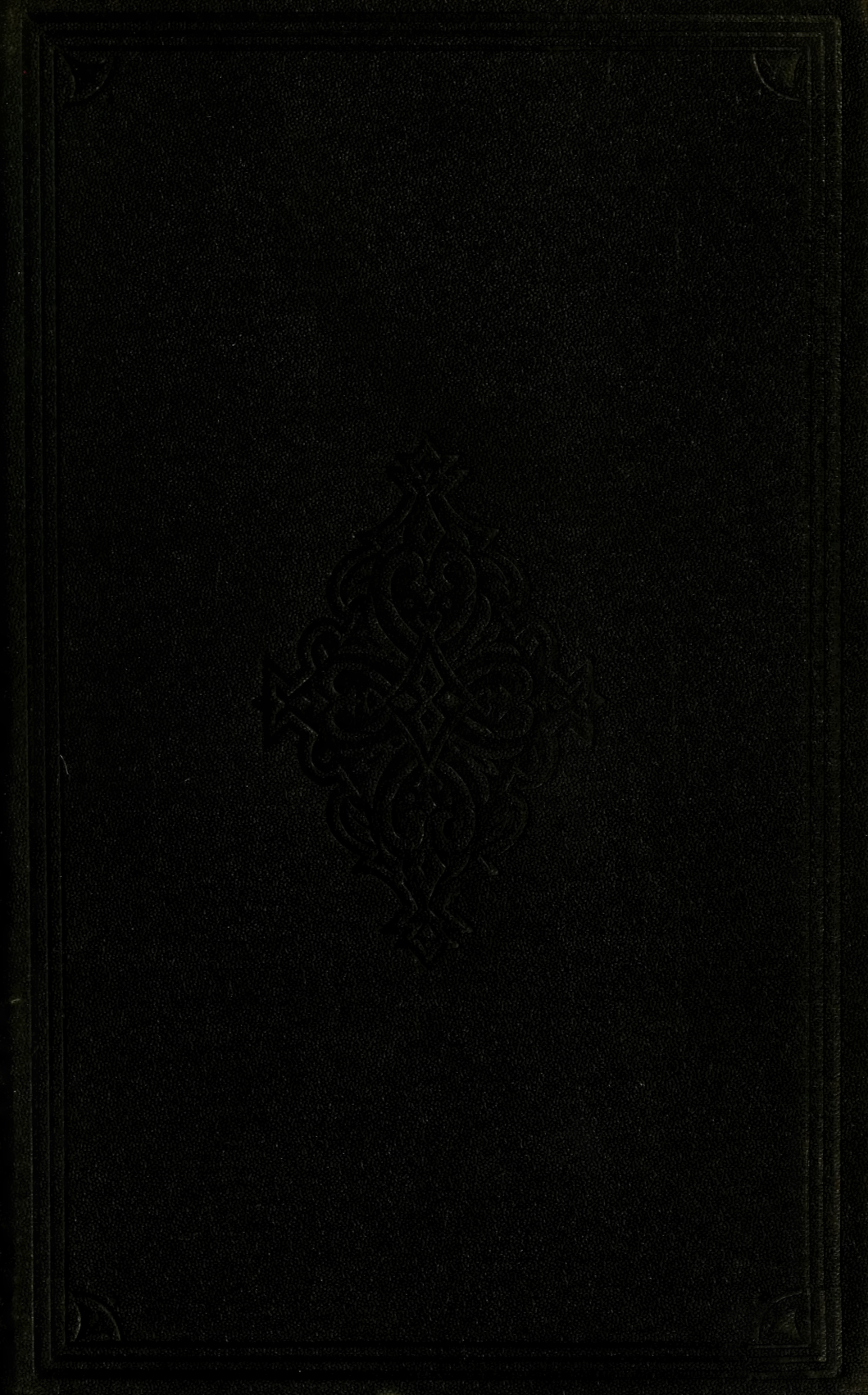
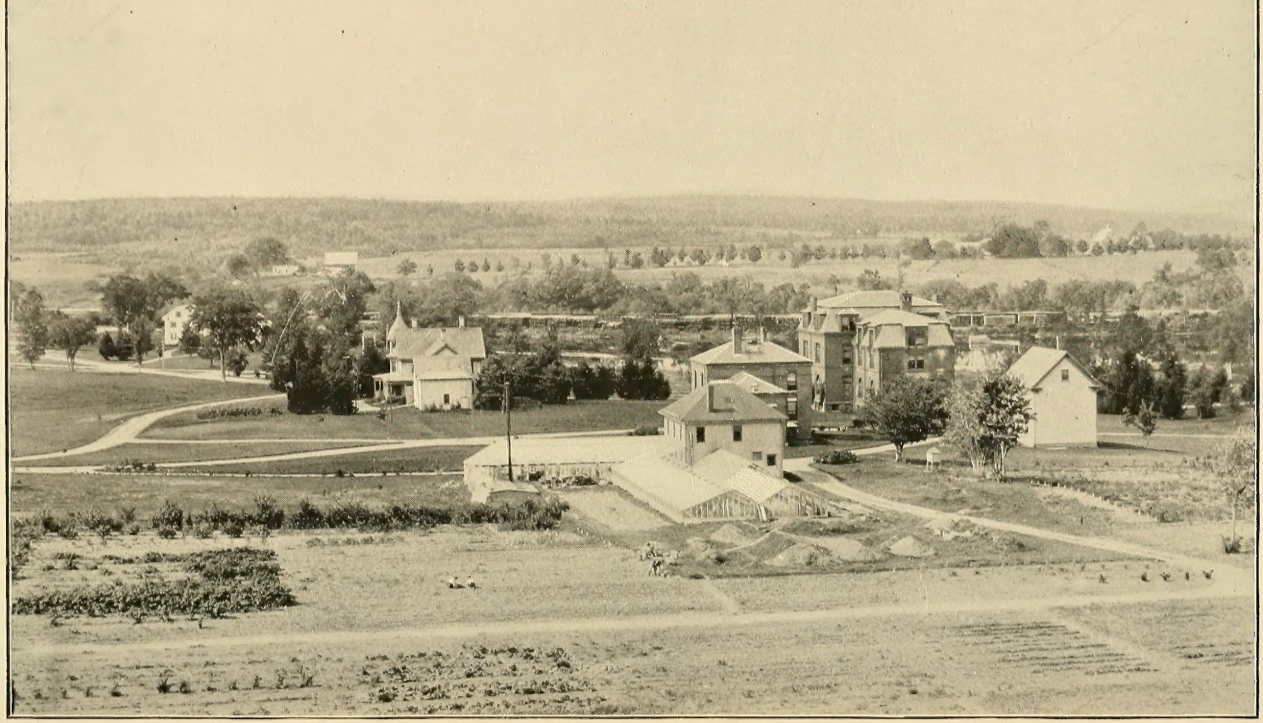




GREEN HOUSES AND OFFICES.

TWELFTH ANNUAL REPORT

OF THE

Maine Agricultural Experiment Station

ORONO, MAINE

1896

Part II of the Annual Report of the Maine State College.

AUGUSTA
KENNEBEC JOURNAL PRINT
1897

The Bulletins of this Station will be sent free to any address in Maine. All requests should be sent to

Maine Agricultural Experiment Station,
Orono, Maine.

STATE OF MAINE

A. W. Harris, Sc. D., President Maine State College:

SIR:—I transmit herewith the Twelfth Annual Report of the Maine Agricultural Experiment Station for the year ending December 31, 1896.

CHARLES D. WOODS,
Director.

ORONO, Maine, December 31, 1896.

TABLE OF CONTENTS.

MAINE AGRICULTURAL EXPERIMENT STATION.

THE STATION COUNCIL.

PRESIDENT ABRAM W. HARRIS,	President
DIRECTOR CHARLES D. WOODS,	Secretary
BENJAMIN F. BRIGGS, Auburn,	Committee of Board of Trustees
ARTHUR L. MOORE, Orono,	Committee of Board of Trustees
ELLIOTT WOOD, Winthrop,	Committee of Board of Trustees
B. WALKER McKEEN, Fryeburg,	State Board of Agriculture
ORA O. CROSBY, Albion,	State Grange
CHARLES S. POPE, Manchester,	State Pomological Society
JAMES M. BARTLETT,	Members of the Station Staff
LUCIUS H. MERRILL,	Members of the Station Staff
FRANCIS L. HARVEY,	Members of the Station Staff
FREMONT L. RUSSELL,	Members of the Station Staff
WELTON M. MUNSON,	Members of the Station Staff
GILBERT M. GOWELL,	Members of the Station Staff

THE STATION STAFF.

THE PRESIDENT OF THE COLLEGE.

CHARLES D. WOODS,	Director
JAMES M. BARTLETT,	Chemist
LUCIUS H. MERRILL,	Chemist
FRANCIS L. HARVEY,	Botanist and Entomologist
FREMONT L. RUSSELL,	Veterinarian
WELTON M. MUNSON,	Horticulturist
GILBERT M. GOWELL,	Agriculturist
HENRY B. SLADE,	Assistant Chemist
ORA W. KNIGHT,	Assistant Chemist
LUCIUS J. SHEPARD,	Assistant Horticulturist
MRS. J. HAMLIN WAITE,	Stenographer

REPORT OF THE TREASURER.

Maine Agricultural Experiment Station in account with the United States appropriation, 1895-6:

Dr.

To receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1896, as per act of Congress approved March 2, 1887		$15,000 00

Cr.

By salaries:		
(a) Director and administration officers	$2,150 00	
(b) Scientific staff	4,888 98	
(c) Assistant to scientific staff	2,074 18	
(d) Special and temporary services	227 32	
Total		$9,340 48
Labor:		
(a) Monthly employees	$128 71	
(b) Daily employees	217 54	
(c) Hourly employees	368 12	
Total		714 37
Publications:		
(a) For printing	$349 70	
(c) For envelopes for bulletins and reports	30 00	
(d) Other expenses	19 50	
Total		399 20
Postage and stationery		139 01
Freight and express		204 61
Heat, light and water		381 98
Chemical supplies:		
(a) Chemicals	$120 72	
(b) Other supplies	105 02	
Total		225 74
Seeds, plants, and sundry supplies:		
(a) Agricultural	56 82	
(b) Horticultural	178 91	
(c) Botanical	58 77	
(d) Entomological	1 48	
(e) Miscellaneous	5 25	
Total		301 23

Fertilizers		$ 32 70
Feeding stuffs		340 67
Library		156 09
Tools, implements, and machinery		35 17
Furniture and fixtures		281 32
Scientific apparatus		866 40
Live stock:		
(b) Cattle	$640 00	
(d) Swine	10 00	
Total		650 00
Traveling expenses:		
(a) In supervision of Station work	$134 84	
(b) In attending various meetings	43 50	
Total		178 34
Contingent expenses		233 23
Building and repairs:		
(a) New buildings	$154 61	
(b) Improvements	88 74	
(c) Repairs	276 11	
Total		519 46
Total		$15,000 00

ISAIAH K. STETSON, Treasurer.

I, the undersigned, duly appointed Auditor of the Corporation, do hereby certify that I have examined the books of the Maine Agricultural Experiment Station for the fiscal year ending June 30, 1896; that I have found the same well kept and classified as above, and that the receipts for the year from the Treasurer of the United States are shown to have been $15,000.00, and the corresponding disbursements, $15,000.00; for all of which proper vouchers are on file and have been examined by me and found correct.

And I further certify that the expenditures have been solely for the purposes set forth in the act of Congress approved March 2, 1887.

ELLIOTT WOOD, Auditor.

REPORT OF THE DIRECTOR.

CHAS. D. WOODS.

The work of the first half of the year was conducted under the direction of Professor Jordan. With the change of director which took place July 1, 1896, there was little change in the policy of the Station. Its principal lines of work have been the same as in former years and are briefly referred to in the pages which immediately follow. A more detailed report of the work of the Station during the year is given by my associates in the pages beyond.

The Director wishes here to express his appreciation of the kind reception given to him and the loyal co-operation of his associates in prosecuting the work of the Station.

CHANGES OF STATION STAFF.

There have been a number of changes in the station staff during the year. The following concerning the change of director is taken from the report of the President of the College to the Trustees.

"Professor Whitman Howard Jordan, Sc. D., Director of the Experiment Station, resigned his position July 1, 1896, to accept the directorship of the State Experiment Station of New York. It was a matter of sincere regret that we were unable to retain him, but the opportunities and salary offered him in New York were so much greater than he enjoyed here that he could not be expected to stay with us without changes which would cause an increase of our expenses beyond our means. He was a graduate of the college in the class of 1895. After spending some time in the Experiment Station at Middletown, Conn., the first in the United States, and then recently established, he returned to the college as instructor. He served as professor of agricul-

ture for some years in the Pennsylvania State College, and again returned to Orono as director of the Experiment Station."

"Professor Charles Dayton Woods, B. S., who succeeds Professor Jordan, comes to us from the Storrs (Conn.) Experiment Station, of which he was assistant director. He is a graduate of Wesleyan University, and has studied abroad. He was one of the early workers in the first experiment station in the United States. He holds a commission from the United States Government for investigations on human foods."

After a year's leave of absence which was spent in study abroad and at Cornell University, Professor Munson returned to his duties at the Experiment Station, July 1, 1896.

Mr. Fred C. Moulton, M. S., assistant chemist, resigned August 31st. Mr. Henry B. Slade, A. B., a graduate of Brown University, is his successor.

Mr. Harris Perley Gould, B. S., assistant horticulturist, resigned his position August 31, in order to pursue post-graduate studies elsewhere. He has been succeeded by Mr. Lucius Jerry Shepard, B. S., a graduate of the Massachusetts Agricultural College.

Mr. Ora W. Knight, B. S., a graduate of the College, was appointed assistant chemist December 1st.

Mr. A. M. Shaw, foreman of the farm, resigned December 31, 1896.

Professor G. M. Gowell, M. S., has been appointed agriculturist. This appointment will take effect January 1, 1897.

FERTILIZER INSPECTION.

The number of brands of fertilizers sold in the State seems to be steadily on the increase. Old companies are increasing the number of brands they are offering and new companies are entering the State. In 1894 the Station agent collected 60 brands; in 1895 he collected 74; in 1896 the number was 117, and the indications are that the number of brands sold in 1897 will come well up to 150.

Seventy-seven of the 117 brands sold in the State in 1896 were licensed; the remaining 40, according to the representations of the manufacturers, were exempted from the payment of the analysis fee as coming within the thirty ton limit. The terms of

the law require, however, that these non-paying brands shall be inspected, consequently it is possible for a manufacturer, by selling a small amount of a large number of brands, to increase the work of inspection entirely out of proportion to the analysis fees paid.

As the cost of the fertilizer inspection must be borne entirely by the receipts from license fees, the inspection of the non-paying brands restricts the proper inspection of the regularly licensed brands. To correct this evil the Station Council proposes to ask the legislature of 1897 to so amend the law that the analysis fee shall apply to every brand sold in the State.*

INSPECTION OF CHEMICAL GLASSWARE USED IN CREAMERIES.

Nearly all the glassware that has been examined during the year has come from dealers in dairy supplies. It is reasonable to suppose, therefore, that the butter factories have renewed their stock by purchasing tested bottles and pipettes direct from the dealers and are complying with the law in that respect.

It has been gratifying to note that a very small percentage of the goods inspected the past year was inaccurately graduated.

During the year 1896 there were received and calibrated 801 cream bottles, 280 milk bottles, and 70 pipettes. Of this large amount of glassware only one cream bottle and five pipettes were found to be sufficiently inaccurate to throw them out. All the milk bottles were correct. The Station has adopted a new stamp, and bottles and pipettes found correct are now marked M. E. S.

The text of the law is printed in another place in this report.

NUTRITION OF PLANTS AND ANIMALS.

The box experiments for the purpose of determining the "foraging power" of certain plants for phosphoric acid have been continued. The results obtained up to the spring of 1896 were published in the report of this Station for 1895.

Field experiments on the growth of forage plants and the effects of fertilizers have been continued along the lines of other years. So far as results of value have been obtained they are given beyond.

* This change was secured by act of legislature and approved by the governor February 24, 1897.

Several feeding experiments with milch cows have been made during the year. The results are reported by Mr. Bartlett in another part of this report.

Digestion experiments with sheep are in progress but are not completed. It is expected that these results will be printed in the report for 1897.

These experiments, involving as they do a great deal of chemical work, are time-consuming in their details, and a not inconsiderable portion of the time of the Station chemists has been given to their carrying out.

INVESTIGATION OF THE NUTRITION OF MAN.

The investigation of the nutrition of man, begun three years ago by the United States Department of Agriculture under a special act of Congress, was placed in the immediate charge of Professor W. O. Atwater of Wesleyan University, Middletown, Conn. The director of this Station was then associated with Professor Atwater and shared in the planning and carrying out of these investigations. On coming to this Station, his commission in the United States Department of Agriculture was continued and he still has an active part in this work.

The study of cereal foods, including experiments in digestibility and metabolism, which are in progress at several experiment stations and colleges, is under the immediate care of the director of this Station. The work at the Maine Station in the study of human food during the year has been chiefly on the digestibility of breads made from entire wheat flour, graham flour, and ordinary bread flour. These experiments are not finished. They involve, in addition to the study of the nutrients, the estimation of the fuel values of the foods and of the undigested residues. The metabolism of matter forms an important part of the investigation. These results will be published in bulletins of the Department of Agriculture. Abstracts of these bulletins giving the results will be printed in later reports of this Station. The present report contains an account of studies made by this Station in 1895.

INVESTIGATIONS WITH THE BOMB CALORIMETER.

The study of the fuel value of cattle food and of the food of man gives very valuable information. The chief uses of food are to build tissue, and to furnish the energy requisite for muscular and other work, and for the maintenance of the body heat. The power of food to supply force to do work and maintain temperature can be measured in terms of potential energy. To do this an apparatus called a calorimeter (heat measure) is used. A new form of bomb calorimeter developed by Professor W. O. Atwater and the director of this Station is described in the report of the Storrs (Conn.) Experiment Station for 1894, pages 135-151. Mr. O. S. Blakeslee, mechanician of the Wesleyan University, has made a bomb calorimeter for this Station. Investigations upon the fuel value of foods and the undigested residues of digestion experiments are in progress. Other studies with the bomb calorimeter are planned.

BOTANY.

The work in botany has been continued much as in previous years. The chief work of investigation is along the lines of (1) the diseases of plants and their remedies; (2) the introduction and distribution of weeds in the State; and (3) the life history of plants in relation to remedial measures. Considerable study of the quality of seeds and their contamination with weed seeds has been made.

ENTOMOLOGY.

The work in entomology is along the same lines as that of other years. It consists of (1) the study of the life history of insects doing injury in the State, so as to learn their most vulnerable points and suggest rational remedies; (2) the study of the insects of Maine as to kinds, distribution and variation from year to year, due to climatic changes, food supply and natural enemies; (3) the preparation of specimens for the cabinet to be used in identifying other specimens readily; and (4) preparations of specimens showing the stages in the life history and work of injurious insects.

THE WORK IN HORTICULTURE.

The work in horticulture has been similar to that of previous years. Studies in plant breeding continue as the most important of the lines of inquiry. This work includes a consideration of plants as affected by different conditions of soil, climate and culture, the effects of crossing and of heredity, as well as the improvement of promising wild types. In the forcing houses the study of the tomato has been continued and the culture of other fruits and vegetables, as the currant, radish and lettuce has received attention.

The small fruit plantation has been extended and the different varieties are coming into bearing. Many of the fruits sent to Aroostook county are beginning to bear. Some of the field notes made by the Horticulturist concerning these are given in another part of this report. Experiments on the propagation and culture of the blueberry from selected wild stock are in progress.

Spraying experiments for apple scab have been continued. The season of 1896 was unfavorable for the growth of scab and the results of the experiments are reserved till further trials have been made.

TUBERCULOSIS IN COWS.

Realizing the importance of a better understanding of this disease, the Station has during the year devoted a good deal of attention to the study of bovine tuberculosis. An affected herd of ten animals has been kept isolated from all other animals under as good hygienic conditions as possible. A small barn, 28x40 feet, was erected for their accommodation. The points being studied are: (1) the progress of the disease in affected animals; (2) the conditions under which tuberculin will cause a rise of temperature in tuberculous animals; and (3) the effect of good hygienic conditions on the progress and outcome of the disease. The work is still in progress and other phases of the disease will be taken up. A report of progress is given by Dr. Russell in another part of this report.

THE FARM.

Since the reorganization of the Station in 1888 it has used one of the college barns and has had under cultivation for experimental and other purposes about fifty acres of the college farm.

The oversight of all the work of instruction and investigation of the Department of Agriculture, with the exception of the college farm, is under the charge of one man in either his capacity as Professor of Agriculture or Director of the Station. It was thought that the best interests of the College in its relation to agriculture would be served by having all of the agricultural work of the College consolidated. This will be accomplished January 1, 1897, at which time the management of the college farm will be turned over to the director of the Experiment Station. This transfer is made with such financial support from the College that the Hatch fund will not be encroached upon either temporarily or permanently. The capital necessary for carrying on the farm is furnished by the College. All expenses of management and instruction will be borne by the College. The station funds will be used as in the past, only to defray the cost of experiments.

The farm will be managed primarily as a dairy farm, although considerable attention will be given to swine, sheep and poultry husbandry. The crops grown will be largely hay, fodder, and silage crops. The management of the farm will be, as in the past, under the immediate charge of Professor Gowell.

REPORTS OF THE STATION STILL AVAILABLE FOR DISTRIBUTION.

The Station has a few hundred copies of the Reports for 1888, 1889, 1890, 1893, 1894 and 1895, which will be sent on application so long as the numbers on hand will allow. The Report of this Station is bound with that of the Secretary of Agriculture, so that anyone having the "Agriculture of Maine" has also the Report of this Station.

In order to guide one in asking for these publications the principal papers in each Report are named below.

Address all requests for publications to

Maine Agricultural Experiment Station,
Orono, Maine.

TABLE OF CONTENTS OF REPORTS OF THIS STATION FOR 1888, 1889, 1890, 1893, 1894, AND 1895.

REPORT FOR 1888.

Inspection of fertilizers. Digestion experiments with sheep. The compounding of rations for farm animals. The composition and digestibility of American feeding stuffs. Tests of varieties of potatoes, oats, barley, and peas. Germanation tests of seeds. Descriptions of the following injurious insects: Round-headed apple-tree borer; Flat-headed apple-tree borer; Oyster-shell bark louse; Apple-tree tent-caterpillar; Forest tent-caterpillar; Fall canker-worm; Eye-spotted bud-moth; Apple-tree aphis; Codling moth; Apple maggot; Ash-gray pinion; Pear-tree slug; Indian cetonia; Plum curculio; Cherry-tree plant-louse; Imported currant-worm; Ivy scale insect; Black swallow-tail butterfly; Eyed elater; Hawthorn tingis; Mourning cloak butterfly; Meal-worm beetle.

REPORT FOR 1889.

Inspection of fertilizers. Composition, digestibility and yield of hay from various grasses. Composition, digestibility and yield of corn-fodder. Composition and value of various commercial feeding stuffs. The comparative digestibility of wheat bran and wheat middlings. Composition and digestibility of pea meal. The value of the digestible matter of good hay as compared with the digestible matter of corn ensilage, for milk production. The value of the digestible matter of ensilage as compared with the digestible matter of hay, for growth. Feeding experiments with swine. Tests of several breeds of dairy cows. Field and pot experiments with fertilizers. Field tests with varieties of barley, oats and peas. Seed germination experiments. Experiments with forage plants. The potato rot. Apple scab. The apple maggot. Insecticides. Hog cholera. Parturient apoplexy, (milk fever). The coefficients of digestibility for protein. Loss of food and manurial value in selling sweet corn.

REPORT FOR 1890.

Inspection of fertilizers. Tests of dairy cows. Mechanical loss of butter fat. Effect of delay in setting milk. The mineral ingredients of milk. The fat globules of milk. Tuberculosis in the college herd. Feeding experiments with colts. Feeding experiments with steers. Feeding experiments with swine. Field experiments with fertilizers. Germination tests of seeds. Spraying experiments. Injurious insects. Meteorological operations.

REPORT FOR 1893.

Investigation of the foraging powers of some agricultural plants for phosphoric acid. The composition of fodders and silage from the corn plant. Digestion experiments with sheep. Corn as a silage crop. Feeding experiments. Feeding experiments with cows. Feeding experiments with swine. Waste of fat in the skimmed milk by the deep-setting process. Notes of cabbages, cauliflowers, tomatoes, egg plants and potatoes. Spraying experiments. Catalogue of Maine fruits. Bean and

tomato anthracnose. Potato and beet scab. The Angoumois grain moth; the lime-tree winter-moth; the apple-leaf bucculatrix; the Disippus butterfly; the May beetle; the bean weevil; the pear-blight beetle or shot-borer; the carrot-fly.

REPORT FOR 1894.

Analyses of butter and imitation butter. Field experiments with fertilizers. The profitable amount of seed per acre for corn. Digestion experiments. Feeding experiments. Notes of potatoes and corn. Notes of small fruits and on plant breeding. The orange-colored roestelia or quince rust. Diseases of oats. Night-flowering catchfly. The dichotomous catchfly. Potato scab. The snow flea. The silver fish. The ring-banded soldier-bug. The elm tree bark louse. The gooseberry plant-louse. The oblique-banded carpet beetle. The oak-bark weevil. The fall canker worm. Tuberculin as a diagnostic agent. Bulletins issued in 1894—Fruit-culture. Spraying experiments. Tomatoes. Cauliflowers. Corn as a silage crop. Potatoes. Tuberculosis and glanders. A scheme for paying for cream, etc. Foraging powers of some agricultural plants.

REPORT FOR 1895.

Investigations on the foraging powers of some agricultural plants for phosphoric acid. The profitable amount of seed per acre for corn. Sunflower heads and blackeye peas as silage crops. Feeding experiments with milch cows. The relation of food to the growth and composition of the bodies of steers. Notes on potatoes, sweet corn, peas and cabbage. Notes on plants and insects. Second blooming of pear trees. Cattle lice. The yellow woolly bear. Tapestry moth. The strawberry leaf beetle. The cucumber flea beetle. The currant fly. Bulletins issued in 1895—Important facts about corn. Inspection of fertilizers. A Discussion of certain commercial fertilizers. A discussion of certain commercial foods. Notes on small fruits. Inspection of fertilizers.

ACKNOWLEDGMENTS.

Acknowledgment is hereby made for the following gifts to the Station during 1896:

One-half ton Thomas Phosphate Powder.—Thomas Phosphate Works, Philadelphia.

One Turbine Babcock Tester.—Vermont Farm Machine Company, Bellows Falls, Vermont.

One Peep O'Day Brooder.—E. F. Hudson, Dover, Mass.

One Improved Robbin Potato Planter.—Bateman Mfg. Co., Greenlock, New Jersey.

One Iron Age Sulky Cultivator.—Bateman Mfg. Co., Greenlock, New Jersey.

One New York Champion Horse Hay Rake.—Patten & Stafford, Canastata, New York.

One Bullard Two-Horse Hay Tedder.—Richardson Mfg. Co., Worcester, Mass.

One Deering Ideal, Ball and Roller Bearing Mower, six feet cut.—Deering Harvester Co., Albany, N. Y.

One Acme Pulverizing Harrow.—Duane H. Nash, Millington, N. J.

One Macomber Hand Corn Planter.—Duane H. Nash, Millington, N. J.

One Pound Protectio.—The Protectio Company, Collinsville, Conn.

One package Insecticide, Bug Death.—Danforth Chemical Co., Leominster, Mass.

One gallon prepared putty.—T. H. Nevins, Pittsburg, Pa.

One set Transplanting Implements.—F. Richards, Freeport, N. Y.

One package Cassa Banana Seeds.—J. L. Normand, Marchville, La.

One package Cions, eleven varieties.—C. Howard Shinn, Berkeley, Cal.

The following newspapers and other publications are kindly donated to the Station by the publishers:

Agricultural Epitomist, Indianapolis, Ind.; weekly. American Agriculturist, New York City; weekly. American Creamery, New York City; weekly. American Cultivator, Boston, Mass.; weekly. American Dairyman, New York City; weekly. American Fertilizer, Philadelphia, Pa.; monthly. American Grange Bulletin, Cincinnati, Ohio; weekly. Baltimore Weekly Sun, Baltimore, Md.; weekly. Cultivator & Country Gentleman, Albany, N. Y.; weekly. Dairy World, Chicago, Ill.; weekly. Detroit Free Press, Detroit, Mich.; bi-weekly. Elgin Dairy Report, Elgin, Ill.; weekly. Farming, Toronto, Ont.; monthly. Farmer's Advocate, Burlington, Vt.; weekly. Farmer's Advocate, London, Ont.; weekly. Farmer's Guide, Huntington, Ind.; weekly. Farmer's Home, Dayton, Ohio; weekly. Farmer's Journal, Philadelphia, Pa.; weekly. Farmer's Magazine, Springfield, Ill.; weekly. Farmer's Review, Chicago, Ill.; weekly. Farmer's Voice, Chicago, Ill.; weekly. The Florist's Exchange, New York City; weekly. The Forester, Princeton, N. J.; weekly. Fruit, Dunkirk, N. J.; weekly. Grange Visitor, Charlotte, Mich.; weekly. Green's Fruit Grower, Rochester, N. Y.; weekly. Hoard's Dairyman, Ft. Atkinson, Wis.; weekly. Holstein Fresian Register, Brattleboro, Vt.; monthly. The Homestead, Des Moines, Iowa; weekly. Horticulture, Cuyahoga Falls, Ohio; monthly. Horticultural Visitor, Kinmundy, Ill.; monthly. Industrial American, Lexington, Ky.; monthly. The Irrigation Age, Chicago, Ill.; monthly. The Jersey Bulletin, Indianapolis, Ind.; monthly. The Louisiana Planter, New Orleans, La.; monthly. Maine Farmer, Augusta, Me.; weekly. The Market Garden, Minneapolis, Minn.; weekly. Massachusetts Ploughman, Boston, Mass.; weekly. Mirror & Farmer, Manchester, N. H.; weekly. Montana Fruit Grower, Missoula, Mont. New England Farmer, Boston, Mass.; weekly. New England Florist, Boston, Mass.; weekly. New England Homestead, Springfield, Mass.; weekly. New York Farmer, Port Jervis, N. Y.; weekly. New York Produce Review, New York City; weekly. Northern Leader, Fort Fairfield, Me.; weekly. Ohio Farmer,

Cleveland, Ohio; weekly. Ohio Valley Farmer, Cincinnati, Ohio; weekly. Orange County Farmer, Port Jervis, N. Y.; weekly. Oregon Agriculturist, Portland, Oregon; bi-weekly. Pacific Coast Dairyman, Tacoma, Wash.; weekly. Practical Farmer, Philadelphia, Pa.; weekly. Public Ledger, Philadelphia, Pa.; daily. Rural Californian, Los Angeles, Cal.; monthly. Rural Canadian, Toronto, Ont.; weekly. Rural New Yorker, New York City; weekly. Southern Cultivator, Atlanta, Ga.; weekly. Southern Farmer, New Orleans, La.; weekly. Southern Planter, Richmond, Va.; weekly. Southern States, Baltimore, Md.; monthly. Southwestern Farmer, Wicheta, Kans.; weekly. Success with the Garden, Rose Hill, N. Y.; monthly. Turf, Farm and Home, Waterville, Me.; weekly. Vick's Magazine, Rochester, N. Y.; monthly. Wallace's Farmer, Des Moines, Iowa; weekly. Weekly Call, San Francisco, Cal.; weekly. Western Agriculturist, Chicago, Ill.; weekly.

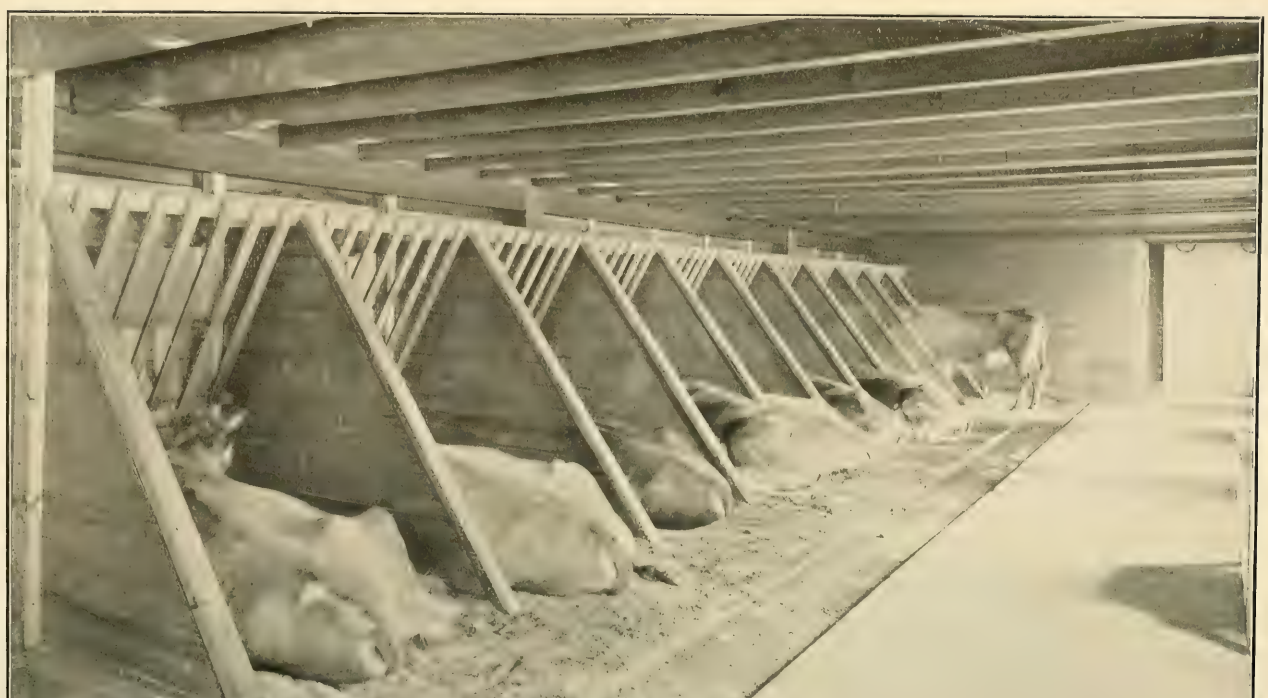
NEW FITTINGS OF THE COW STABLE.

G. M. Gowell.

In the construction of the first cattle barn at the college, separate mangers were provided for each animal, but all stood upon one common platform which was raised four inches above the bottom of the manure trench. The cattle were fastened around the necks with common tie-chains. In fifty feet of the tie-up this platform was four feet and four inches wide, and in the other fifty feet, it was four feet and ten inches wide, the better to accommodate long and short cows.

The difficulty of keeping the animals clean caused us to raise the platform to ten inches above the trench. No other changes were made. With the low platform, one hour had been required for the man to card, brush and properly clean the twenty-nine cows. After the platform was raised it required sixteen minutes of the same man's time to keep them as clean as before. This record extended over several days, and represented fairly the time required with each floor. The advantage with the high platform was, that the cattle would not back down into the trench very frequently and track their voidings up on to the platform to soil themselves when they lay down, as they did when the low platform was used.

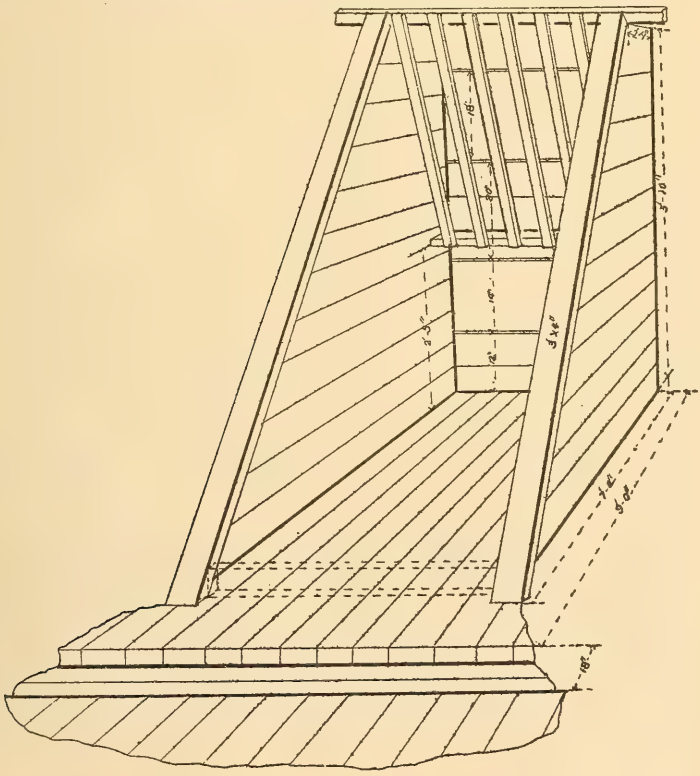
This high platform was not dangerous, causing animals to slip or fall, as is shown by our twelve years experience with it. We never had a case of lameness resulting from its use, and never a case of abortion in our herds, which, had it occurred, might perhaps have been ascribed to this as its cause. We encountered one difficulty in its use. When a cow lay down, the one standing next to her would sometimes step on her teats and bruise or cut them. This was not of frequent occurrence, but yet sufficiently so as to cause considerable trouble and anxiety. If we constructed partitions between the animals to prevent this difficulty they would be compelled to back out of their stalls down over the ten-inch drop into the trench, when we turned them out. This was not convenient for them to do. They had



TIE-UP IN LOWER BARN.

ordinarily turned on the high platform and walked off from it with ease; the partitions would prevent their doing so.

In reconstructing this barn last fall we attempted to secure some plan of stalls that would give the advantages of the one we already had and would at the same time be free from its objectionable features. It was decided to adopt the leading features of the "Hoard Stalls" and make such changes as seemed advisable to adapt it to our wants. The accompanying cut shows the plan and details of construction. The sleepers under the floor have no incline. The floor upon which the cows are placed is nine feet wide and has an incline of two inches in the nine feet. This incline is secured by laying pieces of tapering furring that are nine feet long, and are three inches thick at one end, and one inch thick at the other end, upon the sleepers, and laying the flooring upon them, using one thickness of plank or two thicknesses of boards.



At the side of the platform is the manure trench which is eighteen inches wide. The floor of this trench is made of one thickness of two inch plank laid directly on the floor sleepers. Narrow strips of one inch boards, for furring, are laid on the sleepers, from the manure trench to the outside sill of the barn, and are floored over with two inch plank, covered with one inch boards, breaking joints. When completed this leaves the trench two inches deep. Our stalls vary from three feet and four inches, to four feet in width; the wide ones being reserved for some of the larger animals. Three feet and six inches is about the right average width.

A convenient course to pursue in constructing the stalls is, first, to set the three by four inch studs at the corners of the stalls next to the feed floor of the barn, and then to put in place the eight inch plank which is the bottom of the feed rack and extends from post to post. The bottom of this plank should be twenty-nine inches from the floor, and its back edge should be beveled to take the narrow strips of the feed rack which are nailed to it. The top or head rail, which is two by four inches, is set at an angle, the upper corner being five feet and ten inches from the floor and twenty-eight inches from the front end of the stalls.

The partitions are a single thickness of one inch boards nailed to the three by four studs at the front end of the stalls, and extending back; the ends being cut on an angle to fit into the groove in the inclining three by four header which is nailed to the head rail at one end and the floor at the other end.

This header piece has its corners chamfered and the one inch deep groove is in the four inch side. The manger strips are one by two inches in size, and are placed four inches apart. The head rail is held in place by strips nailed to it and the front studs.

The top floor of the stalls is put down last and is of one inch boards running up and down the stalls. Pieces of three by four joist are placed on edge across the stalls near the ends of the partition and fastened to the floor by two large wire nails. The upper corners of these pieces are chamfered. They are to be put just in front of, and close to the hind feet of the animal when it stands up in the stall with its head close to the slats of the feed rack.

The lower door in front, through which grain and silage are fed is fourteen inches wide, and its lower edge is twelve inches from the floor. The upper door through which the hay is fed is eighteen inches wide and the space between it and the lower door is twenty inches. The doors are hinged at the upper edges and shut down, to avoid the crowding at the hinges, caused by chaff, etc., when hung to shut up. The animals are fastened by leather head halters, the ropes of which are two and one-half feet long, to the ring placed in the edge of the bottom of the feed rack.

The floor in the front part of the stall is swept clean before feeding the grain and silage, which are put directly on the floor. The animal steps forward putting its hind feet in front of the cross piece and eats the grain or silage and then, lifting its head is forced to step back over the cross piece in order to stand comfortably. The animal rarely voids while standing forward eating from the floor, but does so while standing back. When they are first put into the stalls they will sometimes lie down on the cross pieces but they get up very quickly and seek more comfortable positions by stepping in front of the bar and lying there, where there is plenty of room and comfort.

After the cows had been in their quarters about a month and had become accustomed to lying forward in the stalls, the cross pieces were removed. This was done several weeks ago, yet they have all continued to step forward when about to lie down, precisely as they did when the cross pieces were in place. How long they will continue to do so without the cross pieces to prompt them remains to be seen. The only objection to the cross pieces is that they are somewhat in the way of the milkers until they become accustomed to them. When leaving their stalls animals back out into or across the two inch deep manure trench without hesitation.

Our experience, thus far, with these stalls is very satisfactory. The animals have much freedom, as they step back and forth the length of their halters, and are able to reach back and lap themselves much to their satisfaction. They require but little carding and brushing to keep them clean, and while lying down they are safe from the injuries liable to be inflicted by their over-crowding mates.

The material used in the construction of these stalls was native spruce, planed on all sides. The cost of furnishing a barn with these stalls is less than that of stancheons, or mangers and chains. They are so sensible, simple and cheap, that they commend themselves to every cattle owner, whether he has an old fashioned barn or is constructing a new one.

A generous supply of windows is provided for the admission of light and sunshine. Outside windows are used during the coldest weather and are essential to prevent freezing in the tie-up, as it is kept open in front into the drive or feed floor except in the severest weather. This part of the barn furnishes plenty of fresh air to the animals, as it opens directly into the large ventilators on the ridge of the barn which are never closed. When it becomes necessary for the comfort of the animals, to close the shutters in front of them, the tie-up in which they are confined is completely ventilated by the ventilating shutes that are twelve by twenty-four inches, inside measurement, and extend from the tie-up, up the walls and roof to the ventilators at the ridge. These shutes are as near air tight as they can be made with matched boards and building paper, and have an upright height of forty-five feet.

It is essential that the ventilators be tight, as every little crack acts as a damper and checks the draft. It is necessary that the shutes be of large size, and as high as possible so as to displace large quantities of foul air. One of these shutes to each fifty feet in length of the tie-up, ventilates so completely that the air seems fresh and dry in the morning, after the room has been closed during the night. The cellar is ventilated by four shutes of similar size, but greater length, arranged in the same way.

For watering, two troughs are placed, in the one hundred feet long tie-up, next the wall, behind the cattle. A rope about two feet long is fastened near the ends of each trough. These ropes, and the ones in the stalls, have snaps at their ends, and the cattle are quickly unfastened and led to the trough and secured. Four animals are in process of watering at the same time. They cannot wander about, and the ropes are so short that they cannot play with each other and waste the time of the herdsman. After using individual watering buckets or

fountains, of a good pattern, for two years, we have discarded them for the reasons that they get foul quickly and require much cleaning. They have valuable features and we gave them up with reluctance. Our troughs are emptied and cleaned twice every day and filled with fresh water.

The bull pens are on the opposite side of the barn from the tie-up. They are nine by sixteen feet in size and have substantial walls. For fastening the animal a steel rod ten feet long and one and one-fourth inches in diameter, is placed horizontally along one of the long sides of the pen, thirty inches from the floor and two inches from the wall. It is held in position by a strong bolt at each end, and held away from the wall by thick washers. A strong sliding ring with swivel is placed on the rod, and the bull is fastened to it with chain or halter. He is at liberty to get considerable exercise by walking back and forth the length of the rod and yet he is securely fastened. This arrangement saves the time of the attendant required in exercising the mature animal that is unsafe if turned loose in the yards, and it gives the creature a chance for voluntary exercise at all times.

ANALYSES OF FODDERS AND FEEDING STUFFS.

In connection with the work of the Station, analyses of the following miscellaneous feeding stuffs have been made by the Station chemists. For the most part the analyses were made in connection with the feeding experiments or experiments upon the growth of plants. In no case were they undertaken merely to increase the amount of this class of data. The methods of analyses recommended by the Association of Official Agricultural Chemists were employed.

The results of the analyses are given in the tables which follow:

COMPOSITION OF FODDERS AND FEEDING STUFFS ANALYZED IN 1896, CALCULATED TO WATER CONTENT AT TIME OF TAKING SAMPLE.

	Laboratory number.	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat
		%	%	%	%	%	%
Sunflower heads	4004	86.07	1.10	1.93	3.79	5.62	1.49
Sunflower, whole plant	4005	85.21	1.92	1.70	4.00	6.14	1.03
English horse beans	4006	82.65	2.09	3.88	3.71	7.18	0.49
Silage—mature corn, sunflower heads, horse beans	599	70.33	1.73	3.44	6.33	16.44	1.73
Silage—mature corn, sunflower heads, horse beans	600	69.61	1.74	3.80	6.43	16.25	2.17
Silage—mature corn, sunflower heads, horse beans	601	69.89	1.58	4.25	5.79	16.80	1.69
Silage—mature corn, sunflower heads, horse beans	602	68.95	1.43	4.38	5.96	17.34	1.94
Maine Field Corn, planted at 6 inches	4001	80.64	1.18	1.91	3.76	11.90	0.60
Maine Field Corn, planted at 9 inches	4002	80.68	1.14	1.85	4.21	11.62	0.50
Maine Field Corn, planted at 12 inches	4003	79.26	1.25	2.21	4.09	12.60	0.59
King Gluten Meal	613	8.80	1.54	33.13	1.35	39.40	15.78
Potato Pomace	614	10.96	2.71	6.56	10.26	68.99	0.52
Juncus Gerardi	594	7.99	5.50	7.56	26.37	48.46	4.12

COMPOSITION OF WATER FREE SUBSTANCE OF FODDERS AND FEEDING STUFFS ANALYZED IN 1897.

	Laboratory number.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
		%	%	%	%	%
Sunflower heads	4004	7.89	13.87	27.20	40.33	10.70
Sunflower, whole plant	4005	13.04	11.55	27.04	41.60	6.78
English horse beans	4006	12.07	22.34	21.41	41.35	2.82
Silage—mature corn, sunflower heads, horse beans	599	5.83	11.60	21.35	55.38	5.84
Silage—mature corn, sunflower heads, horse beans	600	5.75	12.50	21.15	53.50	7.10
Silage—mature corn, sunflower heads, horse beans	601	5.22	14.10	19.25	55.82	5.61
Silage—mature corn, sunflower heads, horse beans	602	4.60	14.10	19.20	55.86	6.24
Maine Field Corn planted at 6 inches	4001	6.10	9.88	19.40	61.49	3.10
Maine Field Corn planted at 9 inches	4002	5.88	9.58	21.79	60.16	2.59
Maine Field Corn planted at 12 inches	4003	6.04	10.68	19.70	60.74	2.86
King Gluten Meal	613	1.69	36.35	1.48	43.18	17.30
Potato Pomace	614	3.02	7.36	11.52	77.58	0.52
Juncus Gerardi	594	5.98	8.22	28.70	52.62	4.48

PROFITABLE AMOUNT OF SEED PER ACRE FOR CORN.

J. M. Bartlett.

This experiment was planned by Prof. Jordan and is a repetition of those made for the same purpose in 1894 and 1895.* An acre of land was used this season as before, and for a dressing it received fifteen two horse loads of stable manure, 250 pounds acid South Carolina Rock, 100 pounds nitrate of soda and 75 pounds muriate of potash.

The acre was divided into twelve plots, or four sets of plots with three plots in a set. The corn was planted May 19. On one plot in each set the single kernels were planted six inches apart, on another nine inches, and on the third twelve inches. This gave four plots or one-third of an acre planted by each method.

Great pains were taken to insure a stand of stalks in accordance with the plan, and the experiment appeared to be a success so far as the field work was concerned. The growth of the corn was all that could be desired and the crop produced was greater than ever before secured here by this method of planting. September 8-10, it was harvested and put in the silo, the kernels being well glazed and in the best condition for silage.

Below is given the composition of the 1896 crop and the ratio of yield for all three years.

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* Reports of this Station for 1894 p. 33 and 1895 p. 19.

COMPOSITION OF WATER FREE SUBSTANCE OF CORN (WHOLE PLANT) FROM VARYING QUANTITIES OF SEED.

Distance Planted.	Laboratory number.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
		%	%	%	%	%
Kernels 6 inches apart	4001	6.10	9 87	19.42	61.47	3.10
Kernels 9 inches apart	4002	5.90	9.57	21.79	60.15	2.59
Kernels 12 inches apart	4003	6.03	10.66	19.72	60.75	2.84

YIELD PER ACRE OF CORN (WHOLE PLANT) FROM VARYING QUANTITIES OF SEED.

Distance Planted.	Crop of 1894.			Crop of 1895.			Crop of 1896.		
	Total yield.	Dry matter.	Yield dry matter.	Total yield.	Dry matter.	Yield dry matter.	Total yield.	Dry matter.	Yield dry matter.
	Lbs.	%	Lbs.	Lbs.	%	Lbs.	Lbs.	%	Lbs.
6 inches apart	21,315	21.1	4,497	16,020	37.42	5,995	34,110	19.36	6,604
9 inches apart	22,530	20.9	4,709	15,780	38.47	6,071	34,680	19.32	6,700
12 inches apart	20,190	20.5	4,139	15,675	35.45	5,558	31,815	20.74	6,598

The results so far reached indicate that the amount of seed may vary greatly without materially affecting the yield of dry matter in the mature crop. The average yield per acre of dry matter for the three seasons with the several rates of seeding are as follows: Kernels six inches apart 5,699 pounds; at nine inches 5,827 pounds; at twelve inches 5,432 pounds.

There appears so far to be only a small difference between six inches and nine inches seeding, whereas the yield from the twelve is considerably less.

SUNFLOWERS AND ENGLISH HORSE BEANS AS SILAGE CROPS.

J. M. Bartlett.

For three seasons sunflowers have been grown on a small scale for a silage crop. In 1894 and 1895 very fair yields were secured but the season of 1896 was very favorable and an exceedingly heavy crop was the result.

Horse beans have been grown for two seasons, but owing to late planting and drought the crop of 1895 was not up to the average yield. In 1896 the seed was planted early for this climate, May 18th. The plants grew well, attaining a height of 3 to 4 feet, and contained many matured pods when harvested. A good yield was secured but it is possible that it could have been made somewhat larger, without impairing the quality, by planting somewhat closer. The plants stood about one foot apart in drills three to three and one-half feet apart.

Both crops were harvested September 8-10, run through the silage cutter and mixed with corn in the silo, in the following proportions: one-fourth acre of sunflowers, one-half acre of horse beans, and one acre of corn. The whole plant of one-half of the sunflowers was put in the silo mixed with corn and beans. Of the remaining half the heads only were used.

Both mixtures were found to be well preserved when the silo was opened in January, and were greedily eaten by the cows. The stalks of the sunflowers were so large and coarse that it seemed doubtful whether the cattle would eat them, but after being ensiled the mixture was as well relished as the pure corn. The cost of growing these crops can be estimated to be about the same as that of corn. The land should be put in about the same condition and the labor of caring for them is not materially different.

YIELD PER ACRE IN POUNDS.

Names of Plants.	Weight as harvested.	Weight of dry matter.
Sunflower, heads	27,040	3,767
Sunflower, whole plant	48,800	7,219
English horse bean, whole plant	20,160	3,497

CHEMICAL COMPOSITION OF THE PLANTS.

	Fresh Material as Harvested.						Dry Material (Water Free).				
	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Ether extract.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Ether extract.
	%	%	%	%	%	%	%	%	%	%	%
Sunflower, heads	86.07	1.10	1.93	3.79	5.62	1.49	7.89	13.87	27.20	40.33	10.70
Sunflower (whole plant)	85.21	1.92	1.70	4.00	6.14	1.03	13.04	11.55	27.04	41.60	6.78
Horse bean (whole plant)	82.65	2.09	3.88	3.71	7.18	0.49	12.07	22.34	21.41	41.35	2.82

The very large yield of sunflowers (whole plant) per acre shown in the table above would apparently secure for them a favorable position among coarse fodder plants for silage material.

The yield of dry matter is slightly larger than has ever been obtained at the Station from corn, but notwithstanding that fact it cannot be considered as desirable a plant to raise for fodder where corn can be grown successfully. Its chemical composition is about the same as that of southern corn grown in this climate; the exceedingly coarse, rough stalks and leaves of the plant make it less palatable as a fodder and were it not ensiled would be largely rejected by stock.

The chief value, therefore, of the experiment with this plant consists in showing the utility of the silo in saving such materials and preventing waste. Sunflowers and other coarse plants are often grown for seed or other purposes when only a small portion of the plant is used. The coarse parts that were formerly thrown away can be now utilized and made into palatable and nutritious food for stock by ensiling.

Horse beans are rich in protein and promise to rank well with plants of that class as forage crops. They have the ability, like most legumes, to gather nitrogen from the air, and consequently do not exhaust the soil of that element. At the present time, however, when the price of nitrogenous feeds, like gluten meal and cotton seed meal, is so low, it is a question whether it is not more profitable for a farmer to give his attention largely to growing corn for coarse fodders and buy nitrogenous feeds to balance up the ration.

TESTS OF SEPARATORS.

J. M. Bartlett.

These tests were not undertaken with the idea of making an extensive investigation of separators, but to compare, principally for our own satisfaction, the three hand machines that are now in the dairy building; two of which, the Empire and United States, have been placed there free of cost for use in the dairy school. The DeLaval Company also supplied us with one of the Humming Bird machines for that purpose.

The machines used, sizes and capacities are shown in the table. The operator could detect no material difference in the ease of running of the United States No. 5 or Baby No. 2. The Empire being a larger machine of course ran harder. He, however, preferred the United States to the others on account of the simplicity of the bowl, it requiring less time to set it up, clean, etc.

If in handling the DeLaval discs they are arranged on a wire, the difference in time and work required to clean and set them up more than that required for one of the simpler bowls, is not so much as one would think.

In the first tests that were made the bowl washings were tested, to estimate losses in that direction, but as the amount of loss was about the same for each machine and the percentage was proportional to the amount of milk run through, this factor was disregarded in the experiment.

The determination of fat in the skimmed milk was made in most cases both by the gravimetric and the Babcock volumetric methods.

The Babcock method, the writer finds, is not reliable when the fat runs below .05 or .06 per cent, even when the B. & W. skimmed milk bottle is used. In several cases, not given in the table, where the Babcock method showed no fat or only a trace, the gravimetric showed .06 to .08 per cent. There are a great

many chances for such small amounts of fat as are found in separator skimmed milk to become lost by sticking to the sides of the bottle when all conditions are not exactly right, and after it once adheres the centrifugal force used will not remove it. The results of the tests are here given in tabular form.

TESTS OF SEPARATORS.

Kind of Separator.	Capacity of machine.	Time required for 100 pounds milk.	Revolutions of handle per minute.	Temperature of milk.	Fat in cream.	Fat in skimmed milk gravimetric method.	Fat in skimmed milk Babcock method.
U. S. Separator No. 5....	270 to 350	18 m.	45 to 48	85° F.	28.0	.04	.05
U. S. Separator No. 5 ...	270 to 350	19 m.	45 to 48	85° F.	29.0	.06	.04
U. S. Separator No. 5 ...	270 to 350	17 m.	45 to 48	85° F.	34.0	.12	.10
U. S. Separator No. 5....	270 to 350	17 m.	45 to 48	85° F.	35.0	.14	.12
De Laval Baby No. 2....	325 to 350	22 m.	40 to 42	85° F.	30.0	.....	.06
De Laval Baby No. 2....	325 to 350	21 m.	40 to 42	85° F.	30.0	.06	.07
De Laval Baby No. 2....	325 to 350	20 m.	40 to 42	85° F.	33.0	.10	.09
De Laval Baby No. 2....	325 to 350	19 m.	40 to 42	85° F.	33.0	.09	.10
Empire No. 5	400	14 m.	45 to 48	85° F.	26.0	....	.05
Empire No. 5	400	13 m.	45 to 48	85° F.	28.4	.....	.04
Empire No. 5	400	13 m.	45 to 48	85° F.	34.0	.11	.04

FEEDING EXPERIMENTS WITH MILCH COWS.

J. M. Bartlett.

(1) Gluten meal compared with cotton-seed meal for milch cows.

(2) Silage compared with grain as food for milch cows.

(3) Ground oats compared with wheat bran for milch cows.

(4) Nutriotone for the production of milk.

Feeding experiments with milch cows under ordinary conditions are somewhat unsatisfactory. There are many factors, beyond the experimenter's control, which come in to cause greater variations in milk yield than would be produced by any change in the ration one would care to make use of in rational feeding. Conclusive results are, therefore, not to be expected from single, brief feeding trials. It is only from the accumulated data of a large number of such trials that results of a reliable nature are obtained. Of course a very wide ration like that of timothy hay and corn meal will show its inferiority in a single feeding experiment, but the intelligent dairy farmer of today is already aware of that fact, and such irrational feeding experiments are no longer necessary. Considering the question as to whether a ration with a nutritive ratio of 1 to 4 or 1 to 6 is the more profitable, there are very little reliable data on which to base conclusions. Some of the most intelligent dairy farmers claim the best results from the very narrow ration of 1 to 4, while others are equally confident that the wider one of 1 to 6 is the better. It is in studying such problems as this in which results are not decisive that the single experiment is the most unsatisfactory, and it is only from the results of a large number of trials that definite information is obtained. The individuality of cows is a perplexing element in a feeding experiment. Cows are somewhat like people, and a ration that agrees best with one does not always agree with another.

Climatic conditions as heat and cold have a marked effect on some animals. A sudden drop in the temperature will sometimes cause a cow to shrink enough in milk flow to obliterate any difference in yield that might be produced by the food she is eating. Anything that causes nervous excitement may cause a temporary shrinkage in milk flow. A change of milkers, which one is sometimes obliged to make during an experiment, may cause difference enough in the milk yield to spoil the experiment. To eliminate some of these sources of error, the experimenter employs as many animals as practicable and takes careful note of all the conditions under which the experiment is made.

For the experiments which are given in the following pages, six registered Maine State Jerseys, known by the numbers 1, 2, 3, 4, 5 and 6, were used. Their ages ranged from 5 to 8 years, except Nos. 5 and 6, which were 3 and 4 years old respectively. All were fresh in milk and in good condition. Their milk flow was not quite up to their average for the reason that they were recently purchased, and transportation caused a shrinkage from which they did not recover.

In the experiments conducted with these animals they were divided into two groups or lots of three each, making it possible to feed the two rations to be compared through each period, thereby avoiding, to some extent, the errors caused by changes in temperature, advance in the period of lactation, etc.

In calculating the digestible nutrients in the foods used, the American coefficients were employed, except for corn meal, for which the German coefficients were used.

DIGESTION COEFFICENTS USED.

	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Hay	49	53	63	57
Silage	65	76	73	70
Corn meal	76	.....	92	92
Gluten meal	87	.....	91	88
Cotton-seed meal	88	.....	64	97
Bran	78	25	68	72

GLUTEN MEAL COMPARED WITH COTTON-SEED MEAL AS FOOD FOR MILCH COWS.

The object of this experiment, the results of which are given in the following tables, was to compare the feeding value of gluten meal with cotton-seed meal, when fed in such proportions that the quantity of digestible nutrients of the one equalled those of the other.

Gluten meal, a material made from the residue left in the manufacture of starch and glucose from Indian corn or maize, is now offered quite extensively in our markets as a cattle food. There are also several other products made from this residue which are known by various names, such as gluten feed, corn bran, corn germ, etc. None of these, however, are so rich in protein as gluten meal, for the reason that in its manufacture the hull and germ of the kernel is removed, which is not the case in the manufacture of the other materials mentioned. The high grade meals do not differ greatly in composition from linseed meal and average about one-quarter less protein than cotton-seed meal. They also contain but little ash, and are less valuable than the oil meals as manure formers.

In this, as in all the other experiments, the animals were kept in as nearly uniform conditions as possible, and the grain ration fed was small so as to avoid an excess of nutrients in either ration. The cows were weighed at the beginning and close of each period, so that any gain or loss in flesh could be noted, and the milk was accurately weighed at each milking. Samples were taken the last five days of each period, and the average of the results obtained was taken as the average composition of the milk for that period. The butter made from the milk produced, while the cows were on each ration, was tested for quality and hardness.

WEIGHT OF COWS AT THE BEGINNING OF THE EXPERIMENT.

Cow's number	1	2	3	4	5	6
Weight in pounds	790	905	963	990	785	863

RATIONS FED DAILY.

Ration I.
Timothy hay, 15 lbs.; silage, 20 lbs.; mixed grain, 8 lbs. { Gluten meal, 3 lbs. Corn meal, 2 lbs. Bran, 3 lbs.

Ration II.
Timothy hay, 15 lbs.; silage, 20 lbs.; mixed grain, 8 lbs. { Cotton-seed meal, 2 lbs. Corn meal, 2½ lbs. Bran, 3 lbs.

Cows Nos. 5 and 6 received but 6 and 7 pounds of grain respectively. The others received the full ration as given above.

COMPOSITION OF FOODS USED.

Kinds of Food.	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
	%	%	%	%	%	%
Hay	13.2	4.4	5.9	29.0	45.0	2.5
Silage	69.9	1.6	4.0	6.0	16.6	1.9
Corn meal	14.4	1.4	9.3	1.9	69.2	3.8
Gluten meal	9.1	0.9	33.7	1.3	49.5	5.5
Cotton-seed meal	8.0	7.2	42.4	5.6	24.2	12.6
Bran	11.7	5.9	15.4	8.9	54.0	4.1

DIGESTIBLE NUTRIENTS CONSUMED BY EACH LOT OF COWS PER DAY.

Kind of Nutrients.	Ration I with Gluten Meal.				Ration II with Cotton-Seed Meal.			
	Period I. Lot I.	Period II. Lot II.	Period III. Lot I.	Average during tests.	Period I. Lot II.	Period II. Lot I.	Period III. Lot II.	Average during tests.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Protein	7.0	6.5	7.0	6.8	6.2	6.7	6.2	6.4
Carbohydrates	40.6	39.2	40.6	40.1	37.2	38.3	37.2	37.6
Fats	2.4	2.2	2.4	2.3	2.6	2.7	2.6	2.6

TEMPERATURE OF STABLE AND YIELD OF MILK FOR EACH COW PER WEEK.

Periods.*	Temperature of stable.	Yield of Milk per Cow.							
		Cow No. 1.	Cow No. 2.	Cow No. 3.	Total Cows 1—3.	Cow No. 4.	Cow No. 5.	Cow No. 6.	Total Cows 4—6.
	Deg.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
I. Dec. 3 to Dec. 21.									
First week	44	92.4	138.3	141.5	372.2	134.5	147.0	131.3	412.8
Second week	38	91.9	147.8	144.3	384.0	130.8	155.3	137.1	423.2
Third week	49	96.4	148.5	149.6	394.5	130.2	154.7	135.1	420.0
II. Dec. 22 to Jan. 11.									
First week	51	93.3	139.6	141.8	374.7	136.6	160.8	138.3	435.7
Second week	49	93.4	136.6	140.9	370.9	130.0	162.5	135.6	428.1
Third week	35	92.0	132.4	133.9	358.3	127.6	158.6	134.6	420.8
III. Jan. 12 to Feb. 1.									
First week	43	99.1	143.3	137.5	379.9	129.0	155.5	136.7	421.2
Second week	42	92.4	135.6	131.9	359.9	125.9	150.6	128.0	404.5
Third week	41	91.0	130.8	125.0	346.8	121.1	150.0	123.6	394.7

* In periods I and III cows 1, 2 and 3 received the ration containing gluten meal, and cows 4, 5 and 6, that containing cotton-seed meal. In Period II the rations were reversed.

WEIGHT GAINED OR LOST, MILK, SOLIDS AND FAT PRODUCED BY EACH COW FOR EACH PERIOD.

	Period.	Cow's number.	Weight gained.	Weight lost.	Milk.	Solids.	Fat.
RATION I.			Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Gluten meal was fed.	I	1	.....	25	280.6	40.3	14.1
	I	2	21	.....	434.5	60.7	21.7
	I	3	.....	8	435.4	63.3	22.5
	II	4	45	.....	394.2	58.2	19.2
	II	5	.....	10	481.9	68.7	22.1
	II	6	3	.....	408.5	62.2	33.1
	III	1	5	.....	282.5	40.2	14.0
	III	2	1	.....	409.6	57.5	18.4
	III	3	2	.....	394.4	56.5	20.2
RATION II.	I	4	35	.....	395.5	58.9	20.1
	I	5	.....	.....	456.9	62.9	21.2
Cotton seed meal was fed.	I	6	9	.....	403.5	60.8	22.6
	II	1	35	.....	278.6	41.7	14.7
	II	2	16	.....	408.6	57.1	20.9
	II	3	11	.....	416.5	60.0	22.0
	III	4	.....	8	376.0	55.6	18.5
	III	5	10	.....	456.1	64.0	20.3
	III	6	15	.....	388.4	59.7	22.5

TOTAL AND DAILY YIELD OF MILK, SOLIDS AND FAT FOR EACH LOT FOR EACH PERIOD.

RATION.	Period.	Weight gained.	Weight lost.	Milk.	Solids.	Fat.
		Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
I. Gluten meal, Lot I	I	.....	12	1150.5	164.3	58.3
Average daily yield	.....	.....	.....	18.3	2.6	0.92
I. Gluten meal, Lot II	II	38	.....	1284.6	189.1	64.4
Average daily yield	.....	.....	.....	20.4	3.0	1.02
I. Gluten meal, Lot I	III	8	.....	1086.5	154.2	52.6
Average daily yield	.....	.....	.....	17.2	2.4	0.82
II. Cotton seed meal, Lot II	I	44	.....	1255.9	182.5	63.8
Average daily yield	.....	.....	.....	19.9	2.9	1.01
II. Cotton seed meal, Lot II	II	62	.....	1103.7	158.7	57.5
Average daily yield	.....	.....	.....	17.5	2.5	0.91
II. Cotton seed meal, Lot II	III	17	.....	1220.5	179.2	61.3
Average daily yield	.....	.....	.....	19.4	2.8	0.97
I. Average daily yield gluten meal	.....	.....	.....	18.6	.....	0.92
II. Average daily yield cotton seed meal	.....	.....	.....	18.9	.....	0.96

DIGESTIBLE NUTRIENTS EATEN FOR EVERY POUND OF MILK, SOLIDS, AND FAT PRODUCED.

	Ration I with Gluten Meal.								Ration II with Cotton-Seed Meal.							
	Period I. Lot I.		Period II. Lot II.		Period III. Lot I.		Average during tests.		Period I. Lot II.		Period II. Lot I.		Period III. Lot II.		Average during tests.	
	Protein.	Carbohydrates.	Protein.	Carbohydrates.	Protein.	Carbohydrates.	Protein.	Carbohydrates.	Protein.	Carbohydrates.	Protein.	Carbohydrates.	Protein.	Carbohydrates.	Protein.	Carbohydrates.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Milk....	.12	.83	.11	.72	.13	.89	.12	.81	.10	.71	.13	.84	.11	.74	.11	.76
Solids ..	.89	5.86	.72	4.91	.95	6.24	.85	5.67	.71	4.09	.89	5.88	.73	5.03	.78	5.00
Fat.....	2.53	16.53	2.12	14.44	2.79	18.24	2.48	16.40	2.05	14.17	2.45	16.21	2.13	14.71	2.21	15.03

SUMMARY.

The foregoing data indicate that gluten meal is fully equal to cotton-seed meal when fed in sufficient quantity to make the amount of digestible nutrients equal in each ration.

It is not equal to cotton-seed meal pound for pound as a source of protein, as it contains, on an average, about one quarter less of that nutrient.

It makes a very good quality of butter, but slightly softer than that made from cotton seed meal ration when fed in the quantity used in this experiment.

SILAGE COMPARED WITH GRAIN AS FOOD FOR MILCH COWS.

The object of this experiment was to again test the practicability of substituting silage, made according to Professor Robertson's formula, for a portion of the grain ration. The mixture was made as follows: One acre of matured field corn, one-half acre of horse beans, and one-quarter acre of sunflower heads, cut close, were run through the silage cutter and put in the silo. Owing to an unavoidable delay the corn was allowed to stand until too ripe and dry to make the best quality of silage.

The horse beans were rather immature, containing but few pods and were not at their best stage of growth for fodder. Owing to the dry condition of the corn, the silage did not keep well after the silo was opened and the time occupied by the experiment had to be cut down to two periods of two weeks each, which is shorter time than is desirable. With this exception the experiment may be considered a success. The silage was readily eaten and well relished by the cows. The gross amount of silage fed was not so large as in the experiment made in 1895 for the reason that the silage of 1896 contained considerable less water, but the total dry matter fed was about the same.

The ration fed for the first period was the same as fed in the third period of the experiment described above.

DAILY RATIONS FOR COWS.

Ration I. Timothy hay, 20 pounds; silage, 20 pounds; grain, 8 pounds.

Ration II. Timothy hay, 15 pounds; silage, 35 pounds; grain, 4 pounds.

Cows five and six received but six and seven pounds of grain respectively in the first period, and one-half that amount in the second period.

The results of the experiment are found in the following tables:

DIGESTIBLE NUTRIENTS CONSUMED BY EACH LOT OF COWS AND AVERAGE PER COW, PER DAY.

	Ration I.		Ration II.	
	Lot I.	Lot II.	Lot I.	Lot II.
	lbs.	lbs.	lbs.	lbs.
Protein	7.0	6.2	6.8	5.4
Carbohydrates	40.6	37.2	49.2	47.5
Fat	2.4	2.6	2.4	2.4
Total	50.0	46.0	57.4	55.3
Per cow	16.7	15.3	19.1	18.4

COMPOSITION OF MILK FOR LAST FIVE DAYS OF EACH PERIOD.

	Cow 1.		Cow 2.		Cow 3.		Cow 4.		Cow 5.		Cow 6.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
	%	%	%	%	%	%	%	%	%	%	%	%
January 28	14.41	4.80	13.93	4.80	14.24	4.95	14.75	4.80	14.47	4.55	15.28	5.80
January 29	13.62	4.90	13.87	5.20	14.17	5.30	14.64	5.10	13.35	4.50	14.97	5.55
January 30	13.94	4.80	14.56	4.95	14.46	5.20	14.88	4.80	13.74	4.20	15.7	6.00
January 31	14.64	5.30	14.14	4.80	14.45	5.05	14.81	4.85	14.20	4.50	15.62	6.00
February 1	14.52	5.05	13.77	5.00	14.30	5.10	14.86	5.00	14.21	4.55	15.31	5.65
Average	14.23	4.97	14.05	4.95	14.32	5.12	14.79	4.91	13.99	4.46	15.38	5.80
February 11	13.42	4.80	14.12	4.80	14.02	4.85	15.13	4.75	14.52	4.50	15.70	5.65
February 12	14.50	4.95	14.90	5.10	...	5.10	15.80	4.95	15.30	4.75	15.70	5.65
February 13	15.81	4.60	14.38	5.15	44.98	5.40	15.52	4.80	14.76	4.60	15.74	5.75
February 14	14.73	5.10	14.14	5.15	14.61	5.00	15.08	4.95	14.65	4.80	15.97	5.95
February 15	14.48	4.85	14.06	5.10	14.27	5.10	14.60	4.65	14.44	4.50	15.04	5.30
Average	14.59	4.86	14.32	5.06	14.47	5.09	15.23	4.82	14.73	4.63	15.63	5.66

TEMPERATURE OF STABLE AND YIELD OF MILK OF EACH COW PER WEEK.

	Temperature of stable.	1.	2.	3.	4.	5.	6.	Total.
Period I (Ration I).		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
January 19 to January 26	42	92.4	135.6	131.9	125.9	150.6	128.0	764.4
January 26 to February 1	41	91.0	130.8	125.0	121.1	151.0	123.6	741.5
Period II (Ration II).								
February 2—9	44	93.4	125.8	116.3	122.1	148.8	122.9	729.3
February 9—16	41	102.3	125.5	124.5	125.3	147.8	125.0	750.4

TOTAL YIELD OF MILK, SOLIDS AND FAT FOR EACH LOT OF COWS FOR EACH PERIOD.

	Period.	Weight gained.	Milk.	Solids.	Fat.
Ration I—full grain.	I.	lbs.	lbs.	lbs.	lbs.
Lot I		8			
Total yield			706.6	100.3	35.5
Daily yield per cow			16.8	2.4	.8
Lot II		17			
Total yield			800.3	117.4	40.2
Daily yield per cow			19.1	2.8	1.0
Ration II—one-half grain.	II.				
Lot I		70			
Total yield			687.6	99.4	34.5
Daily yield per cow			16.4	2.4	.8
Lot II		60			
Total yield			791.8	120.1	39.7
Daily yield per cow			18.9	2.9	.9

CONCLUSIONS DRAWN FROM THE FOREGOING DATA.

This experiment, although too limited to be of much value in itself, confirms the results of Professor Robertson's investigations and those obtained from experiments made at this Station last year, showing that silage, of the quality used, can be substituted in part for the grain ration of milch cows without causing loss of flesh or lessening the production of milk.

In this case fifteen pounds of silage appeared to equal four pounds of the grain mixture.

GROUND OATS COMPARED WITH WHEAT BRAN FOR MILCH COWS.

In some sections of the State oats are a very important crop and are extensively grown for market or feeding to animals. When the price is so low that it hardly pays to take them to market in exchange for other grains, the station receives frequent inquiries as to their value as feed for milch cows.

The grain is subject to quite wide variations in composition, depending somewhat on the variety, nature of the soil where grown, climatic conditions, etc. As a rule oats grown in high latitudes are heavier, contain less crude fiber and more nutrients than those grown farther south.

Good, heavy, northern grown oats do not vary greatly in composition from wheat bran, the principal difference being that they contain a little less protein, and ash materials. Their feeding value as far as has been determined is not materially different.

The average composition of northern grown oats and wheat bran is shown in the following table:

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
	%	%	%	%	%	%
Oats	10.00	3.0	12.50	9.00	60.50	5.00
Bran	12.00	6.0	15.50	9.00	53.50	4.00

The chemical composition, the digestibility of the two being about the same, would indicate that bran is worth slightly more pound for pound than oats, but so far as they have been tested practically, there does not seem to be any material difference. In the test made at this station, the results of which are given in the following tables, the six cows previously described were used. They were divided into two lots of three each. Lot I received ration I and lot II, ration II, for the first period. The order was reversed in the second period, lot I receiving ration II; lot II, ration I. In the third period both lots were fed as in the first period.

RATIONS FED DAILY.

Ration I—Hay, 20 pounds, mixed grain, 8 pounds. { Bran, 4 pounds. Corn meal, 2 pounds. Cotton seed meal, 2 pounds.

Ration II—Hay, 20 pounds, mixed grain, 8 pounds, { Ground oats, 4 pounds. Corn meal, 2 pounds. Cotton seed meal, 2 pounds.

Cows No. 2, 3 and 4 received the full rations as given above, but Nos. 1 and 6 received but seven pounds of grain mixture, and No. 5 but six pounds.

CHEMICAL COMPOSITION OF FOODS USED.

	Water.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
	%	%	%	%	%	%
Hay	13.2	4.4	5.9	29.0	45.1	2.5
Mixed grain (Ration I)	10.7	5.0	21.1	6.9	49.9	6.5
Mixed grain (Ration II)	10.8	3.8	19.0	8.1	51.8	6.5

TOTAL NUTRIENTS CONSUMED BY EACH LOT FOR EACH PERIOD.

Kinds of Nutrients.	Ration I with Bran.				Ration II with Oats.			
	Period I. Lot I.	Period II. Lot II.	Period III. Lot I.	Average during tests.	Period I. Lot II.	Period II. Lot I.	Period III. Lot II.	Average during tests.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs,	lbs.
Protein	175.6	166.8	175.6	172.7	157.7	165.7	157.7	160.4
Carbohydrates	1208.3	1184.5	1208.3	1200.4	1198.3	1218.4	1198.3	1205.0
Fats	62.3	59.6	62.3	61.4	59.8	62.5	59.8	60.7
Total	1446.2	1410.9	1446.2	1434.5	1415.8	1446.6	1415.8	1426.1
Total per cow per day	23.0	22.4	23.0	22.8	22.5	23.0	22.5	22.6

TEMPERATURE OF STABLE AND YIELD OF MILK FOR EACH COW PER WEEK.

Periods.	Temperature of stable.	Yield of Milk per Cow.							
		Cow No. 1.	Cow No. 2.	Cow No. 3.	Total Cows 1–3.	Cow No. 4.	Cow No. 5.	Cow No. 6.	Total Cows 4–6.
	Deg.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
I—February 23—March 14.									
First week	41	87.1	112.0	113.1	312.2	119.1	124.4	108.4	351.9
Second week	45	83.5	107.8	112.4	303.7	121.4	131.1	109.0	361.5
Third week	41	81.9	106.0	111.4	299.3	122.0	128.4	112.6	363.0
Total		252.5	325.8	336.9	915.2	362.5	383.9	330.0	1076.4
II—March 15—April 4.									
First week	44	87.1	107.9	115.5	310.5	121.0	120.9	103.5	345.4
Second week	44	92.0	108.5	118.5	319.0	121.5	112.8	104.1	338.4
Third week	49	88 9	108.1	120.9	317.9	121.4	114.4	105.3	341.1
Total		268.0	324.5	354.9	947.4	363.9	348.1	312.9	1024.9
III—April 5—April 25.									
First week	50	96.1	101.5	118.5	310.1	125.8	104.8	102.6	333.2
Second week	56	88.5	100.4	119.1	308.0	130.6	102.0	100.5	333.1
Third week	55	86.0	98.3	120.3	304.6	128.9	99.1	107.6	335.6
Total		264.6	300.2	357.9	922.7	385.3	305.9	310.7	1001.9

AVERAGE COMPOSITION OF MILK FOR LAST FIVE DAYS OF EACH PERIOD.

	Cow 1.		Cow 2.		Cow 3.		Cow 4.		Cow 5.		Cow 6.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
	%	%	%	%	%	%	%	%	%	%	%	%
Period I	14.79	5.14	14.13	5.09	14.48	5.08	14.68	5.07	14.34	4.69	15.04	5.35
Period II	14.49	5.08	13.56	4.90	14.15	5.14	14.55	4.96	15.14	5.09	15.46	5.75
Period III	14.79	5.16	14.03	5.22	14.49	5.28	14.25	4.71	15.62	5.07	15.54	5.88

TOTAL YIELD OF MILK, SOLIDS AND FAT FOR EACH COW FOR EACH PERIOD.

	Period.	Cow.	Weight gained.	Weight lost.	Milk.	Solids.	Fat.
			lbs.	lbs.	lbs.	lbs.	lbs.
Ration I—Bran	I	1	...	4	252.5	37.4	13.0
		2	.....	18	325.8	46.0	16.6
		3	...	4	336.9	48.8	17.1
	II	4	20	.....	363.9	53.0	18.1
		5	31	.....	348.0	52.7	17.7
		6	55	.....	312.9	48.4	18.0
	III	1	... ..	18	264.6	39.1	13.7
		2	14	.....	300.1	42.1	15.7
		3	12	.....	357.9	51.9	18.9
Ration II—Oats	I	4	.....	27	362.5	53.2	18.4
		5	12	.....	383.9	55.0	18.0
		6	.....	23	330.0	49.6	17.7
	II	1	29	.....	268.0	38.8	13.6
		2	35	.....	324.5	44.0	15.9
		3	25	.....	354.9	50.2	18.2
	III	4	3	.....	385.3	54.9	18.1
		5	.....	11	305.9	47.8	15.5
		6	.....	25	310.8	48.3	18.3

TOTAL YIELD OF EACH LOT OF COWS FOR EACH PERIOD, AND AVERAGE DAILY YIELD FOR EACH COW.

Ration.	Period.	Weight gained.	Weight lost.	Milk.	Total solids.	Butter fat.
		lbs.	lbs.	lbs.	lbs.	lbs.
Bran—Lot I	I	.....	26	915.2	132.2	46.7
Average daily yield	.....	.....	.....	14.5	2.1	0.7
Bran—Lot II	II	106	.....	1024.83	154.02	53.6
Average daily yield	.....	.....	.....	16.3	2.4	0.9
Bran—Lot I	III	8	.....	922.6	133.1	48.2
Average daily yield	.....	.....	.....	14.6	2.1	0.8
Oats—Lot II	I	.....	38	1076.4	157.9	54.1
Average daily yield	.....	.....	.....	17.1	2.5	0.9
Oats—Lot I	II	89	.....	947.4	133.0	47.8
Average daily yield	.....	.....	.....	15.0	2.1	0.8
Oats—Lot II	III	.....	21	1001.9	151.0	51.9
Average daily yield	.....	.....	.....	15.9	2.4	0.8

TOTAL YIELD OF MILK, TOTAL SOLIDS AND FAT WITH EACH RATION

	Milk.	Total solids.	Butter fat.
	lbs.	lbs.	lbs.
When ground oats were fed	2026	442	154
When bran was fed	1863	419	149

These results show a slightly larger yield when oats were fed than when bran was fed, but the differences are not sufficiently large for one to say that oats have a greater feeding value than bran. Changes in temperature of the stable, and other things that affect the condition of cows may cause even greater differences in yield of milk and butter fat than those shown in this experiment.

We, however, would have a right to infer that ground oats practically have a feeding value equal to bran, and when selling at about the same price, can be profitably substituted for it.

Their mechanical condition is such that they are equally good to mix with heavier feeds like corn, cotton seed, and gluten meals.

NUTRIOTONE FOR THE PRODUCTION OF MILK.

A feeding trial was undertaken with the above mentioned condiment, not with the expectation of obtaining any marked results, one way or the other, but as an object lesson to farmers who are spending their money for articles of that nature.

Nutriotone was taken in preference to any other compounds, not because it is believed to be any worse or better than any other of a like nature, but for the reason that it is being very extensively advertised and persistently sold by the company's agents, at the present time, not only as a curative agent, but as a stimulant to the production of flesh and milk. This impression seems to be substantiated by many inquiries, which have been made either verbally or by letter, to the station office during the past year. The company's agent in conversation with the writer denied that it was now being sold for any thing more than a tonic to be fed animals out of condition, but an inspection of the advertising matter, particularly the testimonials,

would seem to indicate that a different argument is used to the consumer. We have here at the Station a two pound package which was recently sent in for examination. Upon this package are printed the following directions: "For Horses,—If your horse is in good condition, one large tablespoonful added to the food, twice daily, will keep him so with less grain. If in poor condition, blood out of order, hidebound, off his feed, has heaves, worms, etc., two tablespoonfulls mixed with each feed will soon put the horse in a thriving condition. Cows—Give two large tablespoonfuls with each feed. This will produce a great increase of much richer milk. Bullocks—Use two large tablespoonfuls for each feed and they will fatten in less time, with less expense and produce beef much superior in quality. They will have good appetites and not cloy."

From the foregoing directions it would certainly be impossible for one to get any other impression than that the Thorley Food Company, in its desire to increase the sale of its goods, is recommending them for use at all times whether the animals are in good or poor condition.

This experiment furnishes no evidence as to the value of nutriotone as a medicine. In fact, if the Station had been convinced that it was only being sold as such, the investigation would never have been undertaken. We do not, however, believe in purchasing these compounds as tonics or medicines for two reasons. One can tell nothing as to the quality, quantity, or effect of the ingredients they contain. The cost is, as a rule, about double what the drugs would cost bought alone without the filler.

If an animal is out of condition and really needs a tonic, the following could be given with safety and would probably be more effective than nutriotone. Pulverized gentian, 1 lb.; pulverized ginger, 1-4 lb.; pulverized saltpeter, 1-4 lb.; pulverized iron sulphate, 1-2 lb. Mix, and give one tablespoonful in the feed once a day for ten days. Omit for three days, then give ten days more. This mixture can be obtained for twenty cents a pound and has probably more than four times the value of most condimental foods in our markets, as a tonic for the reason it contains no filler like linseed meal or bran.

Other investigators have given this subject of condimental foods some attention.

Sir John B. Laws at Rothamstead, England, more than 50 years ago made thorough investigations in feeding trials and decided that there was no profit in feeding them. An experiment with nutriotone was reported by the Vermont Station Annual Report, 1894, page 150, in which seven Jersey cows were fed five periods of two weeks each. The hay and grain ration were the same throughout the trials. The prescribed amount of nutriotone was fed in the first, third and fifth periods. In the second period no nutriotone was fed and in the fourth two spoonfuls of linseed meal to each feed were substituted for it. The following table shows the total yield of milk and fat and the average per cent of fat for each period:

		Pounds of milk.	Per cent of fat.	Pounds of fat.
January 24—February 6.	Nutriotone fed	1554	5.47	84.78
February 7—20	No nutriotone fed	1566	5.55	86.83
February 21—March 6	Nutriotone fed	1514	5.42	82.02
March 7—20	Linseed meal fed	1531	5.37	82.22
March 21—April 3	Nutriotone fed	1449	5.45	78.96

For experiments, the results of which are given in the following tables, five good Jersey cows fresh in milk were used. They were known by the numbers 1, 2, 3, 4, 5. They were feed liberal rations of hay and grain in proportion to their size. Cows 1, 4 and 5 received a daily ration of 18 lbs. of timothy hay and 8 1-2 lbs. mixed grain per animal. Cows 2 and 3 received 20 lbs. timothy hay and 10 lbs. of mixed grain per day, for a ration. The grain mixture consisted of: Linseed meal (new process), 5 lbs.; corn meal, 2 lbs.; wheat bran, 3 lbs. The same care was used in making these experiments as in all others. The daily rations and milk produced were carefully weighed. Samples of the milk were taken the last five days of each period and analyzed, the averages of these results were taken as the average for the period in which they were obtained.

MILK YIELD PER WEEK FOR EACH COW FOR EACH PERIOD AND AVERAGE TEMPERATURE OF STABLE.

	Temperature of stable.	Milk Produced by Cows.					
		1.	2.	3.	4.	5.	Total.
October 24—November 14.		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
First week	54°	141.2	200.3	188.8	162.4	142.7	835.4
Second week	53°	131.9	208.8	188.3	158.6	142.3	829.9
Third week	52°	125.7	190.0	177.0	150.2	134.1	777.0
November 15 to December 5.							
First week	46°	130.1	179.6	167.4	151.0	127.7	755.8
Second week	46°	128.6	185.0	166.6	151.5	129.7	761.4
Third week	44°	124.8	179.8	161.6	155.1	125.0	746.3
December 6 to 26.							
First week	48°	124.9	168.5	157.3	150.0	122.5	723.2
Second week	43°	120.9	170.0	151.8	146.2	118.3	707.2
Third week	37°	115.0	164.6	148.1	142.9	119.4	690.0

AVERAGE COMPOSITION OF MILK OF EACH COW WHEN NUTRIOTONE WAS FED AND WHEN IT WAS NOT FED.

Cows.	1.		2.		3.		4.		5.	
	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.	Solids.	Fat.
	%	%	%	%	%	%	%	%	%	%
No nutriotone	13.60	4.58	13.76	4.25	13.70	4.32	13.81	4.00	14.57	5.02
Nutriotone	13.75	4.52	13.77	4.35	13.77	4.39	13.83	4.11	14.62	5.02

YIELD OF MILK AND BUTTER-FAT FOR EACH COW FOR EACH PERIOD.

		Cows.					
		No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	Total
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Period I—21 days—without nutriotone.	Milk	398.8	599.1	554.1	471.2	419.1	2442.3
	Fat	18.7	26.6	23.8	20.1	21.3	111.6
Period II—21 days—with nutriotone.	Milk	383.5	544.4	495.6	457.6	382.4	2263.5
	Fat	17.3	23.7	22.2	18.8	19.2	101.3
Period III—21 days—without nutriotone.	Milk	360.8	503.1	457.2	439.1	360.2	2120.4
	Fat	16.2	20.4	19.8	16.4	17.9	90.7

SUMMARY OF RESULTS WITH AND WITHOUT NUTRIOTONE.

	Milk.	Butter fat.
	Lbs.	Lbs.
Average for twenty-one days without nutriotone	2,281	101
Average for twenty-one days with nutriotone	2,264	101

The gradual shrinkage in these experiments is due to advance in period of lactation. In neither of these cases did nutriotone seem to have any effect, favorable or unfavorable. The slightly smaller milk flow with nutriotone does not mean anything in particular except to add increased emphasis to the falseness of the claim that two large tablespoonfuls fed with each feed "will produce a great increase of much richer milk." Of course the money spent for nutriotone in other cases was a dead loss. While there may be instances in which the purchase of a condimental food is financially profitable, it is significant that no exact experiments, conducted by disinterested parties, have shown a return equal to the cost.

EFFECTS OF TUBERCULIN ON TUBERCULOUS COWS.

F. L. Russell.

Since June 10, 1892, we have been testing cows with tuberculin, and during nearly all this time have had some tuberculous animals under observation. The tests, together with the autopsies held, have impressed upon us the fact that tuberculin is a very delicate agent for determining the presence of tuberculosis. It is very doubtful if cows ever react under a properly made tuberculin test unless they have tuberculosis. On the other hand, however, it is very evident that cows sometimes have tuberculosis or at least tuberculous growths in their bodies, and yet fail to react under the tuberculin test.

Others have observed that animals in an advanced stage of the disease sometimes fail to react, but we have had no experience of this sort. Unfortunately or otherwise, according to the standpoint from which we view the matter we have not treated many animals that were in a really bad physical condition. But during all our experience with tuberculin in testing cows we have been struck with the frequency of the failure of tuberculin to cause reaction in cows that were but slightly diseased. They will react at one time and not at another so that it is impossible to predict with any degree of certainty what the result of injecting tuberculin into a slightly diseased cow will be.

The results of the tests of animals with tuberculin extending over considerable periods of time are summed up as concisely as practicable, in a table at the end of this paper. A few of the most interesting and striking cases are discussed in the text immediately following.

One cow, Agnes, injected in June, 1892, underwent a plain reaction, and in the light of subsequent experience, we are bound to believe she was diseased at that time. The next time she was tested was a year and two days later when she failed to react.

During the next three years she was tested six times at intervals varying from twelve days to seven months and nineteen days, and she did not react until the last time she was tested, April 2, 1895, when she underwent what might be called a typical reaction with a maximum temperature of 106.3.

This case compels us to one of four conclusions: Either the test made in June, 1892, was misleading and the cow was not tuberculous at that time, or she recovered and later, in 1895, contracted the disease again; or she was diseased from June, 1892, to May, 1895, and repeated tests with tuberculin failed to reveal the fact; or the tuberculin injected in June, 1892, rendered her so tolerant of the drug that the tuberculin injected a little more than a year later had no effect. A few days before this cow was tested the last time, her udder was badly bruised—probably by the cow next to her stepping on it. For a time under the usual treatment she seemed to be making a good recovery from the injury and then steadily and rapidly grew worse. The swelling extended to the other quarter of the uddder on the same side, she developed a cough and was rapidly losing strength and flesh when she was killed, May 7, 1896. The autopsy revealed tuberculosis involving nearly all of one side of the udder, quite an area of one lung, the inguinal and mediastinal and many of the mesenteric lymphatic glands. There was no doubt but the disease was making rapid progress.

Another case of some interest is a nineteen months old steer (No. 4) that had been tested three times with intervals of seven and one-half and four and one-half months. The last test was made twenty-six days before the autopsy and although the highest temperature observed at any test was 103, the autopsy revealed tuberculosis involving one mediastinal gland and a small area in the right lung. In both localities the tubercular tissue had undergone cheesy degeneration to such an extent as to leave no room for the idea that the disease was contracted after the last test was made only twenty-six days before.

Cows Nos. 5 and 6, were small, grade cows, related to each other and almost identical in appearance. They were always tested the same day and the results were similar to a remarkable degree. When first tested, August 17, 1894, neither reacted. Tested again January 8, 1895, both reacted, and both

reacted again January 25, 1895. They were tested February 6, February 22, March 11, April 20, June 8 and August 1, and did not react at any of these times. They were killed August 22, 1895. The lungs of No. 5 and the lungs and a mediastinal gland of No. 6 contained small cheesy abscesses.

Dunkard Girl was tested first November 21, 1893, before she was a year old. Up to August, 1895, she had been tested six times without reacting. August 13, 1895, she reacted with a temperature of 107.4. August 29, 1895, she was tested again and reacted with exactly the same maximum temperature, 107.4. During September, 1895, she was tested twice and did not react. October 8, 14 days after the last test in September, she reacted with a maximum temperature of 105. She was tested October 19 and October 31, and failed to react. Tested November 20, she reacted with a temperature of 104.8. December 7 she did not react. January 3, 1896, she reacted with a temperature of 106.2. From January 3, 1896, to January 13, 1897, when she was tested the last time, she was given eight tests. The longest intervals being one and one-half month, and four and one-half months, but she failed to react after January 3, 1896. January 15, 1897, she was killed and tubercular lesions of the right lung and of two mediastinal glands were found.

August 13, 1895, a two-months-old heifer Kate, was tested and failed to react. February 14, 1896, she was tested again and did react. From that time to November 3, 1896, she was tested eight times at various intervals, and at each time failed to react, and she has not been tested since.

In considering these cases and others, the records of which are given in the accompanying tables, we notice that, although the animals were all undobtedly tuberculous, out of the 116 tests made, there were 33 reactions and 83 failures. Steer No. 4 did not react at all, but we count the last time he was tested among the failures to react, as the autopsy held twenty-six days later proved that he must have been diseased at the time that test was made.

Why is it that these animals were sometimes affected by tuberculin and at other times not affected?

The amount of tuberculin used in making the injections has been uniform for the same stage of maturity, yet the results

have differed widely. In these cases, where the animals were so slightly diseased that their condition could not be detected by a physical examination, the results have differed so widely that we are forced to the conclusion that we can never tell whether a slightly diseased animal will react to the tuberculin test or not. A reaction may be obtained to-day and again next month, or as in the case of the cow Agnes, reaction may fail for nearly three years and then there be a very decided reaction.

We do not believe that tuberculin is poisonous for cows one day and not another, but our experience might lend some color to such a conclusion. That there is some law underlying the whole matter we believe must be true, but we have not yet seen any satisfactory statement of what the law is.

The theory has been quite generally advanced that aside from a possible curative action, one dose of tuberculin influences the action of the next dose even though it is injected after a considerable interval, the length of time being variously estimated. In view of the facts that animals do not usually acquire a tolerance, either temporary or permanent, for vegetable poisons as the result of one moderate dose; that some tuberculous animals react repeatedly to tuberculin and others do not; and that the intervals between reactions even in our limited experience varies from two days to more than a year, we see no grounds for supporting the theory that the failure of tuberculous animals to react to tuberculin is due to an acquired tolerance of tuberculin.

It is not a wild assumption that the growth of tubercle bacilli in diseased cows keeps their systems charged with tuberculin nearly up to and sometimes a little beyond the point where it manifests its poisonous effects in elevation of temperature. Such animals, charged to the danger point with tuberculin, readily react to a slight addition. The cow that has been taken at a disadvantage and has contracted tuberculosis and then so far recovers as to hold the disease in check, may be compared to the well cow so far as the action of tuberculin is concerned, since her system is free, or comparatively free, from tuberculin and no reaction follows the giving of the usual test dose.

Our experience has suggested to us the possibility that the failure of tuberculin to cause reaction in tuberculous cows at

times may be due to the fact that the disease is not making steady progress.

In the following table there are given the condensed results of the more important cases studied by the Station. As stated in another part of this report* the Station has a herd of ten cows, which have reacted at least once, under investigation. The results here presented are given as a contribution to knowledge upon this important question and are not presented to prove or disprove any particular theory.

See page 14 this Report.

TABLE GIVING THE RESULTS OF TESTS WITH TUBERCULIN MADE AT THE STATION DURING THE YEARS 1892 TO 1896.

Date of Test.	Number of days since the last test was made.	Temperature at the time the tuberculin was injected.	Maximum temperature on the day after the injection.	Rise or decline (—) of temperature.	Remarks.
		Deg.	Deg.	Deg.	
Topaz.					
February 14, 1896.....	First test..	102.1	**105.3**	**3.2**	**Reaction.**
March 8, 1896	23	101.8	102.2	.4	No reaction.
March 13, 1896	5	102.2	102.8	.6	No reaction.
March 21, 1896	8	102.3	101.8	—.5	No reaction.
May 1, 1896	41	102.	101.9	—.1	No reaction.
July 2, 1896....	62	102.6	101.9	—.7	No reaction.
August 18, 1896	47	102.4	102.	—.4	No reaction.
September 15, 1896....	28	102.2	Temper	ature no	t taken.
November 3, 1896.....	49	101.8	101.8	... .	No reaction.
December 9, 1896 . ..	36	101.8	102.2	.4	No reaction.
January 13, 1897	35	102.	**105.2**	**3.2**	**Reaction.**
January 27, 1897	14	101.6	102.9	1.3	No reaction.
February 17, 1897	21	100.9	101.6	.7	No reaction.
Merrill.					
May 24, 1893.....	First test..	101.9	**105.5**	**3.6**	**Reaction.**
November 14, 1893...	175	99.4	102.2	2.8	No reaction.
December 1, 1893. ...	17	100.7	100.4	.3	No reaction.

RESULTS OF TESTS WITH TUBERCULIN—CONTINUED.

Date of Test.	Number of days since the last test was made.	Temperature at the time the tuberculin was injected.	Maximum temperature on the day after the injection.	Rise or decline (—) of temperature.	Remarks.
		Deg.	Deg.	Deg.	
Agnes.					
June 21, 1892	First test..	101.	**104.4**	**3.4**	**Reaction.**
June 23, 1893	367	101.4	102.2	.8	No reaction.
December 25, 1893	188	101.	101.4	.4	No reaction.
August 16, 1894	231	101.8	102.	.2	No reaction.
January 8, 1895	145	100.9	102.	1.1	No reaction.
February 6, 1895	29	100.9	101.3	.4	No reaction.
April 20, 1895	73	101.3	**106.3**	**5.0**	**Reaction.**
Steer 4.					
December 27, 1893	First test..	102.4	103.	.6	No reaction.
August 17, 1894	233	103.	102.1	—.9	No reaction.
January 8, 1885	144	101.4	102.8	1.4	No reaction.
Cow 5.					
August 17, 1894	First test..	100.9	102.	1.1	No reaction.
January 8, 1895	144	100.7	**105.2**	**4.5**	**Reaction.**
January 25, 1895	17	101.1	**105.4**	**4.3**	**Reaction.**
February 6, 1895	12	100.6	101.8	1.2	No reaction.
February 22, 1895	16	101.8	102.	.2	No reaction.
March 12, 1895	18	100.6	102.	1.4	No reaction.
April 20, 1895	39	101.	102.4	1.4	No reaction.
June 8, 1895	49	101.4	101.	—.4	No reaction.
August 1, 1895	54	101.7	102.	.3	No reaction.
Cow 6.					
August 17, 1894	First test..	101.8	102.5	.....	No reaction.
January 8, 1895	144	100.8	**104.4**	**3.6**	**Reaction.**
January 25, 1895	17	101.3	**104.**	**2.7**	**Reaction.**
February 6, 1895	12	101.9	102.2	.3	No reaction.
February 22, 1895	16	101.6	101.6	.0	No reaction.
March 12, 1895	18	100.8	102.4	1.6	No reaction.
April 20, 1895	39	101.3	101.2	—.1	No reaction.
June 8, 1895	49	101.3	102.	.7	No reaction.
August 1, 1895	54	101.7	102.	.3	No reaction.
Dunkard Girl.					
August 13, 1895	116	101.	**107.4**	**6.4**	**Reaction.**
August 29, 1895	16	101.6	**107.4**	**5.8**	**Reaction.**
September 4, 1895	6	101.4	102.5	1.1	No reaction.
September 14, 1895	10	102.6	101.4	—1.2	No reaction.
October 8, 1895	424	102.7	**105.**	**2.3**	**Reaction.**
October 19, 1895	10	101.6	Temperature not taken.		
October 31, 1895	12	101.7	102.4	.7	No reaction.
November 20, 1895	20	101.8	**104.8**	**3.**	**Reaction.**
December 7, 1895	17	101.	101.9	.9	No reaction.
January 3, 1896	27	102.	**106.2**	**4.2**	**Reaction.**
January 10, 1896	7	101.6	101.2	—.4	No reaction.
January 24, 1896	14	101.3	101.2	—.1	No reaction.
February 19, 1896	26	101.5	100.9	—.6	No reaction.
July 2, 1896	134	102.	103.	1.	No reaction.
August 18, 1896	47	101.7	101.6	—.1	No reaction.
September 16, 1896	29	101.7	Temperature not taken.		
November 3, 1896	49	103.	101.4	—1.6	No reaction.
January 13, 1897	72	101.5	102.4	.9	No reaction.

RESULTS OF TESTS WITH TUBERCULIN—CONTINUED.

DATE OF TEST.	Number of days since the last test was made.	Temperature at the time the tuberculin was injected.	Maximum temperature on the day after the injection.	Rise or decline (—) of temperature.	Remarks.
		Deg.	Deg.	Deg.	
Kate.					
February 14, 1896....	185	100.3	**105.3**	**5.**	**Reaction.**
March 8, 1896	23	101.4	102.8	1.4	No reaction.
March 13, 1896.... ...	5	100.4	102.6	2.2	No reaction.
March 21, 1896	8	101.6	102.	.4	No reaction.
May 1, 1896.....	41	101.1	101.8	.7	No reaction.
July 2, 1896...	62	102.8	102.5	—.3	No reaction.
August 18, 1896	47	101.7	102.3	.6	No reaction.
September 15, 1896 ...	28	101.3	Temperature not taken.		
November 3, 1896.....	49	103.	103.	.....	No reaction.
Mina D.					
April 30, 1896	72	101.2	**105.9**	**4.7**	**Reaction.**
July 2, 1896	63	101.7	**105.8**	**4.1**	**Reaction.**
July 7, 1896	5	101.3	102.7	1.4	No reaction.
August 18, 1896	42	101.8	**104.8**	**3.**	**Reaction.**
August 20, 1896	2	102.7	102.7	.....	No reaction.
August 29, 1896	9	102.3	102.7	.4	No reaction.
September 15, 1896 ...	17	101.8	Temperature not taken.		
November 3, 1896.....	49	101.1	102.3	1.2	No reaction.
Ruth C.					
February 14, 1896.....	100	101.2	**106.**	**4.8**	**Reaction.**
March 8, 1896	23	100.8	**103.6**	**2.8**	**Reaction.**
March 13, 1896	5	101.7	100.8	—.9	No reaction.
March 21, 1896	8	101.6	101.7	.1	No reaction.
April 30, 1896	40	103.	101.6	—1.4	No reaction.
July 2, 1896.....	63	102.2	**105.2**	**2.9**	**Reaction.**
July 7, 1896..... ...	5	101.5	101.3	—.2	No reaction.
August 18, 1896	42	102.7	**104.3**	**1.6**	**Reaction.**
August 20, 1896	2	103.4	101.8	—1.6	No reaction.
August 29, 1896	9	103.	102.2	—.8	No reaction.
September 15, 1896 ...	17	102.	Temperature not taken.		
November 3, 1896.....	49	102.1	102.5	.4	No reaction.
December 9, 1896.....	36	101.3	101.2	—.1	No reaction.
January 13, 1897	35	101.6	102.	.4	No reaction.
January 27, 1897.....	14	100.6	103.	2.4	No reaction.
February 17, 1897.....	21	100.8	101.3	.5	No reaction.
Agnes 2.					
February 14, 1896.....	100	101.8	**106.**	**4.2**	**Reaction.**
March 8, 1896.....	23	102.6	**104.**	**1.4**	**Reaction.**
March 13, 1896	5	101.	**103.2**	**2.2**	**Doubtful.**
March 21, 1896	8	101.4	Temperature not taken.		
April 30, 1896	40	101.2	100.	—1.2	No reaction.
July 2, 1896.....	63	102.7	**103.7**	**1.**	**Doubtful**
August 18, 1896.....	46	102.1	102.3	.2	No reaction.
September 15, 1896 ...	28	101.8	Temperature not taken.		
November 3, 1896.....	49	102.2	102.2	.....	No reaction.
Hallie.					
February 14, 1896.....	100	101.7	**106.6**	**4.9**	**Reaction.**
March 8, 1896.....	13	102.	**105.6**	**3.6**	**Reaction**
March 13, 1896	5	102.2	**103.5**	**1.3**	**Doubtful.**
March 21, 1896	8	100.2	102.2	2.	No reaction.
April 30, 1896	40	103.1	**104.3**	**1.2**	**Doubtful.**
July 2, 1896.....	63	101.8	**103.4**	**1.6**	**Doubtful**
July 7, 1896..... .	5	101.3	101.7	.4	No reaction.
August 18, 1896	42	102.	**105.2**	**3.2**	**Reaction.**
August 20, 1896	2	101.8	**105.1**	**3.3**	**Reaction.**

RESULTS OF TESTS WITH TUBERCULIN—CONCLUDED.

DATE OF TEST.	Number of days since the last test was made.	Temperature at the time the tuberculin was injected.	Maximum temperature on the day after the injection.	Rise or decline (—) of temperature.	Remarks.
		Deg.	Deg.	Deg.	
August 29, 1896	9	101.2	102.	.8	No reaction.
September 15, 1896	17	101.7	Temperature not taken.		
November 2, 1896	48	101.7	101.6	.1	No reaction.
February 17, 1897	97	101.6	**105.3**	**3.7**	**Reaction**
Grace 2.					
February 14, 1896	100	99.6	**106.5**	**6.9**	**Reaction.**
March 8, 1896	23	102.	**105.5**	**3.5**	**Reaction.**
March 13, 1896	5	102.	102.8	.8	No reaction.
April 30, 1896	48	100.	100.2	.2	No reaction.
July 2, 1896	63	102.3	**104.7**	**2.4**	**Reaction.**
July 7, 1896	5	101.7	101.8	.1	No reaction.
August 18, 1896	42	102.	102.	.....	No reaction.
September 15, 1896	28	101.4	Temperature not taken.		
November 3, 1896	49	101.5	102.2	.7	No reaction.
December 9, 1896	37	101.4	102.5	1.1	No reaction.
January 13, 1897	35	102.1	102.	.1	No reaction.
January 27, 1897	14	100.8	102.4	1.6	No reaction.
February 17, 1897	21	101.5	**104.1**	**2.1**	**Reaction.**
Melinda 2.					
February 14, 1896	100	101.5	**106.**	**4.5**	**Reaction.**
March 8, 1896	23	101.2	**104.**	**2.8**	**Reaction.**
March 13, 1896	5	99.8	100.9	1.1	No reaction.
March 21, 1896	8	101.7	101.4	—.3	No reaction.
May 1, 1896	41	100.3	101.4	1.4	No reaction.
July 2, 1896	62	102.	102.7	.7	No reaction.
August 18, 1896	47	101.9	102.	.1	No reaction.
September 15, 1896	28	101.3	Temperature not taken.		
November 3, 1896	49	102.	102.1	.1	No reaction.
December 9, 1896	36	99.	101.4	2.4	No reaction.
January 13, 1897	35	102.	102.8	.8	No reaction.
January 27, 1897	14	100.5	102.5	2.	No reaction.
February 17, 1897	21	102.4	102.2	.2	No reaction.
Trilby.					
February 14, 1896	First test..	102.	**106.3**	**4.3**	**Reaction.**
March 8, 1896	23	101.	**105.3**	**4.3**	**Reaction.**
March 13, 1896	5	101.7	103.2	1.5	No reaction.
March 21, 1896	8	101.8	102.1	.3	No reaction.
May 1, 1896	41	102.1	101.6	—.5	No reaction.
July 2, 1896	62	102.7	**105.5**	**2.8**	**Reaction.**
July 7, 1896	5	102.	101.7	—.3	No reaction.
August 18, 1896	42	102.5	103.2	.7	No reaction.
September 15, 1896	28	101.9	Temperature not taken.		
November 3, 1896	49	102.	102.	.....	No reaction.
December 9, 1896	36	102.	102.2	.2	No reaction.
January 13, 1897	35	101.8	102.	.2	No reaction.
January 27, 1897	14	100.8	102.7	1.9	No reaction.
February 17, 1897	21	100 4	102.	1.6	No reaction.

ORCHARD NOTES.

W. M. Munson.

THE STATION ORCHARDS.

In reponse to oft repeated requests for information as to the exact condition of the orchard at the Experiment Station, a somewhat detailed statement is herewith given. In justice to ourselves, however, it should be said that we are not ready to draw conclusions, and this statement is but preparatory to a fuller discussion in a future report.

I. THE PLUM ORCHARD.

The nucleus of the plum orchard was started in the spring of 1889, when several varieties were procured and set in nursery rows. Several more were added in 1890. The effects of the severe winter of 1890 and 1891 were detailed in the annual report of the Experiment Station for 1891.

In 1892 the trees were removed from nursery rows to their present location and several others were added. Some of these have done well; others, as was expected, have failed.

The orchard is situated on heavy clay loam with stiff clay subsoil. The surface drainage is good, but as the land has not been tilled for some years, it was not in good condition for the orchard.

The following notes represent the condition of the orchard at the close of the season in 1896. The numbers refer to the Station records.

American Eagle, 56—Set in 1893. Moderately vigorous. Wood not matured. Kills back somewhat every year.

Arch Duke, 65—Young tree set in 1895. Failed to start. This place was originally occupied by Wild Goose.

Bunker Hill, 29 and 30—29, moderately vigorous, upright. A black knot found on the side of the tree. 30, vigorous, upright, healthy. A good tree.

Cheney, 79 and 80—79, young tree set in 1895. Vigorous. Wood not quite mature. 80, set in 1892. Very vigorous, upright. Wood not fully matured. Top broken off below the branches in the fall of 1893. Now making a good growth.

Coe's Golden, 8, 9 and 10—Moderately vigorous. Fruit spurs well developed. Small amount of fruit on No. 9 in 1893.

Czar, 50—Set in 1895. Has made very slow growth.

Damson, 20—Moderately vigorous, upright. Full crop of fruit in 1896.

DeCaraduc, 69—Set in 1892. The original tree was killed to the ground. Present top is a sprout from the base. The variety is not hardy.

Deep Creek, 45—Set in 1893. Small tree making a weak growth.

De Soto, 55—Set in 1893. Very vigorous, hardy. Wood well matured.

Duane Purple, 17 and 18—17, very vigorous, upright, strong, hardy, healthy. 18, same remarks apply as to 17. Centre of the tree was removed in 1895, but wound is healing well.

Early Red, 95 and 96—A Russian variety. Both are vigorous, upright, hardy. 96, bore a full crop of fruit in 1896. Growth checked.

Field, 35—Moderately vigorous. In good condition. Wood not quite matured. Blossomed, but bore no fruit, in 1896.

French Damson, 33—Set in 1893. Moderately vigorous. Young wood not fully matured.

Forest Garden, 41 and 42—41 set in 1895, replacing the original one of the same variety. Vigorous, hardy, healthy. 42, set in 1893. Very vigorous, hardy. Bore a few fruits in 1896.

German Prune, 2—Hardy, vigorous. In good condition.

Gueii, 23—Young tree set in 1894. Very vigorous. In good condition.

Hawkeye, 59—Set in 1893. Hardy, vigorous, strong. Wood well matured. Very few fruits in 1896.

Hudson River Purple Egg, 31—Very vigorous, upright, hardy. In good condition.

Hungarian Prune, 72—Set in 1892. Moderately vigorous, upright, hardy.

Imperial Gage, 22—Very vigorous, upright. In good condition.

Italian Prune, 3 and 13—Hardy, moderately vigorous. In good condition. Few fruit spurs.

Jefferson, 14—Injured and part of the tree removed in 1894. Tree now moderately vigorous and healthy. Fruit spurs well developed.

Lincoln, 38—Set in 1893. A small, misshapen tree, but now growing well.

Lombard, 1—Vigorous, healthy; one side broken by careless workmen.

Lone Star, 57—Set in 1893 and again in 1895. Killed both times.

Marianna, 51 and 52—Set in 1892. Very vigorous, hardy, spreading. Bore small amount of fruit in 1896.

McLaughlin, 15, 24, 25, and 26—15, badly checked in 1893. Now making a strong, vigorous growth. 24, small, weak tree. Will be replaced. 25, badly checked when removed from the nursery, but now making a vigorous growth. 26, moderately vigorous, spreading. In good condition. One black knot was found on this tree.

Newman, 65—Very vigorous, but tender. Kills back every winter. Worthless for this location.

No. 19 Orel, 81 and 82—A Russian variety of moderately vigorous, upright growth. Perfectly hardy. One black knot found. 82, injured in the trunk, and will probably not be long lived.

No. 20 Orel, 83 and 84—83, the original tree died. Sprouts from the roots of questionable value. 84, vigorous, upright, hardy. No fruit as yet, but promises well for 1897.

Osage, 48—Killed back every year. Died in July, 1896.

Peter's Yellow Gage, 21—Moderately vigorous, upright. In good condition. Tops of shoots not quite matured in the autumn.

Pond's Seedling, 27—Very vigorous, upright grower. In good condition.

Pottawatomie, 44—Set in 1893. Killed back first winter. New top formed from the side shoots. Making a vigorous growth, but wood fails to mature. Not hardy.

Prince Englebert, 28—Vigorous, upright. In good condition.

Prince of Wales, 34—Set in 1893. Vigorous, upright. Young wood immature. One black knot found.

Purple Yosemite, 49—Young tree set in 1895. Very vigorous. Wood well matured. The original tree set in 1893, never started.

Quackenbos, 6—Strong, vigorous grower. In good condition.

Reine Claude, 7—A fine tree. Moderately vigorous. In good condition.

Robinson, 54—Set in 1893. Killed back every year. Wood not matured.

Rockford, 43—Set in 1895. Small tree making a good growth, but wood not quite mature.

Rolling Stone, 75 and 76—75, moderately vigorous, spreading, hardy. 76, making a very vigorous growth. In fine condition.

Saratoga, 40—Set in 1895. Moderately vigorous, healthy. Wood well matured.

Smith's Orleans, 16—Strong, vigorous, hardy. A fine tree. No fruit as yet.

Spaulding, 39—Set in 1895. Healthy. Making a moderately vigorous growth.

Van Buren, 32 and 60—60, very vigorous. Wood well matured. Blossomed, but matured no fruit in 1896. 32, young tree set in 1895.

Victoria, 67 and 68—67, set in 1892. Very vigorous, upright. Wood not well matured. Badly injured in the winter of 1893-4. Present top is from a sprout which started about six inches from the base. 68, vigorous, but not well matured. Growth four feet.

Voronesch Yellow, 93 and 94—A Russian variety, upright, vigorous, hardy. Slow in starting, but now making a vigorous growth. Has not fruited.

Washington, 12—Badly checked when removed from the nursery. Now in good condition. Very vigorous.

Weaver, 53—Set in 1894. Very vigorous, spreading, hardy. The original tree set in 1892 made a very vigorous growth and failing to mature the first year was killed by the hard winter.

Wild Goose, 64—Vigorous grower, but killed back every year. Dead in 1896.

White Nicholas, 97 and 98—97, very vigorous, upright, hardy. A good tree. Black knot found on one side of trunk. 98, bore a full crop of fruit in 1896. The fruit very closely resembles that of Early Red. It is possible that the two varieties were mixed in the nursery.

Wolf, 47, 73 and 74—Set in 1893. Very vigorous, hardy. Has borne no fruit.

Wyant, 77 and 78—77, hardy, vigorous. Fruit buds well developed. Bore small amount of fruit in 1896. Very late. 78, smaller tree than No. 77 because of injury when young.

Yellow Egg, 4 and 5—4, badly checked when removed. Now growing vigorously. Bore a few fruits in 1896. 5, tree injured, one-half dead, the other growing vigorously.

Yellow Transparent, 58—Set in 1893 and again in 1895. Killed both times.

The foregoing notes represent the condition of the plum orchard. The conditions were unfavorable at the time of starting the orchard and there have been many failures. From these failures some valuable lessons have been learned. Most of the standard varieties have proved hardy and are at present in a good thriving condition although few of them have yet fruited.

The Russian sorts have proved hardy and productive, but the quality of those which have fruited is inferior.

Of the varieties which have been found to be too tender for our winter climate we may note: American Eagle, DeCaraduc, Lone Star, Newman, Osage, Pottawatomie, Robinson, Victoria, Wild Goose and Yellow Transparent.

Of the standard varieties which are especially promising at the present time the following may be mentioned: Duane Purple, German Prune, Hudson River Purple Egg, Imperial Gage, Lombard, McLaughlin, Pond's Seedling, Smith's Orleans and Washington.

When the orchard comes into full bearing, the several varieties will be described more in detail.

II. THE APPLE ORCHARD.—STANDARD VARIETIES.

The nucleus of the orchard consisted of a number of trees set in nursery rows in 1890, before the work came under the direction of the writer. These trees were removed to a permanent location in the spring of 1891 and several varieties were added to the list. The soil on which this main orchard was set is variable, part being a heavy clay loam and part a light sand. Thorough cultivation has been given from the first, the land having been used as a vegetable garden.

The following table represents the present condition of the orchard:

PRESENT CONDITION OF STANDARD VARIETIES OF APPLES.

Name.	Habit.	Present Condition.	Growth in 1896.	Age at first fruiting.
			In.	Ys.
Akin		Young tree, set in 1894.		
Alexander	Upright, vigorous, spreading	Vigorous	15	5
Arctic	Very vigorous, spreading	Strong, healthy	20	6
Astrachan	Upright, vigorous	Strong, healthy	12	5
Chenango	Upright, vigorous	Strong, healthy	12	6
Fallawater	Vigorous, spreading, sturdy	Strong, healthy	12	
Fameuse	Vigorous, spreading, sturdy	Strong, healthy	18	5
Haas	Vigorous, spreading, sturdy	Strong, healthy	15	5
Hurlbut	Moderately vigorous, upright	Strong, healthy	20	5
King of Tompkins	Very vigorous	Strong, healthy	15	
Mann	Moderately vigorous, upright	Weak	12	
Milding	Vigorous, upright, sturdy	Strong, healthy	16	
Northern Spy	Vigorous, spreading	Young tree, set in 1894.	6	
Nor'west'n Greening		Young, set in 1895	15	
Oldenburg	Upright, sturdy	Strong, full bearing	15	4
Peck's Pleasant	Low, spreading	Weak	10	
Pewaukee	Very vigorous, spreading	Healthy	18	5
Porter	Moderately vigorous, low, spreading	Healthy	16	
Princess Louise	Vigorous, upright	Healthy	18	5
Red Beitlgheimer	Upright	Weak	6	5
Rolfe	Moderately vigorous, upright sturdy	Strong	10	
Shiawassee Beauty	Very vigorous, spreading	Strong	15	6
Stark	Vigorous, upright, spreading	Strong	12	
Thompson No. 24	Vigorous, upright, spreading	Strong	18	
Thompson No. 26	Vigorous, upright, spreading	Strong	24	
Thompson No. 29	Vigorous, upright, sturdy	Strong	12	
Thompson No. 43	Vigorous, willowy	Strong	12	
Wagener	Moderately vigorous	Strong	10	
Walbridge	Upright, vigorous, spreading	Strong	12	
Wealthy	Upright, vigorous, spreading	Strong	15	4
Westfield	Moderately vigorous	Strong	12	
Winesap	Vigorous, spreading	Strong	15	5
Wolf River	Vigorous, spreading	Strong	18	
Yellow Transparent	Vigorous, spreading	Blighted	6	

The number of trees in the orchard at present is 130, about 30 having been removed on account of a new building. Of this number ten varieties are crabs, and the remainder, 34 varieties, consists mainly of standard varieties of recognized merit. The object in view in starting the orchard in this way was to have a number of the standard sorts for comparison. Many of these will be top-worked with other varieties.

With few exceptions the trees have thrived and proved hardy, although neither soil nor location are well suited to orcharding. Several sorts bore some fruit last season, and the present year many others came into bearing. Most of the varieties in this orchard are well known and require no special mention. Some of those not commonly grown may, however, be noticed in this connection.

Arctic—Tree very vigorous, upright, spreading. Fruit medium, roundish conical; greenish yellow, heavily overlaid with crimson on the sunny side, with splashes of a deeper shade and numerous light dots. Flesh yellowish, crisp, juicy, brisk sub-acid. Good. Bears a strong resemblance to Baldwin and will replace that sort in trying climates. The following notes from Mr. W. A. Taylor of the United States Department of Agriculture are of interest in this connection: "So far as we have been able to ascertain the original tree of Arctic apple was found growing on the farm of John H. Esseltyne, Cape Vincent. New York. Mr. Esseltyne sold the tree some years ago to O. K. Gerrish then of Geneva, N. Y., but now of Lakeville, Mass. After securing a crop of wood for propagation Mr. Gerrish destroyed the original tree to prevent theft of scions. It was therefore impossible to secure specimens of the fruit for examination after the variety was introduced by Mr. Gerrish until the trees sold by him came into bearing. In 1896 the variety bore in New York, Massachusetts, Vermont and Maine, as we received specimens from those states. We consider it a promising variety for market orchards in the north as it is apparently more resistant to the cold than Tompkins King or Baldwin."

Haas—A popular market variety from Missouri. Tree hardy, very vigorous, upright, productive; an early annual bearer. Fruit medium, oblate or slightly conical; skin smooth greenish

yellow, shaded nearly over the whole surface with dark red. Flesh white, tender, juicy, brisk sub-acid. September, October.

Haynes' Sweet—A very vigorous, hardy sort, originating in Waldo county, Maine. Fruit large, oblong, yellow, washed and splashed with scarlet. Stem short, stout, in a broad, shallow, slightly russet cavity. Calyx open; basin shallow, slightly irrregular; core very large. Flesh rather coarse, yellowish, sweet. Good. September to January. This variety is perfectly hardy and vigorous as far north as Caribou. Its color is not bright enough to make it a valuable market sort.

Milding—A strong, hardy variety, originating in New Hampshire. Highly esteemed in Piscataquis county and wherever known. Fruit large, oblate, whitish-yellow, shaded, splashed and mottled with red; flesh light yellow, rather coarse but crisp, tender, juicy, sprightly sub-acid. December, January.

Munson Sweet—A vigorous productive variety of uncertain origin. Fruit medium, oblate, pale yellow often with a blush. Flesh yellowish, juicy, sweet. Highly esteemed wherever known. September to February.

Pewaukee—A seedling of Oldenburg, originating in Wisconsin. Tree hardy, vigorous, upright, spreading, an annual bearer and very productive. Fruit medium to large, roundish. Skin yellow splashed and mottled with red. Flesh white, juicy, brisk acid. Good for cooking. November to February.

Prolific Sweeting—One of the varieties imported from Russia by the Department of Agriculture in 1870. It is a beautiful yellow fruit of medium size. Somewhat resembles Yellow Transparent in form and color. Of this variety Dr. Hoskins writes: "It is the best fall sweet apple I am acquainted with, and I could sell almost unlimited quantities of trees and fruit if I had them. I am now propagating it on a large scale for my own planting." Season September to October.

Rolfe—A valuable early winter variety, originating at Guilford, Me. Tree hardy, vigorous, a good annual bearer. In protected places will thrive as far north as Caribou. Fruit medium to large, oblate, yellowish, shaded and splashed with red. Flesh white, fine grained, tender, sub-acid. December, January.

Shiawassee Beauty—Seedling of Fameuse, originating in Shiawassee county, Michigan. Larger and more oblate than Fameuse, otherwise resembling that variety. Flesh firm, white, tender, brisk sub-acid. October to January.

III. THE APPLE ORCHARD—RUSSIAN VARIETIES.

As stated in a former Report, one feature of our orchard work is the introduction of hardy fruits.

In the spring of 1890 about 75 varieties of Russian apples were procured from the Iowa Agricultural College. Other varieties of apples have been obtained from time to time and many Russian and native plums and other hardy fruits have been added. Some of these trees have been grown at the College, others were sent to different points in Aroostook county and still others to Rangeley. A few of them have fruited and may receive attention at the present time; a general discussion of the subject being deferred till our next Annual Report.

The following field notes represent the condition of the Russian orchard at the Station in September, 1896. This orchard was started in the spring of 1890, with one year old trees obtained from the Iowa Agricultural College.

The soil in which the orchard is located is rather heavy loam with clay sub-soil. It has a southwestern exposure. Garden crops have been grown on the land from the first and thorough cultivation has been given.

Without reference to the character of given varieties the trees are here arranged in alphabetic order. The numbers enclosed in parentheses refer to the original importation list; the other numbers, to the orchard record.

Alexander, 7—Old tree. A well known sort needing no description at this time. Belongs to the Aport family.

Aport (252), 39—Similar to Alexander in tree and fruit. Growth one and one-half feet. First fruited in 1895. Moderately productive. The term Aport is a generic rather than a specific one and covers a family of apples of which the Alexander is perhaps, the best known member.

Aport Ourent, 21—Upright, vigorous, spreading, with dark heavy foliage. Growth one and one-half feet. No fruit.

Arabskoe, 65 and 66—65 moderately vigorous, spreading; very productive, precocious. About one-half bushel was removed in August and the yield at harvest time was one bushel. Growth one foot. The fruit is large, heavy and covered with a rich bloom, somewhat resembling Blue Pearmain. Keeps well into the winter but is of very poor quality. 66, young tree set in 1896. Has made but a slight growth. Matures late. Growth two feet.

Arabka (*257*), 44—Moderately vigorous, upright, spreading. Dark in wood and foliage. Growth one and one-half feet. Fairly productive. Has a tendency to bear the fruit on the ends of long twigs like the Alexander. Same as Arabskoe.

Blushed Calville, 31—Of vigorous, upright habit, resembling Yellow Transparent. Growth one and one-half feet. It so closely resembles Yellow Transparent that its identity is questioned.

Borsdorf (*356-402*), 46—Vigorous, spreading, profusely branched. Branches small and slender. Light colored in wood and foliage. Growth two feet. A few specimen fruits produced in 1896. These are small, oblate, greenish yellow. Mature in late winter.

Cross Apple (*15 M*), 28—Very vigorous, upright, spreading. Branches freely. Limbs long and slender. Growth this year two and one-half feet. Moderately productive. Fruit resembles Haas. This variety does not correspond with the description of Cross Apple as given by various authorities and it is possible that it has been misnamed.

Daisy, 60—Two-year-old tree set in the spring of 1896, making a strong growth.

Early Sweet (*No. 9 Voronesch*), 8 and 52—Vigorous, upright, spreading. Large, heavy foliage. Growth one and one-half feet. No fruit.

Excelsior—One of Gideon's Seedlings. Vigorous, spreading, productive. Like the preceding and like the next one, shows the crab parentage. Wood fully matured. Growth one and one-half feet. Full crop of fruit. Fruit medium, conical, greenish-yellow washed with crimson, slightly russeted. Sharp acid. September to November.

Golden Reinette, 20—Vigorous, upright, spreading, productive, (one and one-half bushels fruit). Branches freely with tendency to form crotches. Fruit small, golden, washed and splashed with carmine. Flesh yellowish, crisp, mildly acid. A promising autumn variety. September to December. (This fruit does not correspond to Budd's description of Golden Reinette and is probably wrongly named.)

Grandmother (*469*), 50—Vigorous, upright, hardy. Growth two feet. But one fruit produced in 1896. Resembles Duchess. Season winter.

Green Crimean (*399*), 48—Vigorous, spreading and productive. Branches freely. Growth one foot. First fruited in 1896. Fruit large, smooth, conical; green, changing to yellow at maturity. A good autumn variety.

Green Sweet, 37—Wrongly named. A small sour winter fruit of no value.

Hibernal (*378*), 47—Of low spreading habit, moderately vigorous. Productive. Growth one foot. First fruited in 1894, (one-half bushel in 1896). Drops badly at maturity. Good for cooking. Season October and November.

Koursk Anis, 13—Set in 1895. Hardy. Moderately vigorous. Growth one foot.

Koursk Reinette, 30—Vigorous, sturdy in habit with few stout branches. Large dark foliage. Growth one and one-half feet. Productive. A promising variety. This variety we have as 20 M. The latter is by Mr. Budd, called "Sweet Longfield."

Large Anis (*413 Dept.*), 54—Moderately vigorous, spreading branches. First fruited in 1896 (one-fourth bushel). Growth one and one-half feet. Fruit resembles Rhode Island Greening.

Lead Apple (*3 M, 277*), 23 and 41—23, vigorous, spreading; branches leave the trunk nearly at right angles, so few crotches are formed. Growth one and one-half feet. Productive (one and one-half bushels in 1896). The variety which we have under the above name is apparently of the Aport family and is not the true Lead Apple as described by Budd. 41, (*277*), very vigorous, upright, compact, few branches, has a tendency to form crotches. Growth one and one-half feet. No fruit. It is possible that when this comes into bearing we shall find that we have the true Lead Apple, although in Bulletin No. 31, Iowa Agricultural

College, Professor Budd refers to No. 277 as *Swinsovka*, a member of the Lead Apple family but not identical with 3M, the true Lead. Further study is evidently necessary.

Longfield (*161*), 36—Vigorous and very productive. Growth two feet. Fruit of medium size, conical, yellow with red cheek. Good for cooking and for dessert. Season September to January. In common with most of the Russian varieties, it drops badly and must be harvested early. Valuable.

Losovka (*4 Orel*), 1—Tree in rather a low situation, badly broken by snow and careless workmen in 1892. Recovered and making a vigorous growth at the present time. Foliage thick and leathery. Of vigorous spreading habit. Growth the present season two feet. No fruit.

Mallett, 14—Upright, compact, vigorous with few branches. Growth two and one-half feet. No fruit.

October, 81—One of Gideon's Seedlings. Moderately vigorous, spreading; few branches; very productive (one and one-half bushels in 1896). Wood well matured. Growth one foot. Fruit small, conical, yellow, washed and splashed with carmine. Flesh white, crisp, acid. A handsome fruit, good for cooking.

Orel No. 7, 3—Very vigorous, spreading. Foliage thick, heavy, resembling Losovka in this respect. Growth two feet. No fruit.

Ostrakoff (*4 M*), 24 and 33—24, vigorous, upright, spreading, with few stout branches and heavy dark foliage. No fruit. 33, young tree set in 1896.

Peter, 79—One of Gideon's Seedlings. Moderately vigorous, spreading; very productive. The habit of the tree as well as the character of the fruit shows the crab parentage. Wood well matured. Growth one foot. Bore a full crop of fruit in 1895 and 1896.

Red Queen (*316*), 45—Upright, sturdy, compact, with few branches. Bore a few specimen fruits in 1896. These were conical, greenish-yellow with blush cheek. Season winter. It is questionable whether this is rightly named.

Repka Aport (*261*), 40—Resembles Alexander. Produced a full crop of fruit which checked the growth to a certain extent. Growth one foot.

Repka, 5—Young tree set in 1896. Growth six inches.

Russian Gravenstein, 35—Very vigorous and spreading. Productive. A promising autumn fruit of about the season of Duchess, which it somewhat resembles.

Sandy Glass, 32—Upright, sturdy with handsome dark foliage. Growth one foot. A second growth started late in the season. But two fruits were produced.

Saunkernaty, 18—Very vigorous, spreading, branches numerous. Foliage small, but thick and with a heavy pubescence. Fruited for the first time in 1896 (one-half bushel). Fruit small, green, of fair quality. Season winter. May be of value in the north.

Silken Leaf (*75 M*), 34—Vigorous, spreading, dark in wood and foliage. Moderately productive. Growth two feet. Fruit small, conical, greenish-yellow overlaid with red.

Sklanka, 16—Very vigorous, upright, hardy. Growth two feet. No fruit.

Skruischapfel, 17—Very vigorous, upright and compact. Branches few and stout. Hardy and productive. Three pecks of fruit this year. Fruit small, of poor quality and drops badly.

Striped Winter, 11—Moderately vigorous, spreading. Light colored in wood and foliage. Growth one and one-half feet. No fruit. Inclined to make a second growth in autumn.

Sweet Pippin (*5 Orel*), 2—An upright, vigorous grower. Foliage smaller and thinner than the preceding. Average growth two feet. No fruit.

Swinsovka, 4—Moderately vigorous, upright, spreading; broad thick leaves of moderate size. Growth one foot. No fruit.

Table Apple, 19—Very vigorous, spreading, branches freely. Foliage thick, leathery, and densely pubescent on under side, of characteristic dark bluish-green color. Growth two feet. Single specimen of fruit produced in 1896. Small, roundish, oblate, green, stalk short, slender in narrow cavity. Calyx small enclosed in a broad shallow basin.

Tiesenhausen, 38—Upright, sturdy, vigorous, productive. Growth two feet. Fruit small and worthless for New England.

Tetofsky, 75 and 76—75, young tree set in 1895. Vigorous, upright, compact. Few stout branches. Very large leathery

foliage. 76, the identity of this tree is doubted. We shall give description later.

Titovka, 69—Very vigorous, upright; has a tendency to form crotches. Few but stout branches. Growth two feet. No fruit.

Titus, 10—Very vigorous, spreading, shoots stout and dark colored. Foliage large, thick and leathery, with heavy pubescence on the under side. Growth one foot. First fruited in 1896 when two specimens were produced. Fruit very large and showy, but coarse grained.

Ukraine (*290*), 42—Upright, vigorous, compact, hardy and productive. Growth one and one-half feet. The fruit is large and handsome. Season September. Good for cooking.

Vargulek (*12 M*), 26—In habit of growth like the preceding. Inclined to form crotches. Rather slender for the heavy load of fruit (one and one-half bushels in 1896), which checked the growth somewhat. Growth one foot. Fruit small to medium, greenish-yellow with stripes and splashes of crimson. Quality good. Drops badly.

38 Voronesch, 53—Moderately vigorous, upright, spreading. Few branches. Growth one foot. Very productive. Fruit of Duchess type, but two weeks earlier.

50 Voronesch, 54—Vigorous, upright, compact. Branches long, but stout. Growth one and one-half feet. No fruit.

Wealthy, 68—Low, vigorous habit. Very productive (two bushels fruit in 1896). In spite of heavy crop made a growth of one foot. This is the best of the seedlings sent out by Peter M. Gideon of Minnesota.

10 M, 25—Very vigorous, upright, compact, with comparatively few but stout branches. Growth one and one-half feet. Very productive, but the fruit drops badly. Season September. Fruit small, conical, greenish-yellow with splashes of red; of poor quality.

13 M, 27—Vigorous, upright, compact, with dark heavy foliage. Growth one and one-half feet. No fruit.

18 M, 29—Upright, spreading with numerous long slender branches. Growth one and one-half feet. No fruit.

984, 51—Moderately vigorous; spreading, few branches. Growth one and one-half feet. No fruit.

387, 12—Moderately vigorous, spreading. Removed to present location in 1892. Growth one and one-half feet. No fruit.

Of the varieties above mentioned the following are at present regarded as most promising: Aport, Arabskoe, Golden Reinette, Hibernal, Lead Apple, Longfield, Russian Gravenstein, Vargulek.

The Gideon Seedlings, Excelsior, October and Peter are very productive and good for cooking but are not specially valuable save in the colder parts of the State.

IV. ORCHARD WORK IN AROOSTOOK COUNTY.

In the spring of 1890 fifty varieties of Russian apples were sent to E. W. Merritt, Houlton, and a duplicate lot to J. W. Dudley, Mapleton. The lot sent to Mapleton was divided, one-half being placed with Edward Tarr. All of the trees sent to Mapleton were placed in nursery rows till they should fruit.

Trees placed with E. W. Merritt—Mr. Merritt set his trees in a young orchard, and has given them good care up to the present time. Some of the varieties have fruited abundantly and proved of considerable value. The following table gives Mr. Merritt's observations concerning such of these trees as have fruited.

MR. MERRITT'S NOTES ON RUSSIAN APPLES.

Variety.	When set.	Habit of growth.	Average yearly growth in feet.	First bore fruit.	Present condition.	Productiveness	Quality.*	Season.
Anisim	1890	Very vigorous	1	1896	Good	7	1st,	L. W.
Anthony	1891	Good	1	1896	Good	9	1st,	L. W.
Aport	1890	Very vigorous	½	1896	Good	4	3d,	E. W.
Aport Seedling	1890	Poor	½	1896	Good	5	3d,	E. W.
Aport Virent	1890		½	1896	Good	4	2d,	E. W.
Arabskoe	1890	Upright	1	1895	Good	9	1st,	L. W.
Blackwood	1888	Vigorous, upright	1	1895	Good	5	2d,	Fall.
Golden Reinette	1890		1	1896	Good	8	1st,	L. W.
Golden White	1888	Medium, upright	1	1895	Good	5	3d,	L. F.
Hibernal	1890	Vigorous	1½	1895	Good	6	3d,	L. W.
Koursk	1890	Good	1	1896	Good	6	2d,	L. W.
Koursk Reinette	1890	Vigorous	¾	1895	Good	8	1st,	E. W.
Lead	1890	Good.	1	1896	Good	6	1st,	L. W.
Longfield	1890	Good	1	1895	Good	10	1st,	L. W.
No. 5 Orel	1890	Vigorous	¾	1896	Good	8	1st,	L. W.
Ostrakoff	1890	Very vigorous	1	1896	Good	7	1st,	W.
Silken	1890	Good	1	1895	Good	7	3d,	E. W.
Switzer	1888	Vigorous, spreading	1	1895	Very Good	7	2d,	Fall.
Titovka	1888	Very vigorous, upright	2	1894	Very Good	9	1st,	Fall.
Vargulek	1890	Good	1	1896	Good	5	3d,	E. W.

* Quality in this table is but relative. Those ranked as first quality are but second when compared with standard sorts. Abbreviations: F—fall; W—winter; E—early; L—late.

Concerning the above list Mr. Merritt writes: "I do not consider any worth propagating unless the tree ranks seven in productiveness and the fruit one in quality. The quantity is indicated more particularly with reference to use for dessert purposes. The trees mentioned in the table are all hardy, and good growers, but some of the trees sent have not come into bearing and are poor growers. Some seemed determined not to grow and have been replaced with trees of approved varieties."

Trees Placed With J. W. Dudley—Many of the varieties sent to Mapleton have already been described in the notes on the Experiment Station orchard. The two lots, however, are not quite comparable, since the trees at the Experiment Station have received more thorough culture and are not crowded into nursery rows. Because of the more vigorous growth of the former, fruiting has in some cases been delayed.

The following notes represent the present status of the trees entrusted to Mr. Dudley:

Aport (252)—Vigorous, upright, spreading. In habit of growth and in fruit resembles the Alexander. First fruited in 1896 (a few specimens). As before remarked, the term Aport applies to a family of apples which includes the Alexander and some other varieties.

Aport Ourent.—There is some doubt as to the identity of this variety. The tree is very vigorous and productive. Fruit large, handsome and promising and will receive further attention.

Arabka, (No. 257)—Broken over by snow several times. At present about the size of a good two-year-old tree and now vigorous.

Arabskoe—Hardy, healthy, vigorous. First fruited in 1896 (one half bushel). Worthy of propagation.

Bogdanoff—Tree upright with thick leathery foliage. First fruited in 1896. Fruit large, smooth and highly colored. Good. Season winter.

Borsdorf, (356)—Upright, vigorous, spreading. First fruited in 1896 (a few specimens).

Cross Apple, (No. 413)—Moderately vigorous, light colored in bark and foliage. First fruited in 1896 (one-fourth bushel).

Golden Reinette—Moderately vigorous and spreading. First fruited in 1895 (one-fourth bushel). The fruit is much smaller than on the tree in the Station orchard.

Grandmother, (No. 469)—Badly injured by the snow in 1891. Recovered and though a small tree, bore some fruit in 1896. Resembles Vargulek.

Green Crimean, (No. 399)—Injured by snow in 1891, but recovered and is now making a moderately vigorous growth.

Limbs have a characteristic horizontal growth. Its habits do not correspond with the habits of the Green Crimean as described by Professor Budd.

Green Sweet—Injured by snow in 1891. Now making a vigorous spreading growth. Has not yet fruited.

Lead Apple, (No. 277)—Vigorous, upright, with few stout branches. Twelve to fifteen inches growth. Has not fruited.

Losovka, (No. 4, Orel)—Vigorous, spreading, with thick leathery foliage. Blossomed in 1896, but no fruit matured.

Red Queen, (No. 316)—Injured by snow in 1891 and 1892. Now making a very vigorous growth. Resembles Tetofsky in habit.

Repka Aport, (No. 261)—This variety was evidently killed and a sprout from the stalk has been allowed to grow.

Rolfe—This variety, seven years from the bud, bore one-half bushel the present season and has proved vigorous and hardy from the first. It is in a somewhat protected situation, but promises well for Aroostook county.

Silken Leaf (75 M)—Vigorous, spreading. Fruited in 1895 and also in 1896. Promising.

Titus—Very vigorous, spreading, with few stout branches and large leathery leaves. Blossomed in 1896 but matured no fruit.

Vargulek, (12 M)—Broken by snow in 1891. Now making a moderately vigorous, upright growth. First fruited in 1895. The fruit is small, rather showy, but very acid and is not of special value.

38, *Voronesch*—Vigorous, upright, spreading, with thick foliage. Fruited in 1895 and also in 1896. Resembles Duchess, but two or three weeks earlier.

50, *Voronesch*—Moderately vigorous, spreading, with long willowy shoots. First fruited in 1896 (one-half dozen specimens).

20 M—A vigorous, upright tree. Bore fruit somewhat similar to Duchess. Evidently wrongly named.

No. 378—Vigorous, upright. Injured by snow in 1891 and 1892 and has never fruited.

Trees Placed With Edward Tarr—The most promising varieties in Mr. Tarr's collection are the following:

Early Sweet—Vigorous, upright, spreading. First fruited in 1896 (one-half bushel). Fruit of medium size, yellow, juicy, sweet. Valuable for the north.

Revel Borsdorfer—Very vigorous, spreading, hardy, productive. Resembles King in habit of growth. Fruit large, conical, yellowish-white, washed and splashed with carmine. Flesh crisp, agreeably acid. Good. Season late autumn and early winter. Very promising.

Royal Table—Very vigorous, upright, spreading, productive. First fruited in 1894. One and one-half bushels in 1896.

Russian Gravenstein—Very vigorous, upright, spreading, with heavy dark foliage. Fruit medium, conical, ribbed, yellow splashed with red, calyx large, closed, in a shallow, irregular basin. Stem one and one-half inches, stout and rather deep cavity. Flesh rather coarse, white, crisp, tender, juicy, brisk sub-acid. Good. Season September. As grown in Aroostook county this variety is some two weeks later than at the Station and the fruit is smaller.

Striped Winter—Vigorous, upright, spreading. Branches sparingly. First fruited in 1894; one-half bushel in 1896.

Other varieties in Mr. Tarr's collection which are of more or less value are: Anis, Antonovka and Mallett.

Orchard Work at Perham.—As stated in a former report* arrangements were made in 1891 by which a large number of varieties of fruits have been sent to the farm of Mr. James Nutting, Perham, Aroostook county. Mr. Nutting died in 1893, but the work has been continued, under the supervision of the writer, by Mr. Oliver Y. Nutting, to whom much credit is due.

The cions set in bearing trees in 1891 made a vigorous growth and most of them have borne some fruit. The close planting and rank growth of the Duchess trees used as stocks have, however, seriously affected the size and quality of the fruit. Aside from the question of hardiness, therefore, the value of many of the different varieties can not as yet be stated.

In 1892 cions of sixteen varieties were crown, grafted on Duchess seedling stocks. Others were added the following year. In 1895 all that were of sufficient size (13 varieties) were

* Report Maine Experiment Station 1891, p. 97.

planted in the orchard and the past season several more were set. At present the young trees are growing finely. The varieties included in the list are the following:

Arthur,	Okobena,
Bethel of Vermont,	Ostrakoff,
Duchess Seedling No. 8,	Patten's Greening,
Korsk Anis,	Prolific Sweeting,
Longfield,	Shiawassee Beauty,
McMahon,	Titus.
North Star,	

Besides the apples above mentioned there are on trial at present several varieties of plums and cherries, all of which are proving hardy and many of which promise to be of value. The list of plums includes the following Russian sorts: Bessarabian, Early Red, Hungarian Prune, Moldavaka, Voronesch Yellow, White Nicholas, 19 and 20 Orel. In addition to these are Cheney, Rollingstone, Wolf, and Wyant of the Americana class.

The cherries include Griotte du Nord, Orel Sweet and 23 Orel. Mr. Nutting reports as follows on these fruits:

"None of the plums sent by you have produced fruit in such abundance as Mooers' Arctic, but they are not yet as old as the latter.

"The cherries are growing well and all but one bore some fruit last year. Orel Sweet and Griotte du Nord are very promising."

NOTES ON WINTER GARDENING.

W. M. Munson.

Eternal vigilance and the exercise of good judgment, both in the management of the crops and in marketing, are far more important than adherence to set rules in conducting successful gardening operations in winter. The grower must possess a love for the business, and must give personal attention to all of the details. All instructions must be regarded as suggestive rather than as rules to be rigorously applied. These considerations being recognized, and the requisite energy being thrown into the work, the business may be very profitable in many localities.

The risks in forcing vegetables are great. For this reason it is advisable to begin in a small way and develop with the business. One must learn how to ventilate, to water, to manage his furnace, and to market. This experimental work is best done, at first, on a small scale. Again, it will in general be necessary to create a special market for winter-forced vegetables and this must be gradually accomplished. In Maine we cannot hope to compete with the growers of Massachusetts in supplying the large wholesale markets, but must depend upon our own larger cities and towns for a market. For this reason a "fancy" market near at hand should be sought.

Aside from the cost of constructing glass houses, the most important items of expense to be considered are the fuel and the labor. The cost of these items can be only approximately estimated, since they will vary with local conditions. A single house standing alone, covering 2,000 square feet of surface, will require not far from twenty-five tons of coal for the year, if a temperature suitable for tomatoes and cucumbers is to be maintained. For lettuce and radishes considerably less is needed. Several houses standing together will require propor-

LETTUCE IN GREEN HOUSE.

tionately less fuel. In the Station forcing houses, covering approximately 4,500 square feet of glass and an office building, about sixty tons per year are used.

One good man with occasional help should be able to do all the work in houses covering 4,000 square feet of ground if the arrangements are convenient.

I. THE HOUSES USED FOR WINTER GARDENING.

1. *Cold Frames.*

The simplest form of glass structure in common use is the ordinary cold frame. This consists of a box of greater or less extent covered with a sash or sashes. The ordinary sash used in gardening work is 3x6 feet. The cold frame used in commercial operations is made by simply placing boards on edge about six feet apart and laying the sash across them, the ordinary soil of the garden being used. The boards are held in place by driving stakes inside and out and by occasional cross pieces. It is well that one side should be about three or four inches higher than the other in order that the rays of the sun light may be received a little more directly and that the water in case of rain shall run off more freely. For amateur gardens a little more care is usually exercised. A frame twelve to fifteen feet or more in length is made, the back side being twelve inches, the front side nine inches high, with pieces of 2x4 in the corners to hold the boxes together. Sashes are then put across as before indicated. In this way the heat of the sun is utilized in warming up the soil earlier in the spring, and plants may be started several weeks earlier than would be possible in the open ground. Aside from its use in starting early plants the cold frame is little used in "winter gardening."

2. *Hot Beds.*

The hot bed is similar to a cold frame with the addition of some artificial means of raising the temperature of the soil. The usual means employed is that of fermenting manure. In preparing a hot bed, it is well to dig a pit about two feet deep and if a permanent bed is desired, this may be either planked up or bricked up to keep out mice. The hot bed is not prac-

ticable for use in midwinter, but may be made as early as March for the starting of early tomatoes, cabbage plants, etc.

In starting a hot bed, fresh, rather strawy manure is used. Horse manure is preferable for this purpose, but sheep manure is sometimes used; that from highly fed animals is best. The manure should be placed in large piles as taken from the stable and turned occasionally to prevent overheating. When the bed is started a layer of manure about six inches deep is placed at the bottom and thoroughly tramped. Then another layer is put in in the same way and so on successively until the pit is full. In case there is not much straw or litter in the manure, alternate layers of leaves may be used to good advantage. This will prevent too rapid fermentation and will make the bed last much longer.

When the pit is filled, a frame similar to the one already described is placed over it and from four to six inches of rich soil are added. The pit for the manure is made about six inches wider than the frame in order that the soil may be heated evenly clear to the edges of the boxes.

In the management of hot beds and cold frames great care is necessary or damage will result from fluctuations in temperature. The volume of air is so small that the atmosphere is quickly affected by outside conditions.

After making the frame a thermometer should be placed within the frame and no seed should be sown until the temperature of the soil has receded to about 80°. In sunny weather constant care is necessary to prevent the burning of the plants. An hour's neglect will sometimes ruin a season's work. It is a good plan to have shades of light cloth to put upon the beds in April and May to avoid this danger. These are best made by tacking pieces of light cotton cloth, which has been soaked in linseed oil, upon wooden frames the same size as the sash. Heavy straw mats are also necessary to protect the beds from cold at night.

Sometimes instead of the single frames described, hot beds are made double, the center being somewhat higher than the sides. In this case, bottom heat is often supplied by means of a flue or hot water pipes instead of fermenting manure. In

general, however, for commercial purposes a cheap forcing house is to be preferred to the "fire hot bed," as such a house may be put up at but little greater expense and the cost of maintaining is but little more, whereas the work may be done much more easily and satisfactorily than is possible with the hot bed. In short, a forcing house may be described as a hot bed large enough to get inside of.

3. *The Forcing House.*

a. The Lean-to:—The lean-to or shed-roof house is a natural development of the cold frame or hot bed, and temporary houses may very easily be made by placing ordinary hot bed sash by the side of a wall. This form has the advantage of cheapness in that the sides of a building may be utilized, but it has the disadvantage of allowing light to come in from only one side. A lean-to house should naturally be placed upon the south side of the wall or building.

b. The Uneven-Span House:—The form in most common use at the present time is the so called two-thirds or three-fourths span house. It is similar to a lean-to excepting that the peak has been cut off, thus doing away with a large amount of waste space and allowing more light to come in. In general, houses of this description are placed east and west with the long slope to the south. Recently there has been some discussion concerning the merits of the practice of placing the short slope to the south. The advantages claimed for this practice being that the rays of the sun are much more directly received by the sharper angle; that the snow slides off more quickly; and a third doubtful advantage claimed is that on the north side the long slope will retain the snow to a certain extent and thus shut out cold drafts. The uneven span house is the form almost universally used for the growing of roses and for most commercial purposes. Figure 1 represents such a house at the Experiment Station, which is used for growing lettuce.

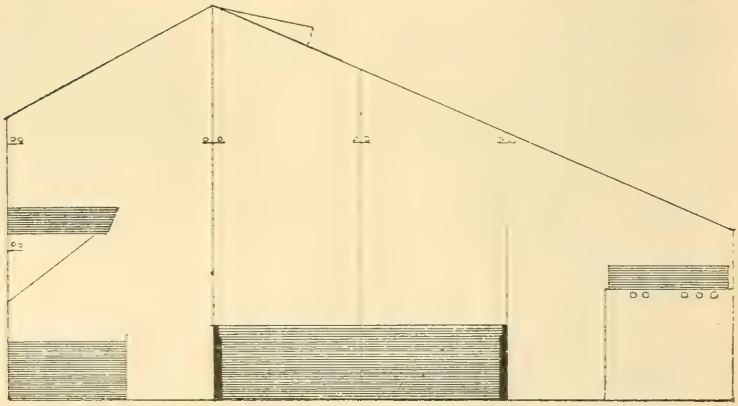


FIG. 1. UNEVEN-SPAN HOUSE.

In making an uneven-span house the angle of the long span with the horizontal is about thirty to thirty-five degrees; that of the short side thirty-five to forty-five, sometimes more.

c. The Even-Span House:—This form, figure 2, is used mainly for narrow propagating houses and for conservatories rather than for commercial forcing houses. It is seldom used in a house more than sixteen feet in width. Even-span houses should be placed with the ridge running north and south. They have the advantage of admitting the sunlight on all sides of the plants.

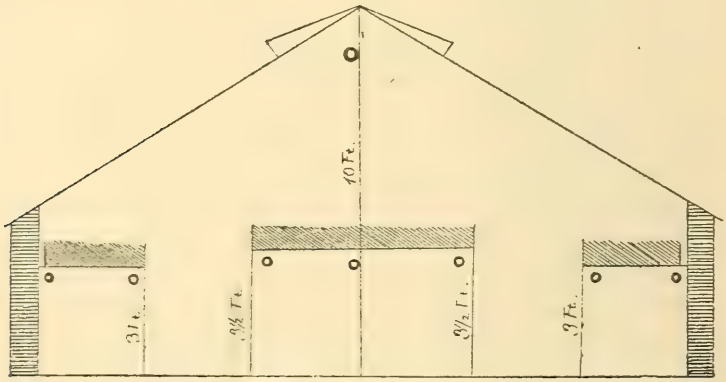


FIG. 2. EVEN-SPAN HOUSE.

4. *Construction of Houses.*

a. Walls and Foundations.—From the nature of the superstructure it is evident that while the foundation of the forcing house need not be specially heavy it must be very rigid. There must be no displacement from lateral pressure nor must there be a possibility of heaving from the action of the frost. If practicable a foundation of cement or stone is desirable, but ordinarily commercial houses are built without such foundation.

The best green house wall is that which at the least expense is perfectly rigid, is durable and will effectually shut out drafts of cold air. A cheap and effective wall is readily made by the use of posts and matched boards. In building such a wall as this, posts are set about four feet apart and in this climate at least four feet deep, that there may be no danger of heaving. The posts should be as uniform in size as possible, about five or six inches being large enough. It is well to place a flat stone in the bottom of the hole before setting the post. A sheet of tarred paper is then tacked on each side of the posts and outside of this the sheathing is placed. Along the top of the posts should be placed a two-inch strip equal in width to the thickness of the posts, and above this the plate. The plate should be about 3x9 inches and bevelled on the top so that moisture may run off readily. It should be grooved on the under side to receive the matched boarding and thus shut off all possibility of the entrance of cold air. It should also have another groove nearer the edge to prevent the backing up of water into the joint formed with the boards. When completed the plate will then project one inch beyond the wall as shown in figure 3.

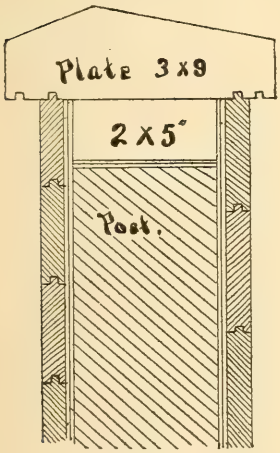


FIG. 3. A CHEAP WALL.

A wall of this description may be built very cheaply and under ordinary conditions will last ten to fifteen years. The posts

should of course be selected with care and cedar or locust should be used.

Brick and tile are sometimes used for green house walls. There is always danger, however, that because of excessive moisture and frequent changes in temperature such a wall will not prove durable. The brick wall which appeals to me most strongly is one used by Professor Green of Minnesota.* This consists of a four-inch brick wall on each side of a three-inch hollow tile with a one-inch air space on each side of the tile—thus making a thirteen-inch wall. In this wall we have three separate dead-air spaces, an arrangement from which we should expect excellent results. Such walls, are, however, very expensive and not advised for ordinary commercial purposes.

Some of the houses at the Experiment Station have been built with a double brick wall with an intervening air-space of about two inches. This arrangement is fairly satisfactory provided the brick used are well burned. In any case it is important that the two courses be tied together at frequent intervals.

b. Roofs:—As already indicated, the simplest form of green house roof is made by the use of ordinary hot bed sash. This form has been modified to a certain extent in the building of orchard houses and other like structures with temporary roofs. In such cases a permanent wooden or iron frame is constructed and sash are put in place whenever the houses are desired for use. At the present time, however, some form of permanent sash bar is considered preferable. Sometimes rafters of 2x4 stuff are placed about six or seven feet apart to give rigidity to the roof, but the tendency at the present time is to use rather heavy sash bars and omit the rafters. In this climate, because of the excessive falls of snow to which we are liable, sash bars about 2x2 1-2 inches should be used. Purlins should also be placed at frequent intervals. All supports may best be made of gas pipe or small steam pipe rather than of wood. The object in all of the details of construction should be to shut out as little light as possible. The gas pipe purlins may be made to serve the double purpose of supporting the roof and of carrying the water where desired. This method is followed in some of the larger commercial establishments. It has been

* Bulletin 7, Minnesota Experiment Station.

suggested that these purlins be utilized in conducting steam for heating, but the advisability of such a practice is questionable because of the alternate contraction and expansion which would follow and the consequent disturbance of the glass. Each sash bar is held in place by means of an iron strap.

A ridge pole of 2x5 stuff is generally used. This should be grooved at the sides to receive the glass, as shown in the figure.

c. Glass:—In general it is better to get second quality double thick glass of pretty good size. We prefer 14x22 or 16x24 although because of the lower price on smaller sizes it is common among florists to use 12x15, this being the largest size at the low prices. Belgian glass is more expensive than the American product but is superior to the latter. In some sections heavy plate glass is employed. Of course this latter is very expensive, but it is very durable.

There is a common notion that a flaw or bubble in the glass is likely to serve as a lens and result in burning foliage. Such, however, is not the case as was shown by some very careful work conducted by Mr. J. C. Blair at Cornell University during the past year; but glass of a wavy character or of uneven thickness should be discarded. It is glass of this character that causes the trouble.

5. *Ventilating and Ventilating Machines.*

In general, ample provision should be made for ventilation. The object of ventilation is to purify the atmosphere rather than to lower the temperature and provision should be made whereby the outside air may be admitted near the base of the house as well as at the ridge. The ventilators should extend the whole length of the house, rather than be confined to a few small sashes. It is better to raise the whole line a little than to raise a few sashes to a greater extent, as in the latter case there is danger of injury from cold drafts. Many growers prefer that the ventilators should spring from the ridge, as in this way the warmest air will escape and it is claimed that the house may be kept cooler in very hot weather. In our own experience, however, we prefer to have two lines of ventilators operated independently. In this way, provided the ventilators are hinged at the ridge, we may avoid direct drafts in case of

high winds. The ventilating sash should, if possible, be from two to three feet wide and should be continuous for the whole length of the house.

There are several styles of ventilating apparatus, among the more prominent of which are the Hippard, manufactured by E. Hippard of Youngstown, Ohio; and the Challenge, manufactured by the Quaker City Machine Company, Richmond, Ind. The latter has been, perhaps, one of the most satisfactory with us. Another style which we have in our houses is the so called automatic cable ventilator manufactured by A. Q. Wolf & Bro., Dayton, Ohio. This style has the merit of cheapness and thus far has been very satisfactory with us. We have had it in operation for three years. The Rochefort apparatus, now on sale by Henry A. Dreer, Philadelphia, is an English machine which acts on the same principle as that made by Wolf Bros. This has been used but very little in this country. The automatic ventilator, manufactured by the Chadbourne-Kennedy Company, of Poughkeepsie, N. Y., is an expensive machine, costing $50, but with us has proved very satisfactory. An extended discussion need not be given in this connection because it is not likely to be of general use among commercial gardeners. In the extensive houses of W. K. Harris, Philadelphia, the machine is, however, exclusively employed and is regarded very highly.

6. *Methods of Heating.*

Whatever method of heating is used it is well first to consider the cost, the efficiency, the durability and the economy both of fuel and attendance. The method of conveying smoke and other products of combustion through the house by means of brick or tile flues has in the main been superseded by the modern methods of steam and hot water heating. The first cost of flues is certainly light and the fact that they are still used by florists in many parts of the country is sufficient proof of their efficiency, but they are not economical and there is always danger of leakage and the escape of coal gas which is very destructive to plant life. In the large lettuce houses which supply the Chicago markets, however, this method of heating is still very commonly used.

In modern green house heating we have only to consider two general systems—steam and hot water in closed circuits. Each system has its ardent champions; each has its advantages and its faults. Both claim economy of fuel and ease of control as specially strong points. It is claimed that the hot water heaters require less attention than steam heaters. This, however, is a doubtful advantage save at night as frequent attention to the fires is essential to the most economical use of fuel. On the other hand, fewer boilers are required to heat a large plant if steam be used and the first cost of piping for steam is very much less than for hot water. There is no doubt that in the economy of construction and in efficiency, when the circuit is very crooked, steam has the advantage. On the other hand, there is less fluctuation in temperature with hot water.

In selecting a hot water heater, observe the amount and arrangement of direct heating surface, the arrangement of water sections in the heater, the ease of cleaning and the readiness with which leaks may be mended. Horizontal sections are usually most efficient.

For steam heating an ordinary second-hand horizontal flue boiler, condemned for high pressure work, will be found cheap and satisfactory.

7. *Pipes and Piping.*

The common practice both with steam and hot water at present is to carry the "riser" or flow pipe to the farther end of the house and there distribute heat by means of smaller return pipes. If practicable there should be a gradual ascent in the flow pipe from the furnace to the point of distribution in the returns. There should then be a gradual descent of the return pipes to the furnace. The size of pipe best suited for returns depends upon the length of the coils and also to a certain extent upon their height above the heater. In general, two inch pipe is to be preferred if hot water is used and one inch or one and one-quarter inch with steam. We sometimes use one and one-half inch pipe for hot water circuits, but unless the coils are very short the friction reduces the efficiency of the apparatus.

There has been much discussion as to the relative merits of placing the pipes overhead in the house or under benches. In general, we have found that a combination of the two systems is preferable.

8. *Internal Arrangements and General Management.*

a. Beds and Benches.—There is a great difference in opinion, as well as in practice, concerning the use of shallow benches or of solid beds in forcing houses. In the great lettuce houses of Arlington, Mass., the solid bed is exclusively used, while the famous Grand Rapids lettuce of Michigan is grown entirely upon shallow beds in flue heated houses. In general, however, we would advocate solid beds for plants requiring no bottom heat, such as cauliflower, lettuce, radishes, etc.; while for semi-tropical plants like melons, cucumbers, beans and tomatoes, benches are preferable. Built as they usually are of waste lumber, benches are short lived and must be renewed in from three to five years, but with a little extra care and attention their durability may be doubled. If wooden legs are used, raise them above the level of the soil and place a stone or brick under them. A better plan, however, is to use old steam pipe for legs and allow the pipe to extend to the top of the front boards, thus holding the latter firmly in place.

Another important consideration in making benches in the green house is that a space be left next to the wall that the hot air from beneath may circulate freely next to the glass and that the plants be not injured by cold drip from the roof. If the supports be of wood, it is specially important that paint be used very freely. In all benches provision should be made for drainage by leaving cracks between the bottom boards. Instead of boards, slate or tile is sometimes used. The latter is preferable, but either of these is of course much more durable than wood and is a better conductor of heat. For ordinary purposes, however, wood will probably continue to be mainly used.

b. The Soil:—The soil for use under glass should, as a rule, be more sandy than that usually called "good garden loam." The reason for this is evident. We know that, other things being equal, plants make a more rapid growth and mature more quickly on warm sandy soils than on heavy loams, and it

is just this quick growth that we must have in the forcing house. The atmosphere is quiet and is so moist that evaporation is reduced to a minimum in the house, and heavier soils are very liable to become sour or in bright sunny weather to lose their water quickly and become hard and "dead."

A good general rule for forcing house soils is to use two parts of sand, two parts of well rotted manure and two parts of loam from the garden or of turf from an old pasture. Freshly prepared soils will never give satisfactory results in the house. For this reason a large quantity of prepared soil should be kept on hand in a convenient place. Rotted sod is the best basis for green house soils. Our own practice is to get a quantity of sods from an old pasture and place these in layers, grass side down, in a regular stack. Alternating with layers of sod may be placed a liberal quantity of stable manure. The top of the heap should be flat or somewhat concave to retain the rain and hasten decay. Decay may also be hastened by a liberal use of lime while the stack is being made. The heap should be thoroughly forked over after a few months and again at the time of removing to the house. At the second handling any desired amount of sand may be added.

c. The Water:—An abundant and unfailing water supply is essential. Where it is possible to use city water, this will be the best source of supply. Otherwise cisterns must be built or wells provided at considerable immediate expense. Rain water or river water is to be preferred if obtainable, but this is not imperative.

When and how to supply the water is far more important than the source of supply, provided there is no injurious element present. The operation of watering is perhaps the most important factor of green house management. The older a gardener grows the more care he takes in watering, for carelessness in this operation is the exciting cause of innumerable diseases of plants. It is the last operation an apprentice is taught and probably not one man in twenty is thoroughly competent in this direction. In all of the life processes of plants, water is an important factor; but it is well known that plants require very different amounts of water at different seasons, in different situations, or in different states of health.

In applying water we must remember that each plant has an individuality which should be taken into consideration. Transpiration (giving off water) is a physiological and not a mechanical process. It is regulated by the vital action of the plant.

The amount of water depends upon, (1) The kind of plant grown. The native home of a plant may suggest the amount of water needed. For instance, the cactus is a native of the desert and requires but little water, while the tomato is found in a moist region and requires a large amount of water. (2) The conditions as to health and disease. As above mentioned, the vital processes of diseased plants being less active, such plants will utilize less water and will be injured if kept too moist. (3) The nature of the soil. Retentive soils will, of course, require different treatment than will light sandy soils. The former, if given too much water, will very soon become heavy and water-soaked, while the latter will stand very liberal applications. (4) The atmosphere of the house. We must remember that the atmospheric conditions of the house are such that the amount of evaporation is greatly reduced. The plants, too, are thickly crowded together and the ground shaded. These facts will have an immediate bearing on the amount of water to be used at any one time. Naturally in bright sunny days much more water is used than in cloudy weather. Indeed, it is advisable to avoid watering so far as possible on cloudy days.

d. When and How to Water:—In the winter it is rarely advisable to syringe plants or to do much heavy watering in the afternoon as the temperature would be lowered too much, thus favoring the development of fungi. In the summer, on the other hand, it is often advisable to water late in the afternoon in order to reduce the temperature. In general, morning is the best time to apply water, and at this time the walks should be thoroughly wet down to keep the atmosphere moist. In any case the soil should be kept constantly moist. Plants like plenty of water to drink, but will not stand wet feet all of the time.

Whether to apply the water in the form of a spray, wetting both the plant and the surface of the soil, will depend on the

kind of crop grown. Roses and other hard wood plants will stand frequent spraying, and it is well to have the surface of the soil moist in the case of melons, cucumbers, etc. Some others, however, thrive best when the surface of the soil is kept dry, so with the latter it is well to force the water to the bottom of the bed in a solid stream, while with the former the thin spray is desirable.

e. The Sunlight:—There is a marked difference in plants, even though closely related, in their ability to stand sunlight. The melon, for instance, will thrive in the strongest sunlight, while the cucumber, which is closely related, also tomatoes and lettuce do better if the roof is slightly shaded during the bright days of spring.

The ill effect of direct sunlight is shown in the "burn" of lettuce and cucumber plants after a few days of cloudy weather. The bright sunlight dries the atmosphere of the house quickly and, according to Galloway, the rapid transpiration causes the breaking down of the tissues. The amount of sunlight is controlled by the use of shades or rollers or more often by painting the roof. A lime white wash applied with a spraying pump is often recommended. This, however, is a temporary expedient as the lime soon washes off. A little salt added to the white wash will greatly increase its adhesive quality. In our own practice we generally use a thin paint of white lead and naphtha, and apply it with a brush. This wash is more durable than the other, is neater, and if not too thick, is readily removed with a cloth or scrubbing brush whenever desired.

f. Insects and Fungi:—The confined atmosphere and high temperature of the green house seem specially favorable to the development of insects and fungous enemies. One of the most common insect enemies is the aphis or green fly, so called. To meet this enemy tobacco smoke is the best weapon. The house should be thoroughly fumigated at least once a week. Trays containing moistened tobacco stems placed upon the steam pipes are sometimes used with good effect.

Snails and slugs are also troublesome. These may best be met by liberal applications of lime and by making traps by placing boards or pieces of potato around in various parts of the house and by hand picking. One of the most common

fungicides is potassium sulphide (liver of sulphur) which may be obtained at any drug store. This is applied by dissolving about one-half ounce in a gallon of water and spraying the plants. It is less conspicuous on the foliage than is the Bordeaux mixture and if used in season is very effective in keeping down most fungous diseases. Whenever a plant is observed to be diseased it should at once be removed and destroyed. "Eternal vigilance is the price of success."

II. VEGETABLES GROWN IN WINTER.

In any garden work, and this is specially true of the winter garden, the secret of success is to have something on the ground constantly. It costs but little more to have some plants half grown and ready to take the place of the first crop when marketed than it does to devote the whole house to a crop and then wait several weeks for the next to come on. In case of plants not readily handled, "catch crops" may be grown in the interim.

The most important crops used in winter gardening are: Lettuce, tomatoes, cucumbers and radishes. Besides these staple crops, there are many of minor importance in themselves but which may form important factors in keeping up a succession of crops or in utilizing otherwise waste space. Among these are: Asparagus, bean, cauliflower, cress, parsley, pepper, etc.

Lettuce.

Lettuce is one of the most satisfactory crops for the beginner in greenhouse gardening. It is easily managed; requires a smaller outlay for a suitable house than is necessary for most crops; it is always in demand, and is not a total loss if not marketed within a certain limited time. The plate represents the lettuce house at the Experiment Station as seen in January. The lower bench was at this time devoted to other purposes. It is often used, however, for carrying forward young plants. From three to four months are required for lettuce to attain the best condition for marketing, though with somewhat strong bottom heat we have taken off a crop in ten weeks from the time the seed was sown. So in growing lettuce for

the winter markets, the seed for the first crop should be started as early as September 1, and other sowings should be made at intervals of about two weeks to insure a constant supply.

Our own practice is to sow the seed in light, rich soil in flats—shallow boxes about 16x20 inches and two inches deep—and place the flats in a moderately warm and well ventilated room to induce rapid growth. A house kept at a night temperature of about fifty degrees is preferred. When the first true leaves are well started, the young plants are pricked out about 2x2 inches in other flats or in shallow beds. Watering is carefully attended to and the soil is stirred frequently. About a month later the plants are transferred to permanent beds, being placed about 6x6 or 8x8 inches—the distance varying with the variety grown. Many successful growers practice handling twice before the final transfer, placing the young plants two inches apart at the first handling and four inches at the second. With the second and third crops this is, doubtless, a good practice as the main body of the house is thus more fully utilized.

The soil for lettuce should be very rich, light and porous. On solid beds we also place a layer of fresh stable manure before putting in the soil; thus having, in effect, a large hot bed in the house. Before the second crop is put on the bed, the soil is enriched by a liberal quantity of well rotted stable manure.

The quality of lettuce is exceedingly variable, depending largely on the conditions of growth. A good lettuce plant is of rather a yellowish green color and the leaves are thin and brittle. To be of the best quality lettuce must be grown rapidly. The element most important in securing rapid growth of foliage is nitrogen; this element we often apply in the form of nitrate of soda. Place about three ounces—a small handful—of the nitrate of soda in a twelve quart can of water and sprinkle the soil thoroughly. In order that the nitrate be applied at the rate of 100 pounds per acre, each can of water should be distributed over a space about nine feet square (81.6 square feet).

During the earlier stages of growth the plants may be watered freely with a coarse spray; but as the heads begin to form and the leaves cover the surface of the ground, we usually

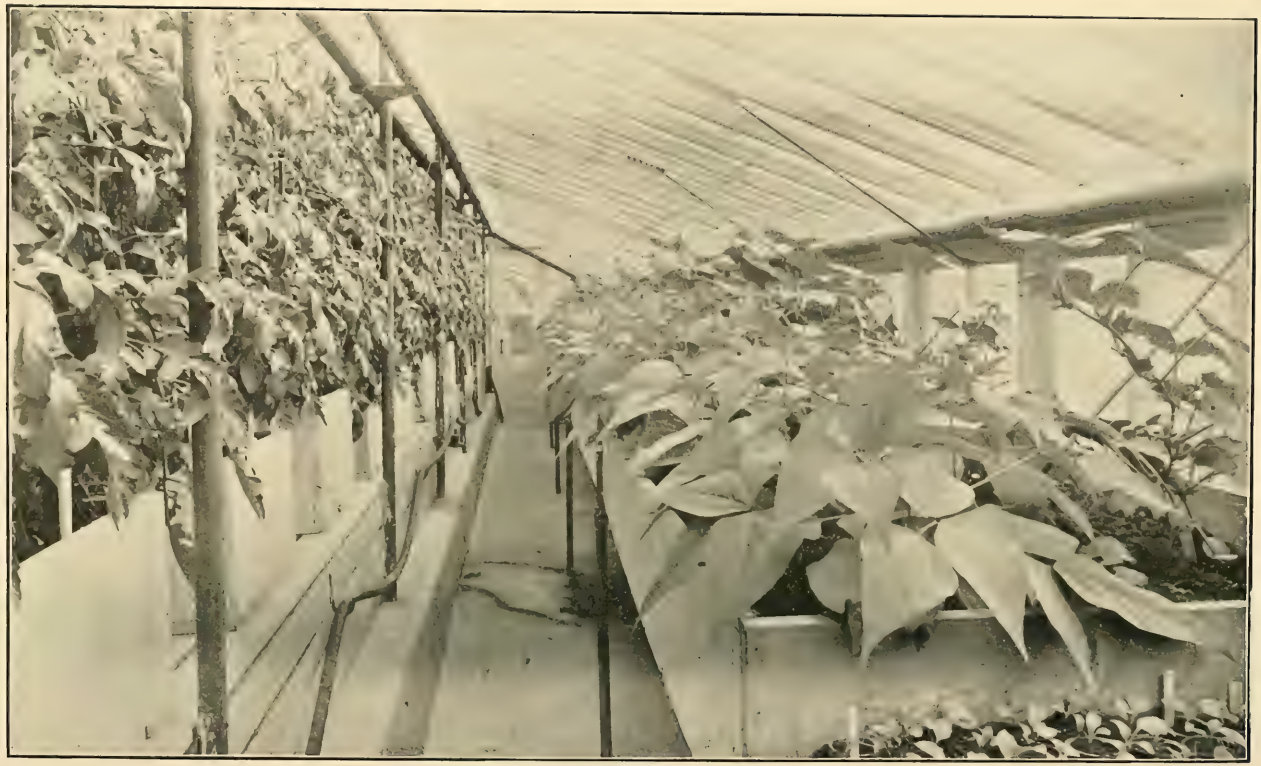
water with a solid stream between the plants. Not infrequently the heading of the plants seems to be hastened by an occasional application of warm water. The marked success of the method of sub-irrigation already outlined will no doubt completely change existing methods. In any case, the atmosphere should be kept moist by frequent spraying of the walks. The leaf surface of the lettuce plant is enormous, and the rapid transpiration in case the atmosphere is very dry will often seriously injure the plants.

The temperature of the lettuce house may be varied considerably, though most growers prefer a night temperature of about forty-five degrees and a range of about twenty degrees during the day. In case it is desired to hold a crop in check for some special purpose, the house may be kept ten degrees lower than here indicated. On the other hand, we often force the crop for a short time by increasing the heat. But, in general, the conditions of temperature should be as nearly uniform as possible.

Insect and fungous enemies must be closely watched. It is a good plan to strew tobacco stems or tobacco dust on the bed among the plants; and thorough fumigation once or twice a week is indispensable. Whenever a plant is affected with mildew it should at once be removed and the use of sulphur on the steam or hot water pipes is recommended. If the soil is stirred frequently, however, and if there is reasonable care in watering and in maintaining a uniform temperature, we are seldom troubled with mildew. One of the advantages claimed for the practice of sub-irrigation is that there is less liability of trouble from disease.

The most profitable varieties to grow will depend entirely on the markets available. In New England there is very little demand for any but the cabbage lettuces, of which there is nothing better than White Seeded Tennis Ball, or a selected strain of this, known as Rawson's Hot House. Of the curled-leaf varieties, Grand Rapids is most popular. The cabbage lettuces are more difficult to grow than the others and usually command a correspondingly higher price.

In marketing, the heads are cut off at the surface of the ground and packed in barrels or crates for shipment. Many



TOMATOES AND BEANS UNDER GLASS.

growers, however, prefer to pull the plants, carefully shaking off all dirt before packing. The demand is best and the prices are highest in February and March, at which time the heaviest crop should mature. In Boston and other eastern markets the prices range from sixty cents to $1 per dozen heads and often higher.

Profits.—Supposing the plants to be set 6x6 inches, we should have four plants per square foot. At sixty cents per dozen this would be twenty cents per square foot for each crop or say fifty cents for the season, as the net proceeds from the house,—a very favorable showing when compared with other crops.

Tomato.

The improved facilities for shipping and the increased extent of the market gardening industry in the South have to a certain extent reduced the demand for hot-house tomatoes; they often bring $1 per pound, however, and seldom in mid winter fall below forty or fifty cents in the Boston markets. In New York competition is stronger and prices are lower, but in most cases the cost of growing and marketing will not exceed thirty or thirty-five cents. Even in the face of southern competition the tomato may be profitably grown, for there is always a demand on the part of some people for the best and the very novelty of hot-house fruit will often count for as much as its unquestioned superiority.*

Cucumber.

The secret of success in growing cucumbers is to have a light, rich soil, good light, strong bottom heat and uniformly high temperature. The ideal house for cucumbers is one which is large enough to allow the vines to attain a good size without interfering with each other; which has rather a flat roof and which will allow ventilation without permitting a draft to strike the plants. A large house is preferable to a small one as the temperature is less quickly affected by outside conditions. As a means of bottom heat, steam or hot water pipes may be used; or if the plants are grown in solid beds fermenting manure is often employed. In our own practice, the plants have been grown in shallow beds heated with steam or hot water.

* For further notes concerning the forcing of tomatoes see Annual Report Maine Experiment Station 1894, p. 55.

Any time after the first of September the tables may be prepared for the winter crop. A layer of potsherds or "clinkers" from the furnace is first spread upon the table to insure good drainage, then light, rich, fibrous soil to a depth of six or eight inches. No time spent in doing thoroughly the work of preparation is wasted.

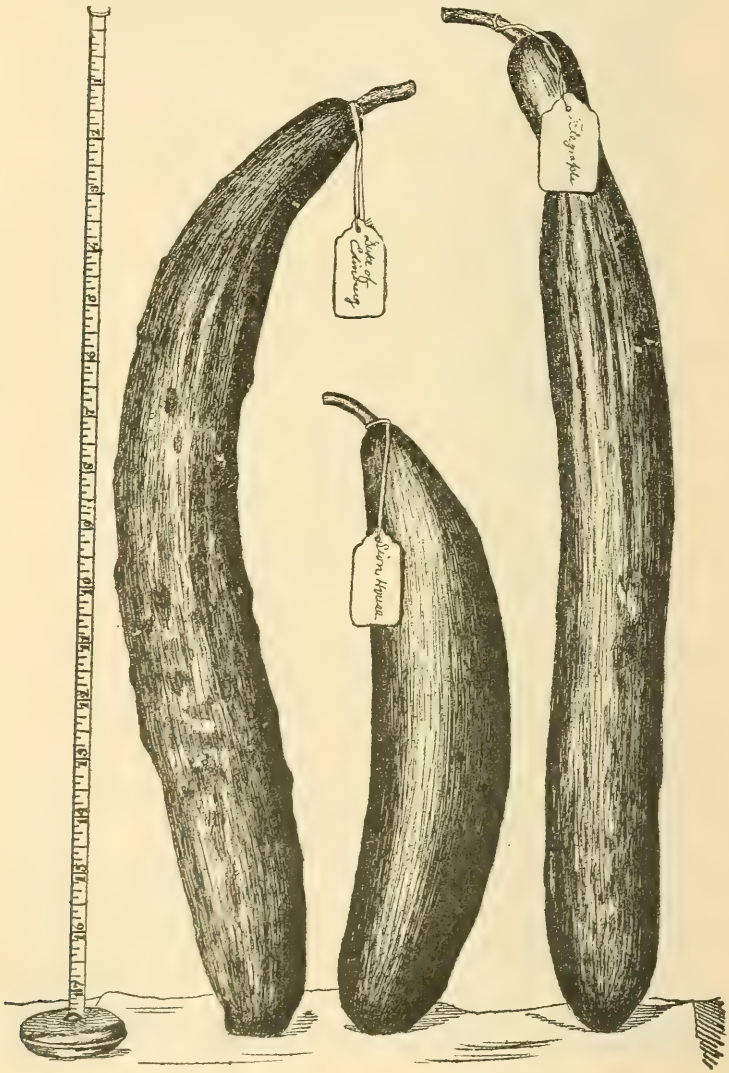


FIG. 4. TYPES OF ENGLISH CUCUMBERS.

The seeds may be sown in the soil where they are to grow or may be started in pots and afterwards transplanted. We usually prefer the latter method. In either case a catch crop may be taken from the bench before the cucumbers are large enough to interfere.

In some sections of the country the English forcing cucumbers are highly prized and it is mainly to this class that attention has been given at the Experiment Station. The cucumbers of this group are very large, varying from fifteen inches to two feet in length, and are practically seedless. The quality is of the best, but the demand for English cucumbers is limited to the fancy trade. Figure 4 represents three of the most popular varieties.

In New England the White Spine, or one of its improved forms, is almost universally grown, and the solid bed rather than the shallow bench is generally used.

As already noted the crop is started any time after the first of September, but the common practice among the larger growers is to raise two and sometimes three crops of lettuce in the house before giving up the space to cucumbers.

About December 1 cucumber seed is sown in a warm house over strong bottom heat. When well started, the young plants are transplanted once or twice to encourage root growth and by the first week in January are in five or six inch pots, and ready for planting out as soon as the lettuce is removed.

Before setting the plants, trenches about one and one-half feet deep and a foot wide are dug about ten feet apart running the full length of the house. These are partly filled with fermenting manure, which should be firmly packed as for a hot bed. The soil is then replaced in the trenches, and the plants set directly over the manure.

The plants are set three and one-half feet apart, two plants at each point for training in opposite directions. Trellises are then made, by placing A shaped supports of iron or wood between each two rows. These supports reach from the bed nearly to the glass and horizontal wires are stretched over them. In this way a V shaped space is left at each row of plants.

The atmosphere should be kept moist and very warm. The temperature should never run below sixty at night and sixty-five is preferable.

Radish.

The radish is among the most easily forced of the vegetables, but in New England markets there is only a relatively small demand for it during the winter. It is best grown as a catch crop—as in the interim between lettuce and cucumbers in spring or between crops of beans—or a single bed may be devoted to this crop in the lettuce house. (See Plate.)

It is usually supposed that the radish demands much the same conditions as lettuce, but in our experience better results have been obtained in a much higher temperature than is suitable for lettuce. The crop must be forced into a rapid and continuous growth in order to secure the fresh, crisp roots that are desired. In rich soil and with sufficient water it is sometimes ready for market in twenty-one days from the seed.

The red turnip-rooted varieties are the ones used mainly for forcing. Of these Cardinal Globe and Non Plus Ultra are among the best. White Box is a favorite in some markets.

An important point to observe in marketing is that the radishes in any given bunch be of uniform size. The wholesale market price will range from $2 to $4 per 100 bunches. A bunch usually takes about eight to twelve roots; varying with the size.

In a general way, as pointed out by Galloway, it is found that about thirty-five per cent. of a given crop of radishes will reach marketable size in thirty-five to forty days, thirty per cent. requiring two to three weeks longer and the rest never mature. Now here is a chance for loss. If the whole crop is taken off when the first plants are mature—as is very desirable—we have no returns from about two-thirds of the ground occupied. On the other hand, if we wait for more of the plants to mature, the next crop is held back fully two weeks and in course of the season this means loss of time sufficient to grow one full crop.

A solution for this difficulty is offered by Professor Galloway of the Department of Agriculture in a very careful study of the relation of the size and weight of seeds to the growth of plants.

In his studies of the radish Mr. Galloway found that, "large seed germinated more quickly and certainly and produced marketable plants sooner and more uniformly than small seeds."

He further concluded:

"(1) By the use of large seed eighty-five to ninety per cent. of the crop may be brought in at the same time.

"(2) Practically all the plants thus grown being marketable no ground is wasted.

"(3) Enough time is saved by using large seed to grow one additional crop during the season. In other words, if four crops are grown, using mixed seed and waiting for plants to attain marketable size, five crops can be grown if large seed is planted.

"(4) The only additional expense is the extra amount of seed used, all the smaller ones being sifted out and thrown away."

This extra expense will average perhaps twenty-five cents per pound of seed. But as one pound will plant about 1,500 square feet of ground, the item is not of great importance.

Beans.

Beans are easily forced and in many places form one of the best secondary catch crops. They are ready for picking in six to eight weeks from the time of sowing and may well be grown on the beds devoted to melons and cucumbers, before the latter need the whole space. The same soil and general conditions described for cucumbers are well suited for the crop.

Beans may be started on the benches where they are to grow, or in pots—two or three beans in a three inch pot—and transplanted in about two weeks. Successive crops are usually started in pots.

Lack of heat in the early stages of growth may delay the crop for a month, so it is not the part of economy to delay heating the house in the fall. A night temperature of about sixty degrees is found best.

Special care is necessary in watering; the leaf surface, and consequently the transpiration of moisture, is enormous and there is danger that the soil may become dry from beneath.

An occasional spraying does no harm, but in general it is best to water with a solid stream and see that the soil is thoroughly wet.

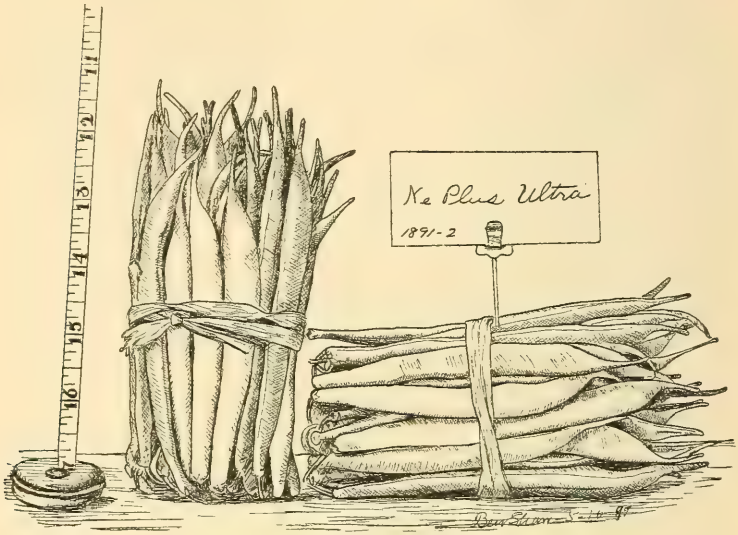


FIG. 5. BEANS READY FOR MARKET.

Growth should be continuous and rapid from the first. A little nitrate of soda, say once a week, after the blossoms appear, will not be amiss. This may be applied in water as described for lettuce.

The crop should all come off within a few days—three or four pickings—so it is important to have the succeeding crop well advanced, that little time may be lost.

The essentials of a good forcing bean are that it should be of compact habit, early maturity, and that there should be an abundance of long, straight cylindrical pods. Sion House is perhaps the best variety for forcing, though Refugee and Ne Plus Ultra have done well. Most of the wax varieties are too unsymmetrical and too susceptible to disease.

For marketing, the pods are tied in bunches of fifty, as shown in figure 5. These bunches should bring fifteen to twenty-five cents each. At this price the crop is profitable.

Asparagus.

This crop is best grown in a portable house, i. e., the roots are planted somewhat more closely than in the field and a temporary house is erected in March to hasten the crop in spring. Sometimes a permanent iron frame is erected and steam pipes are laid about the bed. Glass or canvas is then put on and heat started whenever desired. Such a house is in use at the Cornell University.

An inexpensive modification of this method is sometimes employed. Three rows of asparagus are planted in the ordinary way, the rows, however, being but two feet apart. They are given ordinary field culture till well established. Lines of boards are then set on edge along each side of the bed and hot-bed sashes are laid across, making an ordinary cold frame. The crop may thus be materially hastened, but of course will be later than if supplied with artificial heat. In summer the sashes are removed and the bed is given ordinary open air culture.

The labor and expense of forcing asparagus are light and prices are always remunerative.

Rhubarb.

This crop readily responds to heat and moisture and might well be grown more largely than at present. As usually grown, roots are taken up in the fall and stored till the crop is desired, when they are brought into a moderately warm house and placed under the benches, or in some cases are placed in a "spent" hot-bed. This is a wasteful practice as the roots can be forced but once.

The best plan is that followed in some parts of Massachusetts where a skeleton house is erected, as suggested for asparagus, and provision is made for steam heating. The sides of the house are covered with sheathing or with heavy paper and the sash are put in place whenever it is desired to start the crop. The plants are set two feet apart each way and given ordinary field culture during the summer.

Summary.

Constant watchfulness and the exercise of good judgment are of more importance than adherence to set rules.

A single house standing alone, covering 2,000 square feet of surface, will require about twenty-five tons of coal for the year.

One good man with occasional help should be able to do all the work in houses covering 4,000 square feet of ground surface.

The simplest form of glass structure is the cold frame. Aside from its use in starting early plants it is little used in "winter gardening."

The hot-bed is similar to a cold frame with the addition of "bottom heat."

The uneven span house is the form in most common use. The even-span is used mainly for narrow propagating houses and for conservatories.

The best green house wall is that which, at least expense, is perfectly rigid, is durable, and will effectually shut out drafts of cold air. A cheap and effective wall is made by the use of posts and matched boards.

The glass for greenhouse roofs should be second quality, double thick and of good size—14x22 or 16x24 inches preferred.

The object of ventilation is to purify the atmosphere, rather than to lower the temperature.

In modern greenhouse heating we have only to consider two general systems—steam and hot water in closed circuits.

In general, solid beds are advocated for plants requiring no bottom heat, such as cauliflower, lettuce, radishes, etc.; while for semi-tropical plants like melons, beans and tomatoes, benches are preferred.

When and how to apply water is more important than the source of supply.

There is a marked difference in the ability of plants to stand direct sunlight.

The secret of success is to have something on the ground constantly. The most important crops are lettuce, tomatoes, cucumbers and radishes. Asparagus, bean, parsley, etc., are valuable for keeping up a succession of crops.

NOTES ON PLANTS.

F. L. Harvey.

Specimens of the following plants have come to the Station from correspondents during the year. The sender has been given the information asked and in some instances the weeds have been made the subject of newspaper articles and bulletins.

Wild Peppergrass (*Lepidium intermedium Gray*) has been reported from many localities this season. It is becoming quite common along roadsides and waste places about towns. Source, western clover seed.

Rabbit-Foot Clover is becoming a common weed along roadsides and in waste places about towns.

Vetch (*Lathyrus palustris.*) Coarse and fine-leaved varieties are very common in Southern Maine along railroad embankments and in car yards. It is spreading.

The Orange Hawkweed has been reported from several new localities. It should be carefully looked after.

Rag Weed (*Ambrosia artemisiaefolia*) is becoming a common weed along roadsides and in fields. It is an annual and could be easily eradicated with care.

The Wild Carrot is spreading rapidly in some places. In many localities in the State it is allowed to grow along roadsides unmolested, to scatter seed far and wide.

The Sow Thistle (*Sonchus arvensis*) is becoming very common in cultivated fields. Clean culture would eradicate it.

The Ground Cherry (*Physalis Virginiana*) was reported the past season for the first time. The plant probably came from the West in clover seed.

The Buffalo Bur (*Solanum rostratum*) made its appearance the last season where carloads of western corn were screened. This plant was considered in a special bulletin.

THE CLOVER DODDER continues to be reported from new localities.

BUTTER AND EGGS is becoming a bad weed in Maine. It usually contents itself by growing along roadsides and in waste places, but this season we saw a field overrun with it. The second crop of seeds had matured after the grain was cut.

YELLOW RATTLE (*Rhinanthus crista-galli*) is becoming a great nuisance in grass lands on the islands along the coast and adjacent sea shores. It is an annual and careful culture would check it. We saw this weed along roadsides at Jackson.

GREEN AMARANTHUS or PIG WEED is one of the most common garden weeds in Maine. It will spring up and perfect its seed after the crops have gone by. It should be pulled in the fall before it seeds.

CULTIVATED RYE appeared as a weed in many fields in Maine the past season. Probably introduced with grass seed. Its tall stalks made it conspicuous and growing as a weed it was not recognized by many.

CULTIVATED FLAX is introduced in western clover seed and it is not uncommon to see the beautiful flowers of this plant in fields.

THE STRAWBERRY LEAF BLIGHT is the most common strawberry fungus in Maine, producing brown spots on the leaves.

THE BLACKBERRY RUST was quite abundant the past season. As this fungus lives over winter in the plants, nothing short of destroying the infected plants before they scatter the spores will eradicate the disease.

PLANTS EXAMINED IN 1896.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	Red Baneberry	*Actæa spicata rubra*	A. N. Lufkin, East Orrington.	
2	Wild Peppergrass	*Lepidium intermedium*, Gray.	Fred S. Hayes, Oxford; A. N. Lufkin, East Orrington; H. H. Payson, Hope; L. O. Straw, Newfield; E. G. Barker, Easton	Weed in fields and waste places. Introduced in western clover seed.
3	Spurry	*Spergula arvensis*, L.	I. N. Lapham	Weed in grain fields. Sometimes cultivated for forage.
4	Bladder Ketmia	*Hibiscus Trionum*, *L*	Samuel Libby, Orono	Weed in garden.
5	Rabbit-foot Clover	*Trifolium arvense*, L.	J. G. Harding, Waldo	Weed in fields and along roadsides.
6	Vetch	*Lathyrus palustris.*		
7	Purple Flowering-Raspberry,	*Rubus odoratus*, *L*	B. W. McKeen, Augusta.	
8	Orange Hawkweed	*Hieracium aurantiacum*	O. S. Overlock, South Liberty, and others.	
9	Ragweed	*Ambrosia artemisiæfolia*, L.	J. B. Alline, Addison, and others.	In grass fields.
10	Yellow Daisy	*Rudbeckia hirta*, L	Chas. Plummer, Jr., Charleston	Weed in cultivated land easily eradicated. From the West.
11	Sow Thistle	*Sonchus arvensis*, L	B. W. McKeen, Augusta	Weed in cultivated ground.
12	Husk Tomato, or Ground Cherry,	*Physalis Virginiana*, Mill.	J. W. Butterfield, East Dixfield	Introduced in western clover seed.
13	Buffalo Bur	*Solanum rostratum*, Dunal	E. C. Carll, Buxton	Came up where cars of western corn were unloaded.
14	Clover Dodder	*Cuscuta epithymum*, Murr	A. Merriman, Harpswell Center.	Parasite on clover.
15	Butter and Eggs	*Linaria vulgaris*, Mill	Daniel Lindsay, Carroll	Weed along roadsides and in fields.
16	Pubescent Beardstongue	*Pentstemon pubescens*, Solander	F. E. Bixby, Anson	Weed in cultivated field.

PLANTS EXAMINED IN 1896—CONCLUDED.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
17	Yellow Rattle	*Rhinanthus Crista-galli*, L	R. S. Warren, South Deer Isle	Weed on sandy seashore.
18	Pigweed, Green Amaranthus	*Amarantus retroflexus*, L	E. E. Light, Union	Weed in cultivated ground.
19	Black Bind-weed	*Polygonum convolvulus*, L	Various parties	Introduced in western grain.
20	Coral-Root	*Corallorhiza multiflora*, Nutt	N. W. Lennard, Thomaston	Sent for name.
21	Cultivated Rye	*Secale serale*	E. E. Paine, Jay L. F. Abbott, Lewiston	Weed in cultivated fields.
22	Hungarian Grass	*Setaria Italica*	B. W. McKeen, Augusta	For name. Weed in fields.
23	Strawberry Leaf-blight	*Sphaerella fragariae*, Sacc	Various parties	Very common in Maine.
24	Blackberry Rust	*Cæoma nitens*, Schw	F. A. C. Emerson, Garland	Attacking the leaves of living blackberries.
25	Pear Leaf Blight	*Entomosporium maculatum*, Lev	W. L. Mace, East Winthrop	Attacking the leaves and twigs of pears, causing them to turn black.
26		*Cœnangium conspersum*, Fr	R. C. Fuller, Wilton	Attacking apple trees.

WEEDS AND SEEDS.

That weeds are increasing in Maine is apparent to anyone whose attention has been called to the matter. Scarcely a year goes by without the introduction of some new weed not previously reported from the State. The spread on the farm, or from farm to farm of old acquaintances is of common occurrence.

The weed question has become a serious one to the farmers of Maine. It is a hopeful sign that public opinion is becoming aroused on the subject.

There are several causes for the introduction and spread of weeds, but they are largely under the control of farmers through personal attention and legal enactment.

Weed seeds may get into the State in discarded ballast from vessels; through packing material from other states and countries; on through cars; by migrating birds and other minor sources, although these latter causes are only occasional and accidental. By far the most serious and certain causes are the annual importation of seeds for planting and grain for feed. In later years farmers have grown less grain than formerly and the demand has steadily increased with our growing stock industry. We are more dependant than ever upon other states both for seeds and grain for feeding. With this foreign seed and grain have been introduced the weeds growing in the regions from which they came.

Farmers have not been alive to the importance of not introducing weeds into their fields and have been quite indifferent in regard to the quality of the seeds they have sown and the grain they have fed. They have not seen the importance of destroying weeds in their fields when first introduced; have allowed them to overrun the farm and spread from farm to farm until the fighting of weeds has become a most serious problem. There being no laws against the selling of seeds and grain harboring the seeds of bad weeds, dealers have taken no great pains to offer for sale a quality of seed better than the consumer demanded. Farmers in Maine are largely using a third grade seed when they could get a first grade by paying a little more for it. Dealers say that farmers often from choice take a poorer grade of seed when a better could be had at a few cents

more per bushel. We learn that most of the seed sold in Maine is distributed from Chicago and goes through a screening process to get the weed seeds out. It is by no means thoroughly cleaned. That the seed offered for sale could be farther improved and the percentage of weed seeds reduced to a minimum we have no doubt. All farmers have to do is to demand a clean seed and it will be grown. The price would be higher, but it would be much cheaper in the end. We do not believe that a uniformly absolutely pure seed can be grown. Scattering weed seeds must be expected and farmers must be alive to destroying the scattering weeds that appear in their fields the year they seed and the year following. The remedy would be to demand a purer seed and then carefully destroy the scattering weeds that spring up before they spread.

We believe farmers have overlooked grain brought on the farm for feed, as a source of weeds. *We believe more bad weeds are introduced this way than by seeds.* The seed sold in Maine is screened, while that imported for feed is not screened. The latter would naturally harbor more weed seeds, as the cleaner grain is always selected for seed. Grain is scattered where the cars are unloaded and along highways from the centres of distribution to the farm. In feeding on the farm it gets into manure and thence into the fields. We learn from good authority that grain brought in by the carload for feed is sometimes retailed for seed, and that farmers knowingly, to save (?) a few cents, sow such inferior seed. To determine how far grain imported for feed is a source of weed distribution in Maine we addressed a letter to the Maine Central Railroad and received the following reply:

Professor F. L. Harvey,

Maine State College, Orono, Me.:

Dear Sir,—I have your communication of the 3rd inst., and beg to give you the information that the delivery of cars loaded with western grain is not confined to any one or to a few principal points along our line, but I am sorry to say, for your purpose, that such cars are regularly delivered at every station, though some may receive a larger proportion than others, and such stations I should say would be Portland, Brunswick, Bath,

Gardiner, Augusta, Waterville, Auburn, Lewiston, Winthrop, Oakland, Livermore Falls, Farmington, Skowhegan, Pittsfield, Newport, Dexter, Foxcroft, Belfast, Bangor, and on our White Mountain Division like Fryeburg, Brownfield, Cornish, Steep Falls and Sebago Lake.

That western grain brought in by the carloard is often very foul with weed seeds will appear from the following:

One party sent us a *pound* of seed oats from the West, purchased from a local dealer who represented it as cleaned seed and charged several cents per bushel more for it. It was probably unscreened grain from cars. An examination of this seed gave the following results: 1,160 mustard seeds, 576 black bind-weed, 111 goosefoot, 13 smartweed and sorrel, 28 flax seed, 20 grass seeds, several foxtail, 4 wild morning glory, 3 bugloss and several seeds of six different kinds of compositae, not identified.

From another party we received samples of foul seed screened from oats bought for seed. Eight ounces of the foul seed contained as follows: Black mustard, English charlock, jointed charlock, shepherd's purse, pigweed, bind-weed, smartweed, bugloss, flax seed, morning glory, several kinds of grass seed and compositae, and one seed that looked like the Russian thistle.

Samples like the above are not uncommon. We have examined western oats that were fully one-third by weight jointed charlock. The past season a weed new in Maine, the buffalo bur, came up where a carload of western grain was unloaded and screened. Every town where cars are unloaded is liable to become a centre of weed distribution. The only remedy for this is for farmers to use ground feed and not import whole grain.

In the solution of the seed and weed question the following points may be worthy of consideration by the farmers of the State:

1. As far as possible seed grown in the State should be used. Even if such seed be weedy, no new weeds are likely to be introduced. Many farmers grow clean seed on their farms and thus escape the introduction of weeds.

2. Purchase the best the markets afford, as to plumpness, brightness and freedom from weed seeds. If dealers do not keep a satisfactory seed, demand better and it will be provided. It is best to buy early before the rush of planting time.

3. Farmers should watch their fields carefully, especially after seeding, and destroy any new weeds that appear before they seed and spread. This is absolutely necessary, as seed entirely free from weed seeds is not on the market.

4. Farmers should be alive to the importance of clean culture and the necessity of destroying weeds along roadsides, fence corners, hedge rows and waste places. Weeds take the food supply from plants grown for profit, reduce the yield per acre and are themselves worthless. It takes time and money to kill weeds and they yield no return. It becomes an endless job if weeds are allowed to propagate themselves about the fields and annually scatter a fresh supply of seeds. Better strike a blow at the sources of weed seeds. It would be cheaper in the end.

5. Railroad companies should be made responsible for not destroying weeds that spring up in car yards and about depots where cars of western grains are unloaded, and along railroad embankment where weeds frequently spring up from seed brought long distances in ballast or dropped from passing cars. It is unjust that the farming community should suffer from the carelessness of corporations. Towns should be held responsible for allowing weeds to grow in the streets and roads, around lots, and in waste places, to become centres of distribution to farms.

6. Property owners, residents and non-residents should be responsible for harboring weeds along the roadsides fronting their property. This is desirable to protect careful farmers from their shiftless, thriftless neighbors and from weed patches on unoccupied land.

7. As grain brought in by the carload harbors so many weed seeds, the attention of farmers is called to the danger they run in bringing whole grain on the farm for feed.

FIG. 1.

FIG. 2.

FIG. 3 a & b.

FIG 4.

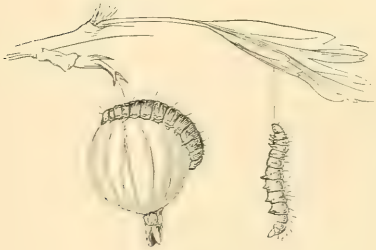


FIG 3 c.

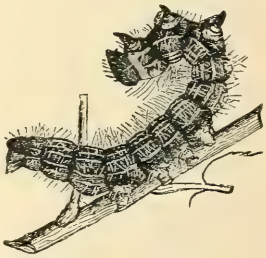


FIG. 5.

FIG. 6.

FIG. 7.

NOTES ON THE INSECTS OF THE YEAR.

F. L. Harvey.

Woodlouse or Sow Bug, a crustacean belonging to the genus Oniscus, was reported as doing damage in mushroom cellars by eating the fungi. They can be killed by putting pieces of potato poisoned by a solution of arsenic in the beds.

Croton Bugs were received from Monmouth, Me. These no doubt were introduced in packing materials. This insect is quite abundant in some towns in the State. It is an importation from Europe. They frequent houses especially about water pipes. Free use of insect powder scattered where they frequent is said to destroy them.

The Oyster-shell Bark-louse is exceedingly abundant and is increasing rapidly. As it saps the vitality of trees without attracting much attention, it is overlooked. It seems to thrive better in the North, being worse in Maine than farther south. It does more injury to young trees. We have received information this season of orchards of young bearing trees so badly infested that the twigs of all the trees were literally covered with the scales. The life history of this scale is given in the Report of this Station for 1888, p. 157, but we wish to add the following regarding treatment. The usual way is to apply a dilute alkaline wash to the trees in the spring after the young lice hatch. These scales could be treated in the winter at any time by applying thoroughly to the trees and small branches with a brush a *strong* alkaline wash, made by dissolving two pounds of whale oil soap in one gallon of water. The cost of the material would be more for the strong wash, but there is more leisure in winter to do the work. The strong wash should not be applied after the leaves start.

THE HEMISPHERICAL SCALE was found quite abundant upon ferns grown in the house at Orono. It is also found on ferns in the Station forcing house. It yields readily to treatment with alkaline or kerosene alkaline solutions.

THE ELM-TREE BARK-LOUSE considered in the Report of this Station, 1894, page 83, was reported again this season as abundant on elms.

The elms in Maine are also infested with CANKER WORMS, MOURNING CLOAK BUTTERFLY, THE OAK-BARK WEEVIL and the STEEL-BLUE FLEA BEETLE, (*Haltica chalybea.*)

THE BUFFALO TREE HOPPER was reported this season for the first time as doing damage to the foliage of apple trees. It is pale grass-green in color, marked with whitish dots and a pale yellow streak along each side. It is an active, jumping insect. The form and size are shown in the accompanying plate, Fig. 1.

THE YELLOW-NECKED APPLE-TREE CATERPILLAR was reported this season for the first time as feeding on the foliage of apple trees. The small white round eggs of this insect are laid side by side in nearly straight rows on the under surface of the leaves. The young larvae eat only the pulp of the leaves. When older they devour all but the stem, destroying all the leaves on a branch. The full grown caterpillars are about two inches long. The head is large and black. The joint next to the head is dull orange. There is a black stripe down the back and four yellow stripes down the sides, alternating with three black ones. Body clothed with soft whitish hairs. Fig. 5 shows the caterpillar in the position it assumes (with the head and tail up) when disturbed. Though partial to apple trees, it attacks plums and pears and several kinds of deciduous trees. It is capable of doing great damage when abundant. The larvae feed together and the branch on which they occur can be cut off or the clusters of insects crushed.

THE FALL CANKER WORM so abundant for several years has not been abundant the past season, though doing some damage in southern and western Maine.

THE CURRANT SPAN WORM is very abundant about Orono. Our attention was called to currant and gooseberry bushes almost barren of foliage from the attacks of this insect. It is very different from the Currant Sawfly worm, which is so common in Maine. It is the larva of a geometrid moth, and has the habit common to inchworms of arching the back when crawling. When full grown it is about an inch long, whitish in color, with a yellow stripe down each side and another along the back. The segments are spotted with black. There is but one brood in a season. The larvae have the habit of suspending themselves with a silken thread when disturbed. Fig. 4 shows the larvae, pupa. The moth is shown in Fig. 2. Hellebore will not destroy this insect. Paris green would be effective, but the worms are worst when the fruit is nearly grown. Possibly a strong wash of whale oil soap and water applied in the winter might destroy the eggs which are deposited on the twigs and branches.

THE GOOSEBERRY FRUIT WORM seems to be on the increase. It is common on the wild gooseberries in Maine and may spread from this source. This worm is the larva of a small moth which is shown in Fig. 3 b. The cocoon is shown in Fig. 3 a. The larva, Fig. 3 c. The moth deposits its eggs upon the young berries and the worms gnaw into the fruit. As they grow, several berries are enclosed in a web, and the worms live on them. Infested berries ripen prematurely. When disturbed, the worms let themselves down quickly by a thread, which makes it difficult to destroy them by hand picking. Rubbish should be removed from under the bushes where the insect hibernates.

THE LIME TREE WINTER MOTH was reported this season in injurious numbers. It seems to remain where the Fall Canker Worm has about disappeared. It was considered and figured in the Report of this Station, 1893, page 161.

THE ARMY WORM made its appearance in limited numbers at Corinth. Mr. W. E. Jordan, who sent us specimens, reported it as feeding on oats.

THE ASH-GRAY PINION was reported again this season as eating into apples. This species is figured in the Report of this

Station, 1888, page 176. The larva of *Pororgia Clintonii* was reported from Aroostook county as feeding on the foliage of apple trees.

THE VELLEDA LAPPET MOTH. This insect was received from Western Maine where it was mistaken for the Gypsy Moth. This species having never been reported before from Maine we give cuts of the moth and larvae.

The body of the larva is covered with warts, which bear tufts of black hairs. On the back and at the sides, gray hairs are mixed with the black. When at rest the caterpillars lie close to the twigs and are hard to see. The flat under-surface is pale orange marked with black dots. See Fig. 6. The moths are gray and white. See Fig. 7.

THE APPLE-TREE TENT CATERPILLAR was very abundant the past season in Western and Southern Maine.

The season has been remarkable for the great number of leaf eating insects reported. Besides those noted or found in the list printed above there were several species of budmoths and leaf rollers, that did much damage. These insects could be controlled by spraying, a practice that is gradually coming into favor among fruit growers in Maine, but which could be employed profitably much more than at present.

THE CURRANT FLY (*Epochra Canadensis*) was more abundant than ever the past season about Orono. It is not generally distributed. There are none in the Station garden, though badly infested gardens occur in Orono.

THE APPLE MAGGOT (*Trypeta pomonella*), we are happy to say, has nearly disappeared in several localities during the past season where it was very bad before. Whether it has really gone or whether the large apple crop has made it appear less numerous on account of abundant food supply is a question. It is probable, however, that the late appearance of snow for the past two years together with freezing and thawing have destroyed the pupae, which are deposited so near the surface. Flies as a class are fragile and subject to injury by great climatic changes.

Rat-tail Larva, the maggot of a species of two winged fly which has a long tail-like appendage to the body, was received for examination.

These maggots live in water or liquid decaying organic matter. So say the books. The long tube like a tail is used as a respiratory organ. One of the specimens received was taken in chip dirt on the floor of a wood-shed. It would seem that they also live in dry situations and put the tube to the surface of the debris to breathe.

From one of the specimens came a large yellowish brown fly. These flies live on the pollen of flowers and are often seen about flowers during the summer.

The Horn Fly continues to be reported but seems to be on the decrease in Maine.

The Buffalo Beetle is spreading. We have had word of it from several new localities the past season.

The Pigeon Tremex is doing considerable damage to maple and other shade trees in some parts of the State.

Ptinus Fir, a small beetle, was reported as badly infesting a bag of timothy seed. The bag had been hanging in a finished room from May until the following March. When examined, thousands of the beetles were found. This is an introduced species from Europe. Probably a few got in before the seed was hung up, and multiplied.

INSECTS EXAMINED IN 1896.

No.	Common Name.	Technical Name.	From Whom Received.	Remarks.
1	Wood-louse. Sow Bug	*Oniscus species*	B. Walker McKeen from Auburn,	Eating mushrooms in cellar.
2	Cat Tick	*Ixodes erinaceus*	T. D. Morril, North Yarmouth	On domestic cat.
3	Croton Bug	*Phyllodromia Germanica*	Mrs. M. O. Edwards, Monmouth.	In store. Probably brought in packing material.
4	Grape-vine Leaf-hopper. Thrips	*Erythroneura vitis*, Harris	Ora Knight, Bangor.	
5	Oyster-shell Bark-louse	*Mytilaspis pomorum*	A. S. Field, Bangor Fred S. Wiggin, Maysville	On apple trees.
6	The Hemispherical Scale	*Lecanium hemisphæricum*, Targioni	Eben Webster, Orono.	On ferns in house.
7	Elm-tree Bark-louse	*Lecanium*	C. H. Morrell, Pittsfield.	
8	The Buffalo Tree-hopper	*Ceresa bubalus* (Fobr.)	R. A. King, East Monmouth	On foliage of apple trees.
9	Yellow-necked Apple-tree Caterpillar	*Datana ministra* (Drury)	J. F. Talbot, Andover	Eating foliage of apple trees.
10	Red-humped Apple-tree Caterpillar	*Œdemasia concinna* (Sm. & Abb.)	F. E. Bixby, Anson	Eating foliage of apple trees.
11	The Fall Canker-worm	*Alsophila pometaria*	Gilman Blood, Foxcroft.	
12	The Currant Span-worm	*Diastictis ribearia*	F. L. Harvey, Orono.	
13	The Gooseberry Fruit-worm	*Dakruma convolutella* (Hübn.)	Mrs. W. H. Davis, West Gardiner,	Attacking the fruit.
14	The Lime-tree Winter Moth	*Hybernia Tiliaria*, Harris	Gilman Blood, Foxcroft R. A. King, East Monmouth	Attacking apple trees. Attacking apple trees.
15	The Army Worm	*Leucania unipuncta*	W. E. Jordan, Corinth	Attacking oats.
16	The Ash-gray Pinion	*Lithophane anthenata* (Walker)	C. H. Davis, Harmony	Eating into apples.
17		*Pororgia Clintonii*	Bagely Bros., Caribou	Larva feeding on apple.
18	The Plum-tree Sphinx	*Sphinx drupiferanum* (Sm. & Abb.)	O. S. Shaw, Winthrop	On apple tree.
19	Fall Web-worm	*Hyphantria textator*, Harris	A. T. Wing, Weld	Pupa on limb of apple tree.

20	THE VELLEDA LAPPET-MOTH.	*Tolype Velleda* (Stoll)	C. H. Thompson, Jay	Mistaken for gypsey moth.
21	APPLE-TREE TENT-CATERPILLAR.	*Clisiocampa Americana*, Harris	D. J. Bixby, South Turner, and several others.	
22	LUNA MOTH	*Tropæa luna*	S. J. Spalding, North Buckfield.	
23	CECROPIA MOTH	*Platysamia Cecropia* (Linn.)	C. Fenderson, Wilton	Cocoon on apple tree.
24	MOURNING CLOAK BUTTERFLY	*Vanessa antiopa*, L	C. H. Morrell, Pittsfield.	
25	RAT-TAIL LARVA	*Mollota*	H. W. Goodwin, West Lewiston	In decaying organic matter.
26	HORN FLY	*Hæmatobia serrata*	J. E. Crocker, St. Albans	On cattle.
27	BUFFALO BEETLE	*Anthrenus Scrophulariæ*, L	Isabel F. Hinckley, Bangor, and others	Destroying carpets.
28	BACON BEETLE	*Dermestes lardarius*	B. H. Dunham, Foxcroft	In pantries from May until October.
29	SUGAR MAPLE BORER.	*Plaginotus speciosus*	Sam. Richards, South Paris	Doing injury to maple trees.
30		*Ptinus fir*	William L. Jackson, Greenfield	Destroying stored Timothy seed.
31	PLUM CURCULIO.	*Conotrachelus nenuphar* (Herbst.)	Chas. Vaughn, Hallowell	Attacking plums.
32	OAK-BARK WEEVEL	*Magdalis olyra* (Herbst.)	C. H. Morrell, Pittsfield	Elm trees.
33	LESSER GRAIN-BEETLE	*Sylvanus surinamensis*, L	N. A. Haskell, New Gloucester	Specimens from Massachusetts.
34	ASH TIMBER-BEETLE	*Hylesenus aculeatus*, Say	W. L. Mowyer, Greene.	
35	MAY-BEETLE	*Lachnosterna fusca* (Frohl.)	Miss M. Minot, Bar Harbor	Feeding on grass roots in lawn.
36	CUCUMBER FLEA-BEETLE	*Crepidodera cucumeris* (Harris)	B. W. McKeen, Augusta	On potato leaves.
37	STEEL-BLUE FLEA-BEETLE	*Haltica chalybea*	C. H. Morrell, Pittsfield	On elms.
38	PEAR-TREE SLUG	*Selandria cerasi*, Peck	C. H. Morrell, Pittsfield	Eating foliage of pear trees.
39	BLACKBERRY SEED-GALL	*Diastrophus cuscutæformis*, O. S	E. F. Roundy, Bangor	Making gall-like excrescence on blackberry leaves.
40	ICHNEUMON	*Pelecinus polyturator*	F. W. Gifford, Dover	About orchards. Probably beneficial.
41	PIGEON TREMEX	*Tremex Columba*, L	S. Richards, South Paris	Boring in maple trees.

A NEW GARDEN SMYNTHURID.

Smynthurus albamaculata n. sp.

By F. L. Harvey.

Body dull blue-black with steel blue reflections in direct light, obscurely marked with numerous small whitish blotches of variable shape and size, arranged in poorly defined transverse bands, giving a marbled appearance. Head, terminal segments of the body, antennae, legs and elater pale purple. Underside of body pale brownish. Sides of head and the vertex yellowish brown. Eye patches black, bordered on the inner margin by a whitish band which is constricted in the middle giving the appearance of two spots. Antennae more than half as long as the body. Ratio of segments 1:2½:3:5. The basal joint widest, globular and whitish. Base of the second segment light. Terminal segment composed of nine joints. (In young specimens apparently eight jointed by the coalescence of the two terminal). Antennae, legs, elater and body clothed with hairs. Body widest behind, abruptly narrowing into the terminal segments. Anal tubercles prominent. Claws medium size. The larger, .031 m. m. with a single tooth on the inner edge near the end. Short claw, .017 m m. plain, broadest in the middle. Two tenent hairs about the length of the longer claw and extending about two-thirds the length of the claw. Furcula short and stout. Ratio to body 4:7. Ratio of parts of furcula: manubrium 4, dentes 4, mucrones 1. Dentes with about ten bristles on the lower edge. Mucrones curved near the base, narrow lanceolate and plain. Length of insect .8 to 1.4m m.

Habitat:—Found abundantly during May and June in gardens. Doing much damage to early garden plants. Attacks radishes, beans, cucumbers, squashes, etc., eating numerous holes in the epidermis of the leaves and sucking the

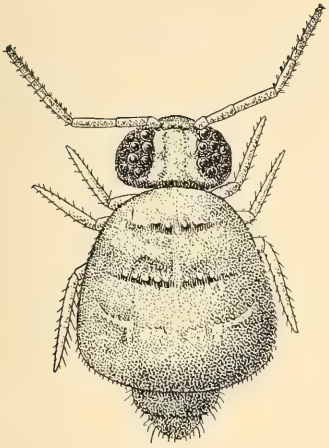


Fig. 1.

Fig. 3.

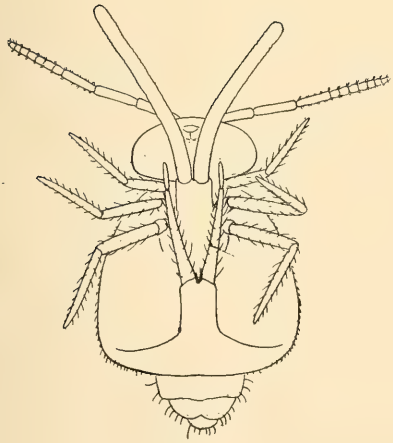


Fig. 2.

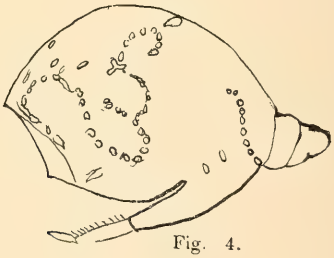


Fig. 4.

Fig. 5.

SMYNTHURUS ALBAMACULATA, Harvey.

juices until the leaves wither. Numerous specimens examined during the last five years. Orono, Me., F. L. Harvey.

Distinguishing characters:—This species has the same habits as Fitch's *S. hortensis* and is equally as injurious. For a long time we took it for that species. It has the dark body and lighter head, legs, antennae and elater of the above. It is, however, readily distinguished by the purple of the head, antennae, terminal segments of the body and elater, the obscure white markings on the body and especially by the nine joints to the terminal segment of the antennae. There being in *S. hortensis six* segment to the terminal joint, according to Fitch and McGillivray—but really seven if Fitch's figure is correct. The only species we know of having been found in America with nine joints to the terminal segment of the antennae is *S. roseus,* Packard, from which our species differs in the color of the body, size and habits.

Remarks:—The young of this species are lighter colored than the adults, appearing brownish to the naked eye and often show only eight joints to the terminal segments of the antennae. The older specimens acquire the blue black color and reflections. The marbled appearance of the body cannot be seen by the naked eye or a hand glass readily and the casual observer would say the body was plain, blackish. The whitish markings can be readily seen by magnifying 75 diameters. They appear as though they were under the skin and show through it. Alcohol and glycerine specimens show the markings plainly.

By careful examination of alcoholic specimens we found there was a median dorsal brownish stripe extending from the head half the length of the body and ending in a clover leaf white spot. There are three obscure transverse bands made up of white spots, giving the surface a mottled appearance. The anterior band from dorsal view shows two white spots each side the median line. The second stripe bears five oblong spots each side of the median line and lower on the sides an S shaped marking composed of a chain of white blotches. Still lower on the side and anterior to the first and sloping forward is another S formed by a chain of spots, the lower loop of the first S making the posterior loop of the second. See Fig. 4.

Starting near the base of the manubrium and running obliquely up the side of the body and ending in the dorsal view is a stripe of oblong whitish spots. The white spot next to the dorsal end placed inward out of line. Fig. 3, a.

We have tried to show the arrangement of these markings in Figs. 3 and 4.

Description of Figures:—Fig. 1, drawn by Mr. J. H. Emerton from live specimens, shows well the form of the body and the obscure transverse bands. The drawing was made from live specimens. Fig. 2, drawn by Mr. Emerton, shows a ventral view of the same. Fig. 3, drawn by the writer, shows in detail the white markings as seen in alcoholic specimens, examined by high powers. No attempt is made to show more than the location of the markings. Fig. 4, is a side view showing location of the spots. Fig. 5, shows structure of the foot.

Remedies:—We do not agree with Fitch that the work of the Smynthurids is entirely secondary, at least this species is capable of sucking the juices in some way without the aid of other insects. The above species was very abundant on cucumbers in my garden this season but we did not notice the Flea Beetle. Some times there would be more than a dozen on a single leaf. In a few days the leaves turned whitish and on examination the epidermis was found full of little pits. Rarely, if ever, was there a hole through the leaf. They attack the new, young plants, eating the seed leaves (cotyledons). The application of dirt, ashes, sulphur or pyrethrum while the dew is on will act as deterrents until the plants are larger when they appear to do but little damage. We searched for specimens June 25th, and found them very scarce.

METEOROLOGICAL OBSERVATIONS.

Reported by L. H. Merrill.

These observations were made under my direction, by members of the Station force. Readings were taken at 7 A. M., 1 P. M. and 9 P. M. The instruments were those in general use by the Weather Bureau. Lat. 44°, 54′, 2″, N. Long. 68°, 40′, 11″, W. Elevation above the sea, 150 feet.

METEOROLOGICAL SUMMARY

For the Six Months Ending December 31, 1896.

	July.	August.	September.	October.	November.	December.	Mean.
Highest barometer	30.56	30.43	30.53	30.71	30.94	30.89	30.68
Lowest barometer	29.69	29.85	29.57	29.57	29.69	29.27	29.60
Mean barometer	30.10	30.14	30.17	29.93	30.27	30.20	30.14
Highest temperature	86	92	87	68	68	45	74
Lowest temperature	55	39	28	23	-4	-9	22
Mean temperature	66	65	55	45	35	20	48
Total precipitation	2.58	4.26	8.00	3.75	4.23	1.30	
Number of days with precipitation of .01 inch or more	6	10	9	15	11	6	
Number of clear days	.....	10	7	9	5	15	
Number of fair days	....	11	15	9	11	11	
Number of cloudy days	.....	10	8	13	14	5	

DIETARY STUDIES AT THE MAINE STATE COLLEGE.

The investigations upon the food and nutrition of man referred to in the Director's Report as in progress in coöperation with the United States Department of Agriculture are reported upon, for the year 1895, in Bulletin 37 of the Office of Experiment Stations on "Dietary Studies at the Maine State College," by W. H. Jordan, the former Director of this Station. The following brief abstract is from that bulletin. A limited number of copies of Bulletin 37, containing the full account of these studies, are at the disposal of the Station. They will be sent to applicants until the supply is exhausted. C. D. W.

Recent discussions in the field of human food economics have dealt largely with the problems involved in purchasing the so-called raw materials. The man of moderate means is taught that whether he is well fed or not does not depend upon what he pays for the food supplied to his family, but is determined by the amount and kind of nutritive ingredients which he consumes. He is told further that the protein from the neck is just as nutritious as the protein from porter-house steak when the skill of the cook renders it as palatable and digestible. It has been repeatedly demonstrated on the basis of chemical analysis and market prices that the edible dry matter of oysters, clams, poultry, and the choice cuts of beef has a market cost much greater than that of the edible dry matter from a fore quarter of beef, or from pork, milk, and cheese. Consequently the housewife and boarding-house steward are assured that there is an opportunity to keep down the cost of supplying the table by purchasing those materials which furnish a unit of nutrition for the least money, provided they can be prepared for the table in such

palatable forms that they are relished and eaten without excessive waste.

It is quite evident, however, that these conditions are more difficult in the concrete than in the abstract. The lack of culinary skill, the necessity for a desirable variety of foods, and the marked differences of individual tastes are all obstacles to the easy application of laboratory demonstrations to the management of a dietary.

It was felt that if these views of food economics could be made useful in practice it would be well worth while to show this by accurate experimental data. It was decided, therefore, that nothing could be undertaken more desirable from a practical standpoint than to attempt an application of the considerations above mentioned.

The work attempted was something more than an ordinary dietary study where the supply of raw materials was simply such as would be dictated by the season, condition of the market, etc. It was rather a dietary study where the supply of raw materials was deliberately controlled in such a manner as to make possible a comparison of the relative cost of different sources of supply.

Whatever opinion may be entertained as to the success and value of this experiment, it certainly has the merit of being perhaps the first attempt in this country to apply to the study of human food economics the same deliberate control of the rations that has for a long time been exercised in similar experiments with farm animals.

THE COLLEGE COMMONS AND THE CONDITIONS UNDER WHICH THE EXPERIMENTS WERE MADE.

The college boarding house is connected with a dormitory, and is patronized chiefly by the students living in the dormitory and in neighboring fraternity club houses. Certain members of the college faculty and a few outside students take their dinners at the boarding house regularly, and others occasionally, thus making a larger number of dinners than of other meals. The regular student boarders were, with a single exception, all young men whose ages ranged from seventeen to twenty-three years, and who weighed on an average about 150 pounds. They were all compelled to take a fair amount of physical exercise,

due to enforced military drill and to afternoon practice work in the laboratories and with engineering instruments in the field. It may be reasonably claimed that these young men performed a considerable amount of work. There were also several women, boarders and employees, who had meals regularly at the commons.

The college commons is conducted on the plan of furnishing the students with their board at cost, with the expectation that the weekly charge shall not exceed $3 nor fall below $2.50. As a matter of fact, the cost during these dietary studies was about $2.75 per week.

The general plan of the studies may be briefly outlined as follows: At the beginning of each dietary study a careful inventory by weight was taken of all the food and food materials in the house. During the experimental period all food purchased was weighed and recorded in the same way, and all table and kitchen waste carefully collected, weighed, and desiccated for subsequent analysis. At the close of the period a second inventory of all materials on hand was taken. In this way the necessary data for ascertaining the net amounts of food consumed were secured. In nearly all cases, except with meats, samples of food materials on hand or purchased during the period were secured for analysis.

THE QUESTIONS STUDIED.

In these dietary studies, as already stated, the attempt was made to deliberately control to some extent the source and supply of animal foods. The object of this control was to bring into comparison high-cost and low-cost foods as a source of protein, with especial attention to the influence of the free use of milk as a low-cost animal food upon the character and cost of the dietary.

Milk was selected for special consideration for the following reasons:

(1) Milk has a widespread use as an article of diet, and in all civilized countries is an important item of food supply.

(2) Milk is a very valuable food. It contains a mixture of the three classes of nutrients in forms that are readily digested and assimilated.

(3) Milk is a low-cost animal food in proportion to its value as based upon chemical analysis. When milk is purchased at $2 per hundred pounds the cost of a pound of edible solids is 15.7 cents, while the cost of a pound of edible solids in beef at $10.50 per hundred pounds is 34.3 cents. This is a comparison of the retail cost of milk with the cost of hind-quarter beef when purchased by the carcass. Beef bought as steak at retail prices would have a much higher comparative cost.

(4) Notwithstanding the high quality and very general distribution of milk as a food, it seems by many to be regarded as a luxury in the purchase of which economy must be exercised. This attitude toward this particular food may in part be explained by the somewhat prevalent notion that a free supply of milk in the dietary is not economical, because it is supposed that as much of other foods is eaten as would be the case if the milk were not taken. This belief runs contrary to certain generally accepted facts which relate to the physiological use of foods, and it only remains for experimental data to prove or disprove its correctness. Again, milk is not given full credit by people at large for its true nutritive value. Surprise is generally occasioned by the statement that a quart of milk has approximately the food value of a pound of steak. It is important to demonstrate for reasons of economy whether, as is the custom with many, it is wise to purchase the least possible quantity of milk and exercise little care in buying meats.

To investigate these questions, five dietary studies were made, as follows:

The first dietary study was made under ordinary conditions, no attempt being made to select the food with any end in view, except to secure the necessary variety. In the second dietary the protein was secured from high-priced sources, and the milk supply was kept at a minimum. In the third dietary study the protein was supplied from less costly sources, and the milk consumption was increased to a maximum. The fourth dietary study was made under normal conditions, except that the milk supply was limited. The fifth dietary study was also made under ordinary conditions, except that milk was very abundantly supplied.

COMPARATIVE QUANTITY AND COST OF ANIMAL AND VEGETABLE FOODS.

It is interesting and suggestive to note the relations in quantity and cost of the animal and vegetable foods in the five dietaries. These relations are very clearly shown in the following abstract of figures from the second table in each dietary:

RELATIVE AMOUNTS OF NUTRIENTS IN ANIMAL AND VEGETABLE FOODS.

	Food materials.	Nutrients.			Cost.
		Protein.	Fats.	Carbohydrates.	
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
First dietary (No. 148):					
Animal food	51.8	59.8	93.5	5.8	63.7
Vegetable food	48.2	40.2	6.5	94.2	36.3
Second dietary (No. 149):					
Animal food	57.4	71.7	96.5	8.6	72.8
Vegetable food	42.6	28.3	3.5	91.4	27.2
Third dietary (No. 150):					
Animal food	58.6	63.4	95.3	9.8	66.4
Vegetable food	41.4	36.6	4.7	90.2	33.9
Fourth dietary (No. 151):					
Animal food	48.7	56.7	94.5	6.7	71.0
Vegetable food	51.3	43.3	5.5	93.3	29.0
Fifth dietary (No. 152):					
Animal food	60.3	64.2	95.7	12.3	73.1
Vegetable food	39.7	35.8	4.3	87.7	26.9
Average:					
Animal food	54.5	63.0	95.0	9.0	69.0
Vegetable food	45.5	37.0	5.0	91.0	31.0

The gross weight of the animal foods purchased varied from 48.7 to 60.3 per cent. of the total food, and their cost varied from 63.7 to 73.1 per cent. of the total cost. The average gross weight of the animal foods for the entire 209 days was 54.5 per cent. of the total food weight, and their proportion of cost was 69.2 per cent. of the total cost. These figures illustrate the relative economic importance of the animal food of the dietary, and, considered in connection with the great variation in the cost of the nutrients in the different kinds of meat, show very clearly the direction in which a family of moderate means has the largest and most promising opportunity for the exercise of economy.

When we see that practically two-thirds of the protein and nearly all of the fat were supplied from the animal foods and over nine-tenths of the carbohydrates from the vegetable foods, it is easy to understand how the character of the diet is readily

modified by varying the proportions of the two classes of nutrients. The family that is able to afford a generous supply of meats is very differently nourished from the families of limited means, where the flour barrel is the chief source of food.

THE REFUSE AND WASTE.

That portion of the food materials which was not eaten included not only that which was edible and was really wasted, but also the refuse, or that which, because not edible, was necessarily rejected. The percentages of the waste in the five dietary studies follow:

SUMMARY OF WASTE IN THE FIVE DIETARY STUDIES.

	Total.	Protein.	Fats.	Carbohydrates.	Fuel value.
First dietary (No. 148):	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Animal	7.5	16.1	30.8	.....	11.7
Vegetable	9.7	5.3	.9	12.7	8.1
Total	17.2	21.4	31.7	12.7	19.8
Second dietary (No. 149):					
Animal	13.0	29.3	33.9	.....	17.8
Vegetable	10.7	5.4	.6	16.3	8.4
Total	23.7	34.7	34.5	16.3	26.2
Third dietary (No. 150):					
Animal	13.5	20.4	50.0	.....	21.2
Vegetable	14.1	7.9	.8	19.9	11.3
Total	27.6	28.3	50.8	19.9	32.5
Fourth dietary (No. 151):					
Animal	2.0	5.6	1.0	.1	.....
Vegetable	12.9	9.5	11.5	15.5	.....
Total	14.9	15.1	12.5	15.6	14.4
Fifth dietary (No. 152):					
Animal	1.8	6.8	1.3	.3	.....
Vegetable	13.3	10.2	12.4	16.8	.....
Total	15.1	17.0	11.1	17.1	15.1

A fair discussion of the preceding figures requires the statement that the college commons was not under the same management in the spring term, including dietaries 1, 2, and 3, as in the fall term during dietaries 4 and 5.

In the spring term the waste was 17.2 per cent. of organic matter during the first dietary, and increased from this to 24 per cent. in the second dietary and 28 per cent. in the third. The excessive waste in the third dietary was probably due in part to the large proportion of fat in the meats, which would be rejected during warm weather.

Dietaries 4 and 5 stand in strong contrast to dietaries 1, 2, and 3, as in the former the waste did not exceed 14.5 per cent. This is a striking illustration of the possible difference which may exist in the economy of management of the food supply of a family or boarding house.

The large waste of nutrients in the spring term is emphasized by the fact that the loss of fats was in greater proportion than that of other nutrients, thus involving a larger relative waste of food energy than is indicated by the percentages of organic matter. When the waste of organic matter was 17.2, 24, and 27 per cent, the corresponding waste of fuel value was 20, 26, and 32 per cent.

While the waste in the fall term is not as low as it might be under more favorable circumstances, it was not greater than frequently exists under boarding-house conditions, where there is not a concerted action on the part of the boarders toward economizing in all reasonable ways.

THE FOOD ACTUALLY EATEN.

In considering the results of these dietary studies, so far as it relates to food consumption the following facts pertaining to the conditions should be taken into account:

In the spring term the period of observation began during the cold weather of February and ended during the warm weather of June, and included a period during which there is usually a marked decrease of appetite.

In the fall term the conditions were reversed, and there was a gradual change to cold weather, which, other things being equal increases the appetite.

The supply of animal foods, and to some extent of vegetable foods, was purposely changed in passing from one period to another.

The nutrients consumed in these dietary studies are briefly summarized in the following table:

SUMMARY OF AMOUNTS AND FUEL VALUE OF NUTRIENTS CONSUMED.

	Protein.	Fats.	Carbohydrates.	Fuel value.
SPRING TERM.	Grams.	Grams.	Grams.	Calories
First dietary (No. 148): Usual food supply...	132	147	751	4,990
Second dietary (No. 149): Costly meats; milk limited	112	164	517	4,105
Third dietary (No. 150): Milk in abundance; other protein less costly	112	106	530	3,620
FALL TERM.				
Fourth dietary (No. 151): Milk supply limited	131	181	579	4,595
Fifth dietary (No. 152): Milk supply unlimited	120	184	436	3,990
Voit's standard, man at moderate work	118	56	500	3,055
American standard (Atwater), man at moderate work	125	.....	.....	3,500

It will be noticed that the consumption of fats and carbohydrates was especially large, while the amount of protein was more nearly in accord with the so-called dietary standards.

The amount of nutrients consumed in the first dietary (from February 25 to April 24) is especially excessive, particularly in the case of the carbohydrates. While this may be explained in part by the uniformly keener appetites of the students at the beginning of a term, it was probably chiefly due to the abundant supply of maple sirup which was furnished during this period. The use of so much sirup involved a correspondingly large consumption of flour. Seventy-four grams of maple sirup and 358 grams of flour were consumed daily per man during the first dietary, whereas during the succeeding dietaries scarcely any sirup was eaten and only 281 grams of flour per day. There can be but little doubt that the free use of sirup on the table leads to an excessive proportion of carbohydrates in the dietary.

The marked decrease in the food consumption as the term progressed is probably accounted for by the gradual elevation of temperature and the changes in the physical condition of the students. The food consumption changed from a fuel value of about 5,000 calories in February, March, and April to less than 3,700 calories in May and June.

THE INFLUENCE OF THE SUPPLY OF ANIMAL FOODS UPON THE SIZE AND COST OF THE DIETARY, WITH ESPECIAL REFERENCE TO MILK.

As has been stated, the attempt was made in four dietary studies to deliberately control to some extent the supply of animal foods and the source of protein. The attempt was also made to determine the relative value of milk in the dietaries.

The following table briefly summarizes the amounts and kinds of food materials purchased in the four dietaries:

FOODS PURCHASED IN FOUR DIETARIES.

	Foods Purchased Daily Per Man.			
	Dietary 149: Milk limited, other protein high cost.	Dietary 150: Milk unlimited, other protein low cost.	Dietary 151: Milk limited.	Dietary 152: Milk unlimited.
Animal food:	Grams.	Grams.	Grams.	Grams.
Beef, veal and mutton	337	130	241	211
Pork, lard, etc.	76	172	114	132
Poultry	71	.....	9	14
Fish, etc.	89	69	61	54
Eggs	112	53	49	28
Butter	83	74	67	40
Milk	810	1,197	873	1,223
Mince meat	.....	.....	.....	2
Total	1,611	1,695	1,414	1,704
Vegetable food:				
Cereals, sugars, etc.	476	595	576	460
Vegetables	638	477	671	464
Fruits	80	121	243	202
Total	1,195	1,193	1,490	1,126
Total food	2,806	2,888	2,904	2,836

In the following table the results of the studies are shown in another form:

GROSS WEIGHTS OF FOOD PURCHASED PER MAN PER DAY.

	Milk.	Animal foods other than milk.	Vegetable foods.	Total foods.
	Grams.	Grams.	Grams.	Grams.
Dietary No. 149: Milk supply limited; high-cost protein	810	801	1,204	2,806
Dietary No. 150: Milk supply unlimited; lower-cost protein	1,197	498	1,203	2,888
Dietary No. 151: Milk supply limited	873	541	1,498	2,904
Dietary No. 152: Milk supply unlimited	1,223	481	1,126	2,836

The tables show very conclusively that the intention to materially modify the kind of animal foods in passing from dietary No. 149 to dietary No. 150 was carried out. The use of beef, veal, mutton, poultry, and eggs was greatly diminished and the consumption of pork and milk increased. The butter eaten was less in the latter period also. In dietaries Nos. 151 and 152 the character of the animal foods other than the milk did not differ greatly. The quantities of high-cost meats were less, but their place was not taken by low-cost meats.

The above figures leave no room for doubt that the free use of milk diminishes the consumption of other foods. In passing from dietary No. 149 to No. 150 the milk consumption per man increased from 810 grams daily to 1,197, and the use of other animal foods decreased from 801 grams to 498 grams, while the vegetable foods were eaten in about the same quantities in the two studies.

Essentially the same result follows in dietaries Nos. 151 and 152, where the milk eaten increased from 873 grams daily to 1,223, the consumption of other animal foods decreasing from 541 grams to 481, and of vegetable foods from 1,490 to 1,126 grams. In the first instance the milk replaced other animal foods, and in the second there was mainly a decrease in the use of vegetable foods. But while the increased consumption of milk diminished the consumption of other materials, what was the effect upon the actual quantity of nutrients taken and upon the cost of the dietary?

The answer to the question is very definite, and may be found in the following comparison of the results of the investigations:

COMPARISON OF NUTRIENTS EATEN.

	Nutrients per Day per Man.				
	Protein.	Fats.	Carbohydrates.	Total.	Cost.
Second dietary (No. 149): Milk limited:	Grams.	Grams.	Grams.	Grams.	Cents.
Animal foods	72	158	53	283	.....
Vegetable foods	40	6	464	510	.....
Total foods	112	164	517	793	34
Third dietary (No. 150): Milk unlimited:					
Animal foods	67	98	65	230	.....
Vegetable foods	45	8	465	518	.....
Total foods	112	106	530	748	26

COMPARISON OF NUTRIENTS EATEN—CONCLUDED.

	Nutrients Per Day Per Man.				
	Protein.	Fats.	Carbohydrates.	Total.	Cost.
Fourth dietary (No. 151): Milk limited:	Grams.	Grams.	Grams.	Grams.	Cents.
Animal foods	79	.....	45	.....	.....
Vegetable foods	52	.....	534	.....	.....
Total foods	131	181	579	891	27
Fifth dietary (No. 152): Milk unlimited:					
Animal foods	83	.....	64	.....	.....
Vegetable foods	37	.....	372	.....	.....
Total foods	120	184	436	740	25

The results are stated in another form in the following table:

SUMMARY OF NUTRIENTS EATEN DAILY PER MAN.

	Protein.	Fat.	Carbohydrates.	Total.	Daily cost per man.
Spring Term.					
Second dietary (No. 149):	Grams.	Grams.	Grams.	Grams.	Cents.
Milk supply limited	112	164	517	793	34
Third dietary (No. 150):					
Milk supply unlimited	112	106	530	748	26
Difference, (increase +, decrease —)	.....	—58	+13	—45	—8
Fall Term.					
Fourth dietary (No. 151):					
Milk supply limited	131	181	579	891	27
Fifth dietary (No. 152):					
Milk supply unlimited	120	184	436	740	25
Difference (increase +, decrease —)	—11	+3	—143	—151	—2

It appears that instead of causing an increased consumption of nutrients, the freer use of milk was attended by a decrease of the nutrients eaten in the spring term amounting to 45 grams daily and in the fall term to 151 grams daily. In the spring term it might reasonably be urged that the coming of warm weather would have the effect noted, all other conditions remaining the same, but this cause certainly could not have been operative in the fall term, when milk was freely supplied, for cold weather came on, and this ordinarily causes a keener appetite. It is interesting to note that in the spring term the addi-

tional milk replaced other animal foods, while in the fall term it replaced vegetable foods. It is reasonable to regard this as to some extent a case of involuntary selection of foods, as with the advent of warm weather the tendency would be to reject animal foods, while the effect of cold weather would be the reverse.

The financial outcome is favorable to the free use of milk. Notwithstanding the largely increased waste, the cost per man per day in the third dietary is 8 cents less than in the second.

The total decrease in the cost of food during dietary No. 150 as compared with dietary No. 149 was about $4.50 per day. The saving should not be credited wholly to the increased supply of milk, because the other animal foods were in part of a less expensive kind.

The saving in dietary No. 152 was less, amounting to only 2 cents per day per man, or a total of $1.57 daily. This smaller saving is equal, however, to $416 for a school year of thirty-six weeks with the number of persons included in third dietary study. It should be noted that this saving was made in spite of the increased proportion of animal foods, an increase which, other conditions remaining unchanged, raises the cost of living.

If, as we have reason to believe, it be true that the average American dietary contains too large a proportion of non-nitrogenous compounds, then the free use of milk, besides cheapening the cost of living, accomplished another desirable result, viz., it raised the proportion of protein in the dietary, thereby making it more rational. The nutritive ratios of the dietaries with a limited supply of milk were 1:7.9 and 1:7.5, and of the dietaries where milk was freely used 1:6.7 and 1:6.8.

SUMMARY.

The main results of these dietary studies are briefly summarized with especial reference to their important practical relations to the economical purchase of human foods.

(1) The cost of the animal foods bought for the commons of the Maine State College during 209 days was 69 per cent. of the total food cost, varying in the different periods from 63.7 to 73.1 per cent. This shows very clearly the direction in which economy can most effectively be exercised in purchasing a food supply.

(2) The freer use of milk did not, as is supposed by some to be the case, increase the gross weight of food eaten. The extra amount of milk consumed replaced other animal foods to a nearly corresponding extent in the first trial and caused a proportionate diminution in the consumption of vegetable foods in the second study.

(3) The actual quantity of water-free nutrients eaten diminished rather than increased when more milk was supplied. This is in marked contrast to the apparent effect of the free use of maple sirup, which was accompanied by a notably large consumption of nutrients.

(4) In both trials the increased consumption of milk had the effect of materially narrowing the nutritive ratio of the dietary, a result which, in view of the recognized tendency of Americans to consume an undue proportion of fats and carbohydrates, appears to be generally desirable.

(5) The dietaries in which milk was more abundantly supplied were somewhat less costly than the others and at the same time were fully as acceptable.

(6) These results indicate that milk should not be regarded as a luxury, but as an economical article of diet, which families of moderate income may freely purchase as a probable means of improving the character of the dietary and of cheapening the cost of their supply of animal foods.

STATION FARM BUILDINGS.

BULLETIN No. 23.

PRESERVATION OF CREAM FOR MARKET.

F. L. Russell.

It is an important feature of our dairy business that there is a growing demand for fresh sweet cream, not only for domestic use, but for exporting to the large cities. During the past year this cream trade from Maine has considerably exceeded $150,000 and each year finds the demand increasing. It has come to be an important question how best to foster this branch of our dairy business, and during that season when butter is most abundant and cheapest—for there is the greatest demand for cream during the summer months—to find a profitable market for this commodity and so reduce the butter supply and at the same time increase the profit from the dairy. One important reason for fostering the cream trade is that cream sold to be consumed as cream is in no large degree a rival of either milk or butter, but enlarges the demand for dairy products at a time when such products are most abundant and most cheaply produced.

The only obstacle in the way of this trade that has retarded its development is the perishable nature of cream. While it is but little more perishable than milk, it is in a sense a manufactured product and subject to delays in the process of manufacture before it can find its way to market. This difficulty is in a measure overcome by the perfecting of cream separators which quickly condense the cream from the milk without any long delay or opportunity for change, or by what is often found to be a more practical way, the cream obtained from the milk by the deep cold setting process is condensed by the separator while it is yet sweet and comparatively fresh.

One reason why there has been more risk in handling cream than milk is the greater value of the cream, involving greater loss when it fails to reach the market in good condition.

As is very generally known at the present time, the souring of cream is due to the growth of minute organisms or plants called bacteria. These bacteria are not present in the milk while it is yet in the udder of the cow, but they are so universally distributed, especially in warm weather, about the barns and in the dust of the air, that the milk has scarcely reached the pail on its way from the udder of the cow before it is contaminated with them. Under favorable conditions for their growth they will cause the milk or cream separated from it to sour and no ordinary straining or even passing the milk through a cream separator will remove them. After the bacteria that cause souring of milk and cream are once introduced, they will multiply rapidly and soon do their work unless they are destroyed or held in check, that is, their growth and multiplying prevented.

METHODS OF DESTROYING THE GERMS.

There seem to be but three methods of preventing this growth and consequent souring of the cream: First, by means of cold; second, addition to the milk or cream of some germicide like boric or salicylic acid; or third, by subjecting the cream to a sufficiently high temperature to destroy the germs. Each of these methods has its advantages and disadvantages when put to practical use, and it is the purpose of this bulletin to show which of them has the most to recommend it.

USE OF COLD.

In this climate during steady cold weather there can be but little objection to the use of cold as a preservative in shipping cream to local markets. Cream that is kept at a temperature below 45 F. will remain sweet for a long time, but in warm weather and when it has to be shipped to a distant point in warm cars, the necessary cold is secured by the use of ice, which is an unsatisfactory method on account of expense, although the quality of the cream brought to market by this method is of the highest.

USE OF GERMICIDES.

The method of adding something to the cream that will destroy the bacteria or prevent their growth, no matter how warm the weather or how distant the market, appeals to the dealer on account of its cheapness, simplicity and effectiveness. Cream in which a sufficient quantity of boric acid or salicylic acid has been introduced, for these are the substances generally used as preservatives of cream, will remain perfectly sweet for an indefinite time even in the hottest summer temperature. These chemicals produce no decided change in the taste or appearance of the cream, and it is no wonder that this method has sometimes been adopted by those who have seen in it a solution of the only difficulty in the way of extending a lucrative cream trade. What, then, are the objections to this method? The first and the very decided objection that will occur to the consumer is, that when paying for sweet and wholesome cream he does not want it diluted with anything else. In view of the comparatively small quantity of the preservative that has to be used, this objection might be overcome by an appeal to the reason of the consumer, if he did not have reason as well as prejudice on his side. If it could be shown that the preservative was as harmless as the cream itself there would, perhaps, be no reasonable objection to it, but the best that can be claimed for these chemical preservatives is, that while they are sure death to bacteria they also endanger the health and derange the digestive apparatus of human beings. Among those qualified to judge of the effect of these substances when taken into the stomach of human beings, there is practically but one opinion, and that is, that the constant consumption of them is harmful even if taken in small quantities. In certain cases where persons are suffering from disease of the digestive organisms, the use of cream preserved by this method is positively dangerous.

The statement is made by Foraster and quoted in the National Dispensatory that boric acid greatly increases the fecal solids and the excretion of albuminous compounds,even when given in a daily dose of seven or eight grains, and that these effects continue for some time after the suppression of the medicine.

The United States dispensatory says that the practice of using salicylic acid for a preservative of articles of food is to be condemned. A commission appointed by the French government reported that the prolonged use of even a very small amount of salicylic acid is dangerous, especially to very aged persons.

It is not difficult to see that it will be fatal to the permanent interests of the cream trade if dependence is placed upon chemical preservatives to keep the cream sweet. Such a practice is quite easily detected by chemical tests and a well founded suspicion that it is commonly resorted to can only work injury to the trade, even in cream preserved by unobjectionable methods.

USE OF HEAT.—PASTEURIZATION.

The third method for keeping cream sweet until it reaches the consumer, namely, by the use of heat, is based upon the fact that bacteria that cause souring of cream are destroyed at a temperature which leaves the cream uninjured. By practical tests it has been found that a temperature of 155 deg. F. continued for ten minutes will destroy nearly all of the souring organisms without seriously injuring the appearance and without perceptibly affecting the taste or wholesomeness of the cream. This method is termed "pasteurization." While pasteurization may not destroy all bacteria that are sometimes found in cream, so that there is no possibility that souring will take place afterwards, it does destroy most of them, and if cream so treated is at once placed in sterilized cans with proper precautions to guard against introducing any more germs, it has been found in practice that it can be shipped to distant markets under all conditions of weather and reach the consumer in a perfectly sweet condition. Pasteurized cream has been successfully shipped from Wisconsin to Maine and California and intermediate points with perfect success.

Perhaps the chief objection that can be urged against this method is the fact that after being heated to 155 deg. F. the cream never seems quite as thick as before, but this is an objection that has little weight when the true cause is known. The taste and appearance, aside from thinness, is like that of fresh cream.

To pasteurize cream it is only necessary to quickly warm it to 155° F., allow it to remain at this temperature for ten minutes and then cool it as quickly as possible. To do this rapidly on a commercial scale requires specially devised apparatus, several forms of which are already on the market. It will be seen that this method involves slightly more trouble and expense than that of preserving with chemicals, but it seems to us that it is the only practical method that is not open to very serious objections and it renders possible a large and permanent extension of what is already a considerable business in this State, and it will without doubt pay the dealers in this commodity to look well into the advantages of this method over any other at their command.

It may not be out of place in this connection to state that the Maine Experiment Station has ordered a pasteurizing apparatus of an improved pattern, which can be seen here a little later by those interested in the cream trade. We intend to carefully investigate the effectiveness of the apparatus and, if it meets with our expectations, we shall be inclined to urge upon the creamery men of the State the advisability of the pasteurizing method of preserving cream in place of the more expensive or otherwise objectionable methods that have formerly been used.

MAINE STATE COLLEGE, Orono, Me., Feb. 24, 1896.

BULLETIN No. 24.

CABBAGES.

H. P. GOULD.

The purpose of this bulletin is to give a concise account of our experience with cabbages during the past season, with a brief discussion of the evidence presented.

The seed was sown April 1st, and the seedlings pricked out into seed-flats April 27th, and set in the field May 25th. The season being exceptionally dry, all of the plants made a weak growth and correspondingly small heads.

1. *Influence of size of seed:*—The idea has been advanced that it is the tendency of plants from large seeds to run to leaves at

the expense of the head, while the tendency of plants from small seeds is to run to head. In order to study the influence of the size of seed on the relative size of the head, fifty of the largest seeds, also fifty of the smallest were selected from each of three varieties. Of two of the varieties, the weight of the smaller seeds was less than half that of the larger; the weight of the smaller seeds of the other variety was a little more than half that of the larger. Each lot of fifty seeds was sowed, and when the plantlets were ready for the first handling, twenty of the best plants from each lot were selected and handled as above stated.

Table I gives the ratio of the average weight of the heads from the small seed to that of the heads from the large seed.

TABLE I.

	Ballhead.	Reynolds' Early.	Harvest Home.
Large seed	1.69	1.37	.94
Small seed	1.00	1.00	1.00

The facts are too obvious to need extended explanation. The large seed of two of the varieties, Ballhead and Reynolds' Early, produced heads which averaged 69 per cent. and 37 per cent. larger respectively, than did those from the small seed. The other variety—Harvest Home—gave contradictory results, the heads from the small seed averaging 6 per cent. heavier than those from the large seed.

2. *Results of tying up the outer leaves:*—It has been thought by some one that by drawing the leaves of the cabbage together and binding them with a string over the head, maturity would be hastened. Accordingly, with this idea in mind, as soon as the heads had fairly commenced to form, three lots of plants were treated in the way described above, i. e., the points of the leaves were drawn together over the head and a string tied around them sufficiently tight to keep them in the desired position. The results obtained relative to the point in question cannot well be expressed by figures, but suffice it to say that the operation seemed to have no influence whatever upon the date of maturity. This treatment, however, was not without its effect, as the figures in table II will show.

TABLE II.

	Harvest Home.	Surehead.	Reynolds' Early.
Outer leaves tied up	.44	.46	.67
Check	1.00	1.00	1.00

Representing the weight of an average head from the check plants by 1 or 100 per cent., an average head from the Harvest Home which received the special treatment, would be represented by 44 per cent. In the same manner, we observe that the heads from the treated plants of Surehead were only 46 per cent. as heavy as the untreated, and Reynolds' Early, 67 per cent. In a word, the size of the heads from the treated plants averaged from 33 per cent. to 56 per cent. by weight smaller than did those from the untreated plants.

Another result of this operation which was even more noticeable than the decreased size of the heads, was the effect upon quality. Although all possible care was taken in tying up the leaves, they did not overlap sufficiently to keep out all moisture, so that during rains a considerable amount of water entered each head. This moisture being so inclosed within the leaves, did not readily evaporate. As a result of this continued dampness, the inner portions of the plants very soon began to decay; it was not long before this effect became noticeable upon the outer leaves, resulting in a large proportion of the leaves falling off long before the season of growth would otherwise have ceased. As a result of this decay, not a single head was produced fit for home use, to say nothing about its marketable qualities.

3. *Effect of Mulching:*—The advisability of using straw or some similar material as a mulch for the purpose of conserving the soil moisture has often been discussed. In order to ascertain the advantages, if any, of such treatment in the culture of the cabbage, three lots of plants, as soon as they were fairly started after being set in the field, were thoroughly mulched with swale hay so that when packed down the mulch was two or three inches thick, the space between the rows of plants being

completely covered. Three lots of plants, corresponding to those mulched, received frequent cultivation. So far as the maturity of the heads was concerned or the per cent. of plants forming heads, the mulching seemed to have no appreciable effect. There was a slight increase in the size of the heads favoring the use of the mulch, as shown in the following table:

TABLE III.

	Lupton.	Surehead.	Harvest Home.
Mulched	1.00	1.07	1.13
Cultivated	1.00	1.00	1.00

The differences are not sufficient to be very conclusive. It will be noticed that there was no difference in the case of the Lupton between the average weights of the heads from the two lots, while the average weights of the other two varieties were only 7 per cent. and 13 per cent. in favor of the plants which were mulched. These differences are so small that we would not feel justified in making too strong claims for the advantages of mulching, as the variations might result from some other causes, yet we may infer from the indications that a mulch can be applied to advantage, especially in a dry season.

4. *Shallow vs. Deep Cultivation:*—It has been our practice in the cultivation of the cabbage, as in that of nearly all vegetables, to use the horse-cultivator with much freedom, running the cultivator as close to the plants as possible without disturbing them. This, oftentimes, becomes in effect a method of root pruning, giving rise to the question,—Does deep cultivation affect the heading of the plants? For the purpose of ascertaining, if possible, the effect of such treatment, four lots of plants were cultivated as described above, while four similar lots were given only such cultivation as could readily be furnished with a common hoe. The various lots of plants were all cultivated with the same frequency, the only difference being the depth to which the soil was stirred. The following table gives the comparative results:

TABLE IV.

Variety and Treatment.	Per cent of immature heads.	Ratio of average weight per head.
Surehead:		
Shallow cultivation	10.5	1.16
Deep cultivation	.0	1.00
One-hundred Weight:		
Shallow cultivation	11.1	1.12
Deep cultivation	.0	1.00
Lupton:		
Shallow cultivation	5.3	.93
Deep cultivation	12.5	1.00
Harvest Home:		
Shallow cultivation	52.6	.72
Deep cultivation	5.0	1.00

The effects as expressed by the above figures are somewhat contradictory. In the case of all but one of the varieties, Lupton being the exception, a larger percentage of the heads from plants which received shallow cultivation were immature at the time when most of the heads were ready for cutting, than from those receiving deep cultivation, the difference varying from about 10 per cent. to over 47 per cent. It seems probable that the deep cultivation which gave to the plants a heavier mulch of finely pulverized soil than that given to the plants receiving the shallow cultivation, so aided in the conservation of the moisture that the plants were able to make a more vigorous growth, and to form more perfect and uniform heads. No specific conclusion can be drawn from a comparison of the average weights, as two of the varieties gave results favoring deep cultivation, while two were against the practice, though the greater difference was in favor of deep cultivation.

RECAPITULATION.

1. The size of the seed seems to have some influence upon the size of the head, the larger seed, as a rule, producing the larger head.

2. The tying up of the outer leaves seems to have no influence upon the maturity of the heads, while it produces a marked decrease in the size and almost invariably causes the head to decay.

3. Mulching with straw or some similar material in a dry season tends to increase the size of the head.

4. Deep cultivation seems to have little if any effect upon the size of the head, but plants so treated appeared to mature more uniformily than plants receiving shallow cultivation.

MAINE STATE COLLEGE,
ORONO, ME., March 1, 1896.

BULLETIN No. 25.

INSPECTON OF FERTILIZERS, 1896.

The bulletin gave the manufacturer's guarantees and the analyses of manufacturer's samples, but as these figures are of only passing value they are omitted here.

BULLETIN No. 26.

INSPECTION OF GLASSWARE USED BY CREAMERIES AND BUTTER FACTORIES TO DETERMINE THE VALUE OF CREAM AND MILK.

J. M. BARTLETT.

Ever since the introduction of the Babcock test for estimating the value of cream or milk at creameries and butter factories, more or less dissatisfaction and in some cases distrust, have prevailed among a few patrons to whom payment has been made on this basis. These complaints have come in various forms. Some creameries have been accused of using incorrectly graduated glassware, pipettes that were too small, thereby making the test too low; others of employing incompetent men to manipulate the test.

In order to remedy such evils if they existed and restore confidence to the minds of the patrons, a law was enacted by the Maine Legislature of 1895, entitled "An act for the Protection of Dairymen," which appears as Chap. 169 of the laws of 1895. Without giving the full text of this law, there is stated below a summary of its principal provisions and requirements.

Section 1. This section requires that every individual or corporation buying milk or cream or apportioning its value on the basis of the fat content shall have all the bottles and pipettes tested for accuracy, which are used in determining the per cent. of fat, and each of these bottles and pipettes shall bear a mark showing that it has been so tested.

Sec. 2. In this section it is made the duty of the Director of the Maine Experiment Station or some person he may designate to execute the provisions of Section 1. The actual expense of this work shall be paid by the persons or corporations for whom it is done.

Sec. 3. This section requires that any person operating the Babcock or other tests for determining the fat in milk or cream which is to be purchased or its value apportioned, must possess a certificate of competency for such work. This certificate is to be issued by the Superintendent of the State College Dairy School in accordance with such rules and regulations as he may devise.

Sec. 4. No one is allowed to use at any creamery, butter factory, cheese factory or condensed milk factory where milk or cream is bought or its value apportioned, or to have in his possession with intent to use, any sulphuric acid of less than one and eighty-two hundredths specific gravity. This section also provides penalties for the violation of the provisions of this act.

Sec. 5. This section fixed the date on which this law shall take effect which is six months from the day of approval, or September 27, 1895.

Early in the spring of 1895 a circular letter was sent to each creamery with which was enclosed a copy of the law giving notice that the Station would be ready to test all glassware after June 1. The examination of candidates and issuing of certificates of competency for making the test was conducted by Professor G. M. Gowell, superintendent of the dairy school, and the work of testing the glassware was delegated to the writer.

METHOD OF MAKING THE TEST.

For this purpose we had made an accurately graduated burette of the same diameter and marked the same as the necks of the cream bottles. The bottle to be tested is filled to the zero mark

with mercury as is also the burette. Then the mercury is allowed to run slowly from the burette into the bottle until the upper line of the mercury stands at the 5 per cent. mark on the burette. The mark at which the upper line of the mercury stands in the neck of the bottle is also noted and if it coincides with the 5 per cent. mark, the graduation is correct. Another portion is now run in until the 10 per cent. mark on the burette is reached and so on until the 25 per cent. mark is reached. Slight errors like one or two-tenths of 1 per cent. have been passed unnoticed, but when there was an error of three-tenths or more, the bottles have been thrown out, not because three-tenths in practice is a serious error, but because it is better to insist that manufacturers shall furnish goods up to their guarantee.

For testing pipettes, an accurately graduated standard pipette is used. It is filled with mercury and then the contents are emptied into the pipette to be tested. If the point reached by the mercury coincides with the mark on the standard pipette, it is of course correct. All bottles and pipettes tested and found correct have been marked with the letters O. K., while those that are not correct are marked "off."

Only about one-half of the creameries of the State have sent their glassware to us, which indicates one of three things: (1) That those who have not responded are not using the test; (2) that they have obtained tested glassware from dealers, or (3) they have not complied with the law. In all, 1,498 cream bottles, 210 milk bottles and 96 pipettes were received prior to January 1st. Thirty-nine of the cream bottles were found to be more inaccurate than the prescribed limit, three-tenths of one per cent. and were consequently thrown out. Twenty-four of the number, however, were found in two small lots which evidently came from some unreliable manufacturer, as the error found was greater in those, in some cases over one-half of one per cent., than in any other lots. Of the 210 milk bottles all were correct, excepting 33 of one lot of 60. The errors in these bottles varied from three-tenths to one per cent. The source of these bottles could not be learned as they were found at the creamery when the parties now occupying it took possession. They were evidently made by some unreliable firm.

The glassware as a whole, however, has been very satisfactory and the new goods received from the manufacturers since the above act went into force have been exceptionally accurate, showing that the law has had the desired effect. No intentional fraud has been detected, the discrepancies discovered evidently being due to errors in graduating.

The law, although in most cases seeming unnecessary, cannot help being beneficial to all parties using the test, as it will eventually exclude the goods of unreliable manufacturers from the State, and will tend to increase confidence in the accuracy of the method upon which are based the payments for milk and cream.

The following is a list of the parties and creameries who have sent us their glassware to be tested:

E. E. Light, Union, Me.
West Paris Creamery, West Paris, Me.
Bethel Dairy, Bethel, Me.
Bridgton Creamery, Bridgton, Me.
W. L. Phillips, East Wilton, Me.
Forest City Creamery, Portland, Me.
Hillside Creamery, Exeter, Me.
A. L. & E. F. Goss Co., Lewiston, Me.
Turner Centre Creamery, Auburn, Me.
New Gloucester Creamery, New Gloucester, Me.
Wonder Brook Creamery, Kennebunk, Me.
John C. Gordon, Ellsworth, Me.
G. F. Gerry, Garland, Me.
Solon Creamery, Solon, Me.
Poland Dairy Association, Poland, Me.
I. O. Winslow, St. Albans, Me.
C. A. Whitney, Norridgewock, Me.
Bangor Creamery, Bangor, Me.
C. C. Nichols, Foxcroft, Me.
E. S. Dixon, Sabbatus, Me.
J. M. Tukey, New Castle, Me.
———Smith, Hampden, Me.
East Pittston Creamery, East Pittston, Me.

MAINE STATE COLLEGE,
ORONO, ME., March 25, 1896.

BULLETIN No. 27.

PEAS—SWEET CORN.

H. P. Gould.

PEAS.

It is a well known fact that nearly all of the earliest varieties of peas are what are commonly known as "smooth" or "hard" peas; the poor quality of this type is equally well known. One of the aims of the introducer has been to secure a sort which should possess the qualities of the later or "wrinkled" varieties and at the same time be as early as the smooth varieties. Efforts in this direction have been at least partially rewarded with success. There have been put upon the market during the past few years several varieties of the wrinkled type which are of excellent quality and also very early.

The purpose of this article is to call attention to a few of the newer varieties of peas which have given good satisfaction as grown in the station gardens.

Our usual rate of seeding has been one quart of seeds to 100 feet of drill, though it is probable that one quart to 75 or 80 feet of drill may be a more profitable rate.

The following descriptions are of "wrinkled" varieties of recent introduction which can be recommended for general cultivation.

Station, (Gregory):—Of moderately vigorous growth; 5 to 6 peas to the pod; quality good; maturing in from 45 to 55 days.

Morning Star, (Childs):—Growth somewhat less vigorous than Station; 5 to 6 peas to the pod; quality excellent; reaches edible maturity in 45 to 55 days.

Exonian, (Thorburn & Co.):—Vines medium height but very small; foliage noticeably light colored; about 6 peas to the pod; maturing in from 50 to 60 days.

Early Woodside, (H. N. Smith):—Of rather dwarf habit; 6 peas to the pod; quality good; from 60 to 70 days required to reach edible maturity.

Climax, (Northrup, Braslan & Goodwin Co.):—A very tall variety with rather small vines; one of the most prolific; quality not of the best; matures in about 70 days.

Echo, (Burpee):—A moderately vigorous grower; 7 peas to the pod; matures in from 65 to 75 days.

Renown, (Burpee):—Of rather dwarf habit; prolific; season medium to late.

Nott's Excelsior, (Maule):—A dwarf sort about 1 foot in height; 5 or 6 peas to the pod; matures in 50 to 55 days. Has received many favorable comments during the past 4 or 5 years.

The above are only a few of the many sorts which might be mentioned in the connection of "new varieties" but to increase the list would be doubtless to increase the indecision if one were selecting varieties for planting.

In our comparison of varieties such well known sorts as American Wonder, Heroine, Stratagem, Telephone, Abundance, and several others of like reputation have been taken as the standard of excellence.

Of the smooth peas, we will simply make mention of the following varieties: Maud S., Sunol, Summit, Rural New Yorker, Alaska, Daniel O'Rourke Improved. These varieties have no marked distinctive characteristics aside from the type and their chief value lies in the earliness of maturity.

It will be observed that in the foregoing descriptions considerable latitude is given for the time required by the different varieties to reach edible maturity. This wide variation is given from the fact the season has considerable influence upon the time required to reach edible maturity, the number of days being less in a warm than in a cold season. The same difference is noticeable in the time required for the maturity of early and late sowed peas of the same variety.

SWEET CORN.

Although corn has received no special attention at this station, several varieties have been grown each year and a few notes taken concerning their behavior.

Every one who is at all familiar with the catalogue of the average seedman is equally familiar with the high sounding and attractive description of varieties which most catalogues contain. We do not wish to infer that such descriptions are given for the purpose of deceiving, yet the fact remains that if one bases his anticipations on the descriptions which he finds, he is more than likely doomed to disappointment at the results which he obtains. While this condition of things does not exist in regard to the descriptions of corn to the extent that it does in regard to many other things, yet not a few of the statements are misleading. Especially have we found this to be true as to statements concerning the date of maturity. Very often varieties described as "early" have proven so late as to be almost worthless, and several so called medium sorts have failed to mature at all. A plausible excuse may appear, however, for this apparent deception when we consider the fact that practically all of the seeds disseminated by the larger seed companies are produced in a climate where the growing season is considerably longer than in Maine.

The following table represents most concisely the more important points relative to the varieties grown the past season:

Variety.	Source of Seed.	Date of first appearance of tassels.	Date of first appearance of silks.	Date of edible maturity.	Number days from planting to date of maturity.	Average length of ears—inches.	Average height of stalks—feet.
Best of All	H. W. Buckbee	July 24	Aug. 1	Sept. 2.	95	....	7.0
Cory (White)	J. M. Thorburn & Co	July 12	July 24	Aug. 17.	79	6.0	4.5
Crosby's Early	J. M. Thorburn & Co	July 20	Aug. 5	Sept. 2.	95	...	6.0
Early Dawn	Johnson & Stokes	July 24	Aug. 7	Sept. 7.	100	7.5	6.5
Early Sweet	D. M. Ferry & Co	July 24	Aug. 7	Sept. 11.	104	9.0	7.5
Early Sunrise	Iowa Seed Company	July 12	July 26	Aug. 17.	79	7.0	6.0
Early Vermont	A. W. Livingston's Sons,	July 12	July 26	Aug. 24.	86	....	4.0
Eastman's Early	Eastman Seed Company	July 12	July 26	Aug. 17.	79	...	4.0
Hance's Early	A. W. Livingston's Sons,	July 24	Aug. 10	Sept. 11.	104	7.5	6.5
Henderson Sugar	Peter Henderson & Co.	July 24	Aug. 7	Sept. 7.	100	9.0	8.0
Hickox Hybrid	D. M. Ferry & Co	July 17	Aug. 7	Sept. 7.	100	9.0	7.0
Honey	Johnson & Stokes	July 24	Aug. 10	Sept. 7.	100	8.0	8.0
Lackey's Early Sweet	J. J. H. Gregory & Son.	July 12	July 26	Aug. 17.	79	6.0	5.0
New England	D. M. Ferry & Co	July 15	Aug. 1	Aug. 31.	93	7.0	6.0
Perry's Hybrid	J. M. Thorburn & Co	July 20	Aug. 5	Sept. 7.	100	8.0	6.5
Quincy Market	J. J. H. Gregory & Co	July 15	July 30	Aug. 26.	88	....	5.0
Shaker's Early	A. W. Livingston's Sons,	July 24	Aug. 8	Sept. 11.	104	8.0	6.5
Stabler's Early	J. J. H. Gregory & Son.	July 29	.....	Sept. 11.	104	8.0	7.5
Melrose	J. M. Thorburn & Co	July 26	Aug. 7	Sept. 5.	98	....	5.0
XX Sugar	W. H. Maule	July 24	Aug. 7	Sept. 11.	104	7.0	5.5
Livingston's Evergreen	A. W. Livingston's Sons,	July 24	Aug. 10	Sept. 15.	108	9.0	7.5
Acme Evergreen	Iowa Seed Company	July 29	Aug. 19	Did not reach edible maturity.	....	....	7.0
Burlington Hybrid	A. W. Livingston's Sons,	July 29	Aug. 7		....	....	7.0
Country Gentleman,	Johnson & Stokes	July 30	Aug. 17		....	....	7.0
Early Large Eight-rowed	A. W. Livingston's Sons,	July 27	Aug. 10		...	....	8.0

The varieties named above were all planted the last of May. The first killing frost was about the middle of September, so that in addition to the varieties which failed to reach edible maturity those which matured on or after September 11, of which there were several, were of but very little value for table use, as the date of edible maturity given in column five refers to the day on which the first ear was found which had reached an edible condition; this date, in most cases, was several days before enough ears could be picked to test the varieties.

For several years past the Cory has been the standard of earliness, but in quality it is far from perfection. As may be observed by referring to the table, several varieties were grown the past season which came to edible maturity on the same date as Cory—79 days from date of planting. The variety—Early

Sunrise—seems worthy of special mention. The quality compares very favorably with that of most later varieties and it was the most prolific variety grown.

Of the varieties which failed to reach edible maturity, we would call attention to the Country Gentleman, from the fact that since its introduction several years ago, no variety has received more favorable comment than this one, but for this State it is of little value on account of its lateness. It may mature under the most favorable conditions although it has been grown here for the past three years and in no case has it reached an edible condition before frosts, when given ordinary field culture.

For the benefit of those who may desire to purchase seeds direct of seedsmen the addresses of the seed merchants referred to in the above table are given herewith: J. M. Thorburn & Co., 15 John St., New York; Johnson & Stokes, Philadelphia, Pa.; D. M. Ferry & Co., Detroit, Mich.; A. W. Livingston's Sons, Columbus, Ohio; J. J. H. Gregory & Son, Marblehead, Mass.; Peter Henderson & Co., 35 and 37 Cortland St., New York; Iowa Seed Co., DesMoines, Iowa; Eastman Seed Co., East Sumner, Maine; Wm. Henry Maule, Philadelphia, Pa.; H. W. Buckbee, Rockford, Ill.

Maine State College,
Orono, Me., March 18, 1896.

BULLETIN No. 28.

POTATO ROT—BORDEAUX MIXTURE AND FUNGIROID AS PREVENTIVES.

H. P. Gould.

Potato rot or "late blight" as it is frequently called, is a common and at the same time, one of the most serious diseases of the potato. It is the result of the growth and development of a fungous plant within the tissues of the leaves and tubers. The first indication of the presence of the fungus is the browning of distinct areas upon the leaves; a portion of the leaf may be affected or the whole leaf may be involved. If the weather is

warm and moist the disease usually spreads with great rapidity, a whole field assuming a brownish or blackened appearance within a few days from the first evidence of the presence of the malady; or if the weather is cool or dry, it may be difficult to distinguish the effect of the fungus from the natural maturing and dying of the foliage.

Early potatoes are seldom if ever injured, as the disease does not make its appearance until July or August.

Just how the tubers become infected is not known. The spores form on the under side of the leaves and fall to the ground. It is probable that these spores are washed by rains into the soil where they come in contact with the tubers and gaining entrance cause the well-known dry rot. It is possible that the mycelium of the fungus descends the stems and enters the tubers in that way, though the former manner of contamination is considered the more probable.

The injury due to the effects of the fungus may result from two causes. If the tops of the late potatoes are killed in July or August, the tubers will remain very small, even though they do not decay; but this latter condition almost invariably accompanies the dying of the tops, (if the dying be due to this fungus,) and when such is the case, the loss due to decay is usually much greater than from the former cause.

Although the direct effect of the disease on the tubers is to produce a dry rot, yet this unhealthy condition of the potato may often induce a "wet rot" which is especially noticeable at the time of digging.

If the weather is such that the fungus is developing rapidly, a very disagreeable and characteristic odor can usually be detected.

This subject has received much attention from experimenters during the past few years and some striking results have been obtained, proving almost beyond a doubt that the disease can be held in check if not absolutely prevented. Bordeaux mixture has invariably given the best results as a preventive of the malady.

By the use of Bordeaux mixture, at the Vermont Experiment Station, the total product in 1892 was increased from the rate of 169 bushels per acre from an unsprayed plat, to 400 bushels from

a sprayed plat; at the Rhode Island Station, in 1890 the increase was 48 per cent., and several other stations report very favorable results.

Quite recently there has been put upon the market a fungicide known commercially as "fungiroid." This article is manufactured by Leggett & Brother, New York, and is said by them to be a powdered Bordeaux mixture and a substitute for that fungicide as ordinarily prepared. So far as I am aware, its qualities have not been thoroughly tested. If fungiroid should prove to be equally as effective as Bordeaux mixture, its advantage over the latter would be its ease of application. This applies especially in the treatment of low-growing plants.

During the past season the subject was given some consideration at this station. There were eighteen rows in the plat used for this work. The first row was sprayed with Bordeaux mixture; fungiroid was applied to the second, while the third was left untreated to serve as a check,—and so on throughout the plat—every third row in order receiving the treatment described above, making six rows sprayed with Bordeaux mixture, six treated with fungiroid and an equal number which received no treatment.

The first application of fungicides was made July 13; two other applications were subsequently made at intervals of about two weeks.

The following table gives a summary of each of the six rows:

BORDEAUX MIXTURE VS. FUNGIROID.

Treatment.	Total weight—pounds.	Ratio of yield.	Weight of decayed tubers—pounds.	Per cent. of decayed tubers.
Bordeaux	262¾	1.00	1.1	.4
Fungiroid	219	.83	18.7	8.5
Check	198¾	.75	20.3	10.2

Referring to the column, "ratio of yield," it will be observed that the total yield of the untreated rows was only 75 per cent. that of the rows sprayed with Bordeaux mixture, or an increase of 25 per cent. from the use of the Bordeaux; the total yield from the rows treated with fungiroid was 83 per cent. that of the rows

sprayed with Bordeaux, or an increase of 17 per cent. in favor of Bordeaux mixture over fungiroid.

The last column gives the per cent. of decayed tubers. The rows sprayed with Bordeaux mixture produced only .4 of 1 per cent. by weight of decayed tubers, while from the unsprayed rows over 10 per cent. by weight of the tubers was decayed. The fungiroid seemed to have but little effect in preventing the decay.

The results do not promise the future for the fungiroid which had been hoped for it, yet we do not wish to draw final conclusions from this one season's trial.

In spraying potatoes for the prevention of the "blight," the first application should be made sometime from the first to the middle of July and subsequent applications should be made at intervals of from ten days to three weeks, depending upon the weather, rainy weather requiring more frequent applications than dry.

If potato bugs are numerous, Paris green may be added to the Bordeaux mixture at the rate of 1 ℔. to 150 gallons of the mixture.

The directions for preparing Bordeaux mixture given in the annual report of the Maine Experiment Station for 1889, may be varied somewhat. The following formula is the one most commonly used: 6 ℔s. copper sulphate, 4 ℔s. fresh unslaked lime, 45 gallons water. Dissolve the copper sulphate in a small quantity of water; slake the lime, adding a few quarts of water after the lime is slaked, and when cool mix with the copper sulphate solution and dilute with enough water to make in all 45 gallons. It is advisable to strain the lime solution before adding to the copper sulphate, as it usually contains more or less coarse material which would clog the spraying apparatus.

The copper sulphate should not be dissolved, nor should the Bordeaux mixture be prepared, in an iron vessel, as the copper compound will act upon the iron.

RECAPITULATION.

Potato rot, late blight or rust, as the disease is variously called, is the result of a fungous parasite; this disease can be held in check if not entirely prevented by the use of fungicides of which

Bordeaux mixture is the most satisfactory. The first application should be made early in July, followed by a second, after a lapse of from ten days to three weeks, according to the weather. Three or four applications should be made.

MAINE STATE COLLEGE,
ORONO, ME., March 31, 1896.

BULLETIN No. 29.

NOTES ON SPRAYING.

W. M. MUNSON.

The fact that insect and fungous enemies of the orchard may be held in check by careful attention to spraying with certain materials, has been so often and so plainly demonstrated that further proof seems unnecessary. By our more progressive farmers the practice is now looked upon as a necessity in successful orchard management, and there are frequent requests for information. To meet these inquiries, and to again call the matter to the attention of others, a brief review of the subject seems desirable at this time. Some points will be more fully discussed in the annual report for the current year.

Preparation for the Work:—If not already attended to, the necessary pumps and nozzles should at once be secured; likewise the chemicals—except the lime for Bordeaux mixture, which should be fresh when used. If a pump is already at hand it should be examined and the packing of the valves should be renewed. Be sure also that the hose is in good condition, as otherwise much valuable time may be lost later in the season.

It is advisable at this time also to prepare the necessary wagon or cart for use when spraying. In low-headed orchards an ordinary stone-boat or low wagon may serve the purpose well.

What is the best pump?—There are so many good pumps on the market at present it is not easy to give a specific answer to the question. The "Eclipse" made by Morrill & Morley, Benton Arbor, Mich., is highly recommended by some, but personally I have not used this form. The Field Force Pump Company, Lockport, N. Y.; The Goulds Manufacturing Company,

Seneca Falls, N. Y.; The Deming Company, Salem, Ohio; W. & B. Douglass, Middletown, Conn., and many other reliable firms are sending out very good pumps. These firms will all send catalogues free on application.

The best nozzle that we have used is the "McGowen," made by John J. McGowen, Ithaca, N. Y., and costs $1.00.

When to spray and why:—No definite time for beginning the work can be stated as this will depend on the season and on the object in view. It is of course understood that the arsenites—of which Paris green is preferred—are used to destroy insects which eat the leaves or fruit, such as bud-moth, canker-worm, codling-moth, etc. The copper salts, of which the best preparation is the Bordeaux mixture, are used to prevent the spread of fungous diseases such as apple scab, brown rot, etc. If the two classes of enemies are to be met, the remedies may be applied at one operation.

In general our recommendation for preventing apple scab would be to spray with Bordeaux mixture just before the fruit buds open, again with the same just as the blossoms fall, and repeat the operation once or twice at intervals of two or three weeks if the season is wet. In the first two lots applied, Paris green should be added in the proportion of 1 ℔ to 150 or 200 gallons, thus destroying leaf-eating insects and the codling-moth.

At least three sprayings should be given as above, and many would advise treatment with a solution of pure copper sulphate —1℔. to 15 gallons water—before the buds burst in spring. There is some question about the importance of this early treatment, but in our own experience such treatment has usually been found advantageous.

Preparation of Bordeaux mixture:—It would seem that this most important of the fungicides should now be perfectly familiar to every orchardist; but it is still a subject of frequent inquiry. As usually prepared the mixture consists of 6 ℔s. copper sulphate, 4 ℔s. quick lime and 50 gallons water. The copper salt is dissolved in a wooden tub, the lime slaked in a separate vessel and when ready for use the two are mixed and diluted as above.

In large orchards much time may be saved by preparing stock solutions of the lime and copper instead of constantly making up a new batch. Dissolve 40 lbs. of copper sulphate in as many gallons of water. A gallon of the solution will thus contain 1 lb. of the copper salt. In a similar way a stock solution of lime may be prepared. Keep both solutions tightly covered and stir thoroughly before dipping any out. A gallon of clear lime water contains only one-sixth of an ounce of lime instead of a pound, as desired. It is now a very simple matter to take six gallons of the copper solution, four of the lime and dilute to the requisite amount.*

Some other formulas:—The Bordeaux mixture and Paris green above mentioned are the standard remedies for orchard work. But there are some insects which are best reached by other means, and it is assumed that the orchardist knows what he is fighting before commencing operations. For currant worms, the specific—after the fruit has set—is fresh white hellebore. For the first brood of this insect we always use Paris green. Aphis and scale insects are best met with kerosene emulsion. For brown rot of plums, after the fruit has partly developed, the ammoniacal solution of copper carbonate is preferred to Bordeaux mixture, as the latter discolors the fruit.

KEROSENE EMULSION.

Hard soap	½ pound.
Boiled water	1 gallon.
Kerosene	2 gallons.

Dissolve the soap in the water, add the kerosene and churn through a force pump for five to ten minutes. In general, dilute about ten times before using. On very tender succulent plants dilute fifteen or twenty times, and for scale insects on woody plants dilute only five times.

HELLEBORE.

Fresh white hellebore	1 ounce.
Water	3 gallons.

A little flour paste added to the mixture will cause it to adhere to the foliage better.

*This subject was fully discussed before the Maine Pomological Society in January, 1895. See Rep. Maine Pom. Soc., 1894, p. 56.

AMMONIACAL COPPER CARBONATE.

Copper carbonate	1 ounce.
Ammonia water	1 quart.
Water	9 gallons.

For this purpose take the strongest ammonia, 26 degrees Beaumé, and dilute it with seven or eight volumes of water before using. This stock solution may be kept indefinitely in closely corked bottles. Dilute as above when ready for use. Several other formulas for the solution of copper carbonate are given, but this one will be found most convenient.

There are many other valuable insecticides and fungicides, but those above named are the most important. It is hoped that the warfare against disease and insect enemies of the orchard will be waged this year as never before.

MAINE STATE COLLEGE,
ORONO, ME., April 10, 1896.

BULLETIN No. 30.

INSPECTION OF FERTILIZERS, 1896.

The bulletin gave the manufacturer's guarantees, the analyses of manufacturer's samples and of samples collected by the Station, but as these figures are of only passing value they are omitted here.

BULLETIN No. 31.

A MODIFICATION OF THE BABCOCK METHOD AND APPARATUS FOR TESTING MILK AND CREAM.

J. M. BARTLETT.

The modifications described in this bulletin, briefly stated, are as follows:

The modification of the method consists chiefly in filling the bottles with hot water after the milk or cream and acid are

added, before they are put in the centrifugal machine and whirled. In this way the separation is completed with one whirling and the time required for the second whirling is saved.

The modifications of the apparatus are: The base portions of the milk and cream bottles are graduated so that no acid measure is required and the base portion of the cream bottle is reduced in size.

While working with the Babcock test some months ago it occurred to the writer that separating the fat before adding water was an unnecssary part of the process if the right conditions could be brought about and that the hot water might be added directly after mixing the acid and milk together. Accordingly, to decide the matter, a series of experiments were conducted, resulting in the adoption of the following method, which has been used successfully for the past six months with all kinds of milk and cream.

METHOD FOR MILK.

After the milk is mixed by stirring or pouring from one vessel to another, the required amount, 17.6 cubic centimeters, is measured into the test bottle. It is then heated to about 70 degrees Fahrenheit, if not already at that temperature, by setting the bottles in a tank of warm water. Twenty cubic centimeters of sulphuric acid (specific gravity 1.82 to 1.825) are added and the bottle shaken by giving it a rotary motion until the milk and acid are thoroughly mixed. The mixture is then allowed to stand not less than five minutes. No harm is done if it stands longer than five minutes and in fact, occasionally, some kinds of milk have to be given a little more time. After standing the necessary time the bottle is given another gentle shake to mix in and dissolve any particles of curd that may have risen to the surface. Hot water is then added nearly to the uppermost mark, the bottle is put in the centrifugal machine and whirled for five minutes at the rate of 1,000 to 1,200 revolutions per minute. A steam turbine machine is best for this purpose but a hand or belt power machine can be used, if hot water is put in the pan to keep the fat melted. After the whirling is completed the percentage of fat can be read off in the usual manner.

It would appear that the time required for the bottles to stand after the acid is mixed with the milk, would offset that gained by omitting the second whirling which is made in the old method; but the writer has often found it necessary with many kinds of milk, especially with that from cows much advanced in the period of lactation, to allow the bottles to stand a while, even when working the two whirling method, in order to get a clear separation of fat. However, every one who does much testing should have at least two sets of bottles, so there would be no loss of time by this process. When two sets of bottles are at hand one set, charged with the milk and acid, can stand while the second set is being filled, and the second set can stand while the first is being whirled. It is much better to make twelve tests at a time than to make a larger number. Twelve are about all one can easily read off before the fat begins to cool and contract in volume.

For the above described modification of the milk test no change of apparatus need be made, but the writer, however, prefers to have the base portion of the bottle graduated as before mentioned so no acid measure is required and only one pouring of the acid is necessary. By having the bottle marked at the point A, Fig. 1, at which mark it holds 37.5 cubic centimeters, one can, after the milk is measured in with the pipette, run the acid in until it is filled to this point. It was found impracticable to use a bottle with a smaller base capacity like the cream bottle described farther on, because of the larger amount of curd in milk than in cream and the small size of the neck of the milk bottle necessitating more space for shaking, breaking up the curd and dissolving it in the acid.

THE CREAM BOTTLE.

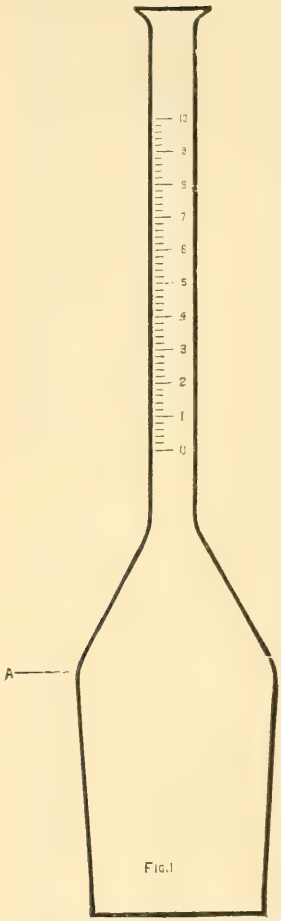


FIG. 1

The bottle here described (Fig. 2) is similar to the regular milk bottle, and also to the Connecticut Station cream bottle, except that the base portion is made of such size as to avoid using an acid measure. The base is made to hold about 38 cubic centimeters up to the neck and after the cream is measured in, the required amount of acid can be added by filling the bottle nearly to the neck or to the point A shown in the cut. The neck portion is large enough to carry 25 per cent. of fat and is graduated to one-half of one per cent. and can be easily read to one-quarter of one per cent. Each per cent. is numbered. Although one cannot read so closely with this as with the bulb neck bottle (described in Bulletin No. 3, Second Series, Maine Experiment Station), which was designed to test both milk and cream, one can read fine enough for all practical purposes. On account of the neck being larger and shorter, this bottle is more easily cleaned than either of the older forms; it is less liable to breakage, and by using the method previously given for milk a test can be made more rapidly. Twenty-five per cent. was fixed upon as the

FIG. 2

capacity of the neck for the reason that a much higher percentage necessitates an increase in diameter which impairs the accuracy in reading and again, nearly all cream shipped to the creameries is raised by the cold deep setting process and seldom contains more than twenty per cent. of fat. If one wishes to test separator cream that is very rich, 9 cubic centimeters or 9 grams of the cream can be taken instead of 18, 9 cubic centimeters of water added and the usual amount of acid. The per cent. of fat obtained in that case of course should be multiplied by two, to give a correct reading.

COMPARISON OF RESULTS OBTAINED BY OLD AND NEW METHODS.

Below are given, in tabular form, a few of the many results obtained on milk and cream in comparing the old method with the one whirling method.

Milk.		Milk.		Milk.		Cream.	
Whirled once.	Whirled twice.	Whirled once.	Whirled twice.	Whirled once.	Whirled twice.	Whirled once.	Whirled twice.
% 5.3	% 5.3	% 5.2	% 5.3	% 3.8	% 3.7	% 18¾	% 18¾
5.6	5.6	5.3	5.4	4.1	4.2	18½	18¾
6.0	6.0	4.7	4.8	5.2	5.0	18¾	18¾
4.9	4.9	5.0	4.9	5.1	5.2	18½	18¾
4.9	5.0	5.8	5.8	5.3	5.1	23½	23¼
5.2	5.2	5.0	5.0	5.0	5.0	23¾	.....
4.6	4.6	4.9	4.9	5.0	5.2	17	17¼
5.0	5.1	4.9	5.0	5.7	5.8	19¼	19

METHOD FOR CREAM.

The method employed for cream is as follows:

Measure 18 cubic centimeters or weigh 18 grams of the thoroughly mixed cream, carrying not more than 25 per cent. of fat, into the bottle. Heat it to about 70° F. if not already at that temperature, then fill the bottle up nearly to the base of the neck (point A, fig. 2) with sulphuric acid, specific gravity 1.82. The acid can be handled in a sharp-nosed pitcher or run in

from a syphon affixed to a bottle or carboy. Mix the acid and cream together thoroughly, which is best done by grasping the neck with the hand, pressing the thumb tightly over the opening and then giving the bottle a rotary motion, holding it upright all the time. The confined air prevents the curd from coming up and sticking to the sides of the neck. The mixing is just as easily done in this as in the old style bottle. The remainder of the process is conducted exactly the same as for testing milk previously given.

If the above directions are followed, a perfectly clear separation will be obtained and also a considerable saving of time over the old method, as only one pouring of the acid and one whirling of the machine are made.

WEIGHING CREAM FOR THE TEST INSTEAD OF MEASURING.

Cream containing twenty-five per cent. of fat or less when sweet and not frothing can be measured with sufficient accuracy to give good results. But when such cream becomes sour it is impossible to get it in condition to measure without a good deal of trouble. If it is simply broken up by shaking, as is often done, it will contain so many air bubbles that the cream drawn into the pipette will weigh less than 18 grams. To illustrate what a difference there is the writer made several tests of sweet cream, then the same samples were allowed to stand in the jars until sour, broken up by simply shaking and tests made by both weighing and measuring out the samples.

	Sweet cream measured.	Sour cream measured.	Sour cream weighed.
No. 1	17¼%	14½%	17¼%
No. 2	18	16	18¼
No. 3	20½	18½	20½

Thick separator cream, which will always contain air bubbles if stirred enough to get a good sample, cannot be accurately measured and must be weighed to get a reliable result; and the writer has become thoroughly convinced that it is necessary for every creamery to have some means at hand to test such cream

accurately. For this purpose the Station is having a special weighing scale made with which one can weigh nearly as rapidly as he can measure with a pipette. When completed it will be on sale by dealers in testing apparatus.

PRECAUTIONS.

That good results and clear separations can be obtained by the previously described modifications the writer and others connected with the College have fully demonstrated. It is necessary, however, that certain details be strictly observed to attain success and to make those points more prominent they are repeated as precautions.

1st. *The acid must be of the proper strength;*—1.82 specific gravity at 60 degrees Fahrenheit is more universally successful than a stronger acid, though 1.825 may be used in some cases. With very rich milk 20 to 21 c. c. of acid of 1.82 specific gravity works much better than a smaller quantity of strong acid, probably because there is less water in rich milk to properly dilute the acid than in poor milk. Rather thin milk will give good results with acid of quite varying strength. If the acid is too strong the fat will be blackened or black particles will appear in the lower part of the fat column. If the acid is not strong enough the fat will appear cloudy and white particles of curd will collect at the lower part of the column so that an accurate reading cannot be made.

2nd. *The milk or cream should not be colder than 70° Fahrenheit or warmer than 80° Fahrenheit when the acid is added.* If the milk or cream is too cold the curd will not all be dissolved in the time allowed, and the fat will appear cloudy with white particles in the lower part of the column which will interfere with the reading. If the milk or cream is too warm the action of the acid will be too violent, the fat will be burned and the whole column appear blackened or if only slightly burned black particles will appear in the lower part of the column.

3rd. *The acid and milk or cream must be thoroughly mixed together and the mixture stand not less than five minutes before hot water is added; otherwise a clear separation will not be obtained.* It is also best to shake the bottle again slightly, just before

adding the hot water, to dissolve any particles of curd that have risen with the fat.

4th. *The bottles must be whirled and heat applied as directed or the separation is liable to be incomplete.* Sometimes a cloudy fat can be cleared by heat and longer whirling.

INSPECTION LAWS IN FORCE IN MAINE.

The text of the laws to regulate the sale and analysis of commercial fertilizers, the testing of glassware used at creameries, and to regulate the sale and analysis of commercial concentrated feeding stuffs are given in full. The law regulating the sale of agricultural seeds is not an inspection law but as it is an important law and some of its provisions are entrusted to the Station Director, it is also printed herewith in full.

An Act to regulate the sale and analysis of Commercial Fertilizers.

Section 1. Every manufacturer, company or person who shall sell, offer or expose for sale in this state any commercial fertilizer or any material used for fertilizing purposes, the price of which exceeds ten dollars per ton, shall affix to every package of such fertilizer in a conspicuous place on the outside thereof, a plainly printed statement clearly and truly certifying the number of net pounds in the package sold or offered for sale, the name or trade mark under which the article is sold, the name of the manufacturer or shipper, the place of manufacture, the place of business and a chemical analysis stating the percentage of nitrogen, or its equivalent in ammonia in available form, of potash soluble in water, and of phosphoric acid in available form, soluble and reverted as well as the total phosphoric acid.

Sect. 2. Every manufacturer, company or person who shall sell, offer or expose for sale in this state any commercial fertilizer or material used for fertilizing purposes, the price of which exceeds ten dollars per ton, shall for each and every fertilizer bearing a distinguishing name or trade mark, file annually with the Director of the Maine Agricultural Experiment Station, between the fifteenth day of November and the fifteenth day of December, a certified copy of the statement, named in section

one of this act, said certified copy to be accompanied, when required, by a sealed glass jar or bottle containing at least one pound of the fertilizer to be sold or offered for sale, and the company or person filing said certified copy with its accompanying sample of fertilizer shall thereupon make affidavit that said sample corresponds within reasonable limits to the fertilizer which it represents in the percentage of nitrogen, total and available phosphoric acid, and potash soluble in water which it contains. Such affidavit shall apply to the entire calendar year next succeeding the date upon which said affidavit is made, unless the person or persons making such affidavit shall give notice to the Director of the Maine Experiment Station that a change is to be made during the year in the percentages of the above named ingredients contained in the fertilizer, in which case he shall, before selling or offering for sale such fertilizer, file another certified statement with an accompanying sample of fertilizer and an affidavit as hereinbefore required. The deposit of a sample of fertilizer as herein provided shall be required by said Director unless the company, manufacturer or person selling or offering for sale a fertilizer coming within the provisions of this act, shall certify that its composition for the succeeding year is to be the same as given in the last previously certified statement, in which case the requiring of said sample shall be at the discretion of said Director.

Sect. 3. The Director of the Maine Experiment Station shall analyze, or cause to be analyzed, all the samples of fertilizers which come into his possession under the provisions of section two of this act, and shall publish the results thereof in a bulletin or report on or before the fifteenth of March next succeeding.

Sect. 4. Any manufacturer, importer, agent or seller of any commercial fertilier, who shall deposit with the Director of the Maine Experiment Station a sample or samples of fertilizer under the provisions of section two of this act, shall pay annually to said Director an analysis fee as follows: Ten dollars for the phosphoric acid and five dollars each for the nitrogen and potash, contained or said to be contained in the fertilizer, this fee to be assessed on any brand sold in the State, and upon receipt of such fee and of the certified statement named in section two

of this act, said Director shall issue a certificate of compliance with this act. Whenever the manufacturer or importer of a fertilizer shall have filed the statement made in section two of this act and paid the analysis fee, no agent or seller of said manufacturer, importer or shipper shall be required to file such statement or pay such fee. The analysis fees received by said Director shall be paid immediately by him into the treasury of said Experiment Station.

Sect. 5. Any manufacturer, importer or person who shall sell, offer or expose for sale in this State any commercial fertilizer without complying with the requirements of sections one, two and four of this act, or any fertilizer which contains substantially a smaller percentage of constituents than are certified to be contained, shall, on conviction in a court of competent jurisdiction, be fined one hundred dollars for the first offense, and two hundred dollars for each subsequent offense.

Sect. 6. The Director of the Maine Experiment Station shall annually analyze, or cause to be analyzed, at least one sample, to be taken in the manner hereinafter prescribed, of every fertilizer sold or offered for sale under the provisions of this act. Said Director is hereby authorized and directed in person or by deputy to take a sample not exceeding two pounds in weight, for said analysis, from any lot or package of fertilizer or any material used for manurial purposes which may be in the possession of any manufacturer, importer, agent or dealer in this State; but said sample shall be drawn in the presence of said party or parties in interest, or their representative, and taken from a parcel or a number of packages which shall not be less than ten per cent. of the whole lot sampled, and shall be thoroughly mixed and then divided into two equal samples and placed in glass vessels and carefully sealed and a label placed on each, stating the name or brand of the fertilizer or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing, and said label shall also be signed by the Director or his deputy and by the party or parties in interest or their representatives at the drawing and sealing of said samples; one of said duplicate samples shall be retained by the Director and the other by the party

whose stock was sampled; and the sample or samples retained by the Director shall be for comparison with the certified statement named in section two of this act. The result of the analysis of the sample or samples so procured shall be published in a report or bulletin within reasonable time.

Sect. 7. Whenever the Director becomes cognizant of the violation of any of the provisions of this act he shall report such violation to the Secretary of the Board of Agriculture, and said Secretary shall prosecute the party or parties thus reported; but it shall be the duty of said Secretary upon thus ascertaining any violation of this act, to forthwith notify the manufacturer or importer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of any fertilizer or fertilizing material if the same shall be found substantially equivalent to the certified statement named in section two of this act.

Sect. 8. All acts and parts of acts inconsistent with this act are hereby repealed.

Sect. 9. This act shall take effect when approved.

Approved February 24, 1897.

Chapter 169.

An Act for the Protection of Dairymen.

Section 1. All bottles, pipettes or other measuring glasses used by any person, firm or corporation, or their agents or employes, at any creamery, butter factory, cheese factory or condensed milk factory, or elsewhere in this State, in determining by the Babcock test, or by any other test, the value of milk or cream received from different persons or parties at such creameries or factories, shall before such use be tested for accuracy of measurement and for accuracy of the per cent. scale marked thereon. Such bottles, pipettes or measuring glasses shall bear in marks or characters ineffaceable the evidence that such test has been made by the authority named in section two of this act. And no inaccurate bottles, pipettes or other glasses shall bear such marks or characters.

Sect. 2. It is hereby made the duty of the Director of the State College Experiment Station, or other competent person designated by him, to test the accuracy of all bottles, pipettes or other measuring glasses used by persons, firms or corporations in this State buying or pooling milk or cream, or apportioning butter or cheese made from the same, by the contents of butter fat contained therein. The Director of the Experiment Station or the person designated by him, shall mark such bottles, pipettes or other measuring glasses as are found correct, in marks or characters which cannot be erased, and which marks or characters shall stand as proof that they have been so tested. The Director of the Experiment Station shall receive for such service the actual cost incurred, and no more, the same to be paid by the persons or corporations for whom it is done.

Sect. 3. Any person, either for himself or in the employ of any other person, firm or corporation, who manipulates the Babcock test or any other test, whether mechanical or chemical, for the purpose of measuring the contents of butter fat in milk or cream for a basis of apportioning the value of such milk or cream, or the butter or cheese made from the same, shall secure a certificate from the superintendent of the dairy school at the State College of Agriculture and Mechanic Arts that he or she is competent and well qualified to perform such work. The rules and regulations in the application for such certificate and in the granting of the same shall be such as the superintendent of that school may arrange, and the fee for issuing a certificate shall in no case exceed one dollar, the same to be paid by the applicant.

Sect. 4. Whoever uses, or has in his possession with intent to use, at any creamery, butter factory, cheese factory or condensed milk factory, any sulphuric acid of less than one and eighty-two hundredths of specific gravity in the process known as the Babcock test, or any other test for determining the butter fat contents of milk or cream, shall on conviction pay a fine not exceeding twenty-five dollars for the first offense, and for a second offense a sum not exceeding fifty dollars. Any person, firm or corporation violating the provisions of section one of this act, shall on conviction pay a fine not exceeding fifty dollars

for the first offense, and for a second offense a sum not exceeding one hundred dollars; and any person violating section three of this act shall on conviction pay a fine not exceeding ten dollars. And it shall be the duty of every inspector of milk, sheriff, deputy sheriff and constable to institute complaint against any person or persons violating the within named provisions of this act, and on conviction one-half of the fines shall go to complainant and the balance to the State.

Sect. 5. This act shall take effect in six months from the date of its approval.

Approved March 27, 1895.

Chapter 334.

An Act to regulate the sale and analysis of Concentrated Commercial Feeding Stuff.

Section 1. Every manufacturer, company or person who shall sell, offer or expose for sale or for distribution in this State any concentrated commercial feeding stuff, as defined in section three of this act, used for feeding farm live stock, shall, in addition to the tax tag described in section five of this act, affix to every package of such feeding stuff, in a conspicuous place on the outside thereof, a plainly printed statement clearly and truly certifying the number of net pounds in the package sold or offered for sale, the name or trade mark under which the article is sold, the name of the manufacturer or shipper, the place of manufacture, the place of business and a chemical analysis stating the percentage of crude protein, allowing one per cent. of nitrogen to equal six and one-fourth per cent. of protein, and of crude fat it contains, both constituents to be determined by the methods adopted at the time by the Association of Official Agricultural Chemists.

Sect. 2. The term concentrated commercial feeding stuff, as here used, shall not include hays and straws, the whole seeds nor the unmixed meals made directly from the entire grains of wheat, rye, barley, oats, Indian corn, buckwheat, and broom corn. Neither shall it include wheat, rye and buckwheat brans

or middlings, not mixed with other substances, but sold separately, as distinct articles of commerce, nor pure grains ground together.

Sect. 3. The term concentrated commercial feeding stuff, as here used, shall include linseed meals, cotton-seed meals, pea meals, cocoanut meals, gluten meals, gluten feeds, maize feeds, starch feeds, sugar feeds, dried brewer's grains, malt sprouts, hominy feeds, cerealine feeds, rice meals, oat feeds, corn and oat chops, ground beef or fish scraps, mixed feeds, and all other materials of similar nature not included within section two of this act.

Sect. 4. Before any manufacturer, company or person shall sell, offer or expose for sale in this State any concentrated commercial feeding stuff, as defined in section three of this act, he or they shall for each and every feeding stuff bearing a distinguishing name or trade mark, file with the Director of the Maine Agricultural Experiment Station a certified copy of the statement named in section one of this act, said certified copy to be accompanied, when the Director shall so request, by a sealed glass jar or bottle containing at least one pound of the feeding stuff to be sold or offered for sale, and the company or person furnishing said sample shall thereupon make affidavit that said sample corresponds within reasonable limits to the feeding stuff which it represents, in the percentage of protein and fat which it contains.

Sect. 5. Each manufacturer, importer, agent or seller of any concentrated commercial feeding stuff, as defined in section three of this act, shall pay to the Director of the Maine Agricultural Experiment Station an inspection tax of ten cents per ton for each ton of such concentrated feeding stuff sold or offered for sale in the State of Maine, and shall affix to each car shipped in bulk and to each bag, barrel or other package of such concentrated feeding stuff, a tag to be furnished by said Director, stating that all charges specified in this section have been paid. The Director of said Experiment Station is hereby empowered to prescribe the form for such tags, and adopt such regulations as may be necessary for the enforcement of the law. Whenever the manufacturer or importer or shipper of a concentrated feed-

ing stuff shall have filed the statement made in section one of this act and paid the inspection tax, no agent or seller of said manufacturer, importer or shipper shall be required to file such statement or pay such tax. The amount of inspection tax received by said Director shall be paid by him into the treasury of the Maine Agricultural Experiment Station. The treasurer of said Station shall make an annual report of receipts and expenditures of funds from this inspection tax, and all receipts in excess of three thousand dollars shall be carried into the state treasury.

Sect. 6. Any manufacturer, importer or person who shall sell, offer or expose for sale or for distribution in this state any concentrated commercial feeding stuff, as defined in section three of this act, without complying with the requirements of the preceding sections of this act, or any feeding stuff which contains substantially a smaller percentage of constituents than are certified to be contained, shall, on conviction in a court of competent jurisdiction, be fined not more than one hundred dollars for the first offense, and not more than two hundred dollars for each subsequent offense.

Sect. 7. The Director of the Maine Experiment Station shall annually analyze, or cause to be analyzed, at least one sample to be taken in the manner hereinafter prescribed, of every concentrated commercial feeding stuff sold or offered for sale under the provisions of this act. Said Director is hereby authorized and directed in person or by deputy to take a sample, not exceeding two pounds in weight, for said analysis, from any lot or package of concentrated commercial feeding stuff which may be in the possession of any manufacturer, importer, agent or dealer in this state; but said sample shall be drawn in the presence of said party or parties in interest, or their representative, and taken from a parcel or a number of packages, which shall not be less than ten per cent. of the whole lot sampled, and shall be thoroughly mixed, and then divided into two equal samples, and placed in glass vessels, and carefully sealed and a label placed on each, stating the name or brand of the feeding stuff or material sampled, the name of the party from whose stock the sample was drawn and the time and place of drawing,

and said label shall also be signed by the Director or his deputy and by the party or parties in interest or their representative at the drawing and sealing of said samples; one of said duplicate samples shall be retained by the Director and the other by the party whose stock was sampled; and the sample or samples retained by the Director shall be for comparison with the certified statement named in section four of this act. The result of the analysis of the sample or samples so procured, together with such additional information as circumstances advise, shall be published in reports or bulletins from time to time.

Sect. 8. Whenever the Director becomes cognizant of the violation of any of the provisions of this act, he shall report such violation to the Secretary of the Board of Agriculture, and said Secretary shall prosecute the party or parties thus reported; but it shall be the duty of said Secretary, upon thus ascertaining any violation of this act, to forthwith notify the manufacturer, importer or dealer in writing, and give him not less than thirty days thereafter in which to comply with the requirements of this act, but there shall be no prosecution in relation to the quality of any concentrated commercial feeding stuff if the same shall be found substantially equivalent to the certified statement named in section four of this act.

Sect. 9. All acts and parts of acts inconsistent with this act are hereby repealed.

Sect. 10. This act shall take effect October first, eighteen hundred and ninety-seven.

Approved March 27, 1897.

Chapter 313.

An Act to regulate the sale of Agricultural Seeds.

Section 1. Every lot of seeds of agricultural plants, whether in bulk or in package, containing one pound or more, and including the seeds of cereals, (except sweet corn), grasses, forage plants, vegetables, and garden plants but not including those of trees, shrubs and ornamental plants, which is sold, offered or exposed for sale for seed by any person or persons in Maine,

shall be accompanied by a written or printed guarantee of its percentage of purity, freedom from foreign matter; provided, that mixtures may be sold as such when the percentages of the various constitutents are stated.

Sect. 2. Dealers may base their guarantees upon tests conducted by themselves, their agents, or by the Director of the Maine Agricultural Experiment Station; provided, that such tests shall be made under such conditions as the said Director may prescribe.

Sect. 3. The results of all tests of seeds made by said Director shall be published by him in the bulletins or reports of the Experiment Station, together with the names of the person or persons from whom the samples of seeds were obtained. The said Director shall also publish equitable standards of purity together with such other information concerning agricultural seeds as may be of public benefit.

Sect. 4. Any person or persons who shall sell, offer or expose for sale or for distribution in this State agricultural seeds without complying with the requirements of sections one and two of this act, shall, on conviction in a court of competent jurisdiction, be fined not to exceed one hundred dollars for the first offense, and not to exceed two hundred dollars for each subsequent offense.

Sect. 5. Any person or persons who shall, with intention to deceive, wrongly mark or label any package or bag containing garden or vegetable seeds or any other agricultural seeds, not including those of trees, shrubs, and ornamental plants, shall be guilty of a misdemeanor and upon conviction in a court of competent jurisdiction shall be fined not to exceed one hundred dollars for the first offense and not to exceed two hundred dollars for each subsequent offense.

Sect. 6. The provisions of this act shall not apply to any person or persons growing or selling cereals and other seeds for food.

Sect. 7. Whenever the Director of the Maine Agricultural Experiment Station becomes cognizant of the violation of any of the provisions of this act, he shall report such violation to the Secretary of the Board of Agriculture, and said Secretary shall prosecute the party or parties thus reported.

Sect. 8. All acts and parts of acts inconsistent with this act are hereby repealed.

Sect. 9. This act shall take effect September one, eighteen hundred ninety-seven.

Approved March 26, 1897.

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