9/9	21.	40.	A.M. 9/11	9/11	" 9/14		
P.M. 9/9	20.	32.	P.M. 9/11	9/12	" 9/14		
A.M. 9/12	24.	36	A.M. 9/13	9/14	P.M. 9/18		
P.M. 9/12	23.	38.	" 9/15	9/15	" 9/19		
A.M. 9/15	26.	40.	" 9/18	9/19	" 9/26		
" 9/12	19.	31.	P.M. 9/17	9/18	A.M. 9/23		
P.M 9/14	20.	38.	" 9/17	9/19	" 9/24	Hibernated.	
A.M. 9/15	27.	38.	A.M. 9/18	9/19	" 9/23		
" 9/15	21.	29.	" 9/16	9/18	P.M. 9/23		
P.M. 9/15	22.	36.	P.M. 9/18	9/19	A.M. 9/25		
A.M. 9/15	20.	29.	A.M. 9/17	9/19	" 9/22		
----------	22.67	35.21	----------	------	----------	----------	37.2

LIFE PERIODS OF THE CORN-EAR

Collected.	Hatched.	Length in mm.	1st molt.	Length.	2nd molt.	Length.	3rd molt.	Length.
9/7	A.M. 9/7	1.5	A.M. 9/9	4.	A.M. 9/22	7.5	A.M. 9/27	11.
9/7	" 9/7	1.5	" 9/9	3.5	" 9/11	6.5	" 9/14	10.
9/7	" 9/7	1.4	" 9/9	4.	P.M. 9/11	6.	" 9/14	12.
9/8	" 9/10	1.5	" 9/14	3.5	" 9/16	7.	Dead	
9/8	" 9/11	1.5	" 9/15	4.	A.M. 9/18	7.	A.M. 9/22	11.
9/8	" 9/11	1.4	" 9/15	4.5	" 9/18	7.	" 9/21	14.
9/8	" 9/12	1.3	" 9/16	3.	" 9/19	6.	" 9/24	12.
9/10	" 9/14	1.6	" 9/18	5.	" 9/20	6.	" 9/23	11.
9/10	" 9/14	1.3	P.M. 9/16	3.5	" 9/19	6.5	P.M. 9/22	11.
9/24	" 9/29	1.4	" 10/2	4.	" 10/5	7.	A.M. 10/8	10.
9/24	" 9/30	1.5	A.M. 10/5	4.	" 10/7	7.5	" 10/8	12.
9/24	" 9/30	1.5	" 10/5	4.	" 10/7	7.	" 10/9	11.
9/27	" 10/1	1.6	----------	----	----------	----	----------	------
9/27	" 10/1	---	----------	----	----------	----	----------	------
10/1	" 10/6	1.2	----------	----	----------	----	----------	------
10/1	" 10/6	1.6	----------	----	----------	----	----------	------
10/1	" 10/6	1.5	----------	----	----------	----	----------	------
10/1	" 10/6	1.5	----------	----	----------	----	----------	------
10/6	" 10/9	1.6	----------	----	----------	----	----------	------
10/6	" 10/9	1.5	----------	----	----------	----	----------	------
10/6	" 10/8	1.4	----------	----	----------	----	----------	------
10/8	A.M. 10/11	1.6	----------	----	----------	----	----------	------
10/8	P.M. 10/11	1.6	----------	----	----------	----	----------	------
10/8	A.M. 10/11	1.3	----------	----	----------	----	----------	------

WORM, 1913 (Con.)

4th molt.	Length.	5th molt.	Length.	Length before entering ground.	Entered soil.	Made cell.	Pupated.
P.M. 9/30	16.	A.M. 10/4	20.	37.	P.M. 10/8	10/9	A.M. 10/12
A.M. 9/16	15.	" 9/18	19.	33.	A.M. 9/24	9/25	" 9/30
" 9/17	18.	" 9/20	22.	40.	" 9/23	9/25	" 9/27
A.M. 9/25	15.	A.M. 9/27	19.	38.	P.M. 10/1	------	A.M. 10/7
P.M. 9/23	17.	" 9/26	21.	39.	" 9/30	10/1	" 10/1
" 9/30	20.	----------	------	28.	A.M. 10/6	Dead	----------
A.M. 9/27	20.	A.M. 9/29	25.	40.	" 10/2	10/3	A.M. 10/8
" 9/26	16.	" 9/29	20.	37.	P.M. 10/2	10/3	" 10/8
" 10/10	15.	" 10/12	20.	39.	" 10/20	------	" 10/25
" 10/11	17.	Dead.	------	------	----------	------	----------
----------	---	----------	------	------	P.M. 10/23	------	" 10/29
----------	---	----------	------	------	----------	------	" 10/25
----------	---	----------	------	------	----------	------	" 10/29
----------	---	----------	------	------	----------	------	" 10/27
----------	---	----------	------	------	----------	------	" 10/27
----------	---	----------	------	------	----------	------	" 10/28
----------	---	----------	------	------	----------	------	" 10/27
----------	---	----------	------	------	----------	------	" 10/31
----------	---	----------	------	------	----------	------	" 10/31
----------	---	----------	------	------	----------	------	" 10/31
----------	---	----------	------	------	----------	------	" 10/31
----------	---	----------	------	------	----------	------	" 11/2
----------	---	----------	------	------	----------	------	" 11/2

LIFE PERIODS OF THE CORN-EAR

Last Generation—Eggs Laid by Adults

Eggs laid.	Hatched.	Length in mm.	1st molt.	Length.	2nd molt.	Length.	3rd molt.	Length.
9/18	A.M. 9/24	1.3	A.M. 9/28	3.5	A.M. 10/1	7.	A.M. 10/3	10.
9/18	" 9/25	1.5	" 9/29	3.	" 10/2	7.	P.M. 10/5	11.
9/18	" 9/25	1.5	" 9/29	4.	P.M. 10/2	7.5	A.M. 10/5	11.
9/18	" 9/25	1.3	" 9/29	3.5	" 10/2	6.	" 10/5	9.
9/20	" 9/25	1.4	" 9/28	3.5	" 10/2	6.5	" 10/5	10.
9/20	" 9/25	1.5	" 9/28	3.5	A.M. 10/1	7.5	" 10/5	12.
9/20	" 9/24	1.5	P.M. 9/26	4.	" 9/30	7.	" 10/3	11.
9/20	" 9/24	1.3	A.M. 9/28	4.5	P.M. 10/2	7.	" 10/6	12.
9/20	P.M. 9/25	1.6	P.M. 9/29	3.	A.M. 10/2	6.	" 10/5	10.
9/22	A.M. 9/28	1.6	A.M. 10/1	4.5	" 10/4	7.	" 10/10	17.
9/22	" 10/1	1.6	" 10/5	4.	" 10/9	7.5	P.M. 10/13	13.
9/27	" 10/2	1.6	" 10/6	4.	P.M. 10/8	7.5	" 10/11	13.
9/27	" 10/2	1.6	" 10/6	4.5	" 10/8	7.	A.M. 10/11	12.
9/27	" 10/2	1.5	" 10/6	4.	A.M. 10/9	7.5	" 10/11	14.
9/29	" 10/3	1.5	" 10/7	3.5	" 10/9	7.5	" 10/11	12.
9/29	" 10/3	1.5	----------	----	----------	----	----------	------
9/30	" 10/5	1.5	P.M. 10/8	4.5	A.M. 10/11	7.5	----------	------
9/30	" 10/5	1.4	A.M. 10/9	4.	" 10/11	7.	----------	------
9/30	" 10/6	1.6	" 10/9	5.	P.M. 10/18	8.	----------	------
10/3	" 10/8	1.6	" 10/11	4.	----------	----	----------	------
10/3	" 10/8	1.5	" 10/11	4.5	----------	----	----------	------
10/3	" 10/8	1.4	" 10/12	4.	----------	----	----------	------
10/3	" 10/8	1.6	" 10/12	3.5	----------	----	----------	------
10/6	" 10/9	1.4	A.M. 10/13	4.5	----------	----	----------	------
10/6	" 10/9	1.5	" 10/13	3.5	----------	----	----------	------
10/10	P.M. 10/14		----------	----	----------	----	----------	------
10/10	A.M. 10/15		----------	----	----------	----	----------	------
10/10	" 10/15		----------	----	----------	----	----------	------
10/10	P.M. 10/14		----------	----	----------	----	----------	------
10/10	A.M. 10/17		----------	----	----------	----	----------	------
10/10	" 10/15		----------	----	----------	----	----------	------
10/10	" 10/15		----------	----	----------	----	----------	------
10/10	" 10/16		----------	----	----------	----	----------	------
10/10	P.M. 10/17		----------	----	----------	----	----------	------

WORM, 1913 (Con.)

Reared in Insectary.

4th molt.	Length.	5th molt.	Length.	Length before entering ground.	Entered soil.	Made cell.	Pupated.
P.M. 10/6	16.	A.M. 10/8	22.	37.	A.M. 10/12	10/13	10/17.
" 10/7	16.	" 10/9	20.	28.	" 10/12	10/14	10/17.
A.M. 10/9	15.	" 10/10	19.	35.	" 10/15	10/14	10/21.
" 10/8	16.	P.M. 10/10	20.	39.	" 10/14	10/15	10/21.
P.M. 10/7	15.	A.M. 10/9	20.	33.	P.M. 10/15	10/17	10/23.
A.M. 10/8	18.	----------	------	39.	" 10/13	10/15	10/17.
" 10/6	17.	P.M. 10/9	22.	36.	" 10/13	Died before pupating.	
----------	---	A.M. 10/9	21.	34.	" 10/13	10/14	10/23.
P.M. 10/7	15.	" 10/11	20.	30.	" 10/14	------	10/23.
A.M. 10/11	19.	" 10/13	21.	33.	----------	------	10/21.
" 10/16	18.	" 10/19	22.	38.	" 10/21	------	10/28.
----------	---	----------	------	------	" 10/23	------	10/30.
----------	---	----------	------	------	" 10/22	------	10/29.
----------	---	----------	------	------	" 10/25	------	10/30.
----------	---	----------	------	------	" 10/22	------	11/1.
----------	---	----------	------	------	" 10/25	------	10/30.
----------	---	----------	------	------	" 10/30	------	10/31.
----------	---	----------	------	------	" 10/25	------	11/1.
----------	---	----------	------	------	" 10/27	------	10/31.
----------	---	----------	------	------	" 10/31	------	11/3.
----------	---	----------	------	------	" 10/30	------	11/3.
----------	---	----------	------	------	" 11/1	------	11/4.
----------	---	----------	------	------	" 10/31	------	11/3.
----------	---	----------	------	------	" 11/1	------	----------
----------	---	----------	------	------	" 10/31	------	11/3
----------	---	----------	------	------	----------	------	Pupated in early November.
----------	---	----------	------	------	----------	------	
----------	---	----------	------	------	----------	------	
----------	---	----------	------	------	----------	------	
----------	---	----------	------	------	----------	------	
----------	---	----------	------	------	----------	------	
----------	---	----------	------	------	----------	------	
----------	---	----------	------	------	----------	------	
----------	---	----------	------	------	----------	------	
----------	---	----------	------	------	----------	------	

Another came out at 12 o'clock and dropped at the end of three minutes.

In the field a single instance of the emergence of the larva was observed on October 15, 1911. The insect came out and dropped at the end of two minutes, reaching the soil about twelve inches from the stalk, crept about 13 inches farther away and entered the ground.

While in the great majority of cases larvae leave the ears by cutting directly thru the husks, they do not always emerge thus, some of them pushing their way out along the old burrow. They may leave either during the day or at night. Twenty-five larvae in as many ears of corn out-of-doors were inclosed with tough paper sacks. Two of them



FIG. 8. Pupa exposed by breaking away one side of its earthen cell. x 2.

cut thru the paper. The rest emerged as follows: September 9, eight emerged at night. September 10, eleven emerged during the day. September 16, six emerged at night.

Some larvae hatched September 4-9, and kept in the Insectary, were observed as to time of emerging for pupation: September 1, one emerged at night; September 16, six emerged from 12:20 P. M. to 2 o'clock; September 16, one emerged at 6 P. M.; September 17, two emerged at night. Totals: At night, 3; in daytime, 9.

The record of larvae from fifty-two ears of corn brought to the Insectary September 10, completes the evidence as to this feature of the habits. The larvae emerged for pupation as follows:

September 11, four, day; September 12, four, day; September 15, six, night; September 16, two, night; September 16,

twelve, day; September 17, eight, night; September 18, six, night; September 18, six, day; September 19, four, day. Totals: at night, 22; daytime, 30.

Depth to which Pupating Larvae Burrow, and the Distance they Travel from the Corn.

In the laboratory it has been noted that larvae frequently go into the soil as far as the cage or other container permits, or in the summer often pupate among rubbish at the surface. When reared in tumblers or Stender dishes, as many of our rearings have been, they can generally be counted on to pupate next the bottom, where the change can often be witnessed. Four inches is a common depth when they are given all the soil they want.

In the following table are given some data relating to this matter, and also with reference to the distance the larvae travel before entering the soil. The pupae were taken from the soil of one of our experiment plots planted in corn.

November 2, 1911.

	Depth—Inches.	Nearest Corn Stalk. (Feet and inches.)	
1.	2 50	2	4
2.	3.00	1	2
3.	1.50	1	8
4.	4.50	1	10
5.	2.50	2	0
6.	6.50	2	4
7.	3.25	0	8
8.	6.00	0	10
9.	2.00	0	9
10.	1.50	1	3
11.	4.50	1	0
12.	2.50	2	3
13.	6.50	1	2
14.	6.00	0	9
15.	1.75	1	5
16.	5.00	1	7
17.	4.00	1	8

18.	3.00	1	0
19.	2.50	1	6
20.	4.00	0	4
21.	3.00	1	8
22.	4.50	1	6
23.	2.00	1	4
24.	3.00	1	6
25.	1.50	1	2
26.	3.50	0	10
27.	0.50	1	8
28.	2.00	1	3
29.	5.50	1	0
30.	4.00	1	2
31.	2.00	0	7
32.	0.50	0	4
33.	3.00	1	3
34.	5.00	0	10
35.	7.00	1	3
36.	6.00	0	6
37.	3.00	1	4
38.	5.50	1	6
39.	5.00	1	4.5
40.	1.00	0	11
41.	2.50	1	5
42.	4.00	2	0
43.	1.50	1	5
44.	4.00	1	2
45.	2.00	1	4

A Bacterial Disease.

From time to time I have observed larvae of the corn-ear worm in an abnormal condition indicating something wrong, but with nothing evident as to the cause. In the fall of 1911, examples were seen that had much the appearance of the cabbage worm when affected with the bacterial disease which causes the tissues to dissolve to a mushy consistency. The dead body is turgid, rigid, extended, the skin with a peculiar whitish appearance on the under side. Blood does not flow from a snipped off fleshy leg unless it is forced out by pressure. The blood of an example examined September 26 contained a large elongate bacillus and a small round form. A culture on agar at this date gave colonies of

a coccus. The independent growths were round, faintly, radiately striate, the surface glossy, white, the center more translucent, with a bluish marginal zone. Subcultures started from the above showed a tendency to assume an amoeboid form where the agar was specially moist. The disease should have further study.

Extent of Injuries.

The corn-ear worm is not as common some seasons as it is others. It may in fact be difficult to find in a locality one summer, and appear in very great numbers another. With local fluctuations of this sort, it is constantly present in corn fields thruout America, doing much damage each year in the country as a whole, not only by eating the corn, but doing vastly more mischief by admitting moisture and with it molds of various sorts, within the husks. For while some molds, such as *Diplodia zeae*, invade corn-ears without help, the majority are incapable of doing so, and most of those to be observed on the so-called moldy corn are present only because the corn worm admits them along the path it makes in invading the ears. Thousands of acres thruout the corn growing sections of North America yield but little corn not in some wise injured by the worms, and seasons of moldy corn are merely seasons during which the insects have been especially common.

The mischief done to the blades is generally of slight importance. The insects attack them only because the ears are not at the time in a suitable condition for food. If the young silk at the ends of the ears is fresh when moths are about, more than nine-tenths of the eggs will be found placed on the tender threads. For a time after hatching the young worms feed on the silk, and work gradually in among the threads until they reach the grain. Here they gnaw a broad burrow along the cob, destroying the grain as they go and leaving a path just under the husks occupied with refuse. They may in this way injure a large part of the outer half of the ear, or may go down well toward the base. Sometimes several worms occupy an ear at the same time, but their dis-

position to attack and destroy one another, results in most cases finally in but one larva to an ear.

While the untouched grain of these ears is good, and may be utilized by farmers, there is always much greater loss than results from the actual destruction of the grain. Injured corn does not sell well, and if badly damaged can hardly be sold at all. If used by the farmer himself, as is the tendency in order that it may not be a total loss, there is the risk of injuring and even killing the animals to which it is fed. For many years numerous complaints have come each winter to the Kentucky Experiment Station of loss from feeding such corn. Hundreds of animals, horses, mules, cattle and poultry, have been lost from some cause thought to be the eating of this moldy corn. Of late complaints are made that silage causes these deaths, but they occurred in Kentucky to my certain knowledge when little or no silage was made in the State.

Figures showing the percentage of injury to different corn varieties have been given on preceding pages. They show that the insect is not partial to any particular variety, but attacks table or field corns, soft or hard, and that it may, if the corn is young after the moths become numerous, attack every ear borne by a planting. Additional observations were made at Hickman in Western Kentucky in 1913, where altho some cotton is grown, the insect confines its depredations very largely to corn. Early sweet corn was there injured more than field corn and probably supplied most of the food to the first brood. By July 10 about 27.5 per cent of the ears were infested. It was estimated that about 12 per cent of the weight of grain of infested ears was destroyed. In the latter part of August and in September the adult moths placed their eggs on the table corns because of the hardening of the field corn. Every ear bore one or more worms and sometimes others were found on the outside of ears near the base. Fully 70 per cent of this corn was made unfit for use. Altho field corn suffered less than table corn it was a decided reference to cotton. After the corn was mature some per-

centages were made by an actual count of grains destroyep. The percentage ranged from 2.1 to 8.5, averaging 4.6.

Corn is stored in cribs and sold in the husks about Hickman, and farmers state that unless it is thoroly dried before putting in the cribs it molds badly and that stock often refuse to eat it. They charge the molding to the ear worm.

From an examination of 5000 ears of field corn it was found that 37 per cent were injured. As already noted the corn that matured earliest escaped most completely.

Injury to Cotton.

The injury to cotton at Hickman was found to be slight. This seemed to be due to the fact that there was a great deal of corn available in the vicinity of the cotton fields. The bolls injured were those nearest the fields of corn as a rule. The infested cotton bolls are recognizable from the round hole left by the worm, with more or less refuse thrown out. The holes were always made at the base or side, not at the free end. Only one opening seemed to be made, this serving both for entrance and exit. Bolls attacked are rendered worthless, such fiber as is not destroyed, being stained. The following is a record of bolls examined for the injury:

Aug.	4.	2	injured in		410
"	11.	3	"	"	613
"	18.	4	"	"	838
"	28.	6	"	"	1222
Sep.	6.	4	"	"	314
"	21.	2	"	"	630
Oct.	2.	10	"	"	800
"	9.	1	"	"	480
"	9.	6	"	"	1310
		38			6617

Cotton growers when questioned stated that the injury was not severe and that they found only an occasional injured boll or none at all in their fields. Cotton has been grown for eight years or more at Hickman and this insect has not at any time seriously injured the crop.

Injury to Tomatoes.

The fruit of tomatoes is always subject to injury, especially when grown near corn. In the early part of the season, when little corn is in a condition for the young worms, tomatoes may suffer seriously. They are attacked like the cotton bolls, the hole being often made near the stem. July 2, 1914, a marketman brought to my dwelling tomatoes, nearly every one of which had been attacked, and one of

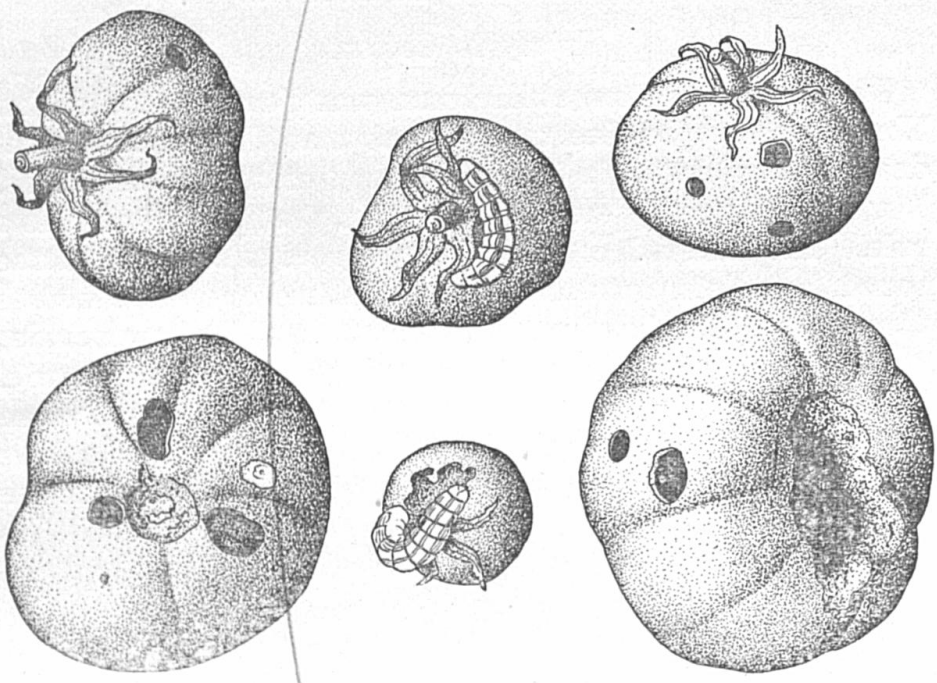


FIG. 9. Tomatoes injured by the corn-ear worm. Reduced.

them contained a nearly mature worm. The injury was noticed at Hickman, and has in fact been brought to my attention by correspondents writing from different parts of the State.

Injury to Tobacco.

This crop is injured severely only when grown near corn. In this case the worms work among the central leaves, and are noticeable especially from their numbers late in the fall on the tender tobacco which grows from the stubs after the

crop is harvested. The insect is not to be regarded as a serious enemy of tobacco when the crop is properly managed.

Other Plants Eaten.

Numerous other plants are attacked slightly, and no doubt scattered individuals mature on them. Toward fall the larvae sometimes feed openly on the heads of late plantings of Hungarian millet. In a field recently examined in Woodford County the blades had been very largely removed by a late brood of the common army worm. These had gone into the soil for pupation, and numerous corn-ear worms were busy stripping the seeds from the heads. Thruout the field numbers of these injured heads could be seen, many of them completely deprived of seeds. Mr. Jewett found examples late in the season on crab grass, and fed confined examples on beans, peas and okra. Dr. Dyar, in Hampson's Catalogue of the Lepidoptera Phalenae, gives Rosa and Calamintha as food plants, while Kaltenbach (Die Phlanzenfeinde) adds *Reseda luteola*. This omnivorousness is of interest as showing how the worms persist in the absence of their accustomed food plants. There is a possibility of small numbers of both early and late broods maturing thus when neither corn nor cotton is present in a neighborhood. Additional facts concerning food plants will be given in another paper dealing with the corn worm.

Treatment for the Corn-ear Worm.

Most of our attention has thus far been given to a study of the insect's life-history, but the matter of remedies for its injuries has been kept in mind from the beginning. Treatment for an insect attacking any field crop is difficult and costly. Sometimes the difficulty prevents satisfactory results, sometimes the cost, sometimes both. The corn-ear worm is not an exception in this respect. It commonly places its eggs on an essential part of corn, the silk. Anything that destroys the eggs, would destroy these tender organs also. Still, results of experiments are not always

what one expects, and it was thought worth while to make some tests of sprays at Hickman, especially because claims had been put forward implying great benefit from such treatment. Perhaps the treatment deters the insect from placing the eggs; more likely such benefit as is secured comes from poisoning the young worms while feeding on the silk.

Experiments made at Hickman.—Several lots of corn were sprayed in August, arsenate of lead paste being used and applied with a hand sprayer. The first three lots were on rather high ground, the corn in the silk stage, tho the development was uneven. The silk was nearly all dry soon after the second spraying. Preliminary examination of the ears showed no infestation until Aug. 1, when a percentage of 4.5 was estimated, most of the infested ears bearing small worms. Final counts of the ears and estimates of the injury were made at the end of the season. At the same time counts were made on equivalent plots of untreated corn.

Plot No. 1. Corn sprayed Aug. 1, Aug. 8, Aug. 15.
Poison—Arsenate of lead at rate of 3 pounds to 50 gallons of water.
Sprayed—No. of ears infested in each 100 examined: 25; 28; 34; 10; 36; 26; 42; 23; 29; 36.
Check—No. of ears infested in each 100 examined: 24; 34; 31; 21; 39; 43; 47; 38; 18; 34.
Totals: Sprayed—289 ears injured in 1000.
Check—329 ears injured in 1000.

Plot No. 2. Corn sprayed Aug. 1, Aug. 8, Aug. 15.
Arsenate of lead at rate of 3 pounds to 50 gallons of water.
Sprayed—No. of ears infested in each 100 examined: 23; 28; 30; 13; 26.
Check—No. of ears infested in each 100 examined: 40; 31; 42; 22; 30.
Totals: Sprayed—120 ears injured in 500.
Check—165 ears injured in 500.

Plot No. 3. Corn sprayed Aug. 1, Aug. 8, Aug. 15.
Arsenate of lead at rate of 2½ pounds to 50 gallons of water.
Sprayed—No. of ears infested in each 100 examined: 18; 21; 30; 10; 16.
Check—No. of ears infested in each 100 examined: 20; 24; 26; 14; 12.
Totals: Sprayed—95 ears in each 500 ears.
Check—96 ears in each 500 ears.

Plot No. 4. The corn in plot No. 4 was sprayed three times in August. At the first spraying the silk was just appearing. At the last spraying it was largely dry. The plot was located on low ground.

Corn sprayed Aug. 2, Aug. 9, Aug. 17.
Arsenate of lead: 3 pounds to 50 gallons of water.
Sprayed—No. of ears injured in each 100 examined: 20; 29; 40; 15; 36; 41; 27; 16; 22; 52.
Check—No. of ears injured in each 100 examined: 16; 31; 34; 48; 40; 39; 28; 22; 35; 37.
Totals: Sprayed—298 ears injured in 1000 examined.
Check—335 ears injured in 1000 examined.

Plot No. 5. This was on low ground and the silk of the corn was fresh at the time of spraying. Egg-laying was at its height when the silk was in good condition and is believed to have received an unusual number of eggs as a result. The plot was sprayed Aug. 4, Aug. 12 and Aug. 20.

Arsenate of lead: 2½ pounds in 50 gallons of water.
Sprayed—No. of ears injured in each 100 examined: 34; 50; 47; 23; 20; 40; 35, 34; 46; 49.
Check—No. of ears injured in each 100 examined: 47; 32; 49; 28; 27; 44; 38, 54; 48; 53.
Totals: Sprayed—378 injured ears in 1000.
Check—420 injured ears in 1000.

In these tests, regarded as merely preliminary, the ears were more thoroly sprayed than would be practicable on a large scale. It was found difficult to get the fluid to penetrate

the bundles of silk, and hence worms hidden in the interior of these masses probably escaped in many cases. The farmers themselves were unfamiliar with the use of insecticides for either corn or cotton.

Tests of Arsenate of Lead Paste and Powder.

A number of experiments in spraying with arsenate of lead paste and dusting with arsenate of lead powder were made on corn during the season of 1914 for the control of the corn-ear worm. The arsenate of lead paste was used at the rate of 3 pounds to 50 gallons of water, and the powder was mixed with an equal amount of dry wood ashes. The corn was treated when the silk was fresh. The plots of corn used were small and were planted two weeks apart after the first planting. The corn planted in the middle of June and thereafter did not mature so as to produce shelled corn. Worms were still found in ears after heavy frosts killed the corn, in the first week of November. The amount of infestation of ears ranged from 84.4 to 100 per cent. Injury was confined mostly to the tips of the ears, but not always, as considerable injury was noted at the bases of ears, in late plantings.

A slight increase in yield was noted for the treated corn as compared with the untreated, except in one case. The spray and powder were applied thoroly to each ear, but only a small amount of poison was used per acre, as noted in the table. The results, as shown by data, would not justify the use of poisons.

The powder used was furnished by the Grasselli Chemical Co., of Cincinnati, with the following printed on the label:

> "Lead arsenate, 96%.
> Inert matter, 4%.
> At least 32% arsenic oxid and
> 62% lead oxid present."

The paste used was furnished by the same company, and is assumed to be of average quality.

Tests of Arsenate of Lead, in 1914.

Plot	Variety	Date planted	Date treated	Arsenate of lead, per acre, pounds	Per cent jured ears	Shelled corn, injured ears, grams	Shelled corn, uninjured ears, grams	Yield per acre, pounds	Gain per acre from use of poison, pounds
1	Yellow Dent	May 16	----------	None	90.9	16590	2795	3419.57	
2	" "	" 16	Aug. 6, 13	6.41 Powder	88.4	18344	3095	3668.511	248.941
3	" "	" 30	----------	None	100.	---------	---------	2050.83	
4	" "	" 30	Aug. 22	3.8 Powder	100.	---------	---------	2431.198	380.368
5	Yellow Popcorn	" 16	----------	None	100.	---------	---------	1212.079	
6	" "	" 16	Aug. 6, 13	6.4 Powder	93.9	4095	265	1243.296	31.217
7	" "	" 30	----------	None	100.	---------	---------	1829.366	
8	" "	" 30	Aug. 13	5.65 Powder	98.	6509	133	1894.2	64.834
9	" "	June 15	----------	None	100.	---------	---------	1468.698	
10	" "	" 15	Sep. 12	5.5 Powder	100.	---------	---------	1676.829	208.131
11	Boone Co. White	May 16	----------	None	100.	---------	---------	2922.458	
12	" "	" 16	Aug. 6, 13	5.8 Paste	90.2	8849	815	3100.482	178.024
13	" "	" 30	----------	None	100.	---------	---------	3142.53	
14	" "	" 30	Aug. 22	3.4 Paste	100.	---------	---------	3187.03	44.5
15	Johnson Co. White	" 16	----------	None	100.	---------	---------	2241.35	
16	" "	" 16	Aug. 13, 22	6.64 Paste	100.	---------	---------	2379.586	138.236
17	" "	" 30	----------	None	100.	---------	---------	2194.5	
18	" "	" 30	Sep. 12	5.5 Paste	100.	---------	---------	2588.355	393.855
19	Early Adams	" 16	----------	None	100.	---------	---------	1890.75	115.11
20	" "	" 16	Aug. 6, 13	6.44 Paste	100.	---------	---------	1775.64	
21	" "	" 30	----------	None	100.	---------	---------	1676.829	68.453
22	" "	" 30	Aug. 13, 22	9.4 Paste	100.	---------	---------	1608.376	
23	Country Gent.	June 6	----------	None	97.5	8945	195	1248.17	
24	" "	" 6	Aug. 6	4.89 Paste	91.9	8465	1310	1339.338	91.168

Corn-ear Worm Injuries in Foreign Countries.

The corn-ear worm bears a bad reputation in some of the British colonial possessions. In India it is a serious pest, attacking large numbers of plants and most of the crops thruout that country, apparently being less inclined to concentrate on any one than it is in America. Rice, hemp, poppy, pulse, indigo, beans, peas and cotton are all badly injured. Writing of its injury to cotton (Indian Museum Notes, Vol. VI, p. 34, 1896) an observer says:

"The common cotton bollworm of Gujarat is a pinkish caterpillar about ½ inch in length. From the caterpillar I reared a small grey moth, which may be *Heliothis armigera*. The boll-worm is always worst when there has been cloudy weather in November, a month or two before cotton ripens. It is one of the chief causes, but not the only cause, of stain in cotton."

In Australia the ear worm shows the same disposition to run riot, and attacks many crops, being exceedingly injurious to them. Prof. C. French states in his Handbook of the Destructive Insects of Victoria that its destructiveness can hardly be surpassed and that there is scarcely a limit to the plants attacked.

Considering the closeness with which the ear worm confines its depredations to corn, tobacco and tomato in this country it is surprising to learn that it is a serious pest in orchards in New Zealand. The Government Entomologist, Mr. Arthur M. Lea, wrote in 1908 that the insect is there known as the maize worm and that it attacks an "immense" variety of plants, including fruits, vegetables, grains, etc. One larva will, he says, destroy several apples before completing its growth, and on young trees the pest destroys the new growth. A letter from an orchardist quoted by him reads: "They are making havoc on the young trees, biting the limbs off about two or three inches from the tops, and perforating all the leaves and destroying the apples."

The same fruit-eating habit is reported from South Africa. Mr. C. P. Lounsbury, in his report as Government Entomo-

logist 1899, p. 49, says it is always troublesome on tomatoes, but also injures green peaches. In 1897-1898 a large proportion of the fruit in many orchards was injured by being eaten into. It retains its corn-eating habit there, however, and late in the season eats into the pods of beans and peas.

The species sometimes assumes cannibalistic propensities when other food is not acceptable, and confined larvae of the corn-ear worm are very likely to devour one another. Professor Berg noted this habit prevailing in Patagonia, not, however, restricted to Chloridea, where he thinks it is due to the heat and drought of summer destroying other food. As quoted by J. A. Lintner (Entomological Contributions, 1875), Professor Berg writes:

"It still remains for me to note a peculiarity of caterpillars, viz: their extreme ferocity—their cannibalistic propensities. All of them, irrespective of family or group manifest the liveliest desire to kill their fellows; while confined they ate only one another, seldom, if ever, touching the food plants. The caterpillars of Bombycidae completely devoured others of the same family, leaving absolutely no fragments of them. They even tore open the cocoons from which they dragged out the pupae and ate them—to which fact I called the attention of my traveling companions."

"In like manner the larvae of the Noctuidae acted among themselves and toward the Bombycidae, and the latter toward the former. Among these last, *Heliothis armiger* [*Chloridea obsoleta*] was gluttonous beyond measure,—one of them devouring in twenty-four hours, from six to seven others."

Food Plants of Other Members of the Genus Chloridea.

A common European species, *C. dipsacea*, eats plant food of widely different sorts, as the following list of genera shows:

Centaurea, Cichorium, Cuculabus, Dianthus, Dipsacus (leaves and flowers), Echium, Gypsophila, Hypochaeris (flowers), Lychnis, Ononis, Plantago, Rumex and Silene.

Chloridea assulta, which I am assured by Professor T. Miyake, of Tokyo, is regarded by Japanese entomologists as

the same as *C. obsoleta,* feeds according to Professor Miyake on tobacco.

Kaltenbach says that *C. ononis* feeds on the flowers and young seeds of *Ononis repens, O. spinosa* and *Salvia pratensis.*

Our own *C. phloxiphaga,* very closely related to the *C. dipsacea* of Europe and Asia, is said to feed on *Grindelia squarrosa* by Dr. H. G. Dyar. Henry Edwards (Transformations of N. A. Lepidoptera) says it feeds on Gramineae.

C. virescens of North and South America, feeds on tobacco and some other plants. It has been reared from the seed capsules of cultivated columbine. The late C. V. Riley gave an instance in the American Entomologist of numerous pupae being taken from a cotton field at Cairo, Georgia, and states that he himself reared the adults from larvae taken from *Solanum sieglinge.** *Rhexia virginica* is given as a food plant of this insect by Henry Edwards (Transformations of N. A. Lepidoptera), also Sesamum.

From all that can be learned of the food habits of the different species it is evident that we have in the genus Chloridea a group of moths partial to the flowers and immature seeds of many plants. No particular botanical group is attacked. The larvae often change from one food plant to another suddenly under pressure of hunger, from grasses, for example, to such widely different plants as Solanaceae. The rather large lists attacked by *C. obsoleta* and *C. dipsacea* illustrate the omnivorous tastes of the insects when in the larval condition.

The species best known to me show a disposition to feed upon plants of two families, the Gramineae and the Solanaceae. Thus we have *C. obsoleta, C. virescens, C. phloxiphaga,* and *C. peltigera* feeding on grasses. On Solanaceae three species are known to feed at times, namely, *C. obsoleta, C. virescens,* and *C. assulta.* The adults also feed actively, flying during afternoons of warm days about flowers of

*I am unable to locate this plant name, either as a synonym or a valid name. However, it was probably a member of the family Solanaceae, very likely a Solanum.

various sorts, generally near corn fields. At one time I found large numbers about the blossoms of cowpeas, at another, about the blossoms of sweet clover (*Melilotus alba*). They are sometimes drawn to baits spread out by collectors on the trunks of trees, but can not be counted on to come to such baits every season, probably because of the greater attractiveness of other sweets. I have sometimes placed baits near corn on which the insects were abundant without getting a specimen.

The Eurasian *Chloridea dipsacea* has the same flower-visiting habit as our corn worm moth. T. B. Fletcher in his life histories of Wei-Hai-Wei Lepidoptera, notes a specimen on the 5th of May flying about flowers in the afternoon.

Chloridea peltigera, another widely distributed species of the East, is noted by Beutenmuller (Jour. N. Y. Ent. Soc. IX) as feeding on corn and passion fruit (Passiflora?) in Australia.

Insect Enemies of the Corn-ear Worm.

The insect has more enemies than might be supposed. It lives most of its life concealed under the husks, but this does not prevent predatory species from following and destroying it. Seven different insect enemies have been observed in the course of our work: One of the Hymenoptera, an egg parasite; three beetles; two true bugs; and one of the Neuroptera (a lace-wing fly).

The Egg Parasite (*Trichogramma pretiosa*).

As the season advances each year a minute yellowish hymenopterous parasite appears in corn fields and destroys some of the eggs of the corn-ear worm, but it has not proved thus far common enough to be considered of much service in reducing the injuries of the worms. It was observed by Mr. Jewett, at Hickman, after September 12, but out of 840 eggs examined only .052% were infested. It was observed also in small numbers in the middle of September at Lexington. It is pale yellow in color, the eyes red brown, the wings hyalin, blue-iridescent, the anterior, oval in outline, rounded at the outer end, the posterior wings slender,

pointed, long-fringed on the posterior margin, the anterior edge with a median claw or hook. Legs yellow.

Mr. Niswonger observed them creeping over the eggs and placing their own minute eggs within the shell, generally one in a place, but sometimes two, and more rarely three. Males under observation died October 8 and females October 9. The infested egg turns black before the parasite emerges. From eggs deposited Obtober 7, adults were produced October 24 and 25. The following gives an idea of the prevalence of the parasite at present.

Corn-ear Worm Eggs Collected by Mr. Niswonger in 1913

Date	No. Collected	No. hatched	Per cent hatched	Parasites
Aug. 25	25	23	92	0
" 26	16	16	100	0
" 28	24	24	100	0
" 29	12	12	100	0
Sep. 2	39	36	92	0
" 3	29	28	96	0
" 6	52	49	94	0
" 8	76	75	97	0
" 9	47	45	95	0
" 10	86	84	97	0
" 11	58	58	100	0
" 13	91	86	94	0
" 15	115	110	95	2
" 16	121	115	95	0
" 18	224	200	89	2
" 19	140	126	90	1
" 22	48	46	95	2
" 24	74	62	83	8
" 27	114	100	87	13
Oct. 1	130	115	88	14
" 6	65	55	84	20
" 8	45	44	97	13
" 10	30	24	80	6

A Predatory Beetle Larva (Telephoridae).

One of the first insects to attract my attention as an enemy of the corn-ear worm was an active, velvety brown or black larva which follows the worms into their burrows and some seasons devours numbers of them. The species has not been determined, but from the abundance on flowers about the edges of

corn fields of a yellowish brown beetle with black markings I have been inclined to think it the adult of this useful larva.

September 20, 1890, I noted its destruction of the pest as follows: "A velvety brown to black beetle larva with yellowish brown head and legs, is common in the ends of corn-ears, and wherever found with the corn worm the latter is dead. A number brought in by an assistant to-day with corn worms had seized the latter and were sucking their juices. I think it is one of the Telephoridae, perhaps *Chauliognathus marginatus*. It can hardly be *C. pennsylvanicus*, a species reputed as an enemy of *Aletia* (*Alabama*) *argillacea*, farther south, for this beetle has not been observed here." It has been seen occasionally since, but is not generally common.

September 19, 1910, the insect was again encountered, and when placed with a corn worm seized the latter a short distance behind the head and began to suck its juices. Since this useful insect has not been reared by me, a few notes made at this time may not be out of place as a means, together with the illustrations, of recognizing it.

Body, of twelve somites, the terminal one about half the diameter of the preceding and blunt behind, bearing beneath a white adhesive structure with which the body is pushed along. Velvety, opaque black, with several series of whitish dashes along each side. Head yellowish brown, with a squarish dusky spot on each side near the base, pubescent, the anterior half glossy; eyes dusky: antennae brown; jaws brown at bases, black at tips. Jointed legs pale yellow.

The Common Lady Beetle (*Megilla maculata*).

One of our commonest lady beetles, the small purple species less than a fourth inch long, with black markings, has proved a constant frequenter of corn, which it visits to feed on the eggs of the corn-ear worm. Its life-history has long been known in some fashion, but for Kentucky no observations relating to it are on record so far as I know.

It is easy to rear so long as it is provided with an abundance of suitable food. The larvae were confined in vials and were fed on plant lice and white fly. The adults were confined in large rearing jars and the eggs secured from them were removed as soon as deposited.

Adults taken June 27 were the first observed in the field. Eggs were deposited the same day. When confined with a young plant bearing plenty of food the female deposited eggs readily.

The number laid varied from thirty-seven to fifty-two. They were generally deposited in a clump, and were attached to the under sides of leaves, in confinement sometimes to the sides of rearing jars. In the field they were well concealed from view. In the Insectary the egg-laying period did not extend over three or four days, tho the adults lived for a longer period.

It became evident that there are at least three broods of the species during a season. The latest brood appeared as adults on October 6, 7 and 8, and all efforts to induce them to lay failed, as did attempts to secure eggs from adults taken in the field. It was evident that they were ready to hibernate as adults. No larvae were found after October 6.

From the shortness of the life-period it is possible that a brood had already developed when the work of rearing in the Insectary started. From the eggs secured June 27 adults developed in 24.5 days. The next brood was complete in 24 days, and a little more. July 27 the third brood was complete, the shortening of the last period being probably a result of a great abundance of food.

The hibernation of the insect has been observed by us for many years. Sometimes large numbers of the adult beetles have been found concealed under boards, stones and logs in sheltered places.

Hippodamia convergens.

This is a brown beetle, the head and thorax black, marked with white, the wing covers yellowish brown, each with six black spots, the three anterior smaller, the two median much the largest. Beneath, largely black. Length about 6 mm. It is found everywhere in Kentucky, and has been observed about corn silk, where with the preceding species it eats the eggs of the corn-ear worm. At Hickman it was found on corn in about equal numbers with *Megilla maculata.*

First Brood of Megilla maculata Reared in Insectary.

Egg stage.	1st instar.	2nd instar.	3rd instar.	4th instar.	Larval period.	Pupal period.	Length of generation–Egg to adult.
(1)							
6/27—6/30	6/30—7/4	7/4—7/7	7/7—7/10	7/10—7/14	6/30—7/14	7/14—7/19	6/27—7/19
3 da., 2 hr.	4 da.	2 da., 15 hr.	2 da., 23 hr.	4 da., 1 hr.	13 da., 19.5 hr.	5 da., 4 hr.	22 da., 2 hr.
(2)							
6/27—6/30	6/30—7/4	7/4—7/13	7/13—7/16	7/16—7/19	6/30—7/19	7/19—7/22	6/27—7/22
3 da., 2 hr.	3 da., 23 hr.	9 da.	2 da., 18 hr.	3 da., 1 hr.	18 da., 18 hr.	3 da., 22 hr.	25 da., 18.5 hr.
(3)							
6/27—6/30	6/30—7/5	7/5—7/12	7/12—7/15	7/15—7/18	6/30—7/18	7/18—7/22	6/27—7/22
3 da., 2 hr.	4 da., 16 hr.	7 da.	3 da.	3 da., 1 hr.	17 da., 17 hr.	3 da., 23 hr.	25 da., 17 hr.
(4)							
6/27—6/30	6/30—7/5	7/5—7/9	7/9—7/12	7/12—7/16	6/30—7/16	7/16—7/21	6/27—7/21
3 da., 1.5 hr.	5 da., 4.5 hr.	3 da., 12.5 hr.	3 da., 3 hr.	3 da., 22 hr.	15 da., 12 hr.	4 da., 22 hr.	24 da., 16 hr.
(5)							
6/27—6/30	6/30—7/5	7/5—7/9	7/9—7/12	7/12—7/16	6/30—7/16	7/16—7/20	6/27—7/20
3 da., 10 min.	5 da., 5.25 hr.	3 da., 12.25 hr.	3 da., 1 hr.	4 da., 1 hr.	15 da., 18.5 hr.	4 da., 10.75 hr.	23 da., 18.25 hr.
Averages:							
3 da., 2.51 hr.	4 da., 14.54 hr.	5 da., 18.34 hr.	2 da., 13 hr.	3 da., 13.94 hr.	16 da., 5.78 hr.	4 da., 19.41 hr.	24 da., 13.56 hr.

Length of Larvae.

Newly hatched.	After 1st molt.	After 2nd molt.	After 3rd molt.
1.6 mm.	3.4 mm.	5.2 mm.	8. mm.
1.5 mm.	3.2 mm.	4.5 mm.	6.5 mm.
1.5 mm.	2.8 mm.	6.5 mm.	7.75 mm.
1.5 mm.	3.3 mm.	4.2 mm.	5.5 mm.
1.4 mm.	3.2 mm.	5.2 mm.	7.2 mm.
Averages:			
1.5 mm.	3.16 mm.	5.12 mm.	6.99 mm.

Second Brood of M. maculata Reared in Insectary.

Egg stage.	1st instar.	2nd instar.	3rd instar.	4th instar.	Larval period.	Pupal period	Length of generation—Egg to adult
3 da., 2.75 hr.	3 da., 16.25 hr.	3 da., 2 2 hr.	2 da., 4 33 hr.	4 da., 1 hr.	16 da., 2.33 hr.	3 da ,19 hr.	19 da., 21.33 hr.
3 da , 2 hr.	3 da., 8 hr.	2 da., 22 hr.	3 da., 12.5 hr.	4 da., 6.25 hr.	11 da , 23.8 hr.	4 da .18 5 hr	19 da., 21.5 hr.
3 da., 2.66 hr.	3 da., 17.6 hr.	3 da.	2 da., 3.5 hr.	4 da., 2.25 hr.	12 da , 23.33 hr	4 da., 17 25hr	19 da., 18.25 hr.
3 da., 2.8 hr.	3 da., 16 hr.	3 da., 0.8 hr.	2 da., 5 hr.	4 da., 0.5 hr.	12 da , 2 33 hr.	4 da..18 hr.	20 da., 17 hr.
3 da., 3 hr.	3 da., 15.25hr.	2 da.	3 da., 0.5 hr.	3 da., 2.5 hr.	11 da , 22.25hr.	4 da .16 hr.	20 da., 1.25 hr.
Averages: 3 da., 2.64 hr.	3 da., 16.62 hr.	2 da., 19.2 hr.	2 da., 14.7 hr.	3 da., 21.7 hr.	14 da., 14.92 hr.	4 da., 12 hr.	24 da., 1.9 hr.

Length of Larvae.

Newly hatched.	After 1st molt.	After 2nd molt.	After 3rd molt.
1.2 mm.	3.3 mm.	5 mm.	6.5 mm.
1.4 mm.	3.5 mm.	5.2 mm.	7.3 mm.
1.3 mm.	3.5 mm.	5 mm.	6.5 mm.
1.3 mm.	3.4 mm.	5.5 mm.	7 mm.
1.3 mm.	4.2 mm.	5.5 mm.	6.5 mm.
Averages: 1.3 mm.	3.58 mm.	5.24 mm.	6.72 mm.

Third Brood of M. maculata Reared in Insectary.

Egg stage.	1st instar.	2nd instar.	3rd instar.	4th instar.	Larval period.	Pupal period	Length of generation-Egg to adult.
3 da., 15 hr.	2 da., 1.5 hr.	2 da.	2 da., 1.5 hr.	2 da., 23.5 hr.	9 da., 1 hr.	3 da., 13.5 hr	14 da., 5.5 hr.
3 da., 15.5 hr.	2 da., 0.5 hr.	2 da., 3 hr.	1 da., 23.25 hr	2 da., 1.25 hr.	8 da., 2.5 hr.	3 da., 9 hr.	15 da., 15 hr.
3 da., 16 hr.	2 da., 4 hr.	1 da., 20 hr.	2 da.	3 da., 1.5 hr.	10 da., 1.5 hr.	2 da.	15 da., 17 hr.
3 da., 15 hr.	2 da., 12 hr.	1 da., 12 hr.	2 da., 1.5 hr.	2 da., 22.5 hr.	8 da.	3 da , 0.5 hr.	14 da., 12 hr.
3 da., 15.5 hr.	2 da., 6 hr.	1 da., 11 hr.	1 da., 13 hr.	2 da., 11 hr.	8 da., 0.5 hr.	3 da., 8 hr.	15 da., 0 5 hr.
Averages: 3 da., 15.4 hr.	2 da., 4.8 hr.	1 da., 18.8 hr.	1 da., 22.24 hr.	2 da., 14.69 hr	8 da., 20 hr.	3 da., 10 hr.	15 da., 4.3 hr.



FIG. 10. TELEPHORIDE LARVA WHICH DESTROYS THE CORN-EAR WORM. X 4.

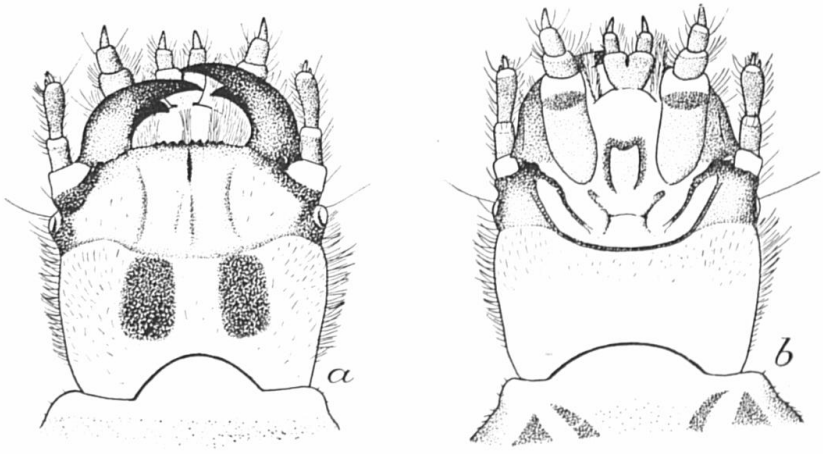


FIG. 11. A, DORSAL VIEW OF HEAD OF LARVA REPRESENTED IN FIG. 10; B, VENTRAL VIEW OF SAME. X 14.4.

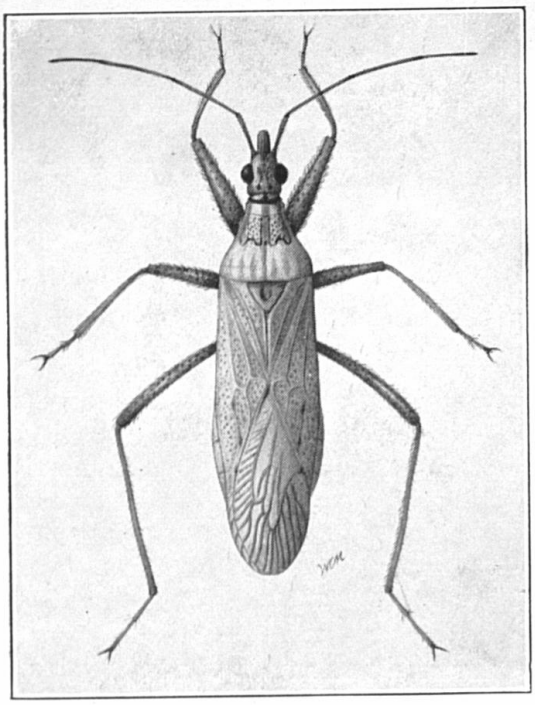


FIG. 12. AN ADULT CORISCUS FERUS. X 6.79.

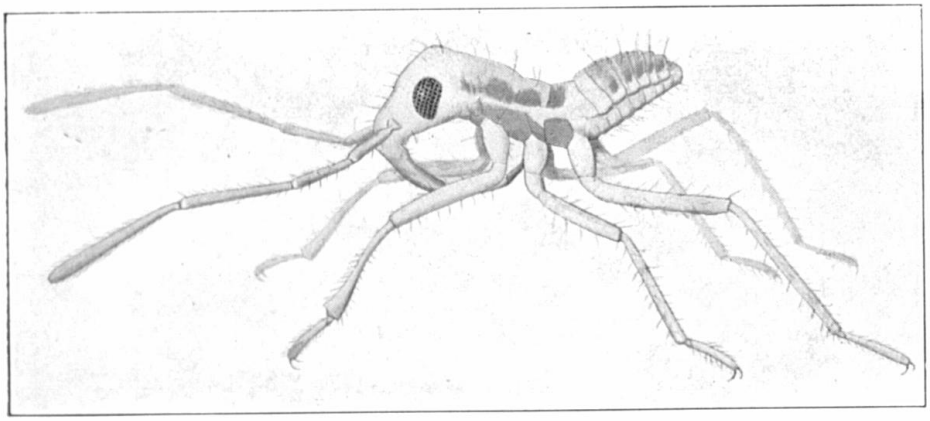


FIG. 13. CORISCUS FERUS JUST HATCHED. X 29.

Coriscus ferus.

A small, pale, brownish gray, puncturing insect has been known to me for many years from its frequent occurrence on all sorts of cultivated crops at most seasons of the year. In our miscellaneous collections it is represented by specimens collected from 1889 to the present time, from June 8 to December 5, when it was found hibernating under boards. It has been found hibernating also November 24 and 25 among matted grass. It is often found among mulching in strawberry beds, among red clover, alfalfa, hemp, wheat, oats, beets, etc., wherever forage, in the way of aphides, or other helpless insects, is to be found. It is often attracted to our light traps. It has proved a useful check on the increase of the corn-ear worm, and some notes made during the year 1913, detailing its molts, are given below.

The adult insect is elongate, flattish, the wings lying flat on the back, the prothorax widest behind and narrowing decidedly to the head, the eyes round and prominent. An obscure dusky bar lies between the eyes, another is sometimes evident along the middle of the prothorax. The scutellum is marked with a yellow dot on each side, sometimes connected with a yellow posterior margin. Legs yellow, flecked with black. Three narrow dusky longitudinal lines on the abdomen beneath. With figure 10 this brief description should help to its recognition.

Coriscus ferus was found to be somewhat difficult to rear. A large part of the broods died in the nymph stage. The rearings were fed on plant lice thruout the season.

Adults were confined in glass breeding jars on potted plants, such as clover, grasses, beans and young corn. Eggs were first found in young corn plants, but did not hatch. The greater number were found in red clover stems, when these were tender. For the first brood reared the egg deposition was not observed, but the eggs were found by dissection of the plant tissue. Later a single female was observed depositing eggs. In this case she stood lengthwise of the stem with the head upward and the abdomen on

the stem, in which position the ovipositor was forced into the stem. The process was repeated, the eggs being placed one above the other at pretty regular intervals. The egg is completely buried in the tissue, and the only outward evidence of its presence is the small cap at its extremity. The egg period ranged from six to twelve days.

Two broods were reared in the Insectary. The time from hatching of the egg to maturity was on an average 18 days and 3 hours for the first brood and for the second, 26.5 days, including the period in the egg stage.

Some irregularity in the number of molts was noted, but five molts were undoubtedly the rule. Two cases gave six molts, according to Mr. Jewett's notes.

First Brood Reared.—Young began to appear July 9, when several were observed as they hatched from eggs in clover stems. Many died after a few days, others reached the adult stage.

Second Brood Reared.—Eggs were deposited July 31, Aug. 7, 8 and 19. The brood had matured Sep. 19. Adults mated readily but no eggs were obtained. Adults from the field also showed no inclination to lay at this season, tho mating was observed among them. No young could be secured by careful sweeping done at this time and it was evident that the insects were prepared to hibernate, as they had already been proved to hibernate, as adults.

First Brood of Coriscus ferus.

1st instar.	2nd instar.	3rd instar.	4th instar.	5th instar.	Hatching to adult.
7/10—7/13	7/13—7/15	7/15—7/17	7/17—7/21	7/10—7/25	7/10—7/25
5 da., .25 hr.	1 da., 20.5 hr	22 hr.	1 da., 1.75 hr	4 da., 23.8 hr	16 da., 18 hr.
7/9—7/14	7/14—7/17	7/17—7/19	7/19—7/24	7/24—8/2	7/9— 8/2
5 da.	2 da., 18.75 h	1 da 23.75 hr	4 da., 22.8 hr	8 da., 23.3 hr	20 da., 12 hr.
7/10—7/13	7/13—7/17	7/17—7/20	7/20—7/24	7/24—7/30	7/10—7/30
3 da., 5 hr.	3 da., .5 hr	2 da., 22.5 hr	4 da., .75 hr	5 da., 5.25 hr	20 da., 5.5 hr.
7/13—7/17	7/17—7/18	7/18—7/20	7/20—7/23	7/23—7/28	7/13—7/28
3 da., 23.5 hr	1 da., .33 hr	1 da., 23.5 hr	3 da., 0.5 hr	5 da., 5.5 hr	15 da., 5.33 hr
7/13—7/17	7/17—7/18	7/18—7/21	7/21—7/24	7/24—7/31	7/13—7/31
4 da., 1 hr.	22.5 hr.	3 da., 1 hr.	2 da., 23 hr	6 da., 22.5 hr	17 da., 22.5 hr
Averages: 4 da., 5.5 hr.	1 da., 22.44 hr	2 da.. 4 hr.	3 da., 6.38 hr	6 da., 6.48 hr	18 da., 3 hr.

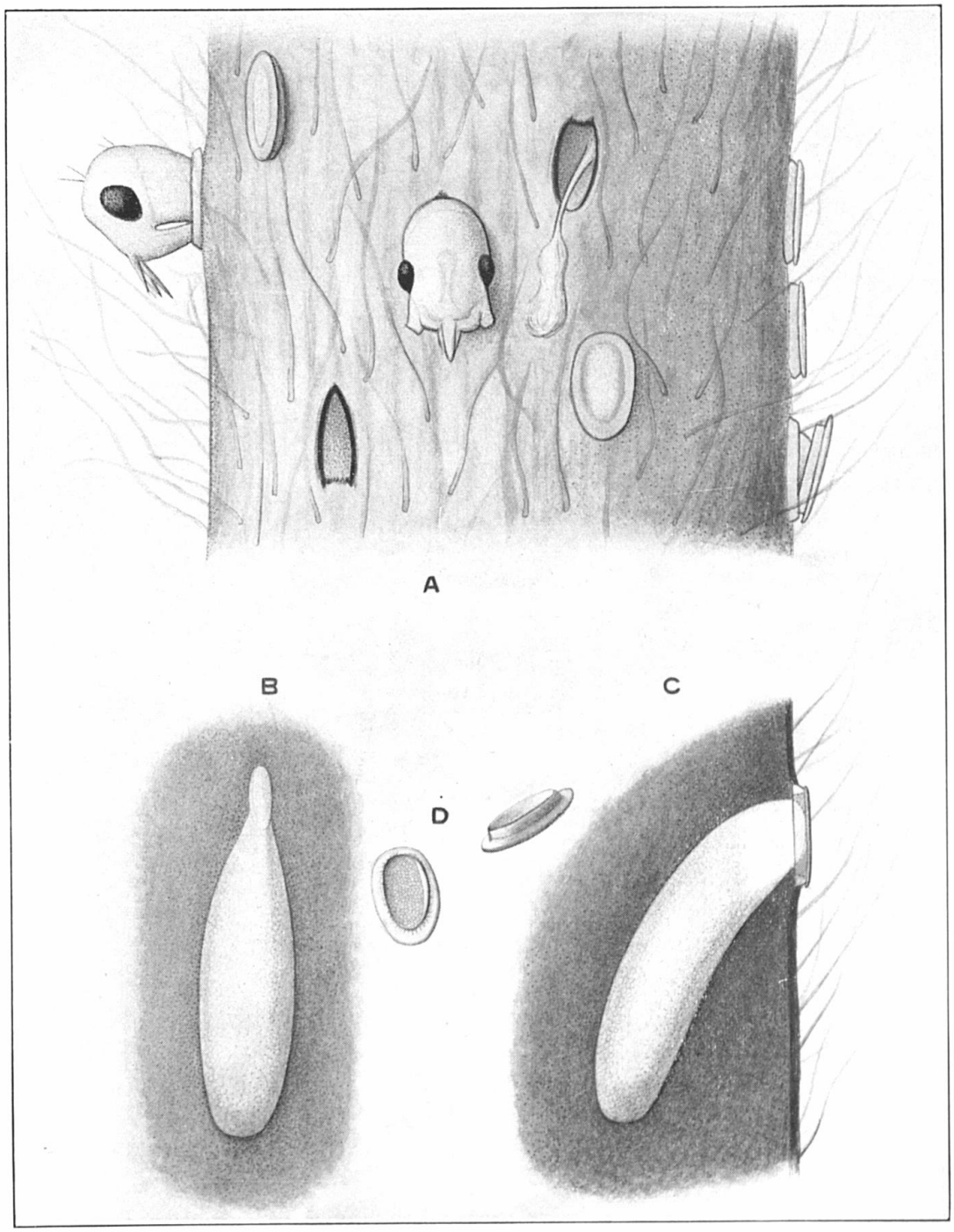
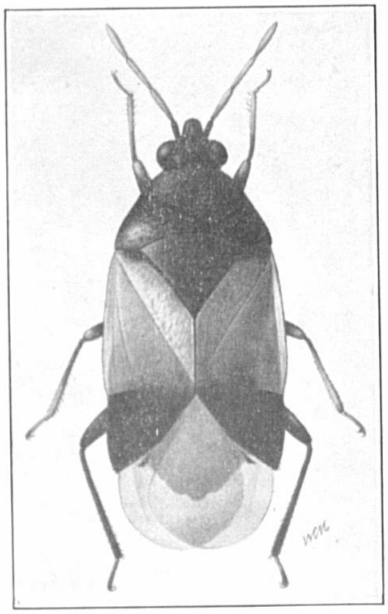
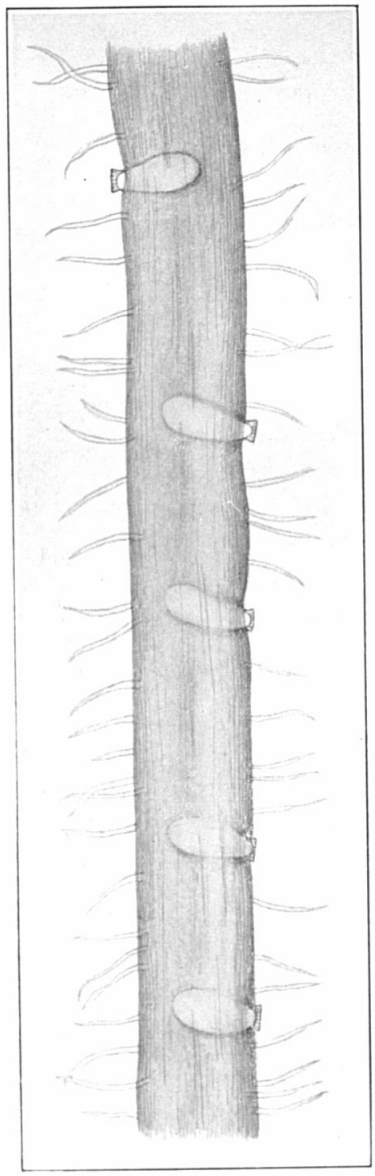


FIG. 14. A, YOUNG OF CORISCUS FERUS COMING FROM EGGS IN RED CLOVER STEM; B, EGG; C, SIDE VIEW OF EGG AS SEEN AFTER SPLITTING STEM; D, TWO EGG CAPS. x 38.



15



16

FIG. 15. ADULT TRIPHLEPS INSIDIOSUS. X 20.

FIG. 16. EGGS OF TRIPHLEPS INSIDIOSUS IN CORN SILK. X 21.

Second Brood of Coriscus ferus.

Egg.	1st instar.	2nd instar.	3rd instar.	4th instar.	5th instar.	Egg to adult.
8/7—8/17	8/17—8/19	8/19—8/26	8/26—8/28	8/28—9/1	9/1—9/8	8/7—9/8
9 da., 17 hr	2 da., 8 hr.	6da., 16.5h	2 da., 1 hr.	3 da.	7 da., .33hr	30 da., 5 hr
8/8—8/15	8/15—8/18	8/18—8/21	8/21—8/22	8/22—8/24	8/24—8/29	8/8—8/29
6da., 15.5hr	3 da., 15hr.	2da., 23.5h	1 da., 1.5hr	1 da., 22 hr	5 da., 1 hr.	20da., 17hr
8/7—8/17	8/17—8/20	8/20—8/23	8/23—8/25	8/25—8/29	8/29—9/3	8/7—9/3
9da. 23.5hr	3da., 1.75h	3da., 0.5hr	2da,. 25 hr.	3da. 22.5hr	4 da.	25d. 23.25h.
7/31—8/12	8/12—8/15	8/15—8/18	8/18—8/21	8/21—8/26	8/26—8/29	7/31—8/29
11da., 20hr	2da. 21.5hr	3 da., 5 hr.	2da., 22.5h	5 da., 0.5h.	3da. 13.5hr	29da., 6.5h
8/19—8/26	8/26—8/29	8/29—9/1	9/1—9/3	9/3—9/7	9/7—9/16.	8/19—9/16
7 da.	3 da., 6 hr	1da., 17 hr.	2da. 23 75h	3da. 22 5hr	8da., 3.5 hr	27da., 5 hr.
Averages: 9 da., .7hr.	3 da., .84hr	3da., 11.9h	2da., 5.18h	3 da., 13.5h	5 da., 3.66h	26d ,12.48h

Triphleps insidiosus.

This minute bug is common at times among corn silk, as it is about various flowers. It appears to feed to some extent on plant juices, but is fond of the juices of various insects, such as species of "Thrips," and is very useful because of its destruction of the eggs of the corn worm. It is only about two millimeters long, and is black largely, with some reddish brown at the bases of the front wings. It was first observed by me July 30, 1889, at Lexington, on millet, and has been frequently seen on many different plants, millet, red clover, alfalfa, etc., its disposition like other carnivorous species being to wander widely. It hibernates as an adult among rubbish at the bases of plants.

In 1912 the insect was first observed about corn during the first week in July. It became more and more common on corn silk as the season advanced. Adults were kept in the Insectary in large numbers and after mating they were isolated in vials and rearing jars. One hundred and six pairs were kept thus during the season, but the number depositing eggs was small. It was already known that the insect fed on the eggs of the corn-ear worm, but it was not always possible to secure a sufficient quantity of this food. In confinement it was frequently observed thrusting its beak into plant tissues.

Species of "Thrips," plant lice and white fly young, together with scale insects (Coccidae) were found most convenient as food for rearings. The young were unable to subsist on plant lice, but did very well on the young of the white fly (*Aleyrodes vaporariorum*).

A search of the plants on which the insects were kept failed in discovering the place of oviposition until at length the eggs were found thrust into the tender corn silk. Doubtless they are at times placed in tender parts of other plants. In the slender fibers they were placed crosswise at regular intervals, and could be easily seen with a magnifier.

On August 12 and 14 newly hatched young were secured, which reached maturity August 21 in the former case and August 23 in the latter, giving a total period of about 9 days for the development after hatching. Later, young were observed as they came from the eggs.

Eggs were deposited August 24 and again August 28. Four insects in a brood of ten reached maturity. There were only four molts during growth to maturity. The average length of the egg stage was 3 days and 1.25 hours. Average length of periods or instars: First, 3 days, 17.15 hrs.; second, 2 days, 1 hr.; third, 2 days, 3 hours.; fourth, 4 days, 0.5 hrs. The average time from egg deposition to maturity was 15 days and 3.25 hrs.

Table Showing Stages in the Development of Triphleps insidiosus.

Egg stage.	1st instar.	2nd instar.	3rd instar.	4th instar.	Total.
8/24—8/27	8/27—8/30	8/30—9/2	9/2—9/5	9/5—9/8	
3 da.	2da.,23.5 hr.	2 da.,17 hr.	3 da., 3.5hr	3 da., 6 hr.	15 da., 2 hr.
8/28—8/31	8/31—9/5	9/5—9/6	9/6—9/7	9/7—9/10	
3 da., 4 hr.	4 da., 19 hr.	1 da., 4 hr.	1 da., 1 hr.	2 da.,22 hr.	13 da., 2 hr.
8/28—8/31	8/31—9/4	9/4—9/6	9/6—9/8	9/8—9/13	
3 da., 1 hr.	4 da., 1.5 hr.	2 da., 5 hr.	2 da., 3 hr.	4 da.,23 hr.	16 da., 5 hr.
8/28—8/31	8/31—9/3	9/3—9/6	9/6—9/8	9/8—9/13	
3 da.	3 da , 3 hr.	2 da.,6.5 hr	2da.,4.5 hr.	4 da.,23 hr.	16 da., 4 hr.
Averages: 3 da.,1.25hr.	3 da.,17.15hr	2 da., 1 hr.	2 da., 3 hr.	4 da., 5 hr.	15 da.,3.25hr

The Lace-wing Fly (*Chrysopa oculata*).

This insect, a common enemy of the corn-ear worm, was reared thru three broods during the season of 1912. The adults were kept in glass rearing jars and wire cages, and readily deposited their eggs in either. Both adults and young were fed on plant lice, white fly young, and some other small insects obtained by sweeping grasses. Aphides were used largely. The larvae molted but twice, and about a month was required for the complete development from the laying of the egg to the emergence of the adult.

The number of eggs laid by an individual varied from twenty-seven to fifty-six. They were placed singly, but a number at about the same time. Several days are required for the laying of the complement of a female, in one instance observed, five days. In depositing the egg the female assumes a position on the leaf with the abdomen bent in a curve, the end in contact with the surface. A small quantity of mucus is first applied, serving as a means of attachment for the stalk, then the tip of the abdomen is raised and the slender thread drawn out, the egg attached at its extremity. The filament produced hardens at once like silk. The whole process requires but a few seconds.

The larva feeds greedily, and it was necessary to isolate individuals at once when hatched because of their disposition to attack and destroy one another.

The adult appears from the pupa case with a thin glossy pellicle inclosing it, which must be molted before it assumes the functions of an adult. It does not feed until this molt is accomplished. As soon as individuals emerged they sought an elevated position, and in a short time the pellicle split over the back and was cast off.

First Brood Reared.—Eggs for this brood were deposited June 27, July 1 and July 2. Thirteen reached maturity. The following table gives details with reference to some of these rearings:

Egg.	1st instar.	2nd instar.	3rd instar.	Larval period.	Pupal period.	Egg to adult.
6/27—7/2	7/2—7/7	7/7—7/10	7/10—7/14	7/2—7/14	7/14—7/28	6/27—7/28
4 da., 20hr.	5 da., 3.5hr	2 da., 17hr.	4 da., 7 hr	12 da., 2 5hr	13 da., 23 hr	30 da., 21.5hr
6/27—7/2	7/2—7/7	7/7—7/10	7/10—7/14	7/2—7/14	7/14—7/29	6/27—7/29
4da. 21.5hr	5 da., 1.5hr	2 da., 17hr	4 da., 5 hr	12 da., 0 5hr	14 da., 18 hr	31 da., 17 hr
6/27—7/2	7/2—7/7	7/7—7/10	7/10—7/14	7/2—7/14	7/14—7/25	6/27—7/25
4da. 16.5hr	5 da., 3.5hr	2 da., 22 hr	3da., 17.5 h	11 da., 17 hr	11 da., 0 5hr	27 da., 12 hr
6/27—7/1	7/1—7/6	7/6—7/9	7/9—7/12	7/1—7/12	7/12—7/24	6/27—7/24
3 da. 21hr.	5 da., 23.5h	3 da	3 da. 0.5 hr	11 da.	12 da , 2.5hr	26 da., 22.5hr
6/27—7/1	7/1—7/7	7/7—7/10	7/10—7/13	7/1—7/13	7/13—7/26	6/27—7/26
3da. 20.5hr	6 da., 1.5hr	3da., 6.5 hr	3 da., 4 hr	12 da., 13 hr	12 da., 12.5hr	28 da., 19 5hr
Averages: 4 da., 10hr.	5d., 10.23 h	2 da., 22 hr	3da, 16.32h	11 da., 21.26h	12da., 21.36h	29 da., 7.68hr

Length of Larvae.

Newly hatched	After first molt	After second molt
1.5 mm.	4.2 mm.	8.2 mm.
1.5 mm.	4.0 mm.	8.0 mm.
1.6 mm.	4.4 mm.	7.5 mm.
1.6 mm.	4.5 mm.	6.8 mm.
1.6 mm.	4.5 mm.	8.0 mm.
Averages;		
1.56 mm.	4.32 mm.	7.7 mm.

Second Brood Reared.—Eggs for the second brood were laid July 20, 31, Aug. 1, 2 and 3. Fourteen reached maturity. Examples are given in the following table:

Egg.	1st instar.	2nd instar.	3rd instar.	Larval period.	Pupal period.	Egg to adult.
7/30—8/6	8/6—8/11	8/11—8/13	8/13—8/16	8/6—8/16	8/16—8/31	7/30—8/31
6 da., 18.5 hr	5 da., 5 hr.	1 da., 17.5 hr	3 da , 6 hr.	10 da., 4.5 hr	15 da., 6.5 hr	32 da., 4.5 hr
8/3—8/10	8/10—8/13	8/13—8/16	8/16—8/18	8/10—8/18	8/18—9/1	8/3—9/1
6 da., 18.5 hr	2 da., 22.5 hr	3 da., 0.5 hr.	2 da., 6 hr.	8 da., 4 hr.	13 da., 3 hr.	28 da., 1.5 hr
8/3—8/10	8/10—8/13	8/13—8/16	8/16—8/18	8/10—8/18	8/18—9/1	8/3—9/1
6 da., 14.5hr	2 da., 23.5hr	3 da., .75hr.	2 da., 6.5 hr.	8 da., 6 75 hr	13 da , 5.5 hr	28 da., 2.75hr
8/3—8/10	8/10—8/13	8/13—8/16	8/16—8/18	8/10—8/18	8/18 -9/2	8/3 9/2
6 da., 16.5 hr	3 da., 25 hr	2 da., 22.5 hr	2 da., 14.5 hr	8 da., 13.25hr	13da. 11.25hr	28 da., 16 hr.
7/31—8/7	8/7—8/11	8/11—8/13	8/13—8/17	8/7—8/17	8/17—9/1	7/31—9/1
6 da., 11 hr.	4 da., 2 hr	2 da. 5 hr	4 da., 4.5 hr.	10 da , 7 hr.	14 da., 13 hr	31 da.
Averages: 6 da., 15.8hr	3 da., 15.43hr	2 da., 11 hr.	2 da., 12 17hr	9 da., 2.35 hr	13da., 21.28h	29 da., 15 hr.

Length of Larvae.

Newly hatched	After first molt	After second molt
1.4 mm.	3 mm.	7 mm.
1.4 mm.	3.5 mm.	7.5 mm.
1.5 mm.	4.0 mm.	7.0 mm.
1.6 mm.	4.5 mm.	8.0 mm.
1.5 mm.	4.0 mm.	6.0 mm.
Averages:		
1.48 mm.	3.8 mm.	7.5 mm.

Third Brood Reared.—The eggs for this brood were laid September 6 to 8. Eleven pupated but went no farther, this being the last brood of the season. Very few adults could be found in the field in the latter part of September, and none were found after October 4. Details concerning this brood follow :

Egg.	1st instar.	2nd instar.	3rd instar.	Larval period.
9/8—9/12	9/12—9/14	9/14—9/19	9/19—9/23	9/12—9/23
4 da., .66 hr.	1 da., 17.66 hr.	5 da., 4.5 hr.	4 da., 1.5 hr.	10 da., 21.33 hr.
9/6—9/10	9/10—9/14	9/14—9/17	9/17—9/23	9/10—9/23
3 da., 19.16 hr.	3 da., 20.25 hr.	2 da., 2.75 hr.	5 da., 22.6 hr.	12 da., 17.6 hr.
9/6—9/10	9/10—9/14	9/14—9/16	9/16—9/22	9/10—9/22
3 da., 20.5 hr.	3 da., 15 hr.	2 da., 1.4 hr.	6 da., 14 hr.	12 da., 6.5 hr.
9/6—4/10	9/10—9/14	9/14—9/17	9/17—9/22	9/10—9.22
3 da., 12 hr.	3 da., 22.75 hr.	3 da., 2 hr.	5 da., 4.5 hr.	11 da., 17.33 hr.
9/6—9/10	9/10—9/15	9/15—9/19	9/19—9/23	9/10—9/23
3 da., 22.5 hr.	4 da., 22 hr.	3 da., 18 hr.	3 da., 20.5 hr.	12 da., 12.5 hr.
Averages:				
3 da., 19.84 hr	3 da., 14.73 hr.	3 da., 9.13 hr.	5 da., 3.72 hr.	12 da., 0.55 hr.

NOTE.—This bulletin may be regarded as a first contribution to a knowledge of the corn-ear worm in Kentucky. Some features of the subject have been only briefly dealt with. The photographs from which half-tones were made are in part the work of Assistant Professor Vaughn and in part my own. Some of the rearings recorded have been looked after by several assistants employed at different times in the Division, Messrs. Vaughn, Kinney and Niswonger deserving special mention in this connection. The drawings were made by Mr. Wm. C. Mathews, formerly of the Division.—H. G.

Kentucky
Agricultural Experiment Station

State University, Lexington, Kentucky

BULLETIN NO. 188

The Relation of Sulfur to Soil Fertility

BY

O. M. SHEDD



STATE UNIVERSITY PRESS
LEXINGTON, KY.
December, 1914.
(593)

KENTUCKY AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

RICHARD C. STOLL, Chairman, Lexington, Ky.
CHARLES B. NICHOLS, Lexington, Ky.
LEWIS L. WALKER, Lancaster, Ky.
HENRY S. BARKER, President of the University.
THE DIRECTOR, Secretary, ex-officio.

JOSEPH H. KASTLE, Director.

STATION COUNCIL

THE DIRECTOR.

A. M. PETER
H. E. CURTIS
H. GARMAN
C. W. MATHEWS
R. M. ALLEN
J. D. TURNER
E. S. GOOD
GEORGE ROBERTS
J. J. HOOPER

DEPARTMENTAL ORGANIZATION

ADMINISTRATION

THE DIRECTOR, Head.
H. E. CURTIS, Bursar.
HYWEL DAVIES, Purchasing Agent.
O. L. GINOCHIO, Secretary to Director.
ADDIE LEE DEAN, Librarian.
ANNA WALLIS, Clerk.
CORNELIA C. PAGE, Clerk.

AGRICULTURAL EXTENSION

F. MUTCHLER, Superintendent.
T. R. BRYANT, Asst. Superintendent.
J. H. CARMODY, Horticulture.
H. B. HENDRICK, Agronomy.
C. D. BOHANNAN, Rural Economics.
W. D. NICHOLLS, Dairying.
H. W. RICKEY, Poultry. (In Cooperation with U. S. Dept. of Agriculture.)
T. E. STOKES, Animal Husbandry. (In Cooperation with U. S. Dept. of Agriculture.)
MARY E. SWEENY, Home Economics.
AUBYN CHINN, Cookery and Dietetics.
RUBY M. BUCKMAN, Sewing and Household Arts.
ANNA BERRY JONES, Clerk.
MARGARET RYAN, Clerk.

AGRONOMY

GEORGE ROBERTS, Agronomist, Head.
E. J. KINNEY, Assistant Agronomist.
P. E. KARRAKER, Soil Survey.
A. E. EWAN, Supt. Experiment Fields.
JESSIE F. CASWALL, Clerk.

ANIMAL HUSBANDRY

(Beef Cattle, Sheep and Swine)

E. S. GOOD, Head.
ROBERT GRAHAM, Veterinary Science, In Charge Hog Cholera Serum Production.
E. W. MUMMA, Asst. In Charge Hog Cholera Serum Production.
O. S. CRISLER, Hog Cholera Serum.
R. L. PONTIUS, Hog Cholera Serum.
W. V. SMITH, Asst. in Animal Husbandry.
M. J. SMITH, Asst. in Animal Husbandry.
M. G. GINOCHIO, Clerk.
E. J. GOTT, Hog Cholera Serum.
A. L. BRUECKNER, Hog Cholera Serum.
LUCY K. HUTCHCRAFT, Clerk.

ANIMAL HUSBANDRY

(Dairy Cattle, Horses and Poultry.)

J. J. HOOPER, Head.
W. S. ANDERSON, Asst. Horse Husb'd.
J. W. NUTTER, Supt. Dairy Farm.
W. D. NICHOLLS, Asst. Dairying.
D. D. SLADE, Supt. Poultry Farm.
P. E. BACON, Elmendorf Milk Records.
ED HUSTON, Asst. in Dairying.
F. WALLACE UTTERBACK, Clerk.

CHEMISTRY

A. M. PETER, Chief Chemist, Head.
S. D. AVERITT, Chemist.
J. S. McHARGUE, Asst. Chemist.
R. PFANSTIEL, Asst. Chemist.
ETHEL V. T. CASWALL, Clerk.

ENTOMOLOGY AND BOTANY

H. GARMAN, Entomologist and Botanist, Head.
MARY L. DIDLAKE, Laboratory Asst.
E. C. VAUGHN, Asst. in Seed Inspection and Plant Breeding.
H. H. JEWETT, Research Asst. Entom.
H. R. NISWONGER, Asst. in Field Work and Nursery Inspection.
LOUISE BEWLAY, Clerk.

FEED

J. D. TURNER, Head.
H. D. SPEARS, Chemist.
E. H. NOLLAU, Asst. Chemist.
ELMER INGRAM, Chief Inspector.
ROGER W. JONES, Inspector.
FANNY C. ROGERS, Clerk.

FERTILIZER

H. E. CURTIS, Chemist, Head.
WM. RODES, Assistant Chemist.
ELMER INGRAM, Inspector.
R. W. JONES, Inspector.
ANNA WALLIS, Clerk.

FOOD AND DRUGS

R. M. ALLEN, Head.
J. O. LaBACH, Chief Chemist.
L. A. BROWN, Chemist, Drugs.
J. W. McFARLIN, Chief Food Inspector.
W. R. PINNELL, Bacteriologist.
C. S. PORTER, Inspector, Drugs.
WALTER SCHEPPELMAN, Inspector, Bakery Sanitation.
E. F. WORTHINGTON, Inspector, Dairy Sanitation.
W. G. TERRELL, Inspector, Foods.
LILLIE LISTON, Chief Clerk.
LENA LISTON, Clerk.

HORTICULTURE

CLARENCE W. MATHEWS, Head.
F. W. HOFMANN, Asst. in Horticulture.
G. B. WURTZ, Consulting Meteorologist.
MURIEL CASWALL, Clerk.

RESEARCH

THE DIRECTOR, Head.
H. GARMAN, Entomologist and Botanist.
D. J. HEALY, Bacteriologist.
E. S. GOOD, Animal Husbandry.
O. M. SHEDD, Chemist.
MARY L. DIDLAKE, Asst. Entomologist and Botanist.
G. D. BUCKNER, Chemist.
H. H. JEWETT, Research Asst. in Entom.

Notice

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Director.

BULLETIN NO. 188.

THE RELATION OF SULFUR TO SOIL FERTILITY.

By O. M. Shedd.

HISTORICAL.

Numerous experiments have been made in the last few years in determining the importance of sulfur compounds in plant growth and their value in soil fertility. In a former publication,[1] the writer gave a resume of the experiments that have been made along this line and more recent ones are included here in order to show the present status of this subject.

Chancrin and Desriot[2] report some further experiments on the effect of adding sulfur to potatoes and beets. The results show that applications of 178 to 356 pounds per acre gave increases in the yield of both crops.

Tritschler[3] has found in experiments with mangelwurzels that the use of sulfur slightly increased the yield and sugar content but this is attributed not so much to the fertilizing action of the sulfur as to its protection of the crop from insects and disease.

Lierke[4] cites observations on fruits which indicate that fertilizing materials containing considerable amounts of sulfates produce better results than those free from such compounds.

Vermorel and Dantony[5] have grown wheat and kidney beans in paraffined pots, the soil in which was freed from organic matter. With nitrogen as nitrates, neither sulfur

(45 and 90 pounds per acre) nor iron sulfide containing 50 per cent of sulfur (90 and 180 pounds per acre) affected the yields significantly, but with the same amount of nitrogen in the form of dried blood, both sulfur and sulfide increased the yield from 30 to 60 per cent.

Magnien[6] cites experiments in which sulfur scattered in the rows at the rate of 2 to 3 grams per meter at planting time apparently doubled the yields of turnips and beets.

H. von Feilitzen[7] found that of the five varieties of potatoes experimented with during 1911, all but one yielded more on the plots receiving 356 pounds of sulfur per acre in addition to normal fertilizers than on those that did not receive sulfur and the tubers were larger and better developed.

Chauzit[8] reports results which show that when 178 pounds of sulfur are added to the soil without the addition of other fertilizers, the yield of grapes was increased from 2 to 20 percent. When used with other fertilizers, its action was more marked, giving yields from 9 to 35 per cent greater than the yields with the plain fertilizers. The sulfur gave the best results with fertilizers high in organic matter.

While most of the experiments on the use of sulfur fertilizers have been made in foreign countries, nevertheless there has been some work along this line in the United States and it might be of interest to mention it here.

Tottingham,[9] of the Wisconsin Experiment Station, has shown in some greenhouse experiments that in the case of rape and radishes, both of which plants contain considerable sulfur, the application of sulfur fertilizers had a marked effect on the yields of dry matter.

Lipman, Blair, Owen and McLean,[10] of the New Jersey Experiment Station, report the results of four years plot experiments with corn, oats, wheat and timothy, using ferrous sulfate at the rate of 50, 100 and 200 pounds per acre, and gypsum at the rate of 200, 500 and 1000 pounds per acre in connection with other necessary fertilizing materials. The results show that there was an increase in dry matter and total nitrogen in every case where ferrous sulfate was used. The plot receiving

ferrous sulfate at the rate of 100 pounds per acre made the greatest gains in total nitrogen in every case and the greatest gains in crop and total dry matter in nearly every case. As a rule, the plot receiving 200 pounds of ferrous sulfate made the least gain. The corn crop on the plot receiving gypsum at the rate of 1000 pounds per acre made gains in grain, dry matter and nitrogen comparable with those made on the plot receiving 100 pounds of ferrous sulfate. The other gypsum plots either made only slight gains or yielded less than the check plot.

Reimer[11] has found on some types of soil in the Rogue River Valley of Oregon, that the yield of alfalfa can be increased from 25 to 500 per cent by the use of either superphosphate or gypsum. Two plots were fertilized with sulfur, one with iron sulfate, one with superphosphate and two with ground phosphate rock. The ground phosphate rock gave no increase. The plots receiving sulfur, iron sulfate and superphosphate at the rate of 300 pounds per acre, produced an increase of 100 per cent over the unfertilized check plots. The plants on the fertilized plots were greener, higher, thicker and freer from weeds.

These results are of interest since analyses made at the Wisconsin and Ohio Experiment Stations show that alfalfa contains more sulfur than phosphorus. The latter Experiment Station has shown that an average crop of alfalfa contains 35 pounds of sulfur and 25 pounds of phosphorus per acre.

EXPERIMENTAL.

In the writer's former publication was given a table of the total sulfur in all the common feeding stuffs taken from the work of Hart and Peterson of the Wisconsin Experiment Station. In the table below are given the results of the analyses of total sulfur made by the writer in some materials which were not included in the former table. The sodium peroxide method[12] was used in this work.

Table 1—Total Sulfur in Plants and Other Materials—Air-Dry Sample.

Material.	Per cent Total Sulfur.
Japan clover hay	.106
Raw bone	.185
Hemp	.107
Cow pea seed (Groit)	.111
Cotton lint	.014
Kentucky phosphate rock	.107
Tennessee " "	.323
" " "	.267
Fresh Sample.	
Lettuce leaves	.013
Radish, including leaves	.066
Parsley	.070
Sweet potato tubers	.021
Celery stalks, including leaves	.053
Ripe tomato	.010
Beets, including tops	.028
Parsnip	.046
Spinach	.063
Kale	.220
Apple, including seed	.043
Asparagus stalks	.088
Peas	.069
Pea pods	.043
Green Hungarian millet, 12 ins. high	.033
Green cow pea vines, 6 ins. high	.077
Rye, heading stage	.120
Vetch, flowering stage	.107
Sweet clover, flowering stage	.082
Bluegrass, 4 ins. high	.134
Black raspberries	.035
Gooseberries	.012
Dewberries	.037
Cymlings	.035
Cherries, including seed	.108

Material.	Per cent Total Sulfur.
Cucumber	.062
Red currant	.056
California plum	.023
" " seed	.045
Blackberries	.040
Carrot	.042
" tops	.114
Canteloupe, including seed	.065
Grape fruit, " "	.020
Peach	.014
" seed	.041
Orange	.026
Lemon, including seed	.022
Limes, " "	.047
Pineapple	.039
" cone	.059
Okra	.054
Green bell pepper	.040
Red " "	.043

As our State produces a large amount of tobacco, several analyses have been made of all the types grown in Kentucky for the purpose of comparing the total amounts of sulfur and phosphorus contained therein. Only the leaf proper was used in this work, the midrib or stem being removed. The sulfur was determined by the sodium peroxide method and the phosphorus by the magnesium nitrate method. [13] The results are given below:

Table II—Per cent Total Sulfur and Phosphorus in Tobacco Leaf.—Air-Dry.

Variety.	County.	Sulfur.	Phosphorus.
White Burley	Fayette	.585	.387
White Burley	"	.523	.392
Yellow Pryor	"	.598	.434
Improved Book	"	.342	.297
*One Sucker	Hickman	.472	.329
*Yellow Pryor	Graves	.389	.247

*Fire cured.

Variety.	County.	Sulfur.	Phosphorus.
†Sumatra	Fayette	.285	.336
†Philippine	"	.326	.329
Little Oronoco	"	.433	.361
†Brazilian	Fayette	.486	.297
Hulett's White Burley	"	.544	.319
*White Burley	"	.486	.336
Hybrid, Little Oronoco X White Burley	"	.474	.370
Greenwood	Henderson	.564	.309
Early Mammoth	"	.490	.322
Hangdown	"	.611	.315
*Dark	Christian	.538	.236
*Boyd	"	.623	.262
*Hybrid, Boyd X Improved One Sucker	"	.217	.273
*Improved One Sucker	"	.558	.310
*Yellow Pryor	"	.484	.291
*Hybrid, Yellow Pryor X Little Yellow	"	.405	.251
*Little Yellow	"	.518	.258
*Little Hill	"	.401	.214
*Improved Henderson Pryor	"	.395	.246
*Clardy	"	.387	.269
*McAdoo	"	.433	.258
*Improved Yellow Mammoth	"	.502	.293
*Improved Yellow Pryor	"	.439	.275
*Non Ruffle	"	.309	.288
*Kelley	"	.370	.249
Average		.458	.302

*Fire cured.
†Cigar type.

It is of interest to note that of the thirty-one samples of tobacco used, only two contained less amounts of sulfur than phosphorus, one had about the same of each, while the remainder contained considerably more, the sulfur in some cases being about double the phosphorus.

In order to determine if sulfur fertilization would benefit some crops grown on our soils, the writer has tried the effect of adding sulfur or its compounds to two types of our soils in greenhouse experiments, and the results are given in the different series below.

Series I—Effect of Sulfur and Gypsum on Tobacco.

The soil used in this series was taken from the Quaternary area in Graves County, on the farm of Boone Easley, 1½ miles northeast of Lynnville. It had been cultivated for several years and did not yield very well. It contained 240 pounds of sulfur and 860 pounds of phosphorus per acre, and had a bad physical character. The soil was heated for an hour between 95° and 100° C. and 15 pounds of soil were used in each box, together with the following substances, calculated to pounds per acre, assuming one acre of the soil, six inches deep, would weigh 1,500,000 pounds.

No. 1 Nothing added.
" 2 100 pounds sulfur per acre.
" 3 500 " " " " ,
" 4 536 " gypsum per acre containing sulfur equivalent to 100 pounds.
" 5 { 200 " potassium nitrate per acre.
{ 500 " calcium phosphate (secondary) per acre.
{ 500 " calcium carbonate per acre.
" 6 Same as No. 5 with addition of 100 lbs. sulfur per acre.
" 7 " " " " " " " 500 " " " "
" 8 " " " " " " " 536 " gypsum " "

In each of the above, 250 Yellow Pryor tobacco seed were planted and distilled water was used throughout the experiments. The plants in the first four boxes above appeared to grow as well as the rest for the first two or three weeks, but after that

their growth ceased while the remainder continued to grow throughout the experiment. The plants in No. 7 grew very fast towards the end and there was no doubt but that Nos. 7 and 8 were larger than the check. When the largest plants had reached the transplanting stage, all were cut close to the ground and immediately weighed. The weights are given below:

No. 1	21 grams.		
" 2	11 "		
" 3	5 "		
" 4	4 "		
" 5	88 "		
" 6	97 "	i. e. 10% gain over check No. 5.	
" 7	109 "	" " 24% " " " " " "	
" 8	109 "	" " 24% " " " " " "	

A comparison of Nos. 1, 2, 3, and 4 with the remainder indicates that this soil was either acid or deficient in other essential elements besides sulfur. The addition of sulfur or gypsum in conjunction with the other elements and calcium carbonate, shows a still better growth due to the sulfur, as will be seen from a comparison of Nos. 6, 7 and 8 with check No. 5.

Series II—Effect of Sulfates on Soy Beans.

The soil used in this series was taken from the Trenton area in Fayette County on the farm of J. A. Hulett, near the Higsby Mill road. This soil had been cultivated for several years without fertilization and produced only fair crops. Clover could not be grown on it successfully although it was only slightly acid. It contained 600 pounds of sulfur and 3040 pounds of phosphorus per acre, assuming the top seven inches of soil as weighing 2,000,000 pounds per acre. The soil was sifted and calcium carbonate added at the rate of 4000 pounds per acre. Sixteen pounds of the air-dried soil were put in two-gallon stone jars supplied with drainage and the following substances computed as pounds per acre were thoroughly mixed with the soil along with the calcium car-

bonate in each case. All experiments were run in duplicate except the iron disulfide. All soluble materials were added in solution.

Jar	Substance Added.	Pounds per Acre.
No. 1	Iron disulfide (pyrite), FeS_2	11
" 2	Ferrous sulfate (copperas), $FeSO_4.7H_2O$	52
" 3	Ammonium sulfate, $(NH_4)_2SO_4$	412
" 4	Calcium sulfate (gypsum), $CaSO_4.2H_2O$	537
" 5	Potassium sulfate, K_2SO_4	543
" 6	Barium " , $BaSO_4$	728
" 7	Magnesium " , $MgSO_4.7H_2O$	769
" 8	Aluminum " , $Al_2(SO_4)_3.18H_2O$	693
" 9	Sodium " , Na_2SO_4	443
" 10	Flowers of sulfur, S	100
" 11	Nothing added but calcium carbonate.	

In Nos. 1 and 2, the sulfur contained in these materials was equivalent to adding 6 pounds of the element while in the remainder it was equivalent to 100 pounds per acre. In each jar were planted 10 soy bean seed which were afterwards thinned to 6 average size plants and distilled water was used throughout the experiment. When the plants were about 10 inches high, Nos. 2, 3, and 5 were more advanced and Nos. 4, 7, 9, and 10 had about the same appearance and were better than the remainder which were about the same as the checks. After the pods were matured, the plants were cut close to the ground, air dried and weighed. At the time of cutting, the largest plants were from 20 to 25 inches high and Nos. 1, 2, 3, 4, 8 and 10 were larger than the remainder and nearly all appeared to be more advanced than the checks. The weights of the tops and seed are given in the following table:

Table III—Weight in Grams of Soy Beans of Series II—Air-Dry.

Jar	Tops and Seed	Per cent Increase over Checks	Seed	Per cent Increase over Checks
No. 1	11.37	20	1.02	.5*
" 2a	10.92		1.56	
" 2b	11.58		1.54	
	22.50	19	3.10	51
" 3a	15.10		2.26	
" 3b	8.98		1.03	
	24.08	27	3.29	60
" 4a	11.62		1.16	
" 4b	9.99		1.26	
	21.61	14	2.42	18
" 5a	8.61		1.04	
" 5b	12.04		2.23	
	20.65	9	3.27	59
" 6a	11.05		1.72	
" 6b	9.27		1.45	
	20.32	8	3.17	55
" 7a	9.02		1.26	
" 7b	12.06		1.56	
	21.08	12	2.82	38
" 8a	12.11		2.13	
" 8b	9.61		1.49	
	21.72	15	3.62	77

*Loss.

Jar	Tops and Seed	Per cent Increase over Checks	Seed	Per cent Increase over Checks
No. 9a	11.62		1.63	
" 9b	9.36		1.21	
	20.98	11	2.84	38
" 10a	12.27		1.47	
" 10b	12.45		2.05	
	24.72	31	3.52	72
" 11a	9.63		1.06	
" 11b	9.25		.99	
	18.88		2.05	

As the sulfur compounds in plants are generally associated with the protein substances, it was thought it might be of interest to determine the total sulfur and nitrogen in the plants of the above series to find if any relation existed between these two elements. The whole plants including seed were ground for this purpose and the results are given in the table below, the nitrogen being calculated to protein.

Table IV—Protein and Sulfur in Soy Beans of Series II.—Air-Dry.

Jar	Per cent Protein	Per cent Sulfur	Grams Protein	Grams Sulfur
No. 1	14.47	.235	1.645	.027
" 2a	14.38	.131	1.570	.014
" 2b	13.56	.107	1.570	.012
	13.97	.119	3.140	.026
" 3a	21.50	.073	3.247	.011
" 3b	23.63	.220	2.122	.020
	22.57	.147	5.369	.031
" 4a	13.94	.073	1.620	.008
" 4b	16.72	.209	1.670	.021
	15.33	.141	3.290	.029

Jar	Per cent Protein	Per cent Sulfur	Grams Protein	Grams Sulfur
No. 5a	17.78	.085	1.531	.007
" 5b	14.35	.231	1.728	.028
	16.07	.158	3.259	.035
" 6a	13.63	.073	1.506	.008
" 6b	15.10	.205	1.400	.019
	14.37	.139	2.906	.027
" 7a	16.47	.088	1.486	.008
" 7b	13.13	.236	1.583	.028
	14.80	.162	3.069	.036
" 8a	12.13	.142	1.469	.017
" 8b	13.81	.172	1.327	.017
	12.97	.157	2.796	.034
" 9a	12.53	.080	1.456	.009
" 9b	14.72	.203	1.378	.019
	13.63	.142	2.834	.028
" 10a	12.25	.195	1.503	.024
" 10b	12.50	.185	1.556	.023
	12.38	.190	3.059	.047
" 11a	17.56	.085	1.691	.008
" 11b	15.10	.098	1.397	.009
	16.33	.092	3.088	.017

The foregoing results show that there is a wide variation in the dry weights of some of the plants in the duplicate jars but the averages show that sulfur fertilization increased the growth of soy beans in all cases. The best results were obtained with sulfur, ammonium sulfate, pyrite and ferrous

sulfate, although appreciable gains were obtained with some of the others.

There is a considerable variation in the percentages of protein and sulfur among the different jars and even on duplicate jars, but these differences are more marked in the case of sulfur. The average percentages show that there is more sulfur in the plants which had sulfur compounds added than in the checks, but this does not hold true with the protein. There seems to be no consistent relation existing between the percentages of sulfur and protein except that in two-thirds of the duplicate sets, the percentage of protein increases as the sulfur content increases, but not in the same proportion. The high protein content of the plants fertilized with ammonium sulfate is interesting.

Series III—Effect of Sulfates on Turnips.

After cutting the soy beans in Series II, the soil in the pots was put through a coarse sieve to remove the roots and used for these experiments. In each, were planted 20 Purple Top turnip seed which were afterwards thinned to 4 average size plants in each jar. Distilled water was used for watering throughout the experiment.

The plants grew very well at first and considerable increases in growth could be observed in several over the checks and also variations in growth among duplicate jars. The weather was becoming most too warm for the growth of turnips and for this reason, the experiment was stopped earlier than was intended. At the end, the plants were taken from the jars, the soil removed and immediately weighed. The weights of the tops and roots are given in Table V. The numbers below are the same as used in Series II.

Table V—Weight in Grams of Turnips of Series III.

Jar	Tops	Roots	Per cent Increase over Checks	
			Tops	Roots
No. 1	25	100	25	117
" 2a	25	85		
" 2b	25	112		
	50	197	25	114
" 3a	26	97		
" 3b	27	66		
	53	163	32	77
" 4a	19	57		
" 4b	38	94		
	57	151	42	94
" 5a	24	40		
" 5b	13	41		
	37	81	*7	*12
" 6a	37	115		
" 6b	19	42		
	56	157	40	71
" 7a	18	30		
" 7b	18	54		
	36	84	*10	*9
" 8a	31	83		
" 8b	26	70		
	57	153	42	66

*Decrease.

Jar	Tops	Roots	Per cent Increase over Checks	
			Tops	Roots
No. 9a	34	74		
" 9b	33	84		
	67	158	67	72
" 10a	25	77		
" 10b	24	56		
	49	133	22	45
" 11a	22	50		
" 11b	18	42		
	40	92		

Series IV—Effect of Sulfates on Clover.

The soil used in these experiments was taken from the same place as that used in Series II. The soil had calcium carbonate added at the rate of 4000 pounds per acre. Sixteen pounds of the air-dried soil were put in two-gallon jars with drainage and the following substances computed as pounds per acre were thoroughly mixed with the soil along with the calcium carbonate in each case. All experiments were run in duplicate except the iron disulfide and sodium thiosulfate. All soluble materials were added in solution.

Jar	Substance Added	Pounds per Acre
No. 1	Iron disulfide (pyrite), FeS_2	11
" 2	Ferrous sulfate (copperas) $FeSO_4.7H_2O$	52
" 3	Ammonium sulfate, $(NH_4)_2SO_4$	412
" 4	Calcium sulfate (gypsum), $CaSO_4.2H_2O$	537
" 5	Potassium sulfate, K_2SO_4	543
" 6	Barium " $BaSO_4$	728
" 7	Magnesium " $MgSO_4.7H_2O$	769
" 8	Aluminum " $Al_2(SO_4)_3.18H_2O$	693
" 9	Sodium " Na_2SO_4	443
" 10	" thiosulfate, $Na_2S_2O_3$	247
" 11	Flowers of sulfur, S	100
" 12	Nothing added but calcium carbonate	

In Nos. 1 and 2, the sulfur contained in these materials was equivalet to adding 6 pounds of the element, while in the remainder it was equivalent to 100 pounds per acre.

In each jar were planted 25 red clover seed, which were afterwards thinned to 12 average size plants in each jar. Distilled water was used throughout the experiment.

No very great differences in the growth of the plants in the different jars could be seen except possibly in two or three instances.

Cuttings of the clover plants about one inch from the crown were made at intervals whenever the plants attained a height of about six inches. The air-dried weights of these are given below:

Table VI—Weight in Grams of Clover of Series IV—Air-Dry.

Jar.	Cutting				
	1st	2nd	3rd	4th	Total
No. 1	7.74	4.39	7.82	8.30	28.25
" 2a	8.22	5.42	7.70	8.62	29.96
" 2b	8.82	5.22	8.90	8.50	31.44
	17.04	10.64	16.60	17.12	61.40
" 3a	8.30	5.52	6.64	7.59	28.05
" 3b	9.43	6.19	7.41	6.87	29.90
	17.73	11.71	14.05	14.46	57.95
" 4a	9.75	6.00	8.67	10.86	35.28
" 4b	9.84	5.69	8.52	9.11	33.16
	19.59	11.69	17.19	19.97	68.44
" 5a	10.45	7.70	10.70	11.57	40.42
" 5b	10.68	7.01	9.94	11.40	39.03
	21.13	14.71	20.64	22.97	79.45
" 6a	10.59	5.75	6.94	7.08	30.36
" 6b	8.28	5.56	6.84	8.51	29.19
	18.87	11.31	13.78	15.59	59.55

Jar.	Cutting				
	1st	2nd	3rd	4th	Total
No. 7a	8.18	5.81	7.90	9.25	31.14
" 7b	10.41	6.57	7.71	9.46	34.15
	18.59	12.38	15.61	18.71	65.29
" 8a	9.21	5.75	7.31	8.59	30.86
" 8b	9.22	5.32	6.34	7.17	28.05
	18.43	11.07	13.65	15.76	58.91
" 9a	9.90	6.57	8.46	11.02	35.95
" 9b	9.77	5.83	6.67	9.23	31.50
	19.67	12.40	15.13	20.25	67.45
" 10	9.54	5.07	5.91	6.77	27.29
" 11a	10.65	7.10	7.96	10.20	35.91
" 11b	10.04	7.16	7.18	9.07	33.45
	20.69	14.26	15.14	19.27	69.36
" 12a	10.60	7.92	7.84	6.76	33.12
" 12b	9.26	6.98	8.44	9.82	34.50
	19.86	14.90	16.28	16.58	67.62

Only one of the substances, potassium sulfate, apparently caused an appreciable increase in growth of the clover over the checks, the use of this resulting in a gain of 17.5 per cent. In four others, the total dry weights were about the same as the checks, while in the remainder they were less. While these experiments seem to indicate that this soil is not deficient in sulfur for the growth of clover, one at least indicates that the soil is deficient in available potassium, which supplied along with sulfur shows a gain. It may be that a comparison of nitrogen, potassium, and phosphorus with and without sulfur, in this soil, would show some interesting results so far as the need of sulfur is concerned. It is also of interest to note that as a result of the addition of calcium carbonate alone to this soil, no difficulty was found in growing

clover, as the check pots indicate, while as previously mentioned, no sucessful growth of clover could be secured on this soil in the field.

Series V—Effect of Sulfates on Cabbage.

The soil used in these experiments was taken from the same field as that used in Series II and had the same amount of calcium carbonate added. Sixteen pounds of the air dried soil were put in boxes about twelve inches square and three inches deep. The following substances calculated to pounds per acre were thoroughly mixed with the soil along with the calcium carbonate in each case. In these experiments, the corresponding carbonates or oxides of the different sulfates were also used containing the same amounts of the basic element in order to determine the effect, if any, of the sulfur contained in the various sulfates. All soluble materials were added in solution.

Box	Substance Added	Pounds per Acre
No. 1	Ferrous sulfide, FeS	33
" 2	Iron disulfide (pyrite), FeS_2	22
" 3	Ferrous sulfate, $FeSO_4.7H_2O$	104
" 4a	Ferric " , $Fe_2(SO_4)_3$	50
" 4b	" oxide, Fe_2O_3	26
" 5a	Nickelous sulfate, $NiSO_4.7H_2O$	105
" 5b	" carbonate, $NiCO_3$	51
" 6a	Cupric sulfate, $CuSO_4.5H_2O$	93
" 6b	" carbonate, $CuCO_3.3Cu(OH)_2$	46
" 7a	Cobaltous sulfate, $CoSO_4.7H_2O$	105
" 7b	" carbonate, $CoCO_3$	45
" 8a	Chromic sulfate, $Cr_2(SO_4)_3$	49
" 8b	" carbonate, $Cr_2O(CO_3)_2$	36
" 9a	Manganous sulfate, $MnSO_4.4H_2O$	83
" 9b	" carbonate, $MnCO_3$	43
" 10a	Lithium sulfate, $Li_2SO_4.1H_2O$	48
" 10b	" carbonate, Li_2CO_3	26
" 11	Ammonium sulfocyanide, NH_4SCN	28

Box	Substance Added	Pounds per Acre
No. 12	Potassium sulfocyanide, KSCN	36
" 13	Sodium " NaSCN	30
" 14	Flowers of sulfur, S	12
" 15	" " " "	100
" 16	" " " "	500
" 17	" " " "	1000
" 18	" " " "	2000
" 19	" " " "	3000
" 20	" " " "	5000
" 21	" " " "	7000
" 22a	Nothing added but calcium carbonate	
" 22b	" " " " "	

The amount of sulfur added in its various compounds above, except where otherwise stated, was equivalent to 12 pounds per acre. These substance were used mainly to test any toxic or catalytic action which they might have on the growing plant, while the varying amounts of sulfur were tried to test their effect on the plant and soil and the rapidity of oxidation as will be explained later.

In each box, were planted 50 Early Jersey Wakefield cabbage seed, which were afterwards thinned to 25 average size plants. Distilled water was used throughout the experiments.

Although the seed germinated in Nos. 19, 20 and 21, the young plants did not grow well, some dying in No. 19, more in No. 20 and all in No. 21. This was due to the fact that the oxidation of the sulfur made the soil acid, the amount of acid formed being in proportion to the quantity of sulfur added, as will be shown later.

With one or two exceptions, no large increases in growth of the plants over the checks could be observed, while in most cases the plants did not grow as well. When the plants in the best boxes had reached the transplanting stage, all were cut close to the ground. The weights of the air dried plants are given below:

Table VII—Weight in Grams of Cabbage Plants of Series V.—Air-Dry.

Box	Tops	Per cent Gain or Loss
No. 1	14.45	— 1
" 2	12.92	— 11
" 3	14.19	— 3
" 4a	13.06	— 10
" 4b	14.83	+ 2
" 5a	13.51	— 7
" 5b	17.17	+ 18
" 6a	11.20	— 23
" 6b	16.86	+ 16
" 7a	12.48	— 14
" 7b	10.14	— 30
" 8a	9.39	— 36
" 8b	12.05	— 17
" 9a	11.91	— 18
" 9b	11.02	— 24
" 10a	9.56	— 34
" 10b	9.94	— 32
" 11	9.81	— 33
" 12	15.73	+ 8
" 13	7.92	— 46
" 14	12.97	— 11
" 15	13.61	— 7
" 16	12.39	— 15
" 17	7.37	— 49
" 18	13.97	— 4
" 19	2.62	— 82
" 20	.63	— 96
" 21	Plants died.	
" 22a	15.71	------
" 22b	13.48	------

After the cabbage plants were cut, acidity determinations were made on the soils to which sulfur had been added and the results below show that the following number of pounds of calcium carbonate per acre were necessary to neutralize the acidity according to the Hopkins method.[14]

Box	Pounds Calcium Carbonate per Acre
No. 15	143
" 16	235
" 17	414
" 18	717
" 19	1213
" 20	4211
" 21	10671
" 22a	143
" 22b	143

The high acidity of Nos. 19, 20 and 21 is due to the fact, as will be shown later, that the large amounts of sulfur were oxidized to sulfuric acid and there not being sufficient quantities of calcium carbonate present to neutralize the acid, the plants in these boxes failed to grow.

Series VI—Effect of Sulfates on Mustard.

The soil in the boxes of Series V was sifted to remove the roots and used for these experiments. In each, were planted 50 Giant Southern Curled mustard seed, which after germinating were thinned to 15 average size plants. Distilled water was used throughout these experiments. During their growth, the plants in the boxes containing the sulfate appeared larger as a rule than those in the boxes containing the corresponding carbonates. Nos. 1, 2, 4a, 9a, 11 and 17 were larger than the remainder. After the best plants had commenced to bloom, all of the plants were cut close to the ground and air-dried. Their weights were as follows:

Table VIII—Weight in Grams of Mustard Plants of Series VI—Air-Dry.

Box.	Tops.	Per cent Gain or Loss.
No. 1	3.75	+ 105
" 2	3.59	+ 96
" 3	2.35	+ 28
" 4a	3.48	+ 90
" 4b	1.25	— 32
" 5a	2.22	+ 21
" 5b	1.50	— 18

Box.	Tops.	Per cent Gain or Loss.
No. 6a	2.44	+ 33
" 6b	1.30	− 29
" 7a	1.86	+ 2
" 7b	1.45	− 21
" 8a	2.86	+ 56
" 8b	1.62	− 11
" 9a	3.87	+ 111
" 9b	2.69	+ 47
" 10a	1.70	− 7
" 10b	1.15	− 37
" 11	3.50	+ 91
" 12	.88	− 52
" 13	2.14	+ 17
" 14	2.11	+ 15
" 15	2.72	+ 49
" 16	2.58	+ 41
" 17	3.17	+ 73
" 18	2.34	+ 28
" 19	No seeds germinated.	
" 20	" " "	
" 21	" " "	
" 22a	2.48	
" 22b	1.19	

Series VII—Effect of Sulfates on Radishes.

The sifted soil used in Series VI was used for these experiments. In each box were planted 20 Scarlet Globe radish seed which after germinating were thinned to 12 average size plants.

From the beginning Nos. 2, 3, 4a and 15 appeared to make a better growth than the checks while a few of the remainder did not grow as well. As the weather was becoming too warm for these plants in the greenhouse, the experiments were stopped before the plants were fully matured. At the end, the soil was removed from the plants and they were immediately weighed. The weights of the tops and roots are given below.

Table IX—Weight in Grams of Radishes of Series VII—Fresh.

Box.	Tops.	Roots.	Per cent Gain or Loss. Tops.	Roots.
No. 1	5	5	— 37	— 37
" 2	14	17	+ 75	+ 112
" 3	10	17	+ 25	+ 112
" 4a	12	18	+ 50	+ 125
" 4b	6	4	— 25	— 50
" 5a	8	5	0	— 37
" 5b	9	5	+ 12	— 37
" 6a	9	6	+ 12	— 25
" 6b	6	4	— 25	— 50
" 7a	8	8	0	0
" 7b	2	2	— 75	— 75
" 8a	11	12	+ 37	+ 50
" 8b	7	3	— 12	— 62
" 9a	9	8	+ 12	0
" 9b	11	15	+ 37	+ 87
" 10a	9	6	+ 12	— 25
" 10b	10	6	+ 25	— 25
" 11	11	11	+ 37	+ 37
" 12	12	8	+ 50	0
" 13	6	5	— 25	— 37
" 14	4	3	— 50	— 62
" 15	16	23	+ 100	+ 187
" 16	11	14	+ 37	+ 75
" 17	10	14	+ 25	+ 75
" 18	9	11	+ 12	+ 37
" 19	A few seeds germinated but plants died.			
" 20	A very few "	"	" " "	
" 21	No "	"		
" 22a	8	10		
" 22b	7	5		

Series VIII—Effect of Sulfates on Alfalfa in Sand Cultures.

The object of these experiments was to determine the availability of different sulfur compounds for the growth of alfalfa which contains a considerable amount of this element. The different sulfates were compared with their corresponding carbonates containing the same amounts of the basic element in order to eliminate, as far as possible, the effect of the base.

The sand used was fine Ohio River sand and contained .013 per cent of total sulfur by the sodium peroxide method. Sixteen pounds of sand in each case were thoroughly mixed with 10 grams of calcium carbonate; 10 grams of calcium phosphate (tertiary); 4 grams of potassium nitrate; 4 grams of magnesium carbonate, and .25 gram of ferric nitrate, and then put in two-gallon jars provided with drainage.

Assuming that if this sand were a soil, the top six inches would weigh 2,000,000 pounds per acre, the following substances calculated to pounds per acre were added to the different jars. All soluble materials were put on in solution.

Jar	Substance Added	Pounds per Acre
No. 1	Ferrous sulfide, FeS	33
" 2	Iron disulfide (pyrite), FeS_2	22
" 3a	Ferrous sulfate, $FeSO_4.7H_2O$	104
" 3b	" oxide, FeO	27
" 4a	Ferric sulfate, $Fe_2(SO_4)_3$	50
" 4b	" oxide, Fe_2O_3	26
" 5a	Nickelous sulfate, $NiSO_4.7H_2O$	105
" 5b	" carbonate, $NiCO_3$	51
" 6a	Cupric sulfate, $CuSO_4.5H_2O$	93
" 6b	" carbonate, $CuCO_3.3Cu(OH)_2$	46
" 7a	Cobaltous sulfate, $CoSO_4.7H_2O$	105
" 7b	" carbonate, $CoCO_3$	45
" 8a	Chromic sulfate, $Cr_2(SO_4)_3$	49
" 8b	" carbonate, $Cr_2O(CO_3)_2$	36
" 9a	Manganous sulfate, $MnSO_4.4H_2O$	83
" 9b	" carbonate, $MnCO_3$	43
" 10a	Lithium sulfate, $Li_2SO_4.1H_2O$	48
" 10b	" carbonate, Li_2CO_3	26
" 11a	Ammonium sulfate, $(NH_4)_2SO_4$	206
" 11b	" carbonate, $NH_4HCO_3.NH_4NH_2CO_2$	163
" 12a	Potassium sulfate, K_2SO_4	272
" 12b	" carbonate, K_2CO_3	215
" 13a	Barium sulfate, $BaSO_4$	364
" 13b	" carbonate, $BaCO_3$	308
" 14a	Magnesium sulfate, $MgSO_4.7H_2O$	384
" 14b	" carbonate, $3MgCO_3.Mg(OH)_2.3H_2O$	142
" 15a	Aluminum sulfate, $Al_2(SO_4)_3.18_2HO$	346
" 15b	" oxide, $Al_2O_3.H_2O$	82

Jar.	Substance Added.	Pounds per Acre
No. 16a	Sodium sulfate, Na_2SO_4	221
" 16b	" carbonate, Na_2CO_3	165
" 17a	Gypsum, $CaSO_4 2H_2O$	268
" 17b	Calcium carbonate, $CaCO_3$	156
" 18	Flowers of sulfur, S	50
" 19	" " " "	100
" 20	" " " "	500
" 21	" " " "	1000
" 22a	Check, nothing added but materials previously noted.	
" 22b	Check, nothing added but materials previously noted.	

In the jars from Nos. 1 to 10a, where sulfur compounds were added, the amount of the element applied to each was equivalent to 12 pounds per acre, while in the remainder, except where otherwise stated, it was 50 pounds per acre. Twenty-five inoculated alfalfa seed were planted in each jar and after germinating these were thinned to 20 average size plants, and watered with distilled water.

The plants grew very well until they were about seven or eight inches in height and then commenced to turn yellow. On this account frequent cuttings were made about one inch from the crown and cut at this stage, they continued to spread and had a good green color throughout the experiment.

As a rule, the plants in the jars containing the sulfur compounds were larger than the checks, or those containing the carbonates, but in a few cases, however, the reverse was true. The air-dried weights of the different cuttings are given in the following table:

Table X.—Weight in Grams of Alfalfa of Series VIII.—Air-Dry.

Jar	Cutting			Total	Total Per cent Gain or Loss	
	1st	2nd	3rd			
No. 1	4.92	3.13	2.92	10.97	+	2
" 2	5.02	3.72	3.71	12.45	+	16
" 3a	2.63	2.67	3.44	8.74	—	18
" 3b	5.35	3.10	5.26	13.71	+	28
" 4a	7.00	3.55	6.23	16.78	+	56
" 4b	6.24	2.88	4.77	13.89	+	29
" 5a	5.36	3.50	1.94	10.80	+	.7
" 5b	5.30	2.20	4.45	11.95	+	11
" 6a	5.15	2.36	3.20	10.71	—	.2
" 6b	4.78	2.98	3.12	10.88	+	1
" 7a	5.60	3.62	3.15	12.37	+	15
" 7b	5.01	2.56	2.45	10.02	—	7
" 8a	4.22	.40	2.28	6.90	—	36
" 8b	5.46	2.53	4.52	12.51	+	17
" 9a	5.76	3.80	3.23	12.79	+	19
" 9b	4.32	2.71	3.74	10.77	+	.5
" 10a	5.24	2.58	5.59	13.41	+	25
" 10b	4.51	3.18	3.07	10.76	+	.3
" 11a	6.06	4.22	5.15	15.43	+	44
" 11b	4.71	3.62	5.28	13.61	+	27
" 12a	5.33	4.06	6.71	16.10	+	50
" 12b	4.91	2.45	4.44	11.80	+	10
" 13a	5.14	2.61	5.30	13.05	+	22
" 13b	5.03	2.35	5.85	13.23	+	23
" 14a	6.09	4.35	7.19	17.63	+	64
" 14b	5.92	3.52	5.28	14.72	+	37
" 15a	5.96	3.82	3.89	13.67	+	27
" 15b	5.65	2.16	4.55	12.36	+	15
" 16a	6.07	4.43	5.68	16.18	+	51
" 16b	4.90	5.37	6.80	17.07	+	59
" 17a	6.31	2.22	5.25	13.78	+	28
" 17b	2.33	1.43	4.30	8.06	—	25
" 18	4.47	3.37	4.05	11.89	+	11
" 19	5.54	3.93	5.68	15.15	+	41
" 20	6.75	2.50	5.62	14.87	+	39
" 21	5.55	2.60	5.97	14.12	+	32
" 22a	5.00	2.05	3.59	10.64		
" 22b	4.39	2.07	4.36	10.82		

The highest yields over the checks, using the sulfate, were obtained with magnesium, ferric, sodium, potassium and ammonium sulfates in the order given, although several large gains were obtained with others. With the carbonates and oxides, the best in order were sodium and magnesium carbonates, ferric and ferrous oxides and ammonium carbonate.

Of the substances used, only chromic sulfate, calcium carbonate, ferrous sulfate and cobaltous carbonate, in the order given, showed losses. Ferrous sulfide, nickelous sulfate, cupric sulfate and carbonate, manganous carbonate and lithium carbonate gave about the same results as the checks, while the remainder gave substantial gains.

With the variable amounts of sulfur used, all gave substantial gains, the best result being obtained with 100 pounds per acre, and any amounts above this gave gradual decreases as the amounts applied became larger. That the sulfur in all cases had been partly oxidized to sulfate when utilized by the plants, will be shown later.

The poor results obtained with calcium carbonate indicate that the nutritive materials in the sand may not have been properly balanced for the best growth of alfalfa, and already contained an abundance of this material in view of the fact that a further addition caused a loss. This might have been caused by the ratio between the amounts of calcium and magnesium becoming too large since the experiments with magnesium carbonate or sulfate gave large gains. This is an interesting point and assumes considerable importance when applied to soil conditions.

In this connection, the work of McCool[15] is of interest since he has shown that a close relationship exists between the nutrient and non-nutrient bases on the growth of plants and an oversupply of one element may prove harmful but its effect can be counteracted by the presence of others. In other words, all elements which are generally present in combination should be properly balanced for the best growth of a plant largely for the same reason that a balanced ration has been found best for an animal.

The above experiments show that alfalfa readily appropriates sulfur for its own growth whether the source of supply be the element or certain of its compounds.

Oxidation of Sulfur to Sulfur Trioxide in the Soil.

Mention has been previously made that when sulfur is added to the soil, it is rapidly oxidized to sulfate and in this form is probably taken up by the plant. That this is true with respect to soil and to a lesser extent with sand, can be seen from the following experiments which have been made along this line.

The procedure used was to determine the sulfates in the soil or sand immediately after adding the sulfur and then later after the plants were grown on it. The official method[16] for the strong hydrochloric acid digestion of the soil was used for the sulfate determinations and all samples were air-dried and put through a 100 mesh sieve for analysis.

EXPERIMENT I.

The soil to which sulfur had been added in Series I was used for these experiments and gave the following results:

Table XI.—Oxidation of Sulfur to Sulfur Trioxide in Soil of Series I.

Box		Per cent Sulfate Sulfur		Per cent Sulfur Oxidized
		At the Beginning	After 123 Days	
No. 1	No sulfur added.	.012	.011	
" 2	100 lbs. sulfur per A.	.012	.016	60
" 3	500 " " " "	.013	.032	57
			After 110 Days	
" 5	No sulfur added.	.009	.010	
" 6	100 lbs. sulfur added.	.012	.015	45
" 7	500 " " "	.013	.032	57

The above results show that after about four months, the amount of sulfur oxidized was generally about 60 per cent of the total quantity present, regardless of whether 100 or 500 pounds per acre had been added.

These results also show why the plants in Nos. 2 and 3 did not make any growth since the soil probably became acid by the large amounts of sulfur oxidized. On the other hand, the plants grew well in Nos. 6 and 7 because calcium carbonate had been added.

EXPERIMENT II.

The soil to which sulfur had been added in Series V was used for the following experiments:

Table XII—Oxidation of Sulfur to Sulfur Trioxide in Soil of Series V.

Box		Per cent Sulfate Sulfur.		Per cent Sulfur Oxidized
		At the beginning.	After 112 days.	
No. 15	100 lbs. sulfur per A.	.016	.020	80
" 16	500 " " " "	.016	.033	68
" 17	1000 " " " "	.017	.047	60
" 18	2000 " " " "	.019	.086	67
" 19	3000 " " " "	.020	.111	61
" 20	5000 " " " "	.023	.181	63
" 21	7000 " " " "	.025	.285	74
" 22a	No sulfur added	.016	.016	
" 22b	" " "	.016	.017	

These results show that from 60 to 80 per cent of the sulfur, regardless of the amount added, was oxidized after a period of about four months. This also holds true whether the soil was only slightly or decidedly acid, for acidity tests which were made at the same time and which have been previously mentioned, showed that the soil in Nos. 19, 20 and 21 was decidedly acid and the acidity increased as the amounts of sulfur became larger. In these boxes, the plants did not grow and most of them died.

If the different amounts of calcium carbonate calculated from the sulfuric acid that was formed by the oxidation of the sulfur in the soil above, are compared with the quantities required by the Hopkins acidity determinations previously mentioned, and then with the amount that was originally added, some interesting relations are shown to exist, as will be seen in the following table:

Table XIII. Pounds of Calcium Carbonate Per Acre.

Box	Before Experiment. Am't. Added.	After Experiment.		
		Equivalent to Sulfur Oxidized	Apparent Excess or Deficiency according to	
			Sulfur Oxidized	Hopkins Method
No. 15	4000	250	+ 3750	— 143
" 16	4000	1062	+ 2938	— 235
" 17	4000	1875	+ 2125	— 414
" 18	4000	4187	— 187	— 717
" 19	4000	5691	— 1691	— 1213
" 20	4000	9875	— 5875	— 4211
" 21	4000	16253	— 12253	— 10671
" 22a	4000	-----	-----	— 143
" 22b	4000	-----	-----	— 143

The differences in some cases between the acidity by the Hopkins method and that calculated from the amount of sulfur oxidized may be due to the fact that the latter represents more free acid than is present since this would gradually combine with other bases, if there was not sufficient calcium carbonate to neutralize it. The amounts obtained by the Hopkins method in some instances are also probably too large, because the soil, before adding calcuim carbonate by this method, only required 164 pounds per acre of this material to overcome its acidity, and after adding 4000 pounds, it still required 143 pounds.

According to the amount of sulfur oxidized, and taking into account the amount of calcium carbonate added, Nos. 15, 16 and 17 should, at the end still be alkaline, No. 18 about neutral and the remainder acid. The Hopkins method also shows a large increase in acidity of No. 19 compared with No. 18 and this also represents the division between those boxes in which the plants made a good growth and those in which the growth was very poor.

It also appears from a comparison of Nos. 15 and 16 above with Nos. 5 and 6 of the preceding experiment that when sulfur is added to the Fayette County soil, it is more rapidly oxidized than in the Graves County soil used in Experiment I. It might be that the larger amount of calcium carbonate

added to the Fayette County soil accounts for this but this is hardly probable in view of the fact that adding calcium carbonate to the Graves County soil did not promote the oxidation of the sulfur as will be seen from a comparison of Nos. 2, 3, 6 and 7 on that soil. Furthermore, it has just been shown that the oxidation of the sulfur proceeds with about the same rapidity regardless of the acidity of the soil.

Another possible explanation is that the Graves County soil was previously heated for one hour between 95 degrees and 100 degrees C. while the other was not, and this may account for the above differences, but further experiments are necessary in order to verify this point.

EXPERIMENT III.

The sand to which sulfur had been added in Series VIII was used for the experiment below:

Table XIV—Oxidation of Sulfur to Sulfur Trioxide in Sand of Series VIII.

Jar		Per cent Sulfate Sulfur.		Per cent Sulfur Oxidized.
		At the beginning.	After 205 days.	
No. 18	50 lbs. sulfur per A.	.003	.009	120
" 19	100 " " " "	.003	.012	120
" 20	500 " " " "	.005	.014	32
" 21	1000 " " " "	.005	.023	34
" 22	No sulfur added	.002	.006	

The above results are probably too high for the amount of sulfur oxidation because of the presence of some pyrite in the sand which was also partially oxidized. There is no doubt however but that some of the sulfur was oxidized in these experiments but not to the extent that it was in the soils.

Oxidation of Organic Sulfur to Sulfur Trioxide in Manure and Manure-Soil Mixtures.

The object of these experiments was to determine if the organic sulfur of manure is oxidized to sulfate both in the presence and absence of soil. The material used was fresh air-dried horse dung which had been ground very fine.

As nitrification proceeds better in a soil which contains calcium carbonate and as sulfur oxidation is somewhat of a similar process, the plan was tried of adding calcium carbonate to some of the mixtures. The Fayette County soil was used and the samples were prepared as follows:

No. 1 50 grams manure to which no water was added during the experiment.
" 2 50 grams manure.
" 3 1 " " , 100 grams soil i. e. 10 tons manure per acre
" 4 5 " " , 100 " " " " " 50 " " " " "
" 5 10 " " , 100 " " " " " 100 " " " " "
" 6 20 " " , 100 " " " " " 200 " " " " "
" 7 Same as No. 1 with the addition of 5 grams calcium carbonate.
" 8 " " " 2 " " " " 5 " " " "
" 9 " " " 3 " " " " .2 " $CaCO_3$ i. e. 2 tons. $CaCO_3$ per acre.
" 10 " " " 4 " " " ,, 1 grams $CaCO_3$ i. e. 10 tons $CaCO_3$ per acre.
" 11 " " " 5 " " " " 2 grams $CaCO_3$ i. e. 20 tons $CaCO_3$ per acre.
" 12 " " " 6 " " " " 4 grams $CaCO_3$ i. e. 40 tons $CaCO_3$ per acre.

After the materials in each were thoroughly mixed, the sulfate was determined by the method previously used. The samples, except where otherwise noted, were then kept in the shade, uniformly moistened with distilled water, and stirred thoroughly about every three days. At frequent intervals, portions were taken and after air drying, the sulfate was determined. The results were as follows:

Table XV—Per Cent Sulfate Sulfur.

Sample.	At the beginning.	After 62 days.	After 185 days.	Per cent total gain.
No. 1	.016	.023	.024	50
" 2	.016	.023	.029	81
" 3	.017	.017	.017	0
" 4	.014	.014	.017	21
" 5	.016	.019	.018	12
" 6	.016	.018	.021	31
" 7	.015	.018	.019	27
" 8	.015	.021	.029	93
" 9	.013	.017	.017	31
" 10	.014	.017	.018	29
" 11	.013	.018	.020	54
" 12	.016	.017	.020	25

The above results show that there has been a gradual oxidation of the organic sulfur in every sample with one exception and in some, the amount is large when calculated to the acre. The wet manure was found to oxidize larger quantities than the dry. In four of the six samples, the addition of calcium carbonate gave somewhat higher results. There appears to be no consistent relation existing between the variable amounts of manure, or manure plus calcium carbonate, which were added to equal quantities of soil except that in each series of experiments along this line, the highest results were obtained when the largest and next to the largest amount of each was present.

The work on sulfur fertilization of soils is to be continued so as to include several other types from the different geological areas of Kentucky.

SUMMARY.

1. Recent experiments by several investigators have shown that on some soils, numerous plants comprising some general farm crops, also vegetables and fruits, are benefited by applications of sulfur or sulfur fertilizers. Among these are wheat, corn, oats, timothy, alfalfa, rape, mangel-wurzels, beets, potatoes, turnips, radishes, beans, grapes and other fruits.

2. Numerous analyses of the total sulfur content of many vegetables, fruits and other materials have been made by the writer and while there are large differences among different materials, several contain considerable amounts of this element.

3. Analyses of thirty-one varieties of tobacco comprising about all the types grown in this State, show that only two contained less sulfur than phosphorus, a large majority containing considerably more, amounting in some cases to double the phosphorus. The average was .458 per cent of sulfur and .302 per cent of phosphorus.

4. The addition of sulfur or gypsum to a fertilizer containing only nitrogen, potassium and phosphorus, when

applied to a Graves County soil, gave a decided increase in growth of Yellow Pryor tobacco over the fertilizer alone.

5. Different sulfur compounds when added to a Fayette County soil, in some instances, gave decided gains in the growth of soy beans. The best result was obtained with the element sulfur. The sulfur content of soy beans which responded to sulfur fertilization was in all cases higher than where no sulfur compound was added but this did not hold true with respect to the protein except where ammonium sulfate was applied.

6. The growth of turnips was materially benefited by sulfur fertilizers on this soil.

7. Clover was not benefited when grown in a Fayette County soil to which sulfur fertilizers were added except where potassium sulfate was used and this may have been due to the available potassium present.

8. In a series of experiments on the Fayette County soil with cabbage, the effect of adding the sulfates of iron, nickel, copper, cobalt, chromium, manganese, lithium, etc., and comparing them with their corresponding carbonates or oxides, was tried. Large amounts of these substances are generally regarded as harmful to plant growth while some investigators have found that small amounts are beneficial. The results obtained with cabbage show that only two proved beneficial, a few had no effect, while several were harmful to the plant.

9. In a continuation of the above experiments on the same soil, mustard and afterwards radishes were grown. With mustard, several of the sulfates gave good gains over the checks and all gave higher yields than their corresponding carbonates. In the case of radishes, the results were more irregular, but there is no doubt but that sulfur fertilization in some cases was beneficial.

10. Experiments were tried in growing alfalfa in sand cultures so as to determine the availabilty of the sulfur in its different compounds for the growth of this plant. The results show that different forms of sulfur are readily used by this plant for its growth. The best results were obtained re-

spectively with magnesium, ferric, sodium, potassium and ammonium sulfates. Good results were also obtained with sulfur. As this sand contained some sulfur compounds, the sulfates were compared with their corresponding carbonates and in nine out of fifteen cases, the sulfates gave better yields than their carbonates. Of the substances used, only four in a total of thirty-eight, gave smaller yields than the checks.

11. When sulfur is added to a soil, it is rapidly oxidized to the sulfate. The oxidation was found to proceed more rapidly in a fertile soil from Fayette County in the Trenton area than in a poorer soil from Graves County in the Quaternary area. One possible explanation is given that may account for this fact.

12. Sulfur was also found to be oxidized in sand cultures but not to the extent that it is in the soil.

13. The oxidation of sulfur was found to produce acidity which if it occurs in sufficient amount and is not neutralized by a base like calcium carbonate, will prevent plant growth.

14. The organic sulfur of horse manure was found to be slowly oxidized to sulfate.

BIBLIOGRAPHY.

[1] Ky. Agr. Exper. Sta., Bull. No. 174, pp. 213-221.

[2] Jour. Agr. Prat. N. Ser. 23 (1912) No. 12, pp. 365-367; Exper. Sta. Rec., 29 (1913), p. 215.

[3] Deut. Landw., Presse. 40 (1913), No. 33, p. 405; Exper. Sta. Rec. 29 (1913), p. 319.

[4] Deut. Obstbau. Ztg., 1913, No. 4, pp. 75-76; Chem. Abs. of Amer. Chem. Soc., 7, No. 16, p. 2823.

[5] Engrais 28, pp. 1304-6; Chem. Abs. of Amer. Chem. Soc. 8, No. 3, p. 545.

[6] Jour. Soc. Nat. Hort. France 4, ser. 14 (1913) Jan. pp. 54-56; Exper. Sta. Rec., 30, No. 2, p. 138.

[7] K. Landtbr. Akad. Handl. och. Tidskr., 52 (1913), No. 2, pp. 120-130; Exper. Sta. Rec., 30, No. 2, p. 139.

[8] Rev. vit., 41, pp. 175-9; Chem. Abs. of Amer. Chem. Soc., 8, No. 8, p. 1482.

[9] Wis. Sta. Bull., No. 228, pp. 20-28.

[10] New Jersey Sta. Rept. 1912, pp. 270-277; Exper. Sta. Rec. 30, No. 4, p. 326.

[11] Taken from Pacific Rural Press of June 27, 1914, account of work done at Experiment Station, Talent, Ore.

[12] U. S. Dept. Agr. Bur. Chem. Bull. No. 107 (Revised), p. 23.

[13] Ibid, p. 2.

[14] Ibid, p. 20.

[15] Cornell University Agr. Exper. Sta., Memoir No. 2.

[16] U. S. Dept. Agr. Bur. Chem. Bull. No. 107 (Revised), p. 14.

Kentucky
Agricultural Experiment Station

State University, Lexington, Kentucky

BULLETIN NO. 189

Commercial Fertilizers

BY

H. E. CURTIS

ANALYSES BY WM. RODES and B. D. WILSON



STATE UNIVERSITY PRESS
LEXINGTON, KY.
December 31, 1914.
(631)

KENTUCKY AGRICULTURAL EXPERIMENT STATION

BOARD OF CONTROL

RICHARD C. STOLL, Chairman, Lexington, Ky.
CHARLES B. NICHOLS, Lexington, Ky.
LEWIS L. WALKER, Lancaster, Ky.
HENRY S. BARKER, President of the University.
THE DIRECTOR, Secretary, ex-officio.

JOSEPH H. KASTLE, Director.

STATION COUNCIL

THE DIRECTOR

A. M. PETER
H. E. CURTIS
H. GARMAN
C. W. MATHEWS
R. M. ALLEN
J. D. TURNER
E. S. GOOD
GEORGE ROBERTS
J. J. HOOPER

DEPARTMENTAL ORGANIZATION

ADMINISTRATION

THE DIRECTOR, Head.
H. E. CURTIS, Bursar.
HYWEL DAVIES, Purchasing Agent.
O. L. GINOCHIO, Secretary to Director.
ADDIE LEE DEAN, Librarian.
ANNA WALLIS, Clerk.
CORNELIA C. PAGE, Clerk.

AGRICULTURAL EXTENSION

F. MUTCHLER, Superintendent.
T. R. BRYANT, Asst. Superintendent.
J. H. CARMODY, Horticulture.
H. B. HENDRICK, Agronomy.
C. D. BOHANNAN, Rural Economics.
W. D. NICHOLLS, Dairying.
H. W. RICKEY, Poultry. (In cooperation with U. S. Dept. of Agriculture.)
T. E. STOKES, Animal Husbandry. (In cooperation with U. S. Dept. of Agriculture.)
MARY E. SWEENY, Home Economics.
AUBYN CHINN, Cookery and Dietetics.
RUBY M. BUCKMAN, Sewing and Household Arts.
ANNA BERRY JONES, Clerk.
MARGARET RYAN, Clerk.

AGRONOMY

GEORGE ROBERTS, Agronomist, Head.
E. J. KINNEY, Assistant Agronomist.
P. E. KARRAKER, Assistant in Soils.
A. E. EWAN, Supt. Experiment Fields.
D. S. MYER, Assistant in Crops.
JESSIE F. CASWALL, Clerk.

ANIMAL HUSBANDRY.

(Beef Cattle, Sheep and Swine.)

E. S. GOOD, Head.
ROBERT GRAHAM, Veterinary Science, in Charge Hog Cholera Serum Production.
E. W. MUMMA, Asst. In Charge Hog Cholera Serum Production.
O. S. CRISLER, Hog Cholera Serum.
R. L. PONTIUS, Hog Cholera Serum.
W. V. SMITH, Asst. in Animal Husbandry.
M. J. SMITH, Asst. in Animal Husbandry.
W. H. SIMMONS, Hog Cholera Serum.
M. G. GINOCHIO, Clerk.
E. J. GOTT, Hog Cholera Serum.
A. L. BRUECKNER, Hog Cholera Serum.
LUCY K. HUTCHCRAFT, Clerk.

ANIMAL HUSBANDRY

(Horses, Dairy Cattle and Poultry.)

J. J. HOOPER, Head.
W. S. ANDERSON, Asst. Horse Husbandry.
J. W. NUTTER, Supt. Dairy Farm.
W. D. NICHOLLS, Asst. in Dairying.
D. D. SLADE, Supt. Poultry Farm.
P. E. BACON, Elmendorf Milk Records.
ED HUSTON, Asst. in Dairying.
F. WALLACE UTTERBACK, Clerk.

CHEMISTRY

A. M. PETER, Chief Chemist, Head.
S. D. AVERITT, Chemist.
J. S. McHARGUE, Asst. Chemist.
R. PFANSTIEL, Asst. Chemist.
ETHEL V. T. CASWALL, Clerk.

ENTOMOLOGY AND BOTANY

H. GARMAN, Entomologist and Botanist, Head.
MARY L. DIDLAKE, Laboratory Asst.
E. C. VAUGHN, Asst. in Seed Inspection and Plant Breeding.
H. H. JEWETT, Research Asst. Entom.
H. R. NISWONGER, Asst. in Field Work and Nursery Inspection.
LOUISE BEWLAY, Clerk.

FEED

J. D. TURNER, Head.
H. D. SPEARS, Chemist.
E. H. NOLLAU, Asst. Chemist.
ELMER INGRAM, Chief Inspector.
ROGER W. JONES, Inspector.
FANNY C. ROGERS, Clerk.

FERTILIZER

H. E. CURTIS, Chemist, Head.
WM. RODES, Assistant Chemist.
ELMER INGRAM, Inspector.
R. W. JONES, Inspector.
ANNA WALLIS, Clerk.

FOOD AND DRUGS

R. M. ALLEN, Head.
J. O. LABACH, Chief Chemist.
L. A. BROWN, Chemist, Drugs.
J. W McFARLIN, Chief Food Inspector.
W. R. PINNELL, Bacteriologist.
C. S. PORTER, Inspector, Drugs.
WALTER SCHEPPELMAN, Inspector, Bakery Sanitation.
E. F. WORTHINGTON, Inspector, Dairy Sanitation.
W. G. TERRELL, Inspector, Foods.
LILLIE LISTON, Chief Clerk.
LENA LISTON, Clerk.

HORTICULTURE

CLARENCE W. MATHEWS, Head.
F. W. HOFMANN, Asst. in Horticulture.
G. B. WURTZ, Consulting Meteorologist.
MURIEL CASWALL, Clerk.

RESEARCH

THE DIRECTOR, Head.
H. GARMAN, Entomologist and Botanist.
D. J. HEALY, Bacteriologist.
E. S. GOOD, Animal Husbandry.
O. M. SHEDD, Chemist.
MARY L. DIDLAKE, Asst. Entomologist and Botanist.
G. D. BUCKNER, Chemist.
H. H. JEWETT, Research Asst. in Entom.

NOTICE.

The Bulletins of the Station will be mailed free to any citizen of Kentucky who sends his name and address to the Director.

BULLETIN NO 189.

ANALYSES OF COMMERCIAL FERTILIZERS.

The amount of plant food is all important in purchasing fertilizers. When a farmer buys a ton of an average commercial fertilizer he buys in reality only about 300 pounds of the actual plant food elements. These elements are necessarily in combination with other elements. For this reason a fertilizer can never contain 100 percent of plant food elements. If he buys a cheap or low grade fertilizer he gets less than this amount. If he buys a high grade fertilizer he may receive as much as 600 pounds. The cost of sacking, hauling, and freighting is the same. Therefore, it is evident that the manufacturer can sell the plant food in a high grade fertilizer cheaper per pound than he can the plant food in a low grade fertilizer. In other words the higher the grade the cheaper can the plant food be bought. Farmers are advised therefore to purchase only high grade fertilizers, that is, those containing high percentages of the elements which it is desired to purchase. This would mean, for example, the purchase of 16 per cent. acid phosphate, rather than a 10 or 12 per cent. grade. Farmers are urged to study the fertilizer requirements of their soils before purchasing fertilizers and literature on this subject may be had on application.

Attention is called to those brands which have less than two per cent. of ammonia or potash. Less than two per cent. of either of these ingredients is too small a quantity where such ingredients are needed, and where not needed it is useless to purchase them. It is an utter waste of money to purchase potash or ammonia in fertilizers containing less than one per cent. of these ingredients.

Number of Brands. There were 746 different brands of

commercial fertilizers registered during the year 1914. Of these different brands, 436 were complete fertilizers, or fertilizers containing all three of the essential ingredients namely: phosphoric acid, nitrogen and potash (non acidulated bone and potash mixtures are not counted in this item); 88 acid phosphates or superphosphates, 15 nitrogenous superphosphates, 110 acid phosphates and potash mixtures, 79 bones, tankage and non-acidulated bone and potash mixtures, 13 potash salts, and 5 samples of nitrate of soda. Samples of these various brands sent by manufacturers have been analyzed, as well as samples collected by deputy inspectors and those sent by farmers, and the results are given in the tables which follow.

Results of Analyses. The results of these analyses show that in most cases the samples analyzed have come fully up to the guarantee, or where there is a slight deficiency in one ingredient, it has been made up by an excess in one or both of the other ingredients. But in a few instances, the deficiency in one ingredient, while fully made up by an excess of the other ingredients, is still too low to be considered acceptable, this being due to bad mixing at the factory. In a few instances, there seems to be an inclination on the part of the manufacturer to guarantee higher percentages than their goods contain. Especially is this the case in a number of instances with respect to the guaranty on total phosphoric acid, where it is four or five per cent. higher than the guaranty on available phosphoric acid. In most of these the analysis shows that while the available phosphoric acid guaranteed is present, the insoluble and total phosphric acid are both deficient. In some cases, however, the deficiency in insoluble phosphoric acid is made up by an excess of available phosphoric acid which is to be preferred, but in such cases the total phosphoric acid is not deficient. Although the insoluble phosphoric acid is of little value, at the same time we feel inclined to call special attention to these guarantees and hope that all persons who purchase fertilizers will carefully study the bulletins and see how the guarantees have compared with our analyses with respect to the

available and total phosphoric acid. Some manufacturers also have used muriate of potash in making fertilizers in which the potash was guaranteed from sulphate.

Methods of Reporting Results. Nitrogen is separated into the various forms in which it occurs, namely, nitrogen in nitrates, nitrogen in ammonia salts and organic nitrogen. In bones, the bone phosphate of lime equivalent is given and the percentage of fineness is shown also, fine bone being that which passes through a sieve with meshes one-twenty-fifth inch square, and medium bone that which passes through a sieve with meshes one-sixth inch square, but not including the fine bone. The analyses are grouped under tables, the classification being based upon the nature of the fertilizer, as follows:

Table 1. Complete fertilizers.
Table 2. Bones, tankage and mixtures of bone and potash.
Table 3. Acid Phosphates.
Table 4. Acid phosphate and potash mixtures.
Table 5. Nitrogenous superphosphates.
Table 6. Potash Salts.
Table 7. Nitrate of soda.

Free Analysis of Fertilizers. It is hoped that farmers who purchase fertilizers in quantity, at least, will take advantage of Section 8 of the fertilizer law, and send a sample to the Station for free analysis.

Essentials in Taking Samples. 1. Take it at the time of purchase and if possible in the presence of agent or seller. 2. Take a sample from not less than two bags, and from one additional bag for every ten purchased; mix these samples carefully and take at least a pint of this mixed sample, put into a fruit jar, seal, box and express to J. H. Kastle, Director, Lexington, Ky. 3. Take the sample in the presence of at least one witness, and have the witness sign the required certificate. 4. The certificate for free analysis to be sent *by mail,* and should be in accordance with the law as given in section 8.

If the sample is taken in accordance with the above direc-

tions it may be sent by express, and the charges will be paid by the Station.

Blank certificates will be furnished free upon application to the Station. The section of the fertilizer law describing the manner in which samples are to be taken for free analysis is also printed on the certificate.

Values Used. In calculating the relative value per ton, the following values have been used.

Soluble and reverted phosphoric acid in mixed fertilizers	6 c. lb.
Soluble and reverted phosphoric acid in plain acid phosphates	5 c. lb.
Insoluble phosphoric acid in mixed fertilizers	2 c. lb.
Phosphoric acid in fine bone	4 c. lb.
Phosphoric acid in medium bone	3 c. lb.
Nitrogen in all fertilizers	17½ c. lb.
Potash in all fertilizers, from sulphate	6 c. lb.
Potash in all fertilizers, from muriate	5 c. lb.

The term "Potash from muriate" does not indicate necessarily that the manufacturers used muriate of potash in furnishing the potash; they may have used sulphate of potash, or other salts of potash, but in all fertilizers where the term "Potash from muriate" is used there is enough chlorine present to combine with the potash, either from salt in the tankage used, or the potash salts used as muriate, kainit, carnallite, etc. As the objection to the use of muriate of potash arises from the chlorine present in this salt, it likewise follows that chlorine in a fertilizer is objectionable, whether put in with the potash or otherwise. The using of sulphate of potash where there is chlorine present in other ingredients of the fertilizer will not obviate the injurious effect of the chlorine, and therefore we take this method of showing chlorine present by designating the potash as "from muriate."

Explanation of the Table. In the table of analyses, following the name of each brand will be found the analysis of

the sample furnished by the manufacturer at the time the fertilizer was entered for sale and which was occompanied by an affidavit giving the guaranteed analysis. This is the analysis that is marked "manufacturer" in the column headed "From Whom Obtained." If any other analyses of the same brand have been made, they will be found following this analysis. These samples have been collected by deputy inspectors or sent in by farmers. The manufacturer's guarantee is printed last in *italic* figures.

The figures in the table which are set in bold face type are those results which, in the judgment of the Director, were too low to be acceptable.

The names of the manufacturers are arranged in alphabetical order, and the analyses of the same brand have been grouped together.

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	A. D. Adair & McCarty Bros., Atlanta, Ga.	
44126	Adair's Soluble Pacific Guano	Manufacturer
44528	Big Leaf Tobacco Producer	Manufacturer
	The American Agr'l Chemical Co., Cincinnati Sales Dept., Cincinnati, Ohio.	
44198	Complete Fertilizer	Manufacturer
44607		S. McKinley, Columbia
44200	H. Gr. Tobacco and Truck Fertilizer	Manufacturer
44608		J. H. Dodson, Maysville
44201	Special Potato and Vegetable Manure	Manufacturer
44202	A. A. C. K. and T. Special Manure	Manufacturer
44609		Snow & Conrad, Dry Ridge
44206	A. A. C. High Grade Tobacco Grower	Manufacturer
44611		Jay Small & Son, Mayfield
44207	A. A. C. Wheat and Corn Special	Manufacturer
44612		Lowry, Hines & Co., Science Hill
44900		Lowry, Hines & Co., Science Hill
	The American Agr'l Chemical Co., Cincinnati Sales Dept., Cincinnati, Ohio.	
44209	Bradley Fert. Works Potato and Root Fertilizer	Manufacturer
44210	Bradley Fert. Works Corn and Wheat Phosphate	Manufacturer
44211	Bradley Fert. Works Dissolved Bone with Potash	Manufacturer
	The American Agr'l Chemical Co., Cincinnati Sales Dept., Cincinnati, Ohio.	
44216	Cleveland Dryer Works Phospho Bone	Manufacturer

Complete Fertilizers.

Phosphoric Acid.			Nitrogen.				Equivalent to Ammonia.	Potash.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
10.09	1.03	11.12				1.84	2.23	1.46	0.86	$21.74	44126
10.00						*1.65*	*2.00*	*2.00*		*19.78*	
7.15	1.12	8.27				0.94	1.14	3.98	1.62	18.24	44528
7.00						*0.82*	*1.00*	*5.00*		*16.27*	
11.72	2.09	13.81		0.66	0.70	1.36	1.65	2.35		22.01	44198
10.14	0.98	11.12		0.94	0.90	1.84	2 23	2.40		21.40	44607
10.00	*2.00*	*12.00*				*1.65*	*2.00*	*2.00*		*20.58*	
8.65	1.78	10.43		0.67	0.84	1.51	1.83	0.74	4.36	22.35	44200
8.49	1.62	10.11		0.83	1.12	1.95	2.37		5.26	23.98	44608
8.00	*2.00*	*10.00*				*1.65*	*2.00*		*5.00*	*22.18*	
4.79	1.76	6.55				0.94	1.14	11.44		21.18	44201
5.00	*2.00*	*7.00*				*0.82*	*1.00*	*10.00*		*19.67*	
8.56	1.47	10.03		1.18	1.37	2.55	3.10		6.35	27.41	44202
7.96	1.21	9.17		1.60	0.93	2.53	3.07	0.90	5.14	25.96	44609
8.00	*2.00*	*10.00*				*2.47*	*3.00*		*6.00*	*26.25*	
7.47	1.84	9.31		0.95	0.95	1.90	2.31		11.42	30.05	44206
8.19	1.84	10.03		0.81	1.49	2.30	2.79	9.34		27.96	44611
8.00	*2.00*	*10.00*				*1.65*	*2.00*		*10.00*	*28.18*	
7.72	2.79	10.51		0.25	1.46	1.71	2.08	2.43		18.80	44207
8.34	1.90	10.24		1.07	0.77	1.84	2.23	2.42		19.63	44612
8.40	1.05	9.45		1.14	0.72	1.86	2.26	2.23		19.24	44900
8.00	*2.00*	*10.00*				*1.65*	*2.00*	*2.00*		*18.18*	
8.24	2.28	10.52				1.03	1.25	3.85		18.26	44209
8.00	*2.00*	*10.00*				*0.82*	*1.00*	*3.00*		*16.27*	
11.08	1.94	13.02		0.34	0.69	1.03	1.25	1.45		19.14	44210
10.00	*2.00*	*12.00*				*0.82*	*1.00*	*1.00*		*16.67*	
9.69	1.63	11.32		0.38	0.82	1.20	1.46	2.65		19.13	44211
8.00	*2.00*	*10.00*				*1.03*	*1.25*	*2.00*		*16.01*	
11.03	2.08	13.11		0.45	0.60	1.05	1.27	1.40		19.15	44216
10.00	*2.00*	*12.00*				*0.82*	*1.00*	*1.00*		*16.67*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	The American Agr'l Chemical Co.	
44217	Cleveland Dryer Works Potato and Tobacco Fertilizer	Manufacturer
44904		W. G. Wesley, Mangum
	The American Agr'l Chemical Co., Bowker Fert. Works, Cincinnati, Ohio.	
44221	Harvest Bone	Manufacturer
44615		Dunagan & Kirtley, Horse Cave
44907		Dickinson Bros'. Wareh'se, Glasgow
44223	Fish Guano	Manufacturer
44617		Darnell Hdwe Co., Russell Springs
44908		Dunagan & Kirtley, Horse Cave
44224	Grain and Grass Grower	Manufacturer
44618		M. D. Royse, Winchester
44909		Miller, Cartwright & Miller, Elkton
44225	Kentucky Special	Manufacturer
44619		Dunagan & Kirtley, Horse Cave
44910		J. B. Perkins, Waynesburg
44226	Tobacco Grower	Manufacturer
44620		A. G. Miller & Co., Magnolia
44227	10% Manure	Manufacturer
44229	High Grade Fertilizer	Manufacturer
44622		Browning, McReynolds & Co., Lewisburg
	The American Agr'l Chemical Co., Michigan Carbon Works, Cincinnati, Ohio	
44232	Red Line Complete Manure	Manufacturer
44234	Red Line Tobacco Manure	Manufacturer

Complete Fertilizers.

Phosphoric Acid.			Nitrogen.				Equivalent to Ammonia.	Potash.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
8.01	1.96	9.97				0.97	1.18	3.85		$17.64	44217
8.44	1.31	9.75		0.34	0.62	0.96	1.17	3.10		17.11	44904
8.00	*2.00*	*10.00*				*0.82*	*1.00*	*3.00*		*16.27*	
8.52	1.58	10.10		0.28	0.64	0.92	1.12	1.25		15.32	44221
7.88	2.61	10.49				1.07	1.30	1.18		15.43	44615
8.77	1.06	9.83		0.48	0.47	0.95	1.15	1.15		15.42	44907
8.00	*2.00*	*10.00*				*0.82*	*1.00*	*1.00*		*14.27*	
8.56	1.66	10.22		0.27	0.78	1.05	1.27	3.79		18.40	44223
9.05	1.94	10.99				0.77	0.93	2.98	1.70	19.36	44617
8.97	0.65	9.62		0.34	0.71	1.05	1.27	3.28		17.98	44908
8.00	*2.00*	*10.00*				*0.82*	*1.00*	*3.00*		*16.27*	
8.16	2.69	10.85		0.35	1.46	1.81	2.20	2.51		19.72	44224
8.70	1.61	10.31		1.02	0.84	1.86	2.26	2.70		20.29	44618
8.48	1.25	9.73		0.66	1.06	1.72	2.09	2.18		18.88	44909
8.00	*2.00*	*10.00*				*1.65*	*2.00*	*2.00*		*18.18*	
8.52	1.50	10.02		0.63	0.60	1.23	1.49	4.32		19.45	44225
8.06	1.59	9.65		0.42	0.95	1.37	1.66	4.56		19.67	44619
7.56	0.84	8.40				1.35	1.64	4.36		18.50	44910
8.00	*2.00*	*10.00*				*1.23*	*1.50*	*4.00*		*18.71*	
9.43	1.72	11.15		0.76	0.95	1.71	2.08	1.02	4.29	24.17	44226
8.85	0.97	9.82		1.12	0.69	1.81	2.20	1.18	3.92	23.23	44620
8.00	*2.00*	*10.00*				*1.65*	*2.00*		*5.00*	*22.18*	
4.84	1.67	6.51				0.94	1.14	10.89		20.66	44227
5.00	*2.00*	*7.00*				*0.82*	*1.00*	*10.00*		*19.67*	
8.85	1.30	10.15		1.07	1.58	2.65	3.22		6.39	28.09	44229
7.96	2.05	10.01		0.79	1.81	2.60	3.16	0.84	5.48	26.89	44622
8.00	*2.00*	*10 00*				*2.47*	*3.00*		*6.00*	*26.25*	
7.44	1.52	8.96				1.05	1.27	1.48		14.70	44232
7.00	*1.00*	*8.00*				*0.82*	*1.00*	*1.00*		*12.67*	
7.68	2.15	9.83				0.99	1.20	3.88		17.43	44234
8.00	*2.00*	*10.00*				*0.82*	*1.00*	*3.00*		*16.27*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	The American Agr'l Chemical Co.	
44217	Cleveland Dryer Works Potato and Tobacco Fertilizer	Manufacturer
44904		W. G. Wesley, Mangum
	The American Agr'l Chemical Co., Bowker Fert. Works, Cincinnati, Ohio.	
44221	Harvest Bone	Manufacturer
44615		Dunagan & Kirtley, Horse Cave
44907		Dickinson Bros'. Wareh'se, Glasgow
44223	Fish Guano	Manufacturer
44617		Darnell Hdwe Co., Russell Springs
44908		Dunagan & Kirtley, Horse Cave
44224	Grain and Grass Grower	Manufacturer
44618		M. D. Royse, Winchester
44909		Miller, Cartwright & Miller, Elkton
44225	Kentucky Special	Manufacturer
44619		Dunagan & Kirtley, Horse Cave
44910		J. B. Perkins, Waynesburg
44226	Tobacco Grower	Manufacturer
44620		A. G. Miller & Co., Magnolia
44227	10% Manure	Manufacturer
44229	High Grade Fertilizer	Manufacturer
44622		Browning, McReynolds & Co., Lewisburg
	The American Agr'l Chemical Co., Michigan Carbon Works, Cincinnati, Ohio	
44232	Red Line Complete Manure	Manufacturer
44234	Red Line Tobacco Manure	Manufacturer

Complete Fertilizers.

Phosphoric Acid.			Nitrogen.				Equivalent to Ammonia.	Potash.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
8.01	1.96	9.97				0.97	1.18	3.85		$17.64	44217
8.44	1.31	9.75		0.34	0.62	0.96	1.17	3.10		17.11	44904
8.00	*2.00*	*10.00*				*0.82*	*1.00*	*3.00*		*16.27*	
8.52	1.58	10.10		0.28	0.64	0.92	1.12	1.25		15.32	44221
7.88	2.61	10.49				1.07	1.30	1.18		15.43	44615
8.77	1.06	9.83		0.48	0.47	0.95	1.15	1.15		15.42	44907
8.00	*2.00*	*10.00*				*0.82*	*1.00*	*1.00*		*14.27*	
8.56	1.66	10.22		0.27	0.78	1.05	1.27	3.79		18.40	44223
9.05	1.94	10.99				0.77	0.93	2.98	1.70	19.36	44617
8.97	0.65	9.62		0.34	0.71	1.05	1.27	3.28		17.98	44908
8.00	*2.00*	*10.00*				*0.82*	*1.00*	*3.00*		*16.27*	
8.16	2.69	10.85		0.35	1.46	1.81	2.20	2.51		19.72	44224
8.70	1.61	10.31		1.02	0.84	1.86	2.26	2.70		20.29	44618
8.48	1.25	9.73		0.66	1.06	1.72	2.09	2.18		18.88	44909
8.00	*2.00*	*10.00*				*1.65*	*2.00*	*2.00*		*18.18*	
8.52	1.50	10.02		0.63	0.60	1.23	1.49	4.32		19.45	44225
8.06	1.59	9.65		0.42	0.95	1.37	1.66	4.56		19.67	44619
7.56	0.84	8.40				1.35	1.64	4.36		18.50	44910
8.00	*2.00*	*10.00*				*1.23*	*1.50*	*4.00*		*18.71*	
9.43	1.72	11.15		0.76	0.95	1.71	2.08	1.02	4.29	24.17	44226
8.85	0.97	9.82		1.12	0.69	1.81	2.20	1.18	3.92	23.23	44620
8.00	*2.00*	*10.00*				*1.65*	*2.00*		*5.00*	*22.18*	
4.84	1.67	6.51				0.94	1.14	10.89		20.66	44227
5.00	*2.00*	*7.00*				*0.82*	*1.00*	*10.00*		*19.67*	
8.85	1.30	10.15		1.07	1.58	2.65	3.22		6.39	28.09	44229
7.96	2.05	10.01		0.79	1.81	2.60	3.16	0.84	5.48	26.89	44622
8.00	*2.00*	*10 00*				*2.47*	*3.00*		*6.00*	*26.25*	
7.44	1.52	8.96				1.05	1.27	1.48		14.70	44232
7.00	*1.00*	*8.00*				*0.82*	*1.00*	*1.00*		*12.67*	
7.68	2.15	9.83				0.99	1.20	3.88		17.43	44234
8.00	*2.00*	*10.00*				*0.82*	*1.00*	*3.00*		*16.27*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	The American Agr'l Chemical Co.	
44235	A-1 Potash Fertilizer	Manufacturer
44627		P. S. & G. D. Miller, Jamestown
44236	Red Line Crop Grower	Manufacturer
44237	Homestead Bone Black Fertilizer	Manufacturer
44628		J. H. Thurman, Somerset
44912		Miller, Cartwright & Miller, Elkton
44238	Homestead Potato and Tobacco Special	Manufacturer
44629		N. F. Hill, Bowling Green
44239	Homestead 10% Potash Manure	Manufacturer
44630		Woodson Lewis, Greensburg
44241	Homestead Tobacco Grower	Manufacturer
44631		J. R. Davis, Campbellsville
	The American Agr'l Chemical Co. Cincinnati Sales Dept., Cincinnati, Ohio.	
44242	N-W Horseshoe Brand Tobacco Grower	Manufacturer
44632		M. L. Spurling, Campbellsville
44243	N-W Horseshoe Brand Challenge Corn Grower	Manufacturer
44633		Snow & Conrad, Dry Ridge
44913		Grayson County Supply Co. Leitchf'ld
44244	N-W Horseshoe Brand Kentucky Tobacco Grower	Manufacturer
44634		Wm. Addams, Cynthiana
45245	N-W Horseshoe Brand Corn and Wheat Grower	Manufacturer
44635		J. H. Thurman, Somerset
44914		Watkins & Co., Elizabethtown
44246	N-W Horseshoe Brand Potash Manure	Manufacturer
44915		Watkins & Co., Elizabethtown

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.					POTASH.			
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.	Equivalent to Ammonia.	From Muriate.	From Sulphate	Estimated Value Per Ton.	Station Number.
7.86	2.12	9.98				1.00	1.21	3.85		$17.63	44235
8.16	1.85	10.01		0.45	0.54	0.99	1.20	3.34		17.34	44627
8.00	*2.00*	*10.00*				*0.82*	*1.00*	*3.00*		*16.27*	
7.91	2.89	10.80		0.21	1.55	1.76	2.14	2.53		19.34	44236
8.00	*2.00*	*10.00*				*1.65*	*2.00*	*2.00*		*18.18*	
9.08	1.25	10.33		0.62	1.56	2.18	2.65	1.95		20.98	44237
7.49	1.36	8.85		1.19	1.00	2.19	2.66	1.93		19.13	44628
8.23	0.48	8.71		1.07	1.10	2.17	2.63	1.75		19.42	44912
8.00	*2.00*	*10.00*				*2.06*	*2.50*	*1.50*		*19.11*	
9.07	1.78	10.85		0.73	0.86	1.59	1.93	0.92	4.33	23.28	44238
7.47	2.13	9.60		0.70	1.14	1.84	2.23		5.59	22.96	44629
8.00	*2.00*	*10.00*				*1.65*	*2.00*		*5.00*	*22.18*	
5.30	1.38	6.68				0.92	1.12	11.61		21.74	44239
5.30	1.06	6.36				0.98	1.19	10.24		20.46	44630
5.00	*2.00*	*7.00*				*0.82*	*1.00*	*10.00*		*19.67*	
10.83	1.98	12.81		2.30	0.87	3.17	3.85	5.24		30.13	44241
11.01	0.66	11.67		1.83	1.16	2.99	3.63	3.81		27.75	44631
10.00	*2.00*	*12.00*				*2.88*	*3.50*	*3.50*		*26.28*	
8.87	1.28	10.15		0.74	0.81	1.55	1.88	0.92	4.32	22.68	44242
8.54	1.05	9.59		1.00	0.79	1.79	2.17		5.16	23.13	44632
8.00	*2.00*	*10.00*				*1.65*	*2.00*		*5.00*	*22.18*	
8.42	1.52	9.94		0.63	1.59	2.22	2.70	1.91		20.39	44243
8.86	1.05	9.91		0.95	1.45	2.40	2.91	2.12		21.57	44633
8.04	0.94	8.98		1.21	0.93	2.14	2.60	1.81		19.33	44913
8.00	*2.00*	*10.00*				*2.06*	*2.50*	*1.50*		*19.11*	
7.86	2.65	10.51		0.27	1.49	1.76	2.14	2.77		19.42	44244
8.50	1.39	9.89		0.84	0.91	1.75	2.12	2.44		19.33	44634
8.00	*2.00*	*10.00*				*1.65*	*2.00*	*2.00*		*18.18*	
7.77	2.86	10.63		0.27	1.47	1.74	2.11	2.27		18.82	44245
8.36	1.38	9.74		1.00	0.79	1.79	2.17	2.53		19.38	44635
7.84	1.99	9.83		0.66	1.20	1.86	2.26	2.17		18.89	44914
8.00	*2.00*	*10.00*				*1.65*	*2.00*	*2.00*		*18.18*	
7.84	1.96	9.80				0.95	1.15	3.45		16.97	44246
8.01	1.16	9.17		0.24	0.67	0.91	1.10	2.98		16.24	44915
8.00	*2.00*	*10.00*				*0.82*	*1.00*	*3.00*		*16.27*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	The American Agr'l Chemical Co.,	
44247	N-W Horseshoe Brand Dark Tobacco Grower	Manufacturer
44636		Woodson Lewis, Greensburg
	The American Agr'l Chemical Co., Cincinnati Sales Dept., Cincinnati, Ohio.	
44257	Packers Boars Head Brand Sure Growth Potash Manure	Manufacturer
44643		J. H. Wyan. London
44258	Packers Boars Head Brand Special Tobacco Grower	Manufacturer
44644		W. M. West, Murray
44259	Packers Boars Head Brand Corn and Wheat Grower	Manufacturer
44645		J. T. Price, Dabney
44260	Packers Boars Head Brand H. Gr. Vegetable Fertilizer	Manufacturer
	The Armour Fertilizer Works, Nashville, Tenn.	
44017	Armour's Mixed Bone and Potash	Manufacturer
44604		W. H. Cambron, Waverly
44919		I. K. Miller & Sons, Campbellsville
44018	Armour's Bone Meal and Potash	Manufacturer
44920		I. K. Miller & Sons, Campbellsville
44019	Armour's Wheat Special No. 2	Manufacturer
44020	Armour's Record Brand	Manufacturer
44021	Armour's Champion	Manufacturer
44650		Simpson County Hdw. Co., Franklin
44921		Simpson County Hdw. Co., Franklin
44022	Armour's Tobacco Grower	Manufacturer
44651		Barren Co. Gro. & Hdw. Co. Glasgow

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.					POTASH.			
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.	Equivalent to Ammonia.	From Muriate.	From Sulphate	Estimated Value Per Ton.	Station Number.
7.36	1.35	8.71				1.52	1.85	1.50		$16.19	44247
7.79	2.17	9.96				0.95	1.15	1.30		14.85	44636
7.00	*1.00*	*8.00*				*0.82*	*1.00*	*1.00*		*12.67*	
7.93	2.08	10.01				0.97	1.18	3.67		17.42	44257
7.73	1.45	9.18		0.51	0.66	1.17	1.42	0.54	2.48	17.48	44643
8.00	*2.00*	*10 00*				*0.82*	*1.00*	*3.00*		*16.27*	
7.82	2.74	10.56		0.25	1.44	1.69	2.05	2.41		18.81	44258
7.74	0.88	8.62		0.53	1.29	1.82	2.21	2.18		18.19	44644
8.00	*2.00*	*10.00*				*1 65*	*2.00*	*2.00*		*18.18*	
7.85	2.97	10.82				.72	2.09	2.31		18.94	44259
8.33	1.86	10.19		0.93	1.09	2.02	2.45	2.37		20.18	44645
8.00	*2.00*	*10.00*				*1.65*	*2.00*	*2.00*		*18.18*	
8.72	1.48	10.20		0.69	0.84	1.53	1.86	0.98	4.16	22.38	44260
8.00	*2.00*	*10.00*				*1.65*	*2.00*		*5.00*	*22.18*	
11.85	7.99	19.84				1.15	1.40		4.47	26.81	44017
11.93	6.90	18.83				0.67	0.81		2.39	22.90	44604
10.60	8.55	19.15				0.81	0.98		4.22	24.04	44919
10.00	*8.00*	*18.00*				*0.82*	*1.00*		*4.00*	*22.87*	
8.95	13.31	22.26				1.62	1.97		3.51	25.94	44018
11.42	7.50	18.92				1.11	1.35		3.09	24.30	44920
10.00	*6.00*	*16.00*				*1.23*	*1.50*		*3.00*	*22.31*	
10.73	8.25	18.98	0.26		0.74	1.00	1.21	2.11		21.79	44019
10.00	*4.00*	*14.00*				*0.82*	*1.00*	*2.00*		*18.47*	
10.87	9.61	20.48	0.20		0.87	1.07	1.30	1.19		21.82	44020
10.00	*4.00*	*14.00*				*0.82*	*1.00*	*1.00*		*17.47*	
10.52	7.52	18.04				1.80	2.19		2.16	24.52	44021
8.54	3.20	11.74				1.51	1.83		1.70	18.86	44650
9.95	2.65	12.60				1.50	1.82		1.79	20 40	44921
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*2.00*	*21.78*	
9.92	8.91	18.83				1.92	2.33		5.55	28.84	44022
9.02	4.32	13.34				1.42	1.72	0.62	3.89	22.81	44651
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*5.00*	*22.98*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	The Armour Fertilizer Works.	
44023	Armour's H. Gr. Tobacco and Potato Grower	Manufacturer
44652		W. H. Henderson, Vanceburg
44024	Armour's Grain Grower	Manufacturer
44653		Barren Co. Gro. & Hdw. Co. Glasgow
44922		Barren Co. Gro. & Hdw. Co. Glasgow
44025	Armour's Corn and Wheat Grower	Manufacturer
44654		Simpson County Hdw. Co., Franklin
44026	Armour's Bone, Blood and Potash	Manufacturer
44027	Armour's White Burley and Black Tobacco	Manufacturer
44655		Stewart A. Dorsey, Carlisle
44028	Armour's Dark Tobacco Special	Manufacturer
44656		C. L. Dowdy, Mayfield
44029	Armour's Wheat, Corn and Oats Special	Manufacturer
44657		Barren Co. Gro. & Hdw. Co. Glasgow
44923		Barren Co. Gro. & Hdw. Co. Glasgow
44030	Armour's Ammoniated Bone and Potash	Manufacturer
	The Armour Fertilizer Works, for The T. J. Turley Co., Owensboro, Ky.	
44040	Ideal Half and Half	Manufacturer
44041	Ideal Grain Grower	Manufacturer
44668		McAtee Beauchamp Hardware Co., Russellville
44929		McAtee Vickers Hdw. Co. Russellv'l
44042	Ideal Tobacco Grower	Manufacturer
44669		McAtee Beauchamp Hardware Co., Russellville

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.					POTASH.			
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.	Equivalent to Ammonia.	From Muriate.	From Sulphate.	Estimated Value Per Ton.	Station Number.
8.74	5.39	14.13				1.74	2.11		10.93	$31.86	44023
7.93	4.12	12.05				**1.16**	1.41	1.04	9.62	**27.81**	44652
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*10.00*	28.98	
8.50	10 84	19.34				1.99	2.42	2.14		23.65	44024
7.86	6.31	14.17				1.39	1.69	2.35		19.17	44653
8.98	5.70	14.68		0.57	0.97	1.54	1.87	1.84		20.29	44922
8.00	*4.00*	*12.00*				*1.65*	*2.00*	*2.00*		*18.98*	
9.08	5.69	14.77				1.02	1.24	4.06		20.81	44025
8.05	4.62	12.67				0.65	0.79	0.80	3.08	18.29	44654
8.00	*4.00*	*12.00*				*0.82*	*1.00*	*4.00*		*18.07*	
8.11	3.54	11.65		2.30	1.91	4.21	5.11	0.90	7.14	35.36	44026
8.00	*4.00*	*12.00*				*4.12*	*5.00*		*7.00*	*34.02*	
8.58	6.64	15.22		1.50	1.57	3.07	3.73	0.90	4.01	29.42	44027
6.84	4.84	11.68		1.09	1.85	2.94	3.57	1.04	3.84	26.09	44655
8.00	*4.00*	*12.00*				*2.88*	*3.50*		*4.00*	*26.08*	
8.35	11.32	19.67				1.86	2.26		4.44	26.39	44028
7.27	4.64	11.91		0.39	1.21	1.60	1.94	**0.60**	**2.63**	19.94	44656
7.00	*4.00*	*11.00*				*1.65*	*2.00*		*4.00*	*20.58*	
7.90	9.42	17.32				1.01	1.23	0.78	0.53	18.21	44029
7.21	6.09	13.30				0.71	0.86	0.65		14.23	44657
7.22	3.85	11.07				0.73	0.89	0.74		13.50	44923
7.00	*4.00*	*11.00*				*0.82*	*1.00*	*1.00*		*13.87*	
6.40	13.94	20.34				2.62	3.18	2.16		24.59	44030
6.00	*4.00*	*10.00*				*2.47*	*3.00*	*2.00*		*19.45*	
10.06	13.91	23.97				1.66	2.02		2.57	26.52	44040
10.00	*6.00*	*16.00*				*1.23*	*1.50*		*2.00*	*21.11*	
8.52	6.90	15.42				1.00	1.21	3.05		19.52	44041
8.44	4.30	12.74		0.29	0.95	1.02	1.24	2.54		17.96	44668
8.28	1.86	**10.14**				0.94	1.14	3.10		17 07	44929
8.00	*4.00*	*12.00*				*0.82*	*1.00*	*3.00*		*17.07*	
8.90	9.80	18.70				1.77	2.15		4.44	26.13	44042
7.70	3.26	10.96	0.75		0.86	1.61	1.95	1.00	4.99	23.17	44669
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*4.00*	*21.78*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Armour Fert. Wks. for T. J. Turley Co.	
44043	Ideal Truck and H. Gr. Tobacco Grower	Manufacturer
44662		McAtee Beauchamp Hardware Co., Russellville
44045	Ideal Wheat Grower	Manufacturer
	The Armour Fertilizer Works, Nashville, Tenn.	
44046	Smith's Special Tobacco Grower	Manufacturer
44047	Smith's Corn and Wheat Grower	Manufacturer
44930		Greenville Hdw. & Gro. Co. Greenv'l
44048	Smith's Success Crop Grower	Manufacturer
44049	Smith's Standard Tobacco Grower	Manufacturer
44050	Smith's Ky. Tobacco Grower	Manufacturer
44051	Smith's H. Gr. Potato Grower	Manufacturer
44052	Smith's Grain Special	Manufacturer
44931		Ragle & Schoolcraft, Somerset
44053	Smith's Beef, Blood and Bone	Manufacturer
44932		Ragle & Schoolcraft, Somerset
44054	Smith's Pure Bone Meal with Potash	Manufacturer
44059	Fischer Brothers Special	Manufacturer
44663		The Fischer Bros. Co., Newport
44060	Fischer Brothers H. Gr. Fertilizer	Manufacturer
44664		The Fischer Bros. Co., Newport

Complete Fertilizers.

PHOSPHORIC ACID.			NITROGEN.					POTASH.			
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.	Equivalent to Ammonia.	From Muriate.	From Sulphate	Estimated Value Per Ton.	Station Number.
8.30	5.62	13.92	0.42		1.42	1.84	2.23		11.38	$32.31	44043
7.79	2.72	**10.51**	0.26		1.22	1.48	1.80	**1.04**	**7.38**	**25.52**	44662
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*10.00*	*28.98*	
9.47	11.03	20.50				1.66	2.02	2.31		23.89	44045
8.00	*4.00*	*12.00*				*1.65*	*2.00*	*2.00*		*18.98*	
8.64	9.22	17.86				1.74	2.11	0.60	4.99	26.74	44046
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*5.00*	*22.98*	
7.40	11.64	19.04				1.86	2.26	2.29		22.34	44047
8.48	7.46	15.94	0.56		1.10	1.66	2.02	2.17		21.14	44930
8.00	*4.00*	*12.00*				*1.65*	*2.00*	*2.00*		*18.98*	
7.77	9.26	17.03				1.07	1.30	1.17		17.94	44048
7.00	*4.00*	*11.00*				*0.82*	*1.00*	*1.00*		*13.87*	
8.45	11.87	20.32				1.89	2.29		4.34	26.72	44049
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*2.00*	*19.38*	
7.94	11.70	19.64				1.95	2.37		4.43	26.36	44050
7.00	*4.00*	*11.00*				*1.65*	*2.00*		*4.00*	*20.58*	
8.57	5.57	14.14	1.22		1.38	2.60	3.16		6.54	29.46	44051
8.00	*4.00*	*12.00*				*2.47*	*3.00*		*6.00*	*27.05*	
11.00	7.28	18.28	0.25		0.81	1.06	1.29	1.58	0.61	22.13	44052
9.86	3.44	13.30				0.78	0.95	1.96		17.90	44931
10.00	*4.00*	*14.00*				*0.82*	*1.00*	*2.00*		*18.47*	
11.01	7.61	18.62				1.86	2.26		2.33	25.56	44053
10.31	3.30	13.61	0.27		1.43	1.70	2.06	0.60	1.12	21.58	44932
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*2.00*	*21.78*	
12.12	8.20	20.32				1.19	1.44		4.35	27.21	44054
10.00	*8.00*	*18.00*				*0.82*	*1.00*		*4.00*	*22.87*	
8.26	10.15	18.41				1.44	1.75		4.90	24.89	44059
7.89	2.82	10.71		0.23	1.16	1.39	1.69	0.84	4.31	21.48	44663
8.00	*4.00*	*12.00*				*1.23*	*1.50*		*4.00*	*20.31*	
8.09	6.60	14.69		0.98	1.58	2.56	3.11		6.33	28.91	44060
7.52	6.20	13.72	0.32	0.66	1.33	2.31	2.80	**0.72**	**3.25**	**24.21**	44664
8.00	*4.00*	*12.00*				*2.47*	*3.00*		*6.00*	*27.05*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	The Armour Fertilizer Works.	
44085	Miller's Premium Tobacco Grower	Manufacturer
44086 44665	Miller's Dandy Tobacco Grower	Manufacturer Miller, Cartwright & Miller, Elkton
44551 44666	Dowdy's Tobacco Special	Manufacturer C. L. Dowdy, Mayfield
44552 44667	Dowdy's Tobacco Grower	Manufacturer C. L. Dowdy, Mayfield
	Baugh & Sons Co., Norfolk, Va,	
44548	Baugh's Animal Base and Potash Compound	Manufacturer
44550	Baugh's Complete Animal Base Fertilizer	Manufacturer
	C. S. Brent, Lexington, Ky.	
44530 44670	Brent's Tobacco Special	Manufacturer Manufacturer's Warehouse
44556 44671	Brent's Grain Grower	Manufacturer Manufacturer's Warehouse
	The Cincinnati Phosphate Co., Cincinnati, O.	
44491	High Grade Manure	*
44492	Grain and Grass Grower	*
44496	Tobacco, Potato and Beet Grower	*
44499	Bone and Phosphate Mixture Wheat Special	*
44500 44672	Truck and Tobacco Fertilizer	* A. H. Dawson, Owingsville

*The manufacturer failed to furnish sample required by law.

Complete Fertilizers.

PHOSPHORIC ACID.			NITROGEN.					POTASH.			
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.	Equivalent to Ammonia.	From Muriate.	From Sulphate	Estimated Value Per Ton.	Station Number.
10.00	1.75	**11.75**		1.11	1.57	2.68	3.25	0.74	6.39	$30.49	44085
10.00	*4.00*	*14.00*				*2.47*	*3.00*		*6.00*	*29.45*	
8.45	10.34	18.79				1.82	2.21	0.66	3.66	25.70	44086
9.24	4.30	13.54		0.44	0.66	**1.10**	1.34		**3.20**	**20.50**	44665
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*4.00*	*21.78*	
8.74	4.79	13.53				1.73	2.10		10.80	31.43	44551
7.60	4.55	12.15	0.46		1.23	1.69	2.05	**0.96**	**6.77**	**25.94**	44666
8.00						*1.65*	*2.00*		*10.00*	*27.38*	
9.22	7.81	17.03				1.75	2.12		5.20	26.55	44552
7.64	5.81	13.45	0.21		1.22	1.43	1.74	0.74	3.93	21.97	44667
8.00						*1.65*	*2.00*		*5.00*	*21.38*	
8.26	1.12	9.38		0.94	0.84	1.78	2.16	2.32		18.91	44548
8.00						*1.65*	*2.00*	*2.00*		*17.38*	
8.00	1.28	9.28		0.88	9.74	1.62	1.97	5.73		21.51	44550
8.00						*1.65*	*2.00*	*5.00*		*20.38*	
8.61	2.79	11.40	0.35	0.83	1.08	2.26	2.74		**6.25**	26.86	44530
7.54	2.79	10.33	0.33	1.14	1.02	2.49	3.02	**1.08**	**5.54**	26.62	44670
6.00						*2.47*	*3.00*		*8.00*	*25.45*	
9.22	2.80	12.02	0.60		0.64	**1.24**	1.51	2.19		18.71	44556
9.27	2.27	11.54	0.52		0.71	**1.23**	1.49	0.74	1.04	18.33	44671
8.00	*2.00*	*10.00*				*1.65*	*2.00*	*2.00*		*18.18*	
8.00	*1.00*	*9.00*				*1.23*	*1.50*	*2.50*		*16.81*	44491
8.00	*1.00*	*9.00*				*0.82*	*1.00*	*2.00*		*14.87*	44492
8.00	*1.00*	*9.00*				*0.82*	*1.00*	*4.00*		*16.87*	44496
8.00	*8.00*	*16.00*				*1.23*	*1.50*	*2.00*		*19.11*	44499
6.23	2.44	8.67				1.82	2.21	0.70	5.22	21.79	44500
6.00	*1.00*	*7.00*				*1.65*	*2.00*		*6.00*	*20.58*	44672

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Continental Fertilizer Co., Louisville, Ky.	
44284	Bear Beef, Blood and Bone	Manufacturer
44673		Grayson County Sup. Co., Leitchf'ld
44936		Wm. Leming, Hodgenville
44285	Bear Grain Special	Manufacturer
44286	Bear Tobacco Grower	Manufacturer
44674		Grayson County Sup. Co., Leitchf'ld
44287	Bear Potato Grower	Manufacturer
44288	Bear Truck Grower	Manufacturer
44675		Grayson County Sup. Co., Leitchf'ld
44289	Bear Special Tobacco Grower	Manufacturer
44676		T. Z. Leachman, Greensburg
44290	Bear Grain Grower	Manufacturer
44677		Wm. Leming, Hodgenville
44291	Bear Slaughter House Bone	Manufacturer
44292	Bear High Grade Tobacco and Potato Grower	Manufacturer
44678		T. Z. Leachman, Greensburg
44293	Bear Spl. Corn and Wheat Grower	Manufacturer
44679		T. Z. Leachman, Greensburg
44593	Bear Special Grain Grower	Manufacturer
	Duncan & Bro., La Grange, Ky.	
44125	Tiger Brand Tobacco Grower	Manufacturer
44517	Tiger Brand Potato Grower	Manufacturer

Complete Fertilizers.

PHOSPHORIC ACID.			NITROGEN.				Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
9.92	2.40	**12.32**	0.38		1.60	1.98	2.40	0.58	2.01	$22.78	44284
8.92	2.68	11.60	0.66		0.58	**1.24**	1.51		2.08	**18.61**	44673
11.35	1.96	13.31	0.55		0.88	1.43	1.74		**1.54**	21.26	44936
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*2.00*	*21.78*	
10.62	1.05	**11.67**	0.37		0.32	0.69	0.84	0.60	1.34	**17.79**	44285
10.00	*4.00*	*14.00*				*0.82*	*1.00*		*2.00*	*18.87*	
8.32	1.39	**9.71**	0.28	1.41	0.88	2.57	3.12	0.84	6.27	27.90	44286
7.67	1.42	**9.09**	1.38		0.81	2.19	2 66	1.30	5.55	**25.40**	44674
8.00	*4.00*	*12.00*				*2.47*	*3.00*		*6.00*	*27.05*	
8.57	1.44	10.01	0.26	1.46	0.83	2.55	3.10	1.02	5.88	27.87	44287
8.00	*4.00*	*12.00*				*2.47*	*3.00*		*6.00*	*27.05*	
7.83	1.73	**9.56**				1.75	2.12		10.61	28.95	44288
6.30	1.31	7.61	1.10		0.43	1.53	1.86	1.34	9.23	**25.86**	44675
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*10.00*	*28.98*	
8.65	0.82	**9.47**	0.25		0.54	0.79	0.96	0.54	1.07	15.30	44289
7.57	3.00	**10.57**	0.31		0.57	0.88	1.07	0.54	0.88	14.96	44676
8.00	*4.00*	*12.00*				*0.82*	*1.00*		*1.50*	*15.87*	
8.41	1.05	**9.46**	0.44			0.44	0.53		4.19	17.08	44290
7.47	2.47	**9.94**	0.30		0.31	0.61	0.74	4.29		**16.38**	44677
8.00	*4.00*	*12.00*				*0.41*	*0.50*		*4.00*	*17.44*	
7.78	2.04	**9.82**	0.21		1.53	1.74	2.11		2.77	19.57	44291
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*2.00*	*19.38*	
7.56	2.18	9.74	0.31		1.29	1.60	1.94	0.80	3.76	20.85	44292
7.28	2.83	10.11	0.52	0.27	0.81	1.60	1.94	0.86	2.94	19.86	44678
7.00	*4.00*	*11.00*				*1.65*	*2.00*		*4.00*	*20.58*	
7.55	0.80	**8.35**				0.74	0.90		1.34	13.58	44293
9.63	2.61	12.24	0.32		0.54	0.86	1.04		1.10	16.93	44679
7.00	*4.00*	*11.00*				*0.82*	*1.00*		*1.00*	*14.07*	
8.99	0.23	**9.22**				0.45	0.55		3.18	16.28	44593
8.00	*4.00*	*12.00*				*0.41*	*0.50*		*3.00*	*16.24*	
7.64	5.02	12.66	1.45		0.43	1.88	2.28		6.36	25.39	44125
8.00	*2.00*	*10.00*				*1.65*	*2.00*		*6.00*	*23.38*	
8.07	3.66	11.73	1.60		0.66	2.26	2.74		6.81	27.22	44517
8.00	*2.00*	*10.00*				*2.47*	*3.00*		*6.00*	*26.25*	

TABLE I

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Duncan & Bro.	
44519 44681	Tiger Brand Grain Grower	Manufacturer Manufacturer's Warehouse
44547	Tiger Brand Superphosphate	*
44554	Tiger Brand Special Corn and Wheat Grower	Manufacturer
	The Empire Guano Co., Nashville, Tenn.	
42994	Special Corn Grower	Manufacturer
42995	Climax Wheat Grower	Manufacturer
42996	Favorite Manure	Manufacturer
42997	Special Grain Grower	Manufacturer
42998	Blood, Bone and Potash	Manufacturer
42999	Red Banner Special	Manufacturer
43000	Red Banner Tobacco Special	*
44001 44683	High Grade Tobacco Grower	Manufacturer J. L. Durham, Greensburg
44002	High Grade Tobacco Special	*
44003	Climax Tobacco Grower	Manufacturer
44004	XXX Tobacco Special	Manufacturer
44005	Wheat and Corn Grower	Manufacturer

*The manufacturer failed to furnish sample required by law.

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.				Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
13.75	5.30	19.05	0.37		0.40	0.77	0.93		2.10	$23.84	44519
10.53	5.14	15.67	0.29		0.63	0.92	1.12		0.92	19.02	44681
12.00	*2.00*	*14.00*				*0.82*	*1.00*		*1.00*	*19.27*	
											44547
8.00	*2.00*	*10.00*				*1.65*	*2.00*		*2.00*	*18.58*	
9.96	4.84	14.80				1.76	2.14		3.66	24.44	44554
10.00	*2.00*	*12.00*				*1.65*	*2.00*		*2.00*	*20.98*	
10.06	10.44	20.50				1.30	1.58	0.74	2.23	24.22	42994
8.00	*5.00*	*13.00*				*0.82*	*1.00*		*3.00*	*18.07*	
10.73	4.44	15.17				2.20	2.67	**0.82**	**2.40**	26.06	42995
10.00	*5.00*	*15.00*				*1.65*	*2.00*		*4.00*	*24.58*	
11.73	6.45	18.18				1.51	1.83	0.92	1.88	25.13	42996
10.00	*5.00*	*15.00*				*0.82*	*1.00*		*3.00*	*20.47*	
11.17	8.92	20.09				1.27	1.54	0.58	0.63	22.76	42997
10.00	*5.00*	*15.00*				*0.82*	*1.00*		*1.00*	*18.07*	
9.83	7.88	17.71				2.12	2.57	0.74	1.93	25.42	42998
8.00	*5.00*	*13.00*				*1.65*	*2.00*		*2.00*	*19.78*	
10.80	5.83	16.63				2.38	2.89	0.64	1.03	25.50	42999
10.00	*5.00*	*15.00*				*1.65*	*2.00*		*2.00*	*22.18*	
											43000
8.00	*5.00*	*13.00*				*1.65*	*2.00*		*2.00*	*19.78*	
10.10	7.47	17.57				2.00	2.43	0.92	2.53	26.07	44001
8.87	6.49	15.36		0.83	0.77	1.60	1.94	1.90	2.55	23.80	44683
8.00	*5.00*	*13.00*				*1.65*	*2.00*		*4.00*	*22.18*	
											44002
8.00	*5.00*	*13.00*				*1.65*	*2.00*		*8.00*	*26.98*	
10.77	4.42	15.19				2.25	2.73	**0.74**	**2.59**	26.42	44003
10.00	*5.00*	*15.00*				*1.65*	*2.00*		*4.00*	*24.58*	
9.73	3.74	13.47				2.24	2.95	**1.44**	**5.62**	29.20	44004
8.00	*5.00*	*13.00*				*1.65*	*2.00*		*10.00*	*29.38*	
12.47	8.39	20.86				0.55	0.67	0.64	1.46	22.64	44005
11.00	*5.00*	*16.00*				*0.41*	*0.50*		*1.00*	*17.84*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	The Evansville Packing Co., Evansville, Ind.	
44404	Tobacco Special	Manufacturer
44406	Half and Half Mixture	Manufacturer
44407	Special 10% Potash	Manufacturer
44408 44685	Potato and Tobacco Grower	Manufacturer W. A. Guenther & Sons, Owensboro
44409 44686	Beef, Blood and Bone	Manufacturer Eldred Hardware Co., Princeton
44410	Favorite Formula	Manufacturer
44411	Corn and Wheat Special	Manufacturer
44412	Harvest King	Manufacturer
44413	Bone and Potash	Manufacturer
44416 44688	Guenther's Superior Corn Grower	Manufacturer W. A. Guenther & Sons, Owensboro
44417 44689	Guenther's Corn and Tobacco Gr.	Manufacturer W. A. Guenther & Sons, Owensboro
44418	Guenther's Superior Vegetable Gr.	Manufacturer
44419	Guenther's Superior Tobacco Fert.	Manufacturer
44420	Guenther's 10% Potash	Manufacturer

Complete Fertilizers.

Phosphoric Acid.			Nitrogen.				Equivalent to Ammonia.	Potash.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
10.85	1.80	12.65				3.45	4.19		3.79	$30.37	44404
10.00	*2.00*	*12.00*				*3.29*	*4.00*		*4.00*	*29.12*	
10.13	2.15	12.28				2.70	3.28	2.84		25.31	44406
10.00	*2.00*	*12.00*				*2.47*	*3.00*	*2.00*		*23.45*	
4.82	1.49	6.31				0.90	1.09		10.39	22.00	44407
5.00	*1.00*	*6.00*				*0.82*	*1.00*		*10.00*	*21.27*	
7.24	3.21	10.45				1.81	2.20		5.01	22.32	44408
7.47	2.78	10.25				1.69	2.05		4.95	21.93	44685
8.00	*2.00*	*10.00*				*1.65*	*2.00*		*5.00*	*22.18*	
8.20	2.50	10.70				1.68	2.04		2.15	19.30	44409
7.98	2.96	10.94				1.46	1.77	1.42	1.81	19.46	44686
8.00	*2.00*	*10.00*				*1.65*	*2.00*		*2.00*	*18.58*	
10.23	3.16	13.39				1.79	2.17		6.61	27.74	44410
10.00	*2.00*	*12.00*				*1.65*	*2.00*		*7.00*	*26.98*	
11.17	2.00	13.17				0.79	0.96	3.00		19.97	44411
12.00	*2.00*	*14.00*				*0.82*	*1.00*	*3.00*		*21.07*	
7.27	2.15	9.42				1.06	1.29	2.44	0.61	16.46	44412
8.00	*2.00*	*10.00*				*1.00*	*1.21*	*2.00*		*15.90*	
6.05	2.24	8.29				1.21	1.47	1.08		13.48	44413
7.00	*2.00*	*9.00*				*0.82*	*1.00*	*1.00*		*13.07*	
7.48	2.03	9.51				1.07	1.30	2.95		16.49	44416
8.35	2.27	10.62				1.15	1.40	1.79		16.75	44688
8.00	*2.00*	*10.00*				*1.00*	*1.21*	*2.00*		*15.90*	
8.08	2.51	10.59				1.83	2.22		2.07	19.59	44417
7.32	2.89	10.21				1.44	1.75	0.56	1.83	17.74	44689
8.00	*2.00*	*10.00*				*1.65*	*2.00*		*2.00*	*18.58*	
11.07	1.68	12.75				3.60	4.37		3.76	31.06	44418
10.00	*2.00*	*12.00*				*3.29*	*4.00*		*4.00*	*29.12*	
10.44	2.80	13.24				1.99	2.42		6.84	28.83	44419
10.00	*2.00*	*12.00*				*1.65*	*2.00*		*7.00*	*26.98*	
5.24	1.33	6.57				1.95	2.37		10.05	23.70	44420
5.00	*1.00*	*6.00*				*0.82*	*1.00*		*10.00*	*21.27*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Federal Chemical Co., Louisville, Ky.	
42823	Daybreak Standard Corn and Wheat Grower	Manufacturer
44691		Richmond Coal & Sup. Co., Richmond
42824	Daybreak High Grade Fertilizer	Manufacturer
42825	Daybreak Favorite	Manufacturer
42826	Daybreak Special Tabacco Grower	Manufacturer
42827	Daybreak Vegetable Grower	Manufacturer
44692		R. C. Perry, Smokey Valley
42828	Daybreak Standard Crop and Tobacco Grower	Manufacturer
44693		J. R. Sower Hdw. Co., Frankfort
42829	Daybreak Special Manure	Manufacturer
42830	Grigsby's Special Wheat Grower	Manufacturer
42831	Daybreak Wheat and Corn Special	Manufacturer
44694		A. H. Miller Imp. Co., Elizabetht'n
44941		A. H. Miller Imp. Co., Elizabetht'n
42832	Daybreak Corn and Clover Grower	Manufacturer
42833	Daybreak Grain Grower	Manufacturer
42834	Daybreak Potato and Tobacco Gr.	Manufacturer
44695		Warehouse, Horse Cave
42837	Daybreak Beef, Blood and Bone	Manufacturer

Complete Fertilizers.

Phosphoric Acid.			Nitrogen.				Equivalent to Ammonia.	Potash.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
11.12	6.67	17.79		2.31		2.31	2.80	0.74	2.27	$27.56	42823
8.51	3.86	12.37	0.89		0.96	1.85	2.25	2.94		21.17	44691
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*2.00*	*19.38*	
14.03	2.80	16.83		2.33		2.33	2.83		2.87	29.56	42824
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*2.00*	*21.78*	
14.88	1.80	16.68		1.44		1.44	1.75		3.94	28.35	42825
11.00	*4.00*	*15.00*				*0.82*	*1.00*		*3.00*	*21.27*	
11.70	3.97	15.67		1.77		1.77	2.15	0.80	5.64	29.40	42826
8.00	*4.00*	*12.00*				*1.23*	*1.50*		*6.00*	*22.71*	
11.97	4.12	16.09		2.25		2.25	2.73	0.64	4.79	30.28	42827
7.65	4.07	11.72	1.21		0.65	1.86	2.26	0.74	6.17	25.46	44692
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*5.00*	*22.98*	
10.54	5.98	16.52		1.61		1.61	1.95	0.82	4.10	26.42	42828
8.85	4.58	13.43	0.33		0.62	0.95	1.15	5.38		21.16	44693
8.00	*4.00*	*12.00*				*0.82*	*1.00*		*4.00*	*18.87*	
13.52	3.95	17.47		1.41		1.41	1.71		2.85	26.16	42829
10.00	*4.00*	*14.00*				*0.82*	*1.00*		*2.00*	*18.87*	
14.23	3.61	17.84		1.43		1.43	1.74		2.84	26.94	42830
10.00	*2.00*	*12.00*				*0.82*	*1.00*		*2.00*	*18.07*	
14.64	3.90	18.54		1.03		1.03	1.25	0.50	1.47	25.00	42831
11.86	5.43	17.29				0.53	0.64	1.43		19.69	44694
11.62	5.11	16.73				0.61	0.74	0.86		18 98	44941
11.00	*4.00*	*15.00*				*0.41*	*0.50*		*1.00*	*17.44*	
12.97	5.94	18.91		1.54		1.54	1.87		2.05	25.79	42832
9.00	*4.00*	*13.00*				*0.82*	*1.00*		*1.00*	*16.47*	
13.25	6.17	19.42		1.16		1.16	1.41		2.38	25.29	42833
9.00	*4.00*	*13.00*				*0.41*	*0.50*		*1.50*	*15.64*	
11.07	2.70	13.77		3.03		3.03	3.68	0.80	7.30	28.53	42834
8.56	3.11	11.67	0.95		0.65	1.60	1.94	0.88	6.16	25.38	44695
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*7.50*	*25.98*	
13.54	2.84	16.38		2.37		2.37	2.88		2.88	29.15	42837
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*2.00*	*21.78*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Federal Chemical Co.	
42838	Daybreak Champion Mixture	Manufacturer
42839	Daybreak H. Gr. Truck and Tobacco Grower	Manufacturer
44110		Wm. F. Klein, St. Matthews
44521		Chas. Scoggan, Buechel
44583		F. Winkler, St. Matthews
44585		Henry Hahn, St. Matthews
44649		R. W. Maddox, Prospect
44942		St. Matthews Produce Ex. St. Mths
42840	Daybreak Red Rooster Grain and Tobacco Grower	Manufacturer
42841	Daybreak Bone and Tobacco Special	Manufacturer
42842	Daybreak Royal Tobacco Mixture	Manufacturer
42843	Daybreak Special	Manufacturer
42857	St. Matthews Produce Exchange Potato Grower	Manufacturer
44082		Fred Rothenburger, St. Matthews
44083		Frank Meisner, Jr., St. Matthews
44084		Felix Kerrick, Louisville
44111		C. H. Brenner, St. Matthews
44112		R. W. Maddox, Prospect
44196		H. D. Murphy, St. Matthews
44324		H. A. Holzheimer, St. Matthews
44522	High Grade Truck and Tomato Gr.	Manufacturer
44523	Best Truck and Tobacco Grower	Manufacturer
44564	Blue Grass Tobacco Grower	Manufacturer
44647	Daybreak Royal Wheat and Grain Special	Manufacturer

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.				Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
15.04	1.59	16.63		1.28		1.28	1.55		3.71	$27.62	42838
11.00	*4.00*	*15.00*				*0.41*	*0.50*		*3.50*	*20.44*	
11.42	2.72	14.14		3.03		3.03	3.68	1.02	5.92	33.52	42839
8.23	2.82	11.05	1.47		0.98	2.45	2.97		7.14	28.16	44110
9.70	2.83	12.53	1.42		1.36	2.78	3.37		6.18	29.92	44521
7.86	2.84	**10.70**	1.40		1.08	2.48	3.01		6.60	27.17	44583
8.48	2.27	10.75	1.67		1.09	2.76	3.35		7.06	29.22	44585
8.49	2.82	11.31	2.06		0.76	2.82	3.42	3.58	3.15	28.55	44649
8.08	2.36	**10.44**	1.46		1.31	2.77	3.36	0.80	6.04	28.39	44942
8.00	*4.00*	*12.00*				*2.47*	*3.00*		*6.00*	*27.05*	
11.31	7.71	19.02		1.05	0.38	1.43	1.74		3.66	26.05	42840
8.00	*4.00*	*12.00*				*0.82*	*1.00*		*2.00*	*16.47*	
13.61	4.45	18.06		1.10		1.10	1.34		3.65	26.34	42841
10.00	*4.00*	*14.00*				*0.41*	*0.50*		*2.00*	*17.44*	
13.16	3.75	16.91		1.18		1.18	1.43		5.09	27.53	42842
10.00	*4.00*	*14.00*				*0.41*	*0.50*		*4.00*	*19.83*	
14.52	1.44	15.96		1.09		1.09	1.32		6.88	30.08	42843
11.00	*4.00*	*15.00*				*0.41*	*0.50*		*5.00*	*22.24*	
11.98	2.33	14.31		3.02		3.02	3.67	0.78	6.08	33.96	42857
8.47	3.21	11.68	1.67		0.93	2.60	3.16		6.04	27.79	44082
9.55	4.62	14.17	1.12		1.22	2.34	2.84		6.31	29.07	44083
8.19	3.42	11.61	1.53		1.14	2.67	3.24		6.40	28.23	44084
9.14	3.51	12.65	1.46		1.04	2.50	3.04		6.34	28.73	44111
8.43	4.17	12.60	1.29		1.08	2.37	2.88		6.75	28.19	44112
8.75	3.94	12.69	1.22		1.30	2.52	3.06		6.77	29.02	44196
9.52	2.80	12.32	1.63		1.03	2.66	3.23		6.56	29.72	44324
8.00						*2.47*	*3.00*		*6.00*	*25.45*	
13.85	0.74	14.59		2.74		2.74	3.33		8.86	37.14	44522
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*6.00*	*26.58*	
10.13	1.66	11.79		2.57		2.57	3.12		11.30	35.38	44523
8.00	*4.00*	*12.00*				*1.25*	*1.52*		*10.00*	*27.58*	
7.66	6.25	13.91		3.06		3.06	3.71	1.44	10.11	35.97	44564
5.00	*5.00*	*10.00*				*1.65*	*2.00*		*10.00*	*25.78*	
15.20	1.63	16.83		1.43		1.43	1.74		2.58	27.00	44647
12.00	*4.00*	*16.00*				*0.82*	*1.00*		*1.00*	*20.07*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Fox Chemical Co., Branch Federal Chemical Co., Louisville, Ky.	
42858 44702	Fox Wheat and Corn Manure	Manufacturer Eaton & McGuire, Clay City
42859 44703	Fox Tobacco Grower	Manufacturer J. F. Brandon & Son, Benton
42860	Fox Wheat and Corn Grower	Manufacturer
42861 44704 44949	Fox Formula	Manufacturer T. Z. Leachman, Greensburg M. L. Spurling, Campbellsville
42862 44705	Fox Special Tobacco Grower	Manufacturer A. B. Beale & Son, Murray
42863	Fox Vegetable Grower	Manufacturer
42864 44706 44950	Fox Crop and Tobacco Grower	Manufacturer M. L. Spurling, Campbellsville O. A. Lutes & Co., Shepherdsville
42865	Fox Early Harvest	Manufacturer
42866 44707	Fox Ten One Ten	Manufacturer M. L. Spurling, Campbellsville
42867	Fox High Grade Tobacco Grower	Manufacturer
42868	Fox wheat and Grain Special	Manufacturer
42869	Fox Bone, Blood and Potash	Manufacturer
42870 44951	Fox Grain Grower	Manufacturer O. A. Lutes & Co., Shepherdsville

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.				Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
11.87	5.99	17.86		2 35		2.35	2.85		2.89	$28.34	42858
8.96	5.64	14.60	0.90		0.62	1.52	1.85	2.31		20.64	44702
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*2.00*	*19.38*	
11.40	6.39	17.79		2.46		2.46	2.99		2.93	28.37	42859
7.99	5.41	13.40	1.23		0.59	1.82	2.21		2.23	20.80	44703
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*2.00*	*19.38*	
13.75	2.77	16.52		2.34		2.34	2.84		3.02	29.42	42860
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*2.00*	*21.78*	
14.59	1.96	16.55		1.44		1.44	1.75		3.80	27.89	42861
12.17	1.50	13.67	0.27		0.64	0.91	1.10	3.42		21.81	44704
10.72	4.35	15.07	0.54		0.57	1.11	1.35	2.72		21.21	44949
11.00	*4.00*	*15.00*				*0.82*	*1.00*		*3.00*	*21.27*	
11.84	4.39	16.23		2.19		2.19	2.66		5.55	30.30	42862
9.11	3.38	12.49	0.89		0.85	1.74	2.11	**1.02**	**3.01**	23.00	44705
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*5.00*	*22.98*	
12.29	4.09	16.38		2.25		2.25	2.73		5.24	30.56	42863
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*5.00*	*22.98*	
11.71	6.06	17.77		1.45	0.20	1.65	2.00		4.83	28.05	42864
8.17	3.53	11.70	0.32		0.67	0.99	1.20	0.62	3.50	19.50	44706
8.83	6.41	15.24	0.31		0.66	0.97	1.18	0.64	3.54	21.45	44950
8.00	*4.00*	*12.00*				*0.82*	*1.00*		*4.00*	*18.87*	
13.91	3.53	17.84		1.43		1.43	1.74		2.82	26.49	42865
10.00	*4.00*	*14.00*				*0.82*	*1.00*		*2.00*	*18.87*	
12.35	0.32	12.67		1.63		1.63	1.98		10.94	33.79	42866
9.59	4.19	13.78	0.76		0.32	1.08	1.31	**7.56**		**24.53**	44707
10.00	*4.00*	*14.00*				*0.82*	*1.00*		*10.00*	*28.47*	
11.71	2.27	13.98		4.08		4.08	4.95	0.68	4.74	35.61	42867
8.00	*4.00*	*12.00*				*3.29*	*4.00*		*4.00*	*27.52*	
15.65	1.26	16.91		1.44		1.44	1.75		2.62	27.46	42868
12.00	*4.00*	*16.00*				*0.82*	*1.00*		*1.00*	*20.07*	
15.30	3.47	18.77		1.03		1.03	1.25		1.86	25.59	42869
11.00	*4.00*	*15.00*				*0.41*	*0.50*		*1.00*	*17.44*	
13.58	5.62	19.20		1.53		1.53	1.86		2.00	26.31	42870
10.93	5.84	16.77				0.84	1.02	1.00		19.40	44951
9.00	*4.00*	*13.00*				*0.82*	*1.00*		*1.00*	*16.47*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Fox Chemical Co., Branch Fed. Chem. Co.	
42871	Fox Grain Special	Manufacturer
42872	Fox Potato and Tobacco Grower	Manufacturer
42875	Fox Ideal Fertilizer	Manufacturer
42876	Red Fox Grain and Tobacco Special	Manufacturer
42877	Fox Burley Tobacco Special	Manufacturer
44708		J. F. Brandon & Son, Benton
42878	Fox Tobacco and Potash Mixture	Manufacturer
44709		T. Z. Leachman, Greensburg
	Globe Fertilizer Co., Branch Federal Chemical Co., Louisville, Ky.	
42890	Eagle Wheat and Corn Grower	Manufacturer
44712		W. H. Lyon, Loretto
42891	Big Four Tobacco Grower	Manufacturer
44713		C. L. Dudley, Flemingsburg
42892	Globe Wheat Grower	Manufacturer
44952		Fred Sandmeyer, Liberty
42893	Braden Formula	Manufacturer
44714		W. H. Lyon, Loretto
42894	Ky. Standard Tobacco Grower	Manufacturer
44715		The Jeffries Hdw. Store, Columbia
42895	Globe Soluble Vegetable Manure	Manufacturer
44716		J. W. Cloyd, Campbellsville

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.					POTASH.			
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.	Equivalent to Ammonia.	From Muriate.	From Sulphate	Estimated Value Per Ton.	Station Number.
13.05	6.18	19.23		1.21		1.21	1.47		2.44	$25.30	42871
9.00	*4.00*	*13.00*				*0.41*	*0.50*		*1.50*	*15.64*	
11.01	2.89	13.90		3.28		3.28	3.98	0.98	6.94	35.16	42872
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*7.50*	*25.98*	
13.97	2.61	16.58		1.22		1.22	1.48		4.22	27.13	42875
11.00	*4.00*	*15.00*				*0.41*	*0.50*		*2.50*	*19.24*	
11.09	7.89	18.98		1.43		1.43	1.74	0.78	2.73	25.54	42876
8.00	*4.00*	*12.00*				*0.82*	*1.00*		*2.00*	*16.47*	
13.45	4.44	17.89		1.11		1.11	1.35		3.47	25.97	42877
10.56	5.65	16.21				0.49	0.59		1.85	18.87	44708
10.00	*4.00*	*14.00*				*0.41*	*0.50*		*2.00*	*17.44*	
13.29	3.82	17.11		1.20		1.20	1.46		5.62	28.42	42878
11.84	4.81	16.65				0.42	0.51	4.73		22.33	44709
10.00	*4.00*	*14.00*				*0.41*	*0.50*		*4.00*	*19.84*	
12.11	5.89	18.00		2.19	0.22	2.41	2.93		2.86	28.76	42890
9.91	5.65	15.56	0.92		0.64	1.56	1.89	1.64	0.63	22.01	44712
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*2.00*	*19.38*	
11.86	6.12	17.98		2.23	0.24	2.47	3.00		2.81	28.70	42891
8.91	5.98	14.89	1.10		0.61	1.71	2.08	2.22		21.29	44713
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*2.00*	*19.38*	
13.83	2.75	16.58		2.35		2.35	2.85		2.97	29.49	42892
10.33	2.55	12.88	1.04		0.70	1.74	2.11	2.12		21.63	44952
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*2.00*	*21.78*	
14.51	1.96	16.47		1.40		1.40	1.70		3.74	27.58	42893
11.91	1.76	13.67	0.47		0.65	1.12	1.36	3.59		22.50	44714
11.00	*4.00*	*15.00*				*0.82*	*1.00*		*3.00*	*21.27*	
12.26	4.07	16.33		2.18		2.18	2.65		5.08	30.07	42894
7.97	4.72	12.69	0.85		0.81	1.66	2.02	4.74	0.55	22.66	44715
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*5.00*	*22.98*	
11.78	4.41	16.19		2.18		2.18	2.65		5.34	29.94	42895
8.74	1.94	10.68	0.85		0.88	1.73	2.10	0.78	5.17	24.31	44716
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*5.00*	*22.98*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Globe Fert. Co., Branch Fed. Chem. Co.	
42896	Universal Crop & Tobacco Grower	Manufacturer
44717		J. W. Cloyd, Campbellsville
42897	Progress Corn and Wheat Grower	Manufacturer
44718		W. H. Lyon, Loretto
44953		L. R. Chelf, Knifley
42898	Globe Blood, Bone and Tob. Mixture	Manufacturer
44719		Evans, Goodman & Maxey, Glasgow
42899	Globe Special Potato Grower	Manufacturer
42900	Globe H. Gr. Tobacco Grower	Manufacturer
44720		W. H. Bragg, Alone
42901	Globe Potato Grower	Manufacturer
44721		Gatliff-Davis Hdw. Co., Williamsb'g
42902	Globe Wheat and Grain Special	Manufacturer
44722		W. H. Lyon, Loretto
42903	Globe Bone and Potash	Manufacturer
42904	Globe Grain and Grass Grower	Manufacturer
44723		A. T. Warder, Epworth
42905	Globe Bone Dust	Manufacturer
44724		C. L. Dudley, Flemingsburg
42906	Globe Grain Grower	Manufacturer
42907	Globe Potato and Tobacco Grower	Manufacturer
44725		Bedford & Tuttle, Winchester

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.					POTASH.			
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.	Equivalent to Ammonia.	From Muriate.	From Sulphate	Estimated Value Per Ton.	Station Number.
11.62	6.29	17.91		1.63		1.63	1.98	0.88	3.68	$27.47	42896
10.20	3.58	13.78	0.51		0.57	1.08	1.31	4.61		22.06	44717
8.00	*4.00*	*12.00*				*0.82*	*1.00*		*4.00*	*18.87*	
14.12	3.58	17.70		1.48		1.48	1.80		2.78	26.89	42897
11.58	4.12	15.70	0.39		0.57	0.96	1.17	2.33		21.24	44718
10.45	6.88	17.33				0.88	1.07	2.50		20.87	44953
10.00	*4.00*	*14.00*				*0.82*	*1.00*		*2.00*	*18.87*	
13.81	3.49	17.30		1.55		1.55	1.88		6.35	31.02	42898
9.56	8.83	18.39				0.56	0.68		3.86	21.59	44719
8.00	*4.00*	*12.00*				*0.41*	*0.50*		*4.00*	*17.44*	
11.32	2.69	14.01		3.05		3.05	3.70	0.92	5.72	33.21	42899
8.00	*4.00*	*12.00*				*2.47*	*3.00*		*6.00*	*27.06*	
11.60	2.40	14.00		3.97		3.97	4.82		5.11	34.91	42900
8.08	3.82	11.90	2.54		0.58	3.12	3.79	**0.74**	**2.72**	**26.15**	44720
8.00	*4.00*	*12.00*				*3.29*	*4.00*		*4.00*	*27.52*	
11.40	2.37	13.77		3.75	0.21	3.96	4.81		5.27	34.81	42901
8.47	5.65	14.12	2.45		0.45	2.90	3.52	**0.74**	**2.11**	**25.84**	44721
8.00	*4.00*	*12.00*				*3.29*	*4.00*		*4.00*	*27.52*	
15.92	1.40	17.32		1.51		1.51	1.83		2.50	28.16	42902
12.28	2.21	**14.49**	0.37		0.68	1.05	1.27	1.14	0.49	21.03	44722
12.00	*4.00*	*16.00*				*0.82*	*1.00*		*1.00*	*20.07*	
14.76	3.93	18.69		1.02		1.02	1.24		1.71	24.90	42903
11.00	*4.00*	*15.00*				*0.41*	*0.50*		*1.00*	*17.44*	
14.90	4.17	19.07		0.96		0.96	1.17		1.79	25.06	42904
12.75	4.49	17.24	0.21		0.46	0.67	0.81	1.34	0.54	21.44	44723
11.00	*4.00*	*15.00*				*0.41*	*0.50*		*1.00*	*17.44*	
13.11	6.16	19.27		1.49		1.49	1.81		1.92	25.71	42905
9.07	5.89	14.96	0.28		0.68	0.96	1.17	1.54		18.14	44724
9.00	*4.00*	*13.00*				*0.82*	*1.00*		*1.00*	*16.47*	
12.55	6.73	19.28		1.13		1.13	1.37		2.30	24.47	42906
9.00	*4.00*	*13.00*				*0.41*	*0.50*		*1.50*	*15.64*	
10.34	3.29	13.63		3.28		3.28	3.98		8.38	35.27	42907
8.03	3.12	11.15	0.79		0.65	1.44	1.75	1.34	7.00	25.67	44725
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*7.50*	*25.98*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Globe Fert. Co., Branch Fed. Chem. Co.	
42908	Globe Special Tobacco Grower	Manufacturer
44558		Elijah Coons, Mt. Sterling
44726		Conrad & Alexander, Dry Ridge
42911	Globe Truck Grower	Manufacturer
42912	Globe High Grade Special	Manufacturer
42913	Globe Good Luck Crop Grower	Manufacturer
42914	Globe Gold Medal Mixture	Manufacturer
42915	Globe Tobacco Dust Special	Manufacturer
44954		Miller & White, Tompkinsville
42916	Globe Ground Tobacco Compound	Manufacturer
44727		J. W. Cloyd, Campbellsville
44955		L. R. Chelf, Knifley
42917	Globe Tip Top Tobacco Grower	Manufacturer
44728		E. S. Ferrill & Sons, Buffalo
44573	Braden's Tobacco Mixture	Manufacturer
	Grigsby & Co., Bardstown, Ky.	
44514	Grigsby's Special Wheat Grower	*
44738		Manufacturer's Warehouse
44959		Manufacturer's Warehouse
	The Groves Company, Cincinnati, O.	
44424	Complete Grain Grower	*
44741		Troutman Bros., Shepherdsville
44425	Corn and Tobacco Grower	*
44742		Haselden Bros.. Lancaster

*The manufacturer failed to furnish sample required by law.

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.				Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
9.69	1.53	11.22		3.41		3.41	4.14	1.28	11.01	$38.67	42908
8.80	1.63	**10.43**	1.46		0.83	2.29	2.78	0.76	9.74	31.68	44558
7.67	2.50	**10.17**	1.93		0.46	2.39	2.90	3.62	6.62	**30.13**	44726
8.00	*4.00*	*12.00*				*2.47*	*3.00*		*10.00*	*31.85*	
10.70	3.25	13.95		1.89		1.89	2.29	1.74	9.41	33.79	42911
8.00	*4.00*	*12.00*				*0.41*	*0.50*		*8.00*	*22.24*	
14.45	1.67	16.12		1.09		1.09	1.32		6.63	29.79	42912
11.00	*4.00*	*15.00*				*0.41*	*0.50*		*5.00*	*22.24*	
13.77	2.86	16.63		1.00	0.20	1.20	1.46		4.96	27.81	42913
11.00	*4.00*	*15.00*				*0.41*	*0.50*		*2.50*	*19.24*	
11.31	7.84	19.15		1.47		1.47	1.78	0.58	2.88	25.90	42914
8.00	*4.00*	*12.00*				*0.82*	*1.00*		*2.00*	*16.47*	
13.37	4.70	18.07		0.93	0.20	1.13	1.37		3.42	25.98	42915
10.22	6.78	17.00				0.67	0.81	1.78		19.10	44954
10.00	*4.00*	*14.00*				*0.41*	*0.50*		*2.00*	*17.44*	
12.68	4.27	16.95		1.13		1.13	1.37		5.15	27.07	42916
11.44	4.86	16.30				0.49	0.59	4.56		22.15	44727
10.42	6.02	16.44				0.73	0.89	**2.22**	**0.80**	20.65	44955
10.00	*4.00*	*14.00*				*0.41*	*0.50*		*4.00*	*19.84*	
13.33	3.07	16.40		2.35		2.35	2.85		2.86	28.89	42917
10.33	2.32	**12.65**	0.83		0.67	1.50	1.82	1.54	0.69	20.95	44728
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*2.00*	*21.78*	
11.92	0.54	**12.46**		1.55		1.55	1.88	0.84	10.05	32.85	44573
10.00	*4.00*	*14.00*				*0.82*	*1.00*		*10.00*	*28.47*	
											44514
10.14	2.42	12.56	0.52		0.23	0.75	0.91		1.86	18.00	44738
10.94	1.86	12.80	0.59		0.30	0.89	1.08		2.64	20.16	44959
10.00	*2.00*	*12.00*				*0.82*	*1.00*		*2.00*	*18.03*	
											44424
7.76	1.50	9.26	0.68		0.35	1.03	1.25	2.12		15.64	44741
8.00	*2.00*	*10.00*				*0.82*	*1.00*	*2.00*		*15.27*	
											44425
8.14	1.31	9.45				0.83	1.01	4.12		17.32	44742
8.00	*2.00*	*10.00*				*0.82*	*1.00*	*4.00*		*17.27*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	The Groves Co.	
44426	Favorite Fertilizer	*
44743		J. H. Pelly, Columbia
44427	10% Potash Fertilizer	*
44744		Haselden Bros., Lancaster
44428	Special Truck Manure	*
44745		T. N. McGlothlan, Irvington
44433	Square Brand Special	*
44434	Perfection Crop Grower	*
44575	Half and Half	*
	Hirsh, Stein & Co., Chicago, Ill.	
44435	Calumet Brand Grain Grower	Manufacturer
44436	Calumet Brand Wheat, Corn and Oats Special	Manufacturer
44748		Hutcheson Bros., Auburn
44437	Calumet Brand Ky. Tob. Grower	Manufacturer
44749		Hutcheson Bros., Auburn
44438	Calumet Brand Special Potato, Tobacco and Onion Grower	Manufacturer
44439	Cal. Br. Spl. 10% Potash Manure	Manufacturer
44440	Cal. Br. Corn and Wheat Grower	Manufacturer
44441	Calumet Br. Am. Dis. Pure Bone and Potash	Manufacturer
44442	Calumet Br. High Grade Garden and Vegetable Grower	Manufacturer

*The manufacturer failed to furnish sample required by law.

Complete Fertilizers.

Phosphoric Acid.			Nitrogen.				Equivalent to Ammonia.	Potash.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
											44426
7.96	1.49	9.45				1.55	1.88	1.26	1.06	$18.11	44743
8.00	*2.00*	*10.00*				*1.65*	*2.00*	*2.00*		*18.18*	
											44427
5.41	1.28	6.69				2.05	2.49	11.32		25.50	44744
5.00	*2.00*	*7.00*				*0.82*	*1.00*	*10.00*		*19.67*	
											44428
8.31	0.87	9.18		0.90	0.84	1.74	2.11	10.13		26.54	44745
8.00	*2.00*	*10.00*				*1.65*	*2.00*	*8.00*		*24.18*	
											44433
8.00	*2.00*	*10.00*				*3.29*	*4.00*	*6.00*		*27.92*	
											44434
12.00	*2.00*	*14.00*				*0.41*	*0.50*	*3.00*		*19.64*	
											44575
10.00	*6.00*	*16.00*				*1.65*	*2.00*	*2.00*		*22.18*	
8.31	1.31	9.62		0.46	1.35	1.81	2.20	2.51		19.34	44435
8.00	*1.00*	*9.00*				*1.65*	*2.00*	*2.00*		*17.78*	
8.68	1.10	9.78		0.39	0.84	1.23	1.49	4.42		19.59	44436
8.11	1.01	9.12				0.84	1.02	4.64		17.71	44748
8.00	*1.00*	*9.00*				*0.82*	*1.00*	*4.00*		*16.87*	
8.96	1.15	10.11		0.56	1.14	1.70	2.06		5.06	23.23	44437
8.54	1.01	9.55		0.53	1.09	1.62	1.97	0.68	4.20	22.04	44749
8.00	*1.00*	*9.00*				*1.65*	*2.00*		*5.00*	*21.78*	
7.59	1.75	9.34		1.31	0.62	1.93	2.34	1.14	10.30	30.07	44438
8.00	*1.00*	*9.00*				*1.65*	*2.00*		*10.00*	*27.78*	
5.22	0.79	6.01				0.84	1.02	10.01		19.53	44439
5.00	*1.00*	*6.00*				*0.82*	*1.00*	*10.00*		*19.27*	
9.07	1.40	10.47				0.77	0.93	3.57		17.71	44440
8.00	*1.00*	*9.00*				*0.82*	*1.00*	*3.00*		*15.87*	
10.53	1.67	12.20		0.95	0.80	1.75	2.12	2.23		21.67	44441
10.00	*1.00*	*11.00*				*1.65*	*2.00*	*2.00*		*20.18*	
8.60	1.29	9.89		0.88	1.46	2.34	2.84	0.76	5.72	26.65	44442
8.00	*1.00*	*9.00*				*2.06*	*2.50*	*6.00*		*23.21*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Hirsh, Stein & Co.	
44443	Cal. Br. Bone Phosphate & Potash	Manufacturer
44444	Calumet Brand High Grade Bone Phosphate and Potash	Manufacturer
44445	Calumet Brand Tobacco Fertilizer	Manufacturer
44446	Cal. Br. Bone, Blood and Potash	Manufacturer
44447	Calumet Br. High Grade Bone, Blood and Potash	Manufacturer
44448	Cal. Br. Bone Black Grain Grow'r	Manufacturer
44960		Pearson & Breedlove, Franklin
	Hopkins Fertilizer Co., New Albany, Ind.	
44460	Old Time Half and Half	Manufacturer
44966		S. O. Moody, Aburn
44461	Old Time Ky. and Indiana Special	Manufacturer
44462	Old Time Potato & Tobacco Grow'r	Manufacturer
44520		Edwin C. Schuler, Prospect
44531		W. L. Martin, St. Matthews
44757		O. T. Pickerill, Hodgenville
44463	Old Time Tobacco Grower	Manufacturer
44464	Old Time Tobacco & Truck Grow'r	Manufacturer
44758		Owen Pickerill, Hodgenville
44465	Old Time Blood and Bone	Manufacturer
44759		O. T. Pickerill, Hodgenville
44967		The Jenkins-Essex Co., Elizabetht'n
44466	Old Time Harvest King	Manufacturer
44760		C. L. & J. S. Fields, Owensboro

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.				Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
10.93	1.17	12.10				0.77	0.93	2.50		$18.79	44443
10.00	*1.00*	*11.00*				*0.41*	*0.50*	*2.00*		*15.84*	
10.93	1.63	12.56				0.35	0.42	5.45		20.45	44444
10.00	*1.00*	*11.00*				*0.41*	*0.50*	*5.00*		*18.84*	
8.96	1.70	10.66		0.28	0.57	0.85	1.03	2.27		16.68	44445
8.00	*1.00*	*9.00*				*0.82*	*1.00*	*2.00*		*14.87*	
11.14	1.66	12.80				0.99	1.20	2.37		19.87	44446
10.00	*1.00*	*11.00*				*0.82*	*1.00*	*2.00*		*17.27*	
9.83	2.35	12.18				1.09	1.32	6.11		22.67	44447
10.00	*1.00*	*11.00*				*0.82*	*1.00*	*5.00*		*20.27*	
8.95	1.16	10.11		0.74	1.43	2.17	2.63	1.74		20.54	44448
8.16	1.11	9.27		0.94	1.10	2.04	2.48	1.74		19.11	44960
8.00	*1.00*	*9.00*				*2.06*	*2.50*	*1.50*		*18.71*	
9.45	5.99	15.44	0.81		1.36	2.17	2.63	2.78		24.12	44460
7.92	7.01	14.93	0.24		1.91	2.15	2.61	1.65		21.48	44966
8.00	*5.00*	*13.00*				*2.06*	*2.50*	*2.00*		*20.81*	
8.72	1.06	9.78	2.34		0.28	2.62	3.18		9.25	31.15	44461
8.00	*1.00*	*9.00*				*2.47*	*3.00*		*8.00*	*28.25*	
8.35	1.21	9.56	2.24		0.22	2.46	2.99		8.05	28.77	44462
7.87	1.61	9.48	1.16		0.98	2.14	2.60		6.43	25.29	44520
8.35	1.82	10.17	1.16		0.87	**2.03**	2.46		6.31	25.43	44531
8.40	3.25	11.65	1.60		0.56	2.16	2.62		**4.84**	**24.75**	44757
8.00	*1.00*	*9.00*				*2.47*	*3.00*		*6.00*	*25.85*	
8.49	1.20	9.69	1.54		0.65	2.19	2.66		4.61	23.87	44463
8.00	*1.00*	*9.00*				*1.65*	*2.00*		*4.00*	*20.58*	
7.38	0.84	8.22	1.16		0.63	1.79	2.17		9.95	27.41	44464
5.30	3.74	9.04	0.64		0.86	1.50	1.82		8.72	23.57	44758
6.00	*1.00*	*7.00*				*1.65*	*2.00*		*8.00*	*22.98*	
8.40	1.34	9.74	1.03		0.55	1.58	1.92	2.47		18.62	44465
8.09	3.68	11.77	0.71		0.83	1.54	1.87	1.28	1.43	19.57	44759
8.07	1.99	10.06	0.72		0.89	1.61	1.95	1.68		17.80	44967
8.00	*1.00*	*9.00*				*1.65*	*2.00*	*2.00*		*17.78*	
9.55	1.24	10.79				1.02	1.24	3.82		19.35	44466
7.78	2.52	10.30				0.71	0.86	1.91		14.75	44760
8.00	*1.00*	*9.00*				*0.82*	*1.00*	*2.00*		*14.87*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Hopkins Fertilizer Co.	
44467	Old Time Tobacco Special	Manufacturer
44468	Old Time Wheat and Corn Grower	Manufacturer
44761		O. T. Pickerill, Hodgenville
44968		The Jenkins-Essex Co., Elizabetht'n
44469	Old Time Bone and Potash	Manufacturer
44591	Raw Bone and Potash Mixture	*
44969		The Jenkins-Essex Co., Elizabetht'n
	International Agricultural Corporation, Nat. Fert. Branch, Nashville, Tenn.	
44158	Old Hickory Tobacco Grower	Manufacturer
44762		S. O. Moody, Auburn
44159	Old Hickory Corn & Wheat Guano	Manufacturer
44160	Old Hickory Extra Spl. Tob. Grow'r	*
44763		S. O. Moody, Auburn
44161	Old Hickory Guano	Manufacturer
44764		Miller, Cartwright & Miller, Elkton
44162	Old Hickory Corn Grower	Manufacturer
44163	Old Hick'y Spl. H. Gr. Tob. Grow'r	*
44164	Old Hickory Tob. Grower No. 2	*
44765		F. A. Yost Co., Hopkinsville
44165	Old Hickory Special Mixture	Manufacturer
44166	Old Hickory Blood and Bone	*
44766		Barnett Bros., London

*The manufacturer failed to furnish sample required by law.

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.				Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
10.94	0.88	11.82				0.52	0.63	5.32		$20.62	44467
10.00	*1.00*	*11.00*				*0.41*	*0.50*	*4.00*		*17.84*	
11.89	1.05	12.94				0.51	0.62	2.78		19.26	44468
9.71	1.98	11.69				0.46	0.56	1.68	0.94	16.86	44761
9.28	2.51	11.79				0.50	0.61	1.68		15.57	44968
10.00	*1.00*	*11.00*				*0.41*	*0.50*	*2.00*		*15.84*	
7.54	0.92	8.46				0.75	0.91	3.26		15.31	44469
7.00	*1.00*	*8.00*				*0.82*	*1.00*	*1.00*		*12.67*	
											44591
7.87	11.03	18.90	0.41		0.85	1.26	1.53	**1.00**	**1.08**	20.56	44969
8.00	*8.00*	*16.00*				*1.23*	*1.50*	*3.00*		*20.11*	
10.55	3.35	13.90		0.69	1.01	1.70	2.06	1.72		21.67	44158
9.58	3.06	12.64				1.85	2.25	6.76		25.96	44762
10.00	*1.00*	*11.00*				*1.65*	*2.00*		*2.00*	*20.58*	
7.15	8.69	15.84				1.09	1.32	**1.34**		17.32	44159
8.00	*1.00*	*9.00*				*0.82*	*1.00*	*2.00*		*14.87*	
											44160
9.09	2.54	11.63				1.71	2.08	10.64		**28.56**	44763
10.00	*1.00*	*11.00*				*1.65*	*2.00*		*10.00*	*30.18*	
7.79	4.31	12.10	0.50		1.03	1.53	1.86	2.37		18.80	44161
8.64	5.97	14.61				1.92	2.33	1.76		21.24	44764
8.00	*1.00*	*9.00*				*1.65*	*2.00*	*2.00*		*17.78*	
10.41	3.63	14.04				0.99	1.20	1.26		18.67	44162
10.00	*1.00*	*11.00*				*0.82*	*1.00*	*1.00*		*16.27*	
											44163
10.00	*1.00*	*11.00*				*1.65*	*2.00*		*8.00*	*27.78*	
											44164
8.79	2.26	11.05				1.90	2.31	5.00		23.10	44765
8.00	*1.00*	*9.00*				*1.65*	*2.00*		*5.00*	*21.78*	
8.95	4.58	13.53				2.50	3.04	2.52		23.84	44165
10.00	*1.00*	*11.00*				*2.47*	*3.00*	*2.00*		*23.05*	
											44166
10.47	3.91	14.38				1.02	1.24	1.30		18.99	44766
10.00	*1.00*	*11.00*				*0.82*	*1.00*	*1.00*		*16.27*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Int. Agr'l. Corp., Nat. Fert. Branch.	
44167	Old Hickory Black Patch Special	*
44168	Old Hickory National Pride of Ky.	*
44597	Old Hickory Special	*
	Int. Agr'l. Corp., Tenn. Valley Fert. Works, Nashville, Tenn.	
44176	Tiger Three Link Guano	Manufacturer
44177	Monarch	Manufacturer
44178	Tiger Blood and Bone	Manufacturer
44179	Tiger Pride of Kentucky	*
44180	Tiger Special Tobacco Grower	*
	Int. Agr'l. Corp., Interstate Phosphate Works, Nashville, Tenn.	
44187	Triangle Fish Tobacco Grower	Manufacturer
44188	Triangle Fish Dark Tobacco Spl.	*
44189	Triangle Fish Tobacco Guano	*
44190	Triangle Fish Corn & Wheat Guano	Manufacturer
44195	Triangle Fish Special Tob. Grow'r	*
	The Jarecki Chem. Co., Cincinnati, O.	
44479	Lake Erie Guano with Phos. & Pot.	*
44768		D. Lewellyn, Sanders

*The manufacturer failed to furnish sample required by law.

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.				Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate.		
											44167
10.00	*1.00*	*11.00*				*0.82*	*1.00*		*12.00*	*$29.67*	
											44168
10.00	*1.00*	*11.00*				*0.82*	*1.00*		*4.00*	*20.07*	
											44597
12.00	*1.00*	*13.00*				*1.65*	*2.00*	*3.00*		*23.58*	
9.75	5.23	14.98		0.69	0.83	1.52	1.85	1.91		21.02	44176
10.00	*1.00*	*11.00*				*1.65*	*2.00*		*2.00*	*20.58*	
9.37	6.80	16.17	0.51		0.99	1.50	1.82	1.92		21.13	44177
8.00	*1.00*	*9.00*				*1.65*	*2.00*	*2.00*		*17.78*	
9.92	3.74	13.66				0.90	1.09	0.97		17.52	44178
10.00	*1.00*	*11.00*				*0.82*	*1.00*	*1.00*		*16.27*	
											44179
10.00	*1.00*	*11.00*				*0.82*	*1.00*		*4.00*	*20.07*	
											44180
8.00	*1.00*	*9.00*				*1.65*	*2.00*		*4.00*	*20.58*	
11.47	3.12	14.59		0.72	1.03	1.75	2.12	1.88		23.02	44187
10.00	*1.00*	*11.00*				*1.65*	*2.00*		*2.00*	*20.58*	
											44188
10.00	*1.00*	*11.00*				*1.65*	*2.00*		*8.00*	*27.78*	
											44189
8.00	*1.00*	*9.00*				*1.65*	*2.00*		*5.00*	*21.78*	
7.21	8.91	16.12				0.94	1.14	1.39		16.89	44190
8.00	*1.00*	*9.00*				*0.82*	*1.00*	*2.00*		*14.87*	
											44195
8.00	*1.00*	*9.00*				*1.65*	*2.00*		*4.00*	*20.58*	
											44479
8.14	1.82	9.96				1.24	1.51	2.94		17.78	44768
8.00	*1.00*	*9.00*				*1.23*	*1.50*	*2.50*		*16.81*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	The Jarecki Chemical Co.,	
44480	Number One Formula	*
44970		Rector & Co., Lewisburg
44484	Raw Bone and Phosphate Mixture	*
44769		D. E. Patterson, Hodgenville
44972		Rector & Co., Lewisburg
44485	Fish Phosphate and Potash Tobacco and Potato Food	*
44770		D. E. Patterson, Hodgenville
44487	Tobacco and Truck Grower	*
44772		D. Lewellyn, Sanders
44488	Indian Br. Tobacco & Potato Fert.	*
44773		Goodman & Hall, Shelbyville
44489	Gilead Phosphate	*
44490	Boone Tobacco Grower	*
44774		Martin-Hodgkin Sup. Co., Winchest'r
	Jones Fertilizer Co., Louisville, Ky.	
44335	Jones Tobacco Grower	Manufacturer
44336	Jones Grain Special	Manufacturer
44337	Jones Miami Valley Phosphate	Manufacturer
44532		W. A. Horton, Waynesburg
44780		Stanley Crouch, Erlanger
44338	Jones Reliable	Manufacturer
44781		Geo. W. Hill & Co., Covington
44339	Jones Special Tobacco Grower	Manufacturer
44782		Oscar Childers, Dry Ridge

*The manufacturer failed to furnish sample required by law.

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.				Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
											44480
7.97	1.62	9.59		0.32	0.62	0.94	1.14	2.07		$15.57	44970
8.00	*1.00*	*9.00*				*0.82*	*1.00*	*2.00*		*14.87*	
											44484
8.04	10.07	18.11				1.28	1.55	2.47		20.63	44769
9.16	9.15	18.31		0.46	0.89	1.35	1.64	1.77		21.15	44972
8.00	*8.00*	*16.00*				*1.23*	*1.50*	*2.00*		*19.11*	
											44485
7.96	1.59	9.55				0.74	0.90	2.04	2.34	17.63	44770
8.00	*1.00*	*9.00*				*0.82*	*1.00*	*4.00*		*16.87*	
											44487
5.20	3.25	8.45				1.64	1.99		6.93	21.60	44772
6 00	*1.00*	*7.00*				*1.65*	*2.00*		*6.00*	*20.58*	
											44488
9.13	1.44	10.57		1.04	1.36	2.40	2.91	0.84	5.27	27.11	44773
9.00	*1.00*	*10.00*				*2.47*	*3.00*		*5.00*	*25.85*	
											44489
8.00	*1.00*	*9.00*				*0.82*	*1.00*	*3.00*		*15.87*	
											44490
8.44	2.24	10.68		0.51	1.18	1.69	2.05	10.82		27.77	44774
8.00	*1.00*	*9.00*				*1.65*	*2.00*		*10.00*	*27.78*	
7.95	2.29	**10.24**		1.67	0.96	2.63	3.19	1.12	5.95	27.93	44335
8.00	*4.00*	*12.00*				*2.47*	*3.00*		*6.00*	*27.05*	
10.85	1.53	**12.38**	0.29		0.45	0.74	0.90	0.54	1.59	18.67	44336
10.00	*4.00*	*14.00*				*0.82*	*1.00*		*2.00*	*18.87*	
9.78	3.03	12.81	0.20		1.67	1.87	2.27	0.52	1.77	22.14	44337
10.14	2.55	**12.69**	0.39		1.08	1.47	1.78	1.20	0.68	**20.36**	44532
11.00	2.44	13.44	0.43		0.66	**1.09**	1.32		2.08	**20.50**	44780
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*2.00*	*21.78*	
8.29	1.17	**9.46**	0.32		0.62	0.94	1.14	0.52	1.44	15.96	44338
10.39	1.57	11.96				0.80	0.97	1.60		17.50	44781
8.00	*4.00*	*12.00*				*0.82*	*1.00*		*1.50*	*15.87*	
8.58	1.08	**9.66**	0.28		0.60	0.88	1.07	0.48	1.07	15.57	44339
9.45	1.45	10.90	0.25		0.61	0.86	1.04	0.84	1.08	17.07	44782
8.00	*4.00*	*12.00*				*0.82*	*1.00*		*1.50*	*15.87*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Jones Fertilizer Co.	
44340 44783	Jones Grain Grower	Manufacturer W. E. Ellis, Hartford
44341	Jones Slaughter House Bone	Manufacturer
44342 44784	Jones Potato Grower	Manufacturer W. E. Ellis, Hartford
44343 44785	Jones Truck Grower	Manufacturer Stanley Crouch, Erlanger
44344 44786	Jones H. Gr. Tob. & Potato Grower	Manufacturer W. E. Ellis, Hartford
44345 44787	Jones Corn and Wheat Grower	Manufacturer Stanley Crouch, Erlanger
44595	Jones Special Grain Grower	Manufacturer
	Kaufman Fertilizer Co., Cincinnati, O.	
44501	Corn, Wheat and Oats Grower	*
44502	Harvest King	*
44503	Golden Rule	*
44504 44788	Spl. Potato and Tobacco Fertilizer	* J. C. Dunavent, Eminence
44505	Half and Half	*
44509 44789	Kentucky Tobacco Grower	* Wm. Sparks, N. Pleasureville

*The manufacturer failed to furnish sample required by law.

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.				Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
8.81	1.17	**9.98**				0.46	0.56		3.91	$17.34	44340
9.78	1.29	11.07				0.51	0.62		3.95	18.79	44783
8.00	*4.00*	*12.00*				*0.41*	*0.50*		*4 00*	*17.44*	
8.00	2.54	**10.54**				1.64	1.99		2.63	19.52	44341
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*2.00*	*19.38*	
8.29	1.68	**9.97**	0.27	1.49	0.93	2.69	3.27	1.00	6.06	28.31	44342
8.69	1.07	**9.76**		1.25	1.05	2.30	2.79	0.84	6.73	27.83	44784
8.00	*4.00*	*12.00*				*2.47*	*3.00*		*6.00*	*27.05*	
7.84	2.50	**10.34**				1.72	2.09		10.47	28.99	44343
8.38	2.84	11.22	0.22		1.25	1.47	1.78	**0.96**	**6.67**	**25.31**	44785
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*10.00*	*28.98*	
7.03	3.38	10.41				1.58	1.92	0.96	4.18	21.30	44344
8.24	2.35	10.59	0.57		0.78	1.35	1.64		4.06	20.43	44786
7.00	*4.00*	*11.00*				*1.65*	*2.00*		*4.00*	*20.58*	
7.58	0.68	**8.26**	0.24		0.54	0.78	0.95	0.62	1.28	14.26	44345
7.43	1.66	**9.09**	0.21		0.61	0.82	1.00		1.29	14.00	44787
7.00	*4.00*	*11.00*				*0.82*	*1.00*		*1.00*	*14.07*	
8.95	0.17	**9.13**				0.44	0.53		3.40	16.44	44595
8.00	*4.00*	*12.00*				*0.41*	*0.50*		*3.00*	*16.24*	
8.00	*1.00*	*9.00*				*1.23*	*1.50*	*2.50*		*16.81*	44501
8.00	*1.00*	*9.00*				*0.82*	*1.00*	*2.00*		*14.87*	44502
8.00	*1.00*	*9.00*				*0.82*	*1.00*	*4.00*		*16.87*	44503
7.30	0.62	7.92		1.07	0.74	1.81	2.20		5.84	22.36	44504
6.00	*1.00*	*7.00*				*1.65*	*2.00*		*6.00*	*20.58*	44788
8.00	*8.00*	*16.00*				*1.23*	*1.50*	*2.00*		*19.11*	44505
8.26	1.03	9.29				0.87	1.06	2.29		15.66	44509
8.00	*1.00*	*9.00*				*0.82*	*1.00*	*2.00*		*14.87*	44789

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Kentucky Fertilizer Co., Branch Federal Chemical Co., Louisville, Ky.	
42929 44790	O. K. Golden Leaf Tob. Grower	Manufacturer S. Y. Cutshaw, Bedford
42930	O. K. High Grade Mixture	Manufacturer
42931 44791	O. K. Tobacco and Veg. Grower	Manufacturer W. A. Ogilvie, Benton
42932 44792	O. K. Crop and Tobacco Grower	Manufacturer D. L. D. Sandefur, Beaver Dam
42933	O. K. Corn and Wheat Grower	Manufacturer
42934	O. K. Grain Grower	Manufacturer
42935 44793	O. K. Corn, Wheat & Oats Grower	Manufacturer C. C. Holt, Jamestown
42938 44794	O. K. Complete Manure	Manufacturer S. Y. Cutshaw, Bedford
42939 44795	O. K. 20% Fertilizer	Manufacturer W. R. Tipton, Agt., Mt. Sterling
42940	O. K. Long Green Tobacco Grower	Manufacturer
42941 44796	Old Kentucky Special	Manufacturer D. L. D. Sandefur, Beaver Dam
42942 44797	O. K. High Grade Fertilizer	Manufacturer D. L. D. Sandefur, Beaver Dam
42943	O. K. Special Crop Grower	Manufacturer

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.				Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
11.20	6.50	17.70		2.38		2.38	2.89		2.91	$27.86	42929
10.00	5.49	15.49	0.97		0.54	1.51	1.83	0.70	1.45	21.93	44790
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*2.00*	*19.38*	
14.49	2.32	16.81		1.46		1.46	1.77		3.66	27.82	42930
11.00	*4.00*	*15.00*				*0.82*	*1.00*		*3.00*	*21.27*	
11.85	3.85	15.70		1.45	0.29	1.74	2.11	0.94	5.28	29.03	42931
8.15	3.38	11.53	0.49		1.05	1.54	1.87	1.64	4.90	24.04	44791
8.00	*4.00*	*12.00*				*1.23*	*1.50*		*6.00*	*22.71*	
12.20	5.53	17.73		1.62		1.62	1.97	0.90	3.95	28.16	42932
10.96	3.90	14.86	0.35		0.68	1.03	1.25	3.82		22.14	44792
8.00	*4.00*	*12.00*				*0.82*	*1.00*		*4.00*	*18.87*	
13.41	4.11	17.52		1.37		1.37	1.66	0.62	2.40	26.03	42933
10.00	*4.00*	*14.00*				*0.82*	*1.00*		*2.00*	*18.87*	
14.94	3.90	18.84		1.05		1.05	1.27		1.84	25.38	42934
11.00	*4.00*	*15.00*				*0.41*	*0.50*		*1.00*	*17.44*	
15.08	3.71	18.79		1.00		1.00	1.21	0.58	1.39	25.33	42935
10.97	5.04	16.01				0.53	0.64	0.56	0.31	17.97	44793
11.00	*4.00*	*15.00*				*0.41*	*0.50*		*1.00*	*17.44*	
13.04	4.68	17.72		1.72		1.72	2.09	0.64	2.85	27.60	42938
7.62	7.22	14.84	0.24		0.67	0.91	1.10	2.37		17.59	44794
8.00	*4.00*	*12.00*				*0.82*	*1.00*		*2.50*	*17.07*	
10.55	1.77	12.32		2.60	0.24	2.84	3.45	1.56	9.16	35.86	42939
8.73	1.81	10.54	1.31		0.61	1.92	2.33		10.97	31.08	44795
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*10.00*	*28.98*	
13.79	2.96	16.75		2.33		2.33	2.83		2.94	29.42	42940
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*2.00*	*21.78*	
14.34	1.39	15.73		1.07		1.07	1.30		6.79	29.67	42941
11.62	4.45	16.07				0.65	0.79	5.24		23.24	44796
11.00	*4.00*	*15.00*				*0.41*	*0.50*		*5.00*	*22.24*	
14.09	2.64	16.73		2.29		2.29	2.78		3.10	29.71	42942
10.79	2.11	12.90	0.66		0.95	1.61	1.95	0.94	1.57	22.25	44797
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*2.00*	*21.78*	
14.54	1.96	16.50		1.24		1.24	1.51		3.51	26.78	42943
11.00	*4.00*	*15.00*				*0.41*	*0.50*		*3.50*	*20.44*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Ky. Fert. Co., Branch Fed. Chem. Co.	
42944	O. K. Potash and Tobacco Special	Manufacturer
44798		W. A. Ogilvie, Benton
42945	O. K. Golden Grain Tob. Mixture	Manufacturer
44799		I. K. Miller & Sons, Campbellsville
44973		I. K. Miller & Sons, Campbellsville
42954	O. K. Champion Tobacco Grower	Manufacturer
44802		Rufus Knight, Sharpsburg
44524	O. K. Gold Medal Truck & Tob. G'r	Manufacturer
44648	O. K. Wheat and Grain Special	Manufacturer
	Louisville Fertilizer Co., Louisville, Ky.	
44262	Eagle H. Gr. Tob. & Potato Grower	Manufacturer
44803		M. C. Beam & Son, New Haven
44272	Eagle Raw Bone Mixture	Manufacturer
44273	Eagle Guano	Manufacturer
44274	Eagle Truck Grower	Manufacturer
44807		C. S. Griffith, Carrollton
44275	Eagle Tobacco Grower	Manufacturer
44808		Schramme & Smith, Shelbyville
44276	Eagle Potato Grower	Manufacturer
44809		Clore Co., Crestwood
44277	Eagle Slaughter House Bone	Manufacturer
44810		M. C. Beam & Son, New Haven
44978		M. C. Beam & Son, New Haven

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.					POTASH.			
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.	Equivalent to Ammonia.	From Muriate.	From Sulphate	Estimated Value Per Ton.	Station Number.
13.42	4.76	18.18		1.08		1.08	1.31		3.31	$25.75	42944
9.99	7.39	17.38				0.55	0.67	0.74	1.36	19.25	44798
10.00	*4.00*	*14.00*				*0.41*	*0.50*		*2.00*	*17.44*	
12.74	4.32	17.06		1.18		1.18	1.43		5.13	27.31	42945
11.73	6.11	17.84	0.20		0.36	0.56	0.68	4.08		22.56	44799
10.17	6.39	16.56				0.70	0.85		4.50	22.60	44973
10.00	*4.00*	*14.00*				*0.41*	*0.50*		*4.00*	*19.84*	
11.12	2.88	14.10		1.80		1.80	2.19	0.94	9.50	33.25	42954
8.72	1.68	10.40	1.05		0.60	1.65	2.00		11.37	30.55	44802
8.00	*4.00*	*12.00*				*0.82*	*1.00*		*10.00*	*26 07*	
12.63	1.57	14.20		2.59		2.59	3.14		6.96	33.21	44524
10.00	*4.00*	*14.00*				*1.23*	*1.50*		*4.00*	*22.71*	
14.97	1.40	16.37		1.47		1.47	1.78		2.64	26.84	44648
12.00	*4.00*	*16.00*				*0.82*	*1.00*		*1.00*	*20.07*	
7.89	2.23	10.12	0.27		1.39	1.66	2.02	0.92	3.69	21.52	44262
7.09	1.21	**8.30**		1.28	0.71	1.99	2.42		4.26	21.07	44803
7.00	*4.00*	*11.00*				*1.65*	*2.00*		*4.00*	*20.58*	
9.51	6.76	16.27	0.31		1.34	1.65	2.00		1.31	21.46	44272
7.00	*8.00*	*15.00*				*1.65*	*2.00*		*1.00*	*18.58*	
10.21	2.91	13.12	0.31		1.54	1.85	2.25	0.58	2.02	22.89	44273
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*2.00*	*21.78*	
7.71	2.36	**10.07**	0.28		1.38	1.66	2.02		10.61	28.73	44274
9.45	3.40	12.85	0.29		1.21	1.50	1.82	0.94	9.17	29.89	44807
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*10.00*	*28.98*	
7.99	1.72	**9.71**		1.69	0.89	2.58	3.13		7.04	27.76	44275
7.74	1.99	**9.73**	1.03		0.93	**1.96**	2.38		**4.94**	**22.88**	44808
8.00	*4.00*	*12.00*				*2.47*	*3.00*		*6.00*	*27.05*	
7.97	1.81	**9.78**	0.34	1.53	0.74	2.61	3.17	1.08	5.71	27.35	44276
8.09	1.29	**9.38**	1.40		0.71	**2.11**	2.56	0.94	5.14	**24.73**	44809
8.00	*4.00*	*12.00*				*2.47*	*3.00*		*6.00*	*27.05*	
7.74	2.17	**9.91**				1.71	2.08	0.54	2.14	19.26	44277
9.01	2.09	11.10	0.35		0.83	**1.18**	1.43	1.89		**17.67**	44810
8.32	2.03	**10.35**	0.29		1.22	1.51	1.83		1.71	**18.13**	44978
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*2.00*	*19.38*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Louisville Fertilizer Co.	
44278	Eagle Grain Grower	Manufacturer
44811		W. S. Kean, Montpelier
44279	Eagle Special Tobacco Grower	Manufacturer
44280	Eagle Soluble Bone	Manufacturer
44281	Eagle Spl. Corn & Wheat Grower	Manufacturer
44812		H. C. Woodson, Brandenburg
44979		J. A. Simpson, Quinton
44283	Eagle H. Gr. Vegetable Grower	Manufacturer
44592	Eagle Special Grain Grower	Manufacturer
44981		L. S. Brough, Bowling Green
	I. K. Miller & Sons, Campbellsville, Ky.	
44109	Miller's Wheat, Corn & Tob. Spl.	*
44982		Manufacturer's Warehouse
	Morris & Co., Chicago, Ill.	
44115	Big Three	Manufacturer
44116	Big Four Bone, Tankage & Potash	Manufacturer
44815	Big Four H. Gr. Tob. & Veg. Growr	Woodson Lewis, Greensburg
44117	Big Five	Manufacturer
44816	Big Five Bone, Tankage & Potash	Woodson Lewis, Greensburg
44120	Big Eight Am. Acid Phos. & Potash	Manufacturer
44986		M. C. Marion & Sons, Elizabethtown
44121	Big Nine Prepared Manure with Phosphate and Potash	Manufacturer
44818	Big Nine Special Tobacco Manure	Woodson Lewis, Greensburg

*The manufacturer failed to furnish sample required by law.

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.				Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
7.91	1.03	**8.94**	0.44			0.44	0.53		4.25	$16.54	44278
8.50	1.81	**10.31**				0.51	0.62	3.84		16.55	44811
8.00	*4.00*	*12.00*				*0.41*	*0.50*		*4.00*	*17.44*	
8.36	1.10	**9.46**	0.35		0.53	0.88	1.07	0.54	1.11	15.42	44279
8.00	*4.00*	*12.00*				*0.82*	*1.00*		*1.50*	*15.87*	
8.30	1.26	**9.56**	0.32		0.57	0.89	1.08	0.44	1.17	15.42	44280
8.00	*4.00*	*12.00*				*0.82*	*1.00*		*1.50*	*15.87*	
7.03	1.01	**8.04**				0.76	0.92		1.22	**12.96**	44281
8.82	1.90	10.72	0.20		0.56	0.76	0.92	0.84	0.48	15.42	44812
9.62	0.52	10.14				0.80	0.97		1.29	16.10	44979
7.00	*4.00*	*11.00*				*0.82*	*1.00*		*1.00*	*14.07*	
8.21	1.36	**9.57**		2.89	0.46	3.35	4.07	1.64	3.07	27.44	44283
8.00	*4.00*	*12.00*				*3.29*	*4.00*		*4.00*	*27.52*	
8.78	0.36	**9.14**				0.40	0.49		3.34	16.09	44592
7.71	0.17	**7.88**				0.54	0.66	2.99		**14.20**	44981
8.00	*4.00*	*12.00*				*0.41*	*0.50*		*3.00*	*16.24*	
											44109
10.53	1.98	12.51	0.45		0.37	0.82	1.00		2.70	19.54	44982
10.00	*2.00*	*12.00*				*0.82*	*1.00*	*1.00*	*1.00*	*17.87*	
7.86	2.98	10.84				2.55	3.10	0.86	1.68	22.43	44115
7.00	*3.00*	*10.00*				*2.47*	*3.00*		*2.00*	*20.65*	
8.55	4.70	13.25				3.68	4.47	1.10	6.20	33.56	44116
8.89	3.53	12.42				3.36	4.08		6.35	31.46	44815
7.00	*5.00*	*12.00*				*3.29*	*4.00*		*6.50*	*29.72*	
7.66	2.74	10.40				2.73	3.31	0.74	0.80	21.55	44117
6.99	4.60	11.59				3.21	3.90	1.30	1.32	24.35	44816
7.00	*3.00*	*10.00*				*2.47*	*3.00*		*1.00*	*19.45*	
7.56	1.86	9.42				1.17	1.42		1.41	15.60	44120
8.49	1.26	9.75				1.25	1.52		1.36	16.70	44986
7.00	*1.00*	*8.00*				*0.82*	*1.00*		*1.00*	*12.87*	
8.03	1.47	9.50				1.02	1.24	0.82	6.45	22.36	44121
8.61	0.85	9.46				0.99	1.20		7.10	22.66	44818
7.00	*2.00*	*9.00*				*0.82*	*1.00*		*7.00*	*20.47*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Morris & Co.	
44122	Big Ten Prepared Manure with Phosphate and Potash	Manufacturer
44987	Big Ten Dark Tobacco Manure	Hatter Hardware Co., Franklin
44124	Big Twelve Prepared Manure with Phosphate and Potash	Manufacturer
44819	Big Twelve Ky. Tobacco Grower	Woodson Lewis, Greensburg
44988		Hatter Hardware Co., Franklin
	Mt. Pleasant Fertilizer Co., Mt. Pleasant Tenn.	
44127	Black Patch Farmers Friend	Manufacturer
44128	Big Success Blood, Bone & Potash	Manufacturer
44129	Big Success Universal	Manufacturer
44130	Big Success Potato Special	Manufacturer
44131	Big Success Cantaloupe and Vegetable Special	Manufacturer
44132	Big Success Corn Special	Manufacturer
44133	Black Patch Grain & Seeding Down	Manufacturer
44989		Logan County Hdw. Co., Russellville
44134	Black Patch Best by Test	Manufacturer
44135	Black Patch Tobacco Special	Manufacturer
44136	Black Patch Tobacco Grower	Manufacturer
44820		T. H. Cochran & Co., Marion
44137	Tenn. and Ky. Tobacco Grower	Manufacturer

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.				Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
8.18	2.36	10.54				1.76	2.14	0.78	1.44	$19.43	44122
8.08	2.46	10.54				1.50	1.82		1.97	18.29	44987
8.00	*2.00*	*10.00*				*1.65*	*2.00*		*2.00*	*18.58*	
7.10	1.64	8.74				1.00	1.21		3.47	16.84	44124
8.70	1.12	9.82				1.36	1.65		2.71	18.90	44819
8.59	1.02	9.61				1.27	1.54		3.35	19.19	44988
7.00	*2.00*	*9.00*				*0.82*	*1.00*		*3.00*	*15.67*	
12.20	6.01	18.21				0.88	1.07	3.30		23.42	44127
10.00	*4.00*	*14.00*				*0.82*	*1.00*	*3.00*		*19.47*	
11.26	6.08	17.34				0.86	1.04		8.29	28.90	44128
9.00	*6.00*	*15.00*				*0.82*	*1.00*		*7.00*	*24.47*	
10.19	8.58	18.77				1.01	1.23	4.18		23.38	44129
8.00	*7.00*	*15.00*				*0.82*	*1.00*	*4.00*		*19.27*	
9.13	6.43	15.56		1.53	1.20	2.73	3.31		6.98	31.47	44130
7.00	*6.00*	*13.00*				*2.47*	*3.00*		*6.00*	*26.65*	
7.52	4.63	12.15		2.30	1.32	3.62	4.39	1.14	11.01	37.89	44131
6.00	*4.00*	*10.00*				*3.29*	*4.00*		*10.00*	*32.32*	
10.55	8.32	18.87		0.98	0.80	1.78	2.16	2.19		24.41	44132
8.00	*6.00*	*14.00*				*1.65*	*2.00*	*2.00*		*19.78*	
11.86	5.74	17.60		1.07	1.04	2.11	2.56	2.59		26.51	44133
10.11	7.50	17.61				1.51	1.83	1.91		22.33	44989
10.00	*4.00*	*14.00*				*1.65*	*2.00*	*2.00*		*21.38*	
14.07	0.40	14.47		1.04	0.83	1.87	2.27		6.97	31.95	44134
12.00	*1.00*	*13.00*				*1.65*	*2.00*		*6.00*	*27.78*	
10.11	3.95	14.06		1.02	0.81	1.83	2.22		11.12	33.46	44135
8.00	*3.00*	*11.00*				*1.65*	*2.00*		*10.00*	*28.58*	
10.75	9.36	20.11				0.95	1.15		4.22	25.03	44136
8.41	9.34	17.75				1.02	1.24		3.63	21.76	44820
8.00	*6.00*	*14.00*				*0.82*	*1.00*		*4.00*	*19.67*	
10.19	7.60	17.79		1.02	0.82	1.84	2.23		4.29	26.86	44137
8.00	*6.00*	*14.00*				*1.65*	*2.00*		*4.00*	*22.58*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Mt. Pleasant Fertilizer Co.	
44145	Great Southern Tobacco Special	Manufacturer
44146	Planters Choice	Manufacturer
44147	Great Southern Superior Tob. Grwr	Manufacturer
44823		A. C. Kimball, Springfield
44148	Great Southern Tobacco Grower	Manufacturer
44149	Universal Tobacco Grower	Manufacturer
44150	Great Southern Potato Special	Manufacturer
44151	Great Southern Corn Special	Manufacturer
	Peruvian Guano Corp. Charleston, S. C.	
44457	Peruvian Guano	Manufacturer
	E. Rauh & Sons Fertilizer Co., Indianapolis, Ind.	
44535	Our Special	Manufacturer
	Read Phosphate Co., Nashville, Tenn.	
42962	Standard Tobacco Grower	Manufacturer
44825		W. T. Kirkman, Elkton
42963	Blood and Bone No. 1	Manufacturer
44993		Hatter Hardware Co., Franklin
42964	High Grade Tobacco Grower	Manufacturer
44826		Hatter Hardware Co., Franklin
42965	High Grade Tobacco Special	Manufacturer
44827		Baker & Glasgow, Murray
42966	Complete Tobacco Grower	Manufacturer

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.					POTASH.			
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.	Equivalent to Ammonia.	From Muriate.	From Sulphate	Estimated Value Per Ton.	Station Number.
10.38	3.94	14.32		0.91	0.73	1.64	1.99		11.08	$33.08	44145
8.00	*3.00*	*11.00*				*1.65*	*2.00*		*10.00*	*28.58*	
11.63	6.32	17.95		0.91	1.06	1.97	2.39	2.47		25.86	44146
10.00	*5.00*	*15.00*				*1.65*	*2.00*	*2.00*		*21.78*	
10.36	7.84	18.20		0.90	0.79	1.69	2.05		4.56	26.96	44147
8.34	9.28	17.62		0.59	1.21	1.80	2.19	1.54	2.12	24.10	44823
8.00	*6.00*	*14.00*				*1.65*	*2.00*		*4.00*	*22.58*	
9.95	9.71	19.66				0.89	1.08		4.83	24.74	44148
8.00	*6.00*	*14.00*				*0.82*	*1.00*		*4.00*	*19.67*	
9.64	7.52	17.16		0.88	0.81	1.69	2.05		6.92	28.80	44149
8.00	*7.00*	*15.00*				*1.65*	*2.00*		*6.00*	*25.38*	
9.17	6.50	15.67		1.36	1.30	2.66	3.23	0.74	6.01	30.86	44150
7.00	*6.00*	*13.00*				*2.47*	*3.00*		*6.00*	*26.65*	
9.92	9.31	19.23		0.83	0.88	1.71	2.08	2.38		23.99	44151
8.00	*6.00*	*14.00*				*1.65*	*2.00*	*2.00*		*19.78*	
11.08	2.78	13.86		2.54	2.24	4.65	5.65	1.08	0.89	32.84	44457
8.00	*5.00*	*13.00*				*4.94*	*6.00*		*2.00*	*31.29*	
11.54	2.69	14.23				2.11	2.56	6.54		28.86	44535
10.00						*1.65*	*2.00*	*6.00*		*23.78*	
8.89	8.96	17.85				1.80	2.19		2.84	23.96	42962
10.33	6.11	16.44		0.63	0.75	1.38	1.68	0.54	1.73	22.29	44825
8.00	*5.00*	*13.00*				*1.65*	*2.00*		*2.00*	*19.78*	
9.40	8.53	17.93				2.02	2.45		2.67	24.96	42963
8.36	4.82	13.18		0.77	0.91	1.68	2.04	1.95		19.79	44993
8.00	*5.00*	*13.00*				*1.65*	*2.00*		*2.00*	*19.78*	
9.07	8.25	17.32				1.97	2.39	0.60	3.04	25.33	42964
8.69	6.80	15.49		0.73	0.72	1.45	1.76	1.08	2.63	22.47	44826
8.00	*5.00*	*13.00*				*1.65*	*2.00*		*4.00*	*22.18*	
9.50	5.93	15.43				1.89	2.29	**0.64**	**5.34**	27.44	42965
9.42	4.91	14.33		0.98	1.07	2.05	2.49	**1.10**	**4.60**	27.06	44827
8.00	*5.00*	*13.00*				*1.65*	*2.00*		*8.00*	*26.98*	
9.34	3.68	13.02				2.02	2.45	**1.30**	**5.80**	**28.01**	42966
8.00	*5.00*	*13.00*				*1.65*	*2.00*		*10.00*	*29.38*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Read Phosphate Co.	
42967	Perfect Tobacco Fertilizer	Manufacturer
42968	Soluble Bone	Manufacturer
44828		M. L. Spurling, Campbellsville
42969	Russell County Special	Manufacturer
42970	Special Potato Grower	Manufacturer
42971	H. Gr. Ammoniated Dissolved Bone	Manufacturer
44829		Blankenship & Richards, Jamest'wn
44994		Hatter Hardware Co., Franklin
42972	Farmers Special Manure	Manufacturer
44830		Barren Co. Gro. & Hdw. Co., Glasgow
44995		Barren Co. Gro. & Hdw. Co., Glasgow
42973	Corn and Wheat Grower	Manufacturer
44831		J. C. Cowherd & Co., Greensburg
42974	Blood and Bone Special	Manufacturer
42975	Wheat and Clover Grower	Manufacturer
42976	Red Diamond Special	Manufacturer
42977	Kentucky Tobacco Grower	Manufacturer
42992	Red Diamond Tobacco Special	Manufacturer
	Smith Agr'l. Chem. Co., Columbus, O.	
44477	Ohio Farmers Corn, Oats & Wheat Fertilizer	Manufacturer
44837		R. M. Parker. Burtonville

Complete Fertilizers.

Phosphoric Acid.			Nitrogen.				Equivalent to Ammonia.	Potash.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
11.10	4.28	15.38				2.09	2.54	0.86	2.41	$26.10	42967
10.00	*5.00*	*15.00*				*1.65*	*2.00*		*4.00*	*24.58*	
9.02	12.13	21.15				1.39	1.69	0.50	1.42	22.74	42968
8.30	3.90	12.20				0.86	1.04	1.74		16.27	44828
8.00	*5.00*	*13.00*				*0.82*	*1.00*	*2.00*		*16.47*	
9.64	10.07	19.71				1.34	1.63	0.70	2.21	23.64	42969
8.00	*5.00*	*13.00*				*0.82*	*1.00*		*3.00*	*18.07*	
8.65	6.12	14.77				1.89	2.29	0.98	3.18	24.25	42970
8.00	*5.00*	*13.00*				*1.65*	*2.00*		*6.00*	*24.58*	
10.84	5.23	16.07				2.46	2.99	0.64	1.08	25.65	42971
10.48	4.18	14.66		0.74	1.04	1.78	2.16	2.05		22.53	44829
9.80	4.91	14.71		0.74	0.98	1.72	2.09	2.13		21.87	44994
10.00	*5.00*	*15.00*				*1.65*	*2.00*		*2.00*	*22.18*	
11.39	6.82	18.21				1.36	1.65		2.64	24.33	42972
9.94	3.98	13.92				0.91	1.10	3.92		20.63	44830
9.89	4.09	13.98		0.27	0.54	0.81	0.98	2.70		19.05	44995
10.00	*5.00*	*15.00*				*0.82*	*1.00*		*3.00*	*20.47*	
13.49	7.50	20.99				0.54	0.66		2.13	23.64	42973
10.94	2.93	13.87				0.53	0.64	1.59		17.75	44831
11.00	*5.00*	*16.00*				*0.41*	*0.50*		*1.00*	*17.84*	
11.79	8.48	20.27				1.35	1.64		1.16	23.66	42974
10.00	*5.00*	*15.00*				*0.82*	*1.00*		*1.00*	*18.07*	
11.24	7.89	19.13				1.25	1.52		1.84	23.24	42975
10.00	*5.00*	*15.00*				*0.82*	*1.00*		*2.00*	*19.27*	
11.00	3.56	14.56				2.62	3.18		2.88	27.25	42976
10.00	*4.00*	*14.00*				*2.47*	*3.00*		*3.00*	*25.85*	
10.70	9.98	20.68				1.49	1.81		1.37	23.69	42977
8.00	*5.00*	*13.00*				*0.82*	*1.00*		*1.00*	*15.67*	
8.11	2.93	11.04				2.91	3.53	1.46	7.00	30.95	42992
8.00	*4.00*	*12.00*				*2.47*	*3.00*		*10.00*	*31.85*	
8.44	1.22	9.66				1.56	1.89	2.28		18.36	44477
9.49	1.47	10.96		0.84	0.72	1.56	1.89	2.54		19.98	44837
8.00						*1.65*	*2.00*	*2.00*		*17.38*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Smith Agricultural Chemical Co.	
44478	Ohio Farmers Tobacco Grower	*
44838		R. M. Parker, Burtonville
	Southern Fertilizer Co., Louisville, Ky.	
44107	Elk Grain Grower	*
44839		Simpson County Hdw. Co., Franklin
45003		Simpson County Hdw. Co., Franklin
44108	Elk Standard Guano	Manufacturer
44840		Simpson County Hdw. Co., Franklin
45004		Simpson County Hdw. Co., Franklin
44525	Elk Special Tobacco Grower	*
44841		Grigsby & Co., Bardstown
44526	Atlas Tobacco Grower	*
44842		Simpson County Hdw. Co., Franklin
44527	Elk Tobacco Grower	Manufacturer
44843		Simpson County Hdw. Co., Franklin
44587	Elk Favorite	*
44596	Elk Special Grain Grower	*
45005		Chas. Ratliff, Princeton
44600	Elk Corn and Wheat Grower	*
	Swift & Co., East St. Louis, Ill.	
44346	Swift's Superphosphate	*
44845		Barren Co. Gro. & Hdw. Co., Glasgow
45007		Barren Co. Gro. & Hdw. Co., Glasgow
44347	Swift's Onion, Potato & Tob. Fert.	*
44846		M. L. Spurling, Campbellsville

*The manufacturer failed to furnish sample required by law.

Complete Fertilizers.

Phosphoric Acid.			Nitrogen.				Equivalent to Ammonia.	Potash.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
											44478
8.54	0.78	9.32		0.44	0.42	0.86	1.04	4.71		$18.28	44838
8.00						*0.82*	*1.00*	*4.00*		*16.47*	
											44107
8.29	1.42	9.71	0.33		0.31	0.64	0.78	1.14	3.67	18.30	44839
8.17	1.61	9.78				0.53	0.64	1.34	2.46	16.61	45003
8.00	*1.00*	*9.00*				*0.41*	*0.50*		*4.00*	*16.24*	
7.82	1.56	9.38	1.22		0.25	1.47	1.78		2.89	18.62	44108
8.24	1.49	9.73	1.21		0.30	1.51	1.83		2.55	18.84	44840
7.50	2.01	9.51	0.37		1.32	1.69	2.05	0.76	1.11	17.81	45004
8.00	*1.00*	*9.00*				*1.65*	*2.00*		*2.00*	*18.18*	
											44525
7.91	1.05	8.96				0.58	0.70	3.89		15.83	44841
8.00	*1.00*	*9.00*				*0.41*	*0.50*		*4.00*	*16.24*	
											44526
7.01	2.07	9.08	0.52		0.26	0.78	0.95	3.76	3.18	19.55	44842
7.00	*1.00*	*8.00*				*0.82*	*1.00*		*7.00*	*20.07*	
7.69	1.67	9.36	2.12		0.25	2.37	2.88		7.77	27.52	44527
7.87	2.18	10.05	1.55		0.31	1.86	2.26		6.34	24.43	44843
8.00	*1.00*	*9.00*				*2.47*	*3.00*		*6.00*	*25.85*	
											44587
8.00	*1.00*	*9.00*				*1.65*	*2.00*	*3.00*	*2.00*	*21.18*	
											44596
10.72	2.49	13.21	0.20	0.41		0.61	0.74	1.64	0.86	18.67	45005
11.00	*1.00*	*12.00*				*0.41*	*0.50*	*1.00*	*1.00*	*17.24*	
											44600
7.00	*1.00*	*8.00*				*0.82*	*1.00*		*1.00*	*12.87*	
											44346
8.16	2.33	10.49				1.63	1.98	2.06		18.49	44845
9.62	1.10	10.72				1.56	1.89	2.18		19.62	45007
8.00	*1.00*	*9.00*				*1.65*	*2.00*	*2.00*		*17.78*	
											44347
8.07	1.54	9.61	0.61		1.12	1.73	2.10	0.80	6.37	24.80	44846
8.00	*1.00*	*9.00*				*1.65*	*2.00*		*7.00*	*24.18*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Swift & Co.	
44348 45008	Swift's Champ. Wht. & Corn Gro'r.	* J. L. Shadoan, Burnside
44349 44847	Swift's Complete Fertilizer	* M. J. Yopp Seed Co., Paducah
44350 44848	Swift's Tobacco & Truck Grower	* M. J. Yopp Seed Co., Paducah
44351	Swift's Ky. Tobacco Grower	*
44352 44849	Swift's Veg. and Tobacco Grower	* Barren Co. Gro. & Hdw. Co., Glasgow
44353	Swift's Diamond "A" Fertilizer	*
44354	Swift's Diamond "B" Fertilizer	*
44355 44850	Swift's Corn, Wheat & Oats Fert.	* M. L. Spurling, Campbellsville
44515	Early Potato & Vegetable Grower	*
44516 44858	Pulverized Sheep Manure	* W. T. Kirkman, Elkton
	Taylor & Powell Fertilizer Co., Springfield, Tenn.	
44536	No. 4 High Grade Tobacco Grower	Manufacturer
44538	Money Maker for Corn	Manufacturer
44539	Grain Special	Manufacturer

*The manufacturer failed to furnish sample required by law.

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.					POTASH.			
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.	Equivalent to Ammonia.	From Muriate.	From Sulphate	Estimated Value Per Ton.	Station Number.
											44348
12.33	1.11	13.44				1.97	2.39	2.26		$24.40	45008
12.00	*1.00*	*13.00*				*1.65*	*2.00*	*2.00*		*22.58*	
											44349
7.95	1.24	9.19				0.96	1.17	1.19		14.59	44847
8.00	*0.50*	*8.50*				*0.82*	*1.00*	*1.00*		*13.67*	
											44350
8.32	1.67	9.99				0.77	0.93		3.91	18.04	44848
8.00	*0.50*	*8.50*				*0.82*	*1.00*		*4.00*	*17.47*	
											44351
10.00	*1.00*	*11.00*				*1.65*	*2.00*	*2.00*		*20.18*	
											44352
8.84	3.12	11.96				2.14	2.60	**3.34**	**3.76**	**27.20**	44849
8.00	*1.00*	*9.00*				*2.47*	*3.00*		*10.00*	*30.65*	
											44353
8.00	*1.00*	*9.00*				*2.47*	*3.00*	*3.00*		*21.65*	
											44354
8.00	*1.00*	*9.00*				*2.47*	*3.00*	*5.00*		*23.65*	
											44355
10.91	1.34	12.25				0.81	0.98	4.11		20.58	44850
11.00	*0.50*	*11.50*				*0.82*	*1.00*	*4.00*		*20.27*	
											44515
6.00	*1.00*	*7.00*				*3.29*	*4.00*		*10.00*	*31.12*	
											44516
1.62	0.18	1.80				2.07	2.51	1.74		11.00	44858
		1.50				*2.06*	*2.50*	*1.50*		*9.61*	
6.31	1.15	7.46	0.84	0.35	1.42	2.61	3.17	1.26	6.99	26.82	44536
8.00						*2.06*	*2.50*		*4.00*	*21.61*	
6.51	1.15	7.66	0.89		1.65	2.54	3.08	6.96		24.12	44538
8.00						*1.23*	*1.50*	*2.50*		*16.41*	
9.04	4.40	13.44	1.09		1.37	2.46	2.99	1.66	4.67	28.48	44539
12.00						*0.82*	*1.00*	*2.00*		*19.27*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Tennessee Chemical Co., Louisville, Ky. and Nashville, Tenn.	
44302	Ox Special Tobacco Grower	Manufacturer
44303	Ox Special Tobacco Guano	Manufacturer
44859		I. K. Miller & Sons, Campbellsville
44304	Ox Ammoniated Bone	Manufacturer
44860		G. W. Richardson, Somerset
45015		G. W. Richardson, Somerset
44305	Ox Truck Grower	Manufacturer
44861		J. J. Shaver, Mayfield
44306	Ox High Grade Tobacco Grower	Manufacturer
44862		W. F. Grainger, Franklin
44307	Ox Slaughter House Bone	Manufacturer
44863		J. S. Duke, Crab Orchard
45016		W. F. Grainger, Franklin
44308	Ox Grain Grower	Manufacturer
44864		G. W. Richardson, Somerset
45017		G. W. Richardson, Somerset
44309	Ox Pride Tobacco Grower	Manufacturer
44865		I. K. Miller & Sons, Campbellsville
44310	Ox H. Gr. Tob. & Potato Grower	Manufacturer
44866		I. K. Miller & Sons, Campbellsville
44311	Ox Special Corn & Wheat Grower	Manufacturer
44867		J. J. Shaver & Co., Mayfield
44323	Ox Best Tobacco Grower	Manufacturer

Complete Fertilizers.

Phosphoric Acid.			Nitrogen.				Equivalent to Ammonia.	Potash.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
10.59	1.15	11.74		1.70		1.70	2.06		12.46	$34.07	44302
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*10.00*	*31.38*	
9.84	3.52	13.36	0.33		1.52	1.85	2.25	0.58	2.02	22.70	44303
9.94	2.33	**12.27**	1.03		0.63	1.66	2.02		2.01	21.08	44859
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*2.00*	*21.78*	
9.84	3.60	13.44	0.36		1.52	1.88	2.28	0.64	2.10	22.99	44304
10.29	3.66	13.95	0.58		1.13	1.71	2.08	0.56	1.51	22.17	44860
11.19	1.28	**12.47**	0.71		0.81	1.52	1.85	1.73		20.99	45015
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*2.00*	*21.78*	
7.58	2.15	**9.73**	0.27		1.49	1.76	2.14	0.96	9.78	28.82	44305
8.09	3.09	11.18	0.56		1.08	1.64	1.99		9.73	28.37	44861
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*10.00*	*28.98*	
8.51	2.21	10.72	0.23		1.36	1.59	1.93	1.18	5.40	24.32	44306
8.84	5.02	13.86				1.58	1.92	**1.95**		**20.10**	44862
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*5.00*	*22.98*	
9.81	2.23	12.04	0.24		1.69	1.93	2.34	0.58	1.96	22.35	44307
9.27	2.03	11.30	0.68		0.83	1.51	1.83	1.28	0.79	19.45	44863
9.06	3.23	12.29				**0.98**	1.19		1.73	**17.18**	45016
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*2.00*	*19.38*	
8.41	1.02	**9.43**	0.31		0.29	0.60	0.73		4.24	17.69	44308
8.96	2.08	11.04	0.20		0.50	0.70	0.85		**3.03**	17.67	44864
8.00	0.80	**8.80**				0.55	0.67	3.48		**15.33**	45017
8.00	*4.00*	*12.00*				*0.41*	*0.50*		*4.00*	*17.44*	
8.02	1.02	**9.04**	0.26		0.63	0.89	1.08	0.54	1.07	14.97	44309
8.46	1.38	**9.84**				0.81	0.98	0.84	0.52	15.00	44865
8.00	*4.00*	*12.00*				*0.82*	*1.00*		*1.50*	*15.87*	
7.12	2.08	**9.20**	0.37		1.36	1.73	2.10	0.74	3.74	20.66	44310
8.14	1.85	9.99	0.97		0.53	1.50	1.82		4.02	20.58	44866
7.00	*4.00*	*11.00*				*1.65*	*2.00*		*4.00*	*20.58*	
7.29	0.73	**8.02**	0.22		0.68	0.90	1.09		1.26	13.70	44311
8.26	3.02	11.28	0 34		0.37	0.71	0.86		0.76	14.52	44867
7.00	*4.00*	*11.00*				*0.82*	*1.00*		*1.00*	*14.07*	
8.04	1.93	9.97		1.75	0.89	2.64	3.20	1.36	5.90	28.10	44323
8.00	*4.00*	*12.00*				*2.47*	*3.00*		*6.00*	*27.05*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Tennessee Chemical Co.	
44594	Ox Special Grain Grower	Manufacturer
	The T. J. Turley Co., Owensboro, Ky.	(See The Armour Fert. Works.)
	Tuscarora Fert. Co., Nashville, Tenn.	
44061	Tuscarora Wheat & Corn Grower	Manufacturer
44062	Tuscarora Dark Tobacco Grower	Manufacturer
44063	Tuscarora Trucker	Manufacturer
44064	Tuscarora Tobacco Special	Manufacturer
44065	Tuscarora Standard	Manufacturer
44066	Tuscarora Big Four	Manufacturer
44067	Tuscarora Ammoniated Phosphate	Manufacturer
44076	Dickinson's Corn, Wht. & Oats Grwr	Manufacturer
44877		Dickinson Bros., Glasgow
44077	Dickinson's Tob. & Potato Grower	Manufacturer
44078	Dickinson's H. Gr. Potash Mixture	Manufacturer
44878		Dickinson Bros., Glasgow
44079	Dickinson's No. 10510 Fertilizer	Manufacturer
	Virginia-Carolina Chemical Co., Cincinnati, Ohio.	
44369	Ky. Burley Tobacco Special	Manufacturer
44879		W. P. Young, Horse Cave
44370	High Grade Top Dresser for Wheat, Oats and Corn	Manufacturer

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.					POTASH.			
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.	Equivalent to Ammonia.	From Muriate.	From Sulphate	Estimated Value Per Ton.	Station Number.
9.06	0.13	**9.19**				0.43	0.52		3.25	$16.33	44594
8.00	*4.00*	*12.00*				*0.41*	*0.50*		*3.00*	*16.24*	
10.21	7.42	17.63				1.76	2.14	2.41		23.79	44061
10.00	*4.00*	*14.00*				*1.65*	*2.00*	*2.00*		*21.38*	
8.53	5.15	13.68				1.84	2.23		9.93	30.66	44062
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*10.00*	*28.98*	
8.48	2.70	11.18		3.23	1.00	4.23	5.14	7.71		33.78	44063
8.00	*4.00*	*12.00*				*4.12*	*5.00*	*7.00*		*32.62*	
8.60	8.59	17.19				1.85	2.25		5.42	26.74	44064
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*5.00*	*22.98*	
9.24	10.62	19.86				1.90	2.31	2.22		24.21	44065
8.00	*4.00*	*12.00*				*1.65*	*2.00*	*2.00*		*18.98*	
7.88	11.05	18.93				1.75	2.12		4.42	25.31	44066
7.00	*4.00*	*11.00*				*1.65*	*2.00*		*4.00*	*20.58*	
8.80	8.22	17.02				1.00	1.21	1.26		18.61	44067
7.00	*4.00*	*11.00*				*0.82*	*1.00*	*1.00*		*13.87*	
8.77	10.71	19.48				1.78	2.16	2.24		23.47	44076
7.91	8.13	16.04				1.46	1.77	1.66	0.54	20.16	44877
8.00	*4.00*	*12.00*				*1.65*	*2.00*	*2.00*		*18.98*	
7.46	11.41	18.87				1.78	2.16		4.46	25.09	44077
7.00	*4.00*	*11.00*				*1.65*	*2.00*		*4.00*	*20.58*	
9.47	5.13	14.60				1.64	1.99		11.30	32.71	44078
7.80	2.65	10.45				**0.91**	1.10	1.46	8.26	**24.98**	44878
8.00	*4.00*	*12.00*				*1.65*	*2.00*		*10.00*	*28.98*	
10.12	3.12	13.24				**1.94**	2.36		11.65	**34.16**	44079
10.00	*4.00*	*14.00*				*4.12*	*5.00*		*10.00*	*40.02*	
10.90	0.57	11.47		1.80		1.80	2.19	1.06	10.47	33.23	44369
12.03	0.98	13.01		1.11	0.45	1.56	1.89		**8.81**	30.86	44879
10.00	*2.00*	*12.00*				*1.65*	*2.00*		*10.00*	*30.58*	
8.28	0.96	9.24	1.98	0.98	0.24	3.20	3.88	6.59		28.11	44370
8.00	*1.50*	*9.50*				*3.29*	*4.00*	*6.00*		*27.72*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Virginia-Carolina Chemical Co.	
44371	Tip Top Tomato Grower	Manufacturer
44372	Royal Vegetable Fertilizer	Manufacturer
44373	Royal Tobacco Fertilizer	Manufacturer
44880		W. P. Young, Horse Cave
44374	Bright Leaf Tob. & Truck Grower	Manufacturer
44881		Silas Shelburne, Mt. Sterling
44375	Monarch Am. Dissolved Bone and Potash	Manufacturer
44376	National Tobacco Fertilizer	Manufacturer
44377	Game Cock Grain & Grass Grower	Manufacturer
44378	Complete Fertilizer	Manufacturer
44882		W. E. Gravely, Brodhead
44379	Beef, Blood and Bone	Manufacturer
44883		I. K. Miller & Sons, Campbellsville
45029		I. K. Miller & Sons, Campbellsville
44380	Royal Blood, Bone and Potash	Manufacturer
44381	Scott's State Standard Guano	Manufacturer
44382	Game Cock Wht. & Corn Compound	Manufacturer
44383	Wheat, Corn and Tobacco Grower	Manufacturer
44884		W. P. Young, Horse Cave
44384	Star Brand Grain Grower	Manufacturer

Complete Fertilizers.

Phosphoric Acid.			Nitrogen.				Equivalent to Ammonia.	Potash.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
8.90	0.29	9.19	0.32	2.88	0.31	3.51	4.26	1.10	3.81	$28.76	44371
7.00	*1.50*	*8.50*				*3.29*	*4.00*		*5.00*	*26.52*	
8.41	1.15	9.56		2.60		2.60	3.16	4.84		24.49	44372
8.00	*1.50*	*9.50*				*2.47*	*3.00*	*4.00*		*22.85*	
9.94	1.15	11.09		1.59	0.37	1.96	2.38	1.00	4.20	25.29	44373
8.90	2.40	11.30		1.35	0.57	1.92	2.33	1.34	4.34	24.91	44880
8.00	*1.50*	*9.50*				*1.65*	*2.00*		*5.00*	*21.98*	
6.87	1.70	8.57		0.52	1.52	2.04	2.48	1.38	5.14	23.61	44374
6.86	3.10	9.96		0.88	0.95	1.83	2.22	2.15	3.54	22.28	44881
6.00	*1.50*	*7.50*				*1.65*	*2.00*		*6.00*	*20.78*	
12.53	1.19	13.72		1.07	0.33	1.40	1.70		3.31	24.39	44375
12.00	*1.50*	*13.50*				*1.23*	*1.50*		*3.00*	*22.91*	
8.15	0.99	9.14		1.17	0.50	1.67	2.03	1.20	3.41	21.32	44376
7.00	*1.50*	*8.50*				*1.65*	*2.00*		*4.00*	*19.58*	
10.32	1.64	11.96		0.94		0.94	1.14	2.96		19.29	44377
10.00	*1.50*	*11.50*				*0.82*	*1.00*	*3.00*		*18.47*	
8.11	2.83	10.94		0.52	1.14	1.66	2.02	2.57		19.24	44378
8.76	1.72	10.48		1.33	0.65	1.98	2.40	2.03		20.16	44882
8.00	*1.50*	*9.50*				*1.65*	*2.00*	*2.00*		*17.98*	
8.11	2.87	10.98		0.55	1.14	1.69	2.05	2.35		19.15	44379
8.42	1.54	9.96		1.19	0.72	1.91	2.32	2.19		19.60	44883
8.07	1.99	10.06		1.02	0.98	2.00	2.43	2.22		19.70	45029
8.00	*1.50*	*9.50*				*1.65*	*2.00*	*2.00*		*17.98*	
8.22	3.01	11.23		0.55	1.11	1.66	2.02	2.02	0.63	19.65	44380
8.00	*1.50*	*9.50*				*1.65*	*2.00*	*2.00*		*17.98*	
8.61	2.84	11.45		0.56	1.15	1.71	2.08	2.52		19.98	44381
8.00	*1.50*	*9.50*				*1.65*	*2.00*	*2.00*		*17.98*	
11.08	1.38	12.46		0.55	0.39	0.94	1.14	0.80	1.74	20.03	44382
10.00	*1.50*	*11.50*				*0.82*	*1.00*		*2.00*	*17.87*	
8.34	2.24	10.58		0.68	0.27	0.95	1.15	4.56		18.80	44383
9.37	2.51	11.88		0.37	0.80	1.17	1.42	4.25		20.59	44884
8.00	*1.50*	*9.50*				*0.82*	*1.00*	*4.00*		*17.07*	
8.47	2.18	10.65		1.04	0.40	1.44	1.75	2.60		18.77	44384
8.00	*1.50*	*9.50*				*1.23*	*1.50*	*2.00*		*16.51*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Virginia-Carolina Chemical Co.	
44385	Diamond Potash Formula for Wht. and Corn	Manufacturer
44386	Champion Corn & Wheat Grower	Manufacturer
44387	Standard Wheat & Corn Grower	Manufacturer
44388	Standard Wheat Special	Manufacturer
44393	Victor Am. Disslvd. Bone & Potash	Manufacturer
44887		G. W. Richardson, Somerset
44394	Champion Tobacco Grower	Manufacturer
44567		W. E. Fishback, Pine Grove
44888		I. K. Miller & Sons, Campbellsville
44403	Norfolk & Carolina Chemical Co.'s General Slaughter House Bone Guano	Manufacturer
	Virginia-Carolina Chemical Co., Memphis, Tenn.	
44090	B. B. B. Beef, Blood & Bone Fert.	Manufacturer
45036		E. S. Duiguid & Son, Murray
44091	Royal Blood, Bone and Potash	Manufacturer
44092	Scott's State Standard Guano	Manufacturer
44093	Royal Vegetable Fertilizer	Manufacturer
44094	National Tobacco Fertilizer	Manufacturer
44892		W. T. Kirkman, Elkton
44095	Royal Tobacco Fertilizer	Manufacturer

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.				Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number.
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.		From Muriate.	From Sulphate		
9.40	2.04	11.44		0.36	0.22	0.58	0.70	5.09		$19.22	44385
9.00	*1.50*	*10.50*				*0.41*	*0.50*	*5.00*		*17.84*	
7.72	2.29	10.01		0.65	0.28	0.93	1.13	2.37		15.81	44386
8.00	*1.50*	*9.50*				*0.82*	*1.00*	*2.00*		*15.07*	
11.17	2.51	13.68		0.72	0.29	1.01	1.23	3.76		21.70	44387
11.00	*1.50*	*12.50*				*0.82*	*1.00*	*3.00*		*19.67*	
10.79	2.66	13.45		0.72	0.28	1.00	1.21	3.65		21.16	44388
11.00	*1.50*	*12.50*				*0.82*	*1.00*	*3.00*		*19.67*	
10.38	3.86	14.24		0.25	1.63	1.88	2.28	2.40		22.98	44393
11.47	4.25	15.72		0.29	1.23	1.52	1.85	2.52		23.30	44887
10.00	*4.00*	*14.00*				*1.65*	*2.00*	*2.00*		*21.38*	
6.41	1.70	8.11		0.67	1.24	1.91	2.32	1.28	9.04	27.19	44394
5.80	2.64	8.44				1.91	2.32	2.98	8.97	28.45	44567
5.55	2.28	7.83				1.81	2.20	1.08	9.18	26.01	44888
5.00	*1.50*	*6.50*				*1.65*	*2.00*		*10.00*	*24.38*	
7.48	2.74	10.22				1.79	2.17	2.40		18.75	44403
8.00	*1.50*	*9.50*				*1.65*	*2.00*	*2.00*		*17.98*	
7.95	2.64	10.59				1.38	1.68	2.31		17.74	44090
8.49	1.16	9.65				1.92	2.33	2.17		19.54	45036
8.00	*2.00*	*10.00*				*1.65*	*2.00*	*2.00*		*18.18*	
8.25	2.47	10.72				1.49	1.81	2.44		18.55	44091
8.00	*2.00*	*10.00*				*1.65*	*2.00*	*2.00*		*18.18*	
8.48	1.34	9.82				1.30	1.58	2.84		18.11	44092
8.00	*2.00*	*10.00*				*1.65*	*2.00*	*2.00*		*18.18*	
8.35	1.95	10.30		0.77	1.41	2.18	2.65	**3.44**		**21.87**	44093
8.00	*2.00*	*10.00*				*2.47*	*3.00*	*4.00*		*23.05*	
7.73	2.26	9.99				1.55	1.92	**2.66**	**0.60**	18.99	44094
7.12	1.50	8.62				1.63	1.98	2.70	2.19	20.18	44892
7.00	*2.00*	*9.00*				*1.65*	*2.00*		*4.00*	*19.78*	
8.42	2.51	10.93				1.46	1.77	4.04	0.95	21.39	44095
8.00	*2.00*	*10.00*				*1.65*	*2.00*		*5.00*	*21.78*	

TABLE I.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Virginia-Carolina Chemical Co.	
44096	Champion Corn & Wheat Grower	Manufacturer
44098	Eureka Special Fertilizer	Manufacturer
44106	Champion Ky. Tobacco Special	Manufacturer
	Wood, Stubbs & Co., Louisville, Ky.	
42955	Acme Brand Blood, Bone & Potash	Manufacturer
44894		Hausgen, Fulton Co., Anchorage
42956	Acme Brand Wheat & Corn Fert.	Manufacturer
42957	Acme Br. Potato & Tobacco Fert.	Manufacturer
44895		Hausgen, Fulton Co., Anchorage
42958	Acme Br. H. Gr. Vegetable Fert.	Manufacturer
42959	Acme Br. Special Truckers Fert.	Manufacturer
44896		Hausgen, Fulton Co., Anchorage

COMPLETE FERTILIZERS.

PHOSPHORIC ACID.			NITROGEN.					POTASH.			
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.	Equivalent to Ammonia.	From Muriate.	From Sulphate	Estimated Value Per Ton.	Station Number.
7.86	2.19	10.05				0.80	0.97	2.29		$15.40	44096
8.00	*2.00*	*10.00*				*0.82*	*1.00*	*2.00*		*15.27*	
8.02	1.91	9.93				0.82	1.00	4.73		**17.98**	44098
10.00	*2.00*	*12.00*				*0.82*	*1.00*	*5.00*		*20.67*	
9.46	1.98	11.44		0.73	0.72	1.45	1.76	**1.66**	**6.99**	**27.27**	44106
10.00	*2.00*	*12.00*				*1.65*	*2.00*		*10.00*	*30.58*	
13.45	2.87	16.32		2.26		2.26	2.74		3.01	28.81	42955
11.32	3.97	15.29	0.29		0.87	**1.16**	1.41	2.12		21.35	44894
10.00	*4.00*	*14.00*				*1.65*	*2.00*		*2.00*	*21.78*	
13.51	3.91	17.42		1.43		1.43	1.74		2.92	26.28	42956
10.00	*4.00*	*14.00*				*0.82*	*1.00*		*2.00*	*18.87*	
11.74	2.66	14.40		2.98		2.98	3.62	1.00	5.72	33.44	42957
8.80	2.60	11.40	1.94		0.74	2.68	3.25		7.27	29.70	44895
8.00	*4.00*	*12.00*				*2.47*	*3.00*		*6.00*	*27.05*	
11.34	2.32	13.66		4.04		4.04	4.90		5.48	35.26	42958
8.00	*4.00*	*12.00*				*3.29*	*4.00*		*4.00*	*27.52*	
11.04	4.08	15.12		3.59		3.59	4.36		4.84	33.26	42959
9.08	5.29	14.37	2.36		0.82	3.18	3.86		2.91	27.64	44896
8.00	*4.00*	*12.00*				*2.47*	*3.00*		*2.00*	*22.25*	

TABLE II.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	The American Agr'l Chemical Co., Cin. Sales Dept., Cincinnati, O.	
44203	Pure Ground Bone	Manufacturer
44897		T. E. Richardson, Campbellsville
44204	Fine Raw Bone	Manufacturer
44898		E. P. Barnes & Bros., Beaver Dam
	The American Agr'l Chemical Co., Bowker Fert. Works, Cincinnati, O.	
44228	Pure Ground Bone	Manufacturer
44621		T. E. Richardson, Campbellsville
44911		C. Y. White & Co., Cave City
	The American Agr'l Chemical Co., Michigan Carbon Works, Cin., O.	
44240	Wolverine Pure Ground Bone	Manufacturer
	The American Agr'l Chemical Co., Cin. Sales Dept., Cincinnati, O.	
44252	N.-W. Horseshoe Br. Pure Ground Bone	Manufacturer
	The American Agr'l Chemical Co., Cin. Sales Dept., Cincinnati, O.	
44261	Packers Boars Head Brand Chicago Bone Meal	Manufacturer
	The Armour Fert. Wks Nashville, Tenn.	
44034	Armour's Bone Meal	Manufacturer
44925		Barren Co. Gro. & Hdw. Co. Glasgow,
44035	Armour's Raw Bone Meal	Manufacturer
44926		Barren Co. Gro. & Hdw. Co., Glasgow
44036	Armour's Bone Meal Special	Manufacturer
44055	Smith's Pure Raw Bone Meal	Manufacturer
44933		Greenv'le Hdw. & Gro. Co., Greenv'le
44058	Smith's Bone Meal	Manufacturer

BONES, TANKAGE &C.

PERCENTAGE OF FINENESS.						POTASH.			
Fine Bone.	Medium Bone.	Total Phosphoric Acid.	Equivalent to Bone Phosphate.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.	Estimated Value Per Ton.	Station Number
75	25	20.32	44.37	2.26	2.74			$23.15	44203
76	24	20.50	44.75	3.22	3.91			26.67	44897
		20.00	*43.67*	*2.47*	*3.00*			*20.65*	
94	6	23.21	50.68	3.49	4.24			30.51	44204
73	27	23.74	51.86	3.13	3.80			28.67	44898
		22.00	*48.06*	*3.29*	*4.00*			*24.72*	
77	23	20.83	45.49	2.31	2.80			23.79	44228
76	24	23.00	50.24	2.46	2.99			25.90	44621
75	25	21.09	46.04	2.53	3.07			24.68	44911
		20.00	*43.67*	*2.47*	*3.00*			*20.65*	
75	25	20.81	45.46	2.43	2.95			24.12	44240
		20.00	*43.67*	*2.47*	*3.00*			*20.65*	
75	25	20.53	49.20	2.30	2.79			23.45	44252
		20.00	*43.67*	*2.47*	*3.00*			*20.65*	
77	23	20.35	44.45	2.23	2.71			23.16	44261
		20.00	*43.67*	*2.47*	*3.00*			*20.65*	
84	16	28.58	62.42	1.97	2.39			28.85	44034
83	17	27.24	59.48	1.74	2.11			26.96	44925
		27.00	*58.96*	*1.65*	*2.00*			*21.98*	
86	14	24.56	53.64	3.87	4.70			32.51	44035
50	50	23.92	52.25	3.77	4.58			29.95	44926
		22.00	*48.06*	*3.71*	*4.50*			*26.19*	
92	8	26.34	57.53	2.99	3.63			31.12	44036
		24.00	*52.42*	*2.47*	*3.00*			*23.05*	
84	16	25.06	54.73	3.85	4.67			32.73	44055
50	50	22.01	48.07	3.74	4.54			28.50	44933
		22.00	*48.06*	*3.71*	*4.50*			*26.19*	
84	16	28.18	61.55	1.98	2.40			28.58	44058
		27.00	*58.96*	*1.65*	*2.00*			*21.98*	

TABLE II.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	The Armour Fert. Wks. Nashville, Tenn.	
44577	Armour's Champion Bone Meal	Manufacturer
44578	Armour's Star Bone Meal	Manufacturer
	The Armour Fertilizer Works for The T. J. Turley Co., Owensboro, Ky.	
44044	Ideal Bone Meal	Manufacturer
	Baugh & Sons Co., Norfolk Va.	
44549	Baugh's Raw Bone Meal Warranted Pure	Manufacturer
	The Cincinnati Phosphate Co., Cin. O.	
44498	Ground Bone	*
	Continental Fert. Co., Louisville, Ky.	
44294	Bear Bone Meal	Manufacturer
44295	Bear Raw Bone Meal	Manufacturer
44937		McElroy-Page Co., Bowling Green
44296	Bear Raw Bone	Manufacturer
	The Empire Guano Co., Nashv'le, Tenn.	
44013	Half and Half Raw Bone Meal and Acid Phosphate	Manufacturer
44014	Special Bone Meal Mixture	Manufacturer
44016	Pure Raw Bone Meal	Manufacturer
	The Evansville Packing Co., Evansville, Ind.	
44405	Pure Raw Bone Meal	Manufacturer
	Federal Chemical Co., Louisville, Ky.	
42854	Daybreak Fine Raw Bone	Manufacturer
44946		A. H. Miller Impl. Co., Elizabetht'n

*The manufacturer failed to furnish sample required by law.

BONES, TANKAGE &C.

PERCENTAGE OF FINENESS.		Total Phosphoric Acid.	Equivalent to Bone Phosphate.	Nitrogen.	Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number
Fine Bone.	Medium Bone.					From Muriate.	From Sulphate.		
85	15	29.22	63.81	0.70	0.85			$24.95	44577
		29.00	*63.34*	*0.82*	*1.00*			*20.27*	
69	31	27.78	60.67	1.92	2.33			27.23	44578
		28.00	*61.16*	*2.06*	*2.50*			*24.01*	
84	16	28.30	61.80	2.00	2.43			28.74	44044
		27.00	*58.96*	*1.65*	*2.00*			*21.98*	
93	7	22.44	49.01	3.73	4.53			31.40	44549
		21.50	*46.98*	*3.71*	*4.50*			*25.89*	
									44498
		20.00	*43.67*	*2.47*	*3.00*			*20.65*	
78	22	27.22	59.46	1.85	2.25			27.05	44294
		27.00	*58.96*	*1.65*	*2.00*			*21.98*	
100		26.50	57.87	2.50	3.04			29.95	44295
95	5	26.14	57.08	2.58	3.13			29.68	44937
		24.00	*52.42*	*2.47*	*3.00*			*23.05*	
57	43	26.26	57.36	3.80	4.61			32.05	44296
		22.00	*48.06*	*3.71*	*4.50*			*26.19*	
50	50	20.32	44.37	2.42	2.94			22.70	44013
		18.00	*39.31*	*2.06*	*2.50*			*18.01*	
48	52	21.06	45.99	1.75	2.12		2.72	24.05	44014
		20.00	*43.67*	*1.65*	*2.00*		*3.00*	*21.38*	
74	26	23.49	51.30	3.65	4.43			30.25	44016
		23.00	*50.24*	*3.82*	*4.65*			*27.17*	
39	61	25.30	55.27	3.76	4.56			30.32	44405
		23.00	*50.24*	*3.71*	*4.50*			*26.79*	
82	18	24.23	52.92	2.62	3.18			27.67	42854
90	10	25.24	55.13	2.85	3.46			29.67	44946
		24.00	*52.42*	*2.88*	*3.50*			*24.48*	

TABLE II.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Federal Chemical Co., Louisville, Ky.	
42855	Daybreak Raw Bone	Manufacturer
44582		John Rothenberger, St. Matthews
44603		John C. Goin, St. Matthews
44947		St. Matthews Pro. Ex., St. Matthews
44576	Pure Bone	Manufacturer
44948		M. L. Spurling, Campbellsville
	Fox Chemical Co., Branch Federal Chem. Co., Louisville, Ky.	
42888	Fox Ground Raw Bone	Manufacturer
42889	Fox Raw Bone	Manufacturer
	Globe Fert. Co., Branch Federal Chemical Co., Louisville, Ky.	
42927	Acorn Raw Bone	Manufacturer
44734		Moss & Gibson, Crestwood
42928	Globe Raw Bone	Manufacturer
44735		Moss & Gibson, Crestwood
	The Groves Co., Cincinnati, O.	
44429	Pure Ground Bone	*
44746		Minges Hdw. Co., Newport
44430	Pure Raw Bone	*
44431	Pure Bone and Potash Mixture	*
44432	Half and Half	*
44747		T. N. McGlothlan, Irvington
	Hirsh, Stein & Co., Chicago, Ill.	
44451	Calumet Brand Special Pure Bone Meal and Potash	Manufacturer
44751		I. K. Miller & Sons, Campbellsville
44961		Pearson & Breedlove, Franklin

*The manufacturer failed to furnish sample required by law.

Bones, Tankage &c.

PERCENTAGE OF FINENESS.						POTASH.			
Fine Bone.	Medium Bone.	Total Phosphoric Acid.	Equivalent to Bone Phosphate.	Nitrogen.	Equivalent to Ammonia.	From Muriate.	From Sulphate.	Estimated Value Per Ton.	Station Number
58	42	21.93	47.89	3.53	4.29			$28.07	42855
58	42	19.07	41.66	3.72	4.52			26.68	44582
60	40	18.46	40.32	3.93	4.77			27.05	44603
58	42	21.93	47.89	3.79	4.60			28.98	44947
		22.00	*48.06*	*3.71*	*4.50*			*26.19*	
78	22	32.66	71.33	1.03	1.25			28.30	44576
29	71	31.00	67.72	1.25	1.52			24.78	44948
		30.00	*65.52*	*1.00*	*1.21*			*21.50*	
85	15	24.50	53.51	2.54	3.08			27.75	42888
		24.00	*52.42*	*2.88*	*3.50*			*24.48*	
69	31	22.19	48.46	3.58	4.35			28.91	42889
		22.00	*48.06*	*3.71*	*4.50*			*26.19*	
82	18	25.06	54.73	2.50	3.04			27.90	42927
79	21	24.58	53.67	2.80	3.40			28.44	44734
		24.00	*52.42*	*2.88*	*3.50*			*24.48*	
71	29	22.41	48.95	3.67	4.46			29.48	42928
59	41	22.11	48.28	3.86	4.69			29.38	44735
		22.00	*48.06*	*3.71*	*4.50*			*26.19*	
									44429
74	26	20.30	44.34	3.60	4.37			27.79	44746
		20.00	*43.67*	*2.47*	*3.00*			*20.65*	
									44430
		22.00	*48.06*	*3.71*	*4.50*			*26.19*	
									44431
		20.00	*43.67*	*0.82*	*1.00*	*5.00*		*19.87*	
									44432
84	16	15.86	34.65	1.37	1.66	2.87		19.85	44747
		16.00	*34.95*	*1.65*	*2.00*	*2.00*		*17.38*	
68	32	20.88	45.60	0.88	1.07	5.25		23.70	44451
63	37	21.98	48.00	0.79	0.96	4.28		23.01	44751
54	46	21.01	45.88	1.07	1.30	4.78		23.41	44961
		20.00	*43.67*	*0.82*	*1.00*	*4.00*		*18.87*	

TABLE II.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Hirsh, Stein & Co.	
44452	Calumet Br. Extra Bone Meal	Manufacturer
44752		I. K. Miller & Sons, Campbellsville
44962		I. K. Miller & Sons, Campbellsville
44453	Calumet Br. Pure Bone Meal	Manufacturer
44753		I. K. Miller & Sons, Campbellsville
44454	Calumet Br. Spl. Pure Bone Meal	Manufacturer
44754		I. K. Miller & Sons, Campbellsville
44455	Calumet Br. Pure Raw Bone Meal	Manufacturer
44755		Salsman & New, Clarkson
44775		L. C. Bell & Son, Adair
44963		I. K. Miller & Sons, Campbellsville
44456	Bland & Alberts' Pure Raw Bone Meal	Manufacturer
	Hopkins Fertilizer Co., New Albany, Ind.	
44458	Old Time Pure Raw Bone	Manufacturer
44756		O. T. Pickerill, Hodgenville
44964		O. A. Lutes & Co., Shepherdsville
44459	Old Time Special Ground Bone	Manufacturer
44965		The Jenkins-Essex Co., Elizabetht'n
	The Jarecki Chem. Co., Cincinnati, O.	
44482	Pure Ground Bone	*
	Jones Fertilizer Co., Louisville, Ky.	
44332	Jones Raw Bone	Manufacturer
44779		C. S. Brent, Lexington
44333	Jones Bone Meal	Manufacturer
44334	Jones Raw Bone Meal	Manufacturer
	The Kaufman Fert. Co., Cincinnati, O.	
44510	Pure Bone	*

*The manufacturer failed to furnish sample required by law.

BONES, TANKAGE &C.

PERCENTAGE OF FINENESS.		Total Phosphoric Acid.	Equivalent to Bone Phosphate.	Nitrogen.	Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number.
Fine Bone.	Medium Bone.					From Muriate.	From Sulphate.		
41	59	28.62	62.50	2.35	2.85			$27.74	44452
48	52	30.28	66.13	2.07	2.51			28.32	44752
51	49	28.34	61.89	2.05	2.49			27.07	44962
		28.00	*61.16*	*2.00*	*2.43*			*23.80*	
58	42	23.46	51.24	2.67	3.24			26.15	44453
58	42	26.76	58.45	2.25	2.73			27.04	44753
		22.00	*48.06*	*2.47*	*3.00*			*21.85*	
58	42	30 88	67.45	0.88	1.07			25.19	44454
55	45	30.60	66.83	1.05	1.27			25.40	44754
		29.00	*63.34*	*0.82*	*1.00*			*20.27*	
75	25	20.83	49.84	3.84	4.66			29.07	44455
78	22	19.61	42.83	3.73	4.53			27.89	44755
71	29	18.12	39.58	3.80	4.61			26.75	44775
66	34	20.43	44.62	3.60	4.37			27.55	44963
		20.00	*43.67*	*3.71*	*4.50*			*24.99*	
66	34	22.13	48.34	4.10	4.98			31.29	44456
		22.00	*48.06*	*3.71*	*4.50*			*26.19*	
50	50	21.88	47.78	3.82	4.64			28.68	44458
49	51	21.22	46.35	3.59	4.36			27.38	44756
58	42	22.39	48.90	4.11	4.99			30.42	44964
		22.00	*48.06*	*3.50*	*4.25*			*25.45*	
40	60	21.34	46.60	2.85	3.46			24.49	44459
48	52	21.50	46.95	2.98	3.62			25.40	44965
		20.00	*43.67*	*2.47*	*3.00*			*20.65*	
									44482
		20.00	*43.67*	*2.47*	*3.00*			*20.65*	
64	36	26.02	56.83	3.74	4.54			32.03	44332
48	52	24.15	52.75	3.98	4.83			30.74	44779
		22.00	*48.06*	*3.71*	*4.50*			*26.19*	
72	28	27.60	60.26	1.87	2.27			27.09	44333
		27.00	*58.96*	*1.65*	*2.00*			*21.98*	
100		26.52	57.92	2.58	3.13			30.25	44334
		24.00	*52.42*	*2.47*	*3.00*			*23.05*	
									44510
		20.00	*43.67*	*2.47*	*3.00*			*20.65*	

TABLE II.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Kentucky Fert. Co., Branch Federal Chemical Co., Louisville, Ky.	
42952	O. K. Fine Raw Bone	Manufacturer
44953	O. K. Raw Bone	Manufacturer
	Louisville Fert. Co., Louisville, Ky.	
44263	Eagle Bone Meal	Manufacturer
44264	Eagle Raw Bone Meal	Manufacturer
44804		M. C. Beam & Son, New Haven
44974		L. S. Brough, Bowling Green
44265	Eagle Raw Bone	Manufacturer
44975		L. S. Brough, Bowling Green
	Morris & Co., Chicago, Ill.	
44113	Big One—Ground Raw Bone	Manufacturer
44813		Hatter Hardware Co., Franklin
44983		Woodson Lewis, Greensburg
44114	Big Two—Pure Bone Meal	Manufacturer
44814		Hatter Hardware Co., Franklin
44118	Big Six—Spl. Bone Meal & Potash	Manufacturer
44984		Woodson Lewis, Greensburg
44119	Big Seven—Bone Meal & Potash	Manufacturer
44817		Woodson Lewis, Greensburg
44985		Woodson Lewis, Greensburg
44123	Big Eleven—Bone Meal & Potash	Manufacturer
	Pero & Stoecker, Louisville, Ky.	
44511	Pure Animal Matter Corn and Wheat Grower	Manufacturer
44991		Watkins & Co., Elizabethtown

Bones, Tankage &c.

Percentage of Fineness.		Total Phosphoric Acid.	Equivalent to Bone Phosphate.	Nitrogen.	Equivalent to Ammonia.	Potash.		Estimated Value Per Ton.	Station Number
Fine Bone.	Medium Bone.					From Muriate.	From Sulphate.		
85	15	24.15	52.75	2.82	3.42			$28.46	42952
		24.00	*52.42*	*2.88*	*3.50*			*24.48*	
61	39	22.16	48.39	3.47	4.21			28.15	42953
		22.00	*48.06*	*3.71*	*4.50*			*26.19*	
74	26	27.78	60.68	1.87	2.27			27.33	44263
		27.00	*58.96*	*1.65*	*2.00*			*21.98*	
100		26.78	58.48	2.61	3.17			30.56	44264
65	35	25.06	54.73	2.25	2.73			26.17	44804
95	5	25.56	55.82	2.93	3.56			30.45	44974
		24.00	*52.42*	*2.47*	*3.00*			*23.05*	
52	48	25.78	56.30	3.72	4.52			31.17	44265
63	37	21.96	47.96	3.54	4.30			28.33	44975
		22.00	*48.06*	*3.71*	*4.50*			*26.10*	
79	21	25.50	55.68	3.36	4.08			31.09	44113
63	37	27.16	59.32	3.16	3.84			30.78	44813
79	21	25.52	55.74	3.04	3.69			29.99	44983
		24.00	*52.42*	*3.29*	*4.00*			*25.92*	
83	17	30.06	65.66	1.78	2.16			29.26	44114
57	43	29.04	63.42	2.21	2.68			28.47	44814
		28.00	*61.16*	*2.06*	*2.50*			*24.01*	
92	8	18.92	41.32	0.60	0.73		2.33	19.74	44118
86	14	17.01	37.16	0.56	0.68		2.19	17.72	44984
		16.00	*34.95*	*0.41*	*0.50*		*2.00*	*13.44*	
88	12	17.44	38.08	1.16	1.41		3.95	22.33	44119
67	33	15.81	34.53	1.64	1.99	1.64	0.86	20.01	44817
88	12	16.58	36.21	1.31	1.59		2.86	20.88	44985
		16.00	*34.95*	*1.23*	*1.50*		*3.00*	*17.51*	
87	13	18.11	39.56	0.81	0.98		10.79	29.81	44123
		16.00	*34.95*	*0.82*	*1.00*		*10.00*	*24.47*	
80	20	14.03	30.65	5.43	6.59			29.68	44511
83	17	15.85	34.62	3.81	4.63			25.48	44991
		10.00	*21.85*	*4.00*	*4.86*			*20.00*	

TABLE II.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Pero & Stoecker.	
44512	Pure Animal Matter & Potash	*
44513	Pure Bone Meal	Manufacturer
44992		Watkins & Co., Elizabethtown
	Read Phosphate Co., Nashville, Tenn.	
42987	Half and Half Raw Bone Meal and Acid Phosphate	Manufacturer
42988	Pure Raw Bone Meal	Manufacturer
42989	Bone Meal Mixture	Manufacturer
	Swift & Co., East St. Louis, Ill.	
44361	Swift's Pure Bone Meal	*
44851		Forbes Mfg. Co., Hopkinsville
45010		Barren Co. Gro. & Hdw. Co,, Glasgow
44362	Swift's Raw Bone Meal	*
45011		Barren Co. Gro. & Hdw. Co., Glasgow
44363	Swift's Pure Bone Meal & Blood	*
44855		W. T. Kirkman, Elkton
44364	Swift's Pure Bone Meal & Potash	*
44856		E. T. Pence, Stanford
45012		Barren Co. Gro. & Hdw. Co., Glasgow
44365	Swift's Ground Steamed Bone	*
44857		W. T. Kirkman, Elkton
45013		Forbes Mfg. Co., Hopkinsville
44366	Swift's Ground Beef Bone	*
44367	Swift's Special Wheat Grower	*

*The manufacturer failed to furnish sample required by law.

BONES, TANKAGE &C.

PERCENTAGE OF FINENESS.		Total Phosphoric Acid.	Equivalent to Bone Phosphate.	Nitrogen.	Equivalent to Ammonia.	POTASH		Estimated Value Per Ton.	Station Number
Fine Bone.	Medium Bone.					From Muriate.	From Sulphate.		
									44512
		10.00	*21.85*	*4.00*	*4.86*		*4.00*	*$24.80*	
74	26	23.74	51.86	3.41	4.14			29.70	44513
66	34	23.79	51.97	3.76	4.56			30.57	44992
		22.00	*48.06*	*3.50*	*4.25*			*25.45*	
47	53	20.81	45.46	2.38	2.89			22.77	42987
		18.00	*39.31*	*2.06*	*2.50*			*18.01*	
64	36	23.74	51.86	3.55	4.31			29.71	42988
		23.00	*50.24*	*3.82*	*4.65*			*27.17*	
41	59	21.29	46.49	1.75	2.12		2.70	23.89	42989
		20.00	*43.67*	*1.65*	*2.00*		*3.00*	*21.38*	
									41361
77	23	25.68	56.08	2.23	2.71			27.18	44854
67	33	23.49	51.30	2.70	3.28			26.69	45010
		24.00	*52.42*	*2.47*	*3.00*			*23.05*	
									44362
52	48	23.66	51.65	4.33	5.26			31.82	45011
		23.00	*50.24*	*3.71*	*4.50*			*26.79*	
									44363
80	20	24.23	52.92	3.33	4.04			30.07	44855
		23.00	*50.24*	*3.71*	*4.50*			*26.79*	
									44364
84	16	26.32	57.47	1.89	2.29	3.57		30.41	44856
79	21	24.79	54.15	1.73	2.10	3.57		28.42	45012
		25.00	*54.59*	*1.85*	*2.25*	*3.00*		*24.48*	
									44365
81	19	23.94	52.28	1.55	1.88			23.67	44857
78	22	20.20	44.12	1.67	2.03			21.12	45013
		20.00	*43.67*	*1.65*	*2.00*			*17.78*	
									44366
		27.00	*58.96*	*2.06*	*2.50*			*23.41*	
									44367
		16.00	*34.95*	*1.20*	*1.46*	*3.00*		*16.80*	

TABLE II.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	Taylor & Powell Fertilizer Co., Springfield, Tenn.	
44540	Raw Bone Meal	*
	Tennessee Chemical Co., Louisville, Ky., and Nashville, Tenn:	
44301 45014	Ox Raw Bone with Potash	Manufacturer W. F. Grainger, Franklin
44316 45019	Ox Raw Bone	Manufacturer W. F. Grainger, Franklin
44317 44870	Ox Raw Bone Meal	Manufacturer Lebanon Carriage & Impl. Co., Leb'n
44318 45020	Ox Bone Meal	Manufacturer J. J. Shaver, Mayfield
	Tuscarora Fert. Co., Nashville, Tenn.	
44071 45026	Tuscarora Bone Meal	Manufacturer Dickinson Bros., Glasgow
44072 45027	Tuscarora Raw Bone Meal	Manufacturer Dickinson Bros., Glasgow
	Virginia-Carolina Chem. Co., Cin., O.	
44586	Ground Animal Bone	Manufacturer
	Virginia-Carolina Chem. Co., Memphis, Tenn.	
44105	Ground Animal Bone	Manufacturer

*The manufacturer failed to furnish sample required by law.

BONES, TANKAGE &C.

PERCENTAGE OF FINENESS.		Total Phosphoric Acid.	Equivalent to Bone Phosphate.	Nitrogen.	Equivalent to Ammonia.	POTASH.		Estimated Value Per Ton.	Station Number
Fine Bone.	Medium Bone.					From Muriate.	From Sulphate.		
									44540
		22.00	*48.06*	*3.71*	*4.50*			*$26.19*	
75	25	22.16	48.39	2.03	2.46		3.39	27.80	44301
69	31	19.97	43.61	1.73	2.10	3.32		24.77	45014
		20.00	*43.67*	*1.85*	*2.25*		*3.00*	*22.08*	
60	40	26.08	56.97	3.78	4.59			32.01	44316
73	27	25.70	56.13	3.63	4.41			31.88	45019
		22.00	*48.06*	*3.71*	*4.50*			*26.19*	
100		26.48	57.84	2.76	3.35			30.84	44317
72	28	25.42	55.52	2.49	3.02			27.63	44870
		24.00	*52.42*	*2.47*	*3.00*			*23.05*	
75	25	27.70	60.49	1.84	2.23			27.21	44318
100		28.74	62.74	2.19	2.66			30.66	45020
		27.00	*58.96*	*1.65*	*2.00*			*21.98*	
85	15	27.14	59.27	1.84	2.23			27.34	44071
70	30	27.96	61.06	1.69	2.05			26.61	45026
		27.00	*58.96*	*1.65*	*2.00*			*21.98*	
94	6	24.96	54.51	3.86	4.69			32.88	44072
76	24	19.97	43.61	4.66	5.66			31.32	45027
		22.00	*48.06*	*3.71*	*4.50*			*26.10*	
80	20	26.36	57.57	2.52	3.06			28.85	44586
		28.00	*61.16*	*1.65*	*2.00*			*22.59*	
82	18	21.83	47.68	3.10	3.76			27.53	44105
		20.00	*43.67*	*3.29*	*4.00*			*23.52*	

TABLE III.—ACID PHOSPHATES.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	PHOSPHORIC ACID. Available.	Insoluble.	Total.	Estimated Value Per Ton.	Station Number.
	The American Agr'l Chemical Co., Cincinnati Sales Dept., Cincinnati, O.						
44205	A. A. C. 16% Acid Phosphate	Manufacturer	16.79	2.46	19.25	$16.79	44205
44610		A. H. Miller Imp'l. Co., Elizabetht'n	17.64	2.12	19.76	17.64	44610
44899		J. T. Price, Dabney	16.04	2.45	18.49	16.04	44899
			16.00	*1.00*	*17.00*	*16.00*	
44208	A. A. C. Acid Phosphate	Manufacturer	15.01	2.14	17.15	15.01	44208
44613		J. H. Thurman, Somerset	12.99	2.27	15.26	12.99	44613
			12.00	*2.00*	*14.00*	*12.00*	
	The American Agr'l Chemical Co., Cincinnati Sales Dept., Cincinnati, O.						
44213	Bradley Fertilizer Works Soluble Dissolved Bone	Manufacturer	15.84	2.52	18.36	15.84	44213
44901		Marcum, Gooch & Payne, Eubank	14.93	2.28	17.21	14.93	44901
			14.00	*2.00*	*16.00*	*14.00*	
	The American Agr'l Chemical Co., Cincinnati Sales Dept , Cincinnati, O.						
44214	Cleveland Dryer Works Horsehead Phosphate	Manufacturer	10.85	2.12	12.97	10.85	44214
44902		O. A. Lutes & Co., Shepherdsville	13.18	2.24	15.42	13.18	44902
			10.00	*2.00*	*12.00*	*10.00*	
44215	Cleveland Dryer Works XXX Superphosphate	Manufacturer	15.73	2.50	18.23	15.73	44215
44623		W. G. Wesley, Mangum	14.85	2.26	17.11	14.85	44623
44903		W. G. Wesley, Mangum	14.51	2.40	16.91	14.51	44903
			14.00	*2.00*	*16.00*	*14.00*	

	The American Agr'l Chemical Co., Bowker Fert. Works, Cincinnati, O.						
44219	Soluble Bone	Manufacturer	15.96	2.32	18.28	15.96	44219
			14.00	*2.00*	*16.00*	*14.00*	
	The American Agr'l Chemical Co., Michigan Carbon Wks., Cincinnati, O.						
44230	Red Line Phosphate	Manufacturer	15.44	2.44	17.88	15.44	44230
44624		L. D. Gooch, Crab Orchard	15.51	2.06	17.57	15.51	44624
			14.00	*2.00*	*16.00*	*14.00*	
	The American Agr'l Chemical Co., Cincinnati Sales Dept., Cincinnati, O.						
44250	N-W Horseshoe Brand Square Deal Phosphate	Manufacturer	16.50	1.96	18.46	16.50	44250
44639		Woodson Lewis, Greensburg	15.30	1.76	17.06	15.30	44639
			14.00	*2.00*	*16.00*	*14.00*	
44251	N-W Horseshoe Brand Quick Acting Phosphate	*					44251
44640		Clarkson Hardware Co., Clarkson	11.01	1.64	12.65	11.01	44640
44917		Watkins & Co., Elizabethtown	11.03	2.08	13.11	11.03	44917
			10.00	*2.00*	*12.00*	*10.00*	
	The American Agr'l Chemical Co., Cincinnati Sales Dept., Cincinnati, O.						
44253	Packers Boars Head Brand Soluble Phosphate	Manufacturer	11.22	1.86	13.08	11.22	44253
44641		W. M. West, Murray	9.33	**1.19**	10.52	9.93	44641
			10.00	*2.00*	*12.00*	*10.00*	
44254	Packers Boars Head Brand Gilt Edge Phosphate	Manufacturer	16.31	1.82	18.13	16.31	44254
44918		J. T. Price, Dabney	14.10	2.32	16.42	14.10	44918
			14.00	*2.00*	*16.00*	*14.00*	
	The Armour Fert. Wks., Nashville, Tenn.						
44037	Armour's High Grade Phosphate	Manufacturer	15.91	3.67	19.58	15.91	44037
44661		Forbes Mfg. Co., Hopkinsville	**14.16**	4.70	18.86	**14.16**	44661
44927		C. M. Langdon, Science Hill	17.11	2.42	19.53	17.11	44927
			16.00	*2.00*	*18.00*	*16.00*	
44038	Armour's Star Phosphate	Manufacturer	15.55	7.15	22.70	15.55	44038
			14.00	*2.00*	*16.00*	*14.00*	

*Sample broken in transit.

TABLE III.—ACID PHOSPHATES.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	PHOSPHORIC ACID. Available.	Insoluble	Total.	Estimated Value Per Ton.	Station Number.
	The Armour Fertilizer Works.						
44039	Armour's Cereal Phosphate	Manufacturer	11.01	14.86	25.87	$11.01	44039
44928		Barren Co. Gro. & Hdw. Co., Glasgow	10.34	6.45	16.79	10.34	44928
			10.00	*2.00*	*12.00*	*10.00*	
	The Armour Fert. Wks. Nashville, Tenn.						
44056	Smith's Soluble Phosphate	Manufacturer	14.70	6.49	21.19	14.70	44056
44934		Greenville Hdw. & Gro. Co., Greenv'le	14.83	1.95	16.78	14.83	44934
			14.00	*2.00*	*16.00*	*14.00*	
	The Cincinnati Phosphate Co, Cin. O.						44495
44495	Wheat Grower	*	*14.00*	*1.00*	*15.00*	*14.00*	
	Continental Fert. Co., Louisville, Ky.						
44298	Bear High Grade Dissolved Bone	Manufacturer	14.07	2.15	16.22	14.07	44298
44680		T. Z. Leachman, Greensburg	15.06	2.28	17.34	15.06	44680
44939		Cohen Bros., Greenville	13.93	**0.20**	14.13	13.93	44939
			14.00	*2.00*	*16.00*	*14.00*	
44299	Bear Phosphate	Manufacturer	13.23	1.78	15.01	13.23	44299
			12.00	*2.00*	*14.00*	*12.00*	
	Duncan & Bro., La Grange, Ky.						
44555	Tiger Brand Phosphate	Manufacturer	19.47	1.16	20.63	19.47	44555
			16.00	*2.00*	*18.00*	*16.00*	
	The Empire Guano Co., Nashville, Tenn.						
44010	Acid Phosphate	Manufacturer	14.58	8.13	22.71	14.58	44010
			12.00			*12.00*	

*The manufacturer failed to furnish sample required by law.

44011	High Grade Acid Phosphate	Manufacturer	16.13	4.65	20.78	$16.13	44011
			14.00			*14.00*	
44012	Climax Acid Phosphate	Manufacturer	17.32	2.52	19.84	17.32	44012
			16.00			*16.00*	
	Evansville Packing Co., Evansville, Ind.						
44415	High Grade Soluble Phosphate	Manufacturer	17.44	2.55	19.99	17.44	44415
			16.00	*2.00*	*18.00*	*16.00*	
	Federal Chemical Co., Louisville, Ky.						
42848	Daybreak H. Gr. Acid Phosphate	Manufacturer	17.94	0.42	18.36	17.94	42848
44698		Louisa Furniture & Hdw. Co., Louisa	19.91	0.64	20.55	19.91	44698
44943		St. Matthews Pro. Ex., St. Matth'ws	18.10	0.80	18.90	18.10	44943
			16.00	*2.00*	*18.00*	*16.00*	
42849	Daybreak Royal Phosphate	Manufacturer	18.13	0.66	18.79	18.13	42849
			14.00	*2.00*	*16.00*	*14.00*	
42850	Daybreak Standard Phosphate	Manufacturer	15.18	5.14	20.32	15.18	42850
44699		J. H. Pelly, Columbia	13.20	8.35	21.55	13.20	44699
			12.00	*2.00*	*14.00*	*12.00*	
42851	Daybreak Star Phosphate	Manufacturer	13.13	8.55	21.68	13.13	42851
			10.00	*2.00*	*12.00*	*10.00*	
42852	Half & Half Phosphate Mixture	Manufacturer	13.22	9.22	22.44	13.22	42852
44944		James Lewis, Creston	11.66	12.69	24.35	11.66	44944
			10.00	*12.00*	*22.00*	*10.00*	
44545	Extra High Grade Phosphate	Manufacturer	19.80	0.83	20.63	19.80	44545
			18.00	*2.00*	*20.00*	*18.00*	
	Fox Chemical Co., Branch Federal Chemical Co., Louisville, Ky.						
42884	Fox High Grade Acid Phosphate	Manufacturer	17.36	0.54	17.90	17.36	42884
			16.00	*2.00*	*18.00*	*16.00*	
42885	Fox Acid Phosphate	Manufacturer	18.08	0.87	18.95	18.08	42885
			14.00	*2.00*	*16.00*	*14.00*	

TABLE III.—ACID PHOSPHATES.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	PHOSPHORIC ACID. Available.	Insoluble.	Total.	Estimated Value Per Ton.	Station Number.
	Fox Chemical Co., Branch Federal Chemical Co.						
42886	Fox Standard Acid Phosphate	Manufacturer	15.60	4.72	20.32	$15.60	42886
44710		Harrison Austin, Beaver Dam	13.58	8.01	21.59	13.58	44710
			12.00	*2.00*	*14.00*	*12.00*	
42887	Fox A. A. Acid Phosphate	Manufacturer	12.62	8.63	21.25	12.62	42887
44711		A. B. Beale & Son, Murray	11.09	13.39	24.48	11.09	44711
			10.00	*2.00*	*12.00*	*10.00*	
	Globe Fertilizer Co., Branch Federal Chemical Co., Louisville, Ky.						
42923	Globe High Grade Acid Phosphate	Manufacturer	17.65	0.43	18.08	17.65	42923
44956		Jeffries Hardware Store, Columbia	18.91	0.73	19.64	18.91	44956
			16.00	*2.00*	*18.00*	*16.00*	
42924	Globe Acid Phosphate	Manufacturer	17.46	1.44	18.90	17.46	42924
44732		The Jeffries Hdw. Store, Columbia	15.55	5.33	20.88	15.55	44732
44957		The Jeffries Hdw. Store, Columbia	17.22	3.77	20.99	17.22	44957
			14.00	*2.00*	*16.00*	*14.00*	
42925	Globe Standard Acid Phosphate	Manufacturer	15.52	4.74	20.26	15.52	42925
44733		Evans, Goodman & Maxey, Glasgow	11.91	8.38	20.29	11.91	44733
44958		J. H. Carter, Mud Lick	13.32	4.74	18.06	13.32	44958
			12.00	*2.00*	*14.00*	*12.00*	
42926	Globe A. A. Acid Phosphate	Manufacturer	13.08	8.66	21.74	13.08	42926
			10.00	*2.00*	*12.00*	*10.00*	

	The Groves Co., Cincinnati, O.						
44421	Monarch Brand	*					44421
44739		T. W. Denney, Science Hill	14.83	1.67	16.50	$14.83	44739
			14.00	*2.00*	*16.00*	*14.00*	
	W. A. Guenther & Sons, Owensboro, Ky.						
44557	Guenther's 16% Acid Phosphate	*					44557
44690		Manufacturer's Warehouse	17.53	1.57	19.10	17.53	44690
			16.00	*2.00*	*18.00*	*16.00*	
	Hopkins Fert. Co., New Albany, Ind.						
44471	Old Time H. Gr. Acid Phosphate	Manufacturer	15.38	1.96	17.34	15.38	44471
			14.00	*1.00*	*15.00*	*14.00*	
44472	Old Time Quick Action Phosphate	Manufacturer	11.14	1.66	12.80	11.14	44472
			10.00	*1.00*	*11.00*	*10.00*	
44646	Hopkins 16% Acid Phosphate	Manufacturer	17.55	2.75	20.30	17.55	44646
			16.00	*1.00*	*17.00*	*16.00*	
	Int. Agr'l. Corp., Nat. Fert. Branch Nashville, Tenn.						
44172	Old Hickory Acid Phosphate	Manufacturer	11.77	5.90	17.67	11.77	44172
			12.00	*2.00*	*14.00*	*12.00*	
44173	Old Hickory H. Gr. Dissolved Bone	Manufacturer	14.99	3.42	18.41	14.99	44173
			14.00	*2.00*	*16.00*	*14.00*	
44174	Old Hickory H. Gr. Acid Phosphate	Manufacturer	15.58	3.80	19.38	15.58	44174
			16.00	*1.00*	*17.00*	*16.00*	
44175	Old Hickory Ky. Acid Phosphate	*					44175
			10.00	*2.00*	*12.00*	*10.00*	
	Int. Agr'l. Corp., Tenn. Valley Fert. Works, Nashville, Tenn.						
44184	Tiger Dissolved Bone	Manufacturer	11.67	5.86	17.53	11.67	44184
			12.00	*2.00*	*14.00*	*12.00*	
44185	Tiger High Grade Dissolved Bone	Manufacturer	14.34	5.07	19.41	14.34	44185
			14.00	*2.00*	*16.00*	*14.00*	

*The manufacturer failed to furnish sample required by law.

TABLE III.—ACID PHOSPHATES.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	PHOSPHORIC ACID. Available.	Insoluble.	Total.	Estimated Value Per Ton.	Station Number.
	Int. Agr'l Corp., Interstate Phosph ate Works, Nashville, Tenn.						
44193	Triangle Fish Dissolved Bone	Manufacturer	14.94	3.29	18.23	$14.94	44193
			14.00	*2.00*	*16.00*	*14.00*	
44194	Triangle Fish Acid Phosphate	Manufacturer	11.95	5.61	17.56	11.95	44194
			12.00	*2.00*	*14.00*	*12.00*	
	The Jarecki Chemical Co., Cincinnati, O.						
44481	C. O. D. Phosphate	*					44481
			14.00	*1.00*	*15.00*	*14.00*	
	Jones Fertilizer Co., Louisville, Ky.						
44330	Jones High Grade Dissolved Bone	Manufacturer	14.20	1.61	15.81	14.20	44330
			14.00	*2.00*	*16.00*	*14.00*	
44331	Jones Phosphate	Manufacturer	12.70	1.22	13.92	12.70	44331
44778		Forbes Mfg. Co., Hopkinsville	**10.13**	2.59	12.72	**10.13**	44778
			12.00	*2 00*	*14.00*	*12.00*	
	The Kaufman Fert. Co., Cincinnati, O.						
44508	Dissolved Phosphate	*					44508
			14.00	*1.00*	*15.00*	*14.00*	
	Kentucky Fertilizer Co., Branch Federal Chemical Co., Louisville, Ky.						
42948	O. K. Phosphate	Manufacturer	18.04	0.80	18.84	18.04	42948
			14.00	*2.00*	*16.00*	*14.00*	
42949	O. K. High Grade Acid Phosphate	Manufacturer	17.82	0.31	18.13	17.82	42949
			16.00	*2.00*	*18.00*	*16.00*	

*The manufacturer failed to furnish sample required by law.

42950	O. K. Standard Phosphate	Manufacturer	15.73	4.39	20.12	15.73	42950
44800		D. L. D. Sandefur, Beaver Dam	13.72	5.07	18.79	13.72	44800
			12.00	*2.00*	*14.00*	*12.00*	
42951	O. K. Good Luck Phosphate	Manufacturer	12.77	8.64	21.41	12.77	42951
44801		W. A. Ogilvie, Benton	10.76	14.38	25.14	10.76	44801
			10.00	*2.00*	*12.00*	*10.00*	
	Louisville Fertilizer Co., Louisville, Ky.						
44270	Eagle High Grade Dissolved Bone	Manufacturer	14.51	1.30	15.81	14.51	44270
44806		Clore Co., Crestwood	14.28	3.11	17.39	14.28	44806
			14.00	*2.00*	*16.00*	*14.00*	
44271	Eagle Phosphate	Manufacturer	13.13	1.95	15.08	13.13	44271
			12.00	*2.00*	*14.00*	*12.00*	
44282	Eagle Excelsior Acid Phosphate	Manufacturer	17.36	1.87	19.23	17.36	44282
44980		M. J. Yopp Seed Co., Paducah	16.42	1.20	17.62	16.42	44980
			16.00	*2.00*	*18.00*	*16.00*	
	Mt. Pleasant Fertilizer Co., Mt. Pleasant, Tenn.						
44142	Black Patch Mt. Pleasant Soluble Bone	Manufacturer	13.51	9.36	22.87	13.51	44142
44821		T. H. Cochran & Co., Marion	13.84	7.43	21.27	13.84	44821
			12.00	*4.00*	*16.00*	*12.00*	
44143	Big Success Mt. Pleasant Special Acid Phosphate	Manufacturer	18.49	3.85	22.34	18.49	44143
			14.00	*2.00*	*16.00*	*14.00*	
44144	Big Success H. Gr. Dissolved Bone	Manufacturer	19.10	0.54	19.64	19.10	44144
44822		Baker & Isaacs, Berea	17.79	1.13	18.92	17.79	44822
			16.00	*1.00*	*17.00*	*16.00*	
44156	Great Southern Acid Phosphate	Manufacturer	19.04	3.60	22.64	19.04	44156
			14.00	*2.00*	*16.00*	*14.00*	
44157	Gr. Southern Spl. Acid Phosphate	Manufacturer	18.66	0.62	19.28	18.66	44157
44824		A. C. Kimball, Springfield	17.25	0.93	18.18	17.25	44824
			16.00	*1.00*	*17.00*	*16.00*	

TABLE III.—ACID PHOSPHATES.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	PHOSPHORIC ACID. Available.	Insoluble.	Total.	Estimated Value Per Ton.	Station Number.
	Read Phosphate Co., Nashville, Tenn.						
42983	Spl. High Grade Acid Phosphate	Manufacturer	16.97	3.05	20.02	$16.97	42983
45000		Baker & Glasgow, Murray	16.45	3.16	19.61	16.45	45000
			16.00			*16.00*	
42984	High Grade Acid Phosphate	Manufacturer	16.31	4.88	21.19	16.31	42984
44835		Hatter Hardware Co., Franklin	15.10	4.84	19.94	15.10	44835
45001		Wolford Bros., Casey Creek	13.53	4.96	18.49	13.53	45001
			14.00			*14.00*	
42985	XXX Dissolved Bone	Manufacturer	15.35	6.71	22.06	15.35	42985
44836		M. B. Hines, Science Hill	13.82	5.25	19.07	13.82	44836
45002		M. B. Hines, Science Hill	12.95	6.18	19.13	12.95	45002
			13.00			*13.00*	
42986	Quick Action Phosphate	Manufacturer	11.39	12.05	23.44	11.39	42986
			10.00			*10.00*	
	Southern Fertilizer Co., Louisville, Ky.						
44599	Elk Phosphate	*					44599
44844		D. L. D. Sandefur, Beaver Dam	13.89	2.00	15.89	13.89	44844
45006		Simpson County Hdw. Co., Franklin	14.24	3.15	17.39	14.24	45006
			14.00	*1.00*	*15.00*	*14.00*	
	Swift & Co., East St. Louis, Ill.						
44357	Swift's Garden City Phosphate	*					44357
			14.00			*14.00*	

*The manufacturer failed to furnish sample required by law.

44358	Swift's H. Grade Acid Phosphate	*					44358
44851		Overstreet & Ireland, La Grange	16.91	0.18	17.09	16.91	44851
			16.00			*16.00*	
	Taylor & Powell Fertilizer Co., Springfield, Tenn.						
44543	16% Acid Phosphate	*					44543
			16.00			*16.00*	
	Tennessee Chemical Co., Louisville, Ky., and Nashville, Tenn.						
44319	Ox Tennessee Best Acid Phosphate	Manufacturer	17.31	1.31	18.62	17.31	44319
44871		I. K. Miller & Sons, Campbellsville	17.45	1.24	18.69	17.45	44871
45021		J. M. Johnson, Benton	17.30	0.17	17.47	17.30	45021
			16.00	*2.00*	*18.00*	*16.00*	
44320	Ox High Grade Dissolved Bone	Manufacturer	14.18	1.20	15.38	14.18	44320
44872		Sexton Bros., Murray	14.00	2.04	16.04	14.00	44872
			14.00	*2.00*	*16.00*	*14.00*	
44321	Ox Phosphate	Manufacturer	13.57	1.39	14.96	13.57	44321
45022		Sexton Bros., Murray	12.28	5.72	18.00	12.28	45022
			12.00	*2.00*	*14.00*	*12.00*	
	Tuscarora Fert. Co., Nashville, Tenn.						
44069	Tuscarora Acid Phosphate	Manufacturer	14.92	6.86	21.78	14.92	44069
44873		C. M. Langdon, Science Hill	13.96	4.40	18.36	13.96	44873
45025		C. M. Langdon, Science Hill	14.25	6.23	20.48	14.25	45025
			14.00	*2.00*	*16.00*	*14.00*	
44070	Tuscarora Bone Phosphate	Manufacturer	11.33	13.11	24.44	11.33	44070
			10.00	*2.00*	*12.00*	*10.00*	
	Virginia-Carolina Chemical Co., Cincinnati, O.						
44389	High Grade Acid Phosphate	Manufacturer	15.38	1.50	16.88	15.38	44389
44885		B. P. Walker, Barbourville	17.29	0.89	18.18	17.29	44885
45030		Elrod & Phelps, Dabney	16.06	2.38	18.44	16.06	45030
			14.00	*2.00*	*16.00*	*14.00*	
44390	Victor High Grade Acid Phosphate	Manufacturer	16.24	1.66	17.90	16.24	44390
			14.00	*2.00*	*16.00*	*14.00*	

*The manufacturer failed to furnish sample required by law.

TABLE III.—ACID PHOSPHATES.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	PHOSPHORIC ACID. Available.	Insoluble	Total.	Estimated Value Per Ton.	Station Number.
	Virginia-Carolina Chemical Co.						
44391	Capital Dissolved S. C. Bone	Manufacturer	12.23	1.61	13.84	$12.23	44391
44886		R. K. M. Flour Co., Livingston	12.63	1.13	13.76	12.63	44886
45031		Elrod & Phelps, Dabney	13.71	2.97	16.68	13.71	45031
			12.00	*2.00*	*14.00*	*12.00*	
44401	I. X. L. Acid Phosphate	Manufacturer	18.26	1.53	19.79	18.26	44401
44891		I. K. Miller & Sons, Campbellsville	17.88	1.96	19.84	17.88	44891
45034		R. H. Chrisman, Berea	17.98	2.29	20.27	17.98	45034
			16.00	*2.00*	*18.00*	*16.00*	
44402	Victor H. Grade Superphosphate	Manufacturer	18.38	1.56	19.94	18.38	44402
45035		I. K. Miller & Sons, Campbellsville	18.12	1.36	19.48	18.12	45035
			16.00	*2.00*	*18.00*	*16.00*	
	Virginia-Carolina Chemical Co., Memphis, Tenn.						
44102	Capital Dissolved S. C. Bone	Manufacturer	11.63	3.91	15.54	11.63	44102
45039		E. S. Duiguid & Son, Murray	12.88	3.85	16.73	12.88	45039
			12.00	*2.00*	*14.00*	*12.00*	
44103	Victor H. Grade Superphosphate	Manufacturer	16.79	1.62	18.41	16.79	44103
			16.00	*2.00*	*18.00*	*16.00*	
44104	Victor High Grade Acid Phosphate	Manufacturer	14.88	1.54	16.42	14.88	44104
			14.00	*2.00*	*16.00*	*14.00*	
	The Wing Seed Co., Mechanicsburg, O.						
44518	Thomas Phosphate Powder (Basic Slag Phosphate)	Manufacturer			18.06	18.06	44518
					17.00	*17.00*	

TABLE IV.—ACID PHOSPHATE AND POTASH MIXTURES.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	PHOSPHORIC ACID. Available.	Insoluble.	Total.	POTASH. From Muriate.	From Sulphate.	Estimated Value Per Ton.	Station Number.
	A. D. Adair & McCarty Bros., Atlanta, Ga.								
44529	High Gr. Potash Compound	Manufacturer	9.72	0.94	10.66	3.38	0.89	$16.49	44529
			10.00			*4.00*		*16.00*	
	The Amer. Agr'l Chemical Co., Cin. Sales Dept., Cincinnati, O.								
44197	Ten Four Grade	Manufacturer	10.84	2.04	12.88	4.06		17.89	44197
44606		W. G. Wesley, Mangum	9.72	2.52	12.24	5.55		18.22	44606
			10.00	*2.00*	*12.00*	*4.00*		*16.80*	
44199	High Grade Bone and Potash	Manufacturer	10.59	1.84	12.43	5.89		19.34	44199
			10.00	*2.00*	*12.00*	*5.00*		*17.80*	
	The Amer. Agr'l Chemical Co., Cin. Sales Dept., Cincinnati, O.								
44212	Bradley Fert. Works Alkaline Bone and Potash	Manufacturer	10.58	2.26	12.84	2.09		15.69	44212
			10.00	*2.00*	*12.00*	*2.00*		*14.80*	
	The Amer. Agr'l Chemical Co., Cin. Sales Dept., Cincinnati, O.								
44218	Cleveland Dryer Works Soluble Bone and Potash	Manufacturer	10.03	2.78	12.81	2.04		15.19	44218
44905		W. G. Wesley, Mangum	11.24	2.13	13.39	2.13		16.47	44905
			10.00	*2.00*	*12.00*	*2.00*		*14.80*	
	The Amer. Agr'l Chemical Co., Bowker Fert. Works, Cin. O.								
44220	Dissolved Bone and Potash	Manufacturer	11.40	2.26	13.66	2.06		16.64	44220
44614		C. Y. White & Co., Cave City	10.16	2.04	12.20	2.23		15.24	44614
44906		T. E. Richardson, Campbellsv.	9.83	2.01	11.84	2.08		14.68	44906
			10.00	*2.00*	*12.00*	*2.00*		*14.60*	

TABLE IV.—ACID PHOSPHATE AND POTASH MIXTURES.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	PHOSPHORIC ACID. Available.	Insoluble.	Total.	POTASH. From Muriate.	From Sulphate.	Estimated Value Per Ton.	Station Number.
	The Amer. Agr'l Chem. Co.								
44222	Potash Fertilizer	Manufacturer	10.23	2.00	12.23	6.07		$19.15	44222
44616		A. H. Miller Implement Co., Elizabethtown	9.48	2.03	11.51	5.09		17.28	44616
			10.00	*2.00*	*12.00*	*5.00*		*17.80*	
	The Amer. Agr'l Chemical Co., Michigan Carbon Wks., Cin. O.								
44231	Red Line Phosphate with Potash	Manufacturer	10.02	2.82	12.84	2.08		15.23	44231
44625		Bradford Bros., Glasgow	10.16	1.89	12.05	2.07		15.02	44625
			10.00	*2.00*	*12.00*	*2.00*		*14.80*	
44233	High Potash Phosphate	Manufacturer	9.63	2.38	12.01	5.82		18.33	44233
44626		E. S. Ferrill & Sons, Buffalo	9.74	1.61	11.35	6.87		19.20	44626
			10.00	*2.00*	*12.00*	*5.00*		*17.80*	
	The Amer. Agr'l Chemical Co., Cin. Sales Dept., Cincinnati, O.								
44248	N-W Horse Shoe Brand 10-5 Potash Manure	Manufacturer	9.39	2.31	11.70	5.93		18.12	44248
44637		Hoskins & Dyche, London	10.06	2.01	12.07	5.24		18.11	44637
			10.00	*2.00*	*12.00*	*5.00*		*17.80*	
44249	N-W Horse Shoe Brand Bone and Potash	Manufacturer	10.02	2.44	12.46	2.12		15.12	44249
44638		E. S. Ferrill & Sons, Buffalo	9.87	2.29	12.16	2.27		15.03	44638
44916		Watkins & Co., Elizabetht'n	10.09	1.72	11.81	1.98		14.78	44916
			10.00	*2.00*	*12.00*	*2.00*		*14.80*	

	The Amer. Agr'l Chemical Co., Cin. Sales Dept., Cincinnati, O.								
44255	Packers Boars Head Brand Kentucky Potash Mixture	Manufacturer	10.53	1.95	12.48	2.11		15.53	44255
44642		T. E. Richardson, Campbellsv.	9.97	1.52	11.49	1.97		14.54	44642
			10.00	*2.00*	*12.00*	*2.00*		*14.80*	
44256	Packers Boars Head Brand Potash Phosphate Fert.	Manufacturer	10.03	2.19	12.21	5.77		18.69	44256
			10.00	*2.00*	*12.00*	*5.00*		*17.80*	
	The Armour Fertilizer Works, Nashville, Tenn.								
44031	Armour's High Grade Phosphate and Potash	Manufacturer	12.74	9.98	22.72	2.09		21.37	44031
44658		Miller, Cartwright & Miller, Elkton	**8.16**	6.64	14.80	3.52		**15.97**	44658
			0012.	*2.00*	*14.00*	*2.00*		*17.20*	
44032	Armour's Soluble Phosphate and Potash	Manufacturer	11.11	9.56	20.6	74.49		21.64	44032
44659		Simpson Co. Hdw. Co., Fr'nklin	9.86	4.69	14.5	**53.03**		16.74	44659
			10.00	*4.00*	*14.0*	*04.00*		*17.60*	
44033	Armour's Phos. & Potash	Manufacturer	10.22	13.67	23.89	2.09		19.82	44033
44660		Barren County Grocery and Hardware Co., Glasgow	11.00	7.92	18.92	1.96		18.33	44660
44924		Barren County Grocery and Hardware Co., Glasgow	10.64	7.11	17.75	1.79		17.40	44924
			10.00	*4.00*	*14.00*	*2.00*		*15.60*	
	The Armour Fertilizer Works, Nashville, Tenn.								
44057	Smith's Bone and Potash	Manufacturer	10.05	10.21	20.26	2.15		18.29	44057
44935		Greenville Hdw. and Grocery Co., Greenville	9.92	0.97	**10.89**	1.98		14.27	44935
			10.00	*2.00*	*12.00*	*2.00*		*14.80*	
	The Cincinnati Phosphate Co., Cincinnati, O.								
44493	Dissolved Phos. and Potash	*							44493
			10.00	*1.00*	*11.00*	*4.00*		*16.40*	
44494	Alkaline Phosphate	*							44494
			10.00	*1.00*	*11.00*	*2.00*		*14.40*	

*The manufacturer failed to furnish sample required by law.

TABLE IV.—ACID PHOSPHATE AND POTASH MIXTURES.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	PHOSPHORIC ACID. Available.	Insoluble.	Total.	POTASH. From Muriate.	From Sulphate.	Estimated Value Per Ton.	Station Number.
	Continental Fertilizer Co., Louisville, Ky.								
44297	Bear Potash Mixture	Manufacturer	9.52	1.15	**10.67**	2.62		$**14.50**	44297
44938		Feese & Murrell, Campbellsv.	12.15	0.73	12.88	1.80		16.67	44938
			10.00	*4.00*	*14.00*	*2.00*		*15.60*	
44300	Bear Bone and Potash	Manufacturer	9.64	1.08	**10.72**	4.57		**16.57**	44300
			10.00	*4.00*	*14.00*	*4.00*		*17.60*	
	The Empire Guano Co., Nashville, Tenn.								
44006	Potash Mixture	Manufacturer	12.32	9.05	21.37	4.94		23.34	44006
			10.00	*4.00*	*14.00*	*4.00*		*17.60*	
44007	Bone and Potash	Manufacturer	11.12	11.50	22.62	2.12		20.06	44007
44684		J. L. Durham, Greensburg	9.65	8.15	17.80	2.74		17.58	44684
			10.00	*4.00*	*14.00*	*2.00*		*15.60*	
44008	Climax Potash Acid	Manufacturer	11.69	8.35	20.04	6.59		23.96	44008
			10.00	*6.00*	*16.00*	*6.00*		*20.40*	
44009	Climax Bone and Potash	Manufacturer	14.45	6.41	20.86	2.64		22.54	44009
			12.00	*4.00*	*16.00*	*2.00*		*18.00*	
	The Evansville Packing Co., Evansville, Ind.								
44414	Grain Grower	Manufacturer	**9.11**	1.62	10.73	**3.14**		**14.72**	44414
44687		Eldred Hdw. Co., Princeton	9.50	1.94	11.44	3.72		15.90	44687
44940		Eldred Hdw. Co., Princeton	9.81	1.70	11.51	4.18		16.63	44940
			10.00	*2.00*	*12.00*	*4.00*		*16.80*	

	Federal Chem. Co., Louisville, Ky.									
42844	Daybreak Bone and Potash	Manufacturer	12.65	6.40	19.05		3.11	21.47	42844
			10.00	*2.00*	*12.00*		*2.00*	*15.20*	
42845	Daybreak Potash Fertilizer	Manufacturer	11.57	6.15	17.72		6.00	23.54	42845
			9.00	*2.00*	*11.00*		*5.00*	*17.60*	
42846	Daybreak Potash Mixture	Manufacturer	13.23	5.11	18.34		4.72	23.58	42846
			10.00	*2.00*	*12.00*		*4.00*	*17.60*	
42847	Daybreak Phos. and Potash	Manufacturer	15.94	2.63	18.57		2.72	23.44	42847
			12.00	*2.00*	*14.00*		*2.00*	*17.60*	
42853	Heads-O-Wheat	Manufacturer	11.44	8.99	20.43		4.81	23.10	42853
44700		Jeffries Hdw. Store, Columbia	10.22	8.12	18.34	4.36		19.87	44700
44945		I. K. Miller & Sons, Campb'lsv.	10.70	8.99	19.69	5.03		21.47	44945
			10.00	*10.00*	*20.00*		*4.00*	*20.80*	
42856	Potash Ten	Manufacturer	10.43	4.50	14.93		12.92	29.82	42856
44701		J. A. Shaver, Greenville	8.30	5.78	14.08	10.05		22.32	44701
			8.00	*4.00*	*12.00*		*10.00*	*23.20*	
42960	Ten Five	Manufacturer	12.93	3.44	16.37		8.02	26.52	42960
			10.00	*4.00*	*14.00*		*5.00*	*19.60*	
44544	Tip Top Mixture	Manufacturer	13.81	1.64	15.45		8.65	27.61	44544
			12.00	*4.00*	*16.00*		*6.00*	*23.20*	
	Fox Chemical Co., Branch Federal Chem. Co., Louisville, Ky.								
42879	Fox Alkaline Bone	Manufacturer	12.82	6.59	19.41		3.13	21.78	42879
			10.00	*2.00*	*12.00*		*2.00*	*15.20*	
42880	Fox Phospho-Potash	Manufacturer	11.75	6.67	18.42		5.97	23.93	42880
			9.00	*2.00*	*11.00*		*5.00*	*17.60*	
42881	Fox Bone Phos. and Potash	Manufacturer	12.88	5.25	18.13		4.83	23.36	42881
			10.00	*2.00*	*12.00*		*4.00*	*17.60*	
42882	Fox Bone Phosphate	Manufacturer	15.05	3.17	18.22		3.21	23.18	42882
			12.00	*2.00*	*14.00*		*2.00*	*17.60*	

TABLE IV.—ACID PHOSPHATE AND POTASH MIXTURES.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	PHOSPHORIC ACID. Available.	Insoluble.	Total.	POTASH. From Muriate.	From Sulphate.	Estimated Value Per Ton.	Station Number.
	Fox Chemical Co.								
42883	Fox Bone and Potash	Manufacturer	11.50	8.16	19.66		3.13	$20.82	42883
			9.00	*2.00*	*11.00*		*1.00*	*12.80*	
	Globe Fertilizer Co., Branch Federal Chem. Co., Louisville, Ky.								
42918	Globe Potash Special	Manufacturer	12.53	7.05	19.58		3.11	21.59	42918
44729		J. W. Cloyd, Campbellsville	11.56	8.67	20.23	2.06		19.40	44729
			10.00	*2.00*	*12.00*		*2.00*	*15.20*	
42919	Globe Potash Formula	Manufacturer	11.88	6.37	18.25		6.11	24.14	42919
44730		Jeffries Hdw. Store, Columbia	8.29	9.56	17.85	5.69		19.46	44730
			9.00	*2.00*	*11.00*		*5.00*	*17.60*	
42920	Globe Bone Phos. and Potash	Manufacturer	13.18	5.04	18.22		4.73	23.52	42920
44731		E. S. Ferrill & Sons, Buffalo	10.51	4.93	15.44	4.96		19.54	44731
			10.00	*2.00*	*12.00*		*4.00*	*17.60*	
42921	Globe Potash Compound	Manufacturer	15.37	2.88	18.25		3.12	23.33	42921
			12.00	*2.00*	*14.00*		*2.00*	*17.60*	
42922	Big Four Phosphate	Manufacturer	11.00	8.10	19.10		3.11	20.17	42922
			9.00	*2.00*	*11.00*		*1.00*	*12.80*	
	Grayson County Fertilizer Co., Leitchfield, Ky.								
44325	Grain Grower	Manufacturer	7.76	1.20	8.96		4.84	15.60	44325
44736		Horse Cave Lumber Co., Horse Cave	7.82	2.09	9.91		**4.34**	15.43	44736
			8.00				*5.00*	*15.60*	

44326	Tobacco Grower	Manufacturer	7.74	1.25	8.99		9.14	20.76	44326
44737		Horse Cave Lumber Co., Horse Cave	**7.07**	2.05	9.12		**6.91**	**17.59**	44737
			8.00				*8.00*	*19.20*	
	The Groves Co., Cincinnati, O.								
44422	Wheat and Oats	*							44422
44740		J. H. Pelly, Columbia	10.52	1.31	11.83	1.87		15.01	44740
			10.00	*2.00*	*12.00*	*2.00*		*14.80*	
44423	Potash Mixture	*							44423
			10.00	*2.00*	*12.00*	*5.00*		*17.80*	
	Hirsh, Stein & Co., Chicago, Ill.								
44449	Calumet Br. Phos. & Potash	Manufacturer	9.94	1.59	11.53	2.55		15.12	44449
44750		Salsman & New, Clarkson	10.53	1.21	11.74	2.56		15.68	44750
			10.00	*1.00*	*11.00*	*2.00*		*14.40*	
44450	Calumet Br. H. Gr. Phosphate and Potash	Manufacturer	10.74	0.89	11.63	6.06		19.31	44450
			10.00	*1.00*	*11.00*	*5.00*		*17.40*	
	Hopkins Fertilizer Co., New Albany, Ind.								
44470	Old Time Potash Mixture	Manufacturer	10.47	1.66	12.13	4.73		17.95	44470
			10.00	*1.00*	*11.00*	*4.00*		*16.40*	
44475	Old Time Hopkins 10 and 2	Manufacturer	10.95	2.07	13.02	3.19		17.16	44475
			10.00	*1.00*	*11.00*	*2.00*		*14.40*	
	Int. Agr'l Corp. Nat. Fert. Br., Nashville, Tenn.								
44169	Old Hickory Bone & Potash	Manufacturer	10.57	5.94	16.51	1.65		16.71	44169
44767		M C. Marion & Sons, Elizabethtown	9.59	5.99	15.58	2.17		16.08	44767
			10.00	*1.00*	*11.00*	*2.00*		*14.40*	
44170	Old Hickory Anti Trust Bone and Potash	*							44170
			10.00	*1.00*	*11.00*	*4.00*		*16.40*	
44171	Old Hickory Sadler's Formula	Manufacturer	11.40	0.78	12.18	1.93		15.92	44171
			12.00	*1.00*	*13.00*	*2.00*		*16.80*	

*The manufacturer failed to furnish sample required by law.

TABLE IV.—ACID PHOSPHATE AND POTASH MIXTURES.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	PHOSPHORIC ACID. Available.	Insoluble.	Total.	POTASH. From Muriate.	From Sulphate.	Estimated Value Per Ton.	Station Number.
	Int. Agr'l Corp., Tenn. Valley Fert. Works, Nashville, Tenn.								44181
44181	Tiger Potash Guano	*	*10.00*	*1.00*	*11.00*	*4.00*		*$16.40*	
			10.59	5.57	16.16	1.77		16.71	44182
44182	Tiger Guano	Manufacturer	*10.00*	*1.00*	*11.00*	*2.00*		*14.40*	
			9.32	6.90	16.22	1.66		15.60	44183
44183	Tiger Bone and Potash	Manufacturer	*8.00*	*1.00*	*9.00*	*2.00*		*12.00*	
	Int. Agr'l Corp., Interstate Phosphate Works, Nashville, Tenn.								44191
44191	Triangle Fish Bone & Potash	*	*10.00*	*1.00*	*11.00*	*4.00*		*16.40*	
			11.12	0.98	12.10	1.79		15.52	44192
44192	Triangle Fish Potash Mixt're	Manufacturer	*10.00*	*1.00*	*11.00*	*2.00*		*14.40*	
	The Jarecki Chemical Co., Cincinnati, O.								44483
44483	Square Brand Phosphate and Potash	*							44971
44971		Rector & Co., Lewisburg	10.02 *10.00*	0.92 *1.00*	10.94 *11.00*	1.66 *2.00*		14.05 *14.40*	
									44486
44486	Super Phosphate and Potash	*							44771
44771		Claud B. Terrell, Bedford	10.13 *10.00*	1.34 *1.00*	11.47 *11.00*	4.53 *4.00*		17.23 *16.40*	

*The manufacturer failed to furnish sample required by law

	Jones Fert. Co., Louisville, Ky.								
44327	Jones Potash Formula	Manufacturer	10.15	0.99	**11.14**	4.94		**17.52**	44327
			10.00	*4.00*	*14.00*	*5.00*		*18.60*	
44328	Jones Bone and Potash	Manufacturer	9.89	1.13	**11.02**	4.59		16.91	44328
			10.00	*4.00*	*14.00*	*4.00*		*17.60*	
44329	Jones Potash Mixture	Manufacturer	9.44	1.36	**10.80**	2.52		**14.39**	44329
			10.00	*4.00*	*14.00*	*2.00*		*15.60*	
	The Kaufman Fertilizer Co., Cincinnati, O.								
44506	Dissolved Bone and Potash	*							44506
			10.00	*1.00*	*11.00*	*4.00*		*16.40*	
44507	Alkaline Bone and Potash	*							44507
			10.00	*1.00*	*11.00*	*2.00*		*14.40*	
	Kentucky Fert. Co., Br. Federal Chemical Co., Louisville, Ky.								
42946	O. K. Potash Special	Manufacturer	12.51	7.01	19.52		3.05	21.47	42946
			10.00	*2.00*	*12.00*		*2.00*	*15.20*	
42947	O. K. Potash Manure	Manufacturer	11.55	6.57	18.12		6.25	23.99	42947
			9.00	*2.00*	*11.00*		*5.00*	*17.60*	
	Louisville Fert. Co., Louisv'le, Ky.								
44266	Eagle Potash Special	Manufacturer	12.54	1.10	13.64	2.50		17.99	44266
44976		M. J. Yopp Seed Co., Paducah	**10.83**	4.14	14.97	2.62		17.28	44976
			12.00	*2.00*	*14.00*	*2.00*		*17.20*	
44267	Eagle Phosphate & Potash	Manufacturer	9.95	0.91	**10.86**	6.80		19.10	44267
			10.00	*4.00*	*14.00*	*6.00*		*19.60*	
44268	Eagle Bone & Potash Comp'd	Manufacturer	9.87	0.99	**10.86**	4.54		16.78	44268
44805		Hogan, Clark & Yates, Elizabethtown	9.94	1.81	**11.75**	3.77		**16.42**	44805
			10.00	*4.00*	*14.00*	*4.00*		*17.60*	
44269	Eagle Potash Mixture	Manufacturer	9.54	0.75	**10.29**	2.60		**14.35**	44269
44977		J. A. Simpson, Burnside	10.40	0.74	**11.14**	1.86		14.64	44977
			10.00	*4.00*	*14.00*	*2.00*		*15.60*	

*The manufacturer failed to furnish sample required by law.

TABLE IV.—ACID PHOSPHATE AND POTASH MIXTURES.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	PHOSPHORIC ACID. Available.	Insoluble.	Total.	POTASH. From Muriate.	From Sulphate.	Estimated Value Per Ton.	Station Number.
	Mt. Pleasant Fertilizer Co., Mt. Pleasant, Tenn.								
44138	Big Success Farmers Choice	Manufacturer	12.93	7.62	20.55		5.96	$25.72	44138
			10 00	*4.00*	*14.00*		*4.00*	*18.40*	
44139	Big Success Banner Tobacco Grower	Manufacturer	13.36	9.08	22.44		2.09	22.17	44139
			10.00	*6.00*	*16.00*		*2.00*	*16.80*	
44140	Big Success Banner Grain Grower	Manufacturer	12.70	8.86	21.56	2.06		20.84	44140
44990		Logan Co. Hdw. Co., Russellv'l	9.80	10.63	20.43	1.82		17.83	44990
			10.00	*4.00*	*14.00*	*2.00*		*15.60*	
44141	Black Patch Wheat Special	Manufacturer	12.23	8.44	20.67	4.54		22.60	44141
			10.00	*4.00*	*14.00*	*4.00*		*17.60*	
44152	Universal Tobacco Special	Manufacturer	13.07	7.14	20.21		4.62	24.08	44152
			10.00	*4.00*	*14.00*		*4.00*	*18.40*	
44153	Ever Ready Tob. Grower	Manufacturer	13.61	9.26	22.87		1.91	22.32	44153
			10.00	*6.00*	*16.00*		*2.00*	*16.80*	
44154	Gr. Southern Wheat Special	Manufacturer	12.25	8.25	20.50	4.05		22.05	44154
			10.00	*4.00*	*14.00*	*4.00*		*17.60*	
44155	Ever Ready Wheat Grower	Manufacturer	13.95	9.71	23.66	1.91		22.53	44155
			10.00	*4.00*	*14.00*	*2.00*		*15.60*	
	Read Phosphate Co., Nashville, Tenn.								
42978	H. Grade Bone and Potash	*							42978
			12.00	*4.00*	*16.00*	*2.00*		*18.00*	

*The manufacturer failed to furnish sample required by law.

42979	Alkaline Bone	Manufacturer	12.21	10.49	22.70	1.88	0.78	21.67	42979
44832		W. L. Calhoun, Montpelier	9.89	4.98	**14.87**	2.13		15.99	44832
44996		Barren County Grocery and Hardware Co., Glasgow	9.89	4.60	**14.49**	1.78		15.49	44996
			10.00	*6.00*	*16.00*	*2.00*		*16.40*	
42980	H. Gr. Spl. Potash Mixture	Manufacturer	11.95	8.92	20.87	3.92	0.97	22.99	42980
44833		Barren County Grocery and Hardware Co., Glasgow	10.08	6.13	16.21	3.90		18.45	44833
44997		Barren County Grocery and Hardware Co., Glasgow	11.32	4.62	15.94	3.96		19.39	44997
			10.00	*4.00*	*14.00*	*4.00*		*17.60*	
42981	Special Wheat Grower	Manufacturer	11.14	8.83	19.97	6.66		23.56	42981
44834		M. B. Hines, Science Hill	9.87	6.12	15.99	6.16		20.45	44834
44998		Hatter Hdw. Co., Franklin	10.78	3.53	14.31	6.03		20.38	44998
			10.00	*5.00*	*15.00*	*6.00*		*20.00*	
42982	High Grade Grain Special	Manufacturer	14.84	2.86	17.70	6.18		25.13	42982
44999		G. W. Richardson, Somerset	**13.06**	2.78	15.84	4.49		**21.27**	44999
			14.00	*3.00*	*17.00*	*5.00*		*23.00*	
	Smith Agricultural Chemical Co., Columbus, O.								
44476	Ohio Farmers Soluble Phosphate and Potash	Manufacturer	9.56	0.69	10.25	1.90		13.65	44476
			10.00			*2.00*		*14.00*	
	Swift & Co., East St. Louis, Ill.								
44359	Swift's High Grade Phosphate and Potash	*							44359
44852		Barren County Grocery and Hardware Co., Glasgow	10.07	0.91	10.98	4.33		16.77	44852
			10.00			*4.00*		*16.00*	
44360	Swift's Spl. Phos. & Potash	*							44360
44853		Duke & Farris, Cave City	10.34	1.06	11.40	1.73		14.56	44853
45009		N. F. Hill, Bowling Green	10.29	0.57	10.86	2.42		15.00	45009
			10.00			*2.00*		*14.00*	
	Taylor & Powell Fertilizer Co., Springfield, Tenn.								
44541	10-4	Manufacturer	**8.75**	6.50	15.25	2.08	8.45	25.32	44541
			10.00				*4.00*	*16.80*	

*The manufacturer failed to furnish sample required by law.

TABLE IV.—ACID PHOSPHATE AND POTASH MIXTURES.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	PHOSPHORIC ACID. Available.	Insoluble.	Total.	POTASH. From Muriate.	From Sulphate.	Estimated Value Per Ton.	Station Number.
	Taylor & Powell Fertilizer Co.								
44542	12-2	Manufacturer	12.02	3.82	15.84	0.92	4.77	$22.59	44542
			12.00				*2.00*	*16.80*	
	Tennessee Chemical Co., Louisville, Ky. and Nashville, Tenn.								
44312	Ox High Grade Potash	Manufacturer	**9.24**	0.88	10.12		5.51	**18.08**	44312
44868		S. O. Moody, Auburn	9.44	5.21	14.65	4.44		**17.85**	44868
			10.00	*4.00*	*14.00*		*5.00*	*19.60*	
44313	Ox Potash Formula	Manufacturer	10.17	0.85	**11.02**	4.58		17.12	44313
			10.00	*4.00*	*14.00*	*4.00*		*17.60*	
44314	Ox Alkaline Bone	Manufacturer	12.46	1.29	13.75	2.62		18.09	44314
			12.00	*2.00*	*14.00*	*2.00*		*17.20*	
44315	Ox Potash Mixture	Manufacturer	9.45	1.13	**10.58**	2.66		**14.45**	44315
44869		S. O. Moody, Auburn	11.97	5.64	17.61	1.92		18.54	44869
45018		J. M. Johnson, Benton	9.93	8.62	18.55	1.65		17.02	45018
			10.00	*4.00*	*14.00*	*2.00*		*15.60*	
44322	Ox Phosphate and Potash	Manufacturer	11.37	0.84	**12.21**		4.56	19.45	44322
45023		W. F. Grainger, Franklin	10.37	4.64	15.01	**1.34**	**0.63**	**16.40**	45023
			10.00	*4.00*	*14.00*		*4.00*	*18.40*	
	Tuscarora Fertilizer Co., Nashville, Tenn.								
44068	Tuscarora Bone and Potash	Manufacturer	10.88	12.43	23.31	2.07		20.10	44068
45024		C. M. Langdon, Science Hill	10.59	7.92	18.51	1.95		17.83	45024
			10.00	*4.00*	*14.00*	*2.00*		*15.60*	

44073	Tuscarora Acid Phosphate and Potash	Manufacturer	10.75	10.34	21.09	5.23		22.27	44073
44874		C. M. Langdon, Science Hill	11.21	5.89	17.10	1.13		16.94	44874
			10.00	*4.00*	*14.00*	*5.00*		*18.60*	
44074	Dickinson's Potash & Phosphate Mixture	Manufacturer	10.82	12.21	23.03	2.03		19.89	44074
44875		Dickinson Bros., Glasgow	9.93	8.07	18.00	1.82		16.96	44875
45028		Dickinson Bros., Glasgow	9.99	9.92	19.91	1.95		17.91	45028
			10.00	*4.00*	*14.00*	*2.00*		*15.60*	
44075	Dickinson's Standard Grain Grower	Manufacturer	10.91	10.68	21.59	4.04		21.40	44075
44876		Dickinson Bros., Glasgow	9.92	7.52	17.44	3.48		18.39	44876
			10.00	*4.00*	*14.00*	*4.00*		*17.60*	
	Virginia-Carolina Chemical Co., Cincinnati, O.								
44395	Victor Bone & Potash Compound	Manufacturer	14.39	2.24	16.63	3.32		21.49	44395
44889		I. K. Miller & Sons, Campbellsville	14.99	2.68	17.67	3.32		22.38	44889
			15.00	*1.50*	*16.50*	*3.00*		*21.60*	
44396	Acid and Potash King	Manufacturer	9.92	1.96	11.88	4.52		17.20	44396
			10.00	*1.50*	*11.50*	*4.00*		*16.60*	
44397	Royal Grain Grower	Manufacturer	10.29	1.72	12.01	4.55		17.59	44397
44890		I. K. Miller & Sons, Campbellsville	10.83	2.74	13.57	4.23		18.33	44890
45032		I. K. Miller & Sons, Campbellsville	11.26	1.52	12.78	4.43		18.55	45032
			10.00	*1.50*	*11.50*	*4.00*		*16.60*	
44398	Prolific Grain & Grass Grwr.	Manufacturer	10.40	1.78	12.18	0.88	4.61	19.60	44398
			10.00	*1.50*	*11.50*		*5.00*	*18.60*	
44399	Grain Food	Manufacturer	9.40	1.98	11.38	2.36		14.43	44399
			10.00	*1.50*	*11.50*	*2.00*		*14.60*	
44400	Capital Bone and Potash Compound	Manufacturer	9.42	2.18	11.60	2.19		14.36	44400
45033		I. K. Miller & Sons, Campbellsville	10.96	1.56	12.52	2.19		15.96	45033
			10.00	*1.50*	*11.50*	*2.00*		*14.60*	

TABLE IV.—ACID PHOSPHATE AND POTASH MIXTURES.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	PHOSPHORIC ACID. Available.	Insoluble.	Total.	POTASH. From Muriate.	From Sulphate.	Estimated Value Per Ton.	Station Number.
	Virginia-Carolina Chemical Co., Memphis, Tenn.								
44097	Champion Bone and Potash Compound	Manufacturer	11.20	1.20	12.40	5.33		$19.25	44097
			10.00	*2.00*	*12.00*	*5.00*		*17.80*	
44099	Royal Grain Grower	Manufacturer	9.48	1.73	11.21	3.89		15.96	44099
45037		Eldred Hdw. Co., Princeton	10.83	2.28	13.11	4.02		17.93	45037
			10.00	*2.00*	*12.00*	*4.00*		*16.80*	
44100	Capital Bone & Potash Compound	Manufacturer	9.05	1.91	10.96	1.98		13.60	44100
44893		E. B. Ferguson, Benton	10.83	2.64	13.47	1.96		16.02	44893
45038		Eldred Hdw. Co., Princeton	10.95	2.31	13.26	1.73		15.79	45038
			10.00	*2.00*	*12.00*	*2.00*		*14.80*	
44101	Victor Bone & Potash Compound	Manufacturer	16.29	2.28	18.57	3.23		23.69	44101
			15.00	*2.00*	*17.00*	*3.00*		*21.80*	

TABLE V.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.
	The Cincinnati Phosphate Co., Cincinnati, O.	
44497	"Bonus"—A Humus Phosphate	*
	Duncan & Bro., La Grange, Ky.	
44546	Tiger Brand Phosphate & Tankage	Manufacturer
44682		Manufacturer's Warehouse
	The Empire Guano Co., Nashville, Tenn.	
42993	Kentucky Tobacco Special	Manufacturer
	Federal Chemical Co., Louisville, Ky.	
42835	Daybreak Harvest Home Bone Meal Mixture	Manufacturer
42836	Daybreak Harvest Bone	Manufacturer
44696		Warehouse, Horse Cave
	Fox Chemical Co., Branch Fed. Chem. Co., Louisville, Ky.	
42873	Fox Half & Half Bone Meal Mixt're	Manufacturer
42874	Fox Ammoniated Bone	Manufacturer
	Globe Fertilizer Co., Branch Federal Chemical Co., Louisviile, Ky.	
42909	Golden Harvest Bone Meal Mixture	Manufacturer
42910	Golden Harvest Bone Meal	Manufacturer
	Int. Agr'l Corp., Tenn. Valley Fert. Works, Nashville, Tenn.	
44186	Monarch Ammoniated Mixture	*
	Ky. Fert. Co., Br. Federal Chemical Co., Louisville, Ky.	
42936	O. K. Special Bone Meal Mixture	Manufacturer
42937	O. K. Bone Meal Mixture	Manufacturer
	Read Phosphate Co., Nashville, Tenn.	
42961	Kentucky Formula	Manufacturer
	Taylor & Powell Fertilizer Co., Springfield, Tenn.	
44537	Half and Half	Manufacturer
44601	Spl. Wheat Fertilizer with Tankage Base	Manufacturer

*The manufacturer failed to furnish sample required by law.

NITROGENOUS SUPERPHOSPHATES.

PHOSPHORIC ACID.			NITROGEN.						
Available.	Insoluble.	Total.	In Nitrates.	In Ammonia Salts.	Organic.	Total.	Equivalent to Ammonia.	Estimated Value Per Ton.	Station Number.
									44497
12.00	*1.00*	*13.00*				*0.41*	*0.50*	*$16.24*	
13.33	6.74	20.07	0.58		0.32	0.90	1.09	21.85	44546
12.23	7.05	19.28	0.53		0.31	0.84	1.02	20.44	44682
12.00	*3.00*	*15.00*				*0.82*	*1.00*	*18.47*	
10.97	8.23	19.20				2.02	2.45	23.52	42993
10.00	*5.00*	*15.00*				*1.65*	*2.00*	*19.78*	
12.33	8.22	20.55		1.59	0.61	2.20	2.67	25.79	42835
10.00	*10.00*	*20.00*				*1.65*	*2.00*	*21.78*	
14.51	2.56	17.07		2.84		2.84	3.45	28.37	42836
10.26	1.56	11.82	1.27		1.59	2.86	3.47	22.94	44696
10.00	*4.00*	*14.00*				*2.47*	*3.00*	*22.25*	
12.23	8.73	20.96		1.71	0.48	2.19	2.66	25.84	42873
10.00	*10.00*	*20.00*				*1.65*	*2.00*	*21.78*	
14.95	2.61	17.56		2.82		2.82	3.42	28.85	42874
10.00	*4.00*	*14.00*				*2.47*	*3.00*	*22.25*	
11.66	8.87	20.53		1.74	0.45	2.19	2.66	25.21	42909
10.00	*10.00*	*20.00*				*1.65*	*2.00*	*21.78*	
13.48	3.19	16.67		2.78		2.78	3.37	27.19	42910
10.00	*4.00*	*14.00*				*2.47*	*3.00*	*22.25*	
									44186
11.00	*1.00*	*12.00*				*0.82*	*1.00*	*16.47*	
12.64	8.27	20.91		1.53	0.70	2.23	2.71	26.29	42936
10.00	*10.00*	*20.00*				*1.65*	*2.00*	*21.78*	
14.91	2.64	17.55		2.79		2.79	3.39	28.72	42937
10.00	*4.00*	*14.00*				*2.47*	*3.00*	*22.25*	
11.13	8.44	19.57				1.94	2.36	23.53	42961
10.00	*5.00*	*15.00*				*1.65*	*2.00*	*19.78*	
9.65	7.41	17.06	0.47		2.25	2.72	3.30	24.06	44537
12.00	*3.00*	*15.00*				*1.85*	*2.25*	*22.08*	
8.54	4.25	12.79	2.02		2.05	4.07	4.94	26.19	44601
10.00						*1.65*	*2.00*	*17.78*	

TABLE VI.—POTASH SALTS.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	POTASH. From Muriate.	POTASH. From Sulphate.	Estimated Value Per Ton.	Station Number.
	Armour Fert. Works, Nashville, Tenn.					
44562	Sulphate of Potash	Manufacturer		52.80	$63.36	44562
				50.00	*60.00*	
44563	Muriate of Potash	Manufacturer	53.20		53.20	44563
			48.00		*48.00*	
	The Empire Guano Co., Nashville, Tenn.					
44015	Muriate of Potash	Manufacturer	51.35		51.35	44015
			50.00		*50.00*	
	German Kali Works, New York, N. Y.					
44087	Muriate of Potash	Manufacturer	38.34	12.46	53.29	44087
			48.00		*48.00*	
44088	Sulphate of Potash	Manufacturer		50.85	61.02	44088
				47.00	*56.40*	
44089	Kainit	Manufacturer	14.08		14.08	44089
			12.00		*12.00*	
	Hopkins Fert. Co., New Albany, Ind.					
44474	Old Time Muriate of Potash	Manufacturer	52.80		52.80	44474
			50.00		*50.00*	
	Read Phosphate Co., Nashville, Tenn.					
42990	Muriate of Potash	Manufacturer	50.95		50.95	42990
			50.00		*50.00*	
	Swift & Co., East St. Louis, Ill.					
44356	Muriate of Potash	*				44356
			50.00		*50.00*	
44368	Sulphate of Potash	*				44368
				48.00	*57.60*	

*The manufacturer failed to furnish sample required by law.

	Tennessee Chem. Co., Louisville, Ky., and Nashville, Tenn.						
44570	Ox Muriate of Potash	Manufacturer	46.60	10.90	59.68	44570
			48.00		*48.00*	
44571	Ox Sulphate of Potash	Manufacturer		53.50	64.20	44571
				50.00	*60.00*	
	Virginia-Carolina Chemical Co., Cin. O.					
44559	Sulphate of Potash	Manufacturer		51.05	61.26	44559
				48.00	*57.60*	

TABLE VII.—NITRATE OF SODA.

Station Number.	Name and Address of Manufacturer and Name of Brand.	From Whom Obtained.	Nitrogen.	Equivalent to Ammonia.	Estimated Value Per Ton.	Station Number.
44561	**Armour Fert. Works, Nashville, Tenn.** Nitrate of Soda	Manufacturer	15.88 *14.81*	19.28 *17.98*	$55.58 *51.84*	44561
44473	**Hopkins Fertilizer Co., New Albany, Ind.** Old Time Nitrate of Soda	Manufacturer	15.18 *15.00*	18.43 *18.22*	53.13 *52.50*	44473
42991	**Read Phosphate Co., Nashville, Tenn.** Nitrate of Soda	Manufacturer	**14.35** *15.25*	17.42 *18.52*	**50.23** *53.38*	42991
44572	**Tennessee Chem. Co., Louisville, Ky., and Nashville, Tenn.** Ox Nitrate of Soda	Manufacturer	15.13 *14.81*	18.37 *17.98*	52.96 *51.84*	44572
44392	**Virginia-Carolina Chemical Co., Cin. O.** Nitrate of Soda	Manufacturer	14.68 *14.83*	17.82 *18.00*	51.38 *51.91*	44392