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Twelfth annual report, Bulletin, no. 79

Murkland, Charles S.

New Hampshire Agricultural Experiment Station

Bulletin 79. November, 1900.

NEW HAMPSHIRE COLLEGE

AGRICULTURAL EXPERIMENT STATION

TWELFTH ANNUAL REPORT

BY CHARLES S. MURKLAND

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND THE MECHANIC ARTS
DURHAM

NEW HAMPSHIRE COLLEGE
OF
AGRICULTURE AND THE MECHANIC ARTS.

AGRICULTURAL EXPERIMENT STATION.

DURHAM, N. H.

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FREDERICK C. KEITH, *Clerk.*

TWELFTH ANNUAL REPORT.

The twelfth annual report of the New Hampshire College Agricultural Experiment Station, for the year ending October 31, 1900, is hereby respectfully submitted. The reports of the departments will be found upon the pages indicated in the following list:

CHARLES S. MURKLAND,
Acting Director.

ANNUAL STATEMENT

Of the Hatch Fund of the New Hampshire College of Agriculture and the Mechanic Arts, for the year ending June 30, 1900.

RECEIPTS.

Cash received from United States treasurer	$15,000.00

EXPENDITURES.

Cash paid for salaries	$9,362.81
labor	1,400.43
publications	1,363.15

Cash paid for postage and stationery	$118.09	
freight and express	80.26	
heat, light, and water	523.76	
chemical supplies	56.67	
seeds, plants, and sundry supplies	251.94	
fertilizers	126.42	
feeding stuffs	148.73	
library	356.21	
tools, implements, and machinery	17.74	
furniture and fixtures	209.68	
scientific apparatus	389.62	
traveling expenses	90.51	
contingent expenses	11.21	
building and repairs	492.77	
		$15,000.00

SUPPLEMENTARY STATEMENT.

Receipts.

Balance on hand	$423.38
Cash received for analysis of fertilizers, water, etc.	799.00
	$1,222.38

Expenditures.

Cash paid for salaries	$656.24	
Scientific apparatus	194.80	
Chemical supplies	28.45	
Publications	256.80	
Labor	31.53	
Balance	54.56	
		$1,222.38

We, the undersigned, duly authorized auditors of the corporation, do hereby certify that we have examined the books and accounts of the New Hampshire College Agricultural Ex-

periment Station for the fiscal year ending June 30, 1900; that we 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, and the corresponding disbursements $15,000; for all of which proper vouchers are on file and have been by us examined and found correct.

Also, that the receipts from fertilizer analyses and farm receipts have been duly expended and vouched for, as per supplementary statement.

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

(Signed)

ROSECRANS W. PILLSBURY,
JAMES E. SHEPARD,
Auditors.

Durham, N. H., August 4, 1900.

REPORT OF VICE-DIRECTOR.

To Charles S. Murkland, Acting Director:

The reports of the different departments of the Agricultural Experiment Station, which are included in the following pages, show the different lines of work pursued by them during the year ending October 31, 1900. Ten bulletins have been issued previous to this report, namely,—

No. 69. Inspection of Fertilizers in 1899. By Fred W. Morse.

No. 70. Experiments with Muskmelons. By Frank Wm. Rane.

No. 71. Corn Culture. By Charles Wm. Burkett.

No. 72. Insect Record for 1899. By Clarence M. Weed.

No. 73. Experiments with Tomatoes and Potatoes. By Frank Wm. Rane.

No. 74. Growing Strawberries in New England. By Frank Wm. Rane.

No. 75. The Forest Tent Caterpillar. Second Report. By Clarence M. Weed.

No. 76. Utilizing the Greenhouse in Summer. By Frank Wm. Rane.

No. 77. Experiments in Road Surfacing. By Charles H. Pettee.

No. 78. Bovine Tuberculosis. By Herbert H. Lamson.

No. 79. Twelfth Annual Report.

Two assistants were added to the station staff by the appointment of Marion Imes, M. S., assistant in animal husbandry, July 1, and David B. Bartlett, B. S., assistant in biology, September 1. Roscoe H. Shaw, B. S., assistant chemist, resigned September 15 to take a position in the University of Wisconsin.

The department of chemistry has pursued essentially the same lines of work reported last year. The results of sundry

minor investigations executed from time to time by this department are for convenience reported at this time.

Composition of Sunflower Seeds.

The work on composition of sunflower seeds was practically all done in 1898, by Messrs. Howard and Vickery, at the time assistants in the department, but the results have not been published. Three lots of Russian sunflower seeds were used, two of which were raised at the station, while the third was furnished by Mr. A. Z. Norcross of Rindge, a member of the New Hampshire College class of 1899. One lot of the seeds grown at the station was black and the other striped. The seeds grown in Rindge were striped and had been picked prematurely, so that they were lighter in weight than the station lots.

The seeds were separated into hulls and meats, which were analyzed separately, in addition to the analysis of the seeds as a whole.

The analytical results are given in the following tables:

	Specific gravity.	Per cent meats.	Per cent hulls.
Seeds from Durham, black	.677	46	54
Seeds from Durham, striped	.649	58	42
Seeds from Rindge, striped	.435	45	55

COMPOSITION OF SUNFLOWER SEEDS.

	Air-dry seeds.		Dry matter.				
	Water.	Dry matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Black Seeds, Durham	4.16	95.84	3.55	16.88	26.79	22.72	30.06
Striped Seeds, Durham	4.26	95.74	3.43	17.75	28.61	21.07	29 04
Striped Seeds, Rindge	4.89	95.11	4.01	18.13	36.22	22.29	19.35
Meats of Black Seeds, Durham	2.03	97.97	4.45	23.59	8 44	19.41	44.11
Meats of Striped Seeds, Durham	2.67	97.33	4.23	23 44	14.89	18.51	38.93
Meats of Striped Seeds, Rindge	3.70	96.30	4 81	33.69	7 50	16.15	37.85
Hulls of Black Seeds, Durham	3.89	96.11	2.89	9 16	42.69	26.17	19.09
Hulls of Striped Seeds, Durham	3.72	96.28	2.95	8.79	47.74	25.83	14.69
Hulls of Striped Seeds, Rindge	4.83	95.17	2.85	8.21	51.69	27.71	9.54

The value of sunflower seeds as a poultry food is well known and is on account of both fat and protein. The immature seeds from Rindge show a marked variation from the other lots, especially in fat of the whole seed and hulls, and in protein of the meats.

Composition of Some Poultry Foods.

In the past two years several lots of poultry foods have been analyzed for different parties, and the results are brought together here for comparison.

COMPOSITION AND COST OF ANIMAL POULTRY FOODS.

Number.	Per cent protein.	Per cent fat.	Cost per 100 lbs.	Remarks.
1	35.00	20.72	$1.60	Meat and bone meal.
2	36.46	12.08	1.75	Meat and bone meal.
3	38.23	11.93	1.30	Meat and bone meal.
4	31.35	12.82	1.25	Meat and bone meal.
7	33.94	13.11	1 60	Meat and bone meal.
5	47.39	18.72	1.90	Beef scraps.
6	32.13	1.61	1.30	Ground dried fish.

COMPOSITION OF GRAIN POULTRY FOODS.

	Protein.	Fat.	Fiber.
H-O Poultry Feed	17.75	5.29	4.02
H-O Scratching Feed	14.62	4.40	4.50
American Poultry Feed	11.47	5.83	5.94
Broken Crackers	8.83	10.80	....
Middlings	15.60	4.00	4.60

The animal foods and broken crackers were received from Milford and the H-O feeds from Suncook. The American Poultry Feed was taken from a single sack sent to the Experiment Station, and it is only fair to say that in the reports of the Maine Feed Inspection this brand has uniformly given about 13 per cent of protein, instead of 11.5. The average composition of middlings is given for purposes of comparison, since the other foods sell for about the same price. The H-O

Scratching Feed consisted of whole wheat and oats, cracked corn, and split peas.

The low fiber in each of the mixed poultry foods shows them to be made of the best grades of grain by-products, and not from chaff.

The animal foods show considerable variation in prices and composition, rendering it advisable to purchase such goods, like fertilizers, on a guaranteed composition.

Seaweed as a Fertilizer.

Although New Hampshire has a limited seacoast, it lies in a thriving agricultural section of the state, and the farmers are much interested in the value of seaweed as a fertilizer, since it costs nothing but the labor of gathering and carting. The samples of seaweed were secured through the co-operation of Mr. David Jenness, of Rye, and Mr. E. B. Lamprey, of North Hampton. The former collected several samples of kelp in November, 1899, weighed and dried them, and forwarded them to the station. The latter sent a large sample of mixed seaweed in a fresh condition in April of this year. The mixed seaweed consisted mainly of kelp, but included rock weed and moss.

COMPOSITION OF SEAWEED.

	Kelp.		Mixed.	
	Wet.	Dry matter.	Wet.	Dry matter.
Water	82.310	.....	81.39	.....
Nitrogen	.260	1.49	.48	2.57
Phosphoric acid	.159	.90	.25	1.35
Potash	.343	1.94	.45	2.40

The subject of seaweed as a manure is fully treated in Bulletin No. 21 of the Rhode Island Experiment Station. The results obtained in our analyses are in accord with those obtained in Rhode Island. Seaweed is worth about one half as much as average stable manure, and needs to be reinforced with acid phosphate, since it contains a low proportion of phosphoric acid.

Maple Syrup from Defoliated Trees.

A sample of maple syrup was received from Lisbon, which was made from the last run of sap in the spring of 1899, produced by trees that had been stripped of their leaves the previous summer by the forest tent caterpillar.

The syrup was dark colored but clear, and its analysis showed no difference in composition from that of other last-run products.

Composition.	
Sugar by saccharimeter	60.60 per cent.
Reducing sugar	1.40 "
Protein	1.56 "
Ash	.67 "
Total solids	66.20 "

Fred W. Morse,

Vice-Director and Chemist.

DEPARTMENT OF HORTICULTURE.

The work in horticulture has been continued along the same lines as during the last year. More or less work has been done in pomology, vegetable gardening, floriculture, and landscape horticulture. Two hundred fifty apple trees and one hundred twenty-five peach trees, also some small fruits, were set out the past spring.

During the year four bulletins and one press bulletin have been issued, viz.: No. 70, "Experiments with Muskmelons"; No. 73, "Experiments with Tomatoes and Potatoes"; No. 74, "Strawberries in New England"; No. 76, "Utilizing the Greenhouse in Summer"; and Press Bulletin No. 39, "Cold Storage for Fruit."

Potato Report.

The interest in potato growing continues to increase each year. Although the present season has been very dry and cut the crop short, especially in the southern part of the state, a

much larger number of varieties has been grown than ever. In various sections certain persons have assisted in improving the value and importance of the crop in the state. Among them are Mr. Burton A. Corbett, B. S., Colebrook, who is making a study of potato breeding, and developing the potato industry as a seedsman, and Mr. C. A. Evans of Claremont, who exhibited at the Concord and Claremont fairs over eighty named varieties grown by himself.

THE STATION TEST.

The results of our variety test for the past season are shown in the accompanying table. In the last two columns can be seen the rate of yield, not only for the past year, but the average for the past four potato seasons.

We have a limited quantity of the varieties named, a few bushels only of each variety; therefore, we cannot offer them for distribution. If there are any persons who desire but a few tubers of any one or a number of the varieties for purposes of testing or making exhibits at fairs we shall be pleased to accommodate them, provided they will pay for transportation and for the time required to put them up for shipment. Should any in the list asked for become exhausted we will reserve the right of substitution. Where possible we would prefer to send by express, advancing the charges. No seed will be sent out after April 20.

TABLE I.—VARIETIES GROWN IN 1900.

Number.	Variety.	Large.	Small.	Yield per acre.	Color.	Average yield for 4 years.	Order of largest yield.	
							Past season	Past 4 yrs.
		lbs.	lbs.	bu.		bu.		
1	Uncle Sam	33 5	5.0	155.2	W	206	35	38
2	American Wonder	30.5	8.5	157.3	"	254	33	25
4	Blush	42.0	9.5	207.7	P	262	12	18
10	Carman No. 1	38.0	6.5	181.5	W	255	20	23
11	Carman No. 3	44 0	7.5	207.7	"	254	11	24
16	Country Gentleman	34.5	13.0	191.5	"	292	16	8
17	Delaware	34.0	7.0	165.3	"	223	29	34
18	Dewdrop Rose	27.5	11.5	157.3	R	260	34	20
24	Early Six Weeks	28.5	10.0	155.2	"	199	37	40
31	Good News	41.5	10.5	209.7	"	189	9	43
36	Harvest Queen	45.0	6.5	207 7	W	288	10	10
38	Honeoye Rose	39.5	5.0	179.4	R	217	23	35
40	Irish Daisy	40.0	4.0	177.4	W	178	24	45
43	Late Puritan	54.5	10.5	262.1	"	353	1	1
44	Leonard's Favorite	37.0	14.0	205.7	R	232	14	31
45	Maggie Murphy	33.5	5.5	157.3	"	211	32	36
47	Mill's Endurance	16.0	2 5	74.6	W	133	46	47
50	Orphan	31.0	7.5	155.2	"	267	36	15
52	Polaris	24.0	10.5	139.1	"	192	42	42
53	Peerless, Jr.	46.5	5.5	209.7	"	250	8	26
57	Quick Crop	29.5	13.0	171.4	"	261	27	19
58	Reeve's Rose	30 0	9.5	159.3	R	313	31	3
61	Rutland Rose	28 5	8.5	149.2	W	259	40	21
62	Rural New Yorker, No. 2	38.0	7.0	181.5	"	235	21	29
64	Seneca Beauty	49.0	8.5	231.9	R	306	4	4
65	Sir William	29.0	11.5	163.3	W	288	30	12
66	Somerset	22.0	8.5	123.0	"	237	44	28
70	Vaughan	26.5	11.5	153.2	"	267	38	16
71	Vick's Advancer	33.5	12.0	183 5	"	227	19	33
74	White Rose	25.0	12.0	149 2	"	258	41	22
75	Wilson's First Choice	49.0	10.0	237.9	"	293	3	7
76	Woodhull's Seedling	24.5	9.5	137.2	"	246	43	27
80	Governor Rusk	40.0	8.5	195 5	R	263	15	17
81	Sir Walter Raleigh	47.0	8.5	223.9	W	286	5	13
84	Livingston	42.0	5.0	189.5	"	233	17	30
86	Fill Basket	45.0	9.0	217.7	"	322	6	2
87	Breck's Chance	39.0	8.0	189.5	R	291	18	9
88	Prolific Rose	35.0	7 5	171.4	"	269	26	14
93	Burns No. 1	30 0	11 5	167.4	W	232	28	32
95	Vigirosa	26 0	12.5	151.2	"	207	39	37
99	Red American Wonder	44.0	7.0	205.7	R	288	13	11
101	White Beauty	42.0	10.5	211.7	W	298	7	6
102	Enormous	58.0	4.5	252.1	"	304	2	5
103	Early Dawn	14.0	11 0	100.8	R	188	45	44
104	Early Andes	13.5	7.0	82.6	"	168	47	46
105	Granite State	37.5	7.0	179.5	W	204	22	39
106	Twentieth Century	35.0	8.5	175 5	"	195	25	41
107	The Commercial	29.0	6.0	141.2	R	141	50	
108	Wonderful	37.0	3.5	163.4	W	163	35	
109	Pingree	29.0	3.5	131.2	"	131	53	
110	Admiral Dewey	22.0	9.0	125.2	"	125	54	Only one year.
111	Washington	48.0	5.0	213.7	"	214	9	
112	Erie	48.0	5.0	213.7	R	214	10	
113	Bottle Best	50.0	2.0	209.7	W	210	12	
114	Extra Early May	27.0	3.0	121.2	R	121	56	
115	Evans' Beauty	22.0	4.0	104.8	W	105	57	
116	Pride of Sunnyside	35 0	5.0	161 3	R	161	37	
117	Burbank's Seedling	50.0	4.0	217.7	W	218	7	
118	Algonquin	57.0	5.5	252.1	"	252	3	
119	Green Mountain	35.0	4.5	159.3	"	159	38	

NOTES ON VARIETIES.

No. 1. *Uncle Sam.* Color white. Shape regular. Runs a little uneven in size but quite a good looking variety.

No. 2. *American Wonder.* Color white. Shape even, long. Not very good this season.

No. 4. *Blush.* Color pink. Shape round, somewhat irregular. Shows up quite well in basket. Eyes quite deep.

No. 10. *Carman No. 1.* Color white. Shape good, somewhat round, compact. A good looking potato.

No. 11. *Carman No. 3.* Color white. Shape regular, round, compact. Skin smooth and of a good, clean color. A fine looking potato.

No. 16. *Country Gentleman.* Color white. Size medium. Shape a little uneven. Did not do very well this year.

No. 17. *Delaware.* Color white. Shape round, regular, smooth. Quite a good looking potato.

No. 18. *Dewdrop Rose.* Color pinkish. Shape rather regular. Size medium. A fairly good looking Rose type.

No. 24. *Early Six Weeks.* Size medium. Shape regular. Color reddish. Quite a good looking variety. Good for very early; not heavy yielder.

No. 31. *Good News.* Size large, quite even. Color red. Shape regular, compact. A good appearing potato.

No. 36. *Harvest Queen.* Size large, quite irregular. Color yellowish white. A fairly good looking potato.

No. 38. *Honeoye Rose.* Shape somewhat irregular, slightly flattened.

No. 40. *Irish Daisy.* Size large. Shape quite regular. Deep eyed. A good looking potato.

No. 43. *Late Puritan.* Size medium. Shape quite regular, somewhat elongated. Color clear white. A fairly good looking variety.

No. 44. *Leonard's Favorite.* Size medium to large. Shape quite even. Color red. Fairly good.

No. 45. *Maggie Murphy.* Shape somewhat irregular. Deep-eyed. Color red. Fairly good.

No. 47. *Mill's Endurance.* Size medium to large. Shape regular. Skin rough. Color white. Fairly good.

No. 50. *Orphan.* Size medium. Shape irregular, long and prongy. Color white, clear skin. Too prongy for best appearance.

No. 52. *Polaris.* Size medium. Color white. Skin smooth. Not very good this season.

No. 53. *Peerless, Jr.* Size very large. Shape round, somewhat flattened, compact. Color white, clear skin. A good variety. Perhaps a little large for market.

No. 57. *Quick Crop.* Size medium. Color yellowish white. Shape quite regular. Not very good appearance.

No. 58. *Reeve's Rose.* Shape regular. Skin rough. Color red. Fairly good.

No. 61. *Rutland Rose.* Size medium. Shape somewhat irregular, with long tendency. Color white.

No. 62. *Rural New Yorker No. 2.* Size medium to large. Shape even, round, and compact. Color white, clear. A very good looking potato.

No. 64. *Seneca Beauty.* Size medium to large. Shape regular. Eyes deep. Color red. A good potato.

No. 65. *Sir William.* Size medium to large. Shape regular. Color white. Skin smooth. A good looking variety.

No. 66. *Somerset.* Size medium to large. Shape quite regular, somewhat flattened. Color white with pinkish tinge. Fairly good.

No. 70. *Vaughan.* Size small to medium. Shape regular. Color white. Not very good. Too small.

No. 71. *Vick's Advancer.* Size small to medium. Shape regular. Color white. Fairly good.

No. 74. *White Rose.* Size medium. Color white. Clear skin. Shape quite regular. Fairly good.

No. 75. *Wilson's First Choice.* Size medium to large. Shape regular. Color white. A good variety.

No. 76. *Woodhull's Seedling.* Size medium. Shape quite regular, somewhat elongated. Color white. Fair.

No. 80. *Governor Rusk.* Size large to very large. Shape regular. Deep-eyed. Color red. A good variety.

No. 81. *Sir Walter Raleigh.* Size large to very large. Shape very regular. Color white. Clear skin. A very good variety.

No. 84. *Livingston.* Size large. Shape a little long but even. Eyes quite deep and pink. Color white, but pink eyes give it a pinkish tinge. Very good.

No. 86. *Fill Basket.* Size medium to large. Shape quite regular. Color white. A good looking variety.

No. 87. *Breck's Chance.* Size medium to large. Shape quite regular, a little flattened. Color light red. Fairly good.

No. 88. *Prolific Rose.* Size large. Shape regular, somewhat flattened. Color pinkish white. Fairly good.

No. 93. *Burr's No. 3.* Color white. Shape quite regular. Under size.

No. 95. *Vigorosa.* Size medium. Shape regular. Color white. A little under size.

No. 99. *Red American Wonder.* Size very large. Shape fairly regular but flattened. Eyes deep. Color red. Not very fine looking.

No. 101. *White Beauty.* Size medium. Shape quite regular, some knobby. Color white. Fairly good.

No. 102. *Enormous.* Size very large. Shape regular. Color white. Skin clear. A very good looking variety.

No. 103. *Early Dawn.* Size medium. Shape regular. Deep eyes. Color red. Fairly good.

No. 104. *Early Andes.* Size small. Shape regular. Color red. Not very good.

No. 105. *Granite State.* Size medium to large. Shape regular. Color white. Very good.

No. 106. *Twentieth Century.* Size medium. Shape somewhat long. Color yellowish white. Skin rough. Fair.

No. 107. *The Commercial.* Size large. Shape quite regular. Eyes quite deep. Color red. Fair.

No. 108. *Wonderful.* Size medium to large. Shape long, quite regular. Color yellowish white. Fairly good.

No. 109. *Pingree.* Size medium. Shape regular. Color pinkish white. Fair.

No. 110. *Admiral Dewey.* Size medium to large. Shape regular. Color white. Fair.

No. 111. *Washington.* Size large. Shape regular, quite long. Color white. Very good.

No. 112. *Erie.* Size medium to large. Shape regular. Somewhat flattened. Color reddish. Good.

No. 113. *Battle Best.* Size large. Shape quite regular. Deep eyes. Color white. Quite good.

No. 114. *Extra Early May.* Size small. Shape fairly regular. Color red. Fair.

No. 115. *Evan's Beauty.* Size medium. Shape fairly regular. Eyes quite deep. Color pinkish white.

No. 116. *Pride of Sunnyside.* Shape irregular. Deep eyes. Color reddish. Fairly good.

No. 117. *Burbank's Seedling.* Size large. Shape long, quite prongy. Color white. Good.

No. 118. *Algonquin.* Size medium to large. Shape regular. Color clear white. Good.

No. 119. *Green Mountain.* Size medium to large. Shape oblong, a little irregular. Color white. Fair.

Tomato Report.

Fifteen new varieties of tomatoes were grown at the station during the past year, besides our main crop varieties, and others yet under test. My assistant, Mr. C. W. Waid, who has made a close study of them, has written the following report. For earlier reports on the tomato, consult Bulletins Nos. 42 and 73 of this station.

The station grew twenty-nine varieties of tomatoes this year (1900) for variety test, besides the main crop. There was in all about one acre set to tomatoes. The first seed sown was put in a tray, March 20, variety, Early Bird, for main crop. March 28 another tray was sown for general crop, variety, Belmont. The varieties were all sown in trays March 28. The first sowing was transplanted March 31, and the second April 12.

The tomatoes for general crop were transplanted into trays, about two inches apart each way. The variety tomatoes were transplanted into thumb pots.

In the second transplanting the general crop tomatoes were transplanted into small boxes, twelve in each box, so arranged that the bottom could be easily removed and the dirt allowed to slip out. This made it easy for the plants to be separated with a ball of dirt around each root. The Early Bird were transplanted into these boxes April 17; the Belmont, April 30.

The second transplanting of variety tomatoes was into four-inch pots and was done April 30.

This year the pot system was a decided advantage over the box system. In the first place the plants had more room for both root and stalk development, and consequently grew more stocky and better proportioned. In trays there is danger of keeping the soil too moist and thus getting a taller and more tender growth.

The ease and efficiency with which tomatoes can be transplanted into the open ground from pots is no small item. The dirt can be removed without disturbing the roots in the least, and thus the plant is not checked in its growth. The per cent of loss from transplanting is very much less when pots are used.

The pots seem to induce early maturity and early fruitfulness. This was particularly noticeable this year, as the varieties were in bearing some days before any of the main crop, although, as will be seen, some of them were planted first, and all set on practically the same kind of ground.

The pot system takes more time and occupies more space, but if this year is a criterion, it surely pays.

This year was an exceptionally poor one for tomatoes, as the drought, from before the time of planting until some time after the fruits had begun to ripen, was not only a decided check on the growth of the plant but was also conducive to dry rot. The kind of soil the tomatoes were planted on made a difference in the amount of rot; where the soil was inclined to dry out the rot was much more prevalent. In the patch at the station this year there was one corner which was planted on a loamy, moist soil, and there was very little rot on this portion of the patch. Where the soil was the most clayey the rot was the worst.

Practically all trouble from dry rot was over after the rain of September 11, and all of the rot worthy of mention occurred before this date.

TABLE II.—VARIETIES GROWN IN 1900.

Number.	Variety.	Average yield of ripe fruit per plant.	Date of first picking.	Average weight of ripe fruit.	Average weight of green fruit per plant.		Average weight of rotten fruit per plant.	Average weight of rotten fruit.	Seedsman.
					Large.	Small.			
		lbs.		oz.	lbs.	lbs.	lbs.	oz.	
35	Acme	8.7	Aug. 3	3.7	1.1	3.8	1.2	2.7	Breck.
57	Table Queen	10.2	Aug. 8	3 6	.8	2.8	1.0	3.3	Henderson.
58	Early Ruby	11.0	July 30	4.4	1.9	2.7	.1	4.0	Henderson.
59	Matchless	5.0	Aug. 13	3.2	2.0	2.2	2.1	3.4	Burpee.
61	The Comrade	5.5	Aug. 6	2.6	1.1	2.7	2.2	2.8	Gregory.
66	Improved Trophy	2.9	Aug. 15	3.9	1.0	2.0	2.1	3.4	Ferry.
70	Burpee's New Combination	6.4	Aug. 6	3.1	.9	1.7	1.4	2.7	Burpee.
71	Best of All	3.9	Aug. 17	3.7	.7	1.8	2.6	2.8	Weeber&Don
72	Seedling (J. & S.)	7.7	July 28	2.5	.0	2.5	.1	1.3	Johnston & Stokes.
73	Freedom	5.1	Aug. 3	2.4	.5	3 0	1.5	1.9	Henderson.
74	G. A. R	3.7	July 30	2.9	.9	1.9	1.3	2.8	Gregory.
75	La Crosse Seedling	6.4	Aug. 8	3.0	.1	.0	.3	2.1	Salzer.
77	Trucker's Favorite	6.6	Aug. 3	4.4	1.6	2.3	.6	3.7	Burpee.
80	Enormous	3 3	July 26	4.9	2.1	2.2	.7	3.8	Livingston
81	Best of All (Ennobled Strain of Sutton's)	3.6	July 30	3.2	.7	1.4	1.1	3.0	Burpee.
82	Early Dwarf Prolific	6.4	Aug. 3	1.5	.0	1.2	.0	.0	Burpee.
83	Burpee's Quarter Century	6.0	Aug. 3	3.7	.6	.9	.7	3.0	Burpee.
84	New Stone	3.8	Aug. 17	4.6	2.8	1.5	1.3	3.1	Northwest'rn Seed Co.
85	The Turner	12.8	Aug. 6	6.9	1.8	.7	.5	5.2	Burpee.
86	Magnus	6.9	Aug. 1	3 4	1.7	1.7	1.6	2.8	Livingston.
87	Aristocrat	4.4	Aug. 8	2.9	.3	1.4	.2	2.7	Livingston.
88	Royal Red	6.9	Aug. 8	4.0	3.5	2.2	1.5	1.7	Maule.
89	Maule's 1900	7.2	Aug. 10	4.6	2.9	2.0	1.7	3.5	Maule.
90	Maule's Earliest	6.8	July 26	4.3	.5	1.9	.1	4.3	Maule.
91	White Excelsior	6.1	Aug. 3	4.8	1.8	2.3	1.4	3.2	Maule.
92	The Quicksure	11.5	July 26	4.8	.6	1.3	.0	.0	Johnston & Stokes.
93	Spark's Earliana	7.3	July 26	3.8	.4	.8	.2	3.1	Johnston & Stokes.
94	Diadem	3.7	Aug. 10	2.7	1.0	3.0	2.6	2.5	Gregory.
95	Potomac	6.1	Aug. 3	2.7	.5	2.4	1.6	2.7	Gregory.

NOTES ON VARIETIES.

No. 35. ACME (Breck). *Vines*—Branches very long, many, foliage quite dense. Setting heavy. *Fruit*—September 28. Green fruit quite plenty and many large enough to mature with a few more days. A good variety.

No. 57. TABLE QUEEN (Henderson). *Vines*—Branches very long and many, foliage dense. *Fruit*—Setting heavy. Fruits quite smooth and attractive. September 28, green fruit mostly small. A good variety.

No. 58. EARLY RUBY (Henderson). *Vines*—Branches long, several, foliage medium. *Fruit*—September 28. Several large fruits nearly mature. A good yielder, quite regular in bearing. Fairly smooth, some rough. Not much rot.

No. 59. MATCHLESS (Burpee). *Vines*—Branches long, many, foliage quite dense. *Fruit*—Several large green fruits September 28. Nice looking fruits. Did not bear very heavy this year. Quite a good many rotten.

No. 61. THE COMRADE (Gregory). *Vines*—Long, many, quite dense foliage. *Fruit*—Fair. September 28, green fruit, smooth, fair size. Considerable rot.

No. 66. IMPROVED TROPHY (Ferry). *Vines*—Branches medium size, many. *Fruit*—Set very poorly, much rot. Did not do well this year.

No. 70. NEW COMBINATION (Burpee). *Vines*—Branches many, medium length, foliage dense. *Fruit*—Fair quantity. Green fruit fairly smooth, not very large. Considerable rot. Did not show the tendency this year to two distinct kinds of fruit that it did last year, probably due to seed.

No. 71. BEST OF ALL (Weeber & Don). *Vines*—Medium size, many, foliage medium. *Fruit*—Medium yield. Fruit smooth. Much rot. This variety did not show up nearly as well this year as last.

No. 72. SEEDLING (Johnston & Stokes). *Vines*—Branches short, many, foliage light. Will admit of close setting and easily trained to one stem. *Fruit*—Set very heavily. To do well must be grown in rich soil. This variety did very well here at the station last winter under glass.

No. 73. FREEDOM (Henderson). *Vines*—Branches long, many, foliage dense. *Fruit*—Set fair crop. Green fruit quite small but even size. Some rot.

No. 74. G. A. R. (Gregory). *Vines*—Branches medium length, many, foliage medium. *Fruit*—Good yield. Some rot. Green fruit smooth, some quite large.

No. 75. La Crosse Seedling (Salzer). *Vines*—Branches very short and few. One of the so-called tree tomatoes. Easily trained to one stem. *Fruit*—Set heavily. Medium size. Not much rot. Fair.

No. 77. Trucker's Favorite (Burpee). *Vines*—Branches medium size, many, foliage medium. *Fruit*—A good setting. Not much rot. Fruit purplish and very smooth. A very fine appearing variety. Showed up well at last of season. Green fruit very smooth.

No. 80. Enormous (Livingston). *Vines*—Branches very long and very heavy, one inch in diameter at base, grows a foot to eighteen inches before branching; foliage dense. *Fruit*—Rather light setting. Good fruit for show but does not bear heavy enough for market purposes.

No. 81. Best of All (Ennobled Strain of Sutton's) (Burpee). *Vines*—Branches medium length, many, foliage dense. Grows quite compact. *Fruit*—Setting not very heavy. Green fruit quite good form. Not much rot.

No. 82. Early Dwarf Prolific (Burpee). *Vines*—Branches very short, so-called tree tomato, foliage light. *Fruit*—Heavily set. A very heavy bearer of small fruits. Easily picked and could be set very close. No rot.

No. 83. Burpee's Quarter Century (Burpee). *Vines*—Branches short, few but heavy, foliage dense. *Fruit*—Set well. Not much rot. Fair.

No. 84. New Stone (Northwestern Seed Co.). *Vines*—Branches long, many, foliage medium. *Fruit*—Good setting. Fruits very smooth and solid. A good variety where much handling is necessary. Does not bear very heavily early in the season but holds on well and does its best later.

No. 85. The Turner (Burpee). *Vines*—Branches very long and heavy, foliage dense. A potato-leaved variety. *Fruit*—A good yielder of large fruits. Fruits have a tendency to irregularity, however, which makes them less valuable. Very little rotten fruit.

No. 86. Magnus (Livingston). *Vines*—Branches medium length, many, foliage dense. *Fruit*—A good setting. Fruit medium size, quite smooth. Fairly good.

No. 87. Aristocrat (Livingston). *Vines*—Branches few and very short. A potato-leaved variety. Foliage very dense. One hill produced heavy foliage but no fruits. *Fruit*—Setting was not very heavy. Fruits small but even and smooth.

No. 88. Royal Red (Maule). *Vines*—Branches medium, many, foliage medium. *Fruit*—Set very well. This variety did not begin to bear heavily early in season, but when it did begin, August

27, it bore regularly and well. The fruits were very smooth and attractive. A very good variety.

No. 89. MAULE'S 1900 (Maule). *Vines*—Branches long, many heavy, foliage quite dense. *Fruit*—Set heavily. Fruits large and quite smooth. Considerable rot. Quite a good variety.

No. 90. MAULE'S EARLIEST (Maule). *Vines*—Branches short, somewhat tree-like, foliage medium. *Fruit*—Setting fair. This was one of the earliest varieties, not only as to first ripe fruits but there was quite a considerable yield from the time it began ripening. Form fair. A good early variety. Scarcely any rot.

No. 91. WHITE EXCELSIOR (Maule). *Vines*—Branches very long, many, foliage medium. *Fruit*—Well set. Not an early variety. Showed up well toward end of season. Fruits very smooth and good shape. Quite a large amount of fruit on the vines September 28. Some rot. A good variety.

No. 92. THE QUICKSURE (Johnston & Stokes). *Vines*—Branches short, rather few, foliage medium. *Fruit*—Very heavy setting. This variety bore very heavily this year, especially for the amount of vine. The foliage and vines are so scattering that the sun gets in well, causing the fruits to ripen quickly, and also making the picking easier. Bore well from start to finish. Short stems would admit of close planting. Scarcely any rot. One of the best this season.

No. 93. SPARK'S EARLIANA (Johnston & Stokes). *Vines*—Branches short, few. Resembles the Quicksure. *Fruit*—A fair setting. Very much like the Quicksure; not as heavy yielder and not quite so early. Very little rot. Very good. Could be set quite close.

No. 94. DIADEM (Gregory). *Vines*—Branches long, thick, foliage heavy. *Fruit*—Setting fair, not large but quite regular, peculiar in being striped with yellow. Did not show up very well.

No. 95. POTOMAC (Gregory). *Vines*—Branches long, many, foliage medium. *Fruit*—Setting fair. Quite a good yielder. Fruits not very large. Some rot. Fairly good.

FRUIT CALENDAR FOR 1900.

The past season has been marked with a bounteous fruit crop. Nearly all kinds of fruit were plentiful. The strawberry crop, as well as other small fruits, was much shortened by the drought, but the orchard fruits were generally good. The early spring was favorable and a large proportion of trees set quantities of fruit. So much was set that it was feared that the trees in

some sections would be overburdened, as they doubtless were; but as the season went on, nature, through agency of wind and survival of the fittest, remedied things to a certain extent. On the whole, apples in particular were a fine crop and comparatively free from injuries. The fruit was of fair size, colored up well, and sold for about one dollar per barrel on the average. Pears, plums, and peaches were plentiful generally and brought in very fair returns. Grapes, again, gave a very heavy yield and demonstrated that New Hampshire grapes can be grown with profit. There is a certain loyalty to home-grown fruit. The exhibits at the fairs were generally very fine. The season was a very severe one for the vegetable grower, especially in the southern part of the state. A continued drought throughout July and August shortened the vegetable crop very much. Most crops suffered, especially on naturally well-drained or light lands. Muskmelons and the celery crops were badly affected. The early potato crop was almost a complete failure, and the late crop was lessened materially except where planted in a very retentive soil. Where irrigation was possible, it was a great advantage. Ornamental planting, unless given special care, was severely checked by the drought. Currants and gooseberries were a fair crop.

FRANK WM. RANE,
Horticulturist.

DEPARTMENT OF AGRICULTURE.

The work of the department of agriculture during the year has been the continuation of that begun in part last year and the year previous to that, with the addition during the present year of work along the line of improving the worn-out pasture lands in the state. During the coming year co-operative experiments in each county of the state will be begun along this same line. Experiments in feeding dairy cattle, horses, and swine are being continued; also, experiments in the best methods of applying manures, soil improvements, and soil moisture, corn culture, forage crops, etc., etc.

These same lines of work will be continued during the coming year.

The College Herd.

The college herd at present consists of seventy head of cattle, thirty-five of these being milch cows. The herd is made up of pure-bred and grade Jerseys, Ayrshires, and Guernseys. There are thirty-five head of young stock, calves, and service bulls.

The herd has been equivalent to 349 milch cows and 64 dry cows for one month, and has produced 171,883 pounds of milk and 10,219 pounds of butter. There has been an average of twenty-nine cows in milk for each month, producing an average of 495 pounds of milk and 28.6 pounds of butter per cow, or an average yearly yield of 5,940 pounds of milk and 343.2 pounds of butter.

HERD RECORD FROM NOVEMBER 1, 1899, TO OCTOBER 31, 1900.

Month.	Number of milch cows.	Number of dry cows.	Milk.			Butter.		
			Total milk.	Average for each milch cow.	Average for herd.	Total pounds produced.	Average for each milch cow.	Average for herd.
November	32	3	13,993	424	400	852	26.6	24.3
December	31	5	13,382	406	372	802	26.0	22.3
January	28	7	12,485	403	357	773	27.6	22.8
February	27	8	9,764	305	280	649	24.0	18.5
March	23	10	11,465	498	347	667	29.0	20.2
April	26	6	13,978	537	437	878	33.7	27.4
May	33	2	16,996	515	487	990	30.0	28.2
June	30	5	16,980	566	485	1,072	35.7	30.6
July	30	4	16,514	550	486	940	31.3	27.6
August	30	4	16,546	551	487	970	32.3	28.5
September	29	6	15,060	520	430	836	29.0	23.8
October	30	5	14,720	490	421	790	26.3	22.5

The data have been taken from the dairy records and the butter calculated from the monthly fat tests by the standard formula butter equals 1 plus $\frac{1}{6}$ fat instead of the actual churned butter, as the latter would involve corrections for milk and cream sold and fed to calves.

CHARLES WM. BURKETT,
Agriculturist.

DEPARTMENT OF ENTOMOLOGY.

The work of the department of entomology during the past year has continued along the lines previously laid down. It has included special studies of a considerable number of injurious insects, notably the American Tent Caterpillar, the Forest Tent Caterpillar, the Cherry Twig-Tyer, the Birch Leaf Caterpillar, and certain species of plant lice. The study of the relations of birds to agriculture has also been continued, special studies having been made of the food of the Myrtle Warbler and the Ruffed Grouse.

Much progress has been made in the collection of New Hampshire insects, nearly ten thousand specimens having been added during the year. Special field trips for collecting purposes have been made to the western and central parts of the state, and the region of the White Mountains. A large number of photographs for purposes of illustration have also been taken. Two bulletins have been issued by the department during the year: "The Insect Record for 1899," in January, and a second report on "The Forest Tent Caterpillar" in May. The Insect Record for this year will be issued as a bulletin at an early date.

All of the entomological work has been benefited by the efficient services of the assistant entomologist, Mr. W. F. Fiske, who has also prepared at my request the article on the "Butterflies of New Hampshire," that is published as a supplement to this year's report. Mention should also be made of the help rendered by Mr. Ned Dearborn in the studies of the food of birds, and by Mr. R. A. Cushman in the miscellaneous work of the department.

CLARENCE M. WEED,
Entomologist.

DEPARTMENT OF BACTERIOLOGY.

During the time covered by this report, the work of this department has embraced the continued study of the biology of ensilage, the life history and treatment of fungous diseases of fruit trees and the potato, the study of the apple fruit in relation to its structure and development, and the problems of a biological nature concerned in its storage.

The following is a preliminary report of the last-mentioned subject:

Storage of Apples.

The term "fruit" has two significations. From a botanical standpoint the fruit is the structure containing the seed, which develops from the pistil or pistils of the flower. In common parlance, a fruit is such a structure of a pulpy or juicy nature, which is desirable for human food, either for the nutriment which it contains, or for its palate-pleasing properties, or both. Whatever may have been the original character of the apple, it has, by long cultivation, been greatly improved until it is today one of the most desirable fruits, and hence is of great commercial importance.

In the apple flower, the part which is to become the apple lies beneath the petals and other conspicuous parts, forming their support. After pollination it begins to grow in size, and continues to do so throughout the summer and early fall. The growth takes place chiefly in the tissues which lie outside of the seed vessels proper and form the edible pulp, while the seeds develop in the central part, called the core. The whole is covered and protected by a thin but tough skin, which is rendered waterproof by a coating of wax. Before maturity the apple is hard and unpalatable, but as it ripens changes take place in it with the result that it becomes softened or mellow, and an agreeable taste and flavor are developed. The agreeable taste of the apple depends largely upon the mixture of acid and sugar, or sweet and sour, which it contains, each variety presenting its own peculiar proportions. The flavor or aroma probably depends upon small quantities or compounds of an ethereal nature

which vary with the variety. The conditions under which ripening proceeds with the best results is an important field for investigation.

As is well known, apples, after they have ripened, are very prone to rot or decay. This is doubtless nature's provision for freeing the seeds from the inclosing fruit. How to control this tendency to rapid decay is the most serious problem to be solved in the handling of apples. As in all forms of decay, as that term is ordinarily used, the rotting of apples is due to the action of some of the lower forms of vegetable life.

In our investigations we have not found bacteria acting as the cause of decay, as is so frequently the case in other material, and this is doubtless due to the acidity of apples, which is unfavorable to their development. The destructive agent in the case of the apple is one or more forms of the fungi. In our experiments, which have been chiefly concerned with the Baldwin, we have found two forms of rot common. In one the affected apple shows a small brown spot upon the surface, which gradually spreads until the whole apple is involved, the pulp remaining tolerably firm. Later the surface becomes darker in color and is seen to be studded with minute pimples or pustules. These are the fruiting of the fungus which causes the rot, and contain the spores by which it is propagated. Microscopic examination of the pulp shows it to be permeated by the thread-like mycelium or vegetative part of the fungus. This form is the so-called "brown rot." Another rot similar in appearance to the foregoing, but producing darker spots and a bitter taste, known as the bitter rot, which frequently affects apples, has not been found at all abundant on the Baldwins in our experiments. In the other common form the color of the rotting area is much lighter than in the preceding forms, being light or yellowish brown; the pulp becomes very soft. The fruiting of the causing fungus occurs in white rounded tufts upon the surface, the tufts taking on later a bluish green color, due to the matured spores. This form of rot is produced by one of the common mold fungi (*Penicillium glaucum*), so abundant on various kinds of decaying matter.

The spores of the fungi causing these rots are produced in immense numbers, especially in the case of the last-mentioned form, and as they are easily floated by slight currents of air, they are widely distributed, and, in all ordinary forms of handling, apples are more or less exposed to infection by them, but certain precautions will tend to limit the danger. Apples barreled in the orchard will be less likely to be infected than if they are previously stored, uncovered, in dusty barns or moldy cellars. The barrels themselves, especially flour barrels, are likely to be sources of infection unless they are thoroughly cleaned. The mold fungus producing the soft rot develops abundantly on such barrels if they are exposed to moisture. Heat and moisture favor the development of the rot-producing fungi, hence the advisability of storing in cool and dry places. In general it may be said that cold storage is the most practical method of controlling the rots which we at present have.

November 18, 1899, twelve boxes (bushel market boxes) of Baldwin apples were shipped to the Quincy Market Cold Storage Company of Boston. The apples were No. 1's, selected from the mixed crop gathered at different dates during October. The boxes were filled after the apples had been thoroughly mixed to secure as great uniformity as possible; about two fifths of them were wrapped in manila tissue paper. The covers of the boxes were made of slats with spaces between so that there was ample chance for the circulation of air. The boxes were withdrawn from cold storage, one each month, until June, when they were withdrawn two per month until the twelve had been exhausted. On receipt of the boxes the apples were examined and the number of sound and rotten ones counted. The sound ones were stored in the station's cold storage room. A similar box for comparison had been kept here from November 18. The following table shows the results:

Box	Returned.	Total.		Unwrapped.		Wrapped.	
		Sound per ct.	Rotten per ct.	Sound per ct.	Rotten per ct.	Sound per ct.	Rotten per ct.
1	Dec. 18, 1899	100	0	100	0	100	0
2	Jan. 17, 1900	*97	3	.....	.....	.....	.....
3	Feb. 14, "	*92	8	.....	.....	.....	.....
4	Mar. 19, "	77	23	83	17	69	31
5	Apr. 23, "	82	18	84	16	78	22
Check kept in station cold storage	Apr. 20, "	61	39	54	46	74	26
6	May 23, "	67	33	63	37	70	30
7	June 19, "	62	38	61	39	64	36
8	" " "	48	52	50	50	46	54
9	July 17, "	54	46	52	48	58	42
10	" " "	55	45	46	54	57	43
11	Aug. 14, "	48	52	45	55	53	47
12	" " "	56	44	48	52	69	31

*In case of Box No. 2, the wrapped apples were not opened when the box was first received. The percentage of sound ones is assumed to have been the same as in the unwrapped. The notes on No. 3 have been lost or mislaid. The percentages given are reckoned from the number in the box at the second examination, which were the sound ones when first received.

The temperature at which the apples were kept in the Boston cold storage was about 34° F. In the station cold storage it was about 40° until April, when it rose to 45° during the first half of the month and to nearly 50° during the latter half.

No satisfactory explanation of the lack of uniformity in the increase of the percentage of rotten ones with length of time of storage can be offered.

The indications from the percentages in case of boxes 5, 6, 7, and check box are that the conditions were more favorable to keeping in the Boston cold storage than in that of the station.

On June 1 only 5 per cent of the check box apples were still

sound, as against more than fifty per cent in case of those still at Boston.

The following table shows the percentages of sound apples in wrapped and unwrapped lots, with difference.

Box.	4	5	6	7	8	9	10	11	12	Check.
Wrapped.....	69	84	70	64	46	58	57	53	69	74
Unwrapped.....	83	78	63	61	50	52	46	45	48	54
	—14	6	7	3	—4	6	11	8	21	20

These figures, except in 4 and 8, are in favor of the wrapped ones. Later examinations of the first five boxes which were kept in the station cold storage after their return showed the same result.

April 20, a comparison of the first four boxes with the check indicated that they had not kept as well since their return as those stored at home; but May 29, a larger percentage of those that had been in the Boston storage were sound than in case of the check.

Silo Temperatures Taken by Electricity.

In the study of the biology of ensilage it is important to know the temperatures to which it is subjected. Only a small portion of the contents of a silo is accessible to the ordinary thermometer,—that portion near the surface. The following is an account of an experiment in taking the temperatures in the depth of the silo by electrical apparatus. The principle on which it is based is the fact, well known in physics, that changes in temperature cause changes in the resistance which different materials offer to the passage of an electric current. The resistance is readily measured with appropriate apparatus, and from it can be calculated the temperature. The part of the apparatus which is directly subjected to the changes in temperature, called an electrode, may consist of wire or other metallic body through which an electric current can be passed. When a metallic electrode is used the higher the temperature the greater the resistance offered and *vice versa*.

The form of apparatus used in this experiment was one designed by the Division of Soils of the U. S. Department of Agriculture for taking the temperature of soils and also the moisture. It consists of an electrode and apparatus for measuring the resistance. The latter is a special adaptation of the "Wheatstone bridge." (See Bulletin 6 of the Division of Soils.)

The electrode is a narrow glass tube filled with a solution of common salt. It is in this column of salt solution that the resistance is measured. Its behavior to changes in temperature is the opposite of that of metallic electrodes, that is, the higher the temperature the less the resistance and *vice versa*.

In the form of electrode used the tube containing the solution is cemented upon a strip of glass about five inches long and one inch wide. To adapt this for use in the silo, where the pressure is considerable and disturbance is likely from the settling of the ensilage and consequent danger of breaking, it was protected by a wooden casing which left the sensitive portion of the electrode uncovered but amply protected from pressure.

The wooden casing was about fifteen inches long to insure its remaining upright when buried in the ensilage, this position being necessary in the form of electrode used. The wires connecting the electrode with the measuring apparatus were No. 12 copper wire insulated with rubber, the two wires being united in a single strand by a woven and tarred outer covering. The conducting wires were fastened to the wooden casing in such a way that no strain could be brought to bear upon the electrode connections. The incased electrodes were buried in the ensilage in the upright position near the center of the silo, and the conducting wires led to the wall of the silo where they would be out of the way; a sufficient length of slack wire where it passed through the ensilage was provided so that settling might not drag the electrode out of position. This arrangement of apparatus proved entirely satisfactory.

The entire apparatus as assembled in the laboratory is shown in figure 1. The changing resistances in the elec-

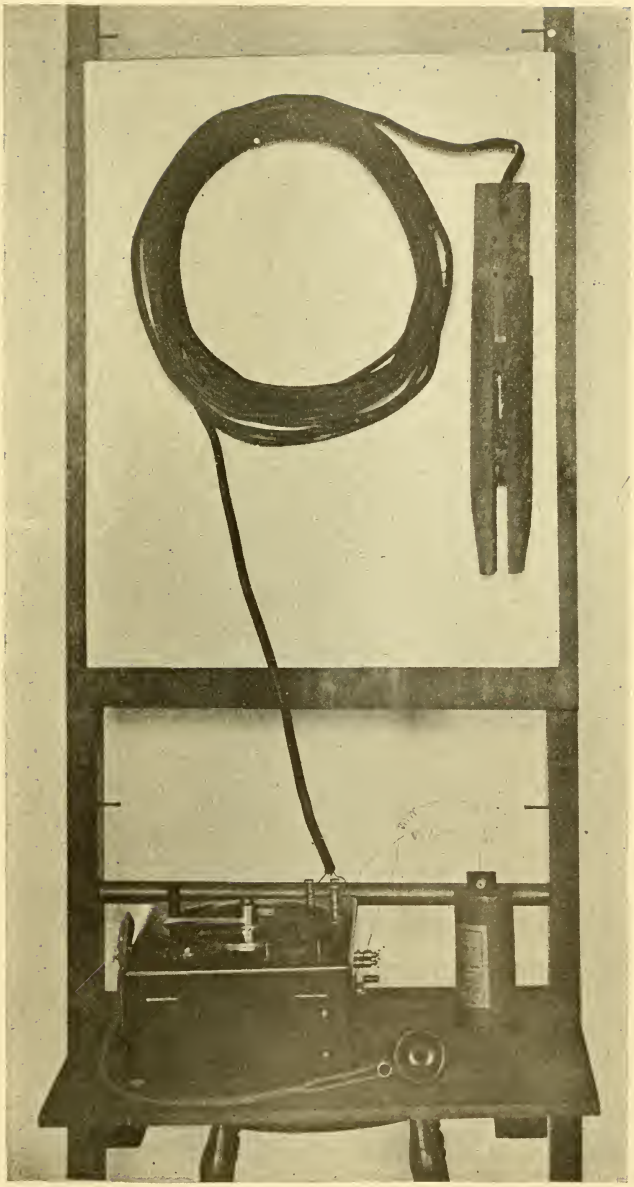

FIG. 1. APPARATUS FOR TAKING SILO TEMPERATURE.

trodes were read and recorded from the time the electrodes were buried until they were uncovered, as the ensilage was used. After removal the electrodes were carefully standardized for each ten degrees of their range by comparison with a mercurial thermometer, and the following tables of temperatures occurring in the silo were computed.

ENSILAGE TEMPERATURES IN DEGREES FAHRENHEIT.

ELECTRODE.	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.
September 9....	118.4	.....	.....	.....	.....
" 9....	117.5	.....	.....	.....	.....
" 10....	114.8	.....	.....	.....	.....
" 10 ...	113.9	.....	.....	.....	.....
" 11....	113.9	84.2	.....	.....	.....
" 12....	113.9	86.0	.....	.....	.....
" 13....	111.2	89.6	.....	.....	.....
" 14....	111.2	91.4	.....	.....	.....
" 15....	109.4	94.1	96.8	.....	.....
" 16....	109.4	95.0	100.4	77.0	111.2
" 17....	108.5	96.8	99.5	78.8	124.7
" 18....	107.6	96.8	97.7	81.5	126.5
" 19....	108.5	96.8	99.5	83.3	127.4
" 20....	108.5	97.7	99.5	85.1	127.4
" 21....	108.5	98.6	97.7	86.0	124.7
" 22....	108.5	99.5	97.7	87.8	122.0
" 23....	108.5	106.4	97.7	88.7	122 9
" 24....	107.6	100.4	97.7	88.7	122.9
" 26....	107.6	102.2	97.7	89.6	122.9
" 27....	107.6	103.1	97.7	91.4	122.0
" 28....	107.6	103.1	97.7	92.3	122.9
" 30....	105.8	104.0	97.7	93.2	120 2
October 3....	105.8	104.0	96.8	94.1	122.0
" 6....	104.9	105.0	96.8	95.9	122.9
" 7....	104.9	105.0	96.8	96.8	120.2
" 8....	104.0	105.0	96.8	96.8	120.2
" 10....	104.0	105.0	96.8	98.6	119.3
" 11....	103.1	104.5	95.9	99.5	119.3
" 14....	102.2	104.5	95.9	99.5	119.3
" 17....	100.4	104.5	95.9	99 5	116.6
" 21....	99.5	104.0	95.0	100.4	116.6
" 25 ...	97.7	104.0	95.0	102.2	117.5
" 29....	95.9	104.0	94.1	103.1	117.5
November 2....	94.1	103.1	93.2	103.1	115.7
" 8....	91.8	102 2	92.3	103.1	115.7
" 12....	90.5	101.3	90.5	103.1	113.9
" 18....	87.8	100.4	90.5	102.2	113.0
" 26....	86.0	98.6	88.7	101.3	112.1
December 3....	78.8	95.9	86.9	100.4	109.4
" 10....	80.6	95.0	86.0	100.4	105.8
" 17....	78.8	93.2	86.0	100.4	102.2
" 27....	76.1	90.5	83.3	99.5	100.4
January 14....	72.5	85.1	81.5	98.6	96.8
" 27....	67.1	.....	77.9	97.7	.....
February 4....	66.2	.....	77.9	97.7	.....
" 17....	71.6	.....	76.1	98.6	.....

The silos are side by side in one corner of the barn; they are double-walled of matched boards, and extend from the basement floor to the plates on which the roof rests, about thirty

feet; their other dimensions are 13x14 feet each. The ensilage experimented on was nearly matured corn cut to about one-inch lengths. The silos were filled as rapidly as possible; the only packing it received was the treading of one or two men necessary to keep the surface level. When filled the ensilage was not weighted but simply covered with a layer of straw or other litter about a foot in depth. When the silos were opened for feeding a layer only a few inches in depth was found unfit for feeding; the remainder was of good quality, barely moist, olive brown in color, slightly acid, with a pleasant aromatic odor.

When ensilage handled as above described remains uncovered a high degree of heat develops in the superficial layers after twenty-four or forty-eight hours. From the surface downward the heat rapidly increases, reaching a maximum at from eight to twelve inches, and from that point gradually decreasing as the depth becomes greater. The maximum temperature taken by mercurial thermometer ranged in our observations from 110° F. to 149°, the latter being the highest degree noted; in the majority of cases it was about ten degrees lower.

Five electrodes were installed, two in silo No. 1 (west) and three in silo No. 2.

Electrode No. 1 was placed in position September 7, between eight and nine feet from the bottom of the silo. It remained about one and one half feet below the surface of the corn over night; the next morning the upper layers were well heated. The first temperature was taken September 9, and was 118.4° F. This proved to be the maximum for this electrode; at a later reading the same day the temperature had already begun to fall. The temperature fell most rapidly during the first ten days, and then gradually and very uniformly until uncovered.

Electrode No. 2 was put in place September 9, about ten feet above No. 1, and was deeply covered by the day's cutting. The temperature rose from 84° September 11 to a maximum of 105° October 6, and then gradually fell to 85° January 14.

Electrode No. 3 was placed in silo No. 2 September 13, about

three and one half feet from the bottom, and remained near the surface over night; heating had begun. The maximum was at the second reading September 16, when it was 100.4°. From that date it fell very slowly till February 17, when it was 76°.

Electrode No. 4 was placed in silo No. 2 September 15, in the middle of the day's cutting, about thirteen feet from the bottom. This electrode showed a very gradual rise from 77° at the first reading to a maximum of 103° October 29; then a more gradual fall to 98.6° February 17.

Electrode No. 5 was placed in silo 2 the same day as No. 4, about four and one half feet above it, and one and one half feet below the surface. This was the end of the filling. The surface remained uncovered for several days and was then covered for perhaps a foot in depth by litter. This electrode showed a rapid rise to a maximum of 127.4° five days after installation; then a gradual (but less uniform than in case of the other electrodes) fall to 96.8° January 14.

HERBERT H. LAMSON,
Bacteriologist.

DEPARTMENT OF METEOROLOGY.

Observations have been continued, as during previous years, with Edwin P. Jewett, New Hampshire College class of 1901, acting as observer during most of the year.

Signal flags, indicative of the weather for the succeeding night and day, have been displayed from 11 A. M. until sunset each day except Sundays and holidays, throughout the year.

The reading of the wet bulb thermometer has been continued throughout the growing season. The summary for the year gives comparisons of temperature, pressure, and precipitation, with averages of five full years. These averages now cover a sufficient period to be of considerable value.

The precipitation for the year has been normal, but the concentration of one third of the total into thirty consecutive days,

covering most of February and a part of March, has not been advantageous to growing crops.

The principal characteristic of this, as likewise of the previous year, has been the lack of moisture during the growing season. As a result, the hay crop was even less than for the year preceding. The snowfall was also abnormally light, and December was noteworthy because no snow fell during the entire month. With ten inches of rain, only six inches of snow were recorded during February. The snowfall for January and March was normal. During the year there were four storms with large precipitation. Three of these occurred within a period of sixteen days in February and March, while one came in September. August was the driest month, with one inch of rainfall.

During July and August, there were three well-defined, though not excessive, hot spells. September, October, and November were characterized by uniformity of temperature. Only light frosts occurred during September and October, and much vegetation remained uninjured until well into November. Only three cold spells occurred during the winter, and these were not excessive. The amount of coal used for heating was, therefore, less than the average.

Vegetation started slowly in the spring. Many seeds rotted before conditions were favorable for growth, and all hoed crops especially were backward. May was a cool month, with an average of three degrees below the mean. This was not due to a few very cold days, but to continued cool weather.

June averaged warm principally because of an excessively hot spell during the last ten days, which ripened up the grass and brought on haying before the grass was properly grown. The result, as already indicated, was a very short crop.

C. H. Pettee,
Meteorologist.

PUBLICATIONS OF EXPERIMENT STATION.

The following publications of the station are available for distribution:

No. 2. Feeding Experiments.
No. 3. When to Cut Corn for Ensilage.
No. 4. The Science and Practice of Stock Feeding.
No. 5. Fertilizers and Fertilizing Materials.
No. 6. Experiments with Fertilizers.
No. 7. Test of Dairy Apparatus.
No. 8. Feeding Experiments. Part 1, Principles of Feeding. Part 2, Cornmeal, Middlings, Shorts, and Cottonseed compared.
No. 9. Effect of Food upon Milk.
No. 11. Pig Feeding. Part 1, Results of Feeding Skimmilk and Cornmeal versus Cornmeal and Middlings. Part 2, Digestion Experiment.
No. 12. Fertilizer Experiments.
No. 14. Ensilage in Dairy Farming.
No. 16. Effect of Food on Composition of Butter Fat.
No. 17. Stock Feeders' Guide.
No. 18. Effect of Food on Milk.
No. 19. Spraying Apples and Pears against Fungi.
No. 20. Effect of Food on Milk. Feeding with Fats.
No. 21. Farmyard Manures and Artificial Fertilizers.
No. 22. Prevention of Potato Blight.
No. 23. Some Dangerous Fruit Insects.
No. 24. The Flow of Maple Sap.
No. 25. The Composition of Maple Sap.
No. 26. Analyses of Fertilizers and Wood Ashes.
No. 27. Spraying Experiments in 1894.
No. 28. Remedies for the Horn Fly.
No. 29. Remedies for Flea Beetles.
No. 30. An Experiment in Road Making.
No. 31. Seventh Annual Report. 1895.
No. 32. Studies of Maple Sap.

No. 33. Two Shade Tree Pests.
No. 34. Surface and Sub-Irrigation out of Doors.
No. 35. The Codling Moth and the Apple Maggot.
No. 36. Analyses of Three Common Insecticides.
No. 37. Crimson Clover.
No. 38. The Tent Caterpillar.
No. 39. The Army Worm.
No. 40. Eighth Annual Report. 1896.
No. 41. Potatoes; Varieties, Fertilizers, Scab.
No. 42. Part 1, Tomato Growing in New Hampshire.
Part 2, Notes on Tomato Breeding.
No. 44. The Canker Worm.
No. 45. Fruit and Potato Diseases.
No. 46. Part 1, An Experiment with a Steam Drill.
Part 2, Methods of Road Maintenance.
No. 48. Ninth Annual Report. 1897.
No. 50. Dehorning Cattle.
No. 51. Sweet Corn for New Hampshire.
No. 52. Growing Muskmelons in the North.
No. 53. The Farm Water Supply.
No. 54. The Winter Food of the Chickadee.
No. 55. The Feeding Habits of the Chipping Sparrow.
No. 56. Poisonous Properties of Wild Cherry Leaves.
No. 57. Forage and Root Crops.
No. 58. Cost of Raising Calves.
No. 59. Tenth Annual Report. 1898.
No. 60. Green Corn under Glass.
No. 61. Inspection of Fertilizers in 1898.
No. 62. Forcing Pole Beans under Glass.
No. 63. Third Potato Report.
No. 64. The Forest Tent Caterpillar.
No. 65. Notes on Apple and Potato Diseases.
No. 66. Experiments in Pig Feeding.
No. 67. The Spiny Elm Caterpillar.
No. 68. Eleventh Annual Report. 1899.
No. 69. Inspection of Fertilizers in 1899.
No. 70. Experiments with Muskmelons.

No. 71. Corn Culture.
No. 72. Insect Record for 1899.
No. 73. Experiments with Tomatoes and Potatoes.
No. 74. Growing Strawberries in New England.
No. 75. The Forest Tent Caterpillar. Second Report.
No. 76. Utilizing the Greenhouse in Summer.
No. 77. Experiments in Road Surfacing.
No. 78. Bovine Tuberculosis.
No. 79. Twelfth Annual Report.
First Annual Report. 1889.
Second Annual Report. 1890.

METEOROLOGICAL SUMMARY.

	Average temperature.		Precipitation.*		Snow in inches.		No. days .01 inch precipitation.		1899-1900.			
	July 1, 1895, to July 1, 1900.	1899-1900.	Average, July 1, 1895, to July 1, 1900.	1899-1900.	Average, July 1, 1895, to July 1, 1900.	1899-1900.	Average, July 1, 1895, to July 1, 1900.	1899-1900.	Prevailing wind direction.	Days clear.	Days partly cloudy.	Days cloudy.
July	69	69	3.95	3.99	.....	.....	10	10	N.W.	14	9	8
August	67	66	.99	1.00	.....	.....	9	6	S. E.	15	10	6
September	59.5	58	4.58	5.12	.....	.....	8	8	S.W	20	2	8
October	48	50	.41	2.15	.....	.....	7	6	N.E.	18	1	12
November	38	37	4.95	1.96	5.7	5.	10	5	N.W.	15	5	10
December	27.4	30	2.78	1.64	5.6	.....	7	8	W.	13	6	12
January	21.6	23	4.38	5.62	19.7	23.5	6	4	N.W.	16	5	10
February	23.8	23	4.58	10.06	15.4	6.	7	7	W.N.W.	12	5	11
March	30.8	28	4.69	6.06	13.9	16.	9	5	N.W.	17	10	4
April	43.8	44	2 46	2.07	1.8	.....	7	5	N.W.	14	6	10
May	55	52	2.91	2 53	.....	.....	9	6	N.W.	16	9	6
June	64.2	66	3 34	1.37	.....	.....	9	7	N. W.	11	14	5
Sum	548.6	546.	45.05	43.59	62.1	50.5	98	77	N.W.	181	82	97
Mean	45.7	45.5	.....	.....	.....	.....	.....	.....				

* Including rain, hail, sleet, and melted snow in inches.