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FIFTY-FIRST

ANNUAL REPORT OF THE SECRETARY

OF THE

MASSACHUSETTS

STATE BOARD OF AGRICULTURE,

TOGETHER WITH THE

SIXTEENTH ANNUAL REPORT OF THE HATCH EXPERIMENT STATION OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

1903.

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State Board of Agriculture, 1904.

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Union (Agr'l and Hort'l),	ALBERT H. NYE of Blandford (P. O. Russell),	1907
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Worcester East,	W. A. KILBOURN of South Lancaster,	1906
Worcester Northwest (Agr'l and Mech'l),	ALBERT ELLSWORTH of Athol,	1907
Worcester South,	C. D. RICHARDSON of West Brookfield,	1907
Worcester County West,	J. HARDING ALLEN of Barre,	1905

THE FIFTY-FIRST ANNUAL REPORT

OF THE

SECRETARY

OF THE

STATE BOARD OF AGRICULTURE.

To the Senate and House of Representatives of the Commonwealth of Massachusetts.

In presenting the fifty-first annual report of the State Board of Agriculture, it seems proper that I should call attention to the fact that I have been its secretary during but six months of the year just closed. The duty therefore devolved upon me of completing the work of the year on the lines already laid out by the Board. I feel it but right to say that I found a most excellent system in force, the Board efficiently organized for carrying out, through its committees, the various lines of work committed to its charge, and all branches of the work of the office were turned over in excellent condition by my predecessor.

The year 1903 has been one of varied results to Massachusetts farmers, according to the lines of agriculture they were particularly engaged in. The frosts of early spring, followed by severe drought, and later by exceptionally cool weather during the summer months, combined to retard the growth of vegetation to such an extent that almost all farm crops were below the average in yield, and some were almost complete failures. Market gardeners had a most successful season, because of high prices received; but fruit growers and general farmers had but poor success. Dairy products generally sold well, and the year would show a profit for dairymen if it were not for the nearly complete failure of the corn crop, both for grain and ensilage. This makes it difficult to say, so dependent are many of our dairymen upon their silos, whether the cost of winter feed will more than offset the effects of the good hay crop and excellent pasturage of the year. Poultry products have sold well, but the cost of production has also been above the average. Of special crops of importance, tobacco was rather a poor crop and onions a practical failure in most localities.

That the agriculture of Massachusetts is of importance in the economy of the Commonwealth is shown by the latest available figures regarding the value of farm products, those for 1899, which show that our 37,715 farms gave, during that year, products to the value of $42,298,274, or over $1,100 from each farm; or, to put it in another way, the average value of these farms being $4,189 each, the value of their annual production in 1899 averaged something over 25 per cent of the value of the farms themselves. In the same year a comparison with the great agricultural States of Iowa, Minnesota, Kansas, Nebraska, Illinois and Missouri, shows that, in the production of flowers and plants, nursery products, onions, potatoes, miscellaneous vegetables, tobacco, hay and forage crops, orchard fruits and small fruits, Massachusetts excels all these States in the average value of products per acre in all these classes, the margin being substantial in each case and more than twofold in many instances.

It is to the service of those engaged in this great producing industry that this Board is primarily devoted, although its work and teachings are so varied as to be of value also to the owner of the pleasure garden and to the mechanic with his back-yard vegetable garden. That its work has been of service in the past is shown by the steady advance in agriculture during the fifty years of its existence. To-day new fields are opening for its activity, and in the line of forestry, insect control and other branches of modern agriculture work will be found for us, as well as in the more familiar lines already committed to our charge.

The various branches of the work of the Board are each taken up in the later portions of this report, and under some of these headings will be found suggestions for future improvement, as well as reports of the accomplishments of the year.

Changes in the Board.

Changes in membership resulting from elections by the several societies will be given in the report of the committee on credentials in the proceedings of the annual meeting.

Members retiring because of expiration of term of service are: A. M. Lyman of the Hampshire Agricultural Society; Enos W. Boise of the Union Agricultural and Horticultural Society; John G. Avery of the Spencer Farmers' and Mechanics' Association; and T. H. Goodspeed of the Worcester Northwest Agricultural and Mechanical Society. A. M. Stevens of the Hoosac Valley Agricultural Society retires from the Board because of the ineligibility of the society to further representation.

We record with sorrow the death of a former secretary of this Board, Hon. John E. Russell of Leicester, at his home on the morning of October 28. The members of the Board and the ex-members who were associated with Mr. Russell on the Board were notified of the hour and place of the funeral services, which were quite generally attended on their part.

Meetings of the Board.

The summer meeting of the Board was held at the Massachusetts Agricultural College, Amherst, June 17, and, while lacking the historical interest attaching to the fiftieth anniversary meeting of the year preceding, was in many respects the most interesting and valuable meeting of the kind as yet held. The members of the Board had an excellent opportunity to inspect the college and experiment station, and to gauge the benefits to be derived from them by the theses of the members of the graduating class at the commencement exercises of the college, held that day. Rev. Dr. Willard Scott of Worcester addressed the meeting of the Board, and his address will be found printed on pages 8–12 of this volume.

The public winter meeting for lectures and discussions was held at Athol, Dec. 1, 2 and 3, 1903, and was highly successful in every way. The speakers engaged were in the first rank on their various subjects, which included poultry raising, forestry, horse breeding, and the maintenance of soil fertility, and the discussions were weighty and thorough. There was a great interest manifested by the farmers of the surrounding towns, and the attendance at all sessions was most gratifying. Due acknowledgment of the assistance rendered by the local society should be made, its officers and members doing all in their power to contribute to the success of the meeting. The lectures and discussions will be found printed on pages 18–196.

The annual business meeting of the Board was held at Boston, Jan. 12 and 13, 1904. The minutes of this meeting, together with the reports submitted by the various committees of the Board, will be found printed on pages 199–229.

Agricultural Societies.

There is an opportunity for these societies to do a great work in the education of the farmer. Their mission is not ended, it is merely undergoing changes; and most of the societies, it is but fair to say, are awake to the importance of their being abreast of the times. The agricultural fair is still a factor in the life of the farmers of the Commonwealth, and the societies need but to meet modern conditions to do good work for agriculture and to meet with financial success. The Commonwealth has a right to expect that societies will make their exhibitions of real value, and this is not to be done by clinging blindly to the stereotyped exhibition of years gone by. Neither does the addition of attractions not agricultural or educational in their nature meet the need of the hour. An eye to the gate is an excellent thing in itself, but carried to extremes may alienate those in the community whose support is of most value, and end in ultimate failure.

The societies are further recommended to exercise caution in the engaging of attractions, and not to incur expenditures in this direction which cannot be balanced by the extra attendance they secure. Many people at twenty-five or fifty cents a head must pass the gates to pay for from two to five thousand dollars put into attractions not of an agricultural character. Bad weather is a drawback that every society must meet with, sooner or later, perhaps once in four years, on an average; and I would earnestly recommend that all societies establish a sinking fund, into which a portion at least of the profits of good years shall be paid, to meet the deficiency that is practically certain when bad weather is met with.

The premium lists of many societies would be benefited by a thorough overhauling. The offering of premiums for breeds or varieties not of economic value is not, in my judgment, for the best interests of agriculture. Cut down the number of classes and increase the size of the premiums in those of economic value. This will result in increasing the competition in these classes and in calling the attention of the farmers to them. The words "and one dollar for the best specimen of any other recognized breed" (or variety) should have no place in the premium lists of our societies. Either a breed or variety is worthy of encouragement, or it is not; and the decision as to those worthy of encouragement should be made with the local conditions carefully considered, and when made scrupulously adhered to. This point is one of particular importance to our agricultural societies, as they have no entry fees to balance premiums paid to a single specimen of some little-known breed.

In general, the fairs held this year were unusually successful. The weather was generally good, and the attendance larger in the aggregate than in any preceding year. The exhibits were extraordinarily good, considering the unfavorable season, and more than usual interest in them was shown by those in attendance. Good order was maintained, and the laws of the State well observed. A little more care as to the class of fakirs admitted is advised in some instances, though objectionable features were, it is reported, immediately suppressed.

The attention of the societies is called to the institute work, and I desire to urge each of them to try to make this feature of its work more successful the coming season than ever before.

Farmers' Institutes.

The appropriation for "the dissemination of useful information in agriculture," from which the farmers' institutes are supported, was $2,700 for the year 1903. This sum was thought ample at the time it was appropriated, but owing to the increased cost of printing, due to the new State contract subsequently promulgated, it would have been entirely insufficient had all the meetings planned for at the beginning of the year been held. On this ground an increase of $300 in this appropriation has been asked for the current year, but until it has been definitely secured, some uncertainty will exist as to just how much can be done. During the current year an attempt will be made in one or more instances to arrange series of meetings for speakers from without the State, but in no case will a society be asked to accept a speaker at a time not convenient for itself. This work is, in my judgment, one of the most important features of the work of the Board, and every effort will be made to strengthen and amplify it. A considerably larger appropriation should be made, in order that Massachusetts may do as much work in this line as is done in other States; and it is a question whether the time has not come for the establishment of this work on similar lines to that of the Dairy Bureau.

The meetings of the year have been generally successful, 106 having been held under the direction and control of the Board in various parts of the State. All the societies represented on the Board held 3 or more institutes, except the Blackstone Valley Agricultural Society, which held but 2, and the Massachusetts Society for Promoting Agriculture, which is represented on the Board by special act and holds no institutes, and 8 societies held 4 or more. There have also been institutes held in various parts of the State not properly covered by societies having membership in the Board, and where there seemed to be a demand for such meetings. The average attendance of the year has been 102, against 104 last year, 107 in 1901, 91 in 1900 and 94 in 1899. At 4 of the meetings the attendance was 300 or over, at 9 from 200 to 300, at 35 from 100 to 200, at 30 from 50 to 100, and at 28 less than 50. Our best efforts will be put forth during the year to strengthen the work in those localities where it shows most weakness.

Nursery Inspection.

The second year of this work has been completed, with excellent results. All the nurseries of the State have been inspected by the Nursery Inspector or his deputies, and the conditions found much improved over those shown by the inspection of the first year. Where the inspector has been unable to issue a certificate of freedom from insects or fungous diseases, the requirement of the law that all stock sold be fumigated with hydrocyanic acid gas has been complied with, with the result that stock from Massachusetts nurseries is now as safe to purchase as from those of any other State, — a condition not existing prior to the passage of this law. A few slight perfecting amendments to the law seem desirable, and if it should appear upon further consideration that the law has been sufficiently tested, they will be introduced at this session of the Legislature. The report of the Nursery Inspector will be found on pages 241–245.

Dairy Bureau.

During the year the newly elected general agent of the Bureau has made the office of the Board his headquarters, being regularly at his desk when not engaged in field or educational work, or in trying cases before the courts. He has also given his whole time to the work. These two changes in policy have brought the work of the Bureau into closer touch with the Board than was possible as previously conducted, and have added greatly to the efficiency of the work. The secretary of the Board is the executive officer of the Bureau, and the work has been carried on with his advice and direction. Details concerning the year's work will be found in the report of the Bureau, printed on pages 355–373.

Cattle Bureau.

This is a Bureau by itself, over which the Board has no control, and for the actions of which it is in no way responsible. This condition of affairs should be changed, and this Bureau brought under the control of the Board of Agriculture, or the alternative course adopted, and a separate Cattle

Commission established. For particulars in regard to the work of the year, see the semiannual report of the Chief of the Cattle Bureau, on pages 249–349.

Forestry.

The forestry interests of Massachusetts are of great and increasing importance. There are at present large areas of practically waste land in the Commonwealth, most of which is suited to the production, with proper care, of some form or another of profitable forest growth. The existing woodlands are also generally neglected, and much could be done in advising their owners as to profitable methods of management. In the judgment of your secretary, the time has come for the establishment of a division or Bureau of this Board, with a forester and perhaps subordinates to him under its control, which should be charged with the general care and management of the forestry interests of the Commonwealth. The extent to which the finances of the Commonwealth should be engaged in the purchase of waste lands and planting of the same to forest growth is a matter for future consideration; but there is no question that, if these waste lands could be so utilized, the net revenue to be derived from them in fifty years' time, after deducting maintenance and interest charges, would be of great assistance in meeting the obligations and expenses of the Commonwealth.

Changes in the Laws.

Your committee appointed to consider and report on changes in the laws relating to agriculture and the agricultural societies has been at work during the year, and has prepared a plan embodying what it believes to be some decided improvements in the laws as they stand to-day, which will be submitted to your consideration at the proper place in the order of business for this meeting.

Crop Reports.

The publication of the monthly crop reports was carried on during the year under the appropriation for "the dissemination of useful information in agriculture." The special articles included in these reports were: "Fruits for the home garden: varieties and culture," by Prof. F. A. Waugh; "Summer management of the dairy herd," by Prof. F. S. Cooley; "Bee keeping: its pleasures and profits," by Dr. Jas. B. Paige (illustrated); "The management of poultry on small farms," by John H. Robinson; "Some important scale insects," by Dr. Henry T. Fernald (illustrated); and "The prevention of fungous diseases peculiar to greenhouse plants," by Dr. Geo. E. Stone (illustrated). There has been a marked increase in the interest taken in this feature of the work of the Board during the year, so much so that it was necessary to increase the number printed from 2,800 for May to 3,200 for the last two months of the season. Calls for the crop reports for July and August, containing the special articles on bee keeping and poultry raising, were so numerous that the supply of these bulletins was quickly exhausted, and many of the calls are as yet unfilled, awaiting the publication of reprints at a later date. The greater part of these requests were from Massachusetts people, although many came from other States, some as far west as California, and others from Australia and Cuba. Where the requests from other States were accompanied with the request that the name of the party be placed on our permanent mailing list, we have been obliged to refuse this favor, feeling that our appropriations were intended primarily for the benefit of citizens of Massachusetts, and that we could not properly carry hundreds of citizens of other States on our permanent mailing list.

Nature Leaflets.

The following illustrated nature leaflets were issued during the year: "Owl friends," "Bird houses" and "Our friend the chickadee," by Edward Howe Forbush; "Bordeaux mixture" and "Edible weeds and pot herbs," by Dr. Geo. E. Stone; and "Plant lice or aphides," by Dr. Henry T. Fernald. These leaflets have been found very useful in supplying information asked for. They have also been found useful in school work, and several teachers have made application for them.

Publications.

The following publications were issued by this office in 1903, most of which may be obtained on application: —

	Pages.	Number.	Date of Issue.
Agriculture of Massachusetts, 1902, .	711*	15,000	June 15.
History and Habits of the Brown-tail Moth.	73	2,000	May 18.
Crop Report No. 1, ...	40	2,800	June 4.
Crop Report No. 2, ...	40	2,800	July 3.
Crop Report No. 3, ...	40	2,900	July 31.
Crop Report No. 4, ...	40	3,100	Sept. 2.
Crop Report No. 5, ...	40	3,200	Oct. 7.
Crop Report No. 6, ...	40	3,200	Nov. 4.
Nature Leaflet No. 14, ...	6	700	May 7.
Nature Leaflet No. 15, ...	6	700	June 27.
Nature Leaflet No. 16, ...	8	700	May 8.
Nature Leaflet No. 17, ...	5	700	June 10.
Nature Leaflet No. 18, ...	4	700	July 31.
Nature Leaflet No. 19, ...	5	700	Oct. 19.
Farmers' institute pamphlet, . . .	16	800	Dec. 23.

* Including fifteenth annual report of the Hatch Experiment Station of the Massachusetts Agricultural College, 163 pages.

There were also issued in pamphlet form the following excerpts from the "Agriculture of Massachusetts," 1902: annual reports of the Dairy Bureau, Chief of the Cattle Bureau, and State Nursery Inspector; "The relation of the Board of Agriculture to the Massachusetts Agricultural College," by Dr. Henry H. Goodell; "Two years with the birds on a farm," by Edward Howe Forbush; "Right and duties concerning highways," by M. F. Dickinson; "Greenhouse construction and management," by Prof. S. T. Maynard; and the special report on "Tree surgery," by Edward Howe Forbush.

Legislation.

The legislation of 1903 having reference to the Board of Agriculture or to the agricultural societies was: "An Act making appropriations for sundry agricultural expenses" (Acts of 1903, chapter 89); "An Act making an appropriation for exterminating contagious diseases among horses, cattle and other animals" (Acts of 1903, chapter 81); a "Resolve to provide for the further dissemination of useful information in agriculture" (Resolves of 1903, chapter 27); and a "Resolve to provide for compensating owners of animals killed in exterminating the foot and mouth disease" (Resolves of 1903, chapter 83).

Legislative Appropriations: Board of Agriculture.

Objects for which appropriated.	1903.		1904.
	Appropriated.	Used.	Appropriated.
Bounties to societies,	$19,800 00	$17,939 51	$18,000 00
Salaries of secretary and clerks,	6,200 00	6,200 00	6,200 00
Travelling and necessary expenses of Board,	1,500 00	1,285 17	1,500 00
Lectures before the Board, etc.,	600 00	559 51	600 00
Dissemination of useful information in agriculture,	2,700 00	2,688 76	2,700 00
Travelling and necessary expenses of the secretary of the Board,	500 00	321 09	500 00
Printing 15,000 copies of "Agriculture of Massachusetts," Pub. Doc. No. 4,	6,000 00	5,539 75	6,000 00
Work of the Dairy Bureau, including salaries,	8,200 00	8,200 00	8,200 00
Printing 2,000 copies "History and habits of the brown-tail moth,"	1,000 00	999 37	–
State nursery inspection,	1,000 00	904 79	1,000 00
M-spikes for marking shade trees in cities,	100 00	100 00	–
Incidental and contingent expenses,	800 00	800 00	800 00
Totals,	$48,400 00	$45,537 95	$45,500 00

The Legislature of 1903 also appropriated $58,000 for exterminating contagious diseases among horses, cattle and other animals: also $40,000 for compensating owners of animals killed in exterminating the foot and mouth disease.

Press Bulletins.

The issuing of the press bulletins, consisting of abstracts of the special articles in the crop reports and other important publications of the Board, has been continued during the year. In this manner the farmers of the State and others interested in agriculture have been kept informed as to what the Board was doing, and what important material it had for free distribution. Believing that it is in accord with the purposes for which the Board was established to give the widest dissemination possible among our people of what we are trying to do for them, this line of work will be continued and extended as far as possible.

Respectfully submitted,

J. LEWIS ELLSWORTH,
Secretary.

Boston, Jan. 12, 1904.

Summary of Crop Conditions, 1903.

The month of May was unusually dry, and the drought checked vegetation and prevented the germination of seeds. Pastures and mowings suffered from drought, and at the close of the month the prospect was for but a scanty crop of hay. Fall seeding wintered well, but also suffered from drought. The apple bloom was a good one for a non-bearing year. Peaches bloomed only in a few localities, and the bloom of pears, cherries and plums was severely injured by frost. Insects did but little damage. Spraying little practised except by fruit specialists, but slowly growing in favor. Farm help rather more difficult to obtain than for several years. Wages averaged $20 per month with board, and $1.50 per day without board.

Insects did little damage in June, the cold, wet weather perhaps holding them in check. Indian corn was very small and backward at the close of the month, and turning yellow in many instances. Haying had not begun, the rainy weather preventing, but a great improvement in the crop was indicated. The acreage of forage crops seemed likely to be considerably increased. The acreage of early potatoes was about normal. Early market-garden crops had generally made poor yields, with increased prices. The flow of milk was remarkably well maintained, with upward tendencies in the price of dairy products, particularly milk. Pastures were much improved by the rains. The strawberry crop was nearly a failure, from frost, drought and rain. Pears, cherries and plums promised light crops. Apples set well, and promised a good yield for an off year.

In July very little damage from insects was reported. Indian corn improved somewhat during the month. The frequent rains delayed haying, and at the close of the month it was still uncompleted in many sections. Rains and warmer weather improved the crop, so that about a normal yield would eventually be secured. Rather more forage crops than usual were planted, and, with the exception of corn, were reported to be in excellent condition. Market-garden crops promised well, with light yields and high prices for those harvested. No early potatoes had been dug, but the crop showed excellent promise. The apple crop was greatly reduced by the mid-summer drop, but was still above the average for a non-bearing year. Pears, cherries and plums did not improve; quinces and grapes promised somewhat better, though not heavy crops; cranberries a short crop, owing to late frosts. Pastures were seldom in better condition. Oats and barley promised well for forage crops, and are mainly used for that purpose.

August reports on Indian corn were most discouraging, and almost a total failure of the crop was looked for, so far as the grain was concerned. The rowen crop was unusually heavy on early-cut fields, but so many fields were cut very late that not more than an average crop seemed likely. Potatoes were somewhat backward, but a fair to good crop was promised. The acreage of tobacco was about the same as last year, but the prospect for the crop was very poor, taken as a whole. Pastures were generally in first-class condition. Oats gave a fair average crop.

The warm weather of September brought Indian corn forward rapidly, but it was nevertheless one of the poorest crops ever secured, poorer even than that of 1902. About an average crop of rowen was indicated, and the weather of the month was very favorable for securing the crop. Fall feed was in excellent condition. All farm work was delayed by the lateness of haying, and less fall seeding than usual was done during the month, but the work progressed well, and that sowed early made a good catch. Onions were a very poor crop in most localities. Potatoes promised to be an unusually good crop, but were shortened by rot, which was general throughout the State, and not more than a three-fourths crop was secured. Root crops generally promised well, though somewhat late. Celery also promised well, as did other late market-garden crops. Apples were blown from the trees to a considerable extent, but still gave a better crop than usual in an off year. Pears were a fair crop; peaches very few; grapes nearly a failure; and cranberries a light crop in the sections of commercial production.

Reports from correspondents the last of October indicated that the Indian corn crop, taking into consideration its uses for grain, stover and ensilage, was a little over one-half a normal crop for the State as a whole. Root crops were generally reported as good average crops, and where raised for market as bringing good prices. Pasture feed remained good very late, and farm stock was reported as in the best of condition. Less fall seeding than usual was done, but early seeding was generally reported in fine condition, with later-sown promising well.

Of the 138 correspondents answering the question in regard to prices received for crops raised for market, 47 spoke of them as average, 85 as higher than usual and only 2 as lower than usual. Ninety-one correspondents, more than a majority, considered hay to have been among the most profitable crops; 44, potatoes; 11, cabbages; 7, oats; 7, sweet corn; 7, cranberries; 5, dairy products, etc. One hundred and four correspondents, an unprecedentedly large number to unite on any one crop, reported Indian corn as among the least profitable crops: 20, potatoes; 8, onions; 6, squashes; 6, apples; 6, tomatoes; 6, fruit; 4, vegetables, etc.

The season of 1903 can hardly be called a profitable one for our farmers. Most crops gave poor yields, which were only in a measure balanced by good prices. Dairy products sold readily and at good prices, but the failure of the corn crop for grain and ensilage must reduce profits for the ensuing winter season. Market gardeners generally had a good year, but horticulturists and general farmers a poor one. Of the 141 correspondents answering the question as to profits, 36 considered the season to have been profitable, 27 fairly profitable, 14 an average season for profit, while 66 thought it had not been a profitable season.

Massachusetts Weather, 1903.

[Compiled from Data furnished by the New England Weather Service.]

The weather of January was of the usual mid-winter type. Several severe storms passed over the State, and frequent severe gales were experienced along the coast. The weather was somewhat milder than usual for January, the mean temperature being about 1° above the normal. There were no unusual extremes of temperature, and the usual warm period, or "January thaw," was absent. The precipitation showed a slight deficiency, as compared with the normal of the month. The snowfall was also rather light, but, owing to the uniform temperature, the ground was generally well covered until the close of the month.

February was marked by rapid and pronounced changes in the weather. A heavy snowstorm, a cold wave, a thaw, thunderstorms and gales of hurricane force were prominent features. The storm of the 16th–17th was unusually severe. It reached all sections with heavy snow, and gales of great violence occurred along the coast. The month was warmer than usual for February, the monthly temperature being about 2° above the normal. The precipitation was also in excess, but the distribution was somewhat irregular. At the close of the month the ground was generally bare of snow.

The weather during March was very pleasant, although unseasonal, and some of its elements were phenomenal. The precipitation was largely in excess, the monthly amounts being from 1½ to 2 inches above the normal. The snowfall was, however, unusually light, and at the close of the month there was none on the ground. The monthly mean temperature was the highest of official record, covering a period of thirty-two years, and averaged 10° above the normal for March. According to authentic records covering a period of a hundred years, the month was the warmest of its name within a century.

The weather of April was uneventful, and generally characteristic of the season. The temperature was somewhat in excess, ranging about 1.5 above the monthly normal. The precipitation was near the normal, the departures generally being from one-quarter to one-half below the usual monthly amounts. Generally speaking, April was a pleasant month. At its close the season was estimated to be from a week to ten days in advance of the normal.

May was distinguished by a preponderance of sunny weather and a marked deficiency of precipitation. The temperature conditions presented no unusual features, except some noticeable extremes during the first week of the month, which ranged from summer heat to winter cold. There was a general freeze on the morning of the 2d. During the third week of the month the temperature conditions were characteristic of mid-summer weather, the mercury ranging well into the 80's. By the middle of the month rain was much needed, and toward the close vegetation showed the effect of the drought, and streams, lakes and wells were becoming low. The rainfall was from 2 to 3 inches below the normal for the month.

During the first three days of June the skies were clear, with summer-like temperatures. During the nine days following the skies were overcast, with the daily temperatures ranging from 4° to 6° below the seasonal average. On the 8th the first rain of the month fell, beginning the breaking of the long drought, which commenced soon after the middle of April. From the 13th to the 25th the weather was characterized by abnormally low temperatures, continuous cloudiness and almost daily rains. The rainfall of the month was unusually large, the amounts ranging from two to three times the normal of June. With slight exceptions during the opening and closing days of the month, the temperature was continuously below the average, and the month one of the most unpleasant of its name.

The weather of July was uneventful, and for the greater part of the mid-summer type. The opening days were overcast, with occasional showers and seasonal temperatures. Little rain fell from the 6th to the 18th, and from the 8th to the 12th a warm wave of considerable intensity prevailed. The chief storm of the month began the 18th, giving general and quite heavy rains. A season of showers and local storms followed. The closing week was pleasant, the weather, with the exception of scattered showers, being fair, with an abundance of sunshine. The monthly mean temperature was very near the normal. The total rainfall of the month was considerably below the normal, but, on account of fairly equitable distribution throughout the month, the deficiency was hardly noticeable.

The first three days of August were clear, although somewhat cool, but were followed by nearly a week of cloudy, rainy weather, the temperature continuing low. After the 9th fair weather prevailed for nearly a week, with more than an average amount of sunshine. The temperature also ranged higher, though continuing below the normal, with cool nights. After the 19th there was much cloudiness and deficiency of sunshine through the greater portion of the remainder of the month. From the 19th to the 23d the temperature was generally normal, but from the 25th unseasonably low temperature set in, continuing nearly to the last of the month. The precipitation of the month was somewhat below the normal, but was quite well distributed. The month was an exception from nearly all Augusts, in the abnormally low temperature, with few warm, summer-like days.

September opened with warm, pleasant and sunny weather, with temperature normal and above during the first five days. This period of fair weather was broken on the 5th with showers and storms, accompanied by hail in some instances. From the 6th to the 9th cooler temperatures prevailed, with night temperatures sufficiently low to cause frosts in many places, which were not widespread and severe. After the 9th the temperature again rose, and was much above the normal until the 19th. On the 16th and 17th general and quite heavy showers occurred, with high winds, succeeded by a period of fair weather, although with more or less cloudiness. On the 27th general showers occurred, with copious rainfall, but from the morning of the 28th until the close of the month generally clear weather prevailed. In general, the weather conditions of the month were seasonal and very favorable.

The first week of October was very pleasant, the weather being characteristic of the season, with generally sunny skies and temperatures ranging in the 60's; but the second seven days were in sharp contrast to the first, a pronounced easterly storm prevailing from the 7th to the 13th inclusive, during which excessive rains fell in all sections, and easterly gales, with fog, prevailed along the coast. During the prevalence of this disturbance shipping of all classes was tied up on account of the gales and high seas, and the rainfall equalled, and in many instances exceeded, the usual monthly amount. A storm of considerable intensity passed over the section on the 17th–18th, during which heavy rains fell and high winds occurred in coast sections. There was little rainfall during the remainder of the month, and, generally speaking, the skies were clear. High winds and gales, however, on the 25th, 26th and 27th, delayed shipping and resulted in loss of life and property. The temperature was almost continuously above the seasonal average until the 20th of the month, after which the weather was somewhat cooler than usual, with frosts and freezing weather on the 25th and 27th, which reached nearly all sections. Taking the month as a whole, the temperature was considerably above the average. Excepting the second week, the weather of the month was favorable for harvesting and housing crops, and for farm operations generally. The abundant moisture and high temperatures were favorable to vegetation, and feed and pasturage of good quality were abundant.

November, in many respects, was an ideal month, the weather being especially favorable for completing the general work of the season. The first half of the month was warmer than usual, but during the last half the temperature was almost continually below the seasonal average. The monthly mean temperature was below normal, the deficiency being from 1° to 3° in all sections. By the close of the month the Connecticut River was frozen over in places, which is much earlier than usual. The precipitation was generally deficient, the exceptions being moderate excesses in parts of Barnstable and Nantucket counties. In some sections the deficiencies were quite marked, the amounts being from 1 to 2 inches. There was above the average amount of sunshine, half of the days of the month being cloudless, and only nine days during which the sky was wholly obscured.

The weather of December was characteristic of the season, and, if anything, somewhat more severe than usual. Like the preceding month, the daily mean temperatures were almost continually below the normal, and the monthly mean shows the weather of the month to be about the coldest for December of authentic record. The monthly mean temperatures over the State ranged from 3° to 5° below the normal. As a result of the cold weather, the ground at the close of the month was reported frozen to an unusual depth. Ice attained an unusual thickness at an early date, and in some sections two crops were harvested and a third ready at the end of the month. The precipitation was generally below the monthly normal, although the departures were in light to moderate amounts. Snow occurred in all sections, the monthly amounts ranging from 1 inch at Rutland to 22 inches at Mt. Tom. There was an average amount of sunshine during twelve clear days. There were eleven cloudy days, and rain or snow fell in measurable amounts on an average of ten days. High winds and severe gales greatly inconvenienced shipping, caused some loss of life and considerable damage to vessels. The most severe storms of the month were those of the 19th–20th and 26th–27th.

Meteorological Observatory of the Hatch Experiment Station (Massachusetts Agricultural College), Amherst.

Annual Summary for 1903.

Pressure (in Inches).

Maximum reduced to freezing, 30.38, November 21, 10 A.M.
Minimum reduced to freezing, 28.61, February 17, 3 A.M.
Maximum reduced to freezing and sea level, 30.70, November 21, 10 A.M.
Minimum reduced to freezing and sea level, 28.93, February 17, 3 A.M.
Mean reduced to freezing and sea level, 29.996.
Annual range, 1.77.

*Air Temperature (in Degrees F.).**

Highest, 97.0, July 9, 4 P.M.
Lowest, — 12.0, January 20, 9 A.M.
Mean, 46.7.
Mean of means of max. and min., 47.0.
Mean sensible (wet bulb), 43.0.
Annual range, 109.0.
Highest mean daily, 79.6, July 9.
Lowest mean daily, — 3.0, January 19.
Mean maximum, 57.8.
Mean minimum, 36.1.
Mean daily range, 21.7.
Greatest daily range, 45.0, February 21, March 14, May 12.
Least daily range, 3.5, June 15, October 11.

Humidity.

Mean dew point, 37.6.
Mean force of vapor, .403.
Mean relative humidity, 73.5.

Wind. — Prevailing Direction West, Southwest.

Summary (Per Cent).

West, 14.
North, north-west, 10.
South, south-west, 12.
West, north-west, 9.
South, 9.
Other directions, 46.

Total movement, 46,256 miles.
Greatest daily movement, 402 miles, April 17.
Least daily movement, 4 miles, August 27.
Mean daily movement, 126.7 miles.
Mean hourly velocity, 5.28 miles.
Maximum pressure, per square foot, 22.0 pounds = 66 miles per hour, February 12, 12 M., W.

Precipitation (in Inches).

Total precipitation, rain or melted snow, 45.45.
Number of days on which .01 or more rain or melted snow fell, 116.
Snow total, in inches, 33.5.

Weather.

Mean cloudiness observed, 53 per cent.
Total cloudiness recorded by sun thermometer, 2,328 hours = 52 per cent.
Number of clear days, 119.
Number of fair days, 98.
Number of cloudy days, 148.

Bright Sunshine.

Number of hours recorded, 2,126 = 48 per cent.

Dates of Frosts.

Last, May 2.
First, September 25.

Dates of Snow.

Last, April 4.
First, October 26.
Total days of sleighing, 52.

Gales of 50 or More Miles per Hour.

January 31, 50 miles, W.; February 9, 56 miles, S.W.; February 12, 66 miles, W.; February 28, 58 miles, S.S.W.; April 18, 50 miles, W.S.W.; July 29, 56 miles, S.W.; December 13, 58 miles, W.; December 22, 51 miles, W.N.W.

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* Temperature in ground shelter.

J. E. Ostrander, *Meteorologist.*
F. F. Henshaw, *Observer.*

SPECIAL BUSINESS MEETING

OF THE

BOARD OF AGRICULTURE,

1903.

SPECIAL BUSINESS MEETING OF THE BOARD.

A special business meeting of the Board of Agriculture was held at the Amherst House, Amherst, June 16, 1903, at 7 o'clock P.M., Mr. W. A. Kilbourn chairman of the executive committee, presiding.

Present: Messrs. Allen, Anderson, Avery, Boise, Bradway, Brewster, Bursley, Burt, Damon, Danforth, Ellsworth, Goodspeed, Gurney, Jewett, Kilbourn, Lyman, Mason, Perham, Reed, Richardson, Shaylor, Smith, Spooner, Stevens, Stockwell, Turner, Wellington and Worth.

The credential of Mr. Walter D. Ross of Worcester, elected by the Worcester Agricultural Society to fill the vacancy caused by the election of Mr. Ellsworth to the secretaryship, was presented and accepted.

A list of societies delinquent in making their annual returns to the secretary of the Board was read, with reasons for said delinquencies, and they were excused by vote of the Board.

The third semiannual report of the chief of the Cattle Bureau was presented and accepted.

Messrs. Goodspeed, Avery and Allen were appointed a local committee of arrangements for the public winter meeting of the Board in December next, to act in conjunction with the committee on institutes and public meetings.

SUMMER MEETING

OF THE

BOARD OF AGRICULTURE

AT

AMHERST.

JUNE 17, 1903.

SUMMER MEETING OF THE BOARD, AT AMHERST.

The summer meeting of the Board of Agriculture was held at the Massachusetts Agricultural College and Hatch Experiment Station, Amherst, in connection with Commencement, on Wednesday, June 17, 1903.

The Board was entertained at the Amherst House Tuesday night, where a special business meeting was held. On Wednesday forenoon barges were taken, and the grounds and buildings of the college and experiment station were visited and inspected. The Board attended the Commencement exercises in the college chapel at 10 o'clock. At 12 o'clock dinner was served in the new dining hall to members of the Board, alumni and visiting friends, nearly 200 persons being present.

After-dinner speaking followed, with First Vice-President Sessions presiding. President Goodell welcomed the Board to Amherst, after which the Rev. Dr. Willard Scott of Worcester addressed the assembly on "The newer feeling for nature," an abstract of which forms a portion of the proceedings of this meeting. After brief remarks by Secretary-elect J. L. Ellsworth, the Chair turned the gathering over to President C. S. Phelps of the College Alumni Association, and the summer meeting of the Board was brought to a close. This meeting was a very enjoyable occasion, and those who attended went home well pleased with the appearance and work of the college and station.

THE NEWER FEELING FOR NATURE.

BY REV. WILLARD SCOTT, D.D., WORCESTER.

Gentlemen of the Massachusetts State Board of Agriculture, I greet you to-day upon this meeting of your body, and upon these beautiful college grounds, with deep feelings of fellow sympathy, and of admiration for the noble work you represent and promote. This is a good world to live in, and our time is a good time. While nature has always made a deep appeal to the human senses, — fair skies, fields and waters which the eyes have enjoyed, glad voices and melodies for the ear, and delicious and nourishing things for the taste and smell, — yet the past half-century has done much to increase all this, especially by putting a meaning into it all, and separating it from most of the dark and wicked superstitions which have so often misinterpreted or terrorized it. There has been a great widening and strengthening of knowledge and faith about everything. New laws have been discovered, older known laws have been much modified by better knowledge of them, and all our tempers and habits have been changed by our new way of looking at the world and living in it. There has been a wholesome and happy gain all around.

For one thing, the world does not seem so large and strange as formerly, before the sea opened her doors both over and under her surface, and all nations and interests became more closely united in sympathy and welfare. The first practicable sub-marine cable does not date back of 1866, though thirteen years of painstaking attempts preceded it. The first yacht which crossed the Atlantic was the "America," in 1851, revolutionizing English yacht building, and becoming the forerunner of a mighty fleet: and the first steamship equipped at private expense for an ocean cruise was Cornelius

Vanderbilt's "North Star," in 1853, — the millionaire's luxury. Crystal Palace, London, in 1851, began the long and increasing series of world's fairs, — "all nations crowding to us," as Carlyle testily growled, "with their so-called industry or ostentatious frothery."

But to-day, going about the world has become so common that we no longer remark it. The "globe-trotter" has only his pleasure for his pains, and a brief paragraph in the local journal of his town, saying that he has returned after a safe journey. Fifty years ago it would have been an event worthy of being telegraphed to Canton and St. Petersburg, if there had been any telegraphs over which to send it. We are in constant communication with everything that happens anywhere on the face of the earth: and here in America, by the clock, have news of important Asian or European doings several hours before they are reported to have occurred. Missionaries no longer bid their friends at home an eternal farewell when they leave for remote lands, and for a small fee may reach them at any time with tidings of life or death. More than that, the dark or unfamiliar continents have been opened up, and many of their ways changed. American machinery for cultivation of the land, and approved sorts of seeds, have gone to all nations: and their produce, of which our fathers never heard, is on our breakfast tables. A business house which has no export or import account is unnoticed beyond its own neighborhood: and the larger houses have correspondents and shippers in every civilized country, and promoters in the others. The foreigner is among us in such numbers that we do not stop to notice him, and the American is seen on every world road.

Such changes, of which these are only the slightest intimations, would be impossible without changing also our whole view of the world, and giving us a very different feeling for it. And this is what has occurred. There is far less uncertainty and mystery about it. It is better known, superficially, — its features, resources, varieties. Its people have grown more familiar, and their habits of life, dispositions and possibilities have been better studied. Their increasing accessibility has made them seem more like neighbors, and a more friendly feeling has grown up between us. There are no more "heathen" in the Roman, or recent English, sense. As the great apostle to the heathen of the first Christian century said to some in his day, we can truly say to those of our own, "Now, therefore, ye are no more strangers and foreigners, but fellow citizens." A hopeful human brotherhood has come about, not very much developed yet, but on the way and promising. Diplomacy between nations has ceased to be a matter of intrigue or hostility, and has become the conference of those who have common interests as to how all parties can get the most from one another. While armaments are still preserved, partly as an old-time heritage, and partly to gratify the vanity of kings and courts, they are not for the threatening of peace, but for its maintenance. Co-operation has become more natural and more necessary, and working in harmony has increased the mutual appreciation and confidence of all. Society has become a better place to live in.

But this acquaintance has extended much beyond the surface, — beyond the mere features of the earth and pleasanter dealings with those who live on it. Being released from the necessity of watching one another so suspiciously, a habit of studying general world-wide interests has grown up, and more familiarity with the world at large is affording a better opportunity for knowing its laws and how they work. Attention has been turned to the study of nature as such; how things grow and reproduce themselves; what surroundings support them better; from what enemies or evils they suffer, and how they may be protected. Science has become a matter of closer observation and induction. A feeling has awakened that the world means good, and not evil, if properly understood and naturally treated; that it holds together, and has a moral purpose. The ancient fear of the powers of nature has passed by. The world is no longer looked upon as fallen, or cursed. It is a growing and gaining world all along the line, — a world full of more possibilities than any one knows even yet. People have come to think more about it, and to feel more kindly, even affectionately, towards it. We believe not only that it was made "very good," but that it has been steadily growing better, and that the world, and the people on it, have all common fortunes; that the best life is not that which lives "off the earth," but in close sympathy with it, and tries to understand and improve it. Out of this feeling a large and increasing nature-literature is being developed; books and charts of every character, descriptive or illustrative of the life, habits and needs of plants and animals; of things on the land, and in the water, and in the air. The whole out-of-doors world has gotten a new meaning, and increasingly the tide is turning from the congestion of our cities, homes, factories and even schools, to the country, the half-holiday, a longer summer vacation, and to those studies, occupations and professions which bring us nearer to nature, and to a better comprehension of its meaning and worth to us. One hears more often than formerly such expressions as "mother earth," "near to nature's heart," "our little brothers of the woods," "the lap of nature," "the return to nature," and the like. The procession of life has halted and turned back on its track towards the fields, the woods and the streams, so long overlooked, feared, or merely delved to extract a living; to the deeper laws of life, so long disregarded, to study out their secrets and woo them with the affection too long withheld. All this has great promise in it.

The ground of this, if we pass on to consider it, is a deep, latent feeling, — now developed almost to the point of a religion, and certainly deeply affecting all our religious beliefs, — that we and nature are one: that we began together, have grown together, and that we have the same fortune and destiny. More than that, it is felt that the whole has religious meaning, and really that any religion we have which excludes the love and reverence of nature has thrown away the very best guide to the God of all things, of whom nature is our most familiar expression. For, paraphrasing one of the old-time maxims of the church, "If a man love not the world which he hath seen, how can he love the world's Maker whom he hath not seen?" It is being more and more felt that we cannot so go through the world, which is God's nearer revelation, and have any reasonable hope of attaining to a better.

The discovery of the overwhelming evidence for man's derivation of life through, and his unity with, nature, has affected all ethical and religious ideas, and greatly for the better. In this way we see that we are of a piece, and cannot profitably surrender the natal relation now, even if it were possible for us to do it. We are brethren. So what is good for the whole is good for us, and what is true of the whole is true for us. And what is true for this world in moral things is probably true also for any world of which we shall ever know anything. This is not the same as making a plea for the old saw, "One world at a time," for no such division of life can be properly made. We need the hopes and plans for to-morrow to help us do to-day's work, or even to make to-day endurable; and precisely so we need the expectations of the world to come, to give incentive to this. But what is felt increasingly is, that the way to the great to-morrow, as to the day after the one we are now living, is the road we are now passing over; and that the best preparation for the future is a loving, intelligent and faithful use of what we have now. As that future world is of God, so is this, and all his work must be of a piece. Surely this feeling adds both dignity and zest to present living, and gives usual human effort a meaning it has often lacked.

Recalling these things, do they not lend an emphasis to the interests you represent here, as a Board of Agriculture? For what really is agriculture but living naturally and humanly with nature, observing her laws, guarding her rights, protecting her from her enemies, seeking ever to understand her better, and to give her a higher place of appreciation and affection in our hearts? and all this because we feel her real kinship with ourselves, and that from her we have nothing to fear, but everything to hope.

PUBLIC WINTER MEETING

OF THE

BOARD OF AGRICULTURE,

AT

ATHOL.

DECEMBER 1, 2 AND 3, 1903.

PUBLIC WINTER MEETING OF THE BOARD,

AT ATHOL.

The annual public winter meeting of the State Board of Agriculture was held at Athol, on Tuesday, Wednesday and Thursday, December 1, 2 and 3, four of the meetings being held in the Academy of Music, and one each in the Opera House and hall of the Young Men's Christian Association. The first meeting was called to order by Secretary Ellsworth, at 10 A.M.

Secretary ELLSWORTH. Ladies and gentlemen, in the absence of the Governor, who is president of this Board, I now have the honor to introduce the Hon. William R. Sessions, first vice-president, who will take charge of the morning session.

The CHAIR. You see by the programme what is prepared for us, so of course you will expect no remarks from me at this time. The time-honored custom of this Board has been to open this session of the winter meeting by asking divine blessing, and Rev. R. G. Bugbee of this place will now offer prayer.

Prayer was then offered by Mr. Bugbee.

The CHAIR. We have never met before in the town of Athol, and the good people here have tendered to us a welcome which the chairman of the selectmen, Mr. Hapgood, will voice.

ADDRESS OF WELCOME, BY MR. HERBERT L. HAPGOOD, CHAIRMAN OF THE BOARD OF SELECTMEN.

Mr. President, members of the State Board and friends, as representative of our townspeople, I extend to you a most hearty welcome. We thoroughly realize our needs along the lines of agriculture, and it is with pleasurable anticipation that we await the intellectual discussions of land culture and farming, from the practical raising of the indispensable fowl to the omnipotent horse.

We are gratified to have the honor of the convention in this place at this time. Although a gathering of this kind requires much work from different committees, the benefit derived from such social and mental intercourse is most advantageous, both in the promotion of agriculture and the advancement of higher motives in all industries.

As you well know, Athol is a manufacturing town. It is pleasant to say that our manufactories are flourishing. Aside from the grave labor problem of the country, we enjoy good times. At least ten of our factories have been established in their present location for many years, and their growth has been constant with each successive year. The younger concerns have rapidly fallen into file, and are proving themselves worthy. But do not fear "to sow your seed in sandy soil." There is plenty of rich soil and pasture land to be found among the hills when the farming understandings are but awakened. And it is our earnest desire that our hospitality will so meet your pleasure that we shall receive your help in planting profitably along these lines of modern agriculture.

RESPONSE FOR THE STATE BOARD OF AGRICULTURE, BY FIRST VICE-PRESIDENT WILLIAM R. SESSIONS.

In replying to this very cordial welcome from the people of Athol, — by the mayor, if I may call the chairman of the selectmen such, — I shall detain you but a few moments.

We recognize in Massachusetts the value of co-operation. The farmers of Massachusetts depend on the communities for a market for their products, and the Board of Agriculture in its past action has endeavored to so conduct its meetings as to make them of interest, a part of them at least, to such communities; and the programme which is presented to you to-day has for this evening's lecture one which is of as much interest to the manufacturing people and to the mercantile people as to the farmers. Some of the other lectures are more particularly agricultural, as is perfectly proper.

We come here for the first time, the Board never having held a public winter meeting in this town. It is time we did hold a meeting here, — no doubt about that. It has been customary with the Board to go from place to place from year to year, so as to give all parts of the State an equal opportunity, as far as might be, to receive the advantage that such a meeting might give. Lecturers of capability, whose reputation extends throughout the country, have been employed, and at this meeting we have lecturers who have a reputation outside the United States.

We thank you, Mr. Chairman, for the cordial welcome you have given us. We hope for a pleasant and profitable meeting, and we shall depend on your citizens to make it such.

We have for the business of the morning a lecture on "Progressive and profitable poultry culture," by Prof. Arthur A. Brigham of Marlborough, connected with the Columbia School of Poultry Culture. Mr. Brigham, as probably all of you know, is a graduate of the Massachusetts Agricultural College, has been a teacher almost all his life, first, perhaps, or early in his life, in Japan, and later on in Rhode Island, and has been successful, to my personal knowledge, in everything he has undertaken; and in the subject he will present to you to-day he will give you not only the theory, but his experience. I have the pleasure of introducing to you Professor Brigham.

PROGRESSIVE AND PROFITABLE POULTRY CULTURE.

BY ARTHUR A. BRIGHAM, PH.D., MARLBOROUGH.

For those who have the interest, the patience and the perseverance necessary to the profitable consideration of statistics, the following special points relating to poultry are given: —

Statistics to study.

A few figures from the latest census report of the United States relative to poultry will give a definite idea of the magnitude of the poultry interests of this country.

The reported number of "chickens" (common domestic fowl) three months old and over, including Guinea fowls, on the farms and ranges of the United States, June 1, 1900, was 233,598,085; the reported number of turkeys was 6,599,367; the reported number of geese was 5,676,863; the reported number of ducks was 4,807,673; total poultry, 250,681,988.

The number of farms in the United States was 5,739,657; the number of farms which kept fowls was 5,096,252. Of all the farms in the United States, 88.8 per cent kept poultry. "Chickens" as a favorite crop certainly rank next to the crop of boys and girls on American farms.

On June 1, 1900, the total value of poultry in the United States was $85,794,996; for the year 1899 the total value of the poultry raised was $136,891,877, or $16.83 per farm. For 1899 the total value of eggs produced was $144,286,158; the total annual poultry products of farms and ranges was $281,178,035. The census report estimates the annual products from poultry not on farms and ranges as follows: poultry raised, $7,000,000; eggs produced, $7,000,000; total annual poultry products of the nation, $295,178,035.

The grand total value of the annual poultry products reported and estimated is almost $300,000,000.

The census of 1900 does not include the poultry under three months old on June 1, 1900, while the census of 1890 did include the young chickens, so that it is difficult to compare the figures for ascertaining the increase in numbers and value in the ten years from 1890 to 1900.

We can obtain a more definite idea of the advance made by comparing the egg production reported. For the census of 1890 the total annual production of eggs in dozens was 819,722,916; for the census of 1900 the dozens reported were 1,293,819,186; this shows 57.8 per cent of increase in egg production between 1890 and 1900.

The average annual production of eggs per fowl, according to the census of 1900, was 5.6 dozens: the average value per dozen eggs was 11.2 cents. The number of eggs per capita of population shown by the census of 1900 was 17 dozens, while in 1890 the average per capita production was 13 dozens.

In the United States the values of several farm products in 1899 were as follows: dairy products, $281,629,958; sheep products, $170,337,002; swine products, $232,027,-707; poultry products, $295,178,035.

In Massachusetts there were in 1900, according to the United States census, 37,715 farms; dairying was the industry on 14,900 farms; sheep were kept on 1,447 farms; poultry was kept on 30,504 farms. The "business hen" is found on over 80 per cent of the farms of Massachusetts.

The value of the total farm products of Massachusetts in 1899 was $42,298,274; poultry raised was valued at $1,407,-681; eggs produced were valued at $2,571,341. Poultry and eggs made over one-eleventh of the total value of the farm products.

In a recent contribution to the press, that veteran editor, Mr. A. F. Hunter, gave, as the result of his study of the reports of the Boston Chamber of Commerce and other sources of information, the following: —

Eggs received in Boston.

YEAR.	No. Cases (30 Dozen).	Highest Price (Cents).	Lowest Price (Cents).
1890,	625,581	28	14½
1891,	635,138	29	15
1892,	711,311	30	13¾
1893,	710,213	36	15
1894,	777,353	25	11
1895,	780,196	29	13
1896,	873,925	24	10
1897,	912,754	23	10
1898,	889,216	25	10
1899,	900,219	29	13
1900,	986,367	28	12
1901,	1,040,555	26	12
1902,	1,053,165	36	15½

The grade of eggs taken for the standard of price is "fresh western," and we give the highest and lowest price of each year. A study of the tables gives some interesting figures. The lowest average price for the whole year is 15½ cents, in 1897; and the highest average price is 22½ cents, reached in 1890 and again in 1902. There was one week in January, and again the second week in February, 1893, when fresh western eggs reached the unusual price of 36 cents a dozen, and yet the average for that entire year was but 20¾ cents. In 1902 the highest price reached was 36 cents, the lowest 15½ cents, and the average for the fifty-two weeks was 22½ cents. Marketmen tell us that not only is the quantity of eggs received in Boston increasing rapidly, but that the price is steadily advancing also; the figures given in the Chamber of Commerce reports, however, hardly bear out the latter statement. Eggs have been unusually high in Boston all of this year, which promises to be a record breaker; but the highest price of last year was no higher than that of 1893, the lowest price of last year only a half cent above the lowest figure of both 1891 and

1893, and the high average price of last year was exactly equal to the average price in 1890; these figures indicate a fairly steady price, taking several years together.

17,334 Tons of Poultry.

The steady increase in the consumption of eggs is outdone by the greater increase in the consumption of poultry; in each of the three years last past there was received in Boston markets more than three times as much dressed poultry as in 1890 or 1891; the receipts more than trebled in ten years. Poultry packages are not uniform in size, but the statistics clerk of the Chamber of Commerce gives the average of the packages as 150 pounds.

Year.	Number of Packages.
1890,	102,113
1891,	95,900
1892,	132,409
1893,	143,200
1894,	164,480
1895,	198,237
1896,	192,236
1897,	211,695
1898,	207,308
1899,	223,481
1900,	314,943
1901,	319,129
1902,	316,319

Of the 316,319 packages of poultry received in Boston last year, 85,200 packages were for export (through shipments to Europe), leaving 231,119 packages for consumption, a total of 34,667,850 pounds, — almost 17,334 tons. The average value of this dressed poultry last year is given as 13 cents a pound, the total value being $4,506,817.50; the grand total for eggs and poultry received in Boston being $11,614,781.25.

Probably $18,000,000 in the Whole State.

There are quite a number of cities in Massachusetts, and inquiry reveals that they too receive considerable quantities of eggs and poultry in direct shipments from outside the State. There are no Chamber of Commerce statistics for these cities, but estimates furnished us by wholesale produce dealers or the managers of cold storage warehouses give us the following figures of receipts of eggs last year: —

City.	No. of Cases.
Worcester,	About 150,000
Springfield,	About 100,000
Holyoke,	About 50,000
Fitchburg,	About 20,000
Lowell,	About 145,000
Lawrence,	About 30,000
Haverhill,	About 20,000
Lynn,	About 50,000
Salem,	About 40,000
Taunton,	About 50,000
Brockton,	About 40,000
New Bedford,	About 40,000
Fall River,	About 70,000
Total,	805,000
Value,	$5,433,750

This total value is a little more than five-sevenths of that of eggs received in Boston; and, as we are assured the proportions of dressed poultry are substantially the same as of eggs, we take five-sevenths of the value of dressed poultry received in Boston as the value of dressed poultry received in those cities, and have $3,219,155, the grand total of eggs and dressed poultry received in Boston and the thirteen other cities named being $20,263,686.

It is certain that a part of the eggs and dressed poultry appearing in the receipts of other cities appears also in the receipts in Boston, being bought in the latter city by dealers in near-by cities, such as Lynn, Salem, Haverhill, Lawrence, Lowell, etc.; but dealers assure us that those figures would be quite balanced by the poultry and eggs brought into cities near the borders of the State by producers living over the line. Then, too, the cities and large towns in the western part of the State receive their supplies from New York City and Albany; and we have left out of the reckoning several cities, such as Newburyport, Gloucester, Marlborough and Northampton. To be perfectly fair in the figures, however, let us deduct $2,263,686 from the total, considering that the figures are duplicated to that amount, and we then have $18,000,000 as the money value of poultry and eggs coming into the State last year.

Advantages and Importance of the Poultry Industry.

Some of the reasons for the evident increase of poultry keeping as an occupation are the following: —

1. Only a small amount of capital is necessary, if the poultry keeper is satisfied to begin with a few fowls and to develop the business gradually.

2. The investment of funds, if properly made, yields prompt and reasonable returns.

3. For starting in the business a small area of land is sufficient, and a location may be selected where the land is not high in price.

4. Dressed fowls and eggs are favorite foods of the people, and as such are in constant demand, at fair prices.

5. The demand for poultry products is increasing, because of the advancing prices of meats of all kinds and the gradual diminishing of the supplies of wild fowls and other game. Furthermore, new and special uses for poultry products, especially eggs, are arising and extending.

6. The products of poultry keeping are concentrated and valuable, though perishable. They can stand considerable expense for prompt transportation in fresh condition to desirable customers. They are salable for cash. There is little if any waste.

7. The fowls utilize much of the wastes of the household and farm, and turn them quickly into products of value.

8. Poultry properly managed enrich and benefit the farm, garden and orchard.

9. Poultry keeping may be advantageously combined with or added to other occupations.

10. The industry is a healthy one, and yields to intelligent, interested, earnest labor a suitable return of profit and pleasure.

In addition to the statistics already given, emphatic indication of the importance of poultry is found in the quantities of dressed fowls and eggs for sale in the stores, stalls and markets of the cities, towns and villages of the State and nation.

Further evidence is given by the large and increasing business done by express companies, railroads, steamboats and other carriers in the transportation of poultry products. Modern methods of rapid transportation have revolutionized poultry keeping as an industry. The supply is no longer limited to the local demand; it has vastly increased, and the surplus is sent to more or less distant consuming centres, to the evident advantage of producer, carrier and consumer. There is no further danger of a glut in the market; cold storage and exportation take care of any temporary excess of production. Poultry farming, although a young industry as yet, employs a host of collectors, carriers and distributors in preparing and delivering its products to consumers. It should also be remembered that probably one-half of the total production is consumed in the households of the producers.

An emphatic indication of the importance of the poultry business is shown in the extensive advertisements of industries which are dependent upon poultry keepers for trade. Examples of these allied industries are the manufactories of incubators, brooders, bone-cutters, cramming machines, poultry fences, roofing and sheathing papers, special poultry feeds, portable poultry houses and poultry appliances.

Among the most striking evidences of the popularity of the keeping of pure-bred poultry are the numerous, worthy and well-patronized poultry papers, and the many attractive and well-attended poultry exhibitions, of which Massachusetts furnishes fine samples.

Foundation Factors.

In preparing for the practice of profitable, progressive poultry culture, the beginner must study the principles involved in their application to the solution of his particular problem. The foundation factors of the poultry business are those of any and every other business, — land, labor, capital, brains. The proper use of these factors by the poultryman who is personally adapted to his business will result in progress and profit. Common sense, wise expenditure and economy, preventing leaks and disease, stopping wastes before they begin, persistent and energetic effort according to a well-defined system, will bring success and profit in poultry. Several practical points command attention.

Location.

Soil. — The ideal land for a poultry farm is sandy loam, which is naturally well drained and yet capable of producing good crops of grass, clover, cabbages and mangolds for green food, and of corn, wheat and oats for grain food, and Canada peas, soja beans and sunflowers as partial substitutes for animal food; and containing gravel, which the fowl may use as grit or grindstones for its gizzard grist-mill.

Slope. — The most favorable aspect is one which inclines gradually to the south, with south-east a second and south-west a third choice. Thereby is secured the full benefit of the sunshine in winter, and ready surface drainage in spring and fall.

Shelter. — The protection of rising ground, preferably covered with forest growth to the north and north-west, is desirable to break the strength of the strong prevailing winds, and aid in producing an approximation to the condition of balmy June in the substantial shelters during the season of severe cold, windy and rainy weather.

Carefully constructed, comfortable houses are most important aids in ameliorating the somewhat unfavorable natural influences of a rugged and changeable climate.

Shade. — Summer as well as winter must be planned for. Sultry, stagnant, superheated surroundings in July and August are unquestionably more debilitating and destructive to hen health than the rigors and sudden changes of our New England winter. There is nothing more comforting and gratifying to hen or human than the cooling shade of leafy trees in the heat of mid-day in summer time. Sufficient trees, then, in the yards or on the range are necessary to the health and happiness of the feathered flocks of the farm.

Structures.

Situation. — The poultry house ought to be placed on a well-drained spot, facing the south or south-east. Its floor, whether of earth, boards or concrete, should be at least six inches above the level of the surrounding ground, and shaped so that any unwelcome water which might get upon it shall immediately flow off and away from the house.

Ventilation. — The hen houses in summer time, instead of being close, stifling boxes, with fronts all of glass, should be made into shady shelters by replacing windows and doors with frames of wire netting, and by otherwise opening up the quarters so that they shall be little more than open sheds or shelters, whose tight roofs will protect the fowls alternately from the scorching rays of the hot sun at noonday and the down-pouring flood of sudden showers, while affording always the free fresh air that would naturally be found by the fowls roosting in trees. At the same time by the aid of wire netting the birds are protected from night prowlers of the four-legged and other varieties.

It is both progressive and profitable in poultry architecture to secure the advantages of the scratching shed or covered exercising place, and to include this space as a part of the comfortable living room during the inclement weather. This is readily and economically accomplished by combining the scratching shed with the laying and roosting room, by providing a roosting platform with curtained front, by wide double front doors for each house or room for a flock of thirty fowls.

How to ventilate the hen house in winter is a much-mooted question. It is easily and economically accomplished in either of two ways: —

A window of two sashes may have the lower sash raised two or three inches and a board inserted under the sash frame, filling the space so that the wind shall not enter directly, but pass between the frames at the middle of the window, and enter the room without creating a direct draft upon the roosting birds. Another plan, where the hen house has a double pitch roof, is to place poles or joists four or five inches apart to form a perforated ceiling at the level of the tops of the plates, say six or seven feet above the floor, and upon this scaffold pile loose straw, hay or evergreen boughs, one or two feet deep. In the gable ends above the "straw loft" place windows or ventilator holes, and by opening the same more or less regulate the entrance and exit of the air, which, sifted by the straw, is supplied fresh, dry and without direct drafts to the fowls in the room below. This plan prevents excessive moisture in the room atmosphere, and corrects any tendency to dampness and chilliness which are the frequent causes of the dreaded scourge termed roup. On the hot, bright days of summer the "straw loft" acts as a shield against the direct down-beating of the sun's rays, and helps to keep the room below equably and comfortably cool, thus lessening the debilitating influences which so frequently weaken the fowl, and prepare for its succumbing to the strain of the molting period.

Breeding.

The idea, so prevalent, that the farmer should each year purchase one or more male birds, and thus introduce "fresh blood" into his flock, is the bane of progressive breeding of poultry. It is going back in stock breeding one hundred and fifty years, to the time when English and American farmers made it a rule to always cross-breed. Robert Bakewell, the father of modern stock breeding, established the principle of breeding together animals of like excellent qualities, regardless of blood relationship. This plan, put in practice by the Colling Bros., produced the splendid Shorthorn breed of cattle. To-day skilful poultry breeders, by careful "line breeding," are producing like results among fowls instead of constantly seeking to introduce new and strange blood, thereby breaking up the tendency to superior egg production, to flesh making and fine feathering, resulting in irregular egg yield, showing scarcity during periods of high prices and abundance when eggs are cheapest, uneven flesh production, and plumage of all kinds and colors. The average farm flock is an heterogeneous mixture of all varieties, sizes, shapes and colors of fowls. They may sometimes have the much-coveted vigor, but possess little else of value or profit to the owner. The exception is the fine flock of one breed, uniform in size, development and color, an important source of profit and pleasure to the farmer and his family, and an effective advertisement of profitable progressiveness. The guiding principle is to breed together the best birds along well-defined lines, without fear of affinity in blood, so long as the stock is strong of constitution and in perfect health.

Every poultry farmer should breed with a definite purpose in view, and develop his own strain of pure-bred poultry for profit. Where time and patience permit, "trap nests" are effective aids in selecting the most productive pullets, which may the next year, as mature fowls, be used in the breeding pens to produce more and better of their kind. Prepotency pays in poultry breeding. It signifies extra strong power in transmitting quality to offspring; and by mating together fowls having the power along the lines of egg production, early and large flesh development, or beautiful shape and attractive plumage, offspring are secured which have enhanced value along these lines, and intensified power in reproducing the same in their progeny.

Incubation.

The subject of artificial hatching is too large to allow of treatment here, but one or two hints may at least be given. Late experiments and experience with hatching machines emphasize the desirability of restricted ventilation, or the supplying of abundant moisture in the air of the egg chamber during the first week of incubation. Either or both of these precautions tend to aid normal rational development of the embryos during the early stages. On the other hand, abundant ventilation, and, if necessary, daily airing of the incubating eggs during the latter half of the incubating period, tends to healthy, regular growth of the chicks in the shells and to safe hatching of vigorous broods of birds.

The very opposite of these conditions too often prevails, and the results include hemorrhages, shown by "blood rings" in the eggs; enlargement of the heart and blood vessels, indicated by large and very bright scarlet veins; a sharply defined body and very dark "eye spot," as seen in the light of the egg-tester. The "blood ring" is the sign of death. The sharp, distinct outline of the embryo and the bright scarlet blood vessels indicate excessive development of the circulatory system, from which later there is a reaction, indicated by sluggish development towards the end of incubation, death in the shell, or failure to hatch even after the shell is pipped. If the chicks do hatch, they are very likely to be weak, to mope about, to "hug the heat" and huddle under the hover of the brooder, to have little appetite, and in spite of the poultryman's care to give up the struggle within ten or twelve days after hatching. When too high a temperature or "hot spots" in the incubator chamber add their influence to excessive ventilation during the early stages of incubation, the results are yet more rapid and deadly. The incubation problem is one which each poultryman has to solve himself, according to his local conditions. That this question is not yet solved by many, is evident from the very poor hatches and the heavy percentage of death in the brooders so commonly experienced.

Feeding.

Chemical analyses and digestion experiments in connection with poultry feeds will aid in reckoning trial rations, and the hens will show by testing how the rations may be improved.

The diet of the fowls must for best results include grains, green food, animal food and mineral food. Costly protein or "flesh-forming" nutrients should not be fed in excess, when cheap starchy constituents will answer for keeping up the heat of the bird's body.

A series of brooder feeding experiments in case of incubator chicks, conducted at the Rhode Island Experiment Station, gave the following results: —

A flock of 46 chicks, fed on egg, liver and green food, reached a death rate of 63.7 per cent, of which 85.8 per cent showed bowel troubles.

A flock of 58 chicks, fed on grain exclusively, showed a death rate of 32.7 per cent, of which 76.5 per cent had digestive troubles.

A flock of 63 chicks, fed on grain and green food, all animal food being withheld, showed a death rate of 9.5 per cent, of which 75 per cent had digestive disorders.

A flock of 52 chicks, fed a complete and balanced ration, including "infertile" eggs, liver, cracked corn, wheat and barley and green food in the form of oat sprouts and chopped onions, had a death rate of 3.9 per cent, and not one chick showed digestive disorder.

Exhaustive experiments, carried on by the New York State Experiment Station, corroborate these results, and also emphasize the necessity of sufficient mineral food for growing chicks and ducklings.

All of these experiments indicated that the increased amount of protein used to balance the grain ration not only reduced the death rate but also promoted rapid growth.

The same principle applies in feeding for egg production, for fattening and finishing for market, for the molting period, and for exhibition condition of fancy fowls. The ration should, for best results, be balanced for its purpose, all the conditions being considered, and use made of the available feeding stuffs which are best adapted, most economical and effective.

Whether mashes shall be fed, or exclusive dry feeding followed; what feed stuffs to use, and the special method of feeding, — all these and other related details must be worked out by the poultryman according to the conditions and as a part of his business.

Specialization.

In working out his problem, the farmer usually finds it necessary to do as other successful business men are doing, and specialize in order to make his poultry pay the largest profit.

The production of the favorite "south shore chickens" has become a business which engages the efforts and employs the equipment on hundreds of farms in south-eastern Massachusetts. Brahma and Plymouth Rock chickens are hatched in summer and autumn, and reared to be sold as roasters the following spring and early summer, when such stock is scarce and high priced in the Boston market.

This is a good illustration of special poultry farming by men who have sufficient enterprise to do things *differently* from the habitual way, when it proves profitable.

Farms devoted exclusively to egg production for market are not lacking, although their number is exceeded by farms on which the raising of broiler and roaster chickens is added to the egg production.

Boston furnishes the best market for fine quality of eggs and market fowl in the United States.

Some farmers who are naturally good salesmen find it advantageous to run retail routes, supplying fresh eggs and dressed chickens weekly to families, which pay good cash prices.

Another line of poultry culture which has been successfully specialized is that of duck raising. Examples of this branch of the business are seen in the large duck farms of James Rankin and of Weber Brothers of Massachusetts.

Another branch of water fowl culture practised with success and profit in New England is geese growing. On numerous farms of eastern Rhode Island and on some farms of south-eastern Massachusetts geese are raised by the farmers and sold to collectors in summer. The birds are prepared for market at large fattening stations, and sold as "green geese" in the great city markets. Massachusetts farmers in several localities might take up the raising of water fowl according to this simple plan with surety of adding to the present income of their farms.

The breeding of pigeons for the purpose of furnishing market squabs is a line of work which combines much pleasure with profit, and may well engage the attention of many a farmer or farmer's boy.

A progressive branch of poultry keeping which is becoming increasingly popular and profitable is the raising of breeding stock of one of the leading popular pure breeds of fowl, for selling to farmers and fanciers.

The fine products of exclusive White Wyandotte farms, Barred, Buff and White Plymouth Rock farms, Rhode Island Red farms, and Light Brahma farms, are more and more frequently advertised. "Farm-raised stock" is increasingly demanded.

The free range, wholesome food and fresh water of the farm enable fowls to develop in full degree the health and vigor which are considered desirable by the poultryman who must confine his fowls within the limits of close houses and yards.

Here is indeed a profitable field for the intelligent farmer who is a lover of fine fowls, and will take the pains to learn thoroughly and practically the principles of breeding which must be followed in developing the best birds of pure breeds.

Instruction.

How shall the farmer learn the poultry business? The best starter for any business life is faithful study in the Massachusetts common school, — the best of its kind in the world. If the poultryman has the advantages of higher education, they should prove helpful. The further training of many a poultryman has been gained by a life course under the direct tutelage of that dear but not always beloved teacher, — experience. Some poultry farmers are sufficiently wise to utilize as fully as possible the results of the experience of others. For those who find it possible to be away from home for a few weeks, there are open the advantages of one of the short courses in poultry culture now offered by several of the State agricultural colleges of New England.

Others who cannot for various reasons leave home may at least gain much valuable instruction by taking a correspondence course in one of the several schools offering special courses in poultry culture. This plan of home study under the guidance of experts in connection with continual interested practice on the farm is proving an effective means for thoroughly preparing the poultryman in his business.

The poultry books and periodicals are another source of information, which if wisely sifted and salted will help to make the industry of the poultryman progressive and profitable.

Investigation.

In order that poultry culture may be placed upon a firmer foundation of knowledge, further investigation and experimentation are necessary.

In the matter of incubation alone there is need of intense examination of the fundamental conditions. To-day the poultry business is based on average hatches of 50 per cent of the eggs incubated, and the raising of an average of 50 per cent of the chickens hatched to market size or maturity.

In the matter of breeding there is necessary a series of experiments, which shall demonstrate the actual application of the principles involved to the satisfaction of the practical poultryman, and enable him to manage his breeding birds according to established facts, instead of being governed by somebody's "say so."

In the feeding of poultry almost no research has been attempted, and no one knows to-day the degree of digestibility of even the common foods used for fowls. Further, there are required extended and exhaustive experiments to determine the practicability of raising and feeding to fowls such crops as Canada peas, soja beans, hemp seed, flaxseed, sunflower seed and other crops containing abundant protein (flesh-forming) nutrients, which may perhaps economically replace the nutrients of similar kind now supplied by the more expensive animal foods, such as beef scraps, meat meal, green bone, etc.

The special fattening or finishing of chickens for market by forced feeding has proved a decidedly profitable practice in England, France, Belgium and Austria. The Canadian government has taken up this matter in connection with the preparation of poultry products for export to the English markets. In the United States the process bids fair to be adopted and largely practised before even the agricultural experiment stations awaken to the desirability of investigating and experimenting in this line under American conditions.

The American hen appears to have been esteemed of too little importance by our State experiment stations to be considered worthy of study. A few intermittent attempts have been made to get at the facts bearing on some phases of poultry housing, feeding and management; but funds have been usually lacking, even when men qualified and interested were ready and eager to investigate to the foundation several important poultry problems.

Those who are pushing this great poultry industry need the knowledge, which they cannot search out for themselves because of lack of time, talent and funds for the same.

What is required is a government experiment station, amply equipped with men and means for searching out the unrevealed truths which, when they become known and understood, will be applied by practical poultrymen in a way to make poultry culture far more progressive and profitable than it is even in the hands of those most successful at the present day. Bacon said "To know well is to understand causes." When Massachusetts poultrymen come to know fully the causes which produce the results in breeding, incubation, brooding and in diseases of poultry, to-day unexplained and unexplainable, they will promptly demonstrate their ability to act on the knowledge gained, and furnish poultry products of the very highest nutritive qualities and in the most wholesome and palatable condition, at reasonable cost to the consumers and increased profit to the producers.

The CHAIR. The professor has given us a fine lecture, and no doubt will be willing to answer questions. The time is yours, and we hope you will improve it. If no one wishes to speak just now, I wish the lecturer would give us a short history of the Rhode Island Reds.

Professor BRIGHAM. They go back, I think, fifty years now to a sea captain in south-eastern Rhode Island, — a man who had retired from the sea, and who wanted to produce better chickens and better eggs than his neighbors; so he got a Malay rooster and a Cochin China hen, and crossed them together and got the results. I was anxious to see if it could be done in these modern times, so I got a Malay cockerel and Cochin China hen, and I got Rhode Island Reds. I visited the home of this sea captain after he was dead, and saw his daughter, and bought some of the birds which were in her yard, which had come down from about a half a century of breeding. The Rhode Island Red is not the result of breeding that bird by direct introduction, but has resulted from all sorts of introduction of blood. In Rhode Island one farmer takes Rhode Island Reds and thinks he can improve them by introducing Light Brahmas; and another thinks he would like to have a Malay; and another a Brown Leghorn. They have the blood of about all the breeds in the world, and ought to be good. Lately, within five or six years, attempts have been made to breed them according to standards. There have been three standards, and they have been mixed up; but there has been lately more uniformity, so that the Reds now are brought to one color and size standard, and are really fine birds, not only in egg and flesh production, but also in plumage. For some years they were produced only for eggs and meat, and they brought a fine price in New Bedford and Boston markets. They had fine breasts and shanks that were toothsome, and were much in demand in those markets as dressed fowls. Now we have brought the plumage to a uniformity in the best flocks, and we have a breed that is worthy of the name.

Mr. W. H. Glazier. How can an ordinary farmer best know what the best-balanced rations are for poultry raising?

Professor Brigham. In the first place, there is Farmers' Bulletin No. 22, written by Dr. Allen, a very careful and practical man, which you can obtain from the Secretary of Agriculture at Washington. In the second place, bear in mind those things I spoke of. Grit you need not reckon in the ratio, but you must have grain and animal and green food. The principal question then comes, How shall I balance the ration? To do this we must know about protein, or muscle-making food: about fat-producing food, which heats the body of the fowl, and is stored up as fat; and we must know about carbohydrates, which is a long word for starch and sugar.

If you will bear in mind that your food, instead of corn, beef scraps, etc., so far as you have to do with it, is protein, carbohydrates and fat, then for a laying hen weighing from three to five pounds you will need to get one part of protein to four or five parts of carbohydrates or fats. You can figure out the balanced rations for laying hens from corn and beef scraps, and get the right amount of protein; and then, after you have figured it out, put it before the hens, and ask them if it is all right. If it is not all right, you might say that the State Board of Agriculture must stand aside until you have settled the matter with the hen, and she will tell you whether it is right or not, in giving the eggs. If you find it wrong, you can add a little more of this or that, until you have it balanced according to the hen's science.

Mr. Glazier. Certain parties advertise balanced foods for sale, but I think such foods are rather expensive. They get something for balancing, and what I think the farmers would like to know is about what you have outlined, — how to balance grains and green food. Now, I would like to ask the lecturer whether the narrow or the wide ration is the better for egg-producing food.

Professor Brigham. Narrow ration, to be sure; but you want to bear in mind, if you have a large amount of corn on hand, and beef scraps and meat are high and you cannot afford to buy them, that you can feed the whole corn and scraps from the table, and get sufficient animal food; but if you have not enough you can use the ration of corn and table scraps, and still have it more economical than to waste your money on excessively high-priced protein food.

Mr. Glazier. We can sometimes buy animal meal, but not scraps. Is animal meal as good?

Professor Brigham. That depends on who makes it, and what it is made from. I think you will find that the principle holds good, that when you are buying grain, if you can get it in coarse form and have the means of grinding, it is much the better. You take analyses and experiments regarding whole corn and cracked corn, and you will see where the chance of adulteration comes in. Take whole oats and compare with ground oats having hulls in them, and you will find there is a large amount of fibre, because they use light oats to grind up, and that means a large amount of husks to a little kernel; and again, in cracked corn they use damaged corn, and after it is ground up you cannot tell as well. The chances are that cracked corn will be of poorer quality than whole corn. Cotton seed ground fine into cotton-seed meal may be palmed off on the farmer for several times its actual value. There are those who usually put up good animal meal, but they are apt to put in everything in the slaughter house that cannot be used for any other purpose than making animal meal, and it is more or less so with beef scraps. The department of foods and feeding at our experiment station is designed to prevent this adulteration, so far as may be possible; and if you are in doubt as to the quality of your purchased feeds, send samples to the experiment station for examination.

Mr. ROBERT T. BOURN (of Templeton). I fed Midland Poultry Feed Nos. 1, 2, 3 and 4, and followed instructions as carefully as possible. I never met such disastrous results with chicks before. They did not grow, did not feather at all well, were the guy of the section in that respect; did not lay until two and one-half months later than ever before, relatively; and, lastly, out of 75 that I had put into small pens for ten to fourteen days' fattening period, not one came out fit to kill, and I could not sell them. They would not eat well, but would leave it, and dig and eat potatoes from a neighbor's field. I never took such nice care of them, and never had such poor results. I lost very heavily by my experiment.

QUESTION. You spoke of raising one special breed. Could you give the names of three or four breeds that would be safe, or either one of which would be safe, for a farmer to start with?

Professor BRIGHAM. I would not hesitate to start with White Plymouth Rocks, White Wyandottes, Rhode Island Reds, or, if you have a market for white eggs, White Leghorns. These have been the breeds farmers have mostly started with, but you can test three or four breeds, and see which fits your conditions best.

In the matter of feeds there is a lesson for us which is worth listening to. I do approve, where farmers have the land, of raising grains for most of the poultry, and I would go farther, and raise them for stock. I think the time is coming when we can raise the grains cheaper than we can buy them, and it does take ready money to pay grain bills.

QUESTION. How about sea or oyster shells during the winter time for laying hens?

Professor BRIGHAM. Both are all right, for they contain carbonate of lime, which the hens can use in making shell. They may also obtain the lime from cast-off egg shells.

QUESTION. How long must we wait for a thoroughly serviceable incubator, if we wait for the study of the growing embryo?

Professor Brigham. About a hundred years.

Mr. Thayer. A few years ago I had some Plymouth Rocks, and by picking out the handsomest rooster in my yard, which was a dark-colored one, in three years' time I ran my fowl into all black. How are we going to breed to keep the flock good?

Professor Brigham. Simply by not picking out the dark ones. A black one is simply what we call reverted, gone back to the old black type from which the Plymouth Rock originated, and you have to look out. That is where the brains come in. You can breed Plymouth Rocks without going outside your flock. You have to breed even lighter, perhaps, than you wish. That is where experience comes in, and you gain the means of mating. In mating you do not always get a third bird like those two, except in a parti-colored bird like the Plymouth Rock. It is done by selection, and using lighter colored fowl than you expect to have in the progeny.

Mr. Thayer. In that way, if you want to increase the size, you would pick out the largest to breed from?

Professor Brigham. Certainly; if you want to get deeper breasts, pick out those with deep breasts and plump shanks; if you want larger shanks, pick them out in the parent. I want you, however, to keep this in mind, — that a bird may have a deep breast and not be able to transmit it, while another bird may transmit that quality strongly. The latter bird is prepotent, we say. It is one thing to possess a quality: it is another thing to be able to transmit that quality to your progeny.

Question. Would you advocate keeping the old cock for the young pullets for the next season?

Professor Brigham. That is just the thing to do; that is line breeding. Breed pullets to sire, and breed cockerel to mother, and in that way you can keep two lines going.

Question. What do you say about the single mating question?

Professor Brigham. That is a good deep question. I say single mating, and there is only one excuse for double mating. In double mating, a pair of birds are mated to produce exhibition cockerels. You have to have in double mating one mating to produce standard pullets, and another to produce standard cockerels. Now, that is all caused by the fact that man establishes a standard which is different from the standard of nature. We can get as good birds by breeding by the natural plan of single mating as we can by breeding according to double mating.

Mr. H. A. Turner (of Norwell). I come from the south shore, which is noted as a good poultry section, but we do not know it all yet. It seems to me that there are a good many discouraged parties in our vicinity now, and, although some are successful, others are not. I was talking recently with one of my neighbors, who had been successful in raising a good many thousand chickens in a few years, and he makes that a specialty. He tries in every way to find out the best method of raising chickens, and he told me he had three lots of chickens, recently hatched, that were dying off like everything, and he didn't know but that they would all die. Some succeed, and others fail and go out of the business. I suppose that if all who go into poultry keeping were successful, there would be very little profit in the business. I wish to ask the lecturer if he thinks that the per cent of incubator chickens is on the increase? Is life long enough to find out how to raise chickens?

Professor Brigham. I think the per cent of incubator chickens is on the increase, but we are a long way away yet. As to whether life is long enough to learn these things and apply them, I think it is not. That is why I advocate the experiment station. One thing is certain, we have not learned it all yet.

One thing you have not brought out, and that is, that in the first year one may be successful, while in the fourth year success may be slight, if any. You will find that this usually comes from keeping the chickens in the same quarters without freshening the quarters. The south shore people have learned this fact, and at times have nothing in their pens but fresh sand and plenty of ventilation. Another thing beginners learn by sad experience, and that is, that they cannot breed lice and be successful in poultry keeping.

The poultry keeper will find that spraying the quarters once a month with a one per cent solution of carbolic acid, to destroy the lice and disease germs, will make a vast difference with the measure of his success.

QUESTION. Is one per cent of carbolic acid sufficient to spray for lice?

Professor BRIGHAM. Yes, I think it is. If you are not satisfied, use three per cent; if that does not meet with success, use five per cent.

QUESTION. How does that compare with kerosene?

Professor BRIGHAM. Kerosene kills them. The louse breathes through its pores. If you can get these substances into contact with the lice, their breathing will be stopped. I suppose that carbolic acid is the best disinfectant and deodorizer for killing germs that we have. I would use the carbolic acid once a month the year round, if possible.

QUESTION. Have you had any experience with carbolinoleum?

Professor BRIGHAM. Yes, I think it is good; all tar products are good. I do not think, however, it is wise to pay a large price for it, when the real thing that kills is carbolic acid. It is all right sometimes to buy these things and use them. In using carbolic acid, you can put one part with ninety-nine parts of water and apply it with a broom or cloth, being careful to keep it from your eyes and clothes. You want to apply it in such a manner that it will come in contact with the lice and mites.

QUESTION. Would you recommend using air-slaked lime?

Professor BRIGHAM. I would not use it, because it would get in the throats of the fowls, and bring on bronchitis and other troubles. If you are going to use it, it better be as whitewash.

QUESTION. I think the lecturer failed to recommend decidedly the Brown Leghorns. Why do they not compare well with the White Leghorns and the other breeds you spoke of?

Professor BRIGHAM. They are all right; I have had them. If you are going to put them on the market as dressed fowls, the white pin-feathers will show less than the dark ones. It is not so much the matter of breeds, as of family and strain in the breeding. There is more difference among the Plymouth Rocks than there is between the Plymouth Rocks and the Wyandottes. When you buy fancy fowls, don't think you are getting anything superb. They are bred for the purpose they are used for, and you have to look out to see that the fellow selling them to you is an honest man.

The CHAIR. The last is quite important.

QUESTION. Is it a common thing, or is there any one here who has known of an egg being developed inside another, — a perfectly developed egg? I have seen two this year.

Professor BRIGHAM. Yes, it is possible. Not only may you get an egg inside an egg, but you get other things. You will have noticed a clot, a black spot in the egg, and other things which may be worse. Disease germs may be enclosed in the white of the egg. That arises from the fact that these germs are in the digestive tract of the fowl, and may move up into the tube called the egg tube, where the egg receives the white, or albumen. If a cholera germ got in this part and was enclosed in the white, it might still live, enclosed in the shell, and be carried outside. All this emphasizes the fact that poultrymen should be very careful to have all the quarters where the fowls are kept cleanly, because these germs of disease flourish where there is filth. Where you have filthy yards and filthy houses, and especially where food is thrown on filthy grounds, you have these germs, and they may get into the digestive tract and from there be carried into the oviduct and into the egg.

Dr. JAMES OLIVER (of Athol). I would like to add something to what the lecturer has said. It is a well-known fact, and I have noticed it a good many times, that people will keep hens and allow them to drink the water which comes from sink spouts. I have thought that diphtheria comes mostly from sink spout water, which gets into the well and into the system in some way. I do not think the public has been sufficiently notified of the fact that it is very dangerous to let hens drink sink spout water.

Mr. L. E. STEWART (of Royalston). One question in regard to Rhode Island Reds. What should the plumage of this breed be? Should it be bright red, or a yellowish red, and also what should be the plumage of the female bird?

Professor BRIGHAM. That depends on whether you are breeding for a standard that is set by the Rhode Island Red Club or a standard of your own. It should be bright, nearly uniform red throughout, and there is very little difference between the male and female, the latter being of a little lighter shade of plumage.

Mr. GLAZIER. What is the best method of killing fowls for the market, where they are to be left with their heads on and undrawn, as the Boston market calls for?

Professor BRIGHAM. I think there is no doubt about using the double-edged knife, and cutting at the back part of the roof of the mouth.

Mr. GLAZIER. There is a point where you can remove the feathers very easily. After you let that fowl get through bleeding and fluttering, the feathers will stick, will they not?

Professor BRIGHAM. The proper time to begin to pull the feathers is just as soon as you get through with the knife. Get them off before the bird is through struggling. It is not cruelty to the fowls at all. After you have thrust the knife into the brain, they do not care about such a small matter as pulling feathers.

The CHAIR. The time we proposed to adjourn has nearly arrived, but before you leave I want to give the information that the lecture to-morrow on the horse will be given at the Opera House, because the stereopticon can be used better there

Adjourned at 12.30 o'clock.

AFTERNOON SESSION.

The meeting was called to order by First Vice-President Sessions, at 2 o'clock.

The CHAIR. We have for this afternoon the subject of "A forest policy for Massachusetts," and the gentleman who is to speak to us is a man who has given his life to the study of forest problems. It is a profession with him, a life's work, a study, — not a fad, nothing of that sort. He has given all his life work to it, and is able to speak from stand-points that very few people in this part of the world can speak from. I take pleasure in introducing to you Dr. B. E. Fernow.

A FOREST POLICY FOR MASSACHUSETTS.

BY B. E. FERNOW, LL.D., ITHACA, N. Y.

Simple truths rule the world, and if we would only find them out and appreciate them in time, and act accordingly, there would be less friction, and the world would be better ordered. "Times change, and we change with them;" but we are always more or less behind with our changes, and must pay the penalty of our tardiness. And if we are individually slow in recognizing truths and in changing our habits and modes of life, the aggregates of individuals, the community, the public and the republic, are still slower to understand, to move, to change.

These commonplace observations on the manner of progress in the world force themselves with a sad foreboding upon him who contemplates or interests himself in the progress of the forestry movement in the United States. To bring about a better, more rational use of our forest resources is the object of this movement, and the truths upon which it is based have been recognized and preached by the thoughtful these hundred years, but the many have hardly yet a conception of what the movement means.

It was your own Massachusetts Society for Promoting Agriculture which offered prizes for the encouragement of forest culture as early as 1804, and similar interest in the question was shown even earlier by the sister society in New York, the Society for Promoting Agriculture, Arts and Manufacture, publishing in 1795 a report "On the best mode of preserving and increasing growth of timber."

The wise governor of your neighbor State, New York, De Witt Clinton, of Erie Canal fame, in a message in 1822, foreboded an evil day from lack of attention, because no "system of economy" for the production of forest supplies was adopted; and he said, "Probably none will be, until severe privations are experienced." Many other speakers and writers in the first decades of last century propagated the idea of a threatened exhaustion of native timber supplies.

That these earlier propagandists of forest culture received scant attention was due to the fact that times soon changed and conditions changed; and with these changes the evil day seemed indefinitely postponed, the necessity for forest culture vanished. These changes were mainly wrought by the opening up of the far west, by extending means of transportation through canals and railroads, and by distributing population, whereby the need for near-by home supplies was overcome; a continental supply of apparently inexhaustible amount was brought into sight and within reach.

Only when, after the war of the rebellion, with the rapid increase in railroad building and in industrial activity, the lumber industry developed into its enormous volume, did the old fear revive. Times had changed again: we find that forest resources are limited, relatively much more so than was anticipated; nevertheless, consumption has grown without reference to this recognized fact.

Such a development of industries, such an increase of material civilization, making everybody more comfortable and also more exacting and ambitious, has taken place in the last thirty years, that actually we are using each of us 35 per cent more lumber to-day than we did twenty years ago, the lumber consumption per capita having risen at the rate of 1½ per cent per annum.

When we see that the other industrial nations, which, like Germany and France, import a large part, and England importing practically all her requirements, show this same increase in wood consumption, are we not justified in being alarmed? Have not times changed so that we also should change — and that radically — in our attitude towards the subject of rational forest use? Has not the evil day arrived which Governor Clinton foresaw, and which another, the Rev. Frederic Starr, in 1865 in an article printed by the United States Department of Agriculture, with almost truly prophetic vision placed near this time? His wise words bear quoting: "It is feared it will be long, perhaps a full century, before the results at which we ought to aim as a nation will be realized by our whole country, to wit, that we should raise an adequate supply of wood and timber for all our wants. The evils which are anticipated will probably increase upon us for twenty years to come with tenfold the rapidity with which restoring or ameliorating measures shall be adopted. The nation has had plenty and to spare; but within thirty years she will be conscious that not only individual want is present, but that it comes to each from permanent national famine of wood."

Within a decade of the appointed time this prediction will be almost literally true.

Let me, at the risk of being charged with wandering from my subject, — which is only apparently a true charge, — adduce some persuasive indications that the day of evil is close upon us; that, therefore, we may now stop arguing and talking, and, like wise men, begin doing.

Study the change of prices in wood; they are sure signs of the conditions of supply and demand. It is perhaps not possible to draw valid conclusions from one statistical item, but if we find that the price of white pine uppers during the thirty years from 1870 to 1900 advanced 50 per cent, and in the three years following advanced 56 per cent, we do not need fine discrimination in order to realize that the end of this class of supply is near. Similarly, all other woods have during the last fifteen years appreciated between 50 and 100 per cent; but there is hardly any lumber of any kind that has not during the last year advanced in price by at least 10 to 15 per cent, excepting culls and other inferior material. The Massachusetts farmer who has only firewood and box boards to sell has probably not benefited much from this change in price, for when the cream has been taken, everybody has skim milk to sell; in other words, the supply of firewood and inferior materials is and will remain for a long time overstocked in many regions, as a consequence of the loss of the saw timber, and through the new growth of inferior quality on mismanaged or unmanaged woodlots and slashings.

The history of stumpage prices is even more telling than that of lumber prices, since in these latter other modifying elements besides the supply of raw material are to be discounted. Unfortunately, this history is more private, and only occasionally accessible. But the fact that the Ontario government during this year has doubled the dues on all timber cut to $2 per thousand, and, in addition, has raised the ground rent on timber limits from $2 to $5 per square mile, certainly shows the sudden recognition of the changed conditions. The reported sale of timber limits at prices double what they brought five years ago and treble what they were valued ten years ago, accentuates this realization;* while in the United States many cases can be cited where the stumpage price paid for desirable timber lands has doubled and trebled within a few months.

The truth is dawning upon the lumbermen that there is actually not enough timber in sight to supply the ever-growing demand for the next thirty years.

Has the evil day come? Has the time for active initiative in forest culture arrived? Nay, it has passed without our knowing it, for all our recuperative measures are now too late to prevent the inconveniences which come with a shortage of timber supplies.

Does this concern Massachusetts? If this question of supplies does not concern the State as such, its citizens separately must necessarily share in the calamity; and, as a member of the Union, the Commonwealth itself must take cognizance of it, and make statesmanlike provision against it.

Another interest, which lies nearer home, comes to light, if we investigate the statistics of the occupancy of the soil, its ownership and the forest conditions of Massachusetts.

Unfortunately, census enumerators still fail to gather information in such a manner that it becomes available for the use of discussing all questions that may arise. The Massachusetts Bureau of Statistics was in this respect an improvement on other census bureaus. The State census and the

* At the last sale of timber limits (December 9), in spite of the increased dues and rent, the bonus paid per acre averaged over $7.

federal census, moreover, show great variations, owing no doubt to differences in classification mainly. We can, however, upon the basis of the State census of 1885 and 1895 and of the federal census of 1880, 1890 and 1900, make some pertinent broad deductions as to probable conditions at present.

Hardly two-fifths of the acreage of the State has been found fit for farming, — fields and pasture, — if we assume that the area at present in farmers' hands represents fairly the farming possibilities of the State. The other three-fifths are woodland, or waste land, namely, about 3,000,000 acres.*

It is interesting to note what changes seem to have taken place in employment of the soil and in ownership. In 1885 the farmers were still credited by the State Bureau of Statistics with round 1,389,000 acres of woodland in a total farm area of 3,900,000 acres, which left the area outside of farms 1,420,000 acres. It would appear that the then reported area of permanent pastures was in 1895 reduced to a round 1,120,000 acres, and the field area to 903,000 acres, — a reduction of land used for farm purposes of over 175,000

* The statistics in point may be stated as follows: The total area of the State is 5,321,600 acres. The cultivated land, according to different authorities, is between 900,000 and 1,300,000 acres. Permanent pastures are reported in 1895 as 1,119,000 acres, leaving for woodland, brush and waste (without making allowance for city or town sites) round 3,000,000 acres, or nearly three-fifths of the State. The figures given for 1875, 1885 and 1895 by the State Bureau of Statistics, and for 1880, 1890 and 1900 by the federal census, placed side by side, are as follows: —

[Amounts are in thousand acres.]

<table>
<tr><th></th><th>1875.</th><th>1880.</th><th>1885.</th><th>1890.</th><th>1895.</th><th>1900.</th></tr>
<tr><td>Total farm area,</td><td>3,402</td><td>3,360</td><td>3,898</td><td>3,000</td><td>3,848</td><td>3,150</td></tr>
<tr><td>Cultivated (improved),</td><td>913a</td><td rowspan="2">2,130</td><td>939</td><td rowspan="2">1,660</td><td>903</td><td rowspan="2">1,290</td></tr>
<tr><td>Permanent pasture,</td><td>1,425b</td><td>1,260</td><td>1,119</td></tr>
<tr><td>Other unimproved and waste,</td><td>89</td><td rowspan="2">1,230</td><td>310</td><td rowspan="2">1,340</td><td>200</td><td rowspan="2">1,850</td></tr>
<tr><td>Woodland,</td><td>930c</td><td>1,389</td><td>1,461d</td></tr>
<tr><td>(Planted),</td><td>–</td><td>–</td><td>(5 9)</td><td>–</td><td>(10.23)</td><td>–</td></tr>
<tr><td>Unclassified (mostly non-resident woodland),</td><td>–</td><td>–</td><td>–</td><td>–</td><td>164</td><td>–</td></tr>
<tr><td>Land outside of farms (woodland and waste),</td><td>1,920</td><td>1,962</td><td>1,424</td><td>2,322</td><td>1,474</td><td>2,172</td></tr>
</table>

a Includes city lots, 37.8.
b Unimproved not specified.
c Includes city woodlands, 23.8.
d Over 300,000 acres owned in lots unattached to farms.

acres. This reduction has, of course, come either by return to wood or waste, or by sale for suburban homes, etc. If we take the federal census figures, the change in total farm area and in cultivated area appears even greater. And if we compare the figures of 1885 and 1900, the area outside of farm holdings in 1900 seems to have increased by more than 50 per cent over the figure in 1885, namely, to 2,172,000 acres, undoubtedly mainly through sales by farmers of timber lands, possibly for suburban sites and summer homes, and by abandonment of farms, although the total number of farms has rather increased.

Altogether these statistics are rather unsatisfactory for any conclusive deductions; yet we are probably justified in coming to the conclusion that, after making ample allowance for changes in use and for absolute waste lands, which must always remain unproductive, and also for land which may still be turned to farm use, there are in the State not less than 2,500,000 acres which can be devoted only to timber growing.

What does this Massachusetts forest acreage produce? We do not know. From the census figures we can hardly find out what we cut from it, let alone the question of how much the cut exceeds the growth. Although it is currently supposed that timber for saw-mill purposes is well-nigh exhausted in Massachusetts, the lumber product is still reported by the saw-mills as over $5,000,000 in value, — a considerable increase over former decades. Undoubtedly much or most of the 500,000,000 feet of lumber sawed is derived from logs cut in neighboring States, but the census taker fails to enlighten us as to the facts except with his opinion. The only certainty of home supply is found in the 10,000,000 feet produced in the independent lumber camps of the State and the 70,000,000 feet of custom sawing. From what evidence exists, we come to the conclusion that timber for saw purposes in the State is of a negligible quantity; the land is mostly coppice, sprout land or stump land, producing mainly fuel wood, with some railroad ties, telegraph poles, fence material and pail stock or box boards.

In 1880 the federal census reports still a home cut of about 200,000,000 feet of logs, valued at $1,828,000, and

890,000 cords of fuel wood, valued at over $4,600,000, the valuation per cord being over $5.

From the State census in 1885 we learn that there were cut on farms, besides 75,000,000 feet of log material, valued at a little less than $10.50, over 400,000 railroad ties, valued at about 38 cents, and nearly 600,000 cords of cordwood, valued at a little less than $3.20 per cord. The total cut was valued at $2,573,000. In 1895 the census taker fails to publish the itemized wood product; only the total value is stated, namely, less than half the value of 1880, with $2,780,000, from which we may judge that practically the same amounts of wood were cut as in 1885.

In 1900 the value of forest products cut on farms had sunk to $1,945,000, — a decrease to only 30 per cent of the value of 1880. There are no data at hand which permit a sure interpretation of these changes, but we are safe in deducing from these figures, in connection with other information, that a continuous deterioration of land and forest conditions is taking place. One-half the State is rapidly sliding down in economic taxable value. One-half of the State has either become or is rapidly becoming waste or inferior brush lands, when it should be a continuous value producer.

There are, we will admit, here and there well-kept wood-lots and attempts at reforestation, of which it is pleasant to make note and to make much of; but I venture to assert that not 10 per cent of this natural woodland area of the State receives any attention, with a view of improving the quality or increasing the quantity of its production.*

What does this deterioration mean to the State at large? First, the material wealth of the State and its taxable property is reduced by as much as remains unproductive of these wild lands, or less productive than it could be. With a population approaching in density the most populated districts of civilized nations, being more densely populated than England, the pioneering days are or should be over for Massachusetts, and the time has arrived for a stable policy with reference to the use of soils, as well as in other direc-

* The census of 1895 finds 10,230 acres of artificially planted or sown forest, as against 5,900 acres in 1885.

tions. It is now possible to know and designate the lands which can profitably be occupied only by forest growth; and it is now time to make every foot of land as productive as it is capable of being made, — to make the State fully civilized in all its outlying districts and corners.

Next, there are indirect influences, which a large, neglected, deteriorating area exercises. I am not much of a believer in the importance of the influence of forest growth on climate in a forest country, although unquestionably such influence locally and in a limited degree exists. Moreover, almost any kind of forest growth, such as nature will establish in spite of man, unless kept off by fire, will satisfy the requirement of the climatic factor. Even the beneficial influence of water flow, which is unquestionable, will be secured by the natural reforestation, if not prevented by fire, and soil washes following the fires.

There will be, no doubt, more or less limited areas, which have been so abused as to baffle unaided nature in her attempts at reclothing them, yet these will be comparatively small. But there is a moral influence which is at least as important to the citizenship of the Commonwealth. Neglect breeds neglect, carelessness induces indifference; thriftlessness in our neighbor may sometimes stimulate by bad example to increased activity and thrift on our part, but when a whole community is slovenly, the character of the best is endangered by contagion.

We have ample examples of this baneful effect of poor surroundings on the morals and character of people. And, if as yet the Massachusetts farmer has nowhere deteriorated to the condition of what is known in the south as the "poor white trash," there is a danger lurking in these neglected woodland areas that might in time create such a class of undesirable, if harmless, citizens.

On moral, if not material grounds, then, the existence of large neglected areas is a matter in which the State or the community must take an active interest, which it must attempt to eradicate.

The question may arise, whether the State at large or the towns should take care of this matter, or how far private interest could be relied upon to do so. So far as self-interest goes in the same direction as communal interest, so far self-rule should be relied upon; so far as the interest of the town is clearly visible, so far the town should be left to manage its own affairs; but there are matters and interests which are not easily discernible; there are matters in which the interest of the individual diverges from those of the community, or the apparent interests of the smaller aggregation, the town, diverges from those of the Commonwealth; or else there are matters and interests so large that the individual or the smaller community cannot afford to take care of them, when it becomes the duty of the larger aggregation, the State, to step in.

The foremost reason for the divergence of interest lies in the time element which circumscribes these interests. The individual lives but a short span of time, hence wants to secure for himself satisfaction for that short time; he is necessarily selfish and ready to neglect the interests of his neighbor, and still more the interests of the future citizen.

The town is longer lived, and must be presumed to have a regard for a longer future; yet even here we will find a tendency to live in the present, and also, if there are divergent interests between two widely separated or even adjoining towns, local interest will naturally carry the day.

The broader interests of the State at large, the differences of present interests, and especially the interests of the future, can be efficiently cared for only by the State at large.

Now, forestry interests are peculiarly of the type which, according as they are viewed from individual, town or State aspects, diverge. The individual lives first of all for gain, hence the forest must give up its stores to fill his pockets; and, since it takes not less than twenty years to secure another, inferior, and not less than sixty to eighty years to grow another lumber crop, his interest in the culled or cut forest is like that in a squeezed lemon, — naturally small.

Do not let yourself be persuaded that financially forestry is anything but curtailing present revenue or making present expenditure for the sake of a future revenue, and hence only he who has a future in view can find forest planting or even forest care profitable business; it pays only in the long run. Especially is this the case with new plantations, while in the virgin, or even in a culled but full-grown timber forest, with present prices and their tendency to rapid increase, it would be possible to figure more readily immediately profitable forest management. So, then, the individual bent only on gain cares little whether the management and neglect of his property injures his neighbor or the future by curtailment either of wood supplies or of water flow, or by soil washes and deterioration.

The town certainly has, or should have, much more interest in its surroundings, for the present as well as the future; yet, if expenditures are to be made by the present for a future contingency, it will probably move slowly and think twice. If a town situated in the lower reaches of a river should suffer from uneven water stages, this will probably not affect the policy of the town at the headwaters.

Here lies, moreover, another most important aspect of the financial question in caring for slow-earning forest property. In a State like Massachusetts the bulk of the permanent forest area is naturally confined to the mountainous sections, hence to the poorer parts. After the original valuable timber is removed, such towns become necessarily less able financially to make any expenditures which are not demanded by present necessity.

With great wisdom did your Legislature recognize this time element by enacting a law which permits towns not only to take or purchase a public domain devoted to forest purposes, but to go into debt for such lands, creating a "public domain fund," to be wiped out by sinking fund arrangements. In this way the law accentuates the interests of the future and the benefits from forest management accruing to it rather than to the present. I should like to know how many, if any, towns have taken advantage of this act in securing forest, — *not* park areas. As far as my information goes, none.

Finally, however, the State's interest cannot be satisfied with merely permitting its small town aggregates to help themselves, but it must more actively assist in establishing a forest policy which will prevent further deterioration of half its territory, and which in doing this will take care of the interests of all future generations of citizens, treating the interests of the whole, present and future, State as a unit. In other words, while some things in forestry matters may be left to private enterprise, others to the civic conscience of the towns, the State has still particular obligations, and now the urgent need of developing a rational forest policy.

What form shall the interest of the State in this large woodland area take? This question has been often discussed before your Board for the last fifty years, and some beneficent legislation has been had; but now is the time to become still more definite, and to do or get done the things still left undone, which have been proposed by those who have addressed you before, among them my good friend, the chairman of your committee on forestry and roads.

A State Forester.

Thirteen years ago, in 1890, when your Board had been ordered by the House of Representatives to "inquire into the conditions of the forests of the State, and to report on needs and methods of their protection and improvement," I had the honor to be represented before you by a brief letter in answer to an inquiry by the chairman of that committee. In this letter I pointed out that some desirable things could perhaps at that time not yet be done, being apparently premature; but I urged as a beginning the appointment of a competent paid man, a State forester, in whose hands the forestry interests of the State should be placed as his sole duty, who, perhaps under your direction, would ascertain the conditions of the forest area of the State, and upon the basis of such a detailed examination could advise you as to the needs and methods of their protection and improvement, and at the same time carry on an educational campaign among farmers and timber land owners, giving them advice as to how they might manage their woodlands to better advantage. One of the first duties of the State forester should be to make a forest survey of the State, for not until you know what you have to deal with can you prescribe its management. Such a man, technically educated, becoming familiar with all the details of conditions and with the people directly concerned and the circumstances surrounding their problems, would soon become wise enough to suggest the details for the formulation and execution of a broad, statesmanlike policy for the State. This suggestion, which General Appleton, as chairman of your forestry committee, embodied in his report, together with other valuable suggestions of his own, is as pertinent to-day as it was then.

Whatever else may be proposed in the way of legislation, — and there is already much that is excellent in your statutes, — providing a competent executive officer who looks after the enforcement and proper application of the law is the most necessary condition of the success of such legislation. The interests are large enough for the State to be able to employ such a man, and the very best man who can be found.

I see that your Board of Agriculture, under act of 1882, acts also as a Board of Forestry, without pay; and as such is to look after forest fires, promotion of forest growth, and "shall have the supervision and management" of the public forest domains, which the towns might acquire. Without reflecting upon the well-known devotion and capacity of the single members of your honorable Board, I submit that the competency of boards in general for executive work may be questioned; that, with the multifarious duties in addition to the private affairs of the members of such a board, only the development of general policy upon the basis of expert advice can be expected of them; but without executive officers specially charged with the execution of these policies their inauguration will always be slow and lame.

Here a discussion as to the propriety of reliance on self-rule would be pertinent. Allow me only to point out that human nature is everywhere the same, and that a policeman or at least a friendly advisor or admonisher is often needful, even where self-interest might be expected to be sufficient.

I also note repeatedly in the reports of the chairman of your committee on forestry and roads a plaintive, although resigned, allusion to the absence of any funds to be applied in carrying out the duties with which your Board is charged. I confess it is somewhat astonishing to a New Yorker to learn that a Yankee Legislature expects something out of nothing, — a result without an expenditure. Do your Yankee business men act on such expectations?

Let me assure you that this forestry question is now in a condition when it must be taken out of the dilettante toying which it has so far mostly experienced; it is a pure, bald business proposition, which must be handled in a business way. Until the State recognizes this fact, and deals with the question seriously, all your efforts can only be lame and half effective.

There are four directions in which the State's interest in the forestry question can take shape: protection of forest property, fostering educational agencies, aid to citizens and corporations, and forest management on its own account. In all four directions your State has already done something, — made a beginning; hence it is only necessary to inquire where and why the results have not been satisfactory, and to suggest new lines of progress in the same direction.

Police Functions.

The first obligation which is recognized by everybody as the foremost duty of the State with reference to any property is its adequate protection. In this respect the question as to the efficiency of existing protection arises probably only with regard to fires. Your laws for the punishment of wanton or willful or careless injury committed on the forest property of another are, as far as I can see, ample. Unfortunately, it is in many if not most cases impossible to apprehend the culprit; moreover, forest property is not, like most other property, restorable except by time, and that in a long time, and it is also peculiarly hazardous as far as fire danger is concerned; it is in these respects different from other properties. Hence these extraordinary difficulties require special provision to prevent the occurrence and to check the progress of forest fires.

Your legislation recognizes this, and, following the lead of New York, like several other States, has introduced the fire warden system. Just because I formulated the first law of this kind for New York in 1885, I am fully aware of its shortcomings, and of the improvements needed, especially in its execution.

In the first place, it appears that this protection against forest fires is not obligatory, but optional with each town; at least, there is no certainty how far the obligation of the town goes. I do not know whether or not any town has refused to go into this fire warden system, but I fear, from some statements I have read, that the law is practically a dead letter. I submit that the State's interest demands, and in fact that each town's interest demands, that the obligation to protect forest property efficiently should be made mandatory. You might as well give up talking about this interesting subject of forestry, if you cannot secure this first duty of a civilized community. If the towns cannot be induced or forced to do their duty, then the State must do it for them.

In the second place, the towns are permitted to appropriate for this service only an amount not exceeding one-tenth of one per cent of their valuation. In other words, if a really serious conflagration threatens them, requiring an extraordinary effort, they are by law prevented from protecting themselves, except by individual effort. This limitation was probably put in to prevent extravagance, but it is evident that some provision in case of emergency is needed.

The New York law, and experience in regard to its defects, and the method in vogue in Ontario, suggest the following improvements. The State should co-operate with the towns in the expense of the fire service in an equitable proportion, and the service should be obligatory on all the towns. To make this co-operative service effective, a chief fire warden must be in charge of it, must have a voice in the appointment of fire wardens, or else may have fire wardens appointed by the State to co-operate with the town warden, and must audit the bills. New York, Maine, Wisconsin and Minnesota have tried this system. In New York the State pays half the expense of the service. One improvement on the method of payment over that existing in New York may be suggested, namely, that the State pay the entire bill, and recover the share of the town, it having been found that the long delay in having town bills settled makes fire fighting a still less desirable occupation than it is in itself. The town determines the rate of pay, which varies between $1 and $2 per day; but the amount to be expended on the whole depends on the exigencies of the season. To assist the poorer towns, the State could bear the heaviest share, establishing a fair division upon the basis of population or of taxable value. From the practice in Canada and the experience in New York we learn that, in addition to the regular organization, there is need, at least in specially dangerous seasons and dangerous localities, to have fire patrols continuously employed, to prevent fires, while the danger lasts. In Canada these patrols are appointed by the government, and paid one-half by the government, one-half by the timber limit holders, — a truly democratic efficient arrangement. In Massachusetts such patrols are probably indicated only in a few localities of scanty population, and with large contiguous forest areas.

The effectiveness of patrols is attested to by the superintendent of the New York Forest Commission. He states that: "During the dry season of 1899 there were 327 fires in the Adirondacks, but none of these occurred on the private preserves, although these preserves include one-third of our northern forests. Their exemption was due to the fact that their lands were constantly patrolled. The preserves employed 98 patrols in all; the State did not employ one."

It is far easier and in the end far cheaper to prevent forest fires than to put them out. I note a flaw in your legislation, dealing with the liability of railroads for setting forest fires; it is entirely based on the civil law of liability for damage to an owner, although I suppose the sections of the criminal law regarding wanton, reckless and careless incendiarism would apply if they were invoked. A requirement of some precautionary measures, as prescribed by the New York law, would certainly be appropriate.

But all such legislation, I repeat, is useless, nay, more, an evil, a moral danger, unless its execution is insured by the existence of a responsible officer. Many precautionary measures could be easily and cheaply introduced by an efficient man at the head of the entire service, besides a feeling of respect for the law, which he could inculcate, and which is really almost the main thing to attain. I must repeat: the first duty of the State is to make property secure; in countries where property is insecure, barbarism is supposed to prevail. By so much as we have failed to secure that protection, by so much we have failed to have attained the highest civilization, and must acknowledge our disgrace. With an efficient protection against fires, the whole forestry problem takes another aspect, the problem is half solved; for it is the fire danger which has to a large extent made the holding and caring for forest property in its immature stages undesirable, and it will continue to do so until this danger is removed.

Whether it would be wisdom to extend the police function of the State beyond this fire service is very doubtful. The experience of Europe has shown that restriction in the use of private property is not only cumbersome and obnoxious, but mostly fails in the expected results. It is far better policy, where a restricted exercise of property rights threatens to injure distant interests of the community at large, to prevent this by acquiring such property for the State or the community. There is only one restriction in using forest property that could be equitably imposed when the State has made efficient effort to control forest fires, namely, that the private owners do not recklessly create specially hazardous conditions for conflagration.

Educational Measures.

The educational function of the State has been thoroughly acknowledged by our democracy in our public school system and by your State in various other ways.

This State Board of Agriculture is, I take it, largely an educational institution; and the bounties which are annually paid to your agricultural and horticultural societies are an expression of the acknowledgment of this educational duty beyond the common school. I see that section 10 of chapter

124 of the Revised Laws makes it mandatory that every such society shall annually offer premiums and encouragement for the raising and preservation of oak and other forest trees adapted for an adequate supply of ship and other timber,— a most excellent provision. If it has not borne fruit, what is the reason? This is worth while investigating.

There is now a special society, the Massachusetts Forestry Association, which charges itself with the development of interest in forestry matters. I have not come before you to praise your institutions, but to help improve them by finding fault and by suggestion. Yet I must praise at least one piece of work of your Forestry Association. In printing a small booklet, containing the laws of Massachusetts relating to trees and woodlands, it did not only do me a great service, enabling me to appear knowingly before you, but the educational value of just this little piece of work can hardly be overestimated, provided the booklet is widely distributed. A widespread, easily obtainable knowledge of the law is the first requisite to its employment. Half the laws become innocuous because they are forgotten, and nobody is specially interested in carrying them out.

There has been much talk of introducing the subject of forestry into the public schools. If thereby is meant that the teachers should be intelligent on the subject, and should incidentally, occasionally or at a set occasion, like Arbor Day, impart such intelligence to their pupils, and arouse in them the interest which they should have in forestry, as well as in agriculture, mining and all other pursuits of man, and perhaps in addition rouse their moral sense against waste by fire or otherwise,— if that is all that is intended, the teachers should be encouraged, and by proper literature enabled to do so. But I am utterly opposed to the introduction of the subject as a regular course, for the simple reason that there is no time for such extension of the common school curriculum, which is already overfull; and there is no necessity if the State does its duty otherwise.

When it comes to the professional teaching of the subject, the matter is different. If the State supports agricultural colleges, there is now no reason why it should not also support forestry colleges, or provide for forestry courses at the Agricultural College. Such courses should be different from those now to be had at universities like Yale, Ann Arbor, Harvard, and lately at Cornell. They should be mainly designed for the use of the farmer in the management of his woodlot, — a very different affair from the management of a large timber forest.

State Aid.

Of the various possible ways in which the State can aid private enterprise towards rational forest management, besides encouragement by education and police regulations, your State has chosen the method of release of taxes for plantations. Your law is in some respects more reasonable than similar laws in other States, yet, if you permit me to say so, it is most crude from a forester's point of view, as well as incongruous from the economist's stand-point. It provides that "all plantations of chestnut, hickory, white ash, white oak, sugar maple, European larch and pine timber trees, in number not less than 2,000 trees to the acre, upon land not at the time of said planting woodland or sprout land, and not having been such within five years previously, the actual value of which at the time of planting does not exceed $15 per acre, shall, with such lands, be exempt from taxation for a period of ten years after said trees have grown in height four feet on the average subsequently to such planting."

Let me analyze these provisions. First, by specifying certain species, — which was done, no doubt, to secure what was considered most valuable, — others just as valuable have been ruled out, of which I will only mention basswood and spruce, especially the Norway spruce. Only recently a publication of the Bureau of Forestry declares the mixture of white pine and Norway spruce, the one which was mainly employed by the New York State College of Forestry, the most satisfactory. Why should not such a plantation enjoy the same privileges as those cited?

The height of the growth at which the tax release is to begin also discriminates between species, for, while it may take six to eight or more years for a pine plantation to attain the height of four feet, the ash or larch or chestnut or indeed any of the others may attain it in half the time, although later the pine will again outgrow them.

The limit of the tax release at the other end will then occur at, say the fifteenth to the twentieth year. If the 2,000 trees are expected to be in existence all this time to earn the release, there will be much disappointment, for it will be only with the greatest difficulty, if not utterly impossible, to keep such a number alive for that time, with some of the species, like ash, larch, or any other light-needing species; it is against their nature to grow so densely. Although with proper mixtures of tolerant and light-needing species this number might be maintained, it is questionable whether this is desirable. At any rate, the desirable number is variable with the species used. The plantation might be made with 2,500 or even 3,000 seedlings set out, maintaining that number perhaps for the first three or four years, which would be a very satisfactory start; but after that it should be left to natural adjustment, and the completeness of crown cover in the plantation as a whole, rather than the numbers, should be the criterion, for that completeness will exist, and exist satisfactorily, with different numbers.

The limitation as to price of land that may have the benefit of tax release seems arbitrarily chosen, although the idea of keeping it to the lowest-priced lands is a good one.

The reason for limiting the length of time for which the tax release is to run is even less apparent, for the tax release stops long before the plantation has become useful.

The object of tax release is, of course, to encourage the infant industry of forest planting. The payment of taxes is supposed to be a discouragement to entering upon this industry. I invite you to contrast the benefit which a planter may secure from the sale of the product of a plantation, and that which he receives from the tax release, and see which should be the very much greater inducement. At best the tax release would probably in no case exceed 20 cents per acre; this release beginning say six years hence and running for ten years has, as any banker will inform you, if figured at 5 per cent, a capital value at present of $1.40. This is supposed to be an inducement to plant up the land at an expenditure which would probably not fall below $10 per acre. In other words, the law invites you to put seven times the amount of value on your land for going untaxed for ten years. It does not say that after that period it will not tax the land according to its true value, based upon the improvement, nor does it refer to the risk of losing the whole investment by fire, under our lack of protection. Do you see much encouragement in this release? How many have started planting for its sake? It is, to be sure, quite pleasant to reduce taxes by any means, if only for a short time, but I doubt whether it is a financial inducement to grow timber.

On the other hand, the financial result of timber planting in itself should be encouragement enough, if the State, the town, will only do its duty of insuring reasonable protection for it.

To demonstrate what inducement to invest in a tree plantation comes from its own results, it is necessary to be somewhat more definite as to the character of the planting, although it would be no trick at all with almost any plantation, made at an expense of $10 per acre, to secure a 5 per cent investment by mere firewood production, in any place where thirty years hence $1 stumpage per cord could be secured, — a not unreasonable assumption for many places in Massachusetts. But to him who has time to wait, a timber proposition would be much more attractive. There is some experience in your State of what white pine can be made to do without very much attention, several hundred acres of plantations being in existence.

Our experience in New York teaches us that we can make a first-class plantation of white pine and spruce, which is better than a pure white pine plantation, at within $10, if we grow our own stock and set out 1,700 two to three year seedlings to the acre. If the planting is properly done, and no misfortune occurs, there is nothing to be done to this plantation until it is about thirty years of age, except that, if it can be utilized, some of the dead material may be removed. By the thirtieth year the number of living trees will have been reduced to say 1,500 at most, the mutual shade and accidents being the cause of their decimation. The object of keeping the stand so dense is to stimulate the height growth, prevent growing into branches, and kill out the lower branches before they are too stout to be broken off easily, so as to secure clear lumber. By that time the average diameter of about 80 per cent of the trees remaining may be only 4 to 5 inches, some stouter, even up to 12 inches, some less, and the height of many, if not most, 40 to 50 feet and more.

Now comes the time to work the crop for diameter increase. This is done by giving individual trees a better chance for development. Doctors differ much as to how this should be done, but here is my recipe. Select about 200 of the best developed, most promising trees for the final harvest crop in as even distribution as may be. If they have not lost their lower branches, trim them up to 20 to 25 feet, which in the case of dead limbs is easily done with a cutting hook; in case of live limbs, of which some may also best be removed, with a cutting chisel on a pole. Thin out around these selected trees so that the crown of each is free, and finds an open space in all directions of 2 to 3 feet to grow into during the next five or six years, and repeat this operation every five or six years, or as often as the crowns become again interfered with by neighbors. Leave the rest of the stand, as long as it does not interfere with the select crop, undisturbed or slightly thinned, if you can make use of the material; its office is mainly to cover the soil, and protect it against drying out, and any thinning out to stimulate its growth should therefore always keep this object in view. It would be possible to secure a cut of inferior box-board material in the fiftieth or even fortieth year, but waiting until the sixtieth year will produce real lumber wood. By that time not only will all the lower growth have been cut out, but of the 200 originally selected perhaps only 150 will remain, making a close crown cover, and protecting by their own shade the soil below. This harvest crop should then have all the trees with a height of 70 to 80 feet in the average, and diameters varying between 12 and 24 inches, and averaging probably not far from 20 inches. The average tree will contain at least 65 cubic feet of wood, or say 10,000 cubic feet per acre, of a character which, with common mill practice, will make 50,000 feet of good boards, besides 25 cords of firewood.*

Who knows what the stumpage of the lumber product alone will be worth sixty years hence? We can only guess, but we have good basis for guessing. In sixty years, as far as lumber prices are concerned, we will be at least in the same condition as the European countries, which have "no surplus" of virgin wood supplies; prices will be at least what they are now in France or Switzerland or Germany. This year stumpage prices of spruce and fir, actually obtained in France, were 12 and 13 cents per cubic foot as standing in the trees, including both saw timber and firewood. At this rate our acre would be worth $1,200. In Switzerland, white pine stumpage was sold this year at 17 cents per cubic foot for the saw timber alone, and spruce and fir at 12½ to 18 cents, according to sizes and transportation facilities. This would make our acre worth at the lowest $750 for the saw timber alone. Or, if we apply the experience of Prussia through sixty-five years of the last century, when the price for wood in general rose at the average rate of 1½ per cent per annum, and assume the present stumpage price at $5 only, the acre would have brought 12 x 50 = $600, which is about 7 per cent on the original investment. Now, money by that time will certainly not be worth more than 2 or 3 per cent; hence, if we discount to the present time at 3 per cent, we find that the $10 now paid out will be repaid ten to twenty times over, with interest.

How does this compare with the encouragement of the tax

* These trees have not developed like the average of the unattended forest, but they are the select best, which for thirty years have been kept in most favorable condition. Such trees, as shown by measurements (see "The white pine," Bulletin No. 22, Forestry Division, United States Department of Agriculture), can attain in sixty to sixty-five years, without any attention, in naturally grown groves, dimensions of 23 inches diameter and 80 feet in height, and averages of 18 inches diameter with 62 cubic feet contents. If only 48 feet of the length with 8 inches at the smallest diameter, *i.e.*, 60 per cent of the cubic contents, are taken for saw timber, then, in common mill practice, counting on 30 per cent waste in slabs and kerf, each such average tree will give over 400 feet B. M., and the acre 60,000 feet, besides some 20 cords of fuel wood.

release? You may say that this figuring is all theoretical, and I admit it; but it is based on measurements and experience elsewhere, even with less vigorous growers than the white pine, and with less care.

Your own Mr. Pratt has reported in your proceedings that, without any attention in the way of thinning, by sowing pine and leaving it to nature unaided to do what it pleased, he had secured, in less than fifty years, 50 and even 60 cords of box-board logs per acre, or as many hundred cubic feet, with some of the trees 2 feet or more in diameter. And among the many measurements which some years ago I had had made of naturally grown pine groves in New England, there was at least one (near Hopkinton, N. H.) which at sixty to sixty-five years of age, with 300 trees, showed 7,870 cubic feet of wood, with diameters varying from 8 to 23 inches, and averaging 14 inches, and heights mostly between 70 and 80 feet.* This is what nature unaided has done. I submit that my claim for the result from an intelligent guidance of nature is modest.

While, then, the tax release cannot be considered much of an encouragement, a just taxation is what everybody, even the forest planter, should be satisfied with. And, if not the land alone is to be taxed, but also its product, and encouragement is needed in the forest-planting business, then let it take the form which prevails in some parts of Germany, and which is justifiable and reasonable, namely, not to collect the tax until the harvest is cut. If, for instance, the annual tax were 20 cents, let it accumulate with 3 per cent to the sixtieth year, when it will amount to about $35, which comes easy to pay when $600 are in sight as a result of the harvest.

Other methods of encouragement are the giving of bounties, which in principle stands on the same order as the tax release, — not only difficult to formulate rationally, difficult to administer, and insufficient unless other stronger inducements exist, which would by themselves make forest growing inviting. Moreover, does not the man who takes an exist-

* See United States Department of Agriculture, Forestry Division, Bulletin No. 22, "The white pine."

ing forest growth, sprout or stump land, and by intelligence and management, utilizing natural reproduction, turns it from useless brush land into highly productive timber land, or who secures the new superior crop by natural regeneration from the judicious harvest of the old timber, — does he not deserve as much recognition as the one who performs the much simpler and easier work of planting a pasture, which is already productive, even though it be at a lower rate?

Distributing Plant Material and Advice.

The aid which the State can give by distribution of plant material, by giving advice as to its use and subsequent management, is on an entirely different basis, at least if properly applied. This is really an educational method, with some financial aspects added.

So little is the idea of forest planting and forest management developed in our country, that really as yet little readily available, practical knowledge exists; and even the plant material cannot be as easily, readily and cheaply secured as is desirable, because of the absence of a large, well-established trade in such plant material. Hence it would be an excellent plan for the State to establish one or several nurseries, in which such plant material should be grown, not for free distribution, but to be sold at cost price.

In connection and as a condition going with this assistance, there should, however, be furnished and be followed expert advice as to the choice of plant material, the method of handling it and of managing it afterwards, as well as of managing the woodlands already in existence. This, too, should not be given entirely free, — I do not believe much in charity and paternal methods, when other methods will accomplish the object, — but an equitable rate can be established in proportion to the acreage or the amount of planting or work, the State bearing the risk of coming out even. The State could afford to employ and command such expert advice for the many, when the individual planter or forest owner would find it difficult, or too expensive, to secure it. Here again comes your State forester to the front.

Town and State Forests.

Lastly, there will arise cases and conditions where the State itself must step in, own the lands and do the reforesting.

Twenty-five years ago the idea of permanent State ownership of land for anything but the immediate need of State business, or to be disposed of to settlers, was considered so inimical to the American spirit and State idea that it was dangerous to propose such an innovation as a State forest reserve for no other purpose than the perpetuation of forests. Now this is all changed. The first State to change its attitude was New York, in 1885, when the beginnings were made of creating a State forest, for the purpose of perpetuating favorable river-flow conditions and timber supply. This reserve comprises now over 1,250,000 acres, and, although lately its purpose has been perverted by selfish sportsman's interests and pleasure seekers, and has made forest management in the reserve impossible, it will be only a short time until the blunder is corrected.

The federal government was persuaded to change its land policy in 1891, and we have now over 60,000,000 acres in forest reserves in the Public Land States, with more to follow. Pennsylvania fell in line in 1899, and is acquiring lands by purchase as fast as practicable, having at last report secured 600,000 acres, and proposing to increase the State forest to 3,000,000 acres at least. Minnesota, Wisconsin and Michigan are working in the same direction.

The proposition for the State of Massachusetts to enter upon a policy of State forests has been brought before you by Colonel Appleton, in 1890, who thought the State should purchase stump or waste lands at low valuation, and by paying the taxes on it make the measure acceptable; and again by Mr. Chamberlain, in 1900, who advocated the purchase of stump lands at $3 per acre.

That activity in this direction is not entirely foreign to your institutions appears from the interesting beginning which the State has made in the Province Lands, in covering some 175 acres with forest growth during the last eight years. This, to be sure, was a protective measure for the purpose of arresting the encroaching sand dunes, which threatened private interests beyond, and on lands already owned by the State.

Your law (Revised Laws, chapter 28, section 23) permitting a town by a two-thirds vote to take or purchase land within its limits which shall be a public domain, "devoted to the culture of forest trees, or to the preservation of the water supply," and to appropriate money and accept gifts of money and land therefor, also points in the direction of communal ownership of lands as considered desirable. The conception of a "public domain loan" I consider an especially excellent one, if only the towns would take advantage of these laws, — if they could only be made to see their advantage in doing so.

Here we have most interesting illustrations as to the advantages accruing financially, as well as otherwise, in the town forests of Germany, from the incomes of some of which not only the entire tax list is paid, but a dividend for distribution among the bona fide citizens results. Goerlitz in Silesia is said to be one of these happy towns. Nineteen per cent of the total forest area of Germany, or nearly 7,000,000 acres, are so owned.

One of these town forests with which I am familiar, that of the city of Goslar (with about 14,000 inhabitants), in the Harz mountains, a spruce forest of 7,368 acres, furnishes the citizens not only with their pure drinking water, healthful enjoyment in hunting and refreshing coolness in summer, but also with a net annual income, which ten years ago amounted to round $25,000, now probably increased to more than $30,000. Here, under careful management, in round figures annually 350,000 cubic feet of wood (or only 47 cubic feet per acre) is cut, of which 46 per cent is saw timber, or about 1,300,000 feet B. M., selling ten years ago at 10 to 16 cents the cubic foot, or approximately $16 per M in the log, cut; 40 per cent consists of poles, posts, small dimensions, selling at 4 cents: and the balance, about 500 cords of wood, selling according to quality from $1.60 to $4.30 per cord.

To give you an idea what good financiers these mountain farmers are, the following will serve. Persuaded by their efficient forest manager, — for they have a first-class professional forester to run this business, and are, not as is often the case with us, each one wiser than the manager, — the city fathers allowed the manager to build roads during fifteen years to and through the woods, until 141 miles were completed, at an expenditure of $25,000. Due to this improvement, making all parts of the forest accessible, and haulage possible over (partly) macadamized roads at any time in the year, an increased return equal to 33 per cent on the investment could be shown.

I am sure if as good financiers are to be found in Massachusetts towns, with as good expert advice, an era of town forests will soon arrive.

Towards such a desirable end the assistance of the State should be readily given by pledging the State's superior credit in acquiring and reforesting waste lands, and enabling the towns without too much sacrifice in the present to establish their town forest, since the State could probably borrow money at a lower rate than the towns. An example may illustrate the method of procedure.

Let us assume that a town has say 1,000 acres of such waste lands which it could secure for say $3,000, borrowing the money from the State at 3 per cent interest; the 1,000 acres to be planted up in the next twenty-five years, *i.e.*, at the rate of 40 acres per year, at a cost of $300; this amount to be borrowed also from the State from year to year, when the interest charges will be annually $90 for the land purchase, and increasing by $9 each year for twenty-five years for the planting cost. The loans will then in the twenty-fifth year, when the reforesting is finished, amount to $10,500, and the interest paid will have amounted to $5,250, varying from $99 in the first to $315 in the last year, which is the maximum annual payment. Now the interest charge becomes stable at this rate, and at the same time each year 40 acres may be thinned. These thinnings can be safely figured to net $2 per acre for the twenty-five-year-old stands; they are to be repeated every five years, and increase then by $1 per acre for the first and by 50 cents for every following five years, — assumptions which are very reasonable. In other words, for the next five years after the loans and the planting are completed the interest charge is met to the extent of \$80 by the thinnings; during the second quinquennium, to the extent of \$200; and in the third, when the first planting is forty years old, a surplus begins to appear. Now arrangements for refunding the loan may be made, or else interest may be paid out of returns for thinnings until the sixtieth year; then the first 40 acres come to harvest, yielding not less than \$24,000, when it is easy to pay off the entire loan at once. These rough calculations may, of course, be refined, and the adjustment may be made even more reasonable, reducing the charges for the earlier part, and letting the future, which reaps the benefit, pay the cost. For instance, the State may bear the burden of the interest charges until the harvest time, when the loans with compound interest have grown to somewhat less than \$70,000, which three harvest years will wipe out. After that every year the town may harvest a proportionate area, replanting it, and pocketing an income forever of more than \$20 for every acre of land which is now worthless and a nuisance. And all the State has done is to loan its credit, not one cent is given in charity; and the town has made no expenditure, except for the care of the property.

Finally, however, there will remain probably a considerable acreage in such undesirable location or condition, from the point of view of the towns, that only the State with its broader and far-reaching interests can advantageously handle these areas and make them useful again.

Some of these areas may find private owners, who will place them into great game preserves, and take care of them for their pleasure, to the exclusion of the people at large. If this is desirable in the spirit of American democracy, then it should be encouraged; but I am democratic enough to prefer that the people, the State, should own as much of these lands as a public domain or forest reserve as does not appear inviting to towns or private forest growers. As a matter of internal improvement, which promises both indirect and direct advantages to the community at large, such a policy of forest reservation should be inaugurated, and with it a system of forest management.

A good beginning in this direction will bring untold indirect advantages. In the first place, it would necessitate the systematic management of these lands under a responsible State forester; in the second place, the management will require the continuous employment of men who become naturally the reliable nucleus of a forest fire warden and patrol system. Not only can the distribution of plant material to would-be planters be more readily attended to, if the State grows this material at the same time for its own use, and the expert advice more readily disseminated, but the good example of the State will find ready followers. It is the good example of the State foresters in Germany, which really do not represent one-third of the German forest area, that has done so much for the well-managed forests of private owners there. But in addition to all the indirect benefits of a State forest reserve, I conceive that the 2,000,000 acres or so, which may appropriately fall into the hands of the State, will, if the State is a good financier, — that is, willing to spend money for some time in the improvement of these lands, — secure in time as good a revenue from these poorest lands as the German States now derive from their forest domains; namely, from $1.62 the poorest, to $4.50 the best, per acre.

This area of 2,000,000 acres is about equal to that of the State forests of Bavaria, which, topographically and climatically similarly situated, produce a constantly increasing annual net income of now nearly $4,000,000, and that by merely taking the annual growth, without decreasing the growing stock: the cut being 72 cubic feet per acre, of which 24 cubic feet are saw material, *i.e.*, 200 feet B. M., and half a cord fuel wood per acre.

Let me, then, summarize what appear to me the desirable actions in establishing a forest policy for Massachusetts, approximately in the sequence of their importance and effectiveness, the first two being of like importance, and the effectiveness of the rest being dependent on these.

1. Improvement in the forest fire laws, making them mandatory under State control and co-operation.

2. The appointment of a State forester, if possible technically educated in charge of the fire service, and of the educational and all other forestry interests of the State.

3. Encouragement by financial aid of all associations and other educational agencies concerned in creating an active interest in forestry.

4. Acquisition by the State for forest reserves of those stump, brush and waste lands, which by their location and condition are of importance to the welfare of the State at large, and do not promise to private enterprise or to town enterprise sufficient inducement to take care of them; and institution of a forest management for these lands, including nurseries for the production of plant material for their own use and distribution.

5. Encouragement of towns to acquire town forests, by advice and by State loans, the State's credit being used to guarantee the public domain fund of the town.

6. Encouragement of private owners to improve their wood lots and plant up waste places, by furnishing expert advice and plant material at cost, and by a just tax law, — not necessarily tax release.

On one point I must lay stress before closing. There is no State in the Union that has enacted more far-reaching legislation regarding the care and preservation of shade trees and for securing public parks. The tree warden is a Massachusetts institution, of which the State may be proud; the trustees of public reservations are a most useful lever for securing the preservation of historic and scenic places. But I must strenuously insist that these are matters which have absolutely nothing to do with the care and rational treatment of the forest areas of the State. This last is an economic question, pure and simple; while the arboricultural pursuits of tree wardens, park superintendents and the absolutely misnamed "city foresters," which your law so miscalls, are of an esthetical nature. Much harm to the forestry movement has been done by not keeping these two laudable movements more distinctly separate.

I close with the hope that Massachusetts will soon do at least as well by her forests as she has done by her shade trees.

The Chair. We have time for the discussion of this subject and for the answering of questions by the lecturer, or statements of experience. Discussion will often bring out points we need to have light upon. I want to hear a word of experience from Mr. Augustus Pratt of Middleborough.

Mr. Pratt. The lecture contains many facts which set us, as citizens of Massachusetts, to thinking. It is a fact, which no one can dispute, that our building material is becoming less and less every year, and when we go abroad to other States for this material we find it necessary to pay much larger prices than we did a few years ago.

Reference has been made to the white pine. It is an excellent building material for us, and it can be grown here in the future at a profit, I believe, to the growers. It is true that forty or fifty years is a long time to look ahead for a crop. Why could not the State exempt entirely from taxation waste land, thousands and thousands of acres of which we have in our Commonwealth, not worth some of it more than a dollar an acre, if the owners would plant it to white pine? Who can tell what the price of pine lumber will be fifty years from now?

Some fifty-five years ago, when I was about eighteen years of age, my father told me that I might take certain pieces of land, one piece of 10 acres and another of 5 acres, and plant them to white pine. I gathered the seed in the fall, and in the spring went on with the men and planted that land to white pine seed. I harvested all of the 10 acres, and a part of the 5-acre lot, and some of the trees on the smaller lot are still standing. Two of the acres of the larger lot, selecting the very best trees, yielded upwards of 50 cords of box logs to the acre. I cannot put that into thousand feet of boards, because our system is to put in three-quarter inch or five-eighth inch box boards; selling it by the cord measure, it gave upwards of 50 cords to the acre. The rest of it gave 40 to 45 cords to the acre. It was a profitable crop, and I was very foolish not to continue it from year to year with waste lands I could have bought at a low price.

Question. How did you plant the seed?

Mr. Pratt. The men went along, one following the other, say 8 feet apart, and with a grub hoe dug up the sod, dropped in the seed, then stepped on it, crowding it in the sod. The land was an old pasture, located so far away from our homestead that it was unsuitable to drive the cattle to. It was my duty to drive the cows there every morning and go after them every night. It was two miles away, and it was a sorry job. As a boy I dreaded it, and when my father gave me leave to plant it, I thought I was killing two birds with one stone. The huckleberry bushes had started a little, from 2 to 2½ feet high, but as a general thing we could go pretty straight. It was a very simple process, and very rapidly performed. I want to add that it is not entirely safe to plant pine seed unless you furnish the young seedlings some protection, some shade at the beginning of growth. The hot sun is liable to kill a number of the young seedlings, if not protected. Some of you may recall that the late Judge John D. Lyman of Exeter, N. H., had a method of planting pine seed which I have thought I would try some time, and I hope some one has tried it. He just sowed the seed broadcast with a little rye. His idea was that the rye would shade the young pines so that they would be able to grow.

I want to make a comparison between this planting of mine and one done by a neighbor two or three years afterwards. He transplanted seedlings. My pine lot made good timber, while his, planted in the same town, and not more than 3 miles away, after a few years began to sprout from the root. I was on his lot some eight years ago, — it has since been sold, and all cut off, — and I was astonished to see that but a very small portion of it was good timber; none of it actually fit to put into what we call edge boards for building purposes, — it would make short box boards. I do not know how to account for the different results, unless it was because of the pine weevil, of which my neighbor had a good many, and I none.

A thought has occurred to me about the distribution of tree seeds. Our national government is doing a big seed business, and has been for many years. Every member of

Congress is obliged to distribute seeds, many of which are worthless to the farmer. My thought is that, if our national government should distribute some forest tree seeds every year to any one who would plant them, and then let the State exempt these plantings from taxation, it would result in great public benefit.

In regard to the comparison of pine and hard wood, with us the day of hard wood has gone by. I have a 5-acre lot of oak timber, excellent for ship timber, but it is valuable to me only as cord wood. Twenty-five to forty years ago that timber was worth more than double what it is to-day. The call for ship timber in my section is over. That is the reason I favor the white pine. Our soil is adapted to the growth of the white pine, and it grows as rapidly as any tree.

QUESTION. When is the seed collected?

Mr. PRATT. I collected the seed about the first of September. You have to watch the trees and collect the burrs before they open. My method was to shake off the burrs and let the boys pick them up and spread them under cover to dry, when the seed falls out. While there are but few seeds in a burr, a day's work with half a dozen boys will result in collecting quite a good deal of seed.

Dr. FERNOW. In regard to the pine weevil, Mr. Pratt is inclined to think that, because his neighbor's pines were planted as seedlings, while his came from seed sown, they were affected by the weevil. That would be all right if observations did not exist where, in many cases, trees grown from seed have been attacked by the weevil. Seedlings, however, are more likely to be affected than sown pine. We, in the Adirondacks, do not know the weevil. We have planted about 300 acres during our three years' experience in college forestry with spruce. We find no difficulty at all.

I would like to speak of government distribution of seeds. I was at one time where I had to assist in this work. When I first went to Washington, in 1896, there was a requirement to distribute forest seeds; and I found that my predecessor had been distributing acorns, which he had had on hand for three years, to encourage tree planting. I found out this, that it is not easy to handle forest seeds, or to give instructions how to handle them, without considerable demonstration. I found out also that the United States is so enormously big that it can do but a very little in this line. The distribution of a few hundred dollars' worth of seed is almost throwing away the money.

The CHAIR. We would like to hear from Mr. Borst, who represents the Massachusetts Forestry Association.

Mr. F. A. BORST (of Boston). It is good to hear the experience of a man like Mr. Pratt. I know that a great deal of that kind of planting has not been done in Massachusetts. In my work as forester of the Massachusetts Forestry Association I have during the past year come in contact with many people who are very enthusiastic about the results of forestry planting; but I want to say just a word about something that it seems to me has not been brought out, and that is, that forestry is not wholly tree planting. Forestry not only starts in with the tree growth, but it might start in with cutting off the tree growth; it might start with taking care of and in protecting what tree growth we already have.

The lecturer has spoken about forest fires. We have made a study of this problem, and we hope we have brought out some of the essential things that must be done in order that our forest lands may be better protected. We have carried on the study throughout the State, and have examined a great many burnt-over areas, and have consulted with fire wardens all over the State. We have studied the laws, and know what the deficiencies are, and we hope to introduce into the incoming Legislature something which will bring about better laws. There is no law that will reach every case; but there are some laws that ought to be off the statute books, and some things ought to be added.

The lecturer has referred to State control. It is undoubtedly true that, although we have fire wardens, we do not get efficient protection. The greater portion of the State is working under the 1886 law, which provides that the towns shall appoint forest firewards. These officials where appointed have no definite instructions or understanding of their responsibilities. They are supposed to put out forest fires, and the town pays the bill, and that is about all there is to it. They are supposed to turn in their reports; some do, and some do not. I have examined all of the records for the last five years, and have travelled over the State, and I do not believe more than half of the fire losses have been reported.

We believe that there should be one man in each town, appointed by the selectmen, who shall be responsible for the putting out of forest fires. Each town should be divided into districts, with a competent man in each district, under orders of and responsible to the fire warden. If you are going to make the fire warden responsible, you must try and control the people so that they will be less careless. They are not careless because they want to be mean, but they don't know the danger. If you are going to make a town fire warden responsible, let him know who has the right, and who has not the right, to light a fire. If he goes to a fire, he must know that it is a real fire, and not, after driving a long distance, find a man is simply burning a big lot of brush. Or, what perhaps would be better still, let the State be the controlling power, and put this work into the hands of one responsible head, — for the selectmen of towns have many duties, and may neglect this one.

Our association has offered to make examinations throughout the State of forest lands. So far as possible we will go and look over the lands, find out the needs and conditions of the owner, the condition of his property, and advise him as to the best methods of handling it. There is as much necessity for properly handling the existing wood lands as for forestry work in planting up the waste lands.

I want to say a word about the cost of forest planting. Dr. Fernow put the cost at $10 an acre. This year we have brought the cost down to $5 an acre. Then the lecturer spoke about a State nursery. I am very strongly in favor of one. It is rather difficult to raise white pine without considerable expense, if you want to raise it profitably. I believe the State should start a nursery, where the white pine could be raised and sold to land owners at cost for forestry purposes. I do not believe the State should give away anything except advice; that is cheap enough.

Now, with regard to our work at the Wachusett reservoir.

We have carried it on the third year, and we raise our own trees, because it is cheaper. We raise them for $3 a thousand, and cannot buy them for less than $15. We have our nurseries there, and the first thing was to establish an ample system of protection. We have been able to control forest fires, and nothing serious has happened. Then we have planted out a large amount of various mixtures, and we have been trying hard to bring down the cost of raising. We have taken existing wood lands, and they have been thinned, and the trees left given a better opportunity for growth. A forestry man believes in planting the trees where he can see them. We give the young trees care for a few years, and then set them out. We have an exhibit here to-day, in the rear of the hall, to show the size of stock in the various stages and sizes used for planting, and photographs which show the work in operation.

QUESTION. What proportion of those trees you plant will succeed?

Mr. BORST. We have 65 per cent.

The CHAIR. It has been suggested that the Agricultural College have some one to teach forestry. Perhaps Mr. Draper, one of the trustees, can tell us about the facilities for teaching it there.

Mr. JAMES DRAPER (of Worcester). During the lecture, when the suggestion was made that a nursery be established at the State's expense, it occurred to me at once that it might be done at the Agricultural College. We have the necessary land, and a professor capable of teaching forestry. We have young men who no doubt would like to be instructed in a more liberal line of forestry than at present, and I believe we have an equipment sufficient to grow and furnish young nursery stock to the best advantage. I went over the State nursery grounds at Boylston the past summer, to which Mr. Borst has referred, and was particularly interested in the planting. We were shown the method of reforestation, and a model nursery managed in a practical way. I was surprised to see what a large per cent of plants were grown there so successfully. If the State is to start another nursery, I want to put in a strong word for the college nursery for the growing of the seedling trees; and to substantiate my position, I would ask Professor Waugh to address you.

Prof. F. A. Waugh (of Amherst). I hardly know whether it would be a safe proposition to undertake, on general principles, but I certainly would like to try it. In discussing the educational features of forestry, the work at Amherst has leaned on the educational side, — that is, its principal commission is educational; and among the various educational institutions in the State the Agricultural College ought to have the first place, to stand at the forefront. We have a strong organization there for the purpose of instruction, and we have as students picked men of the State, I might say men who are going to be influential in the State in years to come, men who make special use of such instruction, and it seems to me from the nature of the case the Agricultural College ought to be of use along this line. Forestry has been introduced at that institution, and the department of landscape architecture has also been added. Our horticultural department comprises fruit growing, vegetable growing, floriculture, bee culture and about everything else. Forestry comes in with some odds and ends to form this department. I think that the college ought to do more in forestry, and that the State ought to help the college more liberally.

The Chair. I see in the audience Mr. O. B. Hadwen of Worcester. He has set out and cared for more trees than any man in the State. Whether he has done much in forestry I cannot say, but I wish he would add a few words to what has been said.

Mr. Hadwen. I have listened with very great interest and satisfaction to the lecture, and most fully approve of what has been suggested in the way of inaugurating and perpetuating the forestry of the State. It is a well-known fact that perhaps half the area of the Commonwealth was never intended by nature for any other purpose than for the growing of forest trees, and I am glad to see that the Board of Agriculture is taking a step in that direction. There is no question but what as time goes on it will add a very great amount to the wealth of the Commonwealth. Still, I can hardly conceive how it can be done, unless it is done by the State, by the town or by large moneyed corporations that care nothing for the actual dividend; and still, as time goes on, it would ultimately become profitable.

While I am not familiar with forestry planting, I am somewhat familiar with tree planting. It is now sixty years since I bought my Worcester farm lot, and in one little corner were some pine trees. These were trees six or eight years old, with limbs growing from the bottom. They are now quite stately, perhaps nearly 100 feet in height, with more than 2 feet of timber in the trunk. The only difficulty I have had is, I didn't quite understand how to prune a pine tree so as to have pure stock. It is the clear wood that is valuable, and not the box boards that have been spoken of. To prune pine trees properly I think requires a good deal of skill, and I am yet to see the man who knows how to do it.

The trees that seem to thrive best in my section are the white pine, Norway spruce, white spruce, the Scotch or European larch, the bass, the tulip, black walnut and chestnut. All these trees I think can be grown profitably. But there is one point in tree growing that has not been mentioned, and that is, trees must be fed. You need not expect to grow trees of large size without sufficient food. They appreciate good care and good nourishment just as much as a hill of corn, and have to have it if they are going to produce large trees in a short time. I have seen the pine tree grow 4 feet in one season; but that would be under good culture, it would not be on poor land. I have in my buildings lumber that I planted as trees, and it has been there some time. I have trees on my place that I planted that will measure 11 feet in circumference 2 feet from the ground. I have black walnut furniture in my house from trees that I planted. If my buildings should burn, I have more trees than would be sufficient to replace the lumber in them. I think I would rather see my buildings burned than the trees destroyed.

Mr. A. M. LYMAN (of Montague). I want to say a word in regard to the yellow pine. We have it, and it has been a great benefit to the town. Large areas of it have been cut off, which are now grown up to scrub oak; but yellow pine is coming in, and we are very friendly to it. It makes good lumber and better wood than white pine. It is more hardy, and will live where white pine will not succeed.

Mr. ETHAN BROOKS (of West Springfield). While we are on this subject of sowing the seed of white pine and shading the seedlings, I think an account of the method pursued by our friends the Shakers, over the line eight miles from Springfield, would be interesting. About forty years ago they found they had more land than they wanted to cultivate. A good deal of it was light, sandy soil, and they changed the tract one way and another, and got white pines to grow there until they settled on this method: they gathered the seed and sowed it broadcast early in the spring, on old, worn-out lands, and that was all. There was grass growing there, wild grass, and it seemed to shade the seedlings sufficiently. They put on six quarts of seed to the acre, and they had wonderful results. They had acres of pine land that would pay a large percentage on their investment.

Mr. J. M. BURT (of Easthampton). Our friends may prefer white pine, but I would rather have chestnut. We get $29 a thousand for chestnut, and $16 for pine, and we can sell them ten times as well as pine. They make ties, telegraph poles and all that sort of thing, and they grow almost spontaneously. You can set them out cheaper than you can pine.

Mr. DRESSER (of Gardner). A few years ago we had a large tract of land, about 150 acres, and some portion of it was poor or light land. I mowed that land myself several times. We kept it until this last year, and disposed of it through fear of fire. The taxes and risk of fire were so great that we thought it better to dispose of the property. The land I stated I had mowed over when a boy came up to sapling pines. They grew very nicely, and nothing was laid out on them. They grew to be very large, and in a good many places were from 3 feet and upwards in circumference, and were very thrifty. In 1885 a fire set by hunters in the vicinity burned over 25 acres of this land, and damaged the property considerably. In 1898 another fire set by the railroad some 5 miles distant went up through that section and burned it over again. In 1901 a fire said to have been set by hunters burned the property over once more. I sold it last winter, since which time it has been burned over again. I speak of this instance as but one of the serious objections to cultivating forestry in certain localities.

Mr. JOHN F. ANDERSON (of Shelburne). We do not seem to have much trouble with fires. Each one of us has a telephone, and when a fire starts we telephone all over town, and our custom is to take hold of the fire and put it out. A few days ago one of my neighbor's buildings took fire, and in less than one hour's time there were fifty men and forty women there. We took ten feet out of the roof, and we lugged carpets and put everything out, and we did it by all taking hold. In Shelburne there is a very eccentric man. He said once, in town meeting, of all the beautiful things in nature the tree and shrub were the most beautiful; and that man has allowed his trees to grow, and has never allowed any man to cut them. He has 30 acres of pine trees, the whole of which I played over when a boy. To-day he has been offered $3,000 for those 30 acres. Nature sows the seed, and these eccentric fellows do not allow anybody to disturb them, and it pays. To-day this man's farm is worth more than it would have been if it had been well cared for and cultivated. Pine pays best of any tree in Shelburne.

Mr. Q. L. REED (of South Weymouth). I want to say a word in regard to forest fires. It is severe enough to have the timber burn, but when the soil also burns, I think that the result is a great deal worse. From 1845 to 1870 I was pretty intimately acquainted with the timber in the forests of Maine. I used to think at that time that it never would be exhausted, but it is now, and there is hardly any pine to be found. This last spring thousands of acres of some of the best spruce in the world were destroyed. The best quality of spruce grows in the longitude of Bangor, and as you go west it grows smaller, what you call "huckleberry," and the same east. That which burned there last spring was the best spruce there was in the United States.

The CHAIR. There is one phase of this forestry subject that is of great interest to me and to every man that dwells in the country towns of Massachusetts, and that is, that after a wood lot is cut over on these side hills, these woody places or sandy plains, the stumpy lot is of very little value, and is often sold for from $1 to $5 an acre, if a customer can be found. While the State of Massachusetts has expended millions of dollars for park purposes, it seems to me the purchase of these cheap lands, at that minimum price, even if the State is not willing to pay for the care of them, would be a wonderfully good investment for future generations, and for the present generation for outing purposes. If the State does not take these lands, they are very soon going to be absorbed by wealthy men for game preserves. We have in western Massachusetts two townships almost entirely absorbed by game preserves. They are reserved for hunting and fishing and for pleasure, — simply a playground for those private people. If the State could devise some plan by which a forester could take all the land offered at a minimum price, it seems to me the public would be greatly benefited, and the next generation would have an income in money.

SECOND DAY.

The meeting was called to order at 10.30 o'clock by First Vice-President Sessions, who said: Mr. T. H. Goodspeed of this town, and member of the Board of Agriculture from the local society, will preside this morning. The success of these meetings has been largely dependent upon him, and you will no doubt be glad to see him in the chair.

The CHAIR. I am glad to see so many present at this meeting. It would give me much greater pleasure, however, if we could have this hall filled at all these meetings, for it seems to me that they are of very great interest and value. It gives me pleasure to announce that we have with us this morning, as the lecturer, a man who is well known to many of you personally, and by reputation to most of you, Dr. George M. Twitchell of Augusta, Me., who will now address you.

OUTLOOK FOR NEW ENGLAND AGRICULTURE.

BY DR. GEO. M. TWITCHELL, EDITOR "*Maine Farmer*," AUGUSTA, ME.

In any study of the subject of agriculture or its right to recognition and support by the State two distinct propositions assert themselves: —

1. That agriculture is the one industry which sustains life.
2. Agriculture is the only industry that conserves the wealth or permanent prosperity of the State and nation.

The first is so self-evident that it would need no argument save that it is well sometimes to call attention to the fact that every day we are within six months of starvation, and the hand of the tiller of the soil alone averts the disaster.

It is well, I say, to call attention to this, because, in drawing our food supplies from the great granaries and storehouses, the thought of the man behind the plow, of the acres to be tilled, of the herds to be cared for, of the orchards to be picked, of the study and investigation demanded and of the myriad round of duties involved, the proposition is lost sight of.

Only in the days of a threatened shortage, in any direction, is the public aroused to its dependence upon him in whose interest this Board was created and this session held. Well will it be when this dependence is forced home upon the artisan, mechanic, tradesman, professional worker or society man with such frequency that he will feel conscious of the dignity of, as well as necessity for, the man with the hoe.

Too long this class has been the butt of all ridicule; too long has the artist's brush or author's pen been allowed to picture him as the illiterate, uncouth, tricky, sharp-faced, sharp-nosed countryman, ignorant of all proper construction of language, obstinate in all matters of dress or observance of society manners, rough and uncouth, capable only of a life so primitive as to provoke curiosity but not awaken interest. The caricatures of the New England farmer, whether in rhymes of the would-be poet or coming from the pencil of the would-be artist, are as far removed from the men on our farms as these poets and artists are from Whittier or Raphael. The character of their work, the coarseness of their conceptions, indicate the shallowness of mental fibre which is willing to sell itself for a dollar to provoke simply a smile. We have laughed at the caricatures, both by pen and brush, but did not realize that these have operated powerfully against the industry.

Never was there justification for such a picture, never a day when the farms, especially in New England, were not only helping feed the world, but the men and women thereon shaping the permanent fabric of our social, intellectual, moral and spiritual life, and insuring that defence of law and order which has made the streets of our cities safe and their population secure.

Emphasize, then, this fact of dependence, for in the strenuous life of the to-morrows before us not only must the farmers feed the millions, but safeguard our institutions. The livelier the sentiment of dependence, in your towns and cities, upon the men who are shaping the agriculture of the twentieth century, the more secure will be the government at Washington or on Beacon Hill.

The incoming of the immense army, not from the shores of Germany, Ireland, Scotland and England, but chiefly from those of the Latin races, places heavier burdens on the conservative, native-born population. Cities and towns are more and more being occupied by that class, so difficult to Americanize, because by training and inheritance antagonistic to the fundamental thought of this government.

Always, everywhere and for all time, the security of the larger thought and freer conception of self-control and self-government has rested on those who have diligently sought, not alone to grow the crops and stock, but to reach after the solution of the intricate problems involved in this growth.

All this only emphasizes the importance of recognition of that class which must ever feed the world, and, more than this, be the hope and stay of the nation.

My second proposition is not so self-evident, yet upon the recognition of its truth hangs the future of the industry.

Cast your eye over the field, and tell me where there is another industry which thrives save by the destruction of natural forces and agents.

Your great manufacturing towns and cities have been built and are sustained out of the forests, coal, granite, ore and traffic therein. Wealth is flowing into these centres, but it is at the expense of nature. Individuals thrive while the country loses. Our giant pulp and paper mills, turning out two hundred and fifty tons of paper, a train load, daily, are eating their way through the forests of Maine with terrible rapidity; and so it is everywhere, save that he who co-operates with nature in the growing of her varied products finds a willing partner, ready to unlock inexhaustible stores of fertility for future crops in response to his intelligent invitation. The larger the harvest the greater the possibilities for another. There is here no drain, no loss, but an ever-increasing ratio of gain. Permanent wealth is insured a nation only through an aggressive agriculture. The greater the demands intelligently made upon the soil the greater the response, and that response only opens the door for possibilities heretofore unknown.

The day will come when the forests will be depleted, the ore exhausted, the coal burned and these varied industries silent; but down through all the cycles of the future the hills and valleys of this State will yield an increasing harvest to him who unlocks the secrets hid in the bosom of Mother Earth and intelligently asks her co-operation in his labors.

Agriculture, of all the industries, alone conserves the permanent wealth of a people, and is the one industry worthy the most critical study and closest adoption by the student of the future.

Rapidly are we passing from simple to more complex relations, and the hum of machinery and whirr of the electric motor dull our ears to the song of increasing outpouring which nature sings through leaf and bud, through flower and fruit, through seed time and harvest.

Men of Massachusetts, who have questioned the future of your agriculture, who have listened to the false prophets who have told of the great wealth of your industries and the passing of your agriculture, who have repeated the charge that Massachusetts is not an agricultural State until the young have accepted it as truth, the day has come when the falsity of these statements must be proven, when the currents of thought and energies of a new life must be centred in defence of this one industry which opens wide the doorway to the largest, freest, fullest life of the future.

We have passed the stage when the simple "how" claimed attention, and are engulfed in the all-embracing consciousness of the "why." We are touching elbows with giant forces to-day, and the mastery of mind is demanded as never before for the solution of the intricate problems facing individual workers in every department of farm life. Only in the solution of the "why" will it be possible to rightly appreciate the "how."

One of your honored sons, whose life is devoted to the study of agriculture, has lately declared that "There must be a change in the spirit of the people before the farmhouses will be occupied by a class that will have much influence in uplifting rural New England." Is this true? If so, then this Board of Agriculture has not met the varying phases of public sentiment in the past with that strong, earnest but bold defence of the farm, of farm life and its significance, as it must in the future. The vastness of the prairies has overwhelmed us, and we have drifted.

What New England needs to-day, yes, what is coming to New England, is a bold spirit of enthusiasm, not for defence, but conquest; not primarily for recognition, but to make recognition certain by doing, by a deeper faith in the value of the farm, a better realization of what it can be made to yield in quantity as well as quality of crops and products, and above all in the quality of manhood. The thrill of the life to-day must be felt in the organized power of the State not to direct, but to suggest; not to instruct, but inspire; not to relieve, but to kindle enthusiasm for rural life, to help open the eyes to see what in the limelight of the present is an open highway for him who thinks, and a life free from the treadmill of the shop, store or factory.

Hard work, you say? Yes, thank God for hard work, for it alone insures a soul worth saving; it is the only safeguard against mental, moral and physical decay.

Labor is rest from the sorrows that greet us;
Rest from the petty vexations that meet us,
Rest from sin-promptings that ever entreat us,
Rest from world-sirens that lure us to ill.
Work, — and pure slumbers shall wait on thy pillow;
Work, — thou shalt ride over care's coming billow;
Lie not down wearied 'neath woe's weeping willow, —
Work with a stout heart and resolute will.

We grow only out of our adversities, and hard work is our greatest blessing, provided that as we labor we think. Brains must direct the hands, or life becomes drudgery; and no man is so inspired to think as he who, at every turn, touches fingers with the Almighty through the myriad forms of life in nature.

Failure has been written all over the past, and our agriculture has been degraded because the effort has been to help by relieving from thinking; in telling men how to do, thereby degrading the conception of what is to be done.

The effort in the future must be to inspire enthusiasm for investigation, to kindle desire for a larger grasp of great principles and a closer touch with nature. Already returns are coming which will enrich the State. The history of the ages confirms the claim that nations have grown strong or weak as they acknowledged or suppressed kinship with the soil.

The primal difference between the civilized and uncivilized man is love of home and its surroundings, and the more powerful the race, the stronger this instinct. As people become migratory in their habits, shifting here and there, as fashion or fancy dictates, love of home, kinship with the soil, faith in one's country and quality in the individual surely degenerate. Forms take the place of principles, and social customs destroy that interdependence so absolutely necessary for mental activity and individual advancement. Money, too quickly or easily won, insures a fictitious prosperity which tears down the true standard of living. The shallowness and hollowness of so-called society is being pushed out into the country, spreading its miasma of contagion, and dwarfing all true sentiments of holy living.

All these questions play an important part in the discussion of the future for the farm, for here the life of the young must be closely interwoven with every thought. We are discussing problems which have to do directly with the more conservative class, — men slow to modify their positions, and still more slow to change practices. Yet must we recognize to-day the fact that the ruts of habit do not run along the highway of progress.

Radical changes are demanded, not in the fundamentals of the industry, but in the means and agencies by which these fundamentals are elaborated. The principles of growth and production are ever the same, but the steps by which that growth and production are secured are ever changing. To these changes, then, serious attention may well be given.

The free, open life of the west, with its broad areas, necessitated the use of machinery, and gradually that conception of the problem has been working its way into the life of New England. Restricted in breadth of cultivated fields, we cannot find place for the gang plow or the traction engine, but the principle involved must be accepted. New England agriculture, in the future, must be an agriculture of machinery. Radical as are the changes, they must be made. The great problem of labor, which to-day overshadows all others in the mind of the average farmer, must be solved by machinery, and the lines of effort those which will return in largest measure for the physical energy expended.

Aroostook County has been the great potato-growing section of the east, until the farmers of the older portions of Maine came to feel that there was no possibility for them to grow this crop with profit, and gradually the acreage has been reduced, until in the great majority of cases the supply of the family has been the measure of the crop. To-day all this is changed. The potato planter, the high-pressure power sprayer and potato digger are coming to be considered necessary agents, and men are finding that from five to ten acres can be produced with machinery at as little cost as one-half acre by hand.

A few years ago the cry was going up from the press, all over the country, of the passing of the potato. Insecticides had been continued for years, composed chiefly of Paris green and carrying a large per cent of arsenic, until by their use the reproductive power of the potato had been weakened to such a degree that the development of the seed boll had been lost, and the per cent of starch greatly reduced. This was the situation throughout Maine, and I assume it was the same all over New England, when bold spirits called attention to the danger of this active poison, and made a plea for the use of agents harmless to the user, but effectual in destroying insect life and promotive of the best life and growth of the plant; the result being that a new era has dawned upon the potato grower, and all over eastern New England to-day cellars are filled with a bountiful crop, where non-poisonous insecticides have been used and spraying continued throughout the season.

Rust and blight have been the great enemies of our potato crop, but scientific investigation gave us Bordeaux mixture, and to-day the grower may be, by this effective compound, insured against the ravages of these two fungous diseases.

A few years ago the hand sprinkler, the shaker or bag, or later the low-pressure hand sprayer, furnished the only means of application, and gave little or no relief except from the insect pests. To-day we have the high-pressure power sprayer, covering one acre per hour, providing for the application of both the insecticide and fungicide in the most thorough manner to every part of every leaf or stalk; and with this machine the farmer may snap his fingers at insects and fungous diseases.

So rapid has been the march of progress that we are continually being startled by what men are doing in the production of new varieties and the restoration of those said to have been worn out; men who, by rigidly abstaining from the use of arsenic in any form as an insecticide, are bringing back in a few years the old-time power and vigor of the potato plant, and multiplying the potato bolls in rich profusion.

The bulletins may cling to the long-established theory and practice regarding arsenic as the base of insecticides; but the practical, every-day farmer, who thinks and studies, has found it a positive injury to his crop, — a promoter of decay and a destroyer of the reproductive powers of the tuber. The agriculture of the future maintains itself when it conforms to the best experiences of to-day, and stands with open vision awaiting a larger development to-morrow. The orchards of New England are feeling a new thrill of life as faith in this industry is quickened through the consciousness that disease pests can be controlled in larger measure, and that the sprayer will save the fruit and stimulate the growth of twig and leaf.

Out of this there is coming a better appreciation of the value of the tree, and this will insure that care and treatment which alone can promote its life and growth. Never has there been a day when our orchards have not yielded a large return for the investment, and never a day when there was such promise for the future as at the present moment.

The orange groves of California or Florida or the peach orchards of Delaware or Georgia may claim their followers and bring them satisfactory returns; but the strong, rugged soil of New England, — these rocky hills are yet to yield a harvest of fruit which in quantity and quality cannot be equalled in all the world, and to supply an ever-increasing demand from an ever-widening market.

Machinery opens the way for that continued cultivation of the ground, so essential, as it does for the protection of fruit and trees, so necessary in the production of the quantity and high quality demanded in the markets to-day.

You cannot rob your orchard of its grass and gather a harvest from its branches. Cultivation here is as much demanded as in the corn field. Growth, liberal growth of limb yearly determines the quality of the fruit, and this comes only by working and feeding the soil.

The milk industry is and must be, with the great bulk of Massachusetts farmers, the chief means of support, and therefore places exacting demands upon the individual. The margins of profit are narrowing as wider zones are reached for the daily supply. You realize this, but how are you meeting the difficulty?

Mr. Ellis told you last year at North Adams that 5,000 pounds of milk yearly per cow was the minimum consistent with profit. Is every three-year-old, and over, in your herds capable of exceeding this amount, — practically 7 quarts daily for 365 days? Has the capacity of every cow been ascertained by a study of rations and the weighing of the daily products? I ask these questions as a business man. You would not keep a hired man who did not earn his wages. Why, then, keep a boarder among your cows for the balance of the herd to support? If sentiment is to govern, these interrogation marks signify nothing; but if business enters in, they demand consideration.

You are making milk on a narrow margin, — there can be no question of this fact; and you must continue to do so in the future, surely until a better sentiment of co-operation is felt inside and outside the present milk belt. Where to economize is the question, — one not to be settled on this platform, for no man can answer it for another. If it were possible that this and other problems connected with profitable milk production could be solved by the scientist, and rations and practices mathematically correct given to the world, the immediate future would witness a great milk-producing trust organized, and the work be carried on after the methods of the Standard Oil Company.

Every man must be a law unto himself, so long as he is dealing with intelligent animals, and his profit is to come from the stimulation of the organs of maternity. At the same time, certain principles suggest themselves for consideration; and, first, the dairyman must never forget that in seeking an increase of milk he must come into closer intimacy with motherhood. You cannot force milk production,

— it must come by invitation. Exalt motherhood in your labors, and you insure larger returns; degrade it, and inevitably you lose.

Here is the reason why larger men are demanded than formerly to be successful milk makers; they are seeking, they must have a larger product; and the increase per head is in the man, must be in the man, before it can be in the cow. The natural law of reversion, which everywhere holds so tenaciously, is checked and advance made only by men with large conceptions and strong determination. It is the objective mind working upon and influencing the subjective.

You cannot maintain this industry on purchased cows. No herd was ever built up in this manner. What is wanted is the patient, nervous, resolute, hearty and persistent milker; and such cows are not found in large numbers at Brighton or Watertown. They are grown by men who begin with calfhood to build tendencies into fixed habits, and establish relations which will invite the largest possible production from the thoroughly unselfish mother. Breeds are secondary to type; families, individuals, are to be studied for what they represent.

In Massachusetts there is no room for the dual-purpose cow, a large flow of standard milk throughout the year being the one consideration, and special-purpose animals the means and instrumentalities. Beefy tendencies in structure thwart milk production; and if any animal so constructed is a great milker, it surely is despite and not because of what must ever be an obstacle.

The cow required should be loose in structure, coarse rather than fine in frame, angular rather than smooth; with broad, thin shoulders; large, roomy barrel; long, well-sprung ribs, set wide apart; broad, strong loins; high wethers and pelvic arch; long, slim quarters; good-sized udder, with greatest possible surface attachment to body; strong and large mouth; open nostrils; clean, intelligent head; the evidence of vigor and stamina in every part, and an eye that tells of life, intelligence and individuality.

Is the picture of such a cow clear before the eye of the mind as I speak? If not, I fear the ideals necessary for a dairyman of to-day are lacking. Such cows always bring returns to their owners. They are the mothers which respond to care, kindness and environment.

In breeding, look well to the male. The meanest scrub is the pure-bred scrub. Herds are yearly being ruined because owners have relied on purity of blood and not studied pedigree and individuality. Always use pure-bred males, but make certain that their dams and grand dams were great producers; that they themselves are of distinctly dairy type back of the shoulders, have that quality and flexibility of skin which indicates what is wanted; have well-defined rudimentaries, free and distinct from the scrotum, and the more of udder development the better; but making certain that, with all these, there is pronounced masculinity in head, neck and shoulders. Too many herds are headed by effeminate bulls, and they never improve the quality of the offspring. Such an animal as has been described, from any of the dairy breeds, will improve the herd, giving heifers which, when intelligently weeded, will give great producers.

You determine very largely the future of the calf before it is six months old. If milk production is to claim attention five or ten years hence, these suggestions are of the gravest importance.

Beyond this, there is the great question of rations. Too many carry their milk checks to the grain stores, and go home empty handed for their labor, save that they have in the dressing that which will increase the value of their farms. Such methods are too slow a way for getting on in the world now.

What crops can be grown to increase the carrying capacity of the farm, and reduce the output for western grain? What combination of grain and fodders will insure the best health and production? What quantity can be fed most profitably? Here are vital problems to every milk or butter producer, and you ask the speakers on this platform to answer them, but they cannot be solved by another. You must "work out your own salvation, with fear and trembling."

If the experiment station could determine this for the dairymen of the State, it would dwarf their manhood, lower the standard of their agriculture, and help make of them a machine. No, every man must be a law unto himself, and no man can, justly or honestly, condemn the industry until, by careful study of the bulletins, by patient toil of brain and hand, by sharp, intelligent selection of sires and dams, by the growing of the greatest possible quantity of fodder of various kinds, by the proper housing of his stock, the renovation of his pastures, best possible care of his cows and regularity in feeding and milking, he has solved the question for himself from a business man's stand-point.

One fact, to be emphasized again and again, is, that you cannot force milk production. It must come, if at all, by invitation; and this suggests that kindness of treatment which will secure comfort to the creature.

Incidentally, it is well to note that loss may come by the production of five per cent milk for a four per cent market; if so, the addition of a heavy milker of poorer quality will balance the whole. You cannot afford to give what you do not get pay for, and what is the severest tax upon the energies of the cow and the pocketbook of her owner.

All these suggestions only emphasize the thought to be pressed upon the attention, — that to be a successful farmer one must be a careful student, a sharp observer, a constant reader and a close thinker, and these qualities tend to a manhood above par in the currency of the world.

New England is honeycombed with iron rails. They stretch away up every valley and search out every hamlet. Stand on our hilltops, and the smoke from thousands of industries tells of the immense calls made three times daily upon the products of the soil to feed the toilers in shops, mills and factories, — calls which should be, might be, supplied from our own rugged, productive acres, if men but had faith in themselves, pride in the occupation, and a realization of the responsive power of our hills and valleys.

Tell me, if you will, why Florida and Delaware should grow your vegetables, California so much of your fruit, and the prairies your corn, beef, mutton, pork, poultry, butter and horses? Is it because your acres are all utilized in the growing of a richer, more profitable product? If so, the query has no force; but as I ride over these granite States I see thousands, yes, hundreds of thousands of acres growing scrubby pines or small oaks, which should be supplying the mouths of our artisans and mechanics. The story may be read all over New England, and it is one to which thoughtful attention must be given.

The man who lives nearest the home market is the one to cultivate that market with greatest profit to himself. No State in all the Union offers such advantages to the truck farmer, who utilizes the experience of the past in lighting the path of the future, as Massachusetts.

You cannot annihilate space, you cannot take from the near-by grower the possible superiority of his fresh product. These two factors have been ignored, and these light soils, warm, responsive, early, neglected, may be, yes, some time will be, made to feed the multitude with small fruits and vegetables. Are these simply assertions without foundation?

New England agriculture in the future is to be concerned, first of all, in feeding its own rapidly growing population; developing its own resources out of its own richer, fresher finished products; and turning to other sections for what can be produced there at less cost than here.

Had I time, I might extend these illustrations over all the field of crop and stock production. They suggest a thought which I would press home upon the attention, not only of the representatives of agricultural societies present, but, through you, upon the mind of every farmer who is seeking a larger harvest and more substantial returns. The agriculture of the future must keep pace with other industries, the wheels be set at as rapid motion, and the skill, energy and application directed to the furtherance of its advancement be as concentrated as in the great shops and mills, or it goes to the wall. You cannot maintain a dual standard along industrial lines.

Our agriculture has suffered for the lack of that aggressive, dominating spirit which has characterized the advance of our mechanical and industrial life. The agriculture of the future must have injected into it that enthusiastic spirit of progress; that sharp, incisive desire for improvement;

that all-absorbing demand for inventions which will assure the toilers on hill and valley all the means, agencies and appliances which, rightly understood, will enhance rural life by increasing the measure of its scope.

Extensive, intensive agriculture must be the motto everywhere for those who have faith in the strenuous life of the present generation. Those who have toiled and struggled in an earlier period, who have been fettered by the smaller conception of hand labor, must either conform to the conditions which face the youth of to-day, or quietly sit in the shadow of the chimney corner and watch the procession in its rapid march. The agriculture of to-morrow cannot be hampered or hindered in its forward movement by those tied to old-time practices, else the State will fail in its development and the industry suffer in its advancement.

> "Theirs not to make reply,
> Theirs not to reason why,
> Theirs but to do and die."

Do you accept the truth of what I am saying? Are you looking at the problems from this stand-point?

Viewing the question as I do, believing in the possibilities of New England agriculture, having faith that we are on the eve of a great forward movement, which is not only revolutionizing our methods, but that through the incoming population from our cities, of the great west and south, to our farms we are to see in the next decade a marked change in the situation, it is to me imperative that we view this question with unbiassed minds, free from all the habits of past years, with only the thought of the largest and freest future for the industry.

No longer can the agriculture of New England be hampered by those who would hold it within the narrow confines of old-time practices, — practices correct under former conditions, correct in principle to-day, but needing to be transformed and conformed to the life and conditions of the twentieth century.

Into the public life of the State, into the controlling influences on Beacon Hill, into all the moving currents which make the civilization of the present moment, this strong, positive, enthusiastic spirit of enterprise for New England agriculture must be pressed earnestly and steadily by every friend of the State.

We are burdened by a system of education which ramifies out from our cities and towns through all the rural sections to our lower grades of primary schools, colored by city life and city thought and shaped by the higher universities and colleges, naturally conservative, always dogmatic, firmly intrenched in long-established ruts, and yet we face the fact that the education of the future is to be industrial.

First of all, there must be planted, firm and deep in the mind of the young, the foundation upon those fundamentals which alone can endure; and, following this, that training which shall best equip the student for the life he is to enter.

To see things, to know things and to do things makes the educated man. Simple knowledge of books can never insure this result; and when this thought of education takes root, the study of nature will begin to receive that attention which alone can open the eyes to the marvellous story to be read upon the surface of Mother Earth.

The present system of education minimizes rural life and the worth and work of agriculture. The education of the future must exalt the one industry which exalts a nation. He who is the most thorough student of nature, who reaches most directly the throbbing heart of tree or animal, who hears the song of the birds and sees the beauty of the flowers, will be the one who will drink deepest draughts from the great storehouse of the libraries: will be the one who will hear most of the harmonies of life and find richest compensation in the studies of the great masters. Not a smattering of this and that, not a little insight into many things, but a well-balanced judgment, the result of calm deliberation upon a few great problems, makes the educated man.

We must never forget that there is a vast distinction between knowledge and education. One is the storing of facts, the other the utilizing of ideas in active life, the weaving of thought and purpose into the warp and woof of every-day living.

Professor Van Dorman says: "Education is training, is securing a knowledge of fundamental facts, of the why and how with which one comes in daily contact; is training the mind to think, the eye to see, the hand to do accurately and quickly and the mind to grasp easily. Such training is as thorough as that which comes from a study of Hebrew, Latin, Greek, mythology, ancient history or other subjects which have little bearing on the every-day life of the educated farmer, directly or indirectly."

President Gibbs of the New Hampshire Agricultural College declares that: "Life has become so complex, and competition so sharp, that one must choose; there is not time for all, and the studies of the first twenty-two years should develop deft fingers as well as trained intellects. I do not wish to be misunderstood. I believe in everything that educates, every college and every school; but I do not believe the old system of collegiate education is adequate at the present time."

Here is the key-note of the future; yet your classical institutions are crowded, while your agricultural and mechanical college receives indifferent attention, to the injury of the industry.

If the authorities quoted are correct, a revolution must be worked in public thought, and the true worth as well as necessity for industrial education presented in such form as to attract the young man of to-morrow. No outlook of the future can neglect this intricate phase of the question. Our land grant colleges are equipped for thorough work. New England agriculture suffers because this work does not claim attention from the masses. What, then, is to be done?

I believe the solution rests largely with those now on the farms or directing the agricultural thought of the hour. Popularize your agriculture by proving its worth. Dignify your agriculture by more pride in the farm. Modernize methods and practices by machinery. Demonstrate the financial results by business-like accounts. Attract the young by your own enthusiasm. If this cannot be done, if these results are impossible, then it is a crime to longer maintain schools for instruction or hold institutes with the avowed object of quickening interest in rural life.

The personality of the men who stand as instructors is a potential factor; but back of that there must be more faith in the industry, made manifest in a deeper enthusiasm, before the young will feel their nerves quivering with desire to strike hands for larger control and wider dominion over the giant forces of nature.

No man can work out the problem by physical power alone by himself to-day. There must centre in and unite with him great forces and agencies; and to compass the work given into his hands, the man must first be a thinker, with power of concentration.

The danger in our industrial life is that, for the lack of this concentration, men will drop to the level of the machines by whose sides they are working, and become automatic in their operations; and the danger out upon the farm is that the mechanical will claim attention to such a degree that men will forget that the hand is to be but the willing servant of an active brain.

The work of this Board of Agriculture, it seems to me, is, first of all, to quicken thought, then to arouse ambition, then to stimulate enthusiasm for the larger lines of service which open on every hand; and the education demanded is not to make men farmers or mechanics or tradesmen, but first of all to make them men, and to cultivate within them the desire to know, to do and to see things as they are, and to grasp their meaning; to realize that life is not all in the hustle and bustle; that there is something beyond the mere making of machines; that more is involved in life than simply the growing of crops or the making of products; that the ownership of things is crude and unsatisfactory, and that mastery comes only when men know by what means and methods the steps which they desire to take are to be obtained.

Honor to the young man who aspires and resolves to own his home or his farm; but if he be content with this ownership, it dwarfs manhood and belittles life. There must be the broader conception of what the home or farm stands for, of the possibilities of either or both for true happiness and growth, or the spirit of manhood dies, and in the lower stratum that life, without impulse or ambition, drags a miserable existence.

Where, with calm action along these lines, we seek to make our industries of greater value because of their significance, and not as the end of education; when we come to understand agriculture, not with reference to the methods of growing a crop or the making of any product, but touching the great problem of life which manifests itself everywhere and seek to enter into close harmony with it, — there is sure to come a compensation not to be found in handling crude products or in bending over a machine.

Not every boy can be trained to a successful life on a farm. Wisely has it been ordained that natural tastes and desires should control; but recreant have we been, in the work of the past, in not setting clearly before the rising generation the opportunities for utilizing those natural desires in fitting themselves for the most harmonious life. Thousands of men in the professions to-day find life a drudgery, because during the formative period, in the work of the schools, they were not helped to see the picture of a life most harmonious.

I pity the man whose environments are such that he cannot be working out his ideals; and well may we urge that system of mental training which will naturally and inevitably strengthen in the minds of the young those natural traits and tendencies which always promote enthusiastic labor. When this is possible, the mass of toilers will become thinkers, not machines, and the measure of the man will be something larger than the sum total of his day's labor.

That this may be stimulated, I would place pride in the farm and its surroundings as the central invigorator and chief inspirer. Out of pride springs enthusiasm, out of enthusiasm courage, out of courage hope, out of hope faith, and out of faith determination. Every man is an artist, leaving upon the fruits of his labors his conception of what is involved therein. We want more pride, that we may have larger conceptions. Read the artist thought and life, not alone on the canvas or marble, but along the highways, about the homes. No matter how much one gathers, how bright the colors, how attractive the spot, if the touch of the artist is not seen in straight furrows, clean hedgerows, neat, tidy outbuildings and well-tilled fields, we know that life there has been shorn of its ambition and swept of its enthusiasm.

Along one of your main trunk lines there are two pictures which I would that I might paint so that you would not forget. Across a broad field, through which runs a brook, I see, backed by a hill, a neat white dwelling and long red barn and outbuildings. The fields, naturally rocky, are well kept, the buildings attractive, the yard clean, and the whole a picture to be cherished. Again, I see another field: the fences are down, the weeds growing rank in the corn, the brush is along the fences and through the fields. The location is a pleasing one, but the buildings are unpainted, except the house; the farm implements are scattered about the place, the stamp of shiftlessness is clearly to be seen: but the farm is named, for on the roof I read, in large letters, "Allcock's plasters cure pain." Are not these two men artists, and have they not painted pictures which will not be forgotten?

No more attractive sight meets the eye of the traveller than the name of the farm clearly painted on the gable of the barn, when in harmony with the surroundings; but no man with a shadow of self-respect will sell his home for an advertising bill-board.

You cannot promote your agriculture on this low level. We must have more pride in our farms, until we are able to put a stop to the decorating of rocks, trees, fences and buildings for the profit of merchandise. Every roof or wall, tree, rock or fence, so blemished, is a barrier in the path of agricultural development, in that it belittles the picture of the home and lowers the conception of the farm.

Sir Humphrey Daly, the great English artist, once said that he "never allowed himself to look on a poor picture, because of its influence upon his own hand and brush." Subtle influences, of seemingly trivial importance, often change the whole tenor of one's life; and, for the best growth to be possible, the outside surroundings must be attractive and inviting.

I have endeavored to lay emphasis on these points, not that they are altogether neglected, but that there is need of a more active agricultural sentiment, to combat the unwarrantable assumption on the part of the reckless lover of sport, who would override all rights of ownership; to check a growing tendency on the part of the State governments to throw the arm of protection around wild game, for the sole purpose of multiplying the same at the expense of the farmer's crops; and to correct a tendency in rural life to pattern after the devotees of fashion, and be discontented with that quiet life of the farm, which, appreciated, will insure time for thought and opportunity for growth.

The introduction of machinery is certain to revolutionize rural life, as it already has industrial: and in the awakening an open door is to be found for such increase of stock, products and crops as will send a volume of fresh blood coursing through every artery, and bring blossom and fruitage to every hillside.

Out of the complex conditions, now manifest on every hand, there is crystallizing a movement which is certain greatly to advance New England agriculture. It is showing itself primarily in the purchase of farms all over New England by those inured to city life, for the permanent improvement of the same as farms, and especially in the attention which nature studies are receiving at the hands of our most valued educational leaders.

I cannot close without placing strong emphasis on the educational work of the grange in promoting rural life. It was created to upbuild agriculture and strengthen love for the farm. Where this purpose has been the controlling influence with the members, your agriculture is most active, its advancement most rapid, the rural homes most attractive, the schools most loyally supported, and the social atmosphere is being clarified from the dross of petty pride and jealousies. The grange has unified and cemented public sentiment for the advance of our agriculture, and, unless swerved by selfish interests or marred by dissensions, it will be, as it must be, the chief ally of this Board in the forward movement of the future for better farms, better homes, better schools, a more intense agricultural spirit, and, as a natural sequence, a more active and self-centred citizenship.

One of our writers pays this noble tribute to agriculture: "When the time had come in the creative evolution for the stamping of the perfected animal with the Divine image that forever separates him from all previous types, it was no wonder that God set man, in whom the perpetual struggle between the body and soul was to take place, in a garden for his education."

The outlook for New England agriculture must be positive, the horizon must broaden or converge, all depending upon those who direct, suggest and inspire the energies of the next quarter of a century.

Here are the markets; here the industries are multiplying rapidly; here is to be the great distributing centre for manufactured products; here are the acres which will yield larger crops than prairie or plantation; and here a climate adapted to the growing of a vast variety of food for man and beast, and of a quality unexcelled upon the face of the earth.

In the constructive work, a more aggressive agriculture, the student, professor and worker have offered the greatest opportunity of their lives. The conditions are favorable, the times are auspicious, the tide is setting towards New England, and the currents of thought are centring about these granite hills.

It is for us to help open wide the gates and usher in a sentiment which shall sweep over New England, multiplying the flocks and herds, the orchards, dairies and crops; insuring that growth of sturdy population which in the future will give that strength of purpose, vigor of thought and loyalty to principle which thus far has made New England the dominating factor in our social, industrial and political life.

The Chair. Before proceeding to a discussion of the subject so ably and interestingly presented to us by Dr. Twitchell, I wish to give notice that luncheon will be served to all visitors in attendance when the meeting adjourns.

Mr. A. M. Lyman (of Montague). What the lecturer has said about waste lands does not need to be corroborated. A great many think farming is not carried on to any extent except where the soil is alluvial and easy to work. If the same enterprise were put into waste lands that is put into alluvial, we would see great results.

Dr. Twitchell. A gentleman in my own State told me yesterday that since the sixteenth day of last March he had sold 126 farms, and that he had received during the year something over 6,000 letters regarding farm property in our State. Ninety per cent of those farms have been sold to people out of the State to be improved as farm property, and only 6 per cent for summer homes. I think there has been the same increase of demand for farm property in your State as with us. Men are selling their farms in the west and coming to New England to buy farms near markets. It is best to make the most of an opportunity that is without doubt coming to us.

I have here a sample of cream, and after the discussion is concluded I would like to have you test it. The cream is nine days old, and was taken from the farm yesterday morning. I am willing to take the statement from the owner of the cows that there is nothing in the bottles but pure cream. I know the man did not use anything as a preservative, and I think you will find that the cream is as sweet as when first separated. How does he produce it? Not by using the old-fashioned milk pail or strainer; not by sterilization, not by pasteurization, because he has not resorted to either of those; but he does it by keeping out of the milk that which would contaminate it. The cows are brushed off before milking, and sponged, and fresh sawdust is scattered over the floor, from which all the droppings have been removed. The pail used is one made by H. B. Gurler, the noted dairyman of Illinois, and provides for holding cheese cloth over the opening in the top, on which is spread a layer of absorbent cotton, and into this the milk is drawn. The result is freedom from all taint of odors and a uniform high quality of pure milk and cream, and such cream is injured by any of the processes like sterilization or pasteurization.

It is guarding the milk from the udder to the separator and cream bottle which insures quality, and nothing else can do this.

QUESTION. How long will it remain in good condition?

Dr. TWITCHELL. I know one lot shipped which was nine days in the expressman's care, and the day after the same was received by the consignee, he came to Manchester to inspect the farm, and contracted for all the cream he could get. He said it was as sweet as ever when it reached him, and this was in June.

QUESTION. How do you account for impurities getting into milk?

Dr. TWITCHELL. It is the dust in the air and on the cows, the odors of the tie-up and particles of dirt on the clothing of the milker, carried into the milk. It is surprising how much of these impurities there will be, even with the care usually taken.

QUESTION. What is absorbent cotton?

Dr. TWITCHELL. It is such as surgeons use. A roll costing twenty cents would last a month or more. It is put up like ordinary cotton, only treated so as to cut the fibre, and permit it to absorb more readily than ordinary cotton.

QUESTION. Do not most cows give in accordance with what they are fed upon? Would not all cows be good cows if fed well?

Dr. TWITCHELL. No, there is and must be a difference. Some cows pay a good profit, others do not; but we lose in that too often we do not open the way for them to do their best. Individual tastes differ among cows as well as men, and the largest yield follows conforming to the tastes of individual animals. The study of rations must be to combine palatability and nutrition with economy; to find the ration which will best satisfy, and at the same time enable the cow to do her best. The study of by-products is all-important, as related to health, comfort, productiveness and economy. The drain on eastern farmers for western grain can be greatly reduced by a study of what can be more cheaply grown at home, and then growing all that is possible.

Mr. A. H. KIRKLAND (of Reading). I believe we are richer for having come here this morning. I believe we have gained much from the eloquent address of the speaker. No matter what our business may be, we have gained new ideas. The farmer needs to have his mental horizon broadened and enriched. There is no better place to think than on the farm.

I want to say a word about summer boarders. They may enrich the farmer's resources and also his life by broadening his horizon. I believe every year nearly every farmer can take boarders in the summer time, and make money out of them. Give them good milk without specks in it, and good butter, — not the kind they can find in the city stores, — and give them good beds to sleep on, and make them comfortable.

My native town was running down about the time when I was a boy, and the church attendance was falling off. A good many people were moving out, and things looked pretty blue there ten years ago, until we took up the summer boarder business. Now we have more and more boarders there every year. Our church gets better support. Men have more money to pay their bills with. The boarders have considerable money with them, and they keep in touch with our private life. Every man from the city brings a crop of new ideas. More than this, I believe the farmers enrich the boarder's life. They go back to the city with a new idea of home life, home as it should be, and it helps them to live a more ideal and useful life.

Mr. James Draper (of Worcester). My line of work is in trying to make the world a little more beautiful and inviting, in embellishing the homes and parks of our city, and I want to emphasize what the lecturer said about advertisements on barns and fences. The idea comes out often in the economies of the farm, — that the owner cannot afford to make these improvements. If they cannot do that, there certainly is no reason for making it worse, and for a small compensation allow their buildings and fences to be degraded.

The Chair. I see Mr. Anderson of Shelburne here. He is a successful farmer, and we would like to hear from him.

Mr. Anderson. I have been very much interested in the lecture, and I have been satisfied not to say a word myself; but I feel, as one of the delegates of the State Board, that I have some duty to perform, some work to do. I don't feel that it is my duty to go to these meetings and do nothing, to take no active part in the doings of the Board.

Gentlemen, it has always been my life to improve the stock of our town, of our county and of our State. If you improve the neat stock of Massachusetts, the horses, the sheep and the swine, you improve the men. No man can look upon a nice animal and not feel that he is blessed; no man can look upon a scrub without feeling scrubby. What we want to do to-day is to encourage young farmers to raise better stock. We can have better cattle in New England if we will only take hold of the matter. It belongs to the State Board of Agriculture, I feel, to take the advance step in the matter of improvement.

Mr. —— (of Petersham). There is nothing that needs improving more than our farms. What is there more exhilarating than to be able to make two tons of grass grow where we have been getting but one? Irrigation will, I think, improve our farms more than any other one thing. It may be expensive at first, but there is nothing which will enrich our farms more. I have increased the production of my farm, which was a good one when I bought it, more than twofold, and my success has certainly made me love that home. I think it makes any one love his home to improve it. I think what we need is to improve these homes. It is what makes us all contented, — to think we have something there, something for our children to look upon, something beautiful; and one thing that makes our homes attractive is to have the city people come and board with us. The city people that come to Petersham are an honor to any town.

Ex-Sec. J. W. Stockwell (of Sutton). I am very glad to add my word to the valuable discourse to which we have listened. I have been travelling around the State some this summer and fall, and have found out some things which interest me intensely. If Massachusetts is to take any rank in the exposition that is to be held in St. Louis, it is because she stands in the front rank in lines of intensive agriculture. In her greenhouses scattered over the hills are produced for our people in the winter season the finest, freshest possible fruits, vegetables and flowers.

In these lines Massachusetts agriculture is making a wonderful advance, and we want to encourage it. I believe the future of Massachusetts depends on this intensive agriculture, on these intensive methods and processes, and it is a wonderful thing for us.

Dr. Twitchell. The time has come for the organized body in your State and mine to take a strong forward step, and lead the forces for a vigorous advance which will be felt on every farm and in every home for the good of the State in all time to come. Milk and butter for our splendid markets, — not beef, for the west can produce at less cost than we; fruit and vegetables; poultry; and then the finer product, flowers, — these are the lines where efforts may be concentrated, intense application given, brains utilized to the utmost and results secured; these are the lines indicated for the next step in advancing New England agriculture.

Afternoon Session.

The meeting was called to order in the Opera House at 2 o'clock by Secretary Ellsworth, who introduced Mr. Augustus Pratt of North Middleborough as the presiding officer.

The Chair. Notwithstanding the fact that bicycles, street cars and automobiles are common in our streets, we still have use for the horse, the most noble of animals, and we shall continue to have use for the horse. I take great pleasure in introducing to you this afternoon a gentleman who is thoroughly informed in regard to the rearing of the right horse for New England. His subject, as I read it here, is "The successful type of horse that may be profitably raised by New England farmers," illustrated by stereopticon, by Mr. Harry W. Smith of Worcester.

THE SUCCESSFUL TYPE OF HORSE THAT MAY BE PROFITABLY RAISED BY NEW ENGLAND FARMERS.

BY MR. HARRY W. SMITH, WORCESTER.

The American Trotter and Roadster.

The successful breeding of trotters by New England farmers has proved, nine cases out of ten, to be a failure, for the reason that in producing the type everything is sacrificed to the one desire, namely, speed; and every one I believe will acknowledge that the hilly, rocky roads of New England are not what one would term proper speedways for the working out of the three and four year olds.

Then, again, when speed is the one desire, to obtain same fifty per cent of the colts raised are made unsound before they come to a marketable age. This is brought about from the fact that few of the breeders have suitable, light road wagons to work the youngsters in; consequently a heavy weight is put behind them, and curbs, spavins, etc., are often the result; or we find they are over-driven by ignorance in training, and a large percentage of the horses become afflicted with chronic indigestion or scouring.

Feeding is also one of the essential points that the average New England farmer is not up on. It is generally conceded by most of the New England breeders that hay is good enough for horses until they are three years old, and then possibly two quarts of oats to a feed.

The following illustration shows how the two-year-olds in England are taken care of and nurtured, and the necessity of careful, generous feeding of the youngsters.

There is absolutely no doubt but what to nine-tenths of the people a fat horse is always more attractive than a thin one, and the same applies equally well to the young stock.

Our thoroughbreds which have come from the Arab stock have within the last one hundred and fifty years been raised from an average height of 14–2 hands to fully 15–3 and 16 hands. This has been brought about by careful, systematic and generous feeding of the youngsters, and it is a fact that many of the training stables to-day feed their two-year-olds twelve to fifteen quarts a day.

It cannot be said that the New England farmer is the only one that has had the one point in view, namely, that of speed. Throughout the whole United States this has been the only point sought for in trotters for years; and this is naturally so, because it is speed that brought the money and won the money.

Cicero J. Hamlin, years ago, was criticised on all sides for purchasing "Mambrino King," the so-called "dude horse," in Kentucky, on account of his good looks. All those who had the pleasure of attending the Madison Square Garden show of 1893–94 remember the handsome chestnut stallion, as he was led down the side line of the ring, with simply a nose band in the hands of his colored attendant. The attention of the vast audience was perhaps equally divided between "Mambrino King" and Prescott Lawrence's celebrated hackney stallion "Fashion."

C. J. Hamlin made up his mind at that time that there would come a time when there would be a call for American trotters that would be good looking and of good type, with well-set-on necks, etc., as well as having the one attribute, namely, speed. He worked for this continually, and was successful, by the aid of his "Mambrino King" and "Chimes" cross, in putting more winners into the 2.10 list than any other stock farm in America; but also, as is generally acknowledged everywhere, the Village Farm has done more to produce good-looking trotters with speed than any other farm. But the Village Farm was the exception; nearly every one worked on the same idea, — speed, speed, speed; consequently one cannot wonder that the breeders here and there scattered throughout New England were impressed with the same fact, and, now that a tremendous demand has come for good-looking trotters as well as those having speed, on the different speedways throughout the United States, those able to produce same are few and far between.

Then, again, a farmer devoting himself to the raising of trotters exclusively is confronted with the fact that he is obliged to put his youngsters in the market to compete with millionaire breeders, who perhaps expect to drop $40,000 or $50,000 a year in their farm or racing stable. A great many of them, being ignorant of the game themselves, do not know what is wanted, and consequently the market is flooded with bad types and bad kinds. It is this flooding of the market annually that makes the price.

The expensive stock farms are all provided with private race tracks, and many of the leading owners are making a point of breeding their youngsters in the south and California; and it can readily be seen that even the rich New England breeder is at a great disadvantage on account of the cold, rigorous winters; and at what disadvantage must the New England farmer be, who has none too warm stables, and the only place to put his colt out in the winter a frozen-up barnyard, and the only place to exercise him through the snow drifts to the post-office and schoolhouse.

That it is possible to breed good-looking speedway horses in New England no one can doubt. All these difficulties have been overcome time and time again in the past, and will be overcome in the future. I shall not dwell long on this point for the simple reason that there will be enough breeders who will still continue to breed trotters.

The cut of "Baron Born" gives one an idea of what is the needed type on the speedway. "Baron Born" by "Baron Wilkes" has won a number of blue ribbons at the Madison Square Garden on account of his rare breeding and good looks; and to those whom it is impossible to wean away from their first love, namely, the American trotter, I can only say this: if a youngster is worth raising, he is worth taking care of; feed him well, clothe him well in winter, and break him carefully. It is far better to break a horse single, so that he will drive evenly on both reins, rather than put him in double for six or seven months, and get him to lugging on one rein.

Go out on the speedway in New York, and you will see that the trotters that bring the prizes are high class in every respect; they not only have speed, but they have manners; they understand, when they are brought around to the door, that they are to stand quietly while their owner gets in; when the reins are taken up, to start easily and pleasantly; not to throw their heads up and down when a horse comes up beside them, but just show by their manner that they are ready to move along, and waiting for the necessary word to be given and their speed called on; but not boiling over, trying to brush with every horse that may come up behind.

The American Trotter as a Heavy Harness Horse.

We can all remember when every American drove in a light four-wheel carriage drawn by either a pair or single horses, with a breast plate, over-draw check, breeching, etc., a collar being only used for draft or job purposes. This was the typical American hitch, and a most satisfactory one for the trotter or roadster.

When one thinks that it is only within a short time, so to speak, that there has been a call for the heavy harness horse in America, it can readily be seen how promptly the type has been produced.

At the last New York show I had the pleasure of spending a good part of the week in the judges' ring with DeLancey Kane, who brought the first four-in-hand coach to America some thirty years ago.

In England and France it has been a custom for years to name the different coaches, for instance, "The Harkaway," "The Rocket," etc. DeLancey Kane's imported English coach was named the "Tally-Ho," and the name was rightly lettered on the coach; consequently, every American, when he saw a four-in-hand coach of any kind, at once called it a "Tally-Ho," and the name, which at first was wrongly given, is now understood everywhere, north, south, east and west.

It was only a question of time when American gentlemen wanted means of carrying more than one or two in a carriage, and this necessitated a more substantial equipage, together with stronger harness, stouter horses, etc. This is what our English brothers had been working on for years, and when in search of heavy carriages, we naturally turned to their Brougham, Victoria, Tandem cart, Stanhope gig, and Coach and Brake.

The English coaches of to-day are principally manufactured by Holland & Holland, and are only equalled by the American coaches manufactured by Brewster. They have a weight of some 2,500 pounds, and sell for about a dollar a pound on either side of the Atlantic.

With the heavy carriage came the heavy harness, broad leathered straps, curb bits, heavy collars, etc.; and how absolutely incongruous our rangy, leggy, light-boned, light-bodied trotter looked in such a harness. He was out of place, and his most enthusiastic admirers must concede ungrudgingly that the hackneys, as a class, far excelled him in compact form, roundly turned quarters and well-set-on tail.

Before 1902 the majority of the heavy harness class in New York were won by imported hackneys, the property of W. Seward Webb, Twombly, A. J. Cassatt, Joseph E. Widener and others. I can remember distinctly when Widener carried off the four-in-hand prize with his team of imported chestnut hackneys that were worth a trip to New York to see.

The American horse dealers in New York at once saw what was wanted, and C. F. Bates, who later developed into one of our largest winners of blue ribbons throughout the horse show circuit, at once took the initiative. He established a farm in Ohio, sending out representatives all through the east and west, purchasing trotting stallions of good conformation, size and action, and sent them to the stock farm, where they were gelded, their tails docked, and taught to drive single, double, four and tandem, and to carry themselves in a proper manner, dropping their chins to the curb, etc.

This at once opened up the field for trotting-bred, heavy harness horses. The prices obtained in the market fairly rival those for winners on the track. At one of the large sales held in New York a year or two ago 44 heads realized $65,750, — an average of $1,494. The first 20 of these horses brought more than $50,000; a four-in-hand realized $10,750.

Thomas W. Lawson paid $29,000 for his four-in-hand of prize-winners, "Glorious Flying Cloud," "Whirling Cloud," "Thunder Cloud" and "Red Cloud," and it is generally acknowledged for horse show purposes as a park team their equal has never been seen. Mr. Lawson has always been a firm believer in the American trotter as a heavy harness horse, and from the start has been willing to pay any price so as to obtain animals which would win the blue ribbon, and be a credit to "Dreamwold."

His exhibit, at the Grafton Country Club horse show in the spring, of "Red Cloud" and "Bonnie" won the heart of every farmer who attended, from Vermont on the north to Connecticut on the south.

When C. F. Bates first brought out "Coxey," "Brown Donna," "Hi," "High Tide," "Whirl of the Town" and others, there were 21 classes exclusively for hackney stallions, mares and colts, and 32 breeders made 110 entries; but this has fallen off year by year, until now there are less than 30 hackneys shown, and these by only 2 or 3 breeders.

In the years 1892–93 I showed "Sky High;" he was by a trotting stallion out of a Morgan mare, bred in New York State. In the high-stepping class at Madison Square Garden in 1892 the competition was not especially keen; but in 1893 he came up against Joseph E. Widener's champion hackney mare "Dorothea," who just carried everything before her at the show in hackney classes.

Widener drove "Dorothea" and I drove "Sky High;" it was the American type and breeding against the English type and breeding, from the drop of the flag. After fifteen or twenty minutes the majority of the horses had been called to the middle of the ring or had been sent out, until there were only four or five of us left. I had been carrying "Sky High" carefully and easily, husbanding his strength as much as possible, for, with his flashy markings, four white feet and white nose, and his previous record, it was impossible for him to be turned out of the ring without a thorough trial. Then came the crucial last ten minutes, and here the American pluck and energy won out. "Sky High" could not only go as high, carrying himself as well, but could go one-third faster; consequently he carried off the coveted blue ribbon, and it was thus in the majority of the heavy harness classes.

Every American has a desire to get there, and get there promptly. The American trotting-bred heavy harness horse, with his ability to go down in 2.20 to 2.30, produces this type; and it is only a question of getting, with the speed, the proper conformation, substance, and, above all, bone.

"Lord Brilliant," winner of 410 blue ribbons and 90 championships, is perhaps the best known of our American heavy harness horses; and the only point against "Lord Brilliant" that can be spoken of is his size, 14–3½, and lack of bone.

"Sundown," in my opinion, was the "beau ideal" of an American heavy harness horse, standing, as he did, some 15–3 hands high.

Judge Moore of Chicago, who has for years been an advocate of the American heavy harness horse, this year commissioned W. D. Grand to purchase "Forest King," the champion heavy harness horse of England, and for once departed from his love of the American type, and brought over the English hackney. He landed a few days before the New York show, but was in good condition when shown against "Lord Brilliant" for the Waldorf-Astoria cup. "Brilliant" was not at his best, being shown by his owner, Dr. Wentz. Then, again, "Forest King" towered above him, and, with his wonderful knee action and almost perfect manners, carried the judges with him, and was adjudged the winner.

The same scene, principally the same audience, the same actors on Saturday night for the championship, both high actors of the highest quality; Judge Moore still driving "Forest King," but Batonyi, the wizard of the tan bark, up behind "Lord Brilliant." It was the battle of the giants. Batonyi at once saw that his only chance with the smaller horse to beat "Forest King" was to show more speed, more quality, more action, and, withal, more "brilliancy;" and added to this must be the power to go twenty-five to thirty minutes round and round the tan bark ring. Judge Moore, who had driven "Forest King" only once before, and had possibly never been up behind a hackney until that time, at once attempted to follow the flying "Brilliant." He was able to do so for a few turns of the ring, but after that it was all over, — but the shouting. Batonyi would carry "Brilliant," with his little side step, around the corners and set him down at the long side of the ring at a 35 or 40 gait, head up, eyes flashing, ears pricked forward, his beautiful neck with just enough substance about it to show strength and crest, and just enough lightness about it to show the necessary curves and quality. The old horse went almost as fast as he had ever gone.

When you think that he was originally kept in the stud at Illinois as a trotting sire; shipped to Boston in 1896 with a carload of horses, and sold at auction there for $145 to Charles F. Baker, who has the honor of developing him as a heavy harness horse; was first shown at the national horse show in 1897, and for five successive seasons has been the champion winner there, — one can readily see that he had a record behind him that no heavy harness horse can ever expect to equal. I grant that he is a bit old, but still the fire and dash were there; and it were far better to still hold him up as the type, and acknowledge him as the champion of American heavy harness horses, than to give the blue ribbon to the imported hackney, with his beautiful manners and high knee action, but thick-necked before the withers, light middle piece, and lacking endurance and speed.

In talking with Fownes, who, with his brother, are the best-known four-in-hand and coaching experts in England (in fact, it was in their honor that the Fownes driving glove was named), he stated that hackneys were never used on the coaches in England, they always preferring some breed with a dash of the thoroughbred.

Now, the hackney should be exactly the type needed for coaching, being, as we all know they are, the ideal, English, heavy harness horse; and this frank acknowledgment of one of the leading exponents in America of English coaching would seem to cover the point conclusively.

There are trotters that are perfectly capable of winning in the heavy harness classes at our door. In this connection the following story will be interesting: —

My "Sky High" was just a little bit hard to handle, so much so that when I went to Genesee valley hunting in the fall I used to leave him in the hands of my friend, Thomas Callahan of Worcester. He got along beautifully with him, and in driving him Mr. Callahan soon became acquainted with what a high stepper and a heavy harness horse should be, so much so that a year or so later he came to my office and stated that he had seen a high stepper in Charlton who was as good as "Sky High." I laughed at the idea, and asked him to produce the horse, which he did. She was a chestnut mare and an in-bred Lambert, and, whereas lacking a little in bone and substance, was one of the best-actioned mares that has ever been produced in America. He kept her for a year or so, and asked my advice as to her disposal. I advised Mr. Charles F. Baker, who had developed "Brilliant," and Mr. Baker purchased the mare, naming her "Queen of Quality."

She was shown at Philadelphia, and carried all before her in the high-stepping classes; was then sold at auction for $1,950, later on was sold for $4,000, and is now going up and down the Bois in Paris, the admired of a thousand eyes, — and she was bred in Charlton.

O. A. Kelley of Worcester had a trotting stallion, "King," of good type, conformation and color. I first saw him at the Grafton Country Club horse show in the roadster class last year, and admired his type, and later on saw him at Sturbridge. I made up my mind that when I was next in need of a heavy harness horse I would purchase him. When "Ting-a-Ling" died I purchased the horse from Mr. Kelley, made him into a heavy harness horse, showed him at the Grafton Country Club horse show, winning three blue ribbons there, beating all comers, and have been offered a very large price for him.

This all goes to show that the American trotter as a heavy harness horse is a success; but it has been generally necessary to take stallions and geld them, to obtain the size, substance and conformation desired.

Hackneys.

Prescott Lawrence's "Fashion," who was one of the first hackneys imported, always had a warm spot in the heart of every heavy harness horse admirer.

The hackney had its origin in England, and came from the efforts of a number of breeders who were interested in the production of a certain type; they found here and there mares of this type, and from this a stud book was started, these mares being marked as inspected mares, — that is, they had been inspected, and were of the proper type.

There is no doubt in the minds of many that to produce the hackney the Suffolk punch and different cart breedings were used; but even with this the case, the hackney as he stands to-day is in the opinion of many the beau ideal of heavy harness horses.

Their breeding was taken up by the leading horse fanciers of England, Burdett-Coutts, with his immense wealth, being one of the foremost breeders.

There was something most attractive about them. The picture of "Fashion" yet before you shows all the fire, vim and dash; and in the hackney there was a breed which, while it produced in its stallions horses of a standard and type, likewise produced the same in its mares, which can hardly be said yet of the American heavy harness horse.

The hackney fever soon came to America, and such breeders as W. Seward Webb at his farm in Vermont, Twombly in New Jersey, Prescott Lawrence in Newport, Henry Fairfax in Virginia, Widener in Philadelphia, A. J. Cassatt of Pennsylvania, soon established large studs, importing thousands and thousands of dollars worth of the best-bred hackneys that could be purchased in England.

In reading the history of the hackney, one is impressed that in "Norfolk Phenomenon," who was said to have done twenty miles an hour in England, was the type of what we wanted in America. But the horses that were brought across the water were not of that type. Away back in the dark ages there may have been hackneys that were able to go twenty miles an hour, but they have never been landed on this side. In fact, in my opinion, the reason why the hackney as a harness horse has not had the proper justice done to him in America, is because the majority of those who were originally imported were kept hog fat, simply shown at the end of the halter, rather than being put into work, and shown in working condition.

Widener's "Dorothea," that "Sky High" defeated at the New York show in 1893, was in hackney show condition rather than heavy harness condition.

The hackney stallions were not in this country a great time before experiments were tried in crossing them on the leading strains.

A. J. Cassatt, who imported "Cadet," the champion of England, to this country, crossed him on a thoroughbred mare, and produced "Clipper," who has won a number of blue ribbons in the saddle classes, both in New York and Philadelphia.

Henry Fairfax, who imported "Matchless Londsboro," a horse who carried all before him at the New York show in 1900, 1902 and 1903, and later sold him to W. Seward Webb for $20,000, did a vast amount of experimenting in breeding to the thoroughbred and the trotting mare.

It was only last year when in Virginia that I came across a splendid type of the heavy harness horse, 15–3, that was a descendant of his stock, half thoroughbred and half hackney.

Webb, Cassatt, Widener, Fairfax and all the rest retired from the ring, as their colts were brought to New York year after year from their stock farms and sacrificed at low prices. There was absolutely no call for the hackney, and, as he was beaten in show after show in the heavy harness classes, it seemed to many a wonder that he was ever produced.

It remained for Eben D. Jordan of Boston, with his Plymouth stud, to take up the fight and show, as he has done at the last two New York shows, Boston and Newport, that there was good in the English hackney when he was properly handled, and the right type purchased from the other side. Mr. Jordan, instead of sending agents, went over himself and personally inspected the many studs, and visited a large number of the attractive horse shows at the old country places and shire towns in England. Whereas he shows yearly in the breeding classes, his greatest pleasure is in winning in the harness classes, and in this he was most successful this year at the New York show. At the last Grafton Country Club horse show we were fortunate enough to have Mr. Jordan exhibit a number of his hackneys, and they made a most favorable impression among the farmers.

Mr. Jordan does not take the position that the hackney as a heavy harness horse is far ahead of the type of the American heavy harness horse; but he does take the position, and rightfully, that the American heavy harness horse is not of a type as yet; he is apt to be light-bodied, rangy looking, and moreover light boned, so much so that it is invariably necessary to go to the stallion to get the proper type of harness horse. In fact, of late years I hardly remember a mare that has been successful in carriage classes.

In "Gentleman John," champion hackney stallion of England and America, Mr. Jordan has a wonderful stock horse, and he is not only large in size, but of good color, temper, and good conformation and bone.

If the hackneys who were founded thirty or forty years ago are now of a type so that like begets like, it is not at all impossible to suppose that hackneys crossed on trotting mares will give them the additional bone and substance which they so much need.

In "Knight Errant," by "Lord Denby 2d," Mr. Jordan has produced a good type; he is a four-year-old bay gelding, standing 16 hands; his dam was "Lady Leonard," a standard-bred mare by "Jay Bird."

Another point which was clearly carried in mind by those who desired to produce a successful harness horse type is the fact that they must have well-turned quarters, the tail carried in the right place, and properly. This the hackney has, and has always had, and is one of the few types that is invariably good in this point. In the American trotting mare we have the pacer type with sloping rumps, and the trotter with its thin neck and badly carried tail, all of which are unsatisfactory from a horse show point of view.

Right here I want to pay a tribute to the American trotting mare, and the chances of what she would produce when properly mated with the English hackney or other breeds. When one stands in the show ring and watches twenty or thirty horses go around, the first thing that catches his eye is action, next speed, next conformation. The hackney has the action and the trotting mare the speed, and what must the combination be? Once in a while, the desired type.

After the horses have been slowed down to a walk, the worst weeded out, then the rest brought into the ring and looked over for conformation, you find the American type of stallion — as I have stated before, there are almost no mares shown — to have the one failing, namely, lightness of bone. A good hunter should be nine inches below the knee, and many a blue ribbon winner does not span seven and one-half inches. Sloping rumps and badly set-on tails are the next most objectionable points; badly carried heads and lack of proper bitting are perhaps the next.

Picking the hackney to pieces, he has a wonderfully well-made head, although a trifle coarse, but broad between the eyes; generally of a good disposition; the neck, especially in the mares, is well cut about the throttle, and crest exceptionally good; but the worst point is the thickness just in front of the shoulders on the neck, — this no doubt comes from the cart breeding. All hackneys are invariably of good color, which is a desirable point.

The majority of those I have seen have the best of feet, broad heels; and this is where many of the American trotters are very lax.

In the American mares we have intense virility, enthusiasm, dash and boundless energy, that carry you at a three-minute gait up hill and down hill.

I drove "Sky High," having Mrs. Smith with me, in a

Stanhope gig weighing 600 pounds, with heavy show harness, after one Boston show in April, forty-five miles from Boston to Worcester in four and one-half hours; and I should believe it perfectly possible to get together a four-in-hand with a 2,500-pound coach to come from Boston to Worcester in the same time; but they would all have to be of the American trotter type.

Now, it must be clear to all that the American mare has just what is lacking in the hackney; and, as I have before remarked, if they are properly interbred, the desired results must ensue in a fair proportion.

Now, when this fair result is obtained, how much better is the position of the farmer than with his young trotter. Here is a horse which when a three or four year old is capable of doing a little work; he is the right size and substance, and there is no reason why he should not be worked to a certain extent, and help earn his hay and oats; and if he is not over-done the chances are that at five or six he is sound. Then, if he is properly bitted, there is a chance that he may be sold and come to his proper position, — that of a heavy harness horse; but if he is not sold for a brougham or coach horse, he makes a most useful delivery or job horse, and on account of size and substance has a certain value over that of the weedy, light-waisted trotter in the heavy truck work of the world. Then, again, if he should remain on the farm, he is large enough to do his share, and need not be kept for light driving alone.

It is to be regretted that the New England farmer did not appreciate the Morgan horse when he had him in all his pureness. Have we ever had, or will we ever have again, a horse that, when you got in behind him, filled you so full with the love of his kind as the Morgan? I grant they ran from 14–3 and 15–1, but this was absolutely the only fault you can put your finger on. They were always of a good color, and nine cases out of ten clean-legged, and chuck full of that controllable energy that makes a success of horse or man.

I remember three or four of them, all chestnuts, well-carried tails, beautiful hazel or blue eyes, ears and mouth asking you questions and answering your questions throughout the entire ride. There are all sorts and degrees of happiness; but no matter how high or how low your degree was, you could always add twenty-five per cent by a ride after one of these chestnut wonders, that never knew what "tire" was, and thought hills were made to run up.

Action.

I have said a good deal about action, and, so as to give you an idea of what action is, it seems necessary to describe it a little more fully.

There is knee action, shoulder action, combination knee and shoulder action; hock action, stifle action, and combination stifle and hock action. The accompanying illustrations give one a very clear idea of the difference between the action of the American heavy harness horse and the hackney. "Jersey Lilly" and "Lord Pick-'em-up" are representative hackneys and blue ribbon winners at a number of the leading shows in New England; "Sporting Duchess" and "Show Girl" won blue ribbons at Newport this year; "Fascination" and "Elevation" carried all before them at the Madison Square Garden show.

It will be readily seen that attractive action and so-called flashy action can be easily obtained by simple knee action and hock action; but there is absolutely no go-ahead to this action, — it is up and down, and it is in the same place, with only possibly a little advance all the time.

To the American trotter there is added shoulder action and stifle action; and they not only show that flashiness, but also place the feet when they are put on the ground at a certain distance ahead, so that the covering of the distance rapidly, or speed, is the result.

One would hardly believe it possible that horses could be trained to show such phenomenal even action both in front and behind as in the illustration shown, — "Sporting Duchess" and "Show Girl;" but the camera is true, and you see before you the knees absolutely even, the hock absolutely even, — in fact, the whole horse poised to a nicety, with his chin dropped and neck bent, consequently his body properly contracted, with the hind legs underneath him where they belong, which is bitting.

Bitting.

I can only devote a few moments to bitting, and I want to say at the outset that I thoroughly appreciate the American abhorrence of curb bits, etc.; but they are absolutely necessary, and it is impossible to drive four horses or even two horses properly with a plain snaffle bit.

As the previous illustration showed, action is brought about to a great extent by proper bitting and the carrying of the chin in the right place: and one would not be able to drive four horses, to turn figure eights, — in fact, have them under proper control at all times, — unless they were properly curbed.

Every horse must be taught to know at once that he is absolutely under your control; and each horse of the four must then, of course, feel the same. No man can hold four horses, should they attempt to run away; but they simply do not attempt it, because they have been taught that they cannot go up against the curb. With the plain or snaffle bit the runaway with well-conditioned horses is easily obtained; but with the curb bit it is almost impossible, — hence the need of same.

Our American horses for years have been driven with the overdraw check, to hold their chins out; and the average race driver has a pair of holders on the reins, and pulls 150 to 200 pounds on the lines; and we all know many and many a horse who pulls two in a buggy on the reins.

This is absolutely wrong for heavy harness horses. The first thing to do is to have the chin dropped, the head in the proper position; have the body in touch with the bit from the point of the chin to the tip of the shoe behind. This was the principle of the celebrated French school of Haut-e-Cole, and it is the principle that all successful hunters, high steppers, heavy harness horses, jumpers and hackneys are broken in on.

There are many different kinds of bits and many different methods of bitting; but with the heavy harness horse the principal point is to teach him that he must not pull a pound. No coachman can keep his proper position on the box, have the team under good control, and be able to drive through a crowded thoroughfare, with a lugging horse, in either a pair or four.

With the curb bit goes the nose band, which is the most important part of it, especially with the port bit; most nose bands are wrongly made, and only for looks. The proper nose band is broad, and can be buckled up tight enough so that the horse, instead of being able to open and close his mouth at will and get away from the bit, finds his jaw held where it belongs.

If I should give any trait which I would consider absolutely necessary for horses of any type, I would say mouth. To show you how necessary this is, I would state that "Sure Pop," by Barrett, that I won the high jump at Boston with, — six feet, six inches, — was almost unmanageable when I first purchased her; she had never been taught to drop her chin, but would throw her head up and boil away at her jumps a thousand miles an hour; there was absolutely no way of settling her into her stride and keeping her back without raising her temper to an ungovernable degree.

Then, again, in driving she had that very pleasant habit of starting out on her hind legs, and seemed to believe that her front feet were made for looks only. I worked her with the curb and broken snaffle, and finally put in a perfectly plain snaffle, the same as the ordinary check bit, before I found out just what was needed. With this I was able to control her absolutely; the broken snaffle pinched her and irritated her; the plain check bit gave her an easy bit when she behaved nicely; the curb bit with the tight nose band when applied let her know immediately that she must turn either to the right or left, or stop at once. After a few days she began to acknowledge the bit, and it was only a question of time before she was going over six and seven feet as quietly as a lady.

The picture of "St. Rudolph," the champion hunter of America, shows the system of nose band, curb bitting and well-carried head. The picture of "Pierrot" gives a slight idea of the Haut-e-Cole method; and in the hands of H. L.

DeBusigney "Pierrot" is a wonderful example of the high school horse.

That there must be something to the mouth and bitting goes from the fact that there has been no way yet brought out that would teach a horse to do this or that at command. Of course we have all seen horses go down the crowded streets with no bit, guided by a whip; but that is simply a trick, consequently of no value.

The "Presidential four at Worcester" shows clearly four horses all in touch, excited by a vast multitude, behind them our strenuous President, and he whom every New England farmer loves best and honors most, — George F. Hoar, — with a brake weighing 1,800 pounds; yet all with their chins in the proper place, and under proper control.

To give you a little idea of the breeding of the four horses, I would state that the off wheeler, "Sapolio," came off a milk wagon in Worcester; the nigh wheeler, "Rubdry," was wheeler on the "Red Jacket" four from Buffalo to Niagara Falls, and was one of a carload of ranch horses, half thoroughbred and half Percheron; the off leader, "Stop Not," is a grandson on one side by "Gallopin," winner of the English Derby, and on the other side by "Barrett," the best thoroughbred that Pierre Lorillard ever owned, — in fact, "Stop Not" is fifteen-sixteenths thoroughbred; the nigh leader, "Ting-a-ling," was by $75 ex a street car, but the pick of the basket, the flower of the flock; there was no doubt a large proportion of Arab in him, as the mottled Belton ticklings on his skin showed. These were horses all of different breedings, all tremendously excited, yet all under control because they were properly bitted.

"The Cad," winner of the $10,000 championship in 1900, is perhaps the best illustration one can get of a thoroughbred under control. He was a horse who, in the hands of McLaughlin the trainer (who was the premier jockey of America for years), was found more or less unmanageable and impossible to bring up to his field of horses, and was continually breaking at the wrong time.

I got him from Mr. Wadsworth of Genesee valley for $150, and I can distinctly remember that it was three days before I could get him so that he could put his head into the proper place, and by pulling, breaking, twisting and rearing he kept me intensely busy. At last I was successful, and, like all of the best horses and best men, the harder they are to manage the better they are in the end. What he accomplished you all know, and the picture now before you shows that he had pitted against him the best riding talent of the country; he won hands down, and never threw his head throughout the entire journey of three miles and a half, over liverpools, water jumps, hurdles, banks, etc.

French Coaches.

Whereas England has gone ahead with its hackneys and produced a successful type of heavy harness horse, at least successful for its short distances and heavy traps, we must look to see what France has done in the same line with its heavy harness horse, namely, the French coach.

But the work in France, rather than being undertaken by individuals, has to a great extent been done by the government, through the national haras.

The French coach horse has never been so popular in the United States, — has never been so much of a fad, so to speak, as the hackneys were; at least not in the east, where the principal horse shows have been held, and this is where the heavy harness horse naturally made his reputation.

Too much credit cannot be given J. S. Sanborn for his pioneer work, so to speak, in bringing over the best French coaches that could be obtained to his Elmwood stud farm at Lewiston, Me.

One has but to read the matter sent out by Mr. Sanborn to see that he is a thorough student of French coaches, and had the ideal, which we are now working for, in view, namely, a heavy harness horse, which would possess action, courage, great road powers, style and beautiful conformation. He spared no pains in importing such stallions as "Gemare," "Lothaire" and others, and crossing them on the native-bred stock.

That the French coach also has a type in its mares is easily seen from the picture of "Clementine;" and in

"Freddie" we have one of the most attractive crosses from a native mare.

Long before Mr. Sanborn started his good work, so to speak, Dunham, the western importer at Oakland Farm, Fort Wayne, Ind., had taken pains to import the finest coach stallions that could possibly be obtained in France; and from the illustration, "America leads in horse importation," now shown, you will see that McLaughlin Bros. not only wanted to win all there was to win in America, but went further, and purchased, from time to time, all the best stallions that could be obtained in France, and showed them before importation.

The French coach has one point which makes him a most desirable stock horse, and that is, that he has fifty to seventy-five per cent of thoroughbred blood in him; and this type of horse was no doubt produced by the crossing of the thoroughbred on the Norman or Percheron mares.

The family of French coach horses, taken as a whole, show more of the beautiful curve and type of the thoroughbred than the hackneys; and many of the horses imported by Mr. Sanborn were closely related to some of the best winners on the tracks of France. For instance, the grand-sire and great grand-sire of "Gemare" were the begetters of trotters that were winners to the amount of 500,000 francs.

To give you the best possible illustration of the crossing of a French coach on a trotting-bred mare, I would show you the picture of "Queenston." This beautiful saddle mare was bred by C. J. and Harry Hamlin at the Village Farm, and was the result of sending out a number of their "Mambrino King" mares to the Dunham Farm at Fort Wayne to be bred to "Perfection;" and certainly "Queenston" shows that she was bred to perfection, as a more perfect animal of her type is hard to be found.

At the Boston horse show in the saddle classes she was almost invincible; at the Grafton Country Club horse show she carried all before her, even to the combination class; and at Newport won on Tuesday, and on Wednesday the championship for the best saddle horse in the show.

I think you will agree with me that the picture of "Queenston" is almost perfect in every detail. The beautiful head, well-cut-out throttle, perfectly turned neck, coming nicely into the shoulders, each foot in its proper place, or, better, in its natural place, well-filled quarters and perfectly set-on tail. Looking at "Queenston" without knowing her breeding, one would say that she was three-quarters thoroughbred.

If the nick of the French coach with our standard-bred mares can produce the type of "Queenston" once, they may do it again. The dam was simply an average mare, one not thought good enough to breed trotters from at the Village Farm; and the value of "Queenston" is what? Anywhere from $1,500 to $3,000. The cost of bringing her up was what? Simply her feed until she was three or four years old, and then careful breaking. In fact, her whole training for saddle purposes could have been done in a five-acre lot, in fact, better than anywhere, so as to make her supple and prompt to bit; and all that is required in the saddle classes is a good walk, good trot and canter and a pleasant disposition, all of which she possesses.

I never had the pleasure of meeting Mr. Sanborn, but I only wish he could have had the pleasure of looking at "Queenston," as he was so interested in the French coach, and was so absolutely sure (and it is this absolute sureness that brings success) that he was on the right line.

Thoroughbreds.

"Ben D'Or," one of the most celebrated sires in England, is beautifully illustrated in the picture now before you, with his stable companion who was always with him nestled up in his accustomed place.

You do not often see a finer type of muscle, sinew and bone; yet you can go down to the race track and you will find stallions almost as good looking to be had for the asking, simply broken down from over-work on a tremendously hard track. Nature has as yet to make a back or middle tendon that can stand what the trainers ask; and year by year good thoroughbreds are broken down by the hundreds.

Pierre Lorillard's "Barrett" was taken to England, as he had been tried on the dirt course and found faster than "Iroquois;" but he was unable to extend himself on the slippery grass courses, and was later brought back to this country. He stood at Genesee valley, and sired some wonderfully good hunters, one of which I purchased, "Sweet Brier," whose dam was a road mare.

To show you the staying qualities of this one-half bred, I would state that she was driven on Saturday from Worcester to Lynn; on Sunday, from Lynn to the Myopia Hunt Club; on Monday she was shown in the hunter classes, and won several ribbons; Tuesday I hunted her on a twelve-mile run at 6 A.M.; at 9 A.M. she started for Worcester, sixty odd miles, and landed there at 9 o'clock that night in good shape, having eaten every meal on the road, and four quarts after she arrived home.

The champion hunter at Islington, "Royal Mask," will give you a little idea of what may be obtained with thoroughbred crosses; and the horse rearing on one leg shows that strength is not necessary to jump, simply the "know how." This was wonderfully exemplified at the last New York horse show, when the half-bred hunter "Rupert" walked into the wings of the jumps from four feet six inches up to six feet without an effort, and hopped over the top of them.

The winning English stallion of 1903 will show you that the thoroughbred type of to-day, instead of being light-boned, thin and lanky, is a wonderful example of much in little, as compared with the Percheron or shire.

There are many sluggish, coarse-bred mares, which, crossed with thoroughbreds, would produce a type of horse such as my "Rubdry." When my country place at Grafton was in the process of construction, "Rubdry" could and did outpull every horse that was on the place; if there was ever a rock to be got out that the others could not start, they put him on, and he generally pulled it. As a weight-carrying hunter he won second at the late Norfolk show, and carried my brother successfully for a season with their hounds; has jumped five feet time and time again, and is a most useful horse in a wheel of four; he has not tremendous action, but from his thoroughbred breeding it is impossible to kill him.

In the illustration of "Blue Grass Maid" we have a typical picture of a Kentucky gaited saddle horse which has been produced by years of careful work of our southern brothers; and the principal sires have in their pedigree the blood of "Squirrel" or "Denmark," who were clean thoroughbred. When quality, suppleness and energy are needed, one must invariably go to the thoroughbred.

In his majesty "Ambush 2d" we have about a perfect type of a thoroughbred steeplechaser; and in winning the grand national, as he did in four and one-half miles, he readily showed that he not only had the ability to jump, but also the brains to carry him around the difficult course without falls from interference or otherwise, and stamina enough to finish out the distance.

It has been proved by Governor Stafford of Palo Alto that it is very necessary to cross out to the thoroughbred to produce our high type of trotters. Our English brothers even go further, — that is, they cross out to the thoroughbred to produce about any type of horse they desire.

The thoroughbred is as much of a type and as game as the American trotter. You will note I give the preference to the American trotter, for the reason that we have thoroughbreds who can run their mile in 1.35½ on a straight track, and in 1.38 and a fraction on a curved track.

Where can we find thoroughbreds that, like the American trotter, can repeat and run six or eight miles all in less than .41 or .42 in the same afternoon? They do not seem to be bred these days; yet the American trotter will go out and try heat after heat in .08 or .09.

Of late there has been a call in England for a lighter horse of the truck type, to have enough breeding to be quick on his feet, start a load promptly, and be tough enough so as not to go wrong.

This type is wonderfully well exemplified in "Black and White" and "Sandow," who are half thoroughbred and half shire horses, and very much of the heavy-weight hunter type. It is this class of horse that is used exclusively on road coaches in and out of England, as they are bred well enough so as to be able to gallop if necessary, and gain enough with the aid of their warm blood to keep the cold blood going.

Review.

Now, suppose that arrangements could be made so that Mr. Jordan's hackney stallions and Mr. Lawson's trotting-bred heavy harness stallions could be shown at the principal "cattle shows" throughout the fall, — as yet they have only been shown at a few shows outside of Boston, Brockton and Grafton, and the average New England farmer is not conversant with them; then in the spring have them walk from town to town, as is the habit in Europe, standing one or two days here and one or two days there, the whole matter being done in a careful, systematic, methodical way, breeding the hackney to the light-boned, waspy, exceptionally breedy-looking mare, and breeding the trotting-bred heavy harness stallion to the cold-bred mares, with the cross of the Percheron or Clyde, and I cannot but believe that good results would ensue. The hackney would correct the bad points of the American mare, and the American stallion would, with his warm blood, speed and dash, help bring up to line the cold-blooded part Percheron, shire or Clyde.

With the two send a thoroughbred stallion, which could also be crossed on a cold-blooded mare, and give to those interested a heavy-weight carrying hunter, or a lighter truck horse or carriage horse, where action is not desirable; and in order to make the matter complete, a coach stallion should be included; then I believe farmers in all parts of the country would be able to obtain just what stock horses they would need, and be able to produce at the end of a certain length of time a desired type.

In France this matter is taken in charge by the government in a most careful way. The stallions are inspected carefully before being put into the stud, and infinite pains are taken that at the fairs suitable prizes are offered for the get of different ages; and in many cases the government itself adds interest to the matter by buying in the better examples.

In my opinion, it would take only a certain length of time, if the matter was gone into carefully, before the very best results would ensue. Some one who was thoroughly conversant with the types that are desired would want to be sent out with the stallions, and it would be perfectly simple to have cuts of the different leading crosses shown to the farmers who are interested in breeding their mares.

And now that horse shows are springing up everywhere, and from the fact that the country fairs are all in want of attractions, it is only a question of time in my opinion before they will all include a horse show among their regular lists, and in a broader plan than they have hitherto done. The mere taking of these stallions around from show to show in the fall would open up an entirely new field for the farmer; and I feel sure that the leading fairs and horse shows of Massachusetts would be very glad to offer prizes for half-breds of this or that type shown by legitimate farmers.

The whole matter could be easily done from one head: and in ten years' time, instead of raising a crop year by year, as we do of trotters, one out of ten of which is useful for regular carriage purposes, we would raise a crop of heavy harness horses, eight out of ten of which would be useful for regular service; and at the same time build up a type of American harness horse, by use of the cross of the hackney, thoroughbred and French coach, that would rectify the bad points in each.

Can any one point to a type to-day and say that it is the true type? In my opinion it is impossible to do so as yet.

By the systematic crossing of the four types of harness horse with standard-bred and cold-blooded mares we would be bound to produce in the course of years the right type: and, if the proper judges were kept at their posts at the shows and country fairs, it would only be a question of time before those in charge of the matter would obtain stallions which, with proper brain work in this stud use, would beget the qualities that are sought for, and would produce the ideal American heavy harness horse.

If the time, brain work and energy of the American farmer has produced the American standard-bred trotter, who to-day stands unrivalled by any type of horse of the world, it would seem to me far easier to produce the heavy harness type. It is far easier to produce hunters than race horses, and the same comparison holds good of the heavy harness horse and the standard-bred race horse. Extreme speed is the hardest goal to gain.

Let us show those interested in breeding an object lesson of what we would produce by the crossing of the different breeds of which I have endeavored to give a little history, and I believe they would agree with me that it is far easier to breed the heavy harness horse than the light harness horse, and the owner's purse in the end would also be of the heavier type.

QUESTION. In your opinion, is it advisable for a breeder to practise the high action we have heard so much about?

Mr. SMITH. I don't think so. There are plenty of ways by which you can readily see whether a horse has high action or not; you do not need to know whether he steps high or not, you can tell by the way he carries himself. It is not necessary to take them out and pound them to get this action; it comes naturally. They can be balanced to bring forth a higher action, but you cannot put it there if it was not there.

QUESTION. You say it can be done by breeding?

Mr. SMITH. Yes.

QUESTION. Is the horse better controlled by a check-rein?

Mr. SMITH. Fashion controls a great deal in the horse world, excepting in the race track or trotting park.

QUESTION. Will you kindly tell us what a colt ought to receive for feed?

Mr. SMITH. The question of feeding is about the same with horses as with the human race. You can get as many horses spoiled by over-feeding as you can by under-feeding. I purchased two or three years ago a thoroughbred, bred by Mr. Haggin. He has eight hundred thoroughbred mares on his Kentucky and California farms, and he has forty or fifty thoroughbred stallions. His product in thoroughbreds is about the highest that can be attained. The horse I bought was the handsomest type I ever saw for a steeple-chase horse, thin and wiry. The same idea applies to horses as to big men. Most big men are apt to be built on the soft type. He was fed on eighteen quarts a day, and became impossible to handle. I bought him, and thought I should have a world-beater. He had catarrhal fever, and he all at once wasted away and became of no value. With this tremendous amount of food he was over-fed. If you can get a horse fat on the ribs, with the fat laid pleasantly, when he goes out in the spring he is rounder and more supple, and he grows easier, and if he grows easier it is more natural.

QUESTION. What is the best kind of feed to give a mature horse?

MR. SMITH. Well, that is a pretty hard question to answer, I believe, and I think you will agree with me. There is not much doubt that if horses are to be worked hard and regularly, oats are like beefsteak, and for a steady diet are something to be depended on; but if one eats oats and beefsteak all the time, he will get run down.

I remember as a boy taking a trip from Oregon to the lower part of California, to San Francisco. There was no railroad, and we were obliged to go all the way on a stage coach. About every eight miles they changed horses, and I would stay up day and night; I would have to stay to keep the seat, that is the only way I could get it; and I found out, from the eight or nine miles, the total distance the horse could go, that they fed a great deal as we did,— oats and hay and mash. There is no doubt about mash being necessary, as it is necessary for us to have an amount of vegetables, and if carrots are fed we have good results. You go where horses are worth thousands of dollars apiece, and you will be surprised at the kind of diet that is given them. At Saratoga and Morris Park they bring carrots and everything you can think of. They bring fresh clover, and many breeders send back to California and have hay brought out. Enoch Wishard goes to infinite pains. He has the whole thing reduced to a system. He watches the horses carefully, and has them all guarded by mosquito netting, and the horses in his stable are made as comfortable and put to as few inconveniences as possible. The health of a horse and the use of a horse depend on how he is fed. We have horses who do not seem to need a mash, but no doubt, in the opinion of most of us, if a horse is turned out to grass a little while before the flies come, it tones and freshens up his digestion, and he lasts longer.

The CHAIR. Dr. Twitchell, we would like to hear from you.

Dr. TWITCHELL. Mr. Chairman, ladies and gentlemen, I have sat here for an hour or more, and have been most intensely interested; and personally I want to thank Mr. Smith, for, while he has shown us all where his natural love and fancy would be, he has given us at the same time a most clear, fair and discriminating setting forth of the essential qualities of all the types he has presented; but, gentlemen, I think I am in the same condition of mind as you. We have not seen our old horse yet. There is one class of horses you want, Mr. Smith, before you show your pictures in Maine. You have not shown us one of our western chunks.

Some years ago I attended fairs in this State and saw horses being bred, and since then I have known a little something, but not so much as to what you are doing now. But if I were home in the State of Maine to-day I should say we might take hold of the work along the lines Mr. Smith has set forth, because the State of Maine is cursed by the western chunk. It is the heaviest burden we have upon us. I don't know whether it applies to you, but I mean the poor little low-headed, coarse-framed, slow-motioned western horse that represents nothing adapted to New England life, or that of New England agriculture. If you have such, go home and knock them in the head to-night. To be behind a horse like "Brilliant" you will be a better man, your head will be in the air, and you will be filled with the thrill of life that always comes in driving a good horse. You get behind a western chunk, and where are you?

I tell you there is an application in this thought of tremendous import. If we burden our farms with that class of stuff, as New England has been burdened for the last ten years, we drag down our agriculture. You put in Maine or Massachusetts those fine horses, horses that will walk more than four miles an hour, free, easy, elastic-moving animals, and they will drag some of us out of the old ways. They would be good for the farm and for the farmer. There are too many ox-horses being employed in plowing. They are not fitted for our conditions to-day. We want better horses. Our agriculture merits better attention. We want more breed in our horses and teams we are driving. We never can get out of our present condition and reach the point we desire until we get freed from the entanglements, and get freed from all deformations. A well-built horse is a help to better agriculture. You may find them in the American trotting horse, in the Percheron crossed with thoroughbreds, with the French coach horses, find them anywhere, but for Heaven's sake, let's find them.

Mr. A. M. Lyman (of Montague). About ten years ago Dr. Twitchell gave a lecture at Greenfield on the horse, and some of us got the best horse we could procure for him to score, and when the scoring was finished it footed up 67. Some of us were disappointed because it didn't score 90. The explanation Dr. Twitchell gave was that the best horse in the world would not score 100, and I should like to know how much nearer to that figure he is now than he was ten years ago.

Mr. Smith. I have been up against the same proposition, ever since I have been in the show ring, in Montreal, New York and Newport, and generally with different judges each time. They bring different types out, and I have agreed with Dr. Twitchell that in the conformation of a horse 40 out of 50 is as high as I believe in placing them. A judge would say put him at 50; I say put him down 40. I say, how can you put him to 50? Is he perfect? I think we are advancing just as much as the trotting record is advancing.

Now, in regard to the question of conformation and type of horse, it is perfectly wonderful how the market has advanced in the last ten or twelve years. When I first showed in New York, in 1891 or 1892, you could count on your fingers the good-looking horses that would come in harness classes: now you can count as many in the dealers' class; and we not only have gone ahead so fast, but pairs are shown now where ten or fifteen years ago it was hard to get well-matched pairs. Now you see eight or ten pairs matched to one not matched. The horse dealers are just as much of business men as any men. They simply scour the country from one end to the other. In Maine there was a man named Bishop who had a wonderful heavy harness horse, and it was reared in Maine, and I tell you in my opinion he was the finest type of horse, and "Sundown" was the name. Mr. Morgan used to go there each year, and had posters put up of the type of horses he wanted, and would have them come to the hotel to see if he wanted them. The same was done by Mr. Bates in the west. When you get the public working on a certain type, they generally produce something, whether horses or soldiers.

QUESTION. Should you use blinders on farm horses?

Mr. SMITH. Well, blinders in my opinion are a pretty useful sort of a thing. They keep a horse a little more alert, and a little more sharp. If a horse is without blinders he is inclined to get a little bit lazy and careless. He does not see as much, and sees only what is in front of him, and is not frightened by objects appearing at the side.

I want to go back to what Dr. Twitchell said about the ox-horse. I don't think I ever heard it put exactly in that way. We were always taught to have a horse with some ping-pong, something that would make you feel good when you got in to ride. I have taken friends out to drive whose fathers had horses, and they have said they did not know before what a good horse meant. The same is true of farmers, — any one with ox-horses. I never heard a better definition than that. If we go back to ox-horses, we are working backwards and bound to get backward. Now, if we get energy in our horses, we are bound to get a little of it ourselves. We are with our horses half the time.

Mr. B. P. WARE (of Marblehead). Many of the suggestions made by the lecturer are very valuable, but I want to warn my farmer friends against the attempt to breed the fast trotting horses that have been shown to us. I suppose not more than one in a thousand attempts is successful, and if perchance you succeed in getting anywhere near the points, it costs to train the horses to a fast pacing trot. It is well enough for millionaires, who are not obliged to earn their money as we farmers do, to indulge in such things if they want to.

Now, in regard to the horse with the string halt, that style of horse is very good for a show, but you see at once with that high action that would tear the forelegs and feet all to pieces in a very little while.

I want to say that all the bob-tail horses we have seen on the screen and on the street represent criminals. You know very well there is a reward of one hundred dollars by the society with a long name, of which I am a director, for any information that will lead to the conviction of the man or men who mutilated any of those horses, — mutilated them for life. It is a shameful thing. When it was first introduced I suppose it was because it was "English, you know," but if it was so then it is not now. When I was abroad I went to Queen Victoria's mews, and there she had one hundred and twenty horses, — not one allowed on her premises with a mutilated tail. King Edward has adopted the same rule; not a bob-tail horse is allowed on the premises. There is an example worthy of imitation by us. It is shameful to see what we do see as represented there, — such mutilation, such cruelty.

The question was asked, What is the best way to feed horses? I learned over there that a study has been made for years as to the best method of feeding carriage horses. The method adopted there at Queen Victoria's mews was to feed horses with six quarts of oats a day, with a sufficiency of hay, with bran mash once a week, and in the winter season an occasional mess of carrots.

Our friend, if I understood him rightly, recommended what seems to me is the proper class to breed. Brother farmers, if we raise a horse, let us raise a good one. Mr. Sanborn has introduced beautiful stallions. I have visited his place and seen the products, — most beautiful horses, and well adapted to New England uses. The thoroughbreds are another safe kind to follow. The hackney I believe our friend recommended, — those three breeds. I have no doubt that the French coach horses, of which "Gemare" is a good representation, would bring to us as farmers good returns for use or sale or anything, and we would be pretty sure of getting a good horse, with the best mare we have.

Speaking of breeding fast trotters, showing the uncertainty of it, I happened to know of the first colt that was produced of the stallion "Sinclair," who was the prize stallion in Massachusetts. The first colt that came from him never was worth more than $125, — I doubt if he was worth that. He was put in a milk wagon, but disgraced that, and was taken out. A homelier horse I never saw, and perhaps that was the highest type stallion of New England for a while. I speak of this showing simply the uncertainty of getting that kind of a horse, if you attempt it, for a fast horse. It is very unsafe for us farmers to attempt any other kind but French coach horses, which, according to my idea, is the proper type to follow as near as we can; and while we are raising colts, if we do, let us get something which is good.

Three years ago I had three generations of horses raised by myself on my farm. I have two now that are beautiful horses, representing the American and the Percheron. Not large and heavy. like the Percheron, a little larger than the American, my little horse has taken first premium, and his walking gait is more enormous than the trotting one. We are satisfied with a fast-walking horse to let him walk a while, but cannot with a slow walker. For farm work you want to have a horse walk as fast as you want him to, rather than to have him only creep along. A fast-walking horse I think is of more importance for the average family farmer, — I don't mean sportsmen; but it is decidedly of more value than any other fast gait that we get. It is just as well to breed a good horse while you are about it; but I beg of you, my friends, don't try to raise a trotter.

Mr. Smith. I think the gentleman who has just spoken has hit the nail squarely on the head. He has come down on the trotter. You remember my first chapter was about the greatness of the trotter; but, while that is so, the average farmer is inadequate to compete against the millionaire. If you are bound to raise a trotter, raise a well-made one, — one you could drive along the Speedway.

In regard to short tails, I am going to go back to that for a little. The Queen of England had reached that time when she did not set the styles over there. Now it comes down to the simple question of style. I don't like a short tail any more than Mr. Ware does; but when you are in New York of an evening you have to wear a full-dress coat. Now, I want to say that at the last one or two New York shows Mr. Gouch, an English expert, came over to judge saddle horses, and he has put the blue ribbon on the long-tailed saddle horse. Now, if Mr. Gouch can go ahead with his good work, he can bring the style around. It is simply a question of style. If the society with the great long name will get as much of a hustle on as the Massachusetts State Board of Agriculture, we would soon get where we could stop docking.

I have my stable as carefully screened as can be. I have an arrangement by which I have sticky fly-paper around, and above that I have sanitas dropped, so as to keep the place clean all the time.

Ex-Secretary Sessions. I want to express my hearty appreciation of the lecture this afternoon, coming as it does from a source where we might expect some fancy ideas rather beyond our approval; but I must say we have had a good, sensible lecture, one that the farmers of Massachusetts can well profit by, and I want to compliment the lecturer on his good, sound common-sense.

THIRD DAY.

The meeting, which was held in the hall of the Young Men's Christian Association, was called to order by First Vice-President Sessions, who introduced Mr. John Bursley of West Barnstable as the presiding officer.

The CHAIR. In yesterday's session there was some criticism made of the Agricultural College, which has done so much for our Massachusetts boys; and I am happy to say at the present time they are undertaking to give our girls instruction in those lessons which are so very dear to all of us who have spent our lives upon the farm; and I assure you it is with great pleasure that I am able to present to you this morning one who acquired his education there, and who, like many others, has gone forth to help organize and carry on the work in agricultural institutions for education all over this country and other countries. It is now my privilege to present to you Dr. Homer J. Wheeler, director of the Rhode Island Agricultural Experiment Station, who will speak to you upon those subjects connected with the keeping of the fertilizing element in our soils.

MANURIAL PROBLEMS IN SOIL RENOVATION AND IMPROVEMENT.

BY HOMER J. WHEELER, PH.D., KINGSTON, R. I.

The most casual observer who traverses southern New England by rail, and more particularly by the common roads, cannot but observe large areas of tillable land which produce crops of little or nothing excepting taxes. Careful inquiry in the same sections will show that certain farm products, which might be produced profitably, are being brought in from other States to supply the demands of local markets. No more striking example of this condition could be named than that furnished by a milk farm in Worcester County, where the owner was buying clover hay from the State of New York to feed to his cows, because he claimed that he could not succeed in raising it. Hay of the best grades is imported in large quantities into Massachusetts, Rhode Island and doubtless other of the New England States, which ought to be produced economically at home. We ought to profit by the example in a similar line presented by the present efficient head of the United States Department of Agriculture, who is using his utmost endeavors to have this country produce at home, in so far as possible, all of the products of the soil which the people of the United States consume. New England has surely suffered enough in the depreciation of agricultural property, as the result of the giving away of the public lands of the west, without sending the capital which is needed at home to still further enrich other sections of the country. No one can question the great advantage to be derived from making all of our waste lands productive, provided it can be done profitably, *i.e.*, if the markets justify such a procedure. The prices of hay and other farm products in New England during the past two or three years are giving great promise of a better future for New England agriculture. So long as the supply is so limited as to maintain good prices, certainly there is no more important problem for our people to consider than that of the best means of renovating our exhausted soils and of maintaining their fertility. In other words, every effort should be made to make the best possible use of the natural water supply, both by tillage and irrigation. The system of agriculture adopted should also be one which will insure the maintenance of a favorable physical condition of the soil, which will involve the least unnecessary waste of manurial elements and which will finally result in the largest profit.

The problems which present themselves along these several lines, and which must be solved before we begin to approach to the ideal in agriculture, are still enough to engage the energies of many agricultural experiment station workers for a long period of time.

The difficulties which beset soil renovation and the maintenance of fertility would be materially reduced provided every farm were immediately adjacent to a large city, and if large stores of low-priced stable manure were always obtainable. Unfortunately, the farms which enjoy such favorable locations are comparatively few, and the great majority of farmers in Massachusetts are and always will be in a greater or less degree dependent upon artificial manures. The dependence of the farmer upon this class of manures emphasizes the necessity for increased agricultural education, and makes a knowledge of agricultural chemistry and of soil physics of greater importance than ever before in the history of New England agriculture.

It was my pleasure, four years ago, at the winter meeting of your Board at Westfield, to present a paper covering in detail the various kinds of chemical manures and their uses. There is but little which was presented at that time which I should care to modify now; but there are a few lines in which additional or more conclusive data have since been obtained, which it may be well to mention at this point.

Concerning the Manurial Value of Sodium.

Since the presentation of the former paper before your Board, Jordan and Jenter of the New York State station at Geneva have conducted a series of experiments upon the sodium problem * with barley, tomatoes and peas, which they summarize as follows: —

1. A deficiency of available potash greatly depressed the yield of the plant, even in the presence of an abundant supply of soda salts. A lack of soda in the presence of potash sufficient for the plant's needs seemed to have no deleterious effect whatever upon growth.

2. Plants to which the necessary supply of potash was not accessible took up more soda than when potash was present in abundance. Soda may be substituted for potash in quantity when the latter is lacking.

3. While the substitution may take place in quantity, it evidently cannot do so in function, as is shown by the limited growth when the plants were deprived of potash, even though soda was appropriated in increased proportions.

4. The experiments incidently suggest the view that the real need of plants for certain essential mineral constituents is not even approximately measured by the proportions of these constituents which the plant takes up.

Our own experiments in this line at Kingston were begun in 1894, and have been continued without interruption ever since. They embrace field and pot experiments with a number of different kinds of plants, and are probably by far the most extensive experiments in this line ever conducted. They are unique by virtue of embracing numerous field trials made under normal soil conditions, which have been carefully studied and controlled for nine years. The result of the experiments to date may be summarized as follows: —

1. No benefit, so far as concerns the yield of the crops, was observed from the application of sodium salts so long as an ample supply of assimilable potassium salts was present.

2. The results confirm fully those of other experiments elsewhere, to the effect that *all* of the functions of potassium

* Bulletin No. 192, pp. 333–350.

cannot be performed by sodium, and hence sodium cannot be made to fully replace potassium in the manures.

3. It appears that, in the absence of sufficient potassium, sodium in excess of that existing naturally in the soil may be helpful to certain plants, *but not to all*.

4. In some instances it seemed possible that sodium might have been helpful by virtue of its indirect action in liberating phosphoric acid and magnesia, but other instances of benefit do not seem to admit of such an explanation.

5. At the Rothamstead station the beneficial action of sodium salts, which has been frequently observed, is attributed to the advantage of the presence of nitric acid in combination with soda rather than with potash, by virtue of the greater solubility of the former salt, on which account the nitrogen was supposed to be more assimilable by plants. The data already at hand at the Rhode Island station do not seem to support this view, for equally as good crops have been secured where no extra sodium was used, thus showing the ability of the crops to take up all of the nitrogen they required, even where sodium was not especially applied; and it seems more probable that where the supply of potassium is limited the sodium may, for example, act as a base in the neutralization of acids which are produced within the plant during the synthetical processes, thus perhaps performing a part, only, of one of the functions of potassium. This seems more probable than that the sodium was necessary in maintaining the turgidity of the plant cells, or in effecting the translocation of starch, or in promoting other physiological functions.

6. There seem to be some plants in connection with which the growth is not beneficially influenced by sodium salts, even in the absence of a sufficient supply of the salts of potassium.

7. Certain plants, on the other hand, which, like turnips, beets and radishes, are capable of taking up large amounts of sodium, appear to be directly helped by it when the potassium supply is limited; while others, such as common millet and oats, which take up only minute quantities of sodium, exhibit no benefit, under such circumstances, from its use.

8. It appears that no one is justified in drawing general conclusions as to the value or the worthlessness of sodium from experiments with only a single kind of plant, or even with a few kinds: but that practically each kind of plant must be experimented with before a proper basis for conclusions regarding it is reached. This would signify that the sodium problem, so far as concerns plant growth, is neither an easy nor a quick one to solve.

9. It is quite possible that, in endeavoring to limit the supply of potassium enough to enable sodium to become effective as a direct manure, there will be danger of depressing it enough in some instances to materially lessen the crop, in which case the attempted gain in cheapening the manures would be offset by a direct loss of crop.

10. The most practical side of the sodium question, and one to which, so far as I am aware, no one has heretofore called attention directly in an economic way, is the fact of its conserving the potassium supply of the soil, when those plants are grown which readily take up considerable amounts of sodium: for, if some sodium is not present and the soil contains more than enough potassium to actually produce the crop, in lieu of taking so much sodium they will remove from the soil more potassium than they require.

Even this benefit could not be expected to an appreciable extent in cases like those of millet and oats, which refuse under any circumstances to take up more than minute quantities of sodium. By way of practical illustration, let us suppose that a farmer is intending to grow a crop of turnips or beets, or some other crop which assimilates sodium readily, upon land which is in good condition, and upon which it is reasonable to suppose that there is present an amount of potassium possibly somewhat in excess of the requirements of the crop. It is obvious that, if nitrogen is applied in the manures in nitrate of soda, a certain quantity of sodium will be at hand to satisfy some of the demand for unnecessary amounts of potassium which might otherwise be made by the plant. If, on the other hand, the nitrogen is supplied in sulfate of ammonia or in organic materials, such a conservation of the natural supply of potassium would not result. For this reason the use of nitrogen in nitrate of soda may be an especially important economical feature in connection with some kinds of plants, entirely aside from any advantage accruing on account of a greater possible assimilability of the nitrogen (?) or of the advantage of a basic residue being left in the soil to counteract the natural tendency to acidity.

Even though Jordan and Jenter and also various European investigators have apparently dismissed the sodium question as settled, it would seem as if we were but entering the portals of possible discovery regarding its actual place as a direct and indirect manure. The problem of the influence of excessive sodium assimilation as compared with a relatively greater assimilation of potassium upon the quality and feeding value of plants is a particularly inviting phase of the problem yet to be studied. This seems particularly the case when we bear in mind that sodium is much more essential in the animal economy than potassium, and that it is possible that crops containing more sodium and less potassium may possess certain advantages for feeding purposes. It is proposed, if time and means allow, to enter eventually upon a study of this side of the problem at the Rhode Island station.

Concerning Certain Phosphatic Manures.

In view of having discussed the question of phosphatic manures in detail in the former paper, no attempt will be made here to enter into a detailed description of all of the different materials which furnish phosphorus to the plant. On the contrary, it is intended to merely hint briefly concerning the relative value of the more common of the phosphatic manures, and to pay especial attention to two sources of phosphoric acid concerning which new and striking data have recently been obtained.

It is still fully accepted that "soluble" phosphoric acid is equally valuable, whether in dissolved bone-black, dissolved bone or in acidulated rock phosphate, which latter product is known in the market as plain superphosphate, dissolved phosphate rock and acid phosphate.

Before dismissing this matter, it should be stated that, upon storing for a long time, some of the soluble phosphoric acid of acid phosphate may change into a less valuable combination than that of either dissolved bone or dissolved bone-black; but this is only the case when the acid phosphate contains considerable quantities of iron and aluminum oxides. On this account, the presence of large amounts of these oxides in acid phosphate is to be avoided, unless the phosphoric acid is nearly all "soluble," and even then unless the goods are to be applied to the soil without material delay. If acid phosphate is so strongly acidulated as to render practically all of the phosphoric acid "soluble," it is not likely to have as good an immediate effect or even after-effect upon acid soil as when less strongly acidulated; and, since dissolved bone is frequently less strongly acidulated than acid phosphate, a better after-effect of the former upon acid, unlimed soils may sometimes result. The lesson from this should be to lime such soils, and not necessarily to employ dissolved bone instead of acid phosphate unless the relative prices justify it.

Concerning "reverted" phosphoric acid, recent experiments at Kingston indicate that it has a widely varying value, dependent (1) upon the materials which furnish it, (2) upon the kind of crop that is grown, and (3) upon the kind of soil to which it is applied. Unfortunately, the official chemist in analyzing fertilizers cannot take into account the two latter factors in reporting upon the value of their phosphoric acid. As the analyses are made to-day, the official chemists of none of the States take into account, in reporting the reverted phosphoric acid, the source from which it is derived; and the consumer of fertilizers is led to think that the reverted phosphoric acid in all fertilizers is equally valuable. In fact, it is probable that the reverted phosphoric acid shown by the ordinary official methods of analysis to be present in bone or tankage on the one hand, and in dissolved bone-black and dissolved bone on the other, is not equally valuable for immediate plant production, the preference being given to the latter two substances. Any discrepancy in value in these materials fades, however, into insignificance as compared with that which appears between any of the materials just named and the reverted phosphoric acid of ignited iron and aluminum phosphate, when taking into account both the immediate and subsequent effects produced.

Strictly speaking, "reverted phosphoric acid" is such as has gone back or reverted from the water-soluble condition (monocalcic phosphate) to dicalcic phosphate, and which is thus no longer soluble in water. This dicalcic phosphate (popularly called two-lime phosphate), though essentially insoluble in pure water, is readily dissolved by the carbonic acid in the soil water and by the acid action of the plant rootlets, so that plants can readily obtain it. Chemists, in searching for an artificial measure of the readily assimilable phosphoric acid, first leach the sample with pure water to remove the soluble phosphoric acid, then the remainder is treated for a given time at a definite temperature with a neutral solution of ammonium citrate. This solution removes all of the dicalcic phosphate, leaving behind the tricalcic (popularly called three-lime phosphate) or insoluble portions. A considerable portion of the phosphoric acid of steamed bone and tankage is also dissolved by the ammonium citrate, notwithstanding that it is not combined as dicalcic but as tricalcic phosphate. It is not infrequent that one-half of the phosphoric acid of tankage and considerable of that of bone therefore appears upon analysis as reverted phosphoric acid. Certain iron and aluminum phosphates are likewise dissolved to a greater or less extent by the ammonium citrate, so that the phosphoric acid contained in them appears upon analysis as "reverted," though none of it is combined either as dicalcic or as tricalcic phosphate. One of the most important deposits of iron and aluminum phosphate is that upon the island of Redonda, which has been given the name of "redondite." This material in its natural condition shows but traces of soluble phosphoric acid, and but about two to three per cent of reverted acid. Upon subjection to heat it loses water, and becomes highly soluble in the ammonium citrate solution, showing "reverted" phosphoric acid often in excess of thirty-two per cent. In earlier experiments at the Rhode Island station both the raw and ignited (heated) iron and aluminum phosphate were tried upon limed and unlimed soil for grass. Both were comparatively of very slight value upon the unlimed land, and upon limed soil the raw aluminum phosphate appeared to have been possibly injurious. The ignited phosphate, on the contrary, proved upon the limed land nearly as effective as some of the most valuable of the phosphates.

In recent years trials have been made of a large number of different kinds of plants, in the course of which the ignited iron and aluminum phosphate has invariably been far more helpful upon the limed soil than upon that which remained unlimed; nevertheless, maximum crops of ordinary garden crops were not obtained, especially in the case of turnips, beets, cabbages, summer squashes and other plants. To be sure, the results that have been produced in recent years have been brought about very largely as a result of the residual effect of former applications. When it is remembered, however, that at its best upon limed soil no distinct advantage of the ignited iron and aluminum phosphate over certain of the superphosphates was obtained, the comparative inferiority of this material in its subsequent action with most hoed crops, even upon limed land, coupled with its practical worthlessness upon acid unlimed soil with practically all of the crops with which it has been tried, excepting possibly one or two of the millets, is enough to condemn the "reverted" phosphoric acid in this material as of inferior value for most purposes.

It is to be presumed that upon lying in the soil the ignited phosphate gradually takes on some of the water which has been driven out artificially, whereby it loses some of its earlier efficiency as a manure. When it is recognized that acid soils, deficient in or wholly devoid of carbonate of lime, are common in Massachusetts, Rhode Island and other sections of the country, and that upon such soils the ignited iron and aluminum phosphate may be practically worthless, the matter assumes unusual importance. This is especially true in view of the fact that this particular phosphate is said to find its way into certain ready-mixed commercial fertilizers in considerable quantities. It is supposed that it is used even by manufacturers who derive most of their phosphoric acid from bone and fish, and who would not be supposed to employ it. Its more general introduction into commercial fertilizers at present, than formerly, is said to be in response to the demands of the consumer for a fertilizer which drills readily. At all events, the manufacturer should sell this phosphate for use only on limestone soils, or the consumer must run the risk that he will not receive full returns from its use. The consumer should also make sure that his soil does not lack lime, if he expects to receive full returns from ready-mixed commercial manures which contain phosphoric acid in this material. Even then it is a serious proposition if it would not be more profitable to mix his own fertilizers, rather than to purchase ready-mixed goods, unless he can be assured of the source of the organic nitrogen, and that this particular phosphate is not used in their manufacture.

It should be borne in mind by every consumer of fertilizers that the term "available," as applied to the phosphoric acid of the commercial manures, has reference to the sum of the phosphoric acid which is soluble in pure water (soluble phosphoric acid) and in ammonium citrate solution (reverted phosphoric acid). The term "available" has therefore come to be a "trade name," and it is not to be inferred that all of the phosphoric acid known as "available" is necessarily readily available to plants, or, in other and more appropriate words, that it is readily "assimilable" by them. To make this more plain, if possible, let us assume that in a given case all of the reverted and hence the "available" phosphoric acid of a fertilizer is present in ignited iron and aluminum phosphate; then little or none of it would be available to the plant, or, in other words, little or none of it would be assimilable, provided it were used upon very acid soil.

In view of the foregoing, it would seem as if the time may have arrived when the agricultural chemists of the United States will find it necessary to modify either the solution employed in the determination of reverted phosphoric acid, or the method of treatment, so as to dissolve less of the phosphoric acid of the ignited iron and aluminum phosphate, thus reducing the apparent percentage of reverted phosphoric acid. A more effective plan may be to determine the alumina in mixed goods as a means of recognizing this particular phosphate. By some such means the consumers should be afforded the full measure of protection which is their due. Doubtless this would increase the cost of the inspection somewhat per brand; but, if an increased fee for inspection were required in consequence, doubtless any independent manufacturers who do not employ this particular phosphate would gladly join hands with the consumer to have the fee raised sufficiently to provide for the added work of analysis, particularly in view of the infinitesimal cost, compared with the great protection which might be afforded.

Regarding "floats," a finely ground unacidulated product from the phosphate rock, I desire to state that in the former paper results from its use with grass were cited, showing it to be quite an effective manure for that crop, if used upon acid soil. Subsequent results have, however, shown it to be comparatively inefficient in connection with garden vegetables and most ordinary crops. Its residual effect is nevertheless distinctly helpful upon acid soil, but in a much less degree than basic slag meal or finely ground steamed bone, to both of which it was also inferior in immediate action.

Basic slag meal, in marked contrast to bone and floats, was strikingly effective from the very outset, proving, where lime was omitted, superior to the superphosphates for certain plants which could not succeed, especially upon a very acid soil.

In fact, the inefficiency of floats has proved so great, for most crops, that, in the rotation experiments where it was introduced at a certain stage, bone is again being employed. The present indications are to the effect that floats are more likely to prove profitable upon acid soil (such as peat or muck, or upon soils containing much sour humus), particularly where grass or certain of the leguminous plants are to be grown, than elsewhere, and under other conditions.

Some Practical Results from the Use of Manures in Rotation.

The best land employed at Kingston in any of the rotation experiments yielded the year before the beginning of the experiment (1892) an average of but 18 bushels of shelled corn per acre. Similar soil in another portion of the same field, under a system of continuous cropping without manure, became so exhausted by the year 1896 as to produce in the entire season Indian corn plants which were only about 5 inches high.

It must be evident, therefore, that the attempt at soil renovation was made upon land which was extremely exhausted. A part of the plan of the experiment was to ascertain the relative efficiency of various rotations of crops in soil renovation, and at the same time to gain as much light as possible upon the best system of manuring where the whole or nearly the whole dependence must be placed upon chemical manures.

Some of the incidental advantages which it was hoped to gain by practising systematic crop rotation were summarized in Bulletin No. 75 of the Rhode Island station, as follows: —

(1) All plants do not draw to an equal extent upon the various manurial ingredients of the soil. Furthermore, plants are unlike so far as concerns their power to assimilate individual ingredients. This is probably due to their sending their roots to different depths, and also to an unlike solvent action of the root juices upon the constituents of the soil.*

(2) By rotating crops, injury by insects is lessened.

(3) Losses caused by fungous and bacterial diseases may also be materially reduced.

(4) The soil is maintained in good tilth, which is an item of great importance. Certain minute organisms which are helpful to plants are more likely to increase in soil where crops are rotated than where no regular system exists.

(5) Weeds are more readily eliminated or avoided where crops are regularly rotated, than under an irregular, slip-shod system of farming.

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* B. Dyer has shown that the acidity or sourness of the juices of the roots of various plants varies to a marked extent. Journal of the Chemical Society (England), 65 (1894), pp. 115–167.

The order of the three-year rotation* is as follows: first year, potatoes; second year, winter rye; third year, clover. Three plots are employed, and the crops were introduced in such a way as to have all three continually represented. The winter rye is usually sown in September after the removal of the potatoes, and clover seed at the rate of 15 pounds per acre is sown the next spring, preferably in March, upon a light snow. The rye can be cut green for fodder or for bedding, or it may be allowed to ripen, as has been done in this instance. Even when the rye is allowed to ripen, a small crop of clover hay is sometimes secured in the same year, provided the season is a wet one; but if it happens to be extremely dry, there is great danger that the clover will be largely killed the first season. Fortunately, this has occurred but once since the experiment was begun, though at least twice only small crops of clover have been obtained the next year after the removal of the rye. This was owing to droughts at the period when the clover should have been making its chief growth.

At the outset the following potato formula was used, at first broadcast, but later one-fourth in the drill: —

Manures applied per Acre (Pounds).

Nitrate of soda,	105
Tankage,	750
Acid phosphate,†	540
Fine-ground steamed bone,	120
Muriate of potash,	300

After the removal of the potatoes, and before seeding to rye, 360 pounds per acre of fine-ground steamed bone are applied.

Nitrate of soda at the rate of 120 pounds per acre was at first employed as a spring top-dressing for the rye after it was well tillered. If applied earlier, it promotes greater

* For a complete description of this experiment for the first two courses of the rotation, see Bulletin No. 74, Rhode Island Agricultural Experiment Station, November, 1900.

† In some of the years the actual quantity of acid phosphate was changed, but it was always made equivalent to the amount used above, with 13 per cent of available phosphoric acid.

tillering at the expense of grain, as has been shown by experiments in Germany.* After a few years all of this application was omitted. This was done in consequence of the continual apparent enrichment of the soil in nitrogen.

Until recently no manures were applied directly for the clover crop. Now an application of 100 pounds of muriate of potash is used per acre annually.

When the experiment was begun it was not supposed that the soil was sufficiently acid to render the growth of clover impossible, but such proved to be the case, and hence it became necessary to use lime, which was applied in some cases at the rate of 1,000 pounds and in others at the rate of 2,000 pounds per acre. Under the definite system since adopted the equivalent of 800 pounds of actual lime (calcium oxide) per acre is now being applied once every six years, after the previous irregularities in liming have been balanced.

History of the Land.

Prior to 1889 the land had been in grass for many years apparently without top-dressing. It was badly infested with moss, and produced annually not far from a quarter of a ton of poor hay per acre. In the summer of 1889 the land was plowed, dressed lightly with finely ground steamed bone, and Hungarian seed was sown. In 1890 about 6 cords of stable manure were applied per acre, and it was seeded again with Hungarian. In 1891 common white beans were planted without manure, and in 1892 Indian corn was similarly planted, for the purpose of ascertaining the relative fertility of the two-fifteenth-acre plots † which had been laid out permanently, in the mean time. Plots 11, 13 and 14 were employed in the experiment. The actual rotation began with potatoes upon Plot 11 in 1893. The following year the rotation upon Plot 14 began with the same crop, and the potato crop came upon Plot 13 in 1895. Plot 14 was

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* P. Wagner, Die Stickstoffdüngung, p. 161, cites results to this effect by Heine.

† The plots are separated by 3-foot paths on the sides and by wide roadways on the ends. The entire area of the plot is manured uniformly. To avoid the errors due to greater or less growth upon the edges of the plot, a strip 3 feet wide on each side and 6 feet wide on each end is first harvested, leaving just $\frac{1}{10}$ of an acre for the final harvesting and weighing.

manured in 1893 with 120 pounds of nitrate of soda, 480 pounds of acid phosphate and 120 pounds of muriate of potash per acre, and was devoted to cow peas. The same autumn the cow peas were plowed under, in preparation for the succeeding potato crop.

Plot 13, as has been stated, did not enter the rotation with a potato crop until 1895. The treatment of the land in the interim was as follows: —

Manures applied per Acre in 1893 (Pounds).

Nitrate of soda,	300
Acid phosphate,	240
Fine-ground bone,	180
Muriate of potash,	120

Spring rye and common red clover seed were sown, but the rye seed was poor and did not germinate, and the clover plants which germinated were dead by 1894, so that no clover crop was secured in that year. The cause for the failure of the clover has since been found to have been the acidity of the soil. No manures were used in 1894.

The potato tubers were cut, in the first four years of the experiment, into one-ounce pieces; but later, based upon the results of experiments by Arthur (Bulletin No. 42, Indiana Agricultural Experiment Station, Lafayette, Ind., November, 1892), they were cut into approximately two-ounce pieces.

In order to avoid potato scab in so far as possible, and still enjoy the advantage from liming, particularly in the line of securing relatively more large potato tubers and in correcting the soil acidity in order that clover might be grown; the lime is applied after the removal of the potato crop, and the seed tubers are treated with corrosive sublimate solution or formalin, to destroy as many as possible of the germs of the potato scab fungus which may be upon them. It is gratifying to be able to state that by this procedure all of the advantages of liming have thus far been derived, without unfavorable results in other respects.

Below are given the yields of potato tubers in each course of the rotation, in bushels per acre: —

First Course of Rotation.

PLOT.	Year.	Large.	Small.	Total.
Plot 11, ...	1893,	60.00	68.33	128.33
Plot 14, ...	1894,	111.17	51.83	163.00
Plot 13, ...	1895,	75.42	39.42	114.84

Second Course of Rotation.

Plot 11, ...	1896,	233.33	48.83	282.16
Plot 14, ...	1897,	192.83	82.00	274.83
Plot 13, ...	1898,	268.30	50.80	319.10

Some of the gains in the latter years of the rotation were doubtless due in a measure to using a portion of the fertilizer in the drill and in some degree also to the lime, which increased the percentage of tubers of large size, even when no marked increase in the total crop was caused. The great improvement is considered to be due principally to the improved physical condition of the soil and to the increase in the store of immediately assimilable plant food.

The following are the results with the winter rye, in yields of straw and grain per acre: —

First Course of Rotation.

PLOT.	Year.	Straw (Tons).	Grain (Bushels).
Plot 11, ...	1894,	1.30	24.29
Plot 14, ...	1895,	.48	–
Plot 13, ...	1896,	1.80	25.89

Second Course of Rotation.

Plot 11, ...	1897,	2.05	26.83
Plot 14, ...	1898,	2.33	23.13
Plot 13, ...	1899,	2.76	23.75

The great increase of straw in the second course of rotation is doubtless attributable in part to the general improvement of the soil, but primarily to the increased supply of assimilable nitrogen, — a condition undoubtedly brought about by the clover and the general system of manuring and cropping.

The results with clover were as follows: —

First Course of Rotation.

PLOT.	Year.	Tons per Acre.
Plot 11, ...	1895,	.71
Plot 14, ...	1896,	3.80
Plot 13, ...	1897,	2.10
Second Course of Rotation.		
Plot 11, ...	1898,	1.48*
Plot 14, ...	1899,	1.45†
Plot 13, ...	1900,	-‡

The small crop in the year 1895 was readily accounted for by injury to the young plants by drought in 1894. Since clover can assimilate atmospheric nitrogen, an increase of soil nitrogen is of no particular advantage to it except in the earliest stages of its growth. The chief factors determining the success or failure of this crop are the temperature and moisture. The original system of manuring apparently required a change in the amount of potash used for the sake of the clover crop, which led to a special application of potash for this crop. It will be remembered that only 300 pounds of muriate of potash were used at first per acre in any case, and then only with the potato crop. It seemed

* Crop injured by drought during June. During this month the rainfall amounted to but .77 inches; in June, 1896, it amounted to about 5 inches; and in June, 1897, to 4.43 inches.

† Crop much injured by severe early drought.

‡ Plants destroyed by the drought in 1899, consequently there was no crop.

possible, therefore, that a small application would be helpful. Perhaps for this purpose high-grade sulfate of potash or preferably double sulfate of potash and magnesia might be used instead of the muriate as a top-dressing for the clover. This is a point which it may yet be desirable to consider.

Upon the basis of the prices used in making the estimates, there was a total loss upon Plot 11 in the first course of the three-year rotation of $37.80, and a net gain* in the second course of $81.80 per acre. Upon Plot 14 there was a total net loss in the first three years of $8.60, and a total net gain in the second course of $44.50 per acre. Upon Plot 13 the total net loss in the first three years of the rotation was $14.70, and the net gain in the last three years amounted to $85.60 per acre. The average net profit for the three plots for the last three years was $70.63 per acre, or $23.54 per annum. After deducting the losses of the first course from the gains of the second, there remains an average net profit of $16.75 per acre annually for the entire period of six years.

It is evident that the system of cropping and manuring is rapidly renovating the land, and in the case of soil in a less impoverished and neglected condition good profits in the first course of the rotation might reasonably be expected.

Plan and General Results of the Four-year Rotation.†

This rotation differs from the three-year rotation previously described, in the introduction of Indian corn. The rotation is as follows: first year, Indian corn on clover sod; second year, potatoes; third year, winter rye; fourth year, common red clover.

Another important point of difference between this rotation and the three-year one is the employment of stable manure, which is spread on the clover sod in the spring and plowed under. Indian corn is then planted without further manures.

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* This does not take into account taxes and interest on the investment.

† For the details of this rotation see Bulletin No. 75, Rhode Island Agricultural Experiment Station, December, 1900.

The potato manure was mixed according to the same formula as in the three-year rotation (see page 157). In the earlier years of the experiment a very large portion of the potato manure was spread broadcast and harrowed into the soil, but in 1900 for the first time the entire amount was applied in the drill, doubtless with material advantage.

After the removal of the potato crop the land was limed, but at such a rate that it shall receive in a long series of years the same total amount of actual lime (calcium oxide) per acre as the plots in the three-year rotation. At the outset lime was not applied in all cases, and a little later some irregularities in its application occurred, which have since been equalized. According to the present plan, each plot is to receive 536 pounds of actual lime (calcium oxide) at each round of the rotation.

At the time of liming, 360 pounds per acre of finely ground steamed bone are sown broadcast, and winter rye is sown at the rate of 1.34 bushels per acre. The following March or early in April common red clover seed is sown broadcast, preferably on a light snow, at the rate of 15 pounds per acre. Later, after the rye has somewhat progressed with tillering, a top-dressing of nitrate of soda, at the rate of 120 pounds per acre, was at first applied. This has subsequently been omitted. The clover which follows in the same year as the rye, and in the following year, received at the outset no manures, but is now top-dressed the last year with 200 pounds per acre of muriate of potash. It is, however, possible, as suggested in connection with the three-year rotation, that an application of the double sulfate of potash and magnesia might be employed more advantageously than the muriate as a top-dressing for the clover.

The plots are laid out, introduced into the rotations, manured over the entire two-fifteenth-acre plot, and harvested in the same manner as described in connection with the previous rotation. The land was of the same general character, but was somewhat poorer in 1892; for Indian corn, grown in that year without manure, was not able to form grain, and the total yield per acre of corn stalks, weighed without drying, ranged from 270 pounds per acre on Plot 18 to 1,500 pounds on Plot 24. The yields upon plots 20 and 22 were 395 and 640 pounds per acre respectively.

The first year of the experiment, upon Plot 18 stable manure, for some unknown reason, was not applied in preparation for the corn crop, but in its stead the following formula was used broadcast, viz.: —

	Pounds per Acre.
Nitrate of soda,	300
Acid phosphate,	450
Muriate of potash,	120

Plot 20 was introduced into the rotation the same year as Plot 18, but it began with potatoes instead of with Indian corn.

Since Plot 22 was to begin the rotation with Indian corn in 1894 so as to follow one year behind Plot 18, and in view of the fact that winter rye had not been sown in the autumn of 1892, spring rye was sown with common red clover seed in the spring of 1893. In view of the exhausted condition of the soil, the following formula was applied before the rye and clover seed were sown, viz.: —

	Pounds per Acre.
Nitrate of soda,	300
Acid phosphate,	240
Fine-ground bone,	180
Muriate of potash,	120

The rye seed was evidently poor, for it is recorded that the crop was a failure. The clover also failed in 1894, owing, as has since been learned, to the acidity of the soil which had not yet been corrected by the use of lime. This failure of the rye and clover was unfortunate, in view of the fact that the year 1894 was the beginning of the actual rotation.

In 1895 the plot was devoted to Indian corn, and from that time forward proceeded according to the regular plan.

Plot 24 should, according to the scheme of rotation, have been occupied by common red clover in 1893; but, as this was impossible, it was manured with the following materials: —

	Pounds per Acre.
Nitrate of soda, ...	120
Acid phosphate, ...	480
Muriate of potash, ...	120

Cow peas were sown and left upon the land to be plowed under the next spring (1894), in preparation for Indian corn.

Below are given the yields of Indian corn and stover in the first course and in the first two years of the second course of the rotation: —

First Course of Rotation.

PLOT.	Year.	Hard Corn (Bushels).	Soft Corn (Bushels).	Total Grain (Bushels).	Stover (Tons).
Plot 18, ...	1893,	3.07	4.07	7.14	.93
Plot 20, ...	1896,	62.86	3.43	66.29	1.93
Plot 22, ...	1895,	43.57	4.29	47.86	1.05
Plot 24, ...	1894,	42.00	8.07	50.07	1.66

Second Course of Rotation.

Plot 18, ...	1897,	82.86	6.50	89.36	3.23
Plot 20, ...	1900,	84.64	1.29	85.93	3.14
Plot 22, ...	–	–	–	–	–
Plot 24, ...	–	–	–	–	–

It will be noticed that the crop of Indian corn produced in 1893, even with the aid of a liberal amount of chemical manures, was but 7.14 bushels of shelled corn and .93 ton of stover. In the case of plots 22 and 24, which had enjoyed the benefit of other manurial treatment in the interim, and which received stable manure before the corn at the rate of 4 cords per acre, the yields of shelled corn were but 47.86 and 50.07 bushels, and of stover but 1.05 and 1.66 tons, respectively. The best yield of any in the first course of the rotation was upon Plot 20, in 1896, which amounted to

66.29 bushels of shelled corn and 1.93 tons of stover per acre.

In striking contrast to these results stand those for the years 1897 and 1900 in the second course of the rotation, upon plots 18 and 20, respectively. In this instance the yields of shelled corn amounted to 89.36 and 85.93 bushels per acre, and of stover to 3.23 and 3.14 tons per acre.

It is quite possible that an important factor in increasing the crops of the second course was the lime which had been applied to plots 18, 22 and 24 in the interim. This is further indicated to some extent by the fact that Plot 20, which gave the greatest yield in the first course, had been limed just previously, while the other three plots had not. Liming has been found, in the course of many experiments, to favor the transformation of nitrogen in organic matter into nitrates; it also appears, in sour soils, to prevent the destruction of nitrates, to improve materially the physical character of the soil and to render certain phosphates soluble.

Below is given a comparison of the potato crops of the four-year rotation in the first course, and also in the first two years of the second course of the rotation, in bushels of tubers per acre: —

First Course of Rotation.

PLOT.	Year.	Large.	Small.	Total.
Plot 20, ...	1893,	52.50	56.67	109.17
Plot 18, ...	1894,	123.17	50.75	173.92
Plot 22, ...	1896,	215.50	51.67	267.17
Plot 24, ...	1895,	89.25	31.75	121.00

Second Course of Rotation.

PLOT.	Year.	Large.	Small.	Total.
Plot 20, ...	1897,	211.67	56.17	267.84
Plot 18, ...	1898,	233.30	67.20	300.50
Plot 22, ...	–	–	–	–
Plot 24, ...	–	–	–	–

From the foregoing table it will be seen that the total yields of tubers in the case of plots 20, 18 and 24 were but 109.17, 173.92 and 121 bushels, respectively. It will be noted also that the relative amount of small or unmerchantable tubers was very great, — a fact which has been observed in many of the former experiments at the Rhode Island station upon acid, unlimed soil. A very marked contrast is afforded by Plot 22 in the first course, which was limed immediately before the potatoes were planted, which produced a total of 267.17 bushels per acre, 215.5 bushels of which were of merchantable size. It will be observed that plots 20 and 18 produced a total of 267.84 and 300.5 bushels respectively in the second course, as compared with 109.17 and 173.92 bushels in the first course of the rotation; and in the second course, after the plots had been limed and improved in tilth and fertility, the percentage of tubers of merchantable size increased remarkably.

The following tables give the weights of winter rye and straw obtained in the first course and in the first two years of the second course of the rotation, in yields per acre: —

First Course of Rotation.

PLOT.	Year.	Straw (Tons).	Grain (Bushels).
Plot 20, ...	1894,	1.30	29.46
Plot 18, ...	1895,	.40	–
Plot 22, ...	1897,	1.91	28.13
Plot 24, ...	1896,	1.60	29.20

Second Course of Rotation.

Plot 20, ...	1898,	1.57	16.25
Plot 18, ...	1899,	2.59	24.46
Plot 22, ...	–	–	–
Plot 24, ...	–	–	–

The crops of straw taken as a whole show a tendency towards regular increase, though with some exceptions. It will be remembered that this tendency to regular increase was also striking in the three-year rotation, as shown by the following arrangement of data from that rotation : —

Table showing the Regular Increase in the Yield of Straw in the Three-year Rotation.

PLOT.	Year.	Tons per Acre.
Plot 11,	1894,	1.30
Plot 13,	1896,	1.80
Plot 11,	1897,	2.05
Plot 14,	1898,	2.33
Plot 13,	1899,	2.76

These results show the increased yield of the straw, which was usually at the expense of grain. This led to the belief that perhaps the spring top-dressing of 120 pounds of nitrate of soda should be omitted, owing to the probable increase in assimilable nitrogen in the soil. So long, however, as the straw is a more important factor in this section, from the market point of view, than the grain, it is possible that the top-dressing might have been continued profitably so long as a tendency to lodging did not arise. The small amount of seed sown is out of consideration for the subsequent grass crop, which would be likely to be lessened by heavy seeding with rye, particularly if the season were a dry one.

The following table gives the results with clover for the first course and for the first two years of the second course of the rotation : —

First Course of Rotation.

PLOT.	Year.	Tons per Acre.
Plot 22, ...	1894,	–
Plot 20, ...	1895,	.39
Plot 18, ...	1896,	4.56
Plot 24, ...	1897,	2.55

Second Course of Rotation.

Plot 22, ...	1898,	2.77
Plot 20, ...	1899,	1.52
Plot 18, ...	–	–
Plot 24, ...	–	–

The only points of particular interest concerning the clover are its inability to succeed upon very acid soil until after liming, as shown at the outset; and its great liability in both the first and second years to injury from drought, which may not, however, be sufficient to materially injure grass, provided it is properly top-dressed early in the season.

At the prices used in the financial estimates in this rotation there was a net loss in the case of Plot 18 of $18.40 for the entire period of the first course of rotation, and a net gain of $80.70 for the second course of four years.

Concerning Plot 20, the only other one in regard to which the full data for both courses of the rotation are already calculated, there was a total loss for the first course of $44, and a gain for the next period of four years of $64.40. In view of the fact that Plot 22 showed a net gain of $46.30 for the first period and Plot 24 a loss of only $17.56, the showing of those two plots for the first eight years gives promise of being much superior to that made by plots 18 and 20.

The indications are to the effect that possibly the three-year rotation may furnish a quicker and more remunerative means of soil renovation than the four-year one, though it might not subsequently prove to be a more profitable one.

The extreme exhaustion and the generally bad condition of the soil upon which these experiments were conducted lead to the belief that upon most soils these rotations would prove profitable from the very outset. The rotations teach most emphatically the uncertainty of the clover crop in dry seasons, unless irrigation is possible; also, that no farmer should sow rye or other seed without first testing its power to germinate. Above all, they show the futility of trying to renovate a very acid soil, particularly where clover is to be grown and where organic nitrogen is contained in the manures, without using slaked lime or wood ashes at the very outset. Had attention been paid to all of these points from the beginning, the losses in many cases might have been turned to profits even in the first course of rotation. In justice to those who had charge of these experiments * at the outset, it should be stated definitely that when they were begun no one in the United States apparently realized that an injurious degree of soil acidity ever existed in our upland and naturally well-drained soils; and when this was demonstrated, at the Rhode Island station, lime was introduced in the manures used in the rotations as soon as feasible. Unfortunately, in some cases a little delay in liming was inevitable, on account of the desire to introduce it after the removal of the potato crop, so as to avoid, in so far as possible, its tendency to promote potato scab.

Two Five-year Rotations of Crops for General Farming.†

The first five-year rotation to be mentioned is as follows: first year, Indian corn on grass sod; second year, potatoes; third year, winter rye; fourth year, grass (timothy and redtop); fifth year, grass.

* The original plan of the rotation and of the manuring was worked out by J. D. Towar and H. J. Wheeler. The responsibility of the execution of the work and its direction rested with Ex-Director C. O. Flagg until 1898, when it was transferred to H. J. Wheeler. In the mean time the immediate care of the details was delegated to J. D. Towar and G. M. Tucker, then to the late J. A. Tillinghast, and finally to G. E. Adams.

† For complete details concerning these rotations, see Bulletin No. 76, and Fifteenth Annual Report, Rhode Island Agricultural Experiment Station.

The second five-year rotation is now identical with the first in manuring and otherwise, excepting that the spring after the winter rye is sown common red clover seed at the rate of 7.5 pounds per acre is sown broadcast. It was hoped that the practical advantage, if any, of introducing into the rotation a leguminous deep-rooted plant, capable of feeding from low depths and of assimilating atmospheric nitrogen, might thus be thoroughly tested. The potato formula of both of the five-year rotations was the same as that used in the three-year and four-year rotations (see page 157). This has, however, since been changed. The Indian corn formula employed in the regular course of the rotation was made up as follows: —

	Pounds per Acre.
Nitrate of soda,	225
Acid phosphate,	420
Fine-ground steamed bone,	105
Muriate of potash,	120

After the removal of the potato crop in each course, the land is to receive in the future a quantity of air-slaked lime,* which will furnish 667 pounds of actual lime (calcium oxide) per acre. Fine-ground steamed bone is also applied at the same time, at the rate of 360 pounds per acre.

The rye was top-dressed at the outset in both rotations at the rate of 120 pounds of nitrate of soda per acre, or just as in the case of the other rotations which have been described. The top-dressing is now, nevertheless, omitted.

For several years the grass was top-dressed in both five-year rotations, as follows: —

	Pounds per Acre.
Nitrate of soda,	120
Dissolved bone-black (or its equivalent of acid phosphate),	300
Muriate of potash,	120

In both rotations the hay crops have been extremely poor, — a factor which has made the rotations in some cases positively unprofitable; in fact, in the rotation without

* At the beginning irregularities in amounts of lime and time of its application occurred, but these have since been equalized, and the land used in these rotations will receive in a period of twenty years the same amount of lime as that devoted to the four-year rotation.

clover the largest crop of hay in any year from 1894 to 1900 inclusive amounted to but 2.12 tons per acre, two crops amounted to less than 1 ton and several others scarcely exceeded a ton. At the outset the soil was too acid to permit of the growth of timothy, and at first red-top seed was omitted in the rotation including the clover, which facts help to explain many of the poor yields. In 1899 a special top-dressing experiment was begun in another connection, to see how much nitrate of soda was required, in the presence of lime and an abundance of assimilable potash and phosphoric acid, to produce 4 tons of hay per acre, in addition to the nitrate naturally formed in the soil. As a result, it has been found that 350 pounds of nitrate of soda per acre are probably sufficient to produce 4 tons of field-cured hay annually under the conditions named, and the average yield of field-cured hay per annum in the experiment referred to has been maintained at over 4 tons per acre for five consecutive years.

Still other experiments have shown that the amount of dissolved bone-black, though supplying phosphoric acid probably in excess of that removed by the crop, was yet probably insufficient, in view of the changes in its assimilability which takes place in the soil. It has also been shown that 120 pounds of muriate of potash were much too little to produce a maximum crop, even when aided by the potash regularly freed from our granitic soil. In other words, it has been abundantly demonstrated that the most faulty feature of the five-year rotations, as originally planned, was in the formula for top-dressing the grass land. In the light of all the recent results to date, it seems probable that the greatest profit obtainable might have resulted had a formula essentially as follows been employed for grass, viz. : —

Proposed Substitute Formula for Top-dressing Grass Land.

	Pounds per Acre.
Nitrate of soda,	350
Acid phosphate,	500–600
Muriate of potash,*	200–250

* It is possible that this could occasionally be replaced profitably by twice the amount of double sulfate of potash and magnesia, particularly in the rotation where clover is grown.

Results secured since the grass formula has been changed have fully justified the conclusions already drawn regarding these rotations.

These rotations have shown, furthermore, that upon poor soils, in bad physical condition, rye is far more likely to succeed at the outset than Indian corn and potatoes. If grass seed is sown with the rye, and the land is then properly top-dressed, excellent crops of Indian corn and potatoes may be secured at a profit. In other words, it is of vital importance, in undertaking to renovate a soil by the use of certain rotations, that the rotation begins with the proper crop. Doubtless this would apply with less force if plenty of stable manure were available, than under conditions where chemical manures must be used wholly or almost exclusively.

In the five-year rotation without clover the yields of Indian corn have risen from 13.78 bushels of shelled corn to 72.57 bushels, and the yields of stover from 1.3 tons to 3.9 tons. The potato crops have also increased from a total of 60 bushels per acre of tubers of marketable size to 283.33 bushels, and in the latter case the total yield was 321.66 bushels.

These rotations were begun at all of the different stages instead of at the most advantageous point in the rotation, which rendered them less remunerative than they would otherwise have been. The faulty grass formula was probably the chief reason why these rotations were not so effective in renovating the soil as the three-year and four-year rotations; but if they had been begun in all cases with winter rye followed by grass, and this had been more liberally manured, it is believed that excellent results could have been obtained, particularly if pains had been taken to lime the land before sowing the rye.

A Five-year Rotation, embracing Seven Crops in Five Years.*

The plan of this rotation was suggested by Ex-Director Chas. O. Flagg of the Rhode Island Experiment Station. The order of rotation is as follows: first year, oats (clover

* The full details of this rotation have not yet been published.

seed sown at the same time as the oats) ; second year, common red clover ; third year, potatoes (winter rye sown after the removal of the potatoes) ; fourth year, winter rye, followed by Hubbard squashes ; fifth year, early peas, followed by Swedish turnips.

The winter rye is usually cut at about the time it is in bloom, and it may be used as a soiling crop or be cured for sale for bedding if desired.

The rotation was designed to meet the needs for one of the rotations upon a farm near a city or village where both milk and vegetables could be sold to advantage.

Below are given the formulas now in use for the several crops, and comments relating to the way in which they are applied.

Formula for Oats.

(Varied slightly from year to year, so as to furnish like amounts of the manurial elements as necessitated by irregularities in the composition of the manures used.)

	Pounds per Acre.
Nitrate of soda,	200
Acid phosphate,	250
Fine-ground bone,	155
Muriate of potash,	160

The common red clover receives no manure except such residues as are left in the soil by the oat crop.

Formula for Potatoes.

(Varied slightly from year to year, as in the case of the oat formula. At first the formula for potatoes given on page 157 was employed.)

	Pounds per Acre.
Nitrate of soda,	200
Dried blood,	330
Acid phosphate,	812
Muriate of potash,	300

The winter rye received at the outset a dressing of about 120 pounds of nitrate of soda per acre in the early spring. This has now been omitted. In this instance, where grain is not the object, but a large quantity of bedding or feed is sought, and where grass seed is not sown with the rye, it is preferable to top-dress the rye with nitrate of soda before tillering is completed, for then a greater number of stalks is likely to be produced, and hence more feed or straw.

In the case of dry seasons the rye removes so much water from the soil that it becomes extremely difficult to make the squash seed germinate without resorting to irrigation. The chances of success with the squashes may be materially increased by setting out potted plants, and watering them, rather than by planting the seed directly.

In the absence of an irrigating plant, and taking the seasons as they run, it might prove more profitable to either cut the rye or plow it under much earlier than the blooming period, so as to prevent the excessive drying out of the soil, and thus render success with squashes more probable. At the outset the manures for the potatoes and squashes were applied broadcast, like those for the turnips and peas. Later, a part of the potato manure was applied in the drill; but at present all of it is used in that manner, and one-half of the manure for the squashes is applied broadcast and one-half in the hill. After the removal of the potato crop, and before sowing rye, 700 pounds of fine-ground bone are sown per acre.

Formula for Squashes.

(Varied as described for the oat formula.)

Pounds per acre as at first used: —		Pounds per acre as now used: —	
Nitrate of soda, . .	330	Nitrate of soda, . .	350
Acid phosphate, . .	500	Acid phosphate, . .	800
Muriate of potash, .	150	Muriate of potash, .	150

Formula for Peas.

(Varied as described for the oat formula.)

Pounds per acre as at first used: —		Pounds per acre as now used: —	
Nitrate of soda, . .	127	Nitrate of soda, . .	127
Acid phosphate, . .	500	Acid phosphate, . .	300
Muriate of potash, .	140	Muriate of potash, .	140

Formula for Turnips.

(Varied as described for the oat formula.)

Pounds per acre as at first used: —		Pounds per acre as now used: —	
Nitrate of soda, . .	250	Nitrate of soda, . .	250
Acid phosphate, . .	700	Acid phosphate, . .	625
Muriate of potash, .	200	Muriate of potash, .	140

If the squash crop is a success, this rotation is likely to yield a good profit, but otherwise the chances are materially reduced. Its applicability depends also upon having a soil where peas mature sufficiently early to make it possible to succeed with the turnips which follow. Upon a very cold, late soil this might be difficult; and, furthermore, such a soil would not be calculated to yield turnips of the finest type and quality. In fact, the soil upon the station farm is not well adapted to either of these crops.

The data thus far secured in this rotation have not yet been published nor arranged for publication, hence it will be impossible at this time to present more than the foregoing scheme of the rotation and the accompanying suggestions.

A Six-year Rotation.

The six-year rotation is essentially identical with the five-year rotation, which includes clover (see page 171), excepting that it is allowed to continue in grass for one additional year. It is therefore as follows: first year, Indian corn; second year, potatoes; third year, winter rye; fourth year, clover and grass; fifth year, grass; sixth year, grass.

The chemical formulas for potatoes, rye, Indian corn and grass were the same as used in the five-year rotation previously described (see pages 170–173). This rotation differs in one particular from the five-year rotation, for three of the plots receive stable manure instead of chemical manures for the Indian corn, the other three plots, however, being treated in the same manner as in the five-year rotations.

At the outset one of the plots in the stable manure series and one in the chemical series received wood ashes. It was planned to employ lime and enough of a potash salt upon the other plots in each series to equal the lime and potash contained in the wood ashes. The reason for comparing the wood ashes on the one hand with lime and potash salts on the other was to see if the latter might not in some cases replace the wood ashes to advantage, and to ascertain by actual experiment if the magical influence generally ascribed to wood ashes in Rhode Island was not, contrary to the prevailing opinion, largely attributable to the lime. As this and other experiments progressed, and it was shown that the beneficial influence of wood ashes was attributable as much to the lime as to the potash, this comparison was finally eliminated from the experiment, so that as now conducted all of the plots in the rotation are manured alike, except in the substitution of the stable manure for the regular corn formula upon three of the plots.

In some instances the rye crops failed in the earlier years of the experiment on account of poor seed, which resulted from the fact that the germinating power of the seed was not first tested, so as to insure that seed of good quality would be used. Aside from injury to the clover crops due to occasional drought, which could not of course be avoided, the chief disappointments in connection with this rotation in the earlier years were the failure of the clover, and the very small grass crops. In this respect the results were much the same as in the two five-year rotations which include grass. The causes for the poor results with clover and grass have since been ascertained to have been the acidity of the soil, which rendered the growth of clover and timothy impossible; and the use of too little nitrogen and potash in the formula for top-dressing grass.

Prior to 1901 many of the grass crops amounted to only from 1 ton to $2\frac{1}{2}$ or 3 tons per acre. Two notable exceptions were the crops upon two of the plots in 1896, which yielded 4.61 and 5.83 tons respectively. Beginning with the year 1901, when the grass formula was changed, the six subsequent yields recorded are: 5.12, 3.4, 3.8, 5.58, 4.18 and 3.98 tons respectively. It has thus been demonstrated that far greater profit results from a more liberal manuring, such as is provided for in the amended grass formula given elsewhere (see page 172), than by the use of the former one (see page 171).

The yields of Indian corn (shelled) by the same manuring employed at the outset have risen from a minimum of 16 bushels to a maximum of 83 bushels; the yields of stover have also risen from a minimum of 1.23 tons per acre to a maximum of 4.05 tons. The potato crops have risen from 130.8 bushels in 1893, only one-half of which were of merchantable size, to 382.3 bushels in 1902, of which less than 10 per cent were under merchantable size; leaving 350 bushels of large or merchantable tubers, as compared with 65.8 bushels in 1893.

The complete data concerning this experiment have not yet been prepared for publication; but what has been given above is enough to show that, whatever the faults in the treatment of the land may have been at the outset, the lessons that have been learned from the earlier failures and from the recognition of the acidity of the soil and the need of more nitrate of soda and muriate of potash for the grass crop are now bearing magnificent fruit, indicating that the scheme of manuring, as now practised, though perhaps still imperfect, is calculated to yield large profits.

Special Experiments in Top-dressing Grass Land.

The experiments in this line which are now in progress are designed to cover the following points, viz.: —

(1) To ascertain the minimum amount of nitrate of soda which, in the presence of sufficient of the other essential elements, will insure a crop of approximately 4 tons of hay per acre annually for a series of years.

(2) To ascertain the minimum amount of muriate of potash which, on a granitic soil, will insure a crop of 4 tons of hay annually for several years, provided an abundance of all the other necessary manures is furnished.

(3) To ascertain the minimum amount of acid phosphate necessary, under the conditions named in (1) and (2), to secure crops of similar size.

(4) To compare the grass crops produced under the Clark system of surface preparation with those obtained by the customary means. This involves using like amounts of lime and other chemicals in each instance.

(5) It is hoped the coming season to make comparisons of the relative effectiveness of like amounts of phosphoric acid, in one instance in acid phosphate, and in the other in basic slag meal, in order to ascertain which will give the best results in top-dressing grass lands, when the other conditions are identical. Only the first of these experiments has as

yet progressed far enough to justify drawing definite conclusions at this time. The results secured are in brief as follows: —

*Experiment concerning the Amounts of Nitrogen to use in Top-dressing Grass Land.**

The land upon which the experiment was conducted had been limed at the rate of 1 ton of slaked lime per acre in 1897. In the spring of 1898 barley was sown, and with it the following quantities of clover and grass seed, viz.: —

	Pounds per Acre.
Common red clover (*Trifolium pratense L.*),	7.5
Timothy (*Phleum pratense L.*),	15.0
Red-top (*Agrostis alba var. vulgaris Thurb.*),	7.5

"Total" phosphoric acid (P_2O_5) has been supplied in acid phosphate as follows: —

	Pounds per Acre.
In the year 1899,	164.1
In the year 1900,	191.1
In the year 1901,	130.0
In the year 1902,	130.0
In the year 1903,	130.0

The amount was increased in 1900 by virtue of using a higher-grade acid phosphate, but it was reduced again in 1901. Upon analyzing the crop of that year, whereby the small amount of phosphoric acid removed was definitely ascertained, we were led to the belief that 65 to 90 pounds per acre would probably be sufficient, or an amount that would be supplied by 500 to 600 pounds of the grade of acid phosphate containing about 13 per cent of "available" phosphoric acid.

The equivalent of actual potash supplied in muriate of potash during the experiment has been as follows, viz.: —

	Pounds per Acre.
In the year 1899,	88.31
In the year 1900,	90.38
In the year 1901,	100.00
In the year 1902,	150.00
In the year 1903,	150.00

* A full history of the manuring and treatment of the plots embraced in this experiment is to be found in Bulletins Nos. 57, 71, 82 and 90 of the Rhode Island Agricultural Experiment Station.

During the first one or two years of the experiment nitrate of soda was applied for the full ration at the rate of 450 pounds per acre; but it was concluded that this amount was more than was required, and the application was reduced to 63 pounds of nitrogen per acre, requiring approximately 400 pounds of nitrate of soda.

A careful study of the analytical results has now led to the belief that 350 pounds of nitrate of soda, if supplemented by the other necessary manures, are enough to insure the production of an average crop of about 4 tons of hay per acre for a period of several successive years.

The three plots employed in the experiment have been manured alike, excepting as concerned nitrogen. One plot has received no nitrogen; one a one-third ration, or 21 pounds of nitrogen per acre in the later years; and the other a full ration, or 63 pounds per acre of nitrogen.

Below are given the yields of field-cured hay, in tons, obtained in each of the years of the experiment from each of the three plots: —

	Without Nitrogen.	With 21 Pounds of Nitrogen per Acre.	With 63 Pounds of Nitrogen per Acre.
Yield in 1899, ...	2.54	3.15	3.46
Yield in 1900, ...	2.00	2.80	4.10
Yield in 1901, ...	1.65	2.78	4.70
Yield in 1902, ...	1.48	2.43	4.10
Yield in 1903, ...	1.64	1.85*	3.76†
Total yield in five years, .	9.31	13.01	20.12
Average yield per annum, .	1.86	2.60	4.02

In 1900 the total number of grass stalks per square foot upon the plot which received the one-third ration of nitrogen in nitrate of soda was 271, of which 36 were timothy and 235 red-top. Upon the plot which received the full ration

* This includes .15 ton secured in the second crop.

† A second crop of .07 ton was obtained, no account of which is made.

of nitrogen in nitrate of soda 236 stalks were present per square foot, of which 104 were timothy and 132 red-top. The timothy stalks occupy more space than red-top, which probably accounts for the smaller total number of stalks where the full ration of nitrogen was applied. A striking feature of this experiment in each of the five years has been the relatively greater amount of timothy where the full ration of nitrate of soda has been used. This has been accounted for upon the assumption that the large residue of soda tends to counteract the development of soil acidity in a greater degree than the one-third ration.

It has been found that, when the larger quantity of nitrogen has been used, the nitrogen of the plant has been more fully built up into albuminoids than otherwise, — a most desirable feature, from the feeder's stand-point.

The losses of hay by shrinkage in the barn have been found to range from 13.3 to 19.6 per cent.

Timothy and red-top grown upon the same area at the same time were not found to be equally rich in nitrogen. In this respect the red-top was richer than the timothy, though a greater proportion of the nitrogen of the latter than of the former had been changed into albuminoids.

As concerns the mineral constituents of timothy and red-top, grown as above specified, the latter contained more lime, magnesia, phosphoric acid and potash than the former. It has been found that every 1,000 pounds of field-cured hay removed from the soil, where the full ration of nitrogen was used, from 5.8 to 6.1 pounds of nitrogen, from 15 to 16.2 pounds of potash and from 3.1 to 3.3 pounds of phosphoric acid.

For the four years from 1899 to 1902 inclusive the profit after paying for the manure, where the full ration of nitrogen was employed, was $48.26 greater than where only a one-third ration of nitrate of soda was used.

The net value of the hay crop of the five years, after paying for the manures at retail prices, amounted, in the case of the plot receiving the full ration of nitrogen, to $150.11. In this estimate the first crop of 1899 was valued at $15 per ton, the second crop of that year and of 1901 at $12 per ton, and each of the other single crops at $16 per ton. These estimates are based upon the weights of the hay after curing in the barn. The shrinkage in the first two years was estimated to have been 20 per cent; in the later years it was actually determined, but found in no case to equal the allowance made in 1899 and 1900.

It is believed at the present time that the following formula would have given possibly a greater net profit than the other employed, viz.: —

	Pounds per Acre.
Nitrate of soda,	350
Acid phosphate,	500–600
Muriate of potash,	225–250

In view of the thousands of acres of "run-out" grass lands, and the lack of stable manure to renovate them, it is believed that a more general use of chemical manures would result in great profit to Massachusetts farmers. But, to succeed, lime must be applied if the soil is very acid (sour); and from 8 to 10 pounds of cleaned red-top seed and 18 to 20 pounds of timothy seed should be sown to insure a full stand of grass, for the greatest profit cannot be made if every square inch of the soil is not occupied by grass plants.

If time allowed, much might be added concerning grass culture; but it is hoped that what has been said may aid at least in a small way in awakening an interest in the subject, which may eventually result in making two blades of grass grow at a profit in Massachusetts where but one grew before.

Secretary Ellsworth. I am going to ask the indulgence of this audience just one moment; I wish to make a motion. The Board of Agriculture extends a vote of thanks to the Worcester Northwest Agricultural and Mechanical Society, and especially to its delegate, Mr. Goodspeed, to its president, Dr. Oliver, and to its secretary, Mr. Ellsworth, for the great interest that they have taken and the work they have done towards the success of these meetings.

Mr. Augustus Pratt (of North Middleborough). I wish to second the motion just made, and to say that for fourteen years, with one exception, I have had the privilege of attending the winter meetings of the Board, and in no case have I seen or known of a more cordial reception than we have received here at Athol. I wish to congratulate those who have had the management of these lectures, which we have enjoyed so much, upon the success of the meeting from the commencement to the close.

Mr. E. W. Boise (of Blandford). I wish to say that for over forty years there have been but few exceptions when I have not attended the winter meetings of the State Board of Agriculture, and for excellence and attention I hardly know of a better one than the present meeting. I therefore also wish to second the motion.

Ex-Secretary Sessions. I want simply to endorse what the others have said. I will not take time to go into particulars. We have had a good meeting, largely attributable to the good management of the local society and the delegate. Our secretary is also to be complimented, as well as Mr. Goodspeed, for the arrangement of the program and the almost perfect carrying out of it.

The motion, being seconded, was passed unanimously by the Board.

Prof. Wm. P. Brooks (of Amherst). I want to express my hearty appreciation, and endorse what the lecturer said as to basic slag, or phosphatic slag, as it is sometimes called. Last year, finding I could not buy it for less than $20 a ton, I wrote to England, and succeeded in laying it in Amherst at $12 a ton, which is a saving of 1 cent a pound for actual phosphoric acid in it, as compared with what I should have had to pay if I had bought it in America. I will add, however, that I have now learned, through the interest of a friend in the fertilizer business, how I can get it without change of the law, without paying the duty. He says if I have it billed as ground phosphate — because it has nothing to do with iron phosphate — it will come in free of duty. I am going to import again more largely than last year, and I am anxious to assist the farmers in this State to get this material cheaper, and shall heartily welcome correspondence from all who would like to get some of this material. The more we import, the lower the cost connected with handling it will be. Let me know what you want, and we will make up an order and get it here in ample season, and, unless your conditions are different from ours, you will be satisfied with your use of this material.

I should subscribe to most of Dr. Wheeler's formulas as a result of my own experience; but I would like to say something in connection with his formula for potatoes. Potatoes are a very important crop, and so I speak of that particularly. I believe that all of you who are growing crops on soils of medium loam or heavy character would do well to use high-grade sulfate of potash, instead of the muriate. You will get more potatoes by using this, as we do at Amherst, and of better cooking quality. We have tried this some ten or twelve different times, extending through the past dozen years, and with very rare exceptions have succeeded. Those exceptions were in very dry years. The sulfate has given us better potatoes, usually 2 per cent more starch in them.

Question. What is the additional cost?

Professor Brooks. Only a little. We use 225 pounds to an acre, and the difference makes only 60 or 65 cents difference, — what you put on an acre. It is an insignificant amount, when we consider we have sometimes obtained 30 bushels more from the sulfate than from the muriate.

What farmer that keeps stock does not wish to grow clover? If you wish to grow clover, you would do well to use sulfate of potash, instead of muriate. Some years we have obtained as good results with muriate, but those are apt to be dry years; in a year where the rainfall is normal, or inclined to be excessive, we get more from sulfate. Dr. Wheeler would tell you, and I agree with him, if the soil contains more lime, the results of muriate would compare more than sulfate. But the use of muriate leads to a greater loss of lime, and lime costs, as does everything else we put on the land; and so, if you can use the sulfate, you therefore cause a less loss of this valuable constituent out of the soil, and when you reckon by the acre it amounts to quite a little.

For grasses, for red-top, for corn, I do not find any considerable difference in the use, — the muriate there will give me as much yield as the sulfate; but with clovers or peas or beans or early garden crops sulfate does best, and with potatoes, as I have said.

Now, some of our fields at Amherst are coming up, and are of much interest in connection with the demonstration of what you can do on grass land without frequently breaking it up; and we have some fields there that will pay those of you who keep stock and want to produce hay to give to your stock to come and see, and listen to the lessons they will teach. We have 8 acres of land, which is now worth, I could convince any of you, $300 an acre to produce hay on, and it has not been plowed for about ten or twelve years. It has given an average crop throughout that time of something like 3½ tons to the acre annually in two cuts without re-seeding, and is not growing poorer, but growing better, at an annual cost of materials put on it of about $10 an acre. You may figure it yourself. It is $10 for what is put on the field, raising a crop of 3½ tons, situated easily, so that it is cut and made and put in the barn. It is returning more than 7 per cent rate of interest on $300 valuation per acre to-day. And we have other fields there which you would like to see, and which will show what you can do about producing hay to furnish to your stock. If you want to add nitrate of soda to timothy, it may be done. If you want to produce hay to feed to your cows or sheep, there is a difference of opinion whether it will pay to use so much nitrate of soda. I can show good results where nitrate of soda is used, and where the turf is increasing by using the basic slag and a little potash year after year.

Question. Have you done anything to the land?

Professor Brooks. Much of the land has not been plowed. Top-dressing has been put on only. It is a peculiar system of top-dressing, which you may not all be able to adopt. One year we put on manure at the rate of 4 cords to the acre. One year that land receives wood ashes, and the next year it has ground bone 400 pounds and muriate of potash 200 pounds. The field is between 8 and 9 acres, divided into three nearly equal parts, and each year we have the manuring rotated. We rotate manures, instead of crops. It is naturally good grass land, and that is the result. But, because ragged robin and some other weeds were rather gaining on the field, we broke it up in 1902, a portion of it, just after cutting the first crop. We plowed it, and then followed the Clark system of harrowing. We harrowed until about the 15th of August, when we seeded more heavily than Dr. Wheeler has spoken of, and this past year we had a bigger hay crop on that portion of the land than I have ever seen. It amounted to about 5 tons on part of the land, — a little over 5 tons to the acre with two crops. I think it will pay to re-plow or re-seed some of the land occasionally, but not often.

QUESTION. You want good sod to start on?

Professor BROOKS. Yes. I believe Dr. Wheeler says, and I know that it is not appreciated to the full value, to cover every inch with grass. That is why I use more seed. I think my experience would indicate that, if you sow as little seed as he stated is used, you would not get so close a turf, and some weeds would be liable to get the start.

Mr. B. P. WARE (of Marblehead). I have the impression that your land requires lime more than the average land of New England. Is that so?

Dr. WHEELER. I think there are lands in New England that require it as much as our own.

Mr. WARE. How can we ascertain whether our land is needing lime or not? There is some simple way by which we can ascertain, I suppose.

Dr. WHEELER. In regard to ascertaining whether soils are acid, that is easily done by taking some blue litmus paper, stirring up a little of the soil with a knife, and using enough water to make it of the consistency of thick griddle-cake dough. Insert the blue litmus paper, and let it stand for half an hour. If at the end of that time the blue color has disappeared and red appears, you may be sure the soil is distinctly acid. There is another test, which is to take two teaspoonfuls of soil in a glass, fill it half full of water, and add a little ammonia water, — a tablespoonful or two of dilute ammonia water, — and you will see after letting it stand a few hours whether you have a black extract. If you get a black extract, you may be sure the soil is in need of lime. The tests are described in Bulletin No. 46, which I can send to any one who will make application for it.

Mr. Ware. In mentioning amounts of lime did you mean air-slacked lime?

Dr. Wheeler. No, calcium oxide.

Mr. Ware. It amounts to how much air-slacked lime?

Dr. Wheeler. I think the application of $\frac{1}{2}$ ton to $\frac{3}{4}$ ton once in five or six years is necessary to maintain the conditions we want. Sometimes, at the outset, if the soil is acid, it may be necessary to put on 1 or $1\frac{1}{2}$ tons of air-slacked lime. If I had a soil that was very heavy clay, or contained a large amount of humus, — black, sour humus, — I might use two tons of lime to an acre, dependent on the crop to be grown. On light, sandy soil I should want to use only $\frac{1}{2}$ or $\frac{3}{4}$ ton.

Mr. Ware. Do plants assimilate lime?

Dr. Wheeler. All higher plants do.

Mr. Ware. Why don't we have it given in analyses?

Dr. Wheeler. It is an essential plant food, and sometimes has not been reported in the analyses, because we have heard so much of the three essential elements that we have forgotten sometimes that lime may be as essential as those three.

Mr. Ware. You spoke in regard to the grass crop, that where you employed nitrate of soda you had plenty of herd's grass, and with nitrogen it increased; where you used no nitrogen all the herd's grass disappeared. Did the roots of the herd's grass die? Weren't they all there?

Dr. Wheeler. Apparently at the end of five years most of them were dead.

Mr. Ware. This change seemed to be in one year?

Dr. Wheeler. What I was talking about was producing grass of a high grade. In that case plenty of manures and lime will insure maintenance of timothy.

Mr. Moore (of Orange). Is it possible to compost our green manure with materials other than lime, for instance, successfully and at a low cost? Might it not be possible to compost it in some way at a reasonable cost to better advantage than by using lime? Sometimes we cannot get lime handily, — that is, we cannot in the winter season, unless we have stored it.

Dr. WHEELER. In reply to that question, I have very great doubts if in New England, at the present price of labor, one can afford to do much composting. If labor were as cheap as in Europe, it might pay to compost. But I think it is better to use manure on the field without composting; and I would say, in regard to stable manure for grass, I believe usually the stable manure should be kept off the grass; the stable manure should be kept for the hoed crops. I have been on many farms where they have top-dressed the grass with stable manure and here and there it has been terribly injured.

QUESTION. Do you have good success in seeding with clover in August and September with your other seed? I cannot do it.

Dr. WHEELER. We have not tried it to any extent, for the reason that we do not consider it the proper time to sow clover seed. The clover seed in the last instance mentioned was sown with the barley in the spring. As a rule, we put clover seed in the last of March or April. We like to put it on the snow, so that we can know whether we get it on evenly. It gets in the soil, and I never had a failure except as a result of an extraordinary drought.

Mr. MELLEN. In regard to manure on clover sod and turning under, I would like to know if you think you get the benefit of the manure.

Dr. WHEELER. I expect, if there has been a big, heavy crop of clover, and there are lots of roots in the soil, we don't get the benefit from the nitrogen, but we do from the other elements. There might be more nitrogen than Indian corn would need. There were only 4 cords used to the acre, while ordinarily I think farmers use 7 or 8 cords to the acre; they are not over-generous. Am I mistaken? Market gardeners use unlimited amounts. There might not be too much for crops maturing more quickly than the Indian corn.

Mr. Q. L. Reed (of South Weymouth). Some of my neighbors in adjoining towns, and where they carry on more farming than they do where I live, rather laugh at plowing and re-seeding. Now, in regard to that formula that you gave, whether that will work on clayey land, where in the spring of the year if you dig a hole it will fill with water, and if you spread manure on that the timothy gets run out a little.

Dr. Wheeler. I don't think, if the timothy has disappeared, that any top-dressing you can put on will bring it back in any considerable quantity.

Mr. Reed. Suppose we put on top-dressing and re-seed it in the spring, and throw on timothy seed?

Dr. Wheeler. If the land is well seeded, and is clayey soil with lime, I think the chances are good that you will get timothy and retain it. I know fields in Rhode Island, and know of those in Massachusetts, where at least the second year's grass crop is largely red-top, notwithstanding the fact that timothy seed was sown; and I think, if pains were taken to investigate those instances, it would be found that it was due to the fact that the soil was acid, and that there was not enough lime and nitrogen there.

Mr. J. H. Allen (of Barre). We have a piece of mowing, $2\frac{1}{2}$ acres of which I am sure has not been plowed for thirty-three years. I am sure that on this piece we have secured 3 tons of hay to the acre, with a second crop. Every fall it has had a good top-dressing of stable manure, and I am sure the grass crop is on the increase. We do not seed to any extent in the fall. I believe in top-dressing with stable manure. I would say that considerable manure from horses and cattle is dumped in the same pile in the cellar. It gets a little bit of handling when loaded in the cart.

Dr. Wheeler. I should like to ask the gentleman if this hay he produced for a long series of years was first-class timothy hay?

Mr. Allen. First-class herd's grass, June grass, etc., which for our cows is better than clear herd's grass.

Dr. Wheeler. I agree with the gentleman that if a man has stable manure enough for both his hoed crops and his grass land, it is all right to top-dress with it, if you want to grow hay to feed the stock. If you have only enough stable manure for hoed crops, and you want to sell hay, use the stable manure for the hoed crops and top-dress with fertilizers, and you will get a higher price for your hay in the market.

Ex-Secretary SESSIONS. I want to compliment the speaker. He said he was going to give us a dry lecture, and it has been very interesting and instructive. About top-dressing, the importance of the matter all rests on what the land is, and where it is situated. When you are talking about Barre and New Braintree, you are talking about nine-tenths of what the State of Massachusetts has to deal with. Those farms as a rule do very little raising of hoed crops, and their grass land is exceedingly fine, and will respond to what Mr. Allen has said about top-dressing. But we want to remember what sort of land we are talking about. I remember a communication in the old "New England Farmer," where a gentleman was telling about when to plow. He said it was suicidal to plow when it was wet: you could not do anything with the ground, and got no crop, and it was useless. I was brought up on a gravelly farm, and what on earth the man meant I could not imagine. I read it through, but before I got through there was an incidental allusion to his land being clayey soil. It gave me the key to what he was saying, but he was giving a rule for all to go by. Before we criticise the advice of our speaker or anybody else, we want to know what kind of land we are talking about.

Mr. THAYER. I seed my land with nothing but clear timothy, about a bushel to the acre. It is kind of a rocky soil. You dig down 2 feet and strike hard pan, blue clay, and I seed that with nothing but timothy. I get clear timothy hay the next season, seed in August. The next year it is about one-half red-top and clover, and the next year there is scarcely any timothy there, more red-top and clover. I would like to ask what is the reason.

Dr. WHEELER. Do you top-dress at all?

Mr. THAYER. No, sir. I believe in putting the manure into the soil, and working it in, and I think you get better results.

Dr. Wheeler. I think, from the fact that the gentleman says the clover grows, the soil cannot be excessively acid, though it might be acid enough to interfere slightly with the growth of timothy, and still permit a growth of clover. So the soil might be acid enough to interfere to a certain degree with the maintenance of timothy, but I think this trouble is because he has not used nitrogen enough. He must be sure there is phosphoric acid and potash there, or all the nitrogen in the world would not avail. I think if he takes the land before the timothy has disappeared, and top-dresses with the formula we have described, he will retain the timothy for a series of years; particularly if he would lime it with wood ashes and use the formula, I am sure that would be the result.

Mr. Thayer. About five years ago I went into the strawberry business, and sorrel grows on my land a good deal, and bothers me in the strawberry bed. I read about liming in the papers, and I put about 2 quarts of air-slacked lime onto a piece 10 feet square. That I think was five or six years ago. Last year was the first time I saw any sorrel on that piece of land, but it is coming back now.

Dr. Wheeler. I am surprised that it all disappeared, but that it became less is natural. We found that after liming we would only get one-third as much sorrel. Where we used sulfate of ammonia we brought about such a condition that we had a crop of sorrel which was the most magnificent one that I had ever seen. In some places where it was limed and treated in a rational manner only here and there was sorrel to be seen.

Mr. Thayer. The little piece of land I referred to I set out to blackberries, and cultivated it every year, and this last season I saw that sorrel was coming in again.

Dr. Wheeler. Did the lime help the blackberries? I should doubt if it did.

Mr. Thayer. The blackberries are as good on that end of the field as on the other.

Professor Brooks. The gentleman spoke of raising strawberries. I would like to ask whether he put strawberries on before the lime on that little piece 10 feet square, and whether the strawberries did as well on that little square as they did on the balance of the field. I will tell the reason why I ask the question.

Mr. Thayer. The piece I had of strawberries was about 5 rods, not actual measurement, but very near 5 rods long, and I should say about 4 rods wide. There were 1,500 plants on the piece that I set out, and this piece — that is, where I put the lime — was right on one corner. I gave some of the strawberries raised there to the editor, and he put in the paper that they would measure 5 inches in circumference. That was on the limed part.

Professor Brooks. I said I had a thought in mind, — some experience that led me to ask the question. Dr. Wheeler's remarks imply that he has found that blackberries usually do not do as well after liming. I have a few observations that indicate that strawberries may be somewhat similar. I will put it as short and brief as possible. I raise strawberries with my own hands in a little garden ; I raise a good many, as we are very fond of them. My strawberries have been the best raised at the college. I had a yield one year at the rate of over 23,000 quarts to the acre. I knew my soil was getting into rather an acid condition. It crusted and cracked, and was hard to work ; it needed lightening up with lime, and I gave it a heavy dressing of lime, and have not been able to raise as good strawberries since. In one part of the college we have strawberries raised with nitrate of soda, with muriate of potash and also with sulfate. We used dried blood with the same, potash salts and sulfate of ammonia. Most crops failed almost absolutely on the combination of sulfate of ammonia and muriate of potash, because, as Dr. Wheeler has pointed out, that made the soil acid. While most of the crops were very poor on that combination, the strawberries have always done well, and sometimes have been about the best in the field. I have not yet satisfied myself whether strawberries need an acid soil, or one sweet with lime.

Question. Can you raise chickweed?

Professor Brooks. There is no difficulty in raising chickweed without any special effort.

Mr. George Cruickshanks (of Fitchburg). It may be of interest to some here to know that the variety of strawberry that Professor Brooks referred to was the Haviland. This variety bore very heavily that year. I have my share of chickweed, and I would like to ask if any one knows of a way to subdue it. I found it a little a few years ago. It did not spread much, because cultivation kept it from increasing; now it spreads over a large territory.

Dr. Wheeler. I will say just a word about chickweed. On my own lawn I applied wood ashes, and the chickweed came in all over it. The ashes made the soil favorable to chickweed; so, thinking I had done too much of a good thing in putting on ashes, I used muriate of potash and acid phosphate and sulfate of ammonia, tending to increase the acidity of the soil, and I have got rid of chickweed.

Mr. Cruickshanks. I have read that two quarts of fine salt to a square rod did not hurt the grass on a lawn, but did hurt the chickweed, and soon killed it out.

Dr. Wheeler. Salt would have the same general tendency as the manures I mentioned.

Mr. Cruickshanks. If a field produces heavy crops of clover, and even if clover comes in very readily all over the field, is that an indication that lime will be of any benefit to that field?

Dr. Wheeler. The fact that clover comes in would rather be an indication that lime would not be needed; yet the soil may be in such an acid condition as to injure certain plants and yet permit of the growth of clover. It is a question of degree. On land where timothy grows stout and clover comes in readily, I think for all ordinary farm crops there will be no need of liming for a long time to come; but it may be possible that even upon that land a crop of beets or of lettuce or of spinach would be somewhat increased. All ordinary crops might not be benefited at all.

Mr. Cruickshanks. My location is between two hills. I have a soil that will stand being laid down well manured, after growing two or three crops of corn, potatoes or other crops. I have had it stand for seven years and still produce a heavy crop of herd's grass. One of the oldest men of

Fitchburg, who died a few months ago, used to call to see me almost every summer. I remarked to him on one occasion that I was just going to mow the poorest piece of herd's grass I had on the place, and it was the last. He watched us mowing it, and he said it was the cleanest and handsomest piece of herd's grass that he ever saw, and the grass had stayed there seven years without any top-dressing. I have grown beets on that very land where the heavy grass grew, and a better crop of Edmand beets I never saw, and they were sown the last of June. A great many of them were too large for the market.

Mr. Trask. Suppose you have not ammonia and litmus paper handy, isn't there something in the growths on your land, either shrub or of herb, that will give you some indication of its sourness? For instance, along the roadside and in bushy ground you frequently see little maples, witch hazels, asters and various other plants with red leaves at the top. Does that indicate that the soil is sour, or that anything is needed in the land?

Dr. Wheeler. I think there is no doubt but that a certain class of vegetation will succeed well on an acid soil; certain other plants are almost never found on an acid soil; so that observations of natural vegetation will often lead one to know whether the soil is acid or not.

Question. Is sorrel an indication?

Dr. Wheeler. Yes, although it will grow on a mortar bed, and we have had it growing on top of a pile of lime. In large quantities it is usually an indication of acid soil.

Mr. Sessions. I want to suggest one thing. I think Mr. Ware asked about the relative value of air-slacked lime and other lime, — whether there is any difference.

Dr. Wheeler. We use one or the other, dependent on the cost. If I were working on sandy soil, I should prefer lime in wood ashes or lime air slacked, for they are not so alkaline. If air slacked a *long time*, I would rather have it on sandy soil, but on clay with sour humus I would take water-slacked lime in preference to air-slacked lime. In regard to the strawberry matter, I think both gentlemen are right, although they are at extremes. Strawberries will succeed on soil somewhat acid. Professor Brooks's soil I think was less acid than that of Mr. Thayer. Professor Brooks probably put on more lime than he did, and he may have made his soil alkaline, and unsuited to the strawberry plant; and the other gentleman put on 2 quarts of lime on a piece 10 feet square, and his soil was acid, although not so bad as before, and by reducing the acid he has made it more favorable to strawberry plants. Some plants will endure even more acid. When we talk about the action of lime, we have to take into account the degree of soil acidity.

QUESTION. Can you give us any feasible way of renovating or renewing pasture land which has not been fertilized for fifty or seventy-five years?

Dr. WHEELER. I think if you would top-dress the land with the same formula which I have given you, substituting basic slag meal for acid phosphate, and putting some double sulfate of potash or ashes in place of muriate of potash, it would be good. For this I should want to use wood ashes. If I used the wood ashes, I might not need to use basic slag meal, the idea of both being to correct any acidity. If you find the soil not acid, I should recommend the top-dressing. This last year, when we were very short of grass in the pastures, a similar top-dressing was applied to the grass fields, and you would be surprised to see how the grass came up, while the other pastures not top-dressed were very poor. There was a certain period in the spring, when, as you know, — or as we know in Rhode Island, — there was a great dearth of feed; and I believe the matter of top-dressing pasture land is something that ought to be attended to, and may be attended by decided profit, particularly where the milk is disposed of at a good price.

QUESTION. Do I understand this is done without re-seeding?

Dr. WHEELER. Yes. In regard to top-dressing, I would say the success depends on sowing it pretty early in the spring, from the 15th to the 25th of April, and seldom as late as the 1st of May in our section, and it probably would apply here. Apply the food while the soil contains enough water; the grass will then push ahead, and later you will get a good crop. If I were in the grass business, growing first-class timothy with red-top, I should be glad to see a dry season every year.

The CHAIR. The hour has come when we must bring this series of meetings to a close. The interest awakened during these meetings is remarkable for our winter season.

The meeting then adjourned *sine die*.

ANNUAL MEETING

OF THE

BOARD OF AGRICULTURE

AT

BOSTON.

JANUARY 12 AND 13, 1904.

ANNUAL MEETING.

In accordance with the provisions of chapter IV. of the by-laws, the Board met at the office of the secretary, in Boston, on Tuesday, Jan. 12, 1904, at 11 o'clock A.M., it being the Tuesday preceding the second Wednesday of January. The Board was called to order by First Vice-President WM. R. SESSIONS, who presided during the meeting.

Present: Messrs. Allen, Anderson, Appleton, Boise, Bradway, Brewster, Bursley, Burt, Damon, Danforth, Ellsworth, Goodell, Gurney, Hersey, Jewett, Kilbourn, Lane, Lyman, Mason, Perham, Peters, Pratt, Reed, Richardson, Ross, Sessions, Shaylor, Smith, Spooner, Stevens, Turner, Wellington and Worth.

An abstract of the annual report of the secretary was presented, read and accepted.

Reports of committees being in order, the committee on agricultural societies, by Mr. Kilbourn, chairman, presented a written report, which was accepted and adopted.

The committee on gypsy moth, insects and birds, by Secretary Ellsworth, presented a written report, which was accepted and adopted as the report of the Board of Agriculture to the Legislature.

At 12 o'clock the Board adjourned to 1.30 P.M.

The Board was called to order by Mr. SESSIONS, at 1.30 P.M.

The report of the Dairy Bureau was read by the general agent, Mr. Harwood, and was accepted and adopted.

The fourth semiannual report of the chief of the Cattle Bureau was presented by Dr. Peters, who read an abstract of the same, and the report was accepted.

The committee on forestry, roads and roadside improvements, by General Appleton, chairman, presented a written report, which was accepted and adopted.

Voted, That the recommendations made in this report be referred to the executive committee.

Voted, That the matter of enforcing the law relating to the offering of premiums and encouragement for the raising and preservation of oak and other forest trees be referred to the executive committee.

The committee on Massachusetts Agricultural College, by Mr. Bursley, chairman, presented a written report, which was accepted and adopted as the report of the Board of Overseers to the Legislature.

The committee on experiments and station work, by Mr. Spooner, chairman, presented a written report, which was accepted and adopted.

The second annual report of the State Nursery Inspector, Dr. H. T. Fernald, was read and accepted.

The report of the librarian was read and accepted.

Voted, That the recommendations made by the librarian be referred to the secretary of the Board for action.

An abstract of the reports of inspectors of the several fairs, prepared by direction of the committee on agricultural societies, was read and accepted.

The report of the special committee on the revision of the agricultural laws was presented and read by Secretary Ellsworth, which report was laid on the table, by vote of the Board.

At 4.45 the Board adjourned to 9.30 A.M., Wednesday.

SECOND DAY.

The Board was called to order by First Vice-President SESSIONS, at 9.30 A.M.

Present: Messrs. Allen, Anderson, Bradway, Brewster, Bursley, Burt, Damon, Danforth, Albert Ellsworth, J. L. Ellsworth, Goodell, Gurney, Hersey, Jewett, Kilbourn, Lane, Leach, Mason, Nye, Paige, Perham, Peters, Pratt, Reed, Richardson, Ross, Sessions, Shaylor, Smith, Spooner, Taft, Turner, Wellington and Worth.

The executive committee, as committee on credentials, by Mr. Kilbourn, chairman, reported the list of qualified members of the Board for 1904. The newly elected members by the several societies are as follows: —

Barnstable County, John Bursley of West Barnstable.
Franklin County, John S. Anderson of Shelburne.
Hampshire, Henry E. Paige of Amherst.
Martha's Vineyard, Johnson Whiting of West Tisbury.
Middlesex North, Henry S. Perham of Chelmsford.
Oxford, W. M. Wellington of Oxford.
Spencer, Henry H. Leach of North Brookfield.
Union, Albert H. Nye of Blandford.
Worcester Northwest, Albert Ellsworth of Athol.
Worcester South, C. D. Richardson of West Brookfield.

The report of the committee on credentials was accepted and adopted.

The records of the first day were read and approved.

The committee on institutes and public meetings, by Mr. Hersey, chairman, presented a written report, which was accepted and adopted.

The report of the special committee on revision of the agricultural laws was taken from the table. The report was read and discussed, and was unanimously accepted and adopted.

Voted, That a legislative committee of five be appointed, and that it be instructed to be prepared to present and support a bill covering the suggestions made in the special report, with power to make minor additions or changes as it may deem necessary to bring the laws relating to agriculture up to date.

The Chair appointed, as the legislative committee, Messrs. Kilbourn of Lancaster, Pratt of North Middleborough, Brewster of Worthington, Bursley of West Barnstable and Ross of Worcester.

Voted, That the chairman and secretary be added to the legislative committee.

On motion of President Goodell, it was

Voted, That the forester provided for in the proposed bill be required, as a part of his duties, to give annually a course of twelve lectures at the Agricultural College.

The committee on domestic animals and sanitation, by Mr. Damon, chairman, presented a written report, which was accepted and adopted.

Election of officers being in order, the chairman declared His Excellency JOHN L. BATES president of the Board (by a by-law of the Board the Governor is *ex officio* president).

Further elections by ballot resulted as follows: —

First vice-president, Hon. WILLIAM R. SESSIONS of Springfield.

Second vice-president, AUGUSTUS PRATT of North Middleborough.

Secretary, J. LEWIS ELLSWORTH of Worcester.

General agent of the Dairy Bureau, PETER M. HARWOOD of Barre.

State nursery inspector, Dr. HENRY T. FERNALD of Amherst.

Election of specialists being in order, it was

Voted, That the offices of botanist and pomologist be separated.

Ballots were then taken, and the elections resulted as follows: —

Chemist, Dr. C. A. Goessmann of Amherst.*
Entomologist, Prof. C. H. Fernald of Amherst.*
Botanist, Dr. Geo. E. Stone of Amherst.*
Pomologist, Prof. F. A. Waugh of Amherst.*
Veterinarian, Prof. James B. Paige of Amherst.*
Engineer, William Wheeler of Concord.
Ornithologist, Edward Howe Forbush of Wareham.

The Chair announced the standing committees as follows (the secretary is, by rule of the Board, a member *ex officio* of each of the standing committees): —

Executive committee: Messrs. W. A. Kilbourn of South Lancaster, Isaac Damon of Wayland, John Bursley of West Barnstable, Wm. H. Spooner of Boston, Francis H. Appleton of Peabody, Augustus Pratt of North Middleborough, C. D. Richardson of West Brookfield, Edmund Hersey of Hingham.

Committee on agricultural societies: Messrs. W. A. Kilbourn of South Lancaster, Q. L. Reed of South Weymouth, O. E. Bradway of Monson, J. Harding Allen of Barre, J. F. Burt of Easthampton.

Committee on domestic animals and sanitation: Messrs. Isaac Damon of Wayland, Johnson Whiting of West Tisbury, John S. Anderson of Shelburne, Wm. A. Lane of Norton, Henry E. Paige of Amherst.

Committee on gypsy moth, insects and birds: Messrs. Augustus Pratt of North Middleborough, J. M. Danforth of Lynnfield, Warren C. Jewett of Worcester, H. H. Leach of North Brookfield, Walter D. Ross of Worcester.

Committee on Dairy Bureau and agricultural products: Messrs. C. D. Richardson of West Brookfield, J. M. Danforth of Lynnfield, Henry E. Paige of Amherst, W. M. Wellington of Oxford, A. H. Nye of Blandford.

Committee on Massachusetts Agricultural College: Messrs. John Bursley of West Barnstable, C. K. Brewster of Worthington, W. C. Jewett of Worcester, Arthur A. Smith of Colrain, C. H. Shaylor of Lee.

Committee on experiments and station work: Messrs. Wm. H. Spooner of Boston, N. I. Bowditch of Framingham, S. B. Taft of Uxbridge, Edmund Hersey of Hingham, H. A. Turner of Norwell.

Committee on forestry, roads and roadside improvements: Messrs. Francis H. Appleton of Peabody, H. A. Turner of Nor-

* Massachusetts Agricultural College.

well, J. W. Gurney of Cummington, H. G. Worth of Nantucket, J. J. Mason of Amesbury.

Committee on institutes and public meetings: Messrs. Edmund Hersey of Hingham, H. H. Goodell of Amherst, Henry S Perham of Chelmsford, Wm. R. Sessions of Springfield, Albert Ellsworth of Athol.

These appointments were approved by the Board.

The secretary appointed his first clerk, Mr. F. H. Fowler, librarian of the Board.

Special assignments being in order, the request of the Middlesex North Agricultural Society for the approval by the Board of Agriculture of its votes, passed at a meeting of the society held on Dec. 2, 1903, to sell a portion of its real estate and to borrow on mortgage the sum of $3,300, was considered.

The delegate of the society was present, and stated the reasons for the sale and mortgage. It appearing that the meeting at which the votes were passed was legally called and held, that the votes were by the necessary two-thirds, that the request for approval had been properly advertised, and no person appearing in opposition to the request, it was

Voted, To approve the above-quoted votes of the Middlesex North Agricultural Society, in accordance with the provisions of chapter 124 of the Revised Laws.

The request of the Union Agricultural and Horticultural Society for the approval by the Board of Agriculture of its vote, passed at a meeting held on Dec. 16, 1903, "to authorize and instruct its treasurer to borrow the sum of $1,300, to be applied to the debt of the society, and as security for the same mortgage the real estate of the society," being in order, the matter was considered.

The secretary of the society was present, and stated the reasons for the mortgage. It appearing that the law had been fully complied with, and no person appearing in opposition to the request, it was

Voted, To approve the above-quoted vote of the Union Agricultural and Horticultural Society, in accordance with the provisions of chapter 124 of the Revised Laws.

The committee on agricultural societies, by Mr. Kilbourn, chairman, reported recommending that the date for the commencement of the fair of the Amesbury and Salisbury Agricultural and Horticultural Society be changed to the second Tuesday after the first Monday in September; that of the Bristol County Agricultural Society to the fourth Tuesday after the first Monday in September; that of the Hoosac Valley Agricultural Society to the third Friday after the first Monday in September; that of the Middlesex North Agricultural Society to the second Friday after the first Monday in September; and that of the Weymouth Agricultural and Industrial Society to the third Thursday after the first Monday in September.

Voted, To change the dates of the several societies, as recommended.

Mr. A. M. Lyman presented and read an essay on "Past and present dairying," which was accepted.

At 12 o'clock the Board adjourned to 1 P.M.

The Board was called to order by First Vice-President SESSIONS, at 1 P.M.

The committee on institutes and public meetings, by Mr. Hersey, chairman, reported that an invitation had been received from the Eastern Hampden Agricultural Society to hold the next public winter meeting of the Board at Palmer, and one from the Middlesex South Agricultural Society to hold it at South Framingham, but without recommendations.

The matter was taken under consideration and discussed, after which the Board voted to hold its next public winter meeting at South Framingham, on Tuesday–Thursday, December 6–8.

The Chair appointed, as a local committee of arrangements for this meeting, to act with the committee on institutes and public meetings, Messrs. Damon, Taft, Jewett and Kilbourn, which appointments were confirmed by vote of the Board.

The committee on institutes and public meetings also reported that an invitation had been extended the Board by the Hillside Agricultural Society to hold its summer meeting at Cummington.

Voted, That the holding of a summer meeting, place and time, be referred to the committee on institutes and public meetings.

The same committee reported recommending that the essays customarily presented and read at the annual meeting be superseded by a lecture by an expert, when it was

Voted, That the matter be left with the committee on institutes and public meetings.

The secretary reported on the delinquencies of certain societies in failing to comply with the law and the regulations of the Board in sending in their annual returns.

Voted, To refer the delinquencies to the executive committee, with power to act.

Mr. Kilbourn, for the committee on agricultural societies, reported, recommending the assignment of inspectors, as follows: —

Amesbury and Salisbury, at Amesbury, September 13, 14 and 15,	A. H. Nye.
Barnstable County, at Barnstable, August 30, 31, and September 1,	C. H. Shaylor.
Blackstone Valley, at Uxbridge, September 13 and 14,	A. Pratt.
Bristol County, at Taunton, September 27, 28 and 29,	A. A. Smith.
Deerfield Valley, at Charlemont, September 15 and 16,	J. Whiting.
Eastern Hampden, at Palmer, October 7 and 8,	J. M. Danforth.
Essex, at Peabody, September 20, 21 and 22,	W. C. Jewett.
Franklin County, at Greenfield, September 21 and 22,	O. E. Bradway.
Hampshire, at Amherst, September 20 and 21,	W. D. Ross.
Hampshire, Franklin and Hampden, at Northampton, October 5 and 6,	H. G. Worth.
Highland, at Middlefield, September 7 and 8,	H. H. Leach.
Hillside, at Cummington, September 27 and 28,	Q. L. Reed.
Hingham, at Hingham, September 27 and 28,	H. S. Perham.

Hoosac Valley, at North Adams, September 23 and 24,	C. D. RICHARDSON.
Housatonic, at Great Barrington, September 28 and 29,	J. M. BURT.
Marshfield, at Marshfield, August 24, 25 and 26,	H. E. PAIGE.
Martha's Vineyard, at West Tisbury, September 20 and 21,	WM. H. SPOONER.
Massachusetts Horticultural, at Boston, September 22, 23, 24 and 25,	F. H. APPLETON.
Middlesex North, at Lowell, September 16 and 17,	J. J. MASON.
Middlesex South, at Framingham, September 20 and 21,	H. A. TURNER.
Nantucket, at Nantucket, August 24 and 25,	W. M. WELLINGTON.
Oxford, at Oxford, September 8 and 9,	ISAAC DAMON.
Plymouth County, at Bridgewater, September 14, 15 and 16,	JOHN BURSLEY.
Spencer, at Spencer, September 22 and 23,	A. ELLSWORTH.
Union, at Blandford, September 14 and 15,	J. S. ANDERSON.
Weymouth, at South Weymouth, September 22, 23 and 24,	W. R. SESSIONS.
Worcester, at Worcester, September 5, 6, 7 and 8,	C. K. BREWSTER.
Worcester East, at Clinton, September 14, 15 and 16,	W. A. LANE.
Worcester Northwest, at Athol, September 5 and 6,	J. W. GURNEY.
Worcester South, at Sturbridge, September 15 and 16,	J. H. ALLEN.
Worcester County West, at Barre, September 29 and 30,	W. A. KILBOURN.

The report of the committee was accepted and adopted.

Mr. C. H. Shaylor presented and read an essay on "Improved live stock," which was accepted.

Voted, That all unfinished business, or new business arising before the next regular meeting of the Board, be left with the executive committee, with power to act.

At 2.45 o'clock P.M. the meeting was dissolved.

J. LEWIS ELLSWORTH,

Secretary.

REPORT OF COMMITTEE ON AGRICULTURAL SOCIETIES.

[Read and accepted at the Annual Meeting, Jan. 12, 1904.]

Your committee have to report that they find the societies generally have done good work. With two or three exceptions they have held successful and well-attended institutes, and have given to them more attention and more effort than in some past years. We do not commend the plan of holding the three institutes in succession at one place, as it seems to us in some cases that this method has been adopted to meet the requirements of the rule that three institutes should be held, rather than fulfilling its purpose of disseminating useful information. We commend to those societies where the institutes have been failures a more careful advertising and an earlier arrangement of programme.

The fairs have been more than usually successful, and the societies with favorable weather have more than paid their expenses. They have shown considerable variety in the conditions of their exhibitions and entertainment. The reports of the inspectors indicate these differences, but generally commend. The efforts of each society to carry forward the work for which these fairs were instituted and are maintained show that in most cases the societies are in good standing.

Respectfully submitted,

WILLIAM A. KILBOURN.
J. HARDING ALLEN.
Q. L. REED.
O. E. BRADWAY.
J. F. BURT.

REPORT OF COMMITTEE ON DOMESTIC ANIMALS AND SANITATION.

[Read and accepted at the Annual Meeting, Jan. 13, 1904.]

Your committee would report that it is its opinion that the condition of the buildings on farms, both dwellings and barns and other outbuildings, has greatly improved over that of a few years ago. This is due to the attention of the farmers being called to the fact that such improvement is a necessity, in consideration of the health of their own families. Another factor has been that those engaged in the retail milk business found that it was for their advantage in a pecuniary way to have the most improved sanitary arrangements in their barns.

Your committee is of the opinion that educational work should be done to secure more humane treatment of stock, so that every owner of domestic animals may not only feel his obligation to the dumb beasts under his care, but may also understand how greatly the welfare of his flocks depends upon his kindness and protecting care. It is necessary to provide comfortable quarters in winter, well lighted and well ventilated, and a suitable amount of exercise is indispensable. There should be an abundance of good feed and clean water, and all the salt desired by the animals. Care should be more systematic than is common, mangers should be kept clean, and feeding time should not vary more than a few minutes. The farmer ought to treat his cow and speak of her as if she were a lady, and if he does, will surely see the results in better pecuniary returns. No animal is more worthy of kind treatment than the horse, and yet of all domestic animals none is more shamefully abused. Often after drawing a heavy load for many miles he is compelled to stand hitched to a post without a blanket, in zero weather, and it is no wonder that under such conditions horses so often sicken with pneumonia. It is absolutely essential that the farmer should have the confidence of his domestic animals. Fear induces disease. The only way to keep stock in perfect health is to see that every want is supplied.

In general, it is the opinion of your committee that, barring the attack of foot and mouth disease that prevailed during the first of the year, the health of domestic animals has been very good during the year. Through the just enactments of our Legislature the farmers whose herds suffered from the foot and mouth disease were recompensed, as fully as money paid at a fair appraisal could recompense them, for the loss of the use of their herds during several months of the year. The disease is now stamped out, and we sincerely hope that there may be no recurrence of it for many years.

Your committee has but little actual work to perform in the lines laid down for it by the Board, having no funds at its disposal. We would renew our recommendation of a year ago, as voiced by the secretary of the Board and the special committee appointed to consider changes in the laws relating to agriculture, that either the Cattle Bureau should be brought under the actual control of the Board, or distinctly separated from it.

Respectfully submitted,

ISAAC DAMON.
JOHN S. ANDERSON.
A. M. STEVENS.
WILLIAM A. LANE.

REPORT OF COMMITTEE ON EXPERIMENTS AND STATION WORK.

[Read and accepted at the Annual Meeting, Jan. 12, 1904.]

We shall notice only a few of the important features of the work at the station, as the reports of the various heads of departments cover the work so well; but a few things seem to deserve mention.

In the pomological department the peach orchard is of special interest. In common with most orchards of the kind, the trees were killed back by the frost and the fruit buds destroyed; these trees were cut back severely early in the season, and by the last of September had grown fine heads, which having been well trimmed out, the foliage was clean and the stems well set with fruit buds, — certainly a remarkable change from their appearance in June. We have seen nothing in other peach orchards that could compare with these trees, which certainly furnish an object lesson for practical cultivators.

A noticeable experiment in the agricultural department was a collection of apple trees, in several groups of four trees each, containing Gravensteins, Greenings, Baldwins and Russets. These several groups were fertilized differently; the trees had been sprayed and carefully pruned, and were in good shape, with round heads, clean foliage, and loaded with fair, smooth fruit; even the smaller apples were clean, and would certainly be worth more for cider than the wormy fruit frequently used. This collection is well worth a visit.

In driving through one of the apple sections of this State last summer we saw scarcely an orchard in bearing that was free from the apple scab or the sting of the apple curculio; but neither precept nor example seems to avail with those most interested. When we consider that it takes no longer to harvest the good apple than the poor one, and that one established fact is that the market is seldom overstocked with the best, it proves that the poor stock is what suffers from the over-supply. This lesson we have learned by many years of practical experience.

In this connection, it is a sad commentary on the apple product of Massachusetts that it has a very low standard in the markets, and shippers sometimes call their produce New Hampshire grown, to secure better prices. We have seen quotations from foreign markets where Baldwin apples, best quality, from Massachusetts, were rated at less than the second quality of the same variety from Maine; in fact, prices for Massachusetts apples rule from one shilling to four shillings less per barrel on the average than those from other States. There are fortunately some exceptions to this rule, to prove what can be done in Massachusetts; a few growers who take proper care of their trees produce the very best fruit, which commands the highest price in the Boston market.

There have been shipped during the past season to England, France, Germany, etc., over 2,500,000 barrels of apples from all ports; of this number, 631,863 barrels were shipped from Boston, though not all grown in Massachusetts, as Maine, New Hampshire and Vermont supplied a part.

Now, if the next year is the so-called "apple year," with a larger crop, to find a ready market the fruit must be in the best condition and well put up, as the eye is the critic in sales of fruit.

Respectfully submitted,

WILLIAM H. SPOONER,
Chairman.

REPORT OF COMMITTEE ON FORESTRY, ROADS AND ROADSIDE IMPROVEMENTS.

[Read and accepted at the Annual Meeting, Jan. 12, 1904.]

In behalf of the committee on forestry, roads and roadside improvements, and with the approval of the full committee, this report is respectfully submitted.

Forestry. — There is still much information remaining upon this subject which can well be placed before our citizens, and which would invite their thoughtful consideration if presented in the most approved and up-to-date ways.

Science and practice have long worked hand in hand in the older and more thickly populated countries, preserving and promoting the useful and necessary features of applied forestry. Such is also the case in parts of our own country, where the decision of the government is that such has become necessary and wise.

In attempting to bring this subject more fully before our people, a system of lectures with lantern slides, well selected, can be made to play a beneficial and important part. Well-planned and well-prepared addresses upon this subject might be put in print, to be used with slides. This is a recognized method, at home and abroad, of disseminating useful information; that is, to permit and urge the delivering of such lectures by persons well trained, by simply making proper application and by using the express.

Such lectures could then be readily given in localities not easily accessible of an evening to the expert who prepared them; and the evening is often the best time for the lecture, as it is the time when most people can most readily come together. The selection of a citizen of the locality, with a suitable voice, and who will have the best interests of the locality at heart, to freely give his services, is always possible.

The possibility of being able to use the lantern becomes an important consideration in this suggested arrangement. But where there is the electric light plant, from which an attachment can be made in the town hall or other suitable hall, the lantern is an easy possibility, and the need of the calcium light jars thus done away with.

Lastly, as to the lantern itself. I believe that there are always persons in all localities that would be ambitious to receive such benefit who would be ready to assume the responsibility of receiving and returning a lantern in good order, after competent use of the same. Printed instructions can be prepared of sufficient distinctness to make the connecting of lantern and using of the slides thoroughly possible, and not difficult.

This supposes that the State shall own for its work in agricultural instruction, in its forestry and other branches, one or more lanterns. This would seem to be a proper request to make of the Legislature, — to appropriate money for two lanterns, sets of slides and prepared addresses for each set. We suggest that the Board refer this matter to their executive committee.

We would again call your attention to the advanced work in constructive forestry now being done in such excellent manner by the Metropolitan Water and Sewerage Board at Clinton. It is an object lesson, worthy of careful study, in the intent of possible addresses on the character and usefulness of the naturally attractive surface of our Commonwealth.

Roads. — These have been greatly advanced in condition, by increased knowledge among all of us, from the greater attention given the subject. The demands of the greater travel in many ways throughout the State, by bicycle, automobile, street car and the companionable and intelligent horse (whether in the shaft or pole or under the saddle), have forced upon us this interesting study, which has resulted in better grades, better crowning and better make-up of road bed, in our methods of intercommunication and of home travel by road.

Roadside Improvements. — We have much to learn upon this subject, although much has been already accomplished. By a wise and as liberal as possible use of the lantern slides, and expert advice, the better to let our people know what can be and has been accomplished upon these lines, we can greatly advance this work; and we can largely extend knowledge concerning destructive pests, — both fungous and insect,— and the effects of wires, bad pruning and other obstructors of beauty and summer shade on our roadsides, with best methods and remedies for lessening these evils.

The subject of advising the agricultural societies to offer prizes for better-cared-for roadsides, as suggested by Mr. Jewett at our last annual meeting, is commended to the attention of our Board.

All of which is respectfully submitted.

FRANCIS H. APPLETON,
Chairman.

Report to the Legislature of the State Board of Agriculture, acting as Overseers of the Massachusetts Agricultural College.

[Revised Laws, chapter 89, section 10, adopted by the Board, Jan. 12, 1904.]

To the State Board of Agriculture, Overseers of the Massachusetts Agricultural College.

Your committee attended the commencement exercises in June, and awarded the Grinnell prizes for excellence in agriculture as follows: the first to Paul Nerses Nersessian of Marash, Turkey; the second to Elmer Myron Poole of North Dartmouth, Mass.

We visited the college again in October, and found that the peculiar season had affected the crops upon the college property as elsewhere; still, the reports from nearly every department were favorable. The presence of larger freshmen and sophomore classes would indicate that our people are beginning to realize the opportunities offered for a good practical education at small expense in this institution. It is a pleasure to note that a larger percentage of students are electing agricultural and horticultural courses, seventy-five per cent of the junior class and ninety-two per cent of the senior class taking these studies.

While some of the stock upon the farm may not be above criticism, we are pleased to notice an improvement in recent years; and that still greater improvement may be made, we would suggest that an appropriation be asked for sufficient to equip the institution with pure-bred herds of the leading breeds.

Other lines of agricultural industry must also be liberally provided for, and to that end your committee would recommend that a new building be provided for the horticultural department, that this branch may have the increased room it greatly needs.

Farmers of Massachusetts, we wish you would visit the college, and learn from your own observation what it is doing, knowing that, if you once became better acquainted with it, you would not only more gladly support it with your money, but would also have your boys enjoy its benefits, for we believe no young man will ever regret the time spent at this institution.

Respectfully submitted,

JOHN BURSLEY.
C. K. BREWSTER.
A. A. SMITH.
C. H. SHAYLOR.
W. C. JEWETT.

REPORT OF COMMITTEE ON INSTITUTES AND PUBLIC MEETINGS.

[Read and accepted at the Annual Meeting, Jan. 13, 1904.]

The summer meeting of the Board was held at Amherst, thus giving the members of the Board an opportunity to look over the farm and see the various experiments under trial, and also to see the results of experiments tried in past years.

The cattle, the trees in the orchards, as well as the vegetables in the gardens, gave valuable information to the members and others who were present, undoubtedly giving them important facts that they had never before been brought in connection with. If members of the Board would visit the farm every year, or once in three years, it would undoubtedly increase their interest in the farm, by giving them a better understanding of the numerous experiments that are continually being tried.

To see the college and the buildings erected for its use cannot do otherwise than increase the farmer's interest in it, and create a desire that his and his neighbor's boys should have a more thorough education than they can get at home.

The country meeting of the Board was held at Athol, and was very successful. The lectures were of a high order, and the attendance was much larger than usual. There can be no doubt that these meetings, held in different parts of the State, are beneficial to the people.

The farmers' institutes have been held as in years past, and the interest in them is increasing every year. The lectures given are more intelligent and better prepared than in the past, because there is better knowledge of how to prepare the soil and how to care for and harvest the crops than formerly. Every improvement made is given not to one but to every farmer who attends the institutes. That the farmers are improving in the preparation of the soil and the cultivation and harvesting of crops is undoubtedly true, and that a portion of this improvement comes from the farmers' institutes is evident to every thinking man who attends the meetings.

Respectfully submitted,

EDMUND HERSEY.
H. H. GOODELL.
ENOS W. BOISE.
HENRY S. PERHAM.

REPORT OF COMMITTEE ON GYPSY MOTH, INSECTS AND BIRDS.*

[Read and adopted at the Annual Meeting, Jan. 12, 1904.]

To the Massachusetts State Board of Agriculture.

The committee on the gypsy moth, insects and birds presents herewith its report for the year 1903. As in recent years, the activities of the committee have been directed mainly to keeping in touch with the increase and depredations of the gypsy moth, and in disseminating information concerning the best means for fighting the pest. Several inspections of the infested district have been made from time to time, particular attention being given to certain localities where large colonies formerly existed, and from which it was believed the pest had been exterminated at the time when active work against the moth was stopped. The natural fecundity of the insect being large, it is apparent that by this date any surviving moths left in these colonies would have multiplied to a noticeable degree. We are glad to state that in none of these colonies, which are described more in detail in another place, were any signs of the moth found.

The year 1903 was especially unfavorable to insect increase. Doubtless the long drought in May and June had an important part in checking insect development. Certainly the season was notable, taking the State as a whole, for the scarcity of insects in injurious numbers. The canker worm was injurious only in a few localities; the tent caterpillar was remarkably scarce; the elm leaf beetle surprised tree lovers by its gratifying diminution in numbers; even that omnipresent denizen of the potato patch, the potato bug, appeared with decimated ranks. In the face of adverse conditions,

* House Document No. 188, 1904.

which checked the development of these common pests of various habit, the gypsy moth not only held its own but made a notable increase in numbers, in severity of attack and in area occupied by the more important colonies. This increase under unfavorable circumstances gives additional evidence of the hardy nature of the moth. Property owners in the infested district may well congratulate themselves on the adverse influence exerted last season on insect increase, for had the season been a normal one the damage by the gypsy moth would doubtless have been more severe.

The spring inspection showed the yellow egg patches of the moth present nearly everywhere in the central infested district of Medford, Malden and Melrose. In other cities and towns important large colonies were noticed. Thus at Arlington along the upper mill pond and in Lexington near the Woburn line thousands of moth nests could be seen in the course of a few minutes' walk. At Saugus in certain of the woodland colonies trees of good size were literally "felted" with the egg masses. The eggs hatched somewhat earlier than usual, and for several weeks — perhaps owing to the May drought — the caterpillars made but little headway. With the advent of rains and hot weather damage by the insect came to view at an alarming rate. In a night almost, it seemed, large areas in residential sections or in woodland were practically defoliated. The stripping of the hillside between the Fells and Wyoming (Melrose) spread from day to day, like a drop of oil on water. This rapid increase in the devastation by the moth continued even into July, when it ceased, as the insects entered the pupal stage.

While the injury was more noticeable, viewed from a little distance, in the woodlands, it was more severely felt in the residential sections. Whole districts, as that between Forest and Salem streets, Malden, were deprived of shade, gardens were ruined and housekeepers put to much annoyance in their efforts to exclude the swarming caterpillars from dwellings. A lady living in the Lebanon Street district of Melrose collected on doors and house walls upward of a bushel of the caterpillars in ten days.

From the citizens of the infested district came numerous requests for advice in destroying the caterpillars, and through the office of the secretary of the Board all such requests received prompt attention. With the pupal season damage ceased, and late rains helped the trees to throw out a second crop of leaves, although it was noticeable that in the worst devastated districts many large trees had succumbed to the attacks of the pest. In southern Melrose, where considerable stripping has occurred for two years past, fifty or more dead pines and many dead oaks are mute witnesses of the insect's power for harm.

As in past years many cities and towns continued the work of suppressing the pest on street trees and in a few cases on private estates. Somerville, Malden, Medford, Lexington, Melrose and many other cities and towns have done excellent work in suppressing the moth on street trees. While the latter as a rule escaped serious damage last season, the nearby colonies on private estates have rapidly increased and threaten to undo the good work accomplished by municipal efforts. Hundreds of private citizens, realizing the danger of harboring such a pest or seeing their trees attacked by the caterpillars, took prompt action, even at considerable expense and personal inconvenience. Medford's well-known citizen, Gen. S. C. Lawrence, is a conspicuous example of this class. The owner of large areas of beautiful woodland, which he has practically opened as a public park, his efforts in resisting the moth have been constant in season and out of season. During the height of the caterpillar season he employed upward of thirty men in the effort to protect his trees from damage. What this public-spirited citizen has done on a large scale other owners of small estates have freely endeavored to accomplish. By suppressing the moth on their own property and thereby saving their trees from harm they have also protected their neighbors from annoyance and loss. Such examples of good citizenship are worthy of the highest commendation. By way of contrast, far too many, either through lack of means or from indifference, have allowed the moth to ravage their trees, breed unrestricted and spread outward to adjoining estates, there to work havoc in future seasons.

Great as has been the injury by the caterpillars the past year, in our opinion the greatest damage will result from the widespread distribution of the moth, which has certainly taken place from the "boiling over" of the large neglected colonies. How great has been this distribution time alone will show, but from years of experience and study of the habits of the pest we know that when a colony reaches the swarming stage, when large areas are stripped and the army of hungry caterpillars marches outward in all directions seeking food, a few years will suffice to show that numerous new colonies are the direct result of this wholesale migration. This is particularly dangerous when the colonies are located near lines of travel. As is well known, caterpillars spin downward on teams, bicyclists, electric cars, trains, etc., and are easily transported from place to place. Mr. Joseph Chase, the well-known Malden nurseryman, reported last July the finding of a large gypsy moth caterpillar in an electric car at the Sullivan Square terminal, Charlestown. Mr. A. H. Kirkland, formerly assistant entomologist to this committee, informs us that at the Oak Grove and Wyoming stations of the Boston & Maine Railroad the young caterpillars literally hung in festoons from the eaves of the depots. At North Saugus Mr. Kirkland gathered two gypsy moth caterpillars from an electric car passing on a turnout. These few instances indicate how the moth is spreading and emphasize the danger from colonies near streets or railroads. One cannot consider the volume of traffic passing through certain badly infested sections without the conviction that the past season has marked a large diffusion of the moth throughout the infested district, and doubtless into regions previously free from its presence.

As pointed out in previous reports, the increase of the moth into woods colonies was not at first as rapid as in the residential districts. These latter localities, however, have received the greatest attention from property owners or municipal authorities, while the woodlands have been neglected. The result is that now the woods colonies have become a serious factor in the problem. At Arlington, Lexington, Medford, Malden, Melrose, Saugus, Lynn and Lynnfield there are many large woodland colonies where the egg clusters may be counted by thousands. No matter how thorough municipal or private efforts to suppress the moth may be, so long as these colonies remain the opportunity for reinfestation is at hand, and from these colonies the caterpillars will spread annually to reinfest the district where the moth has been destroyed. In the experience in the former work by this committee it was found, for example, that so long as there were large woodland colonies in the Saugus and Lynn woods the city of Lynn remained infested in spots from year to year. When these woods colonies were suppressed the source of infestation was cut off and a large part of Lynn was soon freed from the insect.

A new colony at East Bridgewater, Mass., was among the unfortunate developments of the year, since aside from the infestation at Providence, R. I., no findings of the moth south of Boston had previously been made. The colony mentioned was reported through the agency of Mr. A. M. Cobb, Malden, Mass. It is at present of small extent, occupying a part of an apple orchard and probably a small section of woodland near by. Lack of funds prevented us from doing more than verify the finding of the moth at this place, but we have no reason to think that the insect was brought to this place by other than accidental means.

At Lincoln, Mass., there existed at one time a large woodland colony which from its outlying position was considered as an especially dangerous one. A great deal of very thorough work was done here by the employees of this committee, and at the time the work was stopped it was believed that the insect had been practically exterminated at this point. A very thorough examination of this colony made this fall failed to show any signs of the moth. At Georgetown a similar colony was located, had about the same history and received the same treatment as at Lincoln. Here again a very thorough examination, made in December, 1903, failed to reveal the presence of the moth. While it would be too much to say positively that no moths exist in either locality, it is apparent that the treatment given them has been highly effective in suppressing if not exterminating them.

The frequent demands from property owners for advice in combating the moth have led us to include in this report a brief summary of the most effective remedial measures.

Mass of Gypsy Moth Egg-clusters on the Trunk of a Large Elm.

Remedies for the Gypsy Moth.

Fall, Winter, Spring. — From August to May the yellow, hair-covered egg masses of the moth may be found on tree trunks, walls, etc. They should be thoroughly soaked with creosote mixture, applied with a small brush, great care being taken not to break or scatter the egg clusters before they are thoroughly treated.

Summer. — Where egg destruction has been neglected, or where the insects come forth in numbers from nests in walls, etc., spray the foliage thoroughly with disparene or arsenate of lead, three pounds to fifty gallons of water, or with Paris green, one pound to one hundred and fifty gallons of water.

Where caterpillars swarm from adjoining estates on to trees that have been clear from the moth, band the tree trunks thoroughly with raupenleim, or its American substitute, bodlime, or even with tar, printer's ink or other sticky material. Keep these bands fresh by the removal of the masses of insects which form there.

Bands of cloth or bagging tied loosely about the tree trunks will make hiding places where the caterpillars will gather. They should be examined each morning and the insects destroyed by hand. Suitable insecticides and other supplies for destroying the insect may be obtained at any seed store. The prevalence of the moth has led several parties to take up the business of spraying, and where one lacks the facilities for this work it is often more economical and satisfactory to make use of the services of these experts.

AUGUSTUS PRATT.
JOHN M. DANFORTH.
JOHN G. AVERY.
WM. R. SESSIONS.
W. C. JEWETT.
J. LEWIS ELLSWORTH.

REPORT OF THE SPECIAL COMMITTEE ON CHANGES IN LAWS.

[Presented and adopted at the Annual Meeting, Jan. 12, 1904.]

Your committee appointed at the public winter meeting of the Board at North Adams, "to consider the laws relating to agriculture and agricultural societies, to report at some future meeting of the Board, and with power to recommend to the Legislature such changes in the present statutes as shall seem in their judgment expedient," has considered the matter entrusted to it, and begs leave to submit the following report and recommendations: —

That the powers and duties of the Cattle Bureau should be vested in the State Board of Agriculture, to be exercised through a committee of three, of whom the secretary shall be one, which shall have all the powers and duties prescribed by chapter 116, Acts of 1902, for the Governor and Council; and the State Board of Agriculture shall annually elect a director of the cattle division of the State Board of Agriculture, who shall carry out the directions of the Board through its committee, as above outlined, with such clerical and other assistance as shall be authorized by the Board through its committee.

That the powers and duties of the Dairy Bureau, as established by chapter 412, Acts of 1891, should be vested in the State Board of Agriculture, to be exercised through a committee of three, of whom the secretary shall be one, which shall have all the powers and duties now prescribed for the Dairy Bureau; and the State Board of Agriculture shall annually elect a director of the dairy division of the State Board of Agriculture, who shall carry out the directions of the Board of Agriculture through its committee, with such clerical and other assistance as shall be authorized by the Board through its committee.

That a division of forestry should be established, to have charge of the forestry interests of the State, to outline and establish a policy for uniform forest care and propagation, to exercise the duties now entrusted to the forest firewards throughout the State, to have charge of all public reservations set aside for the propagation of forest growth for other than park purposes, to advise and assist the citizens of the State in the establishment and care of valuable forest growth on lands suited to that purpose, said division to consist of three members of the Board, of whom the secretary shall be one; and the State Board of Agriculture shall annually elect a director of the forestry division, who shall carry out the directions of the State Board of Agriculture through its committee, with such clerical and other assistance as shall be authorized by the Board through its committee.

That a division of institutes and public meetings should be established, consisting of three members of the Board, of whom the secretary shall be one, to have charge of the work of the Board in disseminating useful information in agriculture, by means of lectures at institutes and public meetings, by bulletins, crop reports, leaflets or otherwise, as the Board shall direct; and the secretary of the Board shall perform the duties of director of the division of institutes and public meetings.

Respectfully submitted,

WM. R. SESSIONS.
C. K. BREWSTER.
W. A. KILBOURN.
J. LEWIS ELLSWORTH.

REPORT OF THE LIBRARIAN.

[Read and accepted at the Annual Meeting, Jan. 12, 1904.]

To the Secretary of the State Board of Agriculture.

SIR: — The seventh report of the librarian is herewith presented.

The expenses incurred in 1903 on account of the library were $111. Of this amount, $45.50 was expended for current publications for the library and for office use, $39 for binding, $17.42 for books and $9.08 for supplies.

One hundred and nine volumes were added to the library during the year, making the present number of volumes 3,676.

A change in the arrangement of certain sections has been made by bringing together all works on animal husbandry and dairying, reports of dairy commissioners and associations, etc., for the more especial use of the general agent of the Dairy Bureau.

The loaning of books to responsible parties has been continued. Some annoyance is caused by failure to return books within the time limit; but, on the whole, little fault can be found with borrowers. It is gratifying to be able to report that, during the four years the practice of loaning books from the office library has been in vogue, no books have been lost or have been returned in otherwise than in good condition. During the past year 36 persons took out a total of 87 books, — an increase in both particulars over any previous year. The books taken covered the usual range of subject matter, the sections predominating being agriculture, including crops and manures, with 24; forestry, 12; gardening, 9; dairying, 6; Angora goat, 5; swine and poultry, 4 each; fruits, 3; flowers, bee culture and insects, 2 each; miscellaneous bulletins and reports, 13.

A catalogue of the library was prepared and published under direction of the Board under date of June 1, 1899. On that date the library contained 3,181 bound volumes. As an interval of five years has elapsed since the publication of the catalogue, and as about 500 volumes have been added to the library, it is suggested that there be published the present year, preferably under date of June 1, a supplementary catalogue, under the title of "Library Bulletin No. 1: accessions to the office library." It is further suggested that the issue be limited to 500 copies, to be supplied to institutions and individuals having copies of the library catalogue; and that the expense of printing and distributing the bulletin be paid from the appropriation for contingent and incidental expenses in the office of the Board. A preliminary copy of the proposed bulletin is submitted as a part of the librarian's report for 1903.

Respectfully,

F. H. FOWLER,
Librarian.

PAST AND PRESENT DAIRYING.

BY MR. A. M. LYMAN OF MONTAGUE.

Milk and butter were produced by our people as early as 1607, from cows brought from the West Indies, descendants from stock brought there by Columbus in his second voyage in 1493, but the dairy industry made slow progress until within the memory of many of us.

By research we find that at a very remote period the discovery was made that goat's milk carried in skins on camels' backs, when making long journeys, was churned into butter. Later the Arabs galloped to make the butter come quicker, thus showing progress from a slow motion to a quick one in butter making.

In sacred history we find Abraham extending his hospitality to the angels by furnishing real butter and milk, with cakes that Sara baked. In the songs of Moses he sings of riding in high places, that he might eat of the increase of the field, suck honey, and eat butter with milk and wine. Jael, the wife of Heber, won distinction in her plot of treating Sisera with milk and butter, in a lordly dish, as written in the song of Deborah and Barak. When David was in the wilderness, tired and hungry, they brought, with other things, butter and cheese for his sustenance.

We have but little information as to how butter was made in those days, but we well remember the methods of forty years ago; and we may conclude that the improvement from the earliest days of butter making was very gradual indeed. It is true that most of the improvements in dairying have come within the past quarter of a century.

Before the co-operative creamery came into existence, with its machinery, wooden bowls were used, and I have seen cream raised in them. Some of us have used the earthen pan for this purpose. Later, tin pans came into use; followed a little later by the large "gilt-edge" pan, holding several gallons, which is now the best for open setting. The "bureau" arrangement was considered a great improvement, until the "deep-setting" can, submerged in cold water away from all unfavorable influences, came into use.

We remember the old dash churn, — how we had to hold on to it to keep it from going to pieces; later came the crank churns: now it may be said of the making of churns there is no end. Then we recall the drudgery of the housewife, in salting and making up the butter, washing the churn, and the general cleaning up. Also, the marketing of the butter by the men folks took time and effort.

In my early days my father carried on the business of collecting butter in surrounding towns, and disposing of it to the city trade. In this way considerable fine trade was worked up. In time it became my lot to carry on the same business for several years. All this time it was more and more apparent that there must be a more uniform quality to keep this trade. Sorting and arranging shades helped some, but it was found very important that it should be all alike, — good. So an arrangement was made for taking the butter at the dairies "from the churn," carrying it home and working it up. This was an improvement. My ideal, all this time, was to have the cream brought to one place and churned together, making one product; so that, when the time came that such a thing was accomplished, this co-operative plan met with hearty approval. This plan makes it possible to have all the butter the best. When this system is thoroughly carried out, and the rules well obeyed, it will pay the dairyman more for the cream at his door than he can realize from his butter when produced and marketed in the ordinary way.

It is claimed, on good authority, taking the average farmer, with the various devices for creaming milk and the little care given it, that 25 per cent is lost in imperfect creaming and churning. This is a great loss, which the factory not only saves, but a better price for the butter is obtained. It is the uniform good quality that brings the uniform high price. There is a growing fastidiousness among butter eaters. This fact gives urgent and paramount importance to efforts for improvement, which are more possible in creamery than in dairy practice. Creamery butter is unquestionably a success; if not, whence comes this volume of fine, sweet goods, such as tempts the most dainty critic, and gains the praises of the best experts in the land of choice butter?

To make good, aromatic butter, we must do it with the most improved methods. There is more of an improvement in the flavor or aroma, as we call it, in butter made at a creamery than in a dairy, because the ripening process can be managed with greater skill, and the science of using the bacteria can be better practised.

The co-operative creamery has elevated the dairy business; it has introduced new and better methods. It is perpetual; its reputation does not die; nor is its business interrupted when a patron drops out. Organization is of great advantage to the dairy industry. "In union there is strength," as we have found in the co-operation of co-operative creameries. The New York "Sun" lately said: "Creameries scattered over many parts of our country are making considerable change in the condition of farming." So, in our State, especially the western part, the dairy interest is becoming more and more important, and poor farms are enriched by the presence of many cattle. I have seen nothing that denotes so much thrift as is shown on a great many of our little farms that have their cream taken at the door, to be made into butter.

In the commercial world there may be what is termed an over-production of bread and meat and raiment, but there is no danger of an over-production of good butter. Cotton and corn may vie with each other to see which shall be king, but good butter stands alone as queen. To make this noble queen more and more the queen, and to crown her with fadeless glories, is the mission of the co-operative creameries.

As has been said, there is no branch of agriculture in the United States that has made greater progress than dairying during the past few years. No other has received more direct benefit from the art of invention, the teaching of modern science and the intelligent practice of skilled operators. State laws and appropriations of money have been made to foster and promote this industry, and we feel that much new inspiration has been gained in this new century, and perfection will only come by inspiration.

If it is true, as we are informed, that one-half of the butter made in the dairies of this country finds its way to the renovating shop, it is a condition that should be remedied in the near future. In our own State a step forward would be the doing of more educational work through our Dairy Bureau. It should be generally understood that this Bureau is for the encouragement and help of the honest dairyman, as well as for the discouraging and punishing of fraud. A larger appropriation of money by the State for this kind of work would be money well invested, and a manifold return would be given by the milk and cream producers of our Commonwealth.

IMPROVED LIVE STOCK.

BY C. H. SHAYLOR OF LEE.

One of the most important questions of the present day that confronts the farmer is, how to improve his stock, thereby increasing the income of the farm, and making, if possible, a balance on the right side of the account.

The hills in the western counties of our State, which twenty years ago furnished excellent pasture for hundreds of head of cattle and sheep, are now in many sections without a single occupant. Many of these pastures might, I believe, at the present time, be utilized as grazing grounds for well-bred, thrifty young stock, and the owner receive an income from what he now loses.

The probable cause of the decline in the number and quality of stock kept has been the opening up of vast tracts of land in the west, and the low freight rates to the eastern markets. Animals could be raised and fattened in the west and placed on the market in our eastern cities cheaper than they could be produced here. I believe that now the times are changing, and that we can afford not only to raise our dairy animals, but that in our hill towns beef cattle can be profitably produced. This is based on the fact that our abandoned farms are now being occupied by families from the west, who claim that land is cheaper here than there; and our markets, which are constantly growing, are the best in the world.

Farmers owning good hill or mountain pastures, where the stock could be kept through the summer, and with a well-filled silo to furnish an excellent, cheap and nutritious winter food, may raise at a profit not only their heifers for the dairy, but steers for beef, or, if needed, for working cattle, — provided they are of the largest breeds, and placed on the markets in first-class condition. I have in mind two farmers in two different towns in the western part of the State who not only raise their heifers from their choicest cows, but also a few thrifty steers each year, and find no trouble in disposing of them at profitable prices. One advantage in raising good stock and keeping it well is that buyers are always looking after it, and are willing to pay good prices for choice animals.

The silo has come to be one of the leading factors in raising young cattle, either for the dairy or for beef. Experiments conducted at the Illinois experiment station showed that more beef and pork were produced by the use of ensilage, oats and hay than by feeding shock corn, oats and hay. More land was also required to produce the shock corn than the ensilage.

It behooves us here in the east, where our tillable acres are few and our markets good, to exercise our utmost skill to make each acre yield the best crop possible, thereby not only increasing our income, but increasing the fertility and productiveness of our small New England farms.

The question is often asked, Which is the best breed of stock to raise? This, I believe, is a question each must answer for himself. The breed that is best adapted to one section might prove a failure in another. Not only this, but the breeder's preference enters largely into his success with any particular breed of cattle, as well as in any calling or occupation in life. What a man enjoys and enters into with vim and determination is the thing in which he is most likely to succeed, providing he follows it persistently. The man who is thoroughly fitted and who enjoys the detailed work necessitated by the breeding of pure-breds, will get better returns from his lands or flocks than he could by raising grades or crosses. This is not only true of cattle, horses and sheep, but is doubly true of poultry. I believe there is no excuse at the present day for any up-to-date farmer raising anything but pure-bred poultry. There are nearly as many different varieties as there are tastes, and nearly all of the breeds have their good qualities, and any one who is so inclined may secure a breed to his liking. There doubtless is no stock on the farm that pays better for the money invested in it than the poultry.

The income received from scrub stock may, in many cases, be doubled by replacing the scrubs with pure-breds of a uniform type and breeding. In this connection we might profitably quote from an address delivered before the National Association of Live Stock Agents, at Kansas City. The speaker states that "some people say that blooded stock need good stables, high feeding, and all kinds of pampering and petting." The first natural impulse, when such things are said, is to deny them. The statement that some of this pure-bred stock can out-grow the scrub, out-fatten him and out-sell him under any circumstances within reasonable bounds cannot be denied; but the correct answer to this is, that the pure-bred animal is able to pay for all his luxuries with the money he will surely earn. He should be pampered and fed because that is what is going to make him bring the highest market price, and every pound consumed over the food of support gives profit to his owner.

Another illustration is furnished in the feeding of steers for market by two neighbors. Forty high-grade Shorthorn and Herefords, three years old, were fed one hundred and two days on cotton-seed meal and hulls, and when sold weighed 1,250 pounds, and brought $6.30 per hundred. The other native scrub three-year-olds, fed on the same feed, weighed 748 pounds, and brought 4 cents per pound.

What is true of animals raised in the west for beef is equally true of our dairy animals in the east. While it is not possible for all farmers to build up a herd of pure-breds, it is possible and profitable for each one to breed from a pure-bred male, thereby establishing a uniform herd, that can only be excelled by that breed in its purity. Great care should be taken in selecting a bull to build up a herd. His ancestors for two or more generations back should possess in a marked degree the characteristics which the breeder intends to develop and improve upon in his own herd. In order to get the best results, judicious inbreeding may be practised. Having secured a sire of the desired quality, retain him until his heifers come to milk. Many a valuable animal has been slaughtered, which proved, when it was too late, a producer of cows of unusual merit.

One of the best examples of inbreeding is found in the Holstein cattle. This breed of cattle were bred for years in the small country of Holland, without the introduction of any new blood. They were kept for the quantity of milk produced, and to-day stand at the head of all breeds in this respect.

The Holstein, or perhaps a high grade of this breed, is the most popular milk breed for the city milk trade. All that is required of her is a large flow of milk that will stand the test. Her qualities, aside from this one, are not considered, as she is not of the beef type, and cannot be readily fattened.

While I am a believer in a specialty in the breeding of stock on general principles, I believe, too, that the dual-purpose animal has his place in some sections of the State. In our hill towns, which are more remote from our markets, I doubt if any better stock can be kept than the dairy Shorthorn. Grades of this breed are not only well adapted for dairy purposes, but the male may be profitably raised for beef or for working oxen. Then, too, the cows being of good size may, if they prove unprofitable in the dairy, be turned for beef at remunerative prices. Good dairy cows of this type are always in good demand at a good figure.

The Jersey and Guernsey breeds have some very choice representatives in our State. Probably some of the most valuable herds are of these breeds. They are famous for the quality of milk and quantity of butter produced, and with good care and careful breeding render good returns in the best markets, where their products bring the top prices. In other markets, under less favorable circumstances and in the hands of careless breeders, they may prove the opposite.

In a small town in the western part of the State it has been remarked by some of the farmers that "the introduction of the Jersey into the town was thousands of dollars damage to the value of their cattle." This does not prove that the Jersey is not one of the best dairy breeds, but that even our best stock requires certain markets and proper handling to yield the best possible returns.

The tough, hardy Ayrshire, while not as popular as some other breeds, will prove herself, where a good deal of rustling is required to obtain the necessary amount of food, one of the best breeds for the farmer who has a market for a quantity of good milk; and, in sections of this State where the production of milk for market is the specialty, may prove to be a valuable breed.

While Massachusetts is not noted as a live-stock State, a large proportion of the farmers depend on the dairy for their support; and any advancement or improvement along this line which can be accomplished by the Board of Agriculture, aided by our Agricultural College, will be of great worth to the agriculturists of the State.

The loss of the fine herd of pure-breds at the Agricultural College by tuberculosis has been a drawback to our standing as a State in the improvement of blooded cattle; and the sooner they can be replaced, if by only a few of the choicest animals obtainable of the five breeds that may be profitably kept in the State, the better it will be not only for the reputation of the college herd but for the live stock and dairy interests of the State.

If this State Board of Agriculture does all in its power for the improvement of the flocks and herds of the State, something will have been accomplished for agriculture, and the criticisms heaped upon the Board as to its inefficiency as a Board to accomplish the objects for which it stands will in a measure be removed.

SECOND ANNUAL REPORT

OF THE

STATE NURSERY INSPECTOR

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE.

PRESENTED TO THE BOARD AND ACCEPTED,
JAN. 12, 1904.

SECOND ANNUAL REPORT OF THE STATE NURSERY INSPECTOR.

To the Secretary of the Board of Agriculture.

I have the honor to present herewith the second annual report of the State Nursery Inspector.

The duties of this office during the year 1903 have been less varied than heretofore, as the nurserymen have become familiar with the inspection law, and are better prepared to meet its requirements. During the year particular attention has been paid to the cases of florists who carry nursery stock, in addition to their greenhouse plants. To learn which of them had nursery stock, over 700 circulars of inquiry were sent out, the answers to which raised the number of places to be visited from 80 to 110. The amount of stock found at these places varied from a few plants to a half acre or more occupied by them; but the wisdom of inspecting even the smallest of such nurseries is shown by the fact that dangerous pests were found at almost every one.

Regular inspections for the season were begun August 17, and were continued until the work was completed. This is really too early in the season to begin, in order to obtain the best results, and in my opinion no inspections should be permitted before September 1; but with the force available it seemed doubtful if the work could be completed before the commencement of the shipping season if a later start were made, and it did not seem just to delay shipments by beginning at a later date.

One hundred and ten places where nursery stock is grown were inspected this fall, and all but two of these have received certificates that their stock is apparently free from dangerous insect pests and fungous diseases. One nursery cannot receive such a certificate, and its owner is fumigating all stock sold, in accordance with section 4 of the law. The remaining place contains but a few plants, and its owner has done nothing to comply with the law, but has sold no stock.

Of the places inspected for the first time this year little need be said. They were nearly all small, and generally much neglected, the owners giving their attention chiefly to their greenhouses and to herbaceous plants out of doors; and this explains why so many of them were found to be infested. In the nurseries inspected this year a second time the improvement was marked. In 1902 many of them were poorly cultivated, contained many dead and dying trees, and in places were almost thickets. This year found great improvement in all these respects; well cultivated, with the bad stock removed, and much less of a poor grade than the year before, it was evident that the fact that the nurseries were under State supervision had had a beneficial effect, and one which would be of value to any purchaser.

A similar improvement was noticeable as regards the insect pests and fungous diseases. In 1902 there was no difficulty in finding these where they were present, most of the stock infested being noticeably so; this fall, while a number of nurseries were infested, only slight cases could be found after prolonged and careful inspection. These facts mean much to those who purchase plants. They mean, first, that good stock will be sent out, — stock that is of good quality, healthy and vigorous; and, second, that the chance of receiving a tree infested by dangerous pests or fungi has probably been reduced to a very small one. Results such as these are worth obtaining, particularly when we remember that the nurseries of Massachusetts do a business of nearly a million dollars each year.

These results have been obtained this year by the expenditure of $904.79, nearly half of which was used in the travelling and living expenses of the inspectors while making the inspections. They have devoted about twenty-five days each to the hardest kind of work, straining their eyes through the magnifying glass as they examined the stems and branches of the plants, and often working whole hours at a time on their knees where the plants were low-growing varieties. From ten years of personal experience I can say that it is the hardest kind of scientific field work of which I know, requiring a careful preliminary training, that the minute pests and fungi looked for may be recognized at once, under varying and often difficult conditions of light, and often in almost every conceivable position, from the surface of the ground to a height of ten feet or even more. Under such circumstances, experienced men trained for the work are difficult to find; and the State is fortunate in having been able to obtain the services of such efficient deputies as have carried on the inspection during the present year, giving up nearly a month of their time to such severe labor, both physical and mental, for so small a compensation.

The following list of nurseries represents those now known in Massachusetts. Doubtless there are others of which I have as yet not heard, but the number of these must be small. The list includes both those persons who are only or chiefly nurserymen, and those who, though mainly florists or in other occupations, have more or less nursery stock for sale.

Adams, J. W. & Co., Springfield.
Atkins, P. A., Pleasant Lake.
Baker, M. B., Campello.
Barrows, H. E., Whitman.
Beals, E. B., Springfield.
Beech, Jos., South Hadley Falls.
Boston park department, Boston.
Brandley, Jas., Walpole.
Breed, E. W., Clinton.
Briggs, L. H., Smith's Ferry.
Brooks, H. N., South Yarmouth.
City Water Board, Cambridge.
Casey, C., Melrose.
Chadbourne, A. H., Worcester.
Chase, Jos. S., Malden.
Clapp, E. B., Dorchester.
Clark, G. L., Weston.
Clark, J. W., North Hadley.
Continental Nurseries, Franklin.
Cruickshanks, Geo., Fitchburg.
Cutler, Miss M. E., Holliston.
Dighton Nursery Company, Dighton.
Draper, Jas., Worcester.
Dwyer, E. F. & Son, Lynn.
Eastern Nurseries, Jamaica Plain.
Elliott, W. H., Brighton.
Evans, H. D., Ayer.
Farquhar, R. and J., & Co., Boston.
Field, H. W., Northampton.
Finnaghty, Martin, Lenox.
Fish, C. R., & Co., Worcester.
Fiske, C. D., Waltham.
Follansbee Nursery, Haggett's Pond.
Ford, J. P., East Weymouth.
Foster, L. H., Dorchester.
Gates, W. A., Needham.
Geer, J. T., Three Rivers.
Gerrish, O. K., Lakeville.
Gilbert, A. L., Springfield.
Gill, Mrs. E. M., Medford.
Gillett, Edw., Southwick.
Gormley, E. W., Jamaica Plain.
Graves, R. B., Northampton.
Guinivan, D. H., Beverly.
Harmony Grove Cemetery, Salem.

Heurlein, Julius, South Braintree.
Hitchcock, E. H., Agawam.
Horne, H. J., & Co., Haverhill.
Howland, E. H., Holyoke.
Jahn, H. A., New Bedford.
Jennison, W. C., Natick.
Keen, C. R., Cohasset.
Kingman, C. D., Middleborough.
Lawrence, H. V., Falmouth.
Learned & Shirley, Danvers.
Lister, Jas., Stoneham.
MacMulkin, Edw., Jamaica Plain.
Macomber, E. R., Chicopee Falls.
Mann, H. W., Stoughton.
Manning, Jacob, Reading.
Massachusetts Agricultural College, Amherst.
Matthews, N., Jr., Hamilton.
McLaren, Andrew, Westwood.
McMannon, J. J., Lowell.
Mead, H. O., Lunenburg.
Miller, J. W., & Sons, Lynn.
Mylott, John, Lowell.
Newton Cemetery, Newton.
Norton Bros., Dorchester.
Palmer, F. E., Brookline.
Patterson, Wm., Wollaston.
Payne, W. H., Newtonville.
Peckham, S. S., Fairhaven.
Pfaffmann, M., Wollaston.
Phelps, F. H., Lee.
Pierce, Jesse, Beverly Farms.
Pratt, C. S., Reading.
Pratt, F. G., Concord.
Quinn, Jas., Brookline.
Rea, F. J., Norwood.
Rhodes, A. A., Saugus.
Richards, E. A., Greenfield.
Richards, J. E., Needham.
Richards, J. L., Lunenburg.
Robinson, D. A., Everett.
Robinson, L. D., Jr., Springfield.
Saunders, C. O., Everett.
Sawyer, F. P., Clinton.
Shady Hill Nursery Company, Boston.
Shaw, F. E., Rockland.
Southworth Bros., Beverly.
Spinney, F. E., Haverhill.
Story, A. T., Berkley.
Strong, W. C., Waban.
Sylvester, G. F., Hanover.
Thurlow, T. C., West Newbury.
Twomey, M. T., Roxbury.
Walsh, M. H., Woods Hole.
Walters, C., Roslindale.
Watson, T. R., Plymouth.
Wellesley Nursery Company, Newton Lower Falls.
Whiting Nursery Company, Boston.
Whittet & Co., Lowell.
Whittier, W. B., & Co., South Framingham.
Willoughby, G. H., Edgartown.
Wood, Edw., Lexington.
Woodman, E. and C., Danvers.
Wright, G. E., Chelmsford.
Wyman, W. H., North Abington.
Yamanaka & Co., Boston.

It is not possible to give an accurate estimate of the number of acres in nursery stock, and, if it were, it would fail to show the real amount of stock, as one man may and often does plant more on one acre than another does on five. It is certain, however, that there are more than 650 acres of stock in Massachusetts at the present time.

The weakest part of the inspection law at present is that relating to the importation of stock from elsewhere. It matters little how carefully inspections are made here, if poor or infested stock can be brought in from other States. A few slight changes in the law as it stands would make it what it should be, and, as these changes will be of decided benefit without being a hardship to any resident of the State, I would urge their immediate consideration.

FINANCIAL STATEMENT.

Appropriation,		$1,000 00
Compensation of State Nursery Inspector and three deputies,	$527 50	
Travelling and necessary expenses of inspector and deputies,	374 64	
Printing,	2 65	
Unexpended balance,	95 21	
		$1,000 00

I desire here to express my appreciation of the interest you have taken in this work, and of the assistance it has been in obtaining such satisfactory results.

Respectfully submitted,

H. T. FERNALD,
State Nursery Inspector.

AMHERST, Dec. 19, 1903.

FOURTH SEMIANNUAL REPORT

OF THE

CHIEF OF THE CATTLE BUREAU

TO THE

MASSACHUSETTS

STATE BOARD OF AGRICULTURE.

JANUARY 9, 1904.

REPORT.

To the State Board of Agriculture.

I have the honor to submit the fourth semiannual report of the Cattle Bureau of the State Board of Agriculture, as provided for in section 3 of chapter 116 of the Acts of 1902.

This report will be more in detail than the third semiannual report, made to the Board at the meeting at Amherst last June, as the report presented the first of the year is intended to take the place of the annual report formerly made by the Cattle Commission to the Legislature.

The report made in the summer is simply a very brief account of the work done during the first half of the year, while the later one is intended to give a full and detailed statement of the doings of the Cattle Bureau for the entire year. Owing to the necessity of having the report ready by the tenth day of January, it is necessary to close the books of the Bureau the 15th of December. This report therefore includes the period from Dec. 15, 1902, to Dec. 15, 1903.

The report now presented includes the work performed in connection with tuberculosis in cattle and glanders in horses, and also a history of foot and mouth disease, commencing at the point where it was left in the last report, Jan. 1, 1903, to the time of its eradication. Other diseases will be mentioned briefly; but there is not a great deal to say in this connection, as, aside from the outbreak of foot and mouth disease, the year has been more free from other contagious animal diseases than usual, and the principal labor performed aside from that for the suppression of epizoötic aphtha has been chiefly in connection with tuberculosis and glanders.

Owing to the fact that the books are brought up only to the 15th of December each year, the financial statement shows the amount of money on hand at that time, and does not give a clear idea of what the deficiency in the appropriation of the Cattle Bureau may be when all outstanding accounts come in at the end of the year.

For example, the financial statement shows a balance on hand Dec. 15, 1902, of $16,787.01; but at the end of the year there was a deficiency which required an appropriation of $4,500. This deficiency was due to the increased expenditures brought about by the outbreak of foot and mouth disease. If it had not been for this, the amount on hand Dec. 15, 1902, would have been ample to meet all outstanding liabilities.

The appended figures show a balance on hand Dec. 15, 1903, of $2,079.53; but this sum will not be sufficient to meet all the bills which will come in Jan. 1, 1904, and another deficiency appropriation will be required. This deficiency has been kept down to the lowest possible limit by releasing cattle quarantined on suspicion of being tuberculous early in November, when it was apparent that it would not be possible to take any more cattle without causing a large deficiency in the appropriation, which did not seem judicious. Any indebtedness incurred during 1903 in excess of the appropriations is due to increased expenditures incurred on account of foot and mouth disease.

Early in May it was apparent that more money would be needed in order to complete the year's work; and a letter was written to the ways and means committee, calling its attention to this fact, and requesting an additional appropriation of $25,000, but it was decided by the committee that $15,000 would be sufficient, and this sum was allowed.

Certain work cannot be relinquished, such as that relating to glanders, and keeping up the rules requiring cattle brought into Massachusetts from without the State to be tested with tuberculin, in order to be sure that they are free from tuberculosis when placed upon our markets.

Financial Statement.

At the date of the second semiannual report of this Bureau, Dec. 15, 1902, there remained an unexpended balance of	$16,787 01
Appropriated under chapter 81, Acts of 1903, ...	58,000 00
Appropriated under chapter 427, Acts of 1903 (additional),	15,000 00
Appropriated under chapter 264, Acts of 1903 (deficit), .	4,500 00
Total appropriations, etc., ...	$94,287 01

During the year ending Dec. 15, 1903, there has been expended in the work of the Bureau as follows: —

For 1,496 head of cattle condemned and killed as tuberculous,	$33,713 00
For 4 quarantine claims,	9 75
For expenses of killing and burial,	66 78
For expenses of arbitration,	5 75
For 115 quarantine expense claims on account of foot and mouth disease,	9,699 40
For salary of Chief of Bureau,	1,800 00
For expenses of Chief of Bureau,	72 93
For services of agents,	17,971 94
For expenses of agents,	7,998 55
For salaries of clerks and stenographers,	3,736 24
For postage, printing, stationery and other office expenses,	2,538 34
For laboratory and experimental work, exclusive of glanders work,	143 25
For implements, supplies and material for disinfecting,	2,579 73
For expense of quarantine stations at Brighton, Watertown and Somerville,	5,105 05
For expense of glanders work, including killing and burial and laboratory work,	6,766 77
	$92,207 48
Unexpended balance,	$2,079 53

During the year 308 cattle and 5 swine were reported to the Bureau, by butchers, renderers and boards of health, as having been found tuberculous at time of slaughter. These animals were not quarantined, and are not included in the 1,496 head paid for as above. The average price paid for cattle during the year was $22.59.

Bills of 1902 unsettled at date of last report have been paid during the year as follows: —

347 cattle condemned and killed as tuberculous,	$8,741 32
Miscellaneous bills,	5,738 77
Quarantine claims on account of foot and mouth disease,	6,967 65
Total paid on 1902 account,	$21,447 74

By chapter 427, Acts of 1903, as provided in chapter 83, Resolves of 1903, there was appropriated, to be paid out under the direction of the Chief of the Cattle Bureau of the

State Board of Agriculture, to owners of animals slaughtered previous to April 11 of the current year, for the purpose of exterminating the foot and mouth disease, a sum equal to the difference between the amount paid by the United States and the value of such cattle as appraised by the agents of the United States, $40,000.

From this appropriation there have been paid 126 claims for animals, as follows: —

2,261 cows,	average, $52 19,	appraised for . .	$118,006 28
67 bulls,	" 44 77,	" . .	3,000 00
9 oxen,	" 90 55,	" . .	815 00
4 steers,	" 65 00,	" . .	260 00
8 young cattle,	" 21 87,	" . .	175 00
167 calves,	" 15 36,	" . .	2,617 00
208 swine,	" 4 25,	" . .	2,178 00
49 sheep,	" 8 38,	" . .	411 00
5 goats,	" 4 20,	" . .	21 00
2,778 animals,	Total appraisal,	. . . . .	$127,483 28
Seventy per cent paid by the United States,		. . .	89,238 30
Difference, thirty per cent, paid by State,		. . .	$38,244 98
Balance of appropriation unexpended,		. . . . .	$1,755 02

Under the provisions of chapter 220, Acts of 1903, 76 stamps have been furnished to 56 towns in the State, for branding the meat of slaughtered animals intended for food.

There has been received during the year, from various sources, — sale of hides and carcasses of condemned animals, sale of ear tags, tuberculin tests for cattle brought to Brighton by non-resident owners, etc., — the sum of $1,928.37, which has been paid to the State Treasurer.

The Legislature of 1903 amended section 31 of chapter 90 of the Revised Laws so as to read as follows: —

SECTION 31. Tuberculin as a diagnostic agent for the detection of tuberculosis in domestic animals shall be used only upon cattle brought into the Commonwealth and upon cattle at Brighton, Watertown and Somerville; but it may be used as such diagnostic agent on any animal in any other part of the Commonwealth, with the consent in writing of the owner or person in possession thereof, and upon animals which have been condemned as tuberculous upon physical examination by a competent veterinary surgeon. Such tests by the use of tuberculin shall be made without charge to citizens of the Commonwealth, and in all other cases the expense of such tests shall be paid by the owners of such animals or by the person in possession thereof. [*Approved May 5, 1903.*

As all cattle brought to the Brighton market from without the limits of the State are now tested by the agent of the Cattle Bureau in charge of the quarantine stations, and his assistants, and no certificates of test are now received at these stations made by veterinarians residing out of the State, and as many persons bringing cattle into Massachusetts to other points prefer to have the testing done after the arrival of the animals, free of expense, it will be seen that this provision of the law adds materially to the expenses of the Cattle Bureau. Fees from persons not citizens of Massachusetts, received for testing cattle, are turned over to the State Treasurer.

As there are about 20,000 out-of-the-State cattle sold on the Brighton market annually, which it costs about 25 cents per head to test, and 7,000 or 8,000 head brought to other points, 4,000 or 5,000 of which at least have to be tested, and as these tests cost in the neighborhood of $1 for each animal, it can readily be seen that this legislation will add $10,000 or $12,000 per year to the expenses of the Cattle Bureau.

Owing to the difficulty of having all the tests outside of the State made honestly and carefully, it would be more satisfactory to test all animals after arrival; and this plan may be adopted later, if it is found necessary to do so.

The law requires that the results of the inspection of animals and premises, made annually by the inspectors of animals, be incorporated in the annual report of the Cattle Commissioners; and it seems that the intent of the law is that this statement of the condition of the live stock of the State and their surroundings shall be embodied in the report of the Chief of the Cattle Bureau at the close of each year. Owing to the appearance of the foot and mouth disease at the end of 1902, it was found impossible to prepare this report; but a résumé of the work of the local inspectors for 1903 has been compiled, and is given below: —

Work of Local Inspectors for 1903.

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.	Number Goats.
Abington,	119	308	238	108	2	132	121	112	81	55	98	118	-	-
Acton,	122	1,240	790	118	13	117	147	144	131	144	144	145	16	-
Acushnet,	133	597	336	127	1	284	134	94	126	126	128	132	2	1
Adams,	82	933	541	81	23	257	83	75	65	71	83	83	-	-
Agawam,	144	1,500	798	137	-	441	152	137	131	145	146	147	5	-
Alford,	52	448	319	46	197	161	58	35	48	56	53	55	3	-
Amesbury,	129	568	369	87	10	275	137	126	94	65	89	128	-	-
Amherst,	70	994	664	65	-	149	78	71	41	45	71	68	-	-
Andover,	144	1,215	798	129	-	927	149	146	144	145	147	145	-	-
Arlington,	82	203	173	82	-	47	83	74	72	74	83	83	-	-
Ashburnham,	119	664	373	103	34	179	120	113	86	109	111	111	6	-
Ashby,	95	508	337	89	14	104	97	94	76	89	91	97	1	-
Ashfield,	166	1,706	725	153	1,226	337	181	157	149	161	173	178	1	-
Ashland,	79	449	231	74	-	211	79	*-	*-	*-	*-	*-	*-	-
Athol,	112	658	343	96	26	496	116	98	76	86	110	104	2	-
Attleborough,	170	1,052	720	116	-	642	174	165	167	172	170	172	2	-

Auburn,	57	755	399	53	4	339	57	53	50	42	54	57	-	-
Avon,	45	144	121	42	3	94	45	41	33	42	43	45	-	-
Ayer,	28	127	87	28	-	77	30	29	29	29	28	29	-	-
Barnstable,	243	742	438	172	17	605	244	194	233	232	232	232	-	-
Barre,	74	2,063	719	69	57	200	84	80	71	82	82	84	13	-
Becket,	85	780	345	85	176	147	89	68	87	89	88	89	1	-
Bedford,	70	754	460	70	12	484	73	70	72	73	72	73	-	-
Belchertown,	286	2,346	1,346	277	32	465	310	270	275	306	304	310	4	-
Bellingham,	107	613	430	103	3	273	121	108	42	99	107	113	5	-
Belmont,	33	176	104	33	-	245	33	32	30	32	33	33	-	-
Berkley,	80	388	247	73	6	268	80	*-	*-	*-	*-	*-	2	-
Berlin,	87	671	396	87	3	102	91	87	90	89	91	91	-	-
Bernardston,	87	873	424	42	400	254	93	75	55	1	48	89	-	-
Beverly,	66	652	419	59	1	79	68	63	54	66	64	68	2	-
Billerica,	109	865	631	100	-	218	109	107	106	104	98	97	7	-
Blackstone,	104	511	330	86	2	174	105	85	78	74	94	81	-	-
Blandford,	120	1,281	613	113	268	170	151	120	110	141	146	137	2	-
Bolton,	100	860	*-	72	1	206	100	*-	*-	*-	*-	*-	*-	-
Boston,	161	1,005	902	155	-	1,234	166	166	165	166	153	166	6	-
Bourne,	56	143	65	55	-	27	56	55	56	56	56	56	-	-
Boxborough,	50	628	315	47	21	135	57	56	52	55	55	55	-	-

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Work of Local Inspectors for 1903 — Continued.

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Boxford,	60	623	342	56	19	217	69	66	59	65	65	67	2	-
Boylston,	69	734	487	66	4	616	71	66	68	69	68	69	-	-
Braintree,	66	463	375	63	-	272	71	62	67	68	66	70	-	-
Brewster,	92	219	45	87	26	115	92	74	42	89	89	73	6	-
Bridgewater,	165	847	583	162	41	807	166	154	130	134	158	165	2	-
Brimfield,	112	1,284	572	112	123	228	123	117	105	117	123	118	4	-
Brockton,	133	1,022	774	117	-	1,028	139	132	129	124	103	138	-	-
Brookfield,	135	945	545	105	37	240	134	117	103	108	101	125	-	-
Brookline,	25	205	50	21	-	4	27	19	21	18	24	26	-	-
Buckland,	94	949	469	62	74	224	123	104	48	52	90	120	-	-
Burlington,	46	437	337	44	-	3,328	46	46	44	46	46	46	1	-
Cambridge,	15	83	80	15	-	-	16	15	16	16	16	16	-	-
Canton,	126	623	418	125	41	860	128	112	87	116	113	128	-	-
Carlisle,	68	638	410	43	2	85	68	57	53	53	42	67	-	-
Carver,	89	188	113	88	19	85	89	84	83	88	87	86	3	-
Charlemont,	77	701	475	75	89	121	80	74	49	80	68	80	1	-

Charlton, . . .	177	1,909	1,022	173	8	314	179	170	177	177	175	158	1	-
Chatham, . . .	74	170	120	63	-	74	74	56	47	4	68	71	-	-
Chelmsford, . . .	46	482	382	39	4	34	46	46	36	44	35	42	-	-
Chelsea, . . .	31	158	150	27	-	-	31	31	28	28	27	30	-	-
Cheshire, . . .	92	1,063	680	83	65	219	93	49	31	33	80	83	6	-
Chester, . . .	93	879	348	85	402	161	135	106	63	75	127	123	-	-
Chesterfield, . . .	106	1,176	418	82	3	294	132	107	90	121	118	109	1	-
Chicopee, . . .	93	747	449	74	35	345	101	84	83	83	86	88	3	-
Chilmark, . . .	61	319	100	61	3,051	75	57	56	38	57	57	57	2	-
Clarksburg, . . .	51	355	211	45	-	83	52	43	38	46	33	46	2	-
Clinton, . . .	39	91	69	34	-	53	39	30	20	23	28	39	-	-
Cohasset, . . .	116	308	250	33	-	117	118	102	50	10	83	64	2	-
Colrain, . . .	200	2,295	869	186	1,218	670	280	269	266	264	253	280	-	-
Concord, . . .	158	1,740	1,010	153	78	556	172	164	158	157	165	171	1	-
Conway, . . .	92	1,374	423	71	495	493	94	85	69	74	82	93	-	-
Cottage City, . . .	40	137	101	39	2	120	40	38	35	38	38	35	-	-
Cummington, . . .	98	754	424	90	54	74	104	75	65	94	95	105	-	-
Dalton, . . .	32	637	336	29	167	164	41	27	40	40	40	40	-	-
Dana, . . .	83	361	181	78	9	164	83	65	41	58	63	82	-	-
Danvers, . . .	70	757	617	64	-	119	72	59	71	71	71	71	-	-
Dartmouth, . . .	152	1,210	757	147	61	390	155	134	99	88	140	138	-	-
Dedham, . . .	92	563	463	88	-	429	90	81	84	80	81	90	1	2

Work of Local Inspectors for 1903 — Continued.

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Deerfield,*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Dennis,	89	212	108	65	-	79	88	73	64	77	74	66	-	-
Dighton,	99	450	336	98	2	175	110	104	104	107	110	110	-	-
Douglas,	108	360	207	89	-	153	108	86	61	89	90	97	4	-
Dover,	56	589	424	48	2	201	57	54	36	36	49	57	2	-
Dracut,	79	1,202	894	80	12	912	80	78	78	79	80	80	-	-
Dudley,	95	1,156	695	92	-	65	96	89	64	95	90	96	2	-
Dunstable,	46	466	292	41	9	137	47	46	41	47	46	45	6	-
Duxbury,	126	410	252	27	35	259	128	124	107	128	116	128	1	-
East Bridgewater,	164	706	466	160	9	334	167	79	164	166	166	164	17	-
East Longmeadow,	91	583	407	91	-	131	91	72	79	88	91	91	-	-
Eastham,	61	140	94	58	2	57	61	49	37	40	55	53	2	-
Easthampton,	121	1,047	583	121	2	311	137	123	136	137	135	137	-	-
Easton,	187	896	639	185	-	83	197	149	158	195	187	197	2	-
Edgartown,	61	295	184	61	736	186	64	64	64	64	64	64	-	30
Egremont,	96	956	704	96	192	221	104	61	100	104	102	104	13	-

Enfield,	88	575	281	85	24	183	90	79	72	88	84	89	2	-
Erving,	49	173	89	44	-	136	49	47	46	49	48	49	4	-
Essex,	50	588	383	50	3	40	52	51	46	50	49	52	1	-
Everett,	34	183	171	34	-	683	34	22	22	22	22	22	1	-
Fairhaven,	115	490	370	71	-	69	119	119	34	40	76	92	1	-
Fall River,	154	730	534	133	-	399	159	150	107	136	109	159	-	-
Falmouth,	142	422	307	140	-	240	143	134	114	137	135	141	-	-
Fitchburg,	144	987	582	110	1	310	145	140	76	90	79	89	2	-
Florida,	73	556	291	73	9	188	78	48	78	78	78	78	-	-
Foxborough,	132	517	335	128	-	419	134	114	130	133	126	132	1	-
Framingham,	209	1,353	1,059	203	-	377	210	191	183	181	167	200	-	-
Franklin,	149	897	688	132	5	248	151	117	128	142	135	142	1	-
Freetown,	114	336	215	92	6	107	120	103	76	72	103	84	4	-
Gardner,	32	547	347	29	-	67	34	31	25	30	31	34	-	-
Gay Head,	22	79	15	22	-	11	22	19	4	20	22	22	-	-
Georgetown,	86	352	165	84	30	197	86	79	66	78	76	85	2	-
Gill,	70	804	439	61	63	131	82	74	44	7	72	67	1	-
Gloucester,	141	703	424	130	-	274	140	111	83	91	110	124	2	11
Goshen,	48	434	178	40	77	92	53	45	32	36	47	53	-	-
Gosnold,	8	52	20	8	3,079	20	8	8	8	6	8	7	-	-
Grafton,	159	1,479	943	154	184	471	174	161	164	169	169	170	11	-

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Work of Local Inspectors for 1903 — Continued.

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Granby,	128	1,275	1,042	95	19	266	131	122	71	124	106	120	1	-
Granville,	142	1,048	578	142	105	419	176	173	171	175	173	175	8	-
Great Barrington,	140	1,649	928	136	70	537	155	97	145	152	152	154	2	-
Greenfield,	147	1,248	514	145	420	443	147	135	144	145	145	146	-	-
Greenwich,	75	488	293	74	-	122	75	73	73	74	75	53	4	-
Groton,	144	1,061	591	74	101	152	151	141	104	139	88	128	2	-
Groveland,	67	338	183	63	46	140	69	61	60	66	61	68	-	-
Hadley,†	201	1,642	890	153	37	771	254	229	167	228	223	239	2	-
Halifax,	73	189	109	71	7	92	73	61	30	62	40	68	2	-
Hamilton,	64	366	227	59	-	195	64	*-	*-	*-	*-	*-	*-	-
Hampden,	80	763	304	62	-	128	86	78	72	80	82	82	-	-
Hancock,	66	875	431	59	782	202	100	60	47	97	77	99	-	-
Hanover,	114	329	243	111	9	182	114	104	110	111	109	112	2	1
Hanson,	116	193	155	114	-	411	116	91	91	91	90	94	4	-
Hardwick,	129	2,324	1,219	111	22	276	140	124	94	123	128	134	-	-
Harvard,	165	1,639	769	125	80	204	170	157	133	165	122	146	6	-

Harwich, . . .	134	233	164	130	-	93	135	129	78	128	129	129	-	-
Hatfield, ...	125	374	309	125	-	268	125	124	125	125	125	125	-	-
Haverhill, . . .	180	1,395	812	154	-	465	184	178	131	157	144	157	2	-
Hawley, ...	81	852	382	76	217	163	81	71	81	81	81	81	1	-
Heath, ...	83	1,045	427	78	233	250	104	70	98	103	93	104	2	-
Hingham, . . .	165	667	469	164	18	366	164	131	162	164	163	164	-	-
Hinsdale, . . .	96	909	489	94	80	155	109	65	54	54	93	85	1	-
Holbrook, . . .	70	198	134	65	1	408	70	69	66	66	64	70	-	-
Holden, ...	127	1,039	50	110	77	174	131	123	119	122	108	125	-	-
Holland, ...	34	235	93	32	11	84	34	31	19	32	31	33	-	-
Holliston, . . .	120	804	568	108	4	155	124	107	115	117	108	121	1	-
Holyoke, ...	75	717	430	67	2	145	83	54	51	70	66	53	4	-
Hopedale, . . .	30	112	84	28	-	45	32	31	31	32	31	32	1	-
Hopkinton, . . .	129	769	343	90	2	186	129	123	85	82	93	122	1	-
Hubbardston, . .	110	1,030	562	104	78	172	122	112	109	119	108	122	1	-
Hudson, ...	48	373	227	38	1	138	48	44	38	35	40	48	3	-
Hull, ...	18	54	48	14	-	• 19	18	11	6	8	13	12	-	-
Huntington, . . .	102	740	328	102	208	179	111	67	106	106	110	91	3	-
Hyde Park, . . .	18	64	54	16	-	6	10	13	11	12	14	18	-	1
Ipswich, ...	140	939	615	138	-	306	147	142	144	147	147	147	1	-
Kingston, . . .	96	325	183	94	1	252	104	79	79	79	91	104	2	-

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Lakeville,	90	456	222	81	13	195	90	75	70	68	75	90	2	-
Lancaster,	100	732	455	83	42	220	103	71	69	90	88	82	-	-
Lanesborough,	116	1,142	578	116	44	215	120	85	120	120	120	120	-	-
Lawrence,	11	91	68	11	-	87	12	12	10	11	12	12	-	-
Lee,	188	1,022	642	169	444	340	200	148	179	186	193	126	7	-
Leicester,	109	543	350	89	2	152	110	98	73	70	53	110	8	-
Lenox,	18	274	184	18	35	-	18	18	12	11	18	18	-	-
Leominster,	99	974	635	36	13	400	113	107	65	82	54	87	-	-
Leverett,	81	514	311	71	77	197	81	79	60	79	79	81	1	-
Lexington,	45	869	639	43	-	389	45	44	34	38	41	45	-	-
Leyden,	65	792	327	46	280	203	65	62	40	55	55	61	-	-
Lincoln,	97	863	653	94	13	460	98	90	72	79	69	100	3	-
Littleton,	99	1,895	889	99	-	164	99	98	91	97	97	98	3	-
Longmeadow,	46	291	186	50	3	387	54	44	52	54	53	54	-	-
Lowell,	39	285	211	34	1	95	39	35	26	30	29	37	-	-
Ludlow,	111	918	657	103	2	334	111	95	80	88	103	101	-	-

Lunenburg,	123	1,200	707	121	83	252	123	120	118	123	123	123	-	-
Lynn,	85	273	195	54	2	74	85	81	54	81	52	85	1	-
Lynnfield,	43	428	322	42	-	97	46	39	45	46	45	46	-	-
Malden,	10	85	77	8	-	-	12	11	10	8	11	11	-	-
Manchester,	34	110	86	32	8	94	36	32	21	21	26	34	-	-
Mansfield,	101	295	205	91	-	58	100	94	73	82	68	87	5	-
Marblehead,	48	392	286	25	5	151	47	41	20	17	37	10	14	-
Marion,	56	164	123	52	8	166	56	54	50	53	49	54	2	-
Marlborough,	146	1,100	744	141	4	649	152	147	142	141	148	149	13	-
Marshfield,	148	558	336	132	266	203	148	134	67	88	126	144	2	-
Mashpee,	25	34	17	25	-	64	25	24	25	25	25	25	-	-
Mattapoisett,	89	318	196	86	2	276	90	86	66	79	87	89	-	-
Maynard,*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Medfield,	70	587	381	64	-	523	72	69	54	56	69	64	-	-
Medford,	94	430	357	84	-	26	94	85	90	90	89	94	6	-
Medway,	76	489	295	45	-	82	76	71	66	70	60	66	1	-
Melrose,*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Mendon,	97	647	412	93	-	132	110	108	69	93	93	110	3	-
Merrimac,	58	361	230	24	2	117	56	39	29	*-	32	29	-	-
Methuen,	169	1,459	1,042	100	160	490	171	161	108	102	79	171	2	-
Middleborough,	201	788	482	175	27	323	221	191	174	189	194	215	2	-

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Middlefield,	46	578	242	47	331	124	51	48	45	50	50	47	1	-
Middleton,	58	320	201	39	4	106	65	60	48	47	50	63	-	-
Milford,	142	483	357	134	-	279	142	135	129	125	127	142	6	-
Millbury,	137	923	603	123	-	388	154	130	139	145	150	152	4	58
Millis,	61	636	294	58	12	18	64	55	49	59	60	61	1	-
Milton,	110	848	697	110	-	170	113	112	112	112	112	113	3	-
Monroe,	35	187	107	26	41	91	28	28	27	27	27	28	-	-
Monson,†	133	1,345	660	119	66	386	150	135	130	132	128	140	-	11
Montague,	148	1,083	516	116	34	496	157	133	88	127	131	139	6	-
Monterey,	70	697	386	63	75	308	74	48	37	72	72	74	-	-
Montgomery,	42	395	227	42	71	78	42	*–	*–	*–	*–	*–	*–	-
Mount Washington,	16	103	33	13	-	30	16	13	8	10	16	16	-	-
Nahant,	4	15	14	4	-	-	4	3	3	3	3	3	-	-
Nantucket,	77	615	365	75	253	287	78	66	72	72	75	23	-	-
Natick,	77	539	393	68	-	472	77	69	52	41	67	71	3	-
Needham,†	94	763	574	75	10	17	99	32	36	55	67	100	-	-

New Ashford,	24	221	125	24	200	43	24	24	24	24	24	24	-	-
New Bedford,	79	518	395	70	3	146	79	69	56	64	69	76	1	-
New Braintree,	74	1,557	1,027	73	4	75	74	73	74	74	73	72	-	-
New Marlborough,†	19	284	151	16	12	3	21	16	17	19	21	21	-	-
New Salem,	114	528	239	87	60	220	114	99	107	109	104	114	-	-
Newbury,	73	1,373	736	74	13	75	82	68	67	78	78	82	-	-
Newburyport,†	97	465	316	97	-	503	97	19	18	18	18	18	1	1
Newton,	237	1,240	1,140	235	-	-	242	*-	*-	*-	*-	*-	*-	-
Norfolk,	67	377	226	63	-	46	67	66	62	63	65	56	1	-
North Adams,	43	562	348	43	48	59	43	*-	*-	*-	*-	*-	*-	-
North Andover,	64	1,049	718	61	2	22	64	64	62	64	62	64	1	-
North Attleborough,	129	664	542	112	-	205	131	116	82	91	109	120	2	-
North Brookfield,	141	1,297	747	94	-	364	148	148	113	148	116	129	-	-
North Reading,	69	528	312	62	10	158	69	63	66	68	66	68	-	-
Northampton,	188	1,032	597	144	50	393	188	*-	*-	*-	*-	*-	*-	-
Northborough,	131	1,160	782	129	-	177	133	126	119	122	127	130	-	-
Northbridge,	69	557	337	52	-	147	69	58	41	52	59	67	3	-
Northfield,†	98	912	517	78	100	285	100	80	65	96	86	95	-	-
Norton,	145	448	283	138	2	211	145	133	128	122	133	140	-	-
Norwell,	112	264	171	106	30	188	112	100	85	108	110	112	-	-
Norwood,	70	378	266	67	-	62	71	63	60	61	69	70	-	-

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Oakham, ...	52	681	390	51	-	62	56	50	48	50	52	53	1	-
Orange, ...	185	1,159	686	181	49	595	195	185	162	183	180	194	1	-
Orleans, ...	85	193	137	78	34	75	85	75	70	72	67	80	-	-
Otis, ...	110	693	320	109	241	166	111	90	98	111	111	109	-	-
Oxford, ...	93	689	412	91	30	157	95	86	81	96	89	95	-	-
Palmer, ...	111	783	370	105	-	2	111	68	66	68	87	87	-	-
Paxton, ...	60	593	370	54	-	21	64	60	49	55	60	64	-	-
Peabody, ...	52	757	643	52	14	815	52	*-	*-	*-	*-	*-	*-	-
Pelham, ...	40	177	110	39	15	36	40	27	12	27	38	40	-	-
Pembroke, ...	96	237	158	87	30	151	96	*-	95	95	93	92	-	-
Pepperell, ...	169	908	530	164	7	386	174	152	127	156	169	171	4	-
Peru, ...	46	462	224	46	44	27	46	29	46	46	46	46	2	-
Petersham, ...	124	967	498	103	108	357	129	120	69	69	107	119	8	-
Phillipston, ...	64	324	300	64	41	129	71	51	46	11	70	71	1	-
Pittsfield, ...	64	1,248	835	47	2	204	76	63	45	40	48	65	2	-
Plainfield, ...	71	779	365	55	175	224	95	76	54	75	68	84	3	-

Plymouth,†	120	349	249	111	-	324	120	98	98	106	106	113	2	-
Plympton, ...	66	257	120	62	-	83	66	62	58	51	64	44	2	-
Prescott, ...	67	483	243	61	30	149	70	58	57	58	62	45	2	-
Princeton,†	42	901	488	32	64	60	42	9	30	40	39	40	2	-
Provincetown, . . .	13	94	63	13	-	13	13	12	11	6	12	10	-	-
Quincy, ...	206	809	660	186	-	256	219	177	177	179	200	210	5	-
Randolph, ...	87	406	239	81	-	706	92	85	69	83	91	91	-	-
Raynham, ...	48	392	268	43	-	143	49	47	39	40	45	34	2	-
Reading, ...	97	382	326	96	6	89	97	93	95	96	97	97	4	-
Rehoboth, ...	260	1,787	1,138	256	25	892	347	335	245	347	342	347	-	-
Revere, ...	37	138	127	37	1	750	38	26	38	37	37	38	-	-
Richmond, ...	95	575	333	95	650	275	95	74	79	92	89	95	-	-
Rochester, ...	51	250	158	41	-	127	51	49	22	50	49	46	-	-
Rockland, ...	112	293	182	86	-	48	113	107	76	64	64	110	-	-
Rockport, ...	53	217	190	48	-	24	54	53	51	49	51	48	-	-
Rowe, ...	77	724	291	74	208	212	78	*–	*–	*–	*–	*–	*–	-
Rowley, ...	66	643	276	49	22	89	69	54	50	51	50	66	1	-
Royalston,†	111	869	411	78	56	336	118	90	79	81	81	80	3	-
Russell, ...	45	197	96	43	105	89	49	34	32	42	44	45	3	-
Rutland, ...	112	1,113	619	109	-	236	133	129	116	132	122	133	11	-
Salem, ...	12	286	235	12	8	108	14	7	5	6	11	14	-	-

* No report. † Incomplete report.

Work of Local Inspectors for 1903 — Continued.

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.	Number Goats.
Salisbury, ...	116	532	274	105	23	273	116	101	101	102	101	96	9	-
Sandisfield, . . .	113	1,071	465	110	111	155	121	113	115	113	111	120	6	-
Sandwich, ...	89	270	109	62	-	82	89	57	79	85	86	68	-	-
Saugus, ...	45	867	736	40	-	348	57	50	49	50	56	56	3	-
Savoy, ...	86	726	384	73	80	152	104	38	39	45	85	88	1	-
Scituate, ...	124	370	242	123	12	98	123	89	82	101	117	120	-	-
Seekonk, ...	139	1,350	911	122	22	1,754	148	97	99	103	125	121	4	-
Sharon, ...	73	333	229	71	-	34	75	63	62	73	71	51	6	-
Sheffield, ...	188	2,316	1,142	141	85	524	226	152	130	218	213	187	7	-
Shelburne, . . .	105	1,714	68	88	729	344	105	*–	*–	*–	*–	*–	*–	-
Sherborn, . . .	113	1,108	615	111	-	608	128	114	112	115	117	114	4	-
Shirley, ...	61	368	236	55	7	116	65	18	57	58	57	64	-	-
Shrewsbury, . . .	146	1,451	1,061	139	30	479	149	121	142	142	139	147	6	-
Shutesbury, . . .	43	170	54	41	26	79	43	42	42	42	43	43	-	-
Somerset, . . .	69	520	409	67	-	373	69	66	58	68	68	56	1	-
Somerville, . . .	55	147	138	43	-	90	54	47	29	35	40	54	1	-

South Hadley, . . .	123	1,344	956	97	5	305	148	121	119	138	117	146	1	-
Southampton, . .	142	1,135	733	133	65	279	143	111	133	142	139	140	1	-
Southborough, . .	53	1,087	762	32	110	101	59	54	47	45	35	47	-	-
Southbridge, . . .	73	789	468	65	62	193	78	73	70	71	66	77	2	-
Southwick, . . .	132	1,024	606	128	78	270	149	124	139	148	144	143	2	-
Spencer, ...	115	1,545	842	113	29	257	120	114	114	117	114	117	1	-
Springfield, . . .	162	489	305	134	13	1,674	162	64	63	62	103	84	2	-
Sterling, ...	132	1,651	1,227	28	66	153	134	78	72	92	2	104	-	-
Stockbridge, . . .	106	940	549	99	161	409	112	76	77	91	92	107	-	-
Stoneham, . . .	66	315	266	50	-	142	89	32	33	31	51	50	2	-
Stoughton, . . .	132	533	303	100	-	156	136	90	82	101	90	132	2	-
Stow, ...	63	828	491	56	-	47	73	69	69	71	72	72	1	-
Sturbridge, . . .	52	474	243	47	45	154	52	49	50	52	52	52	1	-
Sudbury,* . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Sunderland, . . .	52	563	390	35	10	344	53	33	21	40	17	44	-	-
Sutton, ...	174	1,263	767	152	54	365	186	164	141	176	169	172	6	-
Swampscott,* . . .	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Swansea, . . .	115	1,048	762	114	4	477	135	99	86	125	131	131	-	-
Taunton, ...	238	1,293	1,031	235	12	803	238	*-	*-	*-	*-	*-	*-	-
Templeton, . . .	95	584	364	94	4	209	102	96	83	96	91	100	-	-

* No report.

Work of Local Inspectors for 1903 — Continued.

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.	Number Goats.
Tewksbury,	143	878	549	490	1	553	146	131	121	118	116	82	-	-
Tisbury,	22	75	56	21	1	54	23	17	14	17	20	19	-	-
Tolland,	46	518	257	36	32	146	67	49	50	60	58	66	1	-
Topsfield,	68	650	477	63	-	60	68	*-	*-	*-	*-	*-	*-	-
Townsend,	139	555	320	114	4	243	142	138	131	135	118	141	4	-
Truro,	63	240	157	63	-	57	63	62	63	63	63	63	1	-
Tyngsborough,*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tyringham,	60	630	301	53	143	131	85	80	77	85	84	85	4	-
Upton,	107	601	308	33	1	192	116	66	80	64	93	105	7	-
Uxbridge,	150	889	511	145	37	283	154	142	136	141	147	148	2	-
Wakefield,	82	371	295	80	-	264	89	56	79	80	80	80	7	-
Wales,	56	297	155	25	28	72	61	52	42	50	61	42	2	-
Walpole,	98	513	*-	94	19	272	98	*-	*-	*-	*-	*-	*-	-
Waltham,*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ware,	133	956	646	31	8	337	135	59	12	66	8	134	2	-

Wareham,	89	263	194	89	19	109	89	89	89	89	89	89	1	-
Warren,	134	1,987	998	112	18	269	160	149	97	22	114	121	3	-
Warwick,	83	436	208	78	21	158	87	85	76	86	82	87	-	-
Washington,† ‡	61	686	304	45	485	191	68	28	27	15	47	40	-	27
Watertown,*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Wayland,	83	845	648	83	-	956	83	64	82	82	83	78	-	-
Webster,	35	254	178	33	2	4	37	26	22	27	34	37	-	-
Wellesley,	69	339	262	55	-	1	72	38	39	43	56	72	-	-
Wellfleet,	42	109	62	37	-	36	42	37	37	37	39	42	-	-
Wendell,	55	216	107	55	19	212	56	44	43	41	52	56	-	-
Wenham,	45	246	180	63	-	107	45	40	39	39	43	45	-	-
West Boylston,	80	718	456	76	28	418	83	78	76	78	71	79	-	-
West Bridgewater,	53	818	583	51	16	241	55	41	41	39	52	55	-	-
West Brookfield,	92	1,479	760	79	40	200	107	104	102	103	102	106	-	30
West Newbury,	97	956	585	98	90	325	100	99	99	99	100	100	-	-
West Springfield,	122	932	663	120	14	423	122	111	111	113	115	118	-	-
West Stockbridge,	110	451	319	110	409	355	111	69	69	69	111	111	2	-
West Tisbury,	66	263	146	66	852	92	66	66	66	66	66	66	-	-
Westborough,	109	1,650	1,006	108	11	691	149	142	132	147	131	146	18	-
Westfield,	213	1,387	887	192	20	664	215	198	176	170	188	210	-	-

* No report. † Incomplete report. ‡ 22 deer, 5 moose and 2 elk.

Work of Local Inspectors for 1903 — Concluded.

City or Town.	Number Herds inspected.	Number Neat Cattle inspected.	Number Milch Cows inspected.	Number Herds kept Clean and in Good Condition.	Number Sheep inspected.	Number Swine inspected.	Number Stables inspected.	Number Stables well located.	Number Stables well lighted.	Number Stables well ventilated.	Number Stables kept Clean.	Number Stables with Good Water Supply.	Number Stables improved since Last Report.	Number Goats.
Westford,	99	977	595	92	-	89	103	101	87	95	82	102	-	-
Westhampton,	64	659	290	58	10	104	64	*-	*-	*-	*-	*-	*-	-
Westminster,	68	512	344	65	4	2	69	62	46	2	66	-	5	-
Weston,	131	1,146	815	124	18	544	143	129	134	135	135	140	7	-
Westport,	302	1,462	964	294	23	484	317	209	193	236	287	301	4	-
Westwood,	73	565	426	70	-	387	77	72	72	72	71	72	-	-
Weymouth,	189	658	533	144	2	229	190	166	152	115	114	180	-	-
Whately,	108	846	446	108	19	416	119	113	113	118	114	119	1	-
Whitman,	88	342	289	87	2	212	88	71	73	71	74	88	-	-
Wilbraham,	107	1,021	578	92	-	308	150	89	95	134	106	139	-	-
Williamsburg,	90	777	356	55	30	162	93	79	44	64	58	69	-	-
Williamstown,	199	1,737	1,091	163	999	685	202	182	126	108	184	202	6	-
Wilmington,	89	264	168	86	-	222	89	82	67	84	80	88	-	-
Winchendon,	135	502	331	6	55	307	140	135	130	137	133	140	-	-
Winchester,	21	199	172	17	-	87	21	16	18	20	19	21	-	-

Windsor,	90	1,014	497	88	66	223	109	72	87	101	106	109	-	-
Winthrop,	16	35	34	7	-	-	16	16	16	16	16	16	-	-
Woburn,*	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Worcester,	285	2,182	1,712	277	83	1,943	285	272	272	274	272	280	4	-
Worthington,	104	1,065	505	85	181	242	121	100	102	113	112	114	1	-
Wrentham,	171	737	440	94	-	378	171	*-	*-	*-	*-	*-	*-	-
Yarmouth,	46	135	91	43	-	100	46	44	44	44	42	46	1	-
	32,913	243,291	155,626	29,352	26,377	90,058	34,741	28,066	25,703	27,882	28,898	30,777	575	173

* No report.

The above table shows the work accomplished by the inspectors of animals in various cities and towns.

No reports have been received from the following towns: —

Deerfield,	Sudbury,	Waltham,
Maynard,	Swampscott,	Watertown,
Melrose,	Tyngsborough,	Woburn.

Reports from the following towns are incomplete: —

Ashland,	Newton,	Royalston,
Berkley,	North Adams,	Shelburne,
Bolton,	Northampton,	Taunton,
Hadley,	Noithfield,	Topsfield,
Hamilton,	Peabody,	Walpole,
Monson,	Pembroke,	Washington,
Needham,	Plymouth,	Westhampton,
Newburyport,	Princeton,	Wrenthani.
New Marlborough,	Rowe.	

In Melrose the inspector died, and a new one was appointed about the middle of November, when the inspection should have been brought to a close; and in Waltham the inspector left town, and another was appointed at about the same time. This accounts for no reports being received from these two cities.

The report of the inspectors of animals is in the main not as full as in many of the preceding years.

Many of the inspectors of animals are painstaking, conscientious men; while others are careless, and do not take the pains in the performance of their duties that they should. The trouble in the latter cases is perhaps not altogether the fault of the inspectors, as in some towns the position is not considered of the importance that it really is, and the selectmen appoint the man who will do the work the cheapest; consequently the duties in such towns are not well performed, because no one can afford to do them properly for the price paid. In a few cases there has been a tendency to make the position a reward for political services; but this has been checked, as the appointments are made subject to the approval of the Chief of the Cattle Bureau, and in two or three instances confirmation of appointees has been withheld until a suitable person was named for the position.

At the close of the outbreak of foot and mouth disease a house-to-house inspection was made by agents of the United States Bureau of Animal Industry in towns where the outbreak occurred and in some of the adjoining towns. To assist them in this work the reports of the inspectors of animals for 1902 were lent to the Bureau of Animal Industry, from which to obtain a list of cattle owners in different places. The list of names taken from the book of Dr. E. M. Brastow of Wrentham was found to contain the name of every cattle owner in that town; and that of Dr. N. C. Bullard of North Attleborough contained every cattle owner but two. The names of such inspectors deserve to be placed upon a roll of honor. Unfortunately, this is not the case in every city and town; in many places the lists contained the names of all the large owners, but not the persons who owned only one or two cows. In one town, not far from Boston, and a well-to-do town at that, the list was found to be very meagre; the explanation of the inspector of animals here was that the "selectmen only allowed him $50 per year, and he worked until he thought he had earned that amount, and then stopped."

The law requires inspectors of animals to be sworn to perform the duties of the office faithfully; and, if the town will not allow enough to pay for the performance of the duties properly, then the appointee ought to refuse to accept the position.

Another reason for the inspectors' reports not being better may be due to the fact that the express company to whom the books were given for delivery early in October was very dilatory, and the inspectors did not receive them in some instances for ten days or two weeks after they were taken from the Cattle Bureau office.

TUBERCULOSIS.

As the principal item of expense in the duties of the Cattle Bureau is tuberculosis, it will be mentioned first. As usual, it may be divided under three heads: —

First. — That portion of the work comprised under the quarantining of animals by the local inspectors, on suspicion of being tuberculous, which have to be examined by agents of the Cattle Bureau, and, if found to be diseased, are appraised and killed.

Second. — Testing cattle received at the quarantine stations for sale into the herds of the State, exclusive of beeves for immediate slaughter, and calves under six months old; also testing cattle brought to other points upon which satisfactory certificates of test are not received, and the release of cattle which have been already satisfactorily tested.

Third. — What is known as "voluntary request work," where entire herds are tested at the request of owners, with a view to eradicating tuberculosis from them.

During the year animals have been quarantined in 276 different cities and towns of the State, by local inspectors, as tuberculous or as having been brought into Massachusetts and held in quarantine until satisfactory evidence of tuberculin test was presented to the Chief of the Cattle Bureau, as follows: —

Massachusetts Cattle.

Number released,	466	
Number condemned, killed and paid for,	1,144	
Number permit to kill, and paid for,	28	
Number permit to kill, no award,	121	
Number died in quarantine, no award,	54	
Number condemned and killed, in process of settlement,	297	
Number released for lack of funds,	326	
Total Massachusetts cattle quarantined,		2,436

Cattle from without the State.

Number released,	561	
Number condemned, killed and paid for,	8	
Number condemned and killed, no award,	110	
Number died in quarantine,	1	
Number in quarantine, unsettled,	7	
Total out-of-State cattle quarantined,		687
Whole number cattle quarantined,		3,123

Of the cattle quarantined, two were found affected with actinomycosis, one of which was released and the other condemned and killed.

Of the 118 condemned and killed, on suspicion of being tuberculous, brought into Massachusetts from without the State, 79 were tested and retested at Brighton, and the other 39 were tested at other places. Eight in all were found to show no lesions of tuberculosis, and the State had to reimburse the owners for the value of these animals. These errors were about evenly divided between Brighton and other points. The 561 animals quarantined by the local inspectors because they were brought in from without the State are included among the 8,442 animals brought to points outside of Brighton market, upon which tests were required.

It will be seen that since early in November it has been necessary to release 326 animals for lack of funds. Many of these undoubtedly showed marked physical evidence of disease, and some will doubtless have to be taken care of early in 1904; others have probably been disposed of by their owners as cheap beef, judging from reports received of animals condemned in slaughter houses recently as too badly infected with tuberculosis to be passed as fit for food by agents of boards of health.

The *second section* of the work in connection with tuberculosis includes *testing and releasing* the cattle at Brighton market every week, outside of animals intended for immediate slaughter and calves under six months old; and also the *granting of permits* for cattle brought to other points, and testing those upon which satisfactory certificates of test are not received.

It has been found that the first test on cattle at Brighton does not always prove reliable, and any cattle that give an apparent reaction are held over a week and retested with a double dose of tuberculin. Those reacting a second time are killed, and any that do not react on a retest are released. One hundred and twenty-six reacted the first time; of these, 79 reacted on the second test, and the remaining 47 were released. As the Brighton market was closed for the sale of milch cows and store cattle from Nov. 26, 1902, to July 22, 1903, the figures for cattle tested and released or condemned at Brighton are for animals received there during the last half of the year. Milch cows and store cattle arriving at the yards at Watertown and Somerville each week are taken to the large stock barn at Brighton to be tested, and are sold there.

Receipts of Stock at the New England Dressed Meat and Wool Company's Yards at Somerville, Dec. 15, 1902, to Dec. 15, 1903.

Maine cattle,	463
New Hampshire cattle,	2,867
Vermont cattle,	5,952
Western cattle,	26,634
Sheep,	386,925
Swine,	1,043,093

Cattle not for immediate slaughter have been tested by the Cattle Bureau at Brighton, and are included in the Brighton report.

Receipts of Stock at the Watertown Stock Yards, from Dec. 15. 1902, to Dec. 15, 1903.

Vermont cattle,	3,950
New Hampshire cattle,	1,997
Massachusetts cattle,	1,260
Western cattle,	20,528
Sheep,	10,138
Swine,	1,619
Calves,	7,511

Milch cows and store cattle are driven to the stock barn at Brighton yards, and there tested.

Receipts of Stock at Brighton, from Dec. 15, 1902, to Dec. 15, 1903.

Maine cattle,	5,032
New Hampshire cattle,	300
Vermont cattle,	531
Massachusetts cattle,	9,948
New York cattle,	397
Western cattle,	17,721
Sheep,	25,983
Swine,	10,500
Calves,	20,039
Cattle tested,	6,707
Cattle released after test,	6,628
Cattle condemned after test,	79
Total milch cows and store cattle on the market,	13,149

Total Receipts of Live Stock at the Three Stations, from Dec. 15, 1902, to Dec. 15, 1903.

Cattle,	97,570
Sheep,	423,046
Swine,	1,055,212
Calves,	107,987
Cattle tested at stations (of which 126 are re-tests),	6,707
Cattle released after test,	6,628
Cattle condemned after retest,	79

Of the 79 condemned, 28 were so badly diseased as to have to be rendered; the owners received the returns for beef on all but 5, which were found free from disease, and for which the State had to pay.

The receipts of cattle, sheep, swine and calves from New England were very small during the first half of the year, because of foot and mouth disease, most of the animals having been received since June 15.

Report of Cattle brought into the State during the Year, to Points outside the Quarantine Stations.

During the year 1903, 995 permits were issued to bring cattle into Massachusetts, 164 of which were not used; 12 were cancelled on account of the discovery of foot and mouth disease in New Hampshire and Vermont. On the balance, the following cattle were brought in: —

For dairy and breeding purposes, tested before shipment,	4,717
For dairy and breeding purposes, tested after arrival,	3,725
Calves under six months old, requiring no test,	180
Cattle returned from out-of-State pastures,	230
Cattle to be pastured and returned to Rhode Island,	13
Cattle that died before they could be tested,	3
Cattle that had previously been inspected by the United States authorities, on which no State test was required,	50
Total,	8,918

Ninety-four permits were for cattle for immediate slaughter, 20 being for a carload weekly, and 1 for five or six carloads weekly. On these permits a great many cattle were brought in for beef, the exact number not being recorded, Two permits gave the privilege of bringing cattle in to be fattened and sold for beef later. Seven permits were given for cattle that were to be unloaded *en route* through the State. Nineteen permits were given allowing cattle to be brought into Massachusetts for exhibition purposes, and 4 for cattle to be returned from exhibition in other States. One permit was given allowing cattle to be brought weekly from Rhode Island into this State, after having been previously tested at Brighton and shipped thence to Providence, R. I. One permit was given allowing 20 head of cattle to be brought from Vermont to Haverhill, the cattle being immediately thereafter taken into New Hampshire. This case was promptly reported to the New Hampshire Cattle Commission.

Besides the above, railroad agents, local inspectors and others have reported 265 cattle brought into the State without permission; 104 of these were accompanied by satisfactory certificates of test, 1 was a calf requiring no test, 1 was returned from out-of-State pasture, 27 were for beef, and the remainder, 132, were looked up in every case and tested by agents of the Cattle Bureau.

The tuberculin used by the Cattle Bureau is furnished by the United States Bureau of Animal Industry, with the understanding that it is for State use only, that all tests made will be reported in writing, and that the result of the autopsies on reacting animals will be given.

The *third division* of the work for the eradication of tuberculosis comprises that which is known as *voluntary request work*. This is testing entire herds at the written request of the owners. With the exception of two or three small herds, this has been done only upon the owners signing an agreement stating that they will take what the butcher will allow for animals so slightly diseased as to pass the slaughter house inspection, the State paying only for animals that are so badly diseased that the carcasses have to be rendered. The exceptions were small herds, where the cows were not in beef condition, and where only a small number were likely to react. In cases where the owners agree to accept the butcher's returns upon animals that may safely be used for food, much of the burden falls on the owners, as cows will not bring their full value if killed for beef when in milking condition.

Below is given a report of the herds and cattle tested at the request of owners: —

Number of herds,		16
Number of animals,		438
Number condemned and rendered,	153	
Number condemned, no award,	95	
Number that did not react,	190	
	——	438

Of the number that did not react, 1 was killed at owner's request, and found to be diseased.

In 1902, 17 herds were tested, but they were smaller, and contained only 274 animals. Five of the 16 herds tested in 1903 were retests on herds tested the year before, or the completion of work undertaken the previous year, therefore only 11 belonged to new owners. Four herds were found to be free from disease; in the herds where disease was found some of them were badly infected, and a very large per cent of the animals reacted.

The problem of how best to deal with bovine tuberculosis in order to further diminish it is an important and serious one. At present the law requires owners to be compensated for cattle killed because of tuberculosis, the appraisal being based upon the apparent market value of the animal at the time it is condemned, the limit of value on any one creature being placed at $40. The cattle quarantined by local inspectors on suspicion of having tuberculosis are generally found to be animals that are badly diseased, unsafe to produce milk for human food and unfit to be utilized for beef; and such animals should be killed, to protect the public health, as they are a menace to their stable companions. At the same time, taking a tuberculous animal here and there, perhaps only one or not over two or three from any one owner, does not seem to diminish the amount of tuberculosis perceptibly. Many owners are careless in disinfecting the place where the animal destroyed stood; and, even when the disinfection is thorough, there are other slightly tuberculous creatures left, which develop further symptoms of disease later, until they are in a condition to infect any new purchases that may have been free from disease when put in the stable, but in time arrive at a condition where they have to be quarantined and killed.

During 1903, 690 more cattle have been quarantined by the local inspectors of animals on suspicion of being tuberculous than during the previous year; 322 more have been killed because of this disease, to say nothing of the 326 released from quarantine for lack of funds. If anything, it would seem that ground was being lost in the eradication of tuberculosis among cattle, rather than being gained, under the present system of dealing with this malady. If the money now expended in paying for bad cases of tuberculosis could be used for testing and cleaning up entire herds where the disease exists, more permanent headway might be made towards diminishing its frequency.

This testing could be commenced in cattle-raising districts in the western part of the State, where there are only two or three bad herds perhaps in many of the towns, which are a constant source of danger to the neighboring ones; and, as these localities were cleaned up, work could later be undertaken on the same plan in the infected localities in the eastern part of the Commonwealth. If such measures were adopted, the State ought to disinfect the stables where cattle were killed, and the owner should be required to sign a binding agreement to buy only tested cattle in the future. A second and perhaps a third test might be made by the State the following year or two, to be sure that no diseased animals remained to infect new purchases, and condemned cattle should be paid for from the Cattle Bureau's appropriation. After it appeared certain that a herd was freed from the infection, the owner should be required to maintain it in a state of health thereafter. Any intelligent farmer can learn to use tuberculin himself, and any one who now wishes to can easily keep a tested herd, if he chooses, without State aid. To do this with appropriations no larger than those of the past few years would require a change in the law, providing that individual animals now quarantined by the local inspectors shall be killed, where the public good requires it, without appraisal or payment; or else more money should be appropriated. A cow so badly diseased with tuberculosis as to be a menace to the public health or a source of danger to other cattle is in reality a worthless piece of property; and there seems to be no more reason for paying for such an animal than there is for paying for a horse with glanders, for which the owner receives nothing when it is killed under the provisions of the sanitary laws of the State.

While the present law remains in force, the larger part of the appropriations of the Cattle Bureau will be required to pay for tuberculous cattle quarantined by the local inspectors, and to employ agents to examine, appraise and kill them, leaving only a small part of the appropriations for doing other work. The only other way in which to make more headway and do any permanent work under the present requirements would be to have appropriations sufficiently large to take care of all the bad cases of bovine tuberculosis, and leave a large enough margin with which to properly carry out the other duties required of the Cattle Bureau.

While it is a partial protection to the health of milk and meat consumers to kill badly diseased animals within the limits of the State, yet it does not afford any protection to those using milk from herds in adjoining States, many of which are kept in localities where bovine tuberculosis may prevail as extensively as it does in Massachusetts.

A remedy for this might be to license all milk producers furnishing a public milk supply to people in this State, whether the farms were in Massachusetts or elsewhere; and to refuse licenses to all persons who did not comply with proper requirements for the health of their herds and the cleanliness and sanitary condition of their surroundings.

Whatever course may be pursued in the future, it seems best to continue the requirement of a tuberculin test on all cattle brought into this State for dairy or breeding purposes from other States; as a continual supply of healthy cattle from outside will tend to diminish the prevalence of the disease in this Commonwealth, and give those who realize the importance of so doing an opportunity of buying healthy cattle. Any relaxation of these regulations would also make Massachusetts a dumping ground for diseased cattle from other States. It is regrettable that so many of the cattle coming into this State in a healthy condition are destined to go to dairies where in time they will become infected with this bovine scourge. At present the law does not allow the testing of cattle with tuberculin by the State except animals brought in from without the State, or at Brighton, Watertown and Somerville, and animals that are considered tuberculous by a competent veterinary surgeon; in other cases it cannot be done without the written consent of the owner. If an attempt were to be made to clean up dangerous herds in localities where they were a source of danger to the neighboring cattle, it would be well to amend the law so as to give the Chief of the Cattle Bureau authority to have any herd tested in which one or more tuberculous animals, which could be condemned upon a physical examination, were found to be present.

Many farmers do not seem to realize the importance of keeping incipient tuberculosis out of their herds, even when an opportunity for doing so offers itself, as illustrated by answers to the following letter, sent to owners whose herds were killed because of foot and mouth disease, and whose barns were thoroughly disinfected: —

BOSTON, Dec. 24, 1903.

DEAR SIR: — Last winter your herd was killed by the United States Bureau of Animal Industry, and your premises thoroughly disinfected, giving you an opportunity to restock your farm with healthy cattle. I would like very much if you would be so kind as to inform me what pains you have taken to buy cattle that have been tested with tuberculin, so as to be sure that they were absolutely healthy when you restocked your farm, or whether you have bought cattle without taking any particular precautions to be sure that they were free from any form of contagious disease, particularly tuberculosis.

An early reply will be very much appreciated.

Yours truly, AUSTIN PETERS,
Chief of Cattle Bureau.

There were 107 letters sent and 56 replies received, many of them very interesting. Of the 56 answering, there are 4 who state that their farms have not been restocked and 1 who has restocked only with dry cows, which he sells when they come in, as he finds that it is useless to keep milch cows, as the milk still tastes of disinfectants from his barn, and he cannot find a market for it. The latter writer thinks it would have been preferable to have had his barn burned than to have disinfected it as it was done; he says he thinks one cow died last spring from chloride of lime poisoning. One of the 4 who has not yet stocked up again has not done so because the barn still smells so of disinfectants that he does not care to put cattle in.

About a dozen of the other writers intend to keep only tested cattle; some have taken especial pains to have their animals tested; others buy at Brighton, but have taken pains to buy out-of-the-State cows tested there, and do not intend to buy any that have not been tested.

The other 39 replies state that the writers have not taken any particular pains to buy tested animals; some have bought cattle from without the State that were tested, and then bought a few from neighbors that were not, — some of which, if they should develop disease, will prove sources of infection to the tested ones in time; all state that they have taken particular pains, however, to buy animals that are to the best of their judgment healthy from the stand-point of a careful physical examination. Several do not have any faith in the tuberculin test, and a few have a strong prejudice against it. Several are cow dealers, and state that they cannot avoid occasionally getting a tuberculous cow in the way of trade; but that they have such animals kept away from the rest, and notify the local inspector to quarantine them, so that they may be appraised and killed by an agent of the Cattle Bureau.

The owners of a large milk farm in Westborough state that they intend to keep only tested cattle, but when they restocked it was impossible to buy cows from their neighbors, subject to the test, for various reasons. One of them writes as follows: —

The more ignorant farmers said that they would not have the test applied, because they thought it injured the health of the animals; another refused to sell subject to the test, because the purchaser would get the clean animals, and the seller the tuberculous ones, — not thinking it would be any advantage to him to find out which of his animals were diseased; and others were willing to sell subject to the test, but at such a large advance in price that we thought it cheaper to buy cattle untested, and test them ourselves. This we have done, and now have a herd in the disinfected barns that is free from disease.

From most of the answers received, therefore, it appears that the majority of owners are satisfied to buy cattle that appear to be healthy, from a physical stand-point, without any special reference to whether they will pass a tuberculin test or not.

From what has been said above it is not intended to give the idea that cleanliness, sunlight and ventilation are to be forgotten, as these are of the utmost importance in assisting to maintain the health of the herd.

Foot and Mouth Disease.

The outbreak of foot and mouth disease, which caused so much trouble and excitement a year ago, has been entirely eradicated; all restrictions upon the movement of cattle, sheep, other ruminants and swine in the New England States have been removed, and shipments from the port of Boston resumed. The conditions now existing are exactly as they were prior to the appearance of this disease.

At the time of the last semiannual report to the Board of Agriculture, last June, it was stated that the foot and mouth disease seemed to be practically extirpated, and soon after, July 15, the following order was approved by the Governor and Council, stating that the disease was believed to be eradicated, and all restrictions imposed upon the moving of animals and merchandise within the limits of this Commonwealth were removed; and orders relating thereto were revoked: —

CATTLE BUREAU ORDER, NO. 11.

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, July 15, 1903.

To Transportation Companies, the Brighton Stock Yards Company, and All Persons whom it may concern.

By virtue of the power and authority vested by law in the Cattle Bureau of the State Board of Agriculture, under the provisions of chapter 90 of the Revised Laws and chapter 116 of the Acts of 1902, you are hereby notified that foot and mouth disease, which is a contagious disease and is so recognized under the laws of this Commonwealth, is no longer known to exist in this State, and it is believed that it has been entirely eradicated. Therefore, the orders of the Chief of the Cattle Bureau, approved by the Governor and Council Nov. 26 and Dec. 1, 1902, Feb. 18, March 18 and May 13, 1903, closing the Brighton market, forbidding auctions and public sales and the transportation of neat cattle, sheep, other ruminants and swine, hay, straw, grain bags, cattle hides, calf skins, horns, hoofs, bones and manure in certain cities and towns and sections of this Commonwealth, and restricting the use of certain premises where the disease has existed, are hereby revoked.

The Brighton market may be reopened, and animals moved as formerly within the limits of the State.

The regulations of the Cattle Bureau concerning the importation of neat cattle into Massachusetts previous to the appearance of the foot and mouth disease in the autumn of 1902 still remain in force, except as provided for in chapter 322, Acts of 1903; that is, the orders approved in Council April 23, 1902, and Sept. 10, 1902, as modified by this order, now provide as below: —

1. No neat cattle brought from any State or Territory of the United States, the District of Columbia, Canada or any other country without the limits of this Commonwealth shall be brought within the limits of this Commonwealth, except for delivery directly to the Union Stock Yards in the town of Watertown, the Boston & Albany Stock Yards in Brighton within the city of Boston, or the premises of the New England Dressed Meat and Wool Company in the city of Somerville, except upon a permit signed by the Chief of the Cattle Bureau; and no neat cattle so brought for delivery at any of said points shall be unloaded, except as provided in paragraph 3, at any point other than the said Boston & Albany Stock Yards in Brighton, the Union Stock Yards in Watertown, or the New England Dressed Meat and Wool Company in Somerville.

2. All neat cattle brought within the limits of this Commonwealth from any place designated in paragraph 1 hereof, except

for delivery as provided in the preceding paragraph, must be accompanied by a permit issued by the Chief of the Cattle Bureau.

3. If, for any cause, any such neat cattle are received by any of your agents within the limits of this Commonwealth at any place other than the Union Stock Yards in Watertown, the Boston & Albany Stock Yards in Brighton, or the New England Dressed Meat and Wool Company in Somerville, not accompanied by a permit, as provided in paragraph 2 hereof, you will immediately notify this office, giving the place where said animals were received for shipment, the name of the consignee and destination of said animals. You will not remove said animals or permit them to be removed from the car or vehicle in which they are contained without permission from the Chief of the Cattle Bureau or one of his agents; except that if, by reason of the crowded condition of the car, or because of the long confinement of said animals within the same, or for accident or otherwise, it is deemed expedient by you or your agent to unload the same, such animal or animals may be removed by you from said car or vehicle without permission; but in such case you will notify this office, and you will not allow said animal or animals to go out of the possession of your agent or off of your premises where said animals are unloaded except upon obtaining such permission.

4. All neat cattle brought within the limits of the premises in Brighton, Watertown and Somerville, designated in paragraph 1 hereof, are hereby declared to be quarantined, until released by an agent of the Bureau.

5. All cattle except those for immediate slaughter, or calves under six months old, must be tested with tuberculin by a person approved by the Chief of the Cattle Bureau, either prior to shipment or after arrival at destination, unless permission to omit the test is given by the Chief of the Bureau, for some good reason. Cattle brought to the quarantine stations at Watertown, Brighton and Somerville, upon which a test is required, will be held and tested by the agent of the Cattle Bureau in charge of these stations, free of expense to citizens of Massachusetts; a fee sufficient to cover the cost will be charged other persons. Cattle upon which a test is required, coming to points outside the limits of the quarantine stations, will be tested by an agent of the Cattle Bureau, free of expense to citizens of Massachusetts, and at the expense of other persons, unless accompanied by a certificate of test satisfactory to the Chief of the Cattle Bureau. All such cattle are to be held in quarantine at the expense of the owner, until released by order of the Chief of the Cattle Bureau. Cattle returning from out-of-the-State pastures will not be required to have a

test if they have not been out of the State over six months. Animals under control of the United States Bureau of Animal Industry, Department of Agriculture, intended for export, are not included in this order. Animals believed to be diseased will be killed.

6. Any person violating the provisions of this order will be punished as provided in section 29 of chapter 90 of the Revised Laws.

7. Inspectors of animals throughout the Commonwealth shall publish this order by posting a printed copy of the same in at least three public places within the limits of their respective cities or towns.

This order shall take effect upon its approval.

AUSTIN PETERS,
Chief of Cattle Bureau.

Approved in Council, July 15, 1903.
E. F. HAMLIN,
Executive Secretary.

Since the date of the above order but one outbreak of this disease has occurred, and that was found to be entirely separate and distinct from the outbreak of the preceding winter, and its occurrence may serve to shed some light upon the possible manner in which foot and mouth disease was originally imported into the country. This last outbreak occurred in Wakefield in August, a full account of which will be given later in this report. Before doing so, however, it seems best to give some of the details of further measures taken for the suppression of the disease since Jan. 1, 1903, all of the steps taken up to that date being described in the second semiannual report of the Chief of the Cattle Bureau to the State Board of Agriculture.

January 1 the following notice was sent to owners of animals quarantined because of foot and mouth disease, copies also being sent to inspectors of animals in towns where it existed, to post in public places: —

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, Jan. 1, 1903.

NOTICE.

[To be distributed among owners who have had cattle quarantined on account of foot and mouth disease, and to be posted in public places.]

The attention of cattle owners and other interested persons is called to the fact that the quarantine of premises infected with foot and mouth disease is not confined to cattle, sheep and swine alone, but includes such materials as hay, straw, grain, manure, grain bags and utensils. Where the animals are killed by the United States Bureau of Animal Industry, it does not imply that the material is released from quarantine until the premises have been properly disinfected and the owner has permission from the Chief of the Cattle Bureau of the State Board of Agriculture to remove any materials from the building.

Grain men are forbidden to remove grain bags from premises where the disease exists, until the same have been properly disinfected.

As the killing of cattle on some farms will probably cause the farm hands to seek employment in other places in some instances, all cattle owners in infected localities are advised of the danger of hiring men who have been working on infected premises, unless proper disinfecting measures have been taken. All overalls, jumpers and other outside garments that can be washed should be washed in hot water containing five per cent of crude carbolic acid. Rubbers and rubber boots should be washed off with the same solution. Old boots and hats, and old woolen clothes and the like, that cannot be properly disinfected, should be burned, and not taken onto any person's farm that is free from disease. The men should also be made to thoroughly wash their hands with soap and warm water, trim and clean the finger nails, and then rinse their hands thoroughly with a five per cent solution of crude carbolic acid in water. If the men take proper precautions in going from one place to another, there will be no danger in carrying the disease in this way; but if these precautions are not taken, the danger exists.

Cattle owners are also advised, as a further preventive measure, to prohibit the trespassing of persons from other farms upon their premises, especially butchers travelling from place to place in search of beef cows and veal calves. The latter class of men are especially dangerous, and their access to premises should be forbidden by owners in every instance.

AUSTIN PETERS,
Chief of Cattle Bureau.

Soon after it became apparent that rules and regulations were necessary as to the use of buildings and their contents, as the animals that were not killed recovered, or where they were killed and the premises were disinfected by the disinfecting corps of the United States Bureau of Animal Industry, or similar squads organized by the Chief of the Cattle

Bureau of the State Board of Agriculture. Accordingly the following notice was sent to owners or occupants of premises where foot and mouth disease existed: —

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, Jan. 7, 1903.

To All Persons whom it may concern.

By virtue of the power and authority vested by law in the Cattle Bureau of the State Board of Agriculture, under the provisions of chapter 90 of the Revised Laws, and chapter 116 of the Acts of 1902, and in accordance with an order approved by the Governor and Honorable Council Dec. 1, 1902, giving the Chief of the Cattle Bureau the authority to make necessary rules and regulations for the eradication of foot and mouth disease, it is hereby ordered: —

1. That barns, stables, piggeries and pens where cattle have been killed because of foot and mouth disease shall not have any new cattle, sheep, other ruminants or swine placed in them until six weeks after the animals have been killed, and not until the premises have been disinfected, and permission so to do has been obtained from the Chief of the Cattle Bureau.

On premises where infected animals have recovered and have not been killed, no new cattle, sheep, other ruminants or swine shall be introduced until six weeks after the premises have been disinfected; and no cattle, sheep, other ruminants or swine shall be removed from such premises until sixty days after the premises have been disinfected, and permission has been obtained from the Chief of the Cattle Bureau to do so.

2. No hay, straw, forage, grain, utensils or other material, except manure, shall be removed from premises where animals which have had foot and mouth disease have been in quarantine until sixty days after the premises have been disinfected, and not then until permission has been obtained from the Chief of the Cattle Bureau to do so.

3. Manure from cattle, sheep, other ruminants or swine which have been infected with foot and mouth disease is to be piled in a compact heap and then covered to a depth of two feet with horse manure, or, if horse manure is not available, the surface of the heap is to be liberally mixed with chloride of lime. After two weeks the manure can then be removed with safety, and it is not to be removed until this length of time has elapsed.

It is recommended that, where the animals have not been killed, the hay, forage and grain in the buildings be fed to the animals remaining upon the place.

It is advised that, when the owners purchase new stock to replace animals destroyed, only a few animals be purchased at first, and kept under observation two weeks; if at the expiration of that time they remain healthy, additional live stock may be added. If foot and mouth disease appears among new animals placed upon premises where the disease has existed, the Chief of the Cattle Bureau is to be immediately notified.

Failure to comply with these directions renders the violator liable to the penalties provided for by law under sections 11 and 29 of chapter 90 of the Revised Laws.

AUSTIN PETERS,
Chief of the Cattle Bureau.

How admirably these regulations worked is seen by the results. There has not been a single recurrence of the disease on any premises or any adjoining premises, as a consequence of stocking up again with new animals, moving manure or selling hay, with but one possible exception. This exception was the two yoke of oxen in Quincy killed last spring, which were kept near a place where the cattle were killed during the winter. These oxen were accustomed to drink at a little brook at a point a short distance below where it ran through the barnyard of the premises where the cattle were killed; and when the frost was coming out, and the owner was given permission to move out the manure, the brook seems to have become contaminated and the oxen were infected. The owner of the premises where the cattle had been previously killed was directed not to haul out any more manure to any distance from the buildings, but to pile it near by and compost it with lime and chloride of lime, and to let it remain some weeks longer. This was done, with the result that when it was taken away later no further trouble followed. This work was paid for by the State. In two instances owners of premises that had been infected bought oxen to do the spring work, with no untoward results.

Later in the winter, as the infected area became more clearly defined, it was decided to issue an order making a portion of the State a quarantined district. This was seen to be necessary, as it was found that manure was shipped to points outside, and also that it was the practice among grain dealers in infected towns to send empty grain bags to wholesale grain men at distant points, and when these bags were refilled they might be sent to other points, and possibly carry the disease to some new locality. It does not seem at all unlikely that foot and mouth disease was carried in grain bags from a dealer's in Fitchburg to Foxborough; and the owner of the herd in Foxborough was on the point of sending these bags away at the time his herd was quarantined and killed, and, if an agent of the Cattle Bureau had not taken possession of them and burned them in the nick of time, further spread of the disease might have resulted.

The following order was approved by the Governor and Council February 18: —

CATTLE BUREAU ORDER, No. 8.

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, Feb. 17, 1903.

To Transportation Companies and All Persons whom it may concern.

By virtue of the power and authority vested by law in the Cattle Bureau of the State Board of Agriculture, under the provisions of chapter 90 of the Revised Laws and chapter 116 of the Acts of 1902, you are hereby notified that foot and mouth disease, which is a contagious disease and is so recognized by the laws of the Commonwealth, exists to an alarming extent among cattle, sheep and swine in some sections of this State.

You are hereby further notified that in order to prevent its spread this Bureau has issued the following order, to continue until revoked: —

1. No neat cattle, sheep, other ruminants or swine are to be shipped, transported or driven into or across that portion of the State bounded on the west and north by North Attleborough, Foxborough, Norfolk, Medfield, Sherborn, Framingham, Southborough, Westborough, Marlborough, Sudbury, Stow, Boxborough, Littleton, Westford, Chelmsford, Billerica, Burlington, Lexington, Arlington, Medford, Malden and Revere, and on the east and south by Quincy, Braintree, Randolph, Stoughton, Sharon, Mansfield and North Attleborough, and including the territory covered by the above-named towns, without a permit from the Chief of the Cattle Bureau.

2. No hay, grain bags or manure are to be removed from the above territory without a permit from the Chief of the Cattle Bureau.

Nothing in this order modifies the existing quarantine rules and regulations in force in towns at present declared by the Chief of the Cattle Bureau to be infected.

The only exception to the above order is that cattle, sheep, other ruminants and swine, intended for immediate slaughter, may be conveyed by rail to the following points from without the infected area: the Watertown Stock Yards, the Brighton Abattoir, the New England Dressed Meat and Wool Company, the slaughter house of Austin Davis at Concord Junction, the Boston Packing and Provision Company, the J. P. Squire Company and the North Packing and Provision Company.

Persons disobeying orders issued by the Chief of the Cattle Bureau and approved by the Governor and Council are subject to a penalty as provided in section 29 of chapter 90 of the Revised Laws; that is, a fine not exceeding $500, or imprisonment for not more than one year. This applies not only to this order, but to all previous orders issued for the eradication of foot and mouth disease.

This order shall take effect upon its approval.

AUSTIN PETERS,
Chief of Cattle Bureau.

Approved in Council, Feb. 18, 1903.
E. F. HAMLIN,
Executive Secretary.

This order was faulty because the word "from" was inadvertently omitted in paragraph 1, where it says, "No neat cattle, sheep, other ruminants or swine are to be driven into or across" the quarantined district. This was amended by another order, approved by the Governor and Council March 18, inserting the word "from" between "driven" and "into." Practically this omission made no difference, as the towns surrounding the quarantined district were all posted, and persons were already forbidden to move cattle, sheep or swine on the highways without a permit, or to turn them on any unfenced land.

The order establishing a quarantine district did not include all the towns where the disease had existed, but it seemed to be sufficient, as it made a line running from the boundary of Rhode Island to Quincy Bay on one side, and on the other it extended from the Rhode Island boundary almost to New Hampshire. While cases had occurred in Attleborough, Bridgewater, West Bridgewater, Grafton, Barre, Harvard, Methuen, Andover, North Andover and Danvers, these were early in the outbreak, and keeping these towns posted until all danger was past seemed to be sufficient.

At this time it was believed that pet animals, such as cats and dogs, might carry the disease from place to place, and possibly in some instances they did; also that some persons who had had disease on their premises were careless in going to neighbors in the same clothing and boots that they wore around their own barns. An order was therefore approved February 18, giving the Chief of the Cattle Bureau authority to have small animals destroyed if they were not kept under proper restraint by their owners, and also to forbid certain persons entering their neighbors' premises; but happily it was not necessary to take any action under this order, as there were very few new cases discovered after its approval, and the authority it conferred seemed to have sufficient moral effect. The following is a copy of the order: —

CATTLE BUREAU ORDER, NO. 7.

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, Feb. 17, 1903.

To All Persons whom it may concern.

By virtue of the power and authority vested by law in the Cattle Bureau of the State Board of Agriculture, under the provisions of chapter 90 of the Revised Laws and chapter 116 of the Acts of 1902, you are hereby notified that foot and mouth disease, which is a contagious disease and is so recognized by the laws of the Commonwealth, exists to an alarming extent among cattle, sheep and swine in some sections of this State.

You are hereby further notified that in order to prevent its spread this Bureau has issued the following order: —

1. In localities where foot and mouth disease exists, the Chief of the Cattle Bureau may cause dogs, cats or other small animals running at large to be destroyed, if their owners refuse or neglect to place them under proper restraint after being requested to do so by the Chief of the Cattle Bureau or its authorized agents.

2. Owners or lessees of premises and the employees where animals have been that were infected with foot and mouth disease are hereby forbidden to enter upon premises where neat cattle, sheep, other ruminants or swine are kept, until the infected premises and the boots and clothing of the above-mentioned persons have been properly disinfected, and it is declared safe by the Chief of the Cattle Bureau or its agents for them to enter places where uninfected animals are kept.

Persons disobeying this order are subject to the penalties provided in section 29 of chapter 90 of the Revised Laws.

This order takes effect upon its approval.

AUSTIN PETERS,
Chief of Cattle Bureau.

Approved in Council, Feb. 18, 1903.
E. F. HAMLIN,
Executive Secretary.

Toward the end of April foot and mouth disease had so nearly disappeared that it was feared that inspectors and agents, as well as transportation companies, would become lax in the enforcement of the order of February 18, as amended March 18, establishing a quarantine district; therefore, under date of April 25 a notice was sent them, including a copy of the order, stating that it was still in force, and that its provisions must continue to be complied with.

Early in May two herds were found in Framingham, by agents of the United States Bureau of Animal Industry, which were believed to be infected with foot and mouth disease; and it was thought best to issue another order relating to the quarantine district, so as to include Millis and Ashland, and also to modify section 2 so that baled hay and baled straw could be sent to points outside, and also to include other animal products not mentioned in the earlier orders. For this purpose the following order was approved May 13: —

CATTLE BUREAU ORDER, No. 9.

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, May 13, 1903.

To Transportation Companies and All Persons whom it may concern.

By virtue of the power and authority vested by law in the Cattle Bureau of the State Board of Agriculture, under the provisions of chapter 90 of the Revised Laws and chapter 116 of the Acts of 1902, you are hereby notified that foot and mouth disease, which is a contagious disease and is so recognized by the laws of the Commonwealth, has existed to an alarming extent among cattle, sheep and swine in some sections of this State.

You are hereby further notified that in order to prevent its spread this Bureau has issued the following order, to continue until revoked: —

1. That portion of the State bounded on the west and north by North Attleborough, Foxborough, Norfolk, Millis, Sherborn, Ashland, Southborough, Westborough, Marlborough, Sudbury, Stow, Boxborough, Littleton, Westford, Chelmsford, Billerica, Burlington, Lexington, Arlington, Medford, Malden and Revere, and on the east and south by Quincy, Braintree, Randolph, Stoughton, Sharon, Mansfield and North Attleborough, and including the territory covered by the above-named towns, is hereby declared to be a quarantined district, and no neat cattle, sheep, other ruminants or swine are to be shipped, transported or driven from, into or across said district without a permit from the Chief of the Cattle Bureau.

2. No hay or straw (excepting baled hay and baled straw originally brought in from without the quarantined district), grain bags, cattle hides, calf skins, horns, hoofs, bones or manure are to be removed from the above territory without a permit from the Chief of the Cattle Bureau.

Nothing in this order modifies the existing quarantine rules and regulations in force in towns at present declared by the Chief of the Cattle Bureau to be infected.

The only exception to the above order is that cattle, sheep, other ruminants and swine, intended for immediate slaughter, may be conveyed by rail to the following points from without the infected area: the Watertown Stock Yards, the Brighton Abattoir, the New England Dressed Meat and Wool Company, the slaughter house of Austin Davis at Concord Junction, the Boston Packing and Provision Company, the J. P. Squire Company and the North Packing and Provision Company.

Persons disobeying orders issued by the Chief of the Cattle Bureau and approved by the Governor and Council are subject to a penalty as provided in section 29 of chapter 90 of the Revised Laws; that is, a fine not exceeding $500, or imprisonment for not more than one year This applies not only to this order, but to all previous orders issued for the eradication of foot and mouth disease.

Inspectors of animals in cities and towns within the limits of, and abutting upon, the quarantined district shall publish this order by posting a printed copy of the same in at least three public places within the limits of their respective cities or towns.

This order shall take effect upon its approval.

AUSTIN PETERS,
Chief of Cattle Bureau.

Approved in Council, May 13, 1903.
E. F. HAMLIN,
Executive Secretary.

At the same time the following order was approved, removing the quarantine of Massachusetts against Rhode Island, because the United States Secretary of Agriculture had declared the latter State to be free from foot and mouth disease: —

CATTLE BUREAU ORDER, NO. 10.

COMMONWEALTH OF MASSACHUSETTS,
CATTLE BUREAU OF THE STATE BOARD OF AGRICULTURE,
STATE HOUSE, BOSTON, May 13, 1903.

To Transportation Companies and All Persons whom it may concern.

By virtue of the power and authority vested by law in the Cattle Bureau of the State Board of Agriculture, under the provisions of chapter 90 of the Revised Laws and chapter 116 of the Acts of 1902, you are hereby notified that the order of the Cattle Bureau of the Massachusetts State Board of Agriculture, approved Nov. 19, 1902, forbidding bringing neat cattle, sheep or swine from Rhode Island into Massachusetts, because of the prevalence of foot and mouth disease, is hereby revoked, as the Secretary of the United States Department of Agriculture has declared the State of Rhode Island to be free from foot and mouth disease.

Persons can bring such animals into Massachusetts, subject to the regulations of the Cattle Bureau; that is, persons wishing to bring neat cattle into Massachusetts must obtain a permit from the Chief of the Cattle Bureau before doing so. All neat cattle brought from Rhode Island into Massachusetts are subject to the tuberculin test, excepting calves under six months old or beeves for immediate slaughter.

Inspectors of animals throughout the Commonwealth shall publish this order by posting a printed copy thereof in one or more public places within the limits of their respective cities or towns.

This order shall take effect upon its approval.

AUSTIN PETERS,
Chief of Cattle Bureau.

Approved in Council, May 13, 1903.
E. F. HAMLIN,
Executive Secretary.

These two orders of May 13 were the last found necessary in connection with foot and mouth disease, until the final order of July 15, 1903, was issued, stating that the disease had been stamped out, and that no further restrictions were necessary on account thereof.

Friday morning, March 6, Mr. C. A. Dennen, the agent of the Cattle Bureau in charge of the stock yards at Brighton, Watertown and Somerville, telephoned the Chief of the Cattle Bureau that some cheap beef cattle had just arrived from Bedford, N. H., which appeared to be ailing, and that he was holding them in the pen into which they had been unloaded at the Watertown yards, and he had also forbidden moving the car from the siding on which it stood, and asking the Chief to come over as soon as possible. Mr. Dennen was instructed to telephone Dr. Bunker of Newton to come at once, and the Chief also drove over immediately.

The cattle consisted of a lot of eight cows, a yoke of steers and a bull, shipped by E. R. French of Bedford, N. H., and consigned to J. J. Kelly at the Brighton Abattoir. Several of the animals upon examination showed evidences of having had foot and mouth disease recently, some of the cases were evidently of not over two weeks' standing, and some may have dated back a month.

The United States authorities were notified at once, and the animals were immediately killed in the pen where they were and removed by a renderer, and the pen, as well as the car in which they came, disinfected by the officials of the United States Bureau of Animal Industry.

The following day an order was issued by the United States Secretary of Agriculture, declaring New Hampshire to be quarantined, and forbidding the transportation of any neat cattle, sheep, other ruminants or swine from or across that State.

An investigation by the officials of the United States Bureau of Animal Industry showed a somewhat extensive outbreak of foot and mouth disease in the towns of Bedford, New Boston, Weare, Henniker, Dunbarton, Goffstown, Hookset, Hemstead and the city of Manchester, which had evidently been in existence for some months. Early in the winter foot and mouth disease had been found in three or four herds in Salem, Hudson and Hancock, N. H., but these had been killed and the buildings disinfected, and the State was supposed to be free from the disease: and permits had been given by the Chief of the Cattle Bureau to bring cattle from New Hampshire into Massachusetts, little thinking that such a hotbed of the malady existed there.

If it had not been for the prompt action taken by the agent of the Cattle Bureau of the Massachusetts State Board of Agriculture at the Watertown yards, this outbreak might have continued for some time longer before being discovered, and assumed much larger proportions before the attention of the United States authorities was called to it.

By the last of December, 1902, or first of January, 1903, most of the herds where foot and mouth disease was present had been discovered and quarantined, and were killed by the agents of the United States Bureau of Animal Industry; and the buildings where the animals were killed, or were allowed to remain because they had recovered, were being disinfected as rapidly as possible by the disinfecting squads of the Bureau of Animal Industry: but there was so much of this work to be done that it was decided that it would expedite matters and lessen the danger of the spread of the disease if the work were supplemented by having some of the buildings disinfected by the Cattle Bureau of the State Board of Agriculture. Disinfecting squads were therefore organized in five different localities, each squad being in charge of a veterinarian, and consisting of three or four men, with a large tree-spraying force pump and hose, and a supply of lime and disinfectants. This work was continued through January and well into February, when so few new herds having the disease were discovered that it was possible for the United States authorities to immediately disinfect buildings as soon as the animals in them were slaughtered, when this work was relinquished by the Cattle Bureau's agents, except that in March some work was done by the State in disinfecting the large stock barn at Brighton and the premises of the New England Dressed Meat and Wool Company at Somerville. The yards at Brighton and Watertown were disinfected by the disinfecting corps of the United States Bureau of Animal Industry.

In Chelsea, Everett and that part of Revere where the original outbreak occurred, all the premises where cattle were kept were disinfected, as a large proportion of the population were foreigners, and it was impossible to be sure where the disease had, or had not, existed.

After the disinfection work was completed, the sections of the State where foot and mouth disease had prevailed were divided into districts, and an agent of the Cattle Bureau was placed in charge of each, to see that there was no recurrence of the trouble on any of the premises where it had prevailed, and to enforce rules and regulations of the Cattle Bureau relative to driving or transporting cattle, sheep or swine in posted towns, or moving them in or out of the quarantined portion of the State. This work was continued until the order of July 15 went into effect, removing all the restrictions.

While the moving of all cattle, sheep or swine was prohibited in posted towns, or from, into or across the quarantined district, without a permit from the Chief of the Cattle Bureau, it was found to be impossible to absolutely prevent the moving of these animals in all instances without causing great inconvenience or even hardship, and it became necessary to have a form of permit printed giving persons permission to move animals and merchandise where it was safe to do so. At first all permits were signed by the Chief of the Cattle Bureau, and issued to agents to use at their discretion, in book form, with a stub to fill out, showing what the permits were given for, the stubs to be returned to the office when the book was used up. Later, the books were issued with the Chief's name printed on each permit, to be countersigned by the agent granting the permit. A few of the more reliable inspectors of animals in certain towns were also supplied with these books. Permits had to be given for moving cattle, swine and sheep, as well as for shipping manure, grain bags, hides, etc. The total number of these permits issued for various purposes during the continuance of the restrictions was about 12,000. In towns where there was any danger of a further spread of foot and mouth disease, permits for moving animals required them to be carried on a sled or wagon. Never in the history of Massachusetts have so many cattle enjoyed wagon or sleigh rides as they did during the winter of 1902 and 1903, and it is to be hoped that no such necessity for their doing so will ever occur again.

After the order of February 18 went into effect, forbidding the removal of grain bags from the quarantined district, it was found necessary to disinfect them before granting permits for such removal. Bags were shipped by grain dealers to Providence, Hartford, North Wilbraham, Fitchburg, and even to Buffalo, and it can readily be seen how dangerous this was unless the bags were disinfected.

Accordingly, about the first of March the services of Mr. Willard E. Ward, of the Ward Apparatus Company of Brookline, were secured to fumigate with formaldehyde gas all grain bags and bagging for persons who wished to ship them out of the quarantined district.

From March 1 until the necessity for doing so no longer required it Mr. Ward disinfected between 82,000 and 84,000 grain bags, a number of tons of mixed rags and bagging, and 3,300 pounds of bagging. In addition, several hundred pounds of old bags and bagging were bought from their owners and burned, as too dirty and valueless to be worth the expense of disinfecting.

After the rules and regulations in posted towns had been in force two or three months, some cattle owners and drovers found the restrictions irksome, and, as the disease seemed to be subsiding, thought no further danger existed, and commenced moving cattle without resorting to the formality of obtaining permits. In order to enforce these regulations, it was found necessary to make an example of some of these delinquents, and several were summoned into court in Waltham, Dedham and Quincy. In Quincy a cattle trader pleaded *nolo contendere*, and his case was placed on file. In Waltham, in March, two farmers from Weston and a cow dealer from Watertown were summoned before the district court, and were fined $25 each for driving cattle in posted towns without a permit. The scene of operations was then transferred to the district court in Dedham, and two cow dealers were fined $20 each for driving cattle on the streets of Wellesley; and a calf collector from Needham was fined a similar sum for removing a calf from a farmer's premises without a permit. This had a salutary effect on the rest of the uneasy ones, and no further trouble in this direction worthy of mention was experienced.

In May there arose another difficulty to be encountered, namely, the necessity for sending young stock out of the quarantined district to pasture for the summer. In parts of the quarantined district the farmers can winter more stock than they can summer. This condition prevails particularly in Lincoln, Concord, Lexington, Acton, Littleton and several of the adjacent towns. Many of the farmers send large numbers of cattle to southern New Hampshire every summer, others have pastures in Ashby, Ashburnham, Westminster, Rutland, Princeton and Hubbardston, and when turning-out time came they were very desirous of sending their animals away for the season.

The situation was finally relieved by the United States Secretary of Agriculture issuing an order providing that cattle could be sent to New Hampshire to pasture, subject to the rules and regulations of the New Hampshire Cattle Commission, the cattle to be inspected before shipment by an agent of the Bureau of Animal Industry, and carried by train to the nearest point to the pasture in New Hampshire, and driven the remaining distance.

In this State a similar arrangement was made for those who had pastures in Worcester County. Their cattle were examined by an agent of the Cattle Bureau of the State Board of Agriculture, and then carred to the nearest point to their destination. If the quarantine had been in force in the autumn, it would have been necessary to inspect the cattle and give permits to bring them home again, but the removal of the quarantine regulations did away with the necessity for this.

When Vermont, New Hampshire and Massachusetts were under quarantine by the order of the United States Secretary of Agriculture, it was found that there were many farms on the boundary line which were partly in one State and partly in another, and owners of these farms could not legally drive cattle from one part of their farms to another. This difficulty was remedied by the United States Department of

Agriculture giving a permit to owners to do so, after the application had been approved by the Cattle Commission in an adjoining State and by the Chief of the Cattle Bureau of the Massachusetts State Board of Agriculture.

Late in the winter or early in the spring, after the known cases of foot and mouth disease had been reported, agents of the United States Bureau of Animal Industry made a house-to-house inspection in all the towns where foot and mouth disease had been found, and the adjacent towns, and in some instances went over several towns a second and third time. This work was supplemented by agents of the Massachusetts Cattle Bureau, who conducted a similar inspection in May and June, in towns not already covered by agents of the United States Government.

Agents of the United States Bureau of Animal Industry in this way found two infected herds in Lincoln, in March; two yoke of oxen in Quincy, one cow in Braintree and a small herd in Wayland, in April; and two herds supposed to be infected in Framingham, in May, that were not previously reported. All of these animals were killed and the premises disinfected.

In an outbreak of this kind, considering the unfamiliarity of our farmers with this disease, it is not surprising that a few herds should have been discovered in this way. With the few exceptions mentioned above, the cases were promptly discovered, promptly quarantined under the State authority, and immediately reported to the Chief of the United States Bureau of Animal Industry or its agent. In the cases mentioned, the oxen in Quincy were just developing the disease, and it is doubtful if the owners in two or three of the other cases had any realization of what ailed their cattle.

When Brighton market was re-opened, two veterinarians were detailed to examine the local cattle brought there, as well as any from New Hampshire and Vermont, to be sure that no undiscovered cases were introduced there to endanger the health of the animals. These were in addition to the regular agent and his assistants who test with tuberculin all out-of-the-State cattle. Later, as there seemed to be little or no danger, but one of these veterinarians has been present Tuesdays and Wednesdays: this precaution is still continued. During the cattle show season an agent of the Cattle Bureau attended all the exhibitions of the agricultural societies in or near the localities where the disease existed last winter, but there has been no indication of any reappearance of the trouble.

Chapter 83, Acts and Resolves of 1903, provides as follows:—

RESOLVE TO PROVIDE FOR COMPENSATING OWNERS OF ANIMALS KILLED IN EXTERMINATING THE FOOT AND MOUTH DISEASE.

Resolved, That there be allowed and paid out of the treasury of the Commonwealth, under the direction of the chief of the cattle bureau of the state board of agriculture, to the owners of animals in this Commonwealth that were slaughtered previous to April eleven in the current year, by order of the state authority, for the purpose of exterminating the disease known as the foot and mouth disease, in addition to the amount paid by the United States, a sum equal to the difference between the amount already paid and the value of such cattle, as appraised by the agents of the United States. For this purpose there may be expended from the treasury of the Commonwealth a sum not exceeding forty thousand dollars. [*Approved May 26, 1903.*

Under the provisions of the above resolve, $38,244.98 has been expended. Five owners whose cattle were killed received nothing from the State because they signed an agreement stating that they accepted a certain lump sum from the United States government as the full value of their animals; and the Concord Reformatory made no claim, as the Legislature appropriated a sum of money with which to purchase a new herd for the institution.

The following statement shows the appraisals made upon animals killed, with the names of persons who have no claims either on all or part of their animals, the names of those who had cattle killed since April 11, 1902, and the valuation placed upon them; also the total appraisal upon animals paid for by the United States government on a basis of 70 per cent, upon which the State of Massachusetts has paid the other 30 per cent.

Appraisal.

Appraisal in cases on which full value was paid: —		
Anderson & Christofson (no claim),	$300 00	
Murray Brown (no claim),	500 00	
A. A. Hutchinson (no claim),	125 00	
John L. Pingry (no claim),	1,020 00	
M. Henry Worden (no claim),	95 00	
W. E. Hayden (calves and pigs; no claim),	25 00	
E. Paignon, Jr. (pigs; no claim),	28 00	
		$2,093 00
Appraisal on animals killed after April 11: —		
Edward DeYoung,	$40 00	
Joseph A. Merriam,	270 00	
F. I. Ordway,	602 00	
William Wheeler,	165 00	
E. A. Morrell,	430 00	
George R. Tyzzer,	218 00	
		1,725 00
Appraisal on animals owned by the Massachusetts Reformatory, on which no claim will be made,		2,504 50
Appraisal on herd belonging to E. R. French, a New Hampshire man, slaughtered in Watertown en route to Brighton Abattoir from New Hampshire,		450 00
		$6,772 50
Appraisal on animals on which 30 per cent has already been paid by the State of Massachusetts,		127,483 28
Total appraisal on all animals slaughtered in Massachusetts,		$134,255 78

The sum of $9,699.40 has been paid from the appropriation of the Cattle Bureau for the extermination of contagious diseases among horses and other animals to 115 owners of cattle which had been in quarantine over ten days before being killed, or where the animals recovered and were released from quarantine, as owners of infected herds were not allowed to sell any milk while there was any danger to the public health by so doing.

The provisions of the law requiring this expenditure are found in section 21 of chapter 90 of the Revised Laws, which reads as follows: —

SECTION 21. If animals have been quarantined, collected or isolated upon the premises of the owner or of the person in possession of them at the time such quarantine is imposed, the expense thereof shall be paid by such owner or person; but if specific animals have been quarantined or isolated under the provisions of section five or section nineteen for more than ten days upon such premises, as suspected of being affected with a contagious disease, and the owner is forbidden to sell any of the product thereof for food, or if animals have been quarantined, collected or isolated on any premises other than those of such owner or person in possession thereof, the expense of such quarantine shall be paid by the Commonwealth.

Towards spring it was found that the winter's storms had caused many of the posters printed on heavy cardboard to fall down or blow away, and some may have been torn down by malicious persons. In instances where it was necessary to replace these notices with new ones they were printed on cloth, which was found to be much more durable. In a similar experience all posters intended to be put up out of doors should be printed on cloth in the first place.

The Wakefield Outbreak.

The outbreak of foot and mouth disease at Wakefield in August deserves separate mention, because upon investigation it was found to be distinct from the one of the previous winter, and its source may throw some light upon the cause of the original outbreak, which started in the neighborhood where the lines of Chelsea, Everett and Revere converge, known as Prattsville, as long ago as July or August of 1902.

The outbreak in Wakefield occurred at the farm of Mr. George R. Tyzzer. The disease appeared in one of his cows Friday, August 21. By Sunday, August 23, the herd, consisting of four cows and a calf, showed unmistakable symptoms of foot and mouth disease, and was appraised and destroyed by agents of the United States Bureau of Animal Industry.

This outbreak resulted from some experiments being made at the farm by Mr. Tyzzer's son, Dr. E. E. Tyzzer, assistant in pathology at the Harvard Medical School, upon some calves obtained from various sources in an investigation of vaccine virus. Dr. Tyzzer has kindly made a report of his observations and further experiments tried at the expense of the United States Department of Agriculture, which were undertaken to ascertain the correctness of the view that the disease could be carried by contaminated vaccine virus, and which fully proved the correctness of this supposition. Dr. Tyzzer's report will have to be considered in two parts; the first relating to the experiments at his father's farm, and the consequences; the second giving the experiments tried at the Newcomb estate, in Wakefield, which was hired by the United States Department of Agriculture for this object, and where experimental animals bought for the purpose at Brighton and Somerville were taken. The Newcomb estate is a place near Wakefield Junction, where the house had been burned, upon which there was a small stable where no cattle had been kept for a long time, and which, from its isolation, seemed suitable. The experiments at the Newcomb estate were carried on by the United States Bureau of Animal Industry in conjunction with the Cattle Bureau of the State Board of Agriculture, and with Dr. Tyzzer's assistance, who repeated the experiments with vaccine virus exactly as he had conducted them at his father's farm.

REPORT OF DR. ERNEST E. TYZZER.

Part I. — Experiments preceding the Outbreak of Foot and Mouth Disease in Wakefield.

In the following brief account it is intended to cover the essential facts regarding the experiments which preceded the appearance of foot and mouth disease among the cows of G. R. Tyzzer of Wakefield, Mass., on the 21st of August, 1903.

Being engaged in the study of vaccine with reference to its pathology, I purchased a number of calves and kept them in a portion of my father's (G. R. Tyzzer) barn. Vaccine lesions at various stages of development were desired. It was intended in these experiments to vaccinate the calves at various points on the surface of the body, and to kill them at different intervals of time after vaccination, in order to obtain the lesions. An account of each experiment will be given below.

The ordinary commercial vaccine lymph was not used for these inoculations, as a very fresh and active virus was desired. The virus used was obtained of a vaccine establishment, and was sent sealed in a glass tube. This seal was broken and a portion of the virus was drained into a sterile test tube and plugged with sterile cotton. This portion was used in all the subsequent experiments. Nothing was introduced into this except a sterile glass pipette, and the technique ordinarily employed with pure cultures of bacteria was always observed in handling this tube of virus. Except at times when it was being used for the inoculations, this virus was kept in a refrigerator.

The experiments may be outlined as follows: —

Calf No. 1. — Procured July 21, of Mr. Hone of North Saugus. Vaccinated July 31. Sickened and died August 4. Death, fourteen days after purchase.

Calf No. 2. — Procured July 23, of the Town Farm, Wakefield. Vaccinated July 31. Sickened and died August 5. Death, thirteen days after purchase.

Calf No. 3. — Procured July 23, of Mr. Jesse Edmunds, Wakefield. Vaccinated July 31. Sickened and died August 5. Death, thirteen days after purchase.

The above three calves were fed on fresh milk and boiled Blatchford's food from the time of purchase to the time of death. Some of the milk was procured from a neighboring farm, the rest from G. R. Tyzzer. They were all vaccinated on July 31, four or five days before their death. Animals recovered from the anæsthesia, and the vaccine lesions were developing in all cases. From the time of their purchase up to twenty-four hours before their death the calves seemed to be doing well and thriving.

Calf No. 4. — Procured August 4, of G. R. Tyzzer. This calf had been kept in stable below for three days previous to purchase. Was not vaccinated. Sickened and died August 7. Death, three days after purchase, and about six or seven days after birth.

Calf No. 5. — Procured August 4, of Mr. Strong, Wakefield. This calf was not vaccinated. Sickened and died August 9. Death, five days after purchase.

These two calves (Nos. 4 and 5) were fed a larger amount of fresh milk and a smaller amount of Blatchford's meal, and, as has been noted, were not vaccinated. They were, however, kept in the same places as calves Nos. 1, 2 and 3, and were fed from the same pails.

The train of symptoms preceding death was practically identical in all the five calves. In calves Nos. 1, 2 and 3 vaccine lesions developed at the various points inoculated. In calf No. 1 there appeared, on the border of an inoculation made on the edge of the lip, a vesicle of the size of a cherry, distended with clear fluid. This was ruptured by the animal on the day of its appearance. No similar vesicles were observed in calves Nos. 2 and 3.

These five calves ate well and were apparently thriving up to a period of not more than twenty-four hours preceding their death. It was noticed in some of the calves at this time that the mouth felt slimy when the fingers were introduced for feeding. There was no "slobbering" at any time.

Twelve hours before death the animals were less active. Three of the five were off their feed, and could only be roused up with considerable difficulty. Following this the calves were unable to stand. There was labored respiration for several hours before death, and the animals became progressively weaker and finally insensible. In each case death took place in about twelve hours after the animal showed marked symptoms, *i.e.*, loss of appetite or weakness. There was no marked diarrhœa.

Pathological Findings.

There was slight hypostatic congestion of the lungs in two calves, and in one of these there was about 400 cc. of fluid in the pleural cavity. This process in the lung may have possibly been produced by the passage into the lungs of medicine, administered while the calf was comatose.

The spleens were not enlarged, and appeared pale when sectioned. The intestines were examined in all cases, and no lesions found.

The tongues were examined in all cases. In three calves, Nos. 1, 4 and 5, there were opaque patches on the upper surface of the tongue, varying from 5 mm. to 3 cm. in diameter. The epithelium here was soft, slightly swollen, and scraped off leaving a rough but not a raw surface. These lesions were much more prominent during life. In no case did these lesions appear vesicular, or contain fluid. Microscopically, the lesions were found to be limited chiefly to the epithelium, which had become necrotic over a sharply limited area. The necrosis had extended through all the layers in certain portions of the lesion. The cells were separated by a fibrino-purulent exudate. The feet were examined, and there were no vesicles present.

In summary of the above experiments, it is to be observed that all five calves presented a similarity of symptoms very suggestive of a single disease. The date of death bears no relation to the date of purchase.

Calf No. 1 died four days after being vaccinated, and calves Nos. 2 and 3 died five days after vaccination.

Calf No. 4 died three days after being placed where the others had died, but had been in the stable below for several days.

Calf No. 5 died five days after introduction into the place occupied by the first three calves.

Inasmuch as the disease which was killing these calves presented features not ordinarily met with in vaccinia, and especially on account of the peculiar lesions on the tongue suggesting foot and mouth disease, the cases were reported to Dr. Austin Peters.

The only features suggestive of foot and mouth disease were a few inconspicuous tongue lesions and its seeming infectiousness. Even this infectiousness was doubtful, as the feeding of the calves on a patent meal was more or less experimental. What made the presence of foot and mouth disease seem still more improbable was the failure of the four cows kept in the stable below to contract the disease. During the entire experiments these cows were fed each day from the buckets which were used in feeding the calves. As no disease had appeared among the cows, the presence of foot and mouth disease seemed improbable.

However, on August 21, twelve days after the death of the last calf, one of the cows refused food, and was observed "slobbering." Examination of the mouth showed a ragged ulcer, 4 cm. long, situated on the upper gum. In trying to pull out tongue a large triangular flap was torn from its tip, and the mucous membrane seemed soft and mushy. Seen later in the day, there appeared several elevated areas of mucous membrane on the dorsum of the tongue. Several shallow erosions were present about the edges of the lips. Later on, vesicles developed on the feet. The symptoms seemed characteristic of foot and mouth disease, and the barn was immediately placed under quarantine. On the day following symptoms appeared in the other animals. They were all shot by the United States inspectors August 23.

Part II. — The Experimental Inoculations carried on at the Newcomb Estate.

On account of association of vaccination inoculations with the outbreak of a disease characterized by vesicles of the mouth and feet, it was considered important to investigate the matter at length.

Several cows and calves were obtained by the United States Bureau of Animal Industry, and kept in an isolated barn on the Newcomb estate. Three calves were vaccinated on August 28 on various parts of the body, including the nose and the edge of the lower lip. The same virus was employed as was used in the vaccinations on July 31. The lesions developed in the usual manner, except that on the fourth day a blister-like vesicle developed on the inner border of the vaccine lesion of the lip in all three calves. This was similar in every respect to the lesion observed on the lip of calf No. 1, vaccinated July 31.

One of these vesicles was ruptured, and the fluid was caught on a cloth which was then rubbed in the mouth of cow No. 3. In thirty-six hours there was a rise of temperature, which was followed in forty-eight hours by lesions in the mouth and a vesicular eruption on the udder and teats. Vesicles developed later in the cleft of hoof. The condition of the mouth and feet was identical with that found in G. R. Tyzzer's cows.

The infectiousness of the disease was established by its appearance in the other two cows (Nos. 1 and 2) without their being inoculated.

There seemed after these experiments no question but that the disease originated from the vaccine lymph used in the inoculation. It also seemed probable that in the calves there was, besides vaccinia, a second disease, which became separated in cow No. 3 when inoculated with the fluid of the vesicle which developed on the edge of the lip vaccination of the calf.

Whether or not vaccinia thus presented itself in an unusual form, or whether it was present conjointly with another disease in the case of the cows, was a possibility which it was necessary to consider. To this end lesions were excised from the cows, and a microscopical study made; and lymph collected from the vesicles was used to inoculate rabbits, in order to determine the possible presence of vaccinia. The results of these inoculations and the appearance of the lesions excised are given in the following section: —

Pathological Findings in the Experiments carried on at the Newcomb Estate.

On account of the occurrence of a vesicular eruption on the bags and teats of the cows, which cows subsequently developed vesicles of the feet, the possibility of the co-existence of vaccinia with another disease was provisionally entertained. The gross appearances of the vesicles and pustules on the bag of cow No. 5 were suggestive of cow-pox.

In order to determine the presence or absence of vaccinia in the processes observed, three lines of investigation were followed: —

1. The histological study of the skin lesions.
2. The inoculation of corneas with lymph from various lesions.
3. The vaccination of cows that had recovered from the disease, in order to find out whether the said disease had conferred immunity to vaccinia.

An exhaustive description of the various lesions does not seem desirable in this instance, and will not be attempted. The lesions submitted for examinations may be placed, for the sake of convenience, in three groups, — the mouth lesions, the vesicles of the udders and the pustules of the udders and teats.

Type I: Mouth Lesion. — This appeared during life as a sharply circumscribed opaque area of the mucous membrane, situated on the buccal pad, about 6 mm. in diameter, and slightly elevated. This lesion was associated with several large, ragged ulcerations, situated on various parts of the gum.

This is found to be microscopically an area of necrotic epithelium, the cells of which are dissociated by the exudation present. The lesion is very superficial, involves chiefly the outer three-quarters of the epithelium, and at the periphery is sharply marked off from the surrounding normal epithelium.

The epithelial cells are necrotic, and stain intensely with the diffuse stain. The nuclei may be fragmented and deeply stained, but in general they are very pale, and are in many instances represented by a light spot in the cell. The exudation is purulent or fibrino-purulent in character. The underlying connective tissue contains but few leucocytes. This does not correspond in any essential feature to a vaccine lesion.*

Type II: Vesicles of the Udder and Teats. — These were excised from cow No. 3 the second day after their appearance. One lesion measures about 3 mm. in diameter, and is very superficial. Another in the same specimen has become dry, and is represented by a crust. The third lesion measures 2 cm. in length, the entire epithelium is destroyed, and the dermis is involved for some distance below. The appearances of the necrotic epithelial cells agree in all respects to those of the mouth lesions. The cells are, however, separated by a larger amount of fluid exudate, and either the upper layers of the epidermis or the epidermis as a whole is lifted up to form a vesicle. The vesicles are in all cases filled with sero-fibrinous exudate, containing at this stage many leucocytes and free necrotic epithelial cells. In lesions where the process is more extended, the base of the vesicle is composed of tissue infiltrated with leucocytes, and there is considerable extravasation of blood into the vesicle.

Type III: Pustules and Infected Hair Follicles. — Under this heading are described all those skin lesions obtained from the various cows at the time of autopsy. Most of these consist of

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* Lesions identical in most respects with that just described were found on the tongues of calves which died during the vaccine experiments carried on at the estate of George R. Tyzzer in the early part of August.

pustules of various sizes, which, from their position and character of the necrosis present, may have arisen from vesicles similar to those just described. The lesions from cow No. 5, which were supposed to be cow-pox vesicles, gave no evidence of that disease. Large numbers of cocci are present.

In summary of the above lesions, it is to be noted that they in no instance contain anything typical of the vaccine process. Furthermore, it is impossible that pustules such as were found in case of cow No. 5 could have arisen from vaccine lesions in the time given, and they afford no evidence of that process.

Corneal Inoculations in Rabbits.

Experiment No. 1: Sept. 4, 1903. — Shallow incisions were made in the corneas of two rabbits, and lymph obtained from the foot vesicles of cow No. 3 was rubbed in. Following this inoculation there appeared no gross sign of inflammation, and the cornea became apparently normal. The rabbits were killed three days after inoculation. Microscopical examination showed in each cornea the repair of a simple injury.

Experiment No. 2: Sept. 8, 1903. — The corneas of two rabbits were inoculated with lymph from vesicles on the udders of cow No. 3. There appeared subsequently no inflammation in the eyes of either rabbit. One was killed three days and the other eight days after inoculation. On histological examination, all four corneas were found to be undergoing repair to a simple injury.

Concerning the results of the two experiments just noted, it should be understood that when the rabbit's cornea is inoculated, either with active vaccine lymph or with small-pox virus, a characteristic lesion is produced, which contains large numbers of the vaccine organisms, *Cytoryctes vacciniæ*. Inasmuch as this lesion is very constant, and forms a delicate test for the presence of vaccine virus in every form thus far met with, it seems improbable that either the fluid of the udder vesicles or the fluid of the foot vesicles contained vaccine.

Experiment No. 3: Sept. 18, 1903. — The corneas of calf No 7 were inoculated with material from the vesicles of the bag of cow No. 5. This was followed by inflammation in both eyes. There was considerable opacity and loss of corneal substance. The calf was killed three days after inoculation. Examined histologically, there was a considerable degree of œdema of the cornea as a whole. Masses of staphylococci were found in the tissues at the base and edges of the ulcer. There is no evidence of vaccinia, and the lesion is evidently due to cocci, which it will be remembered were found in large numbers in the pustules of cow No. 5, which lesions were used for the inoculations.

Vaccination of Cows.

The following experiment was undertaken in order to ascertain whether or not the cows that had passed through the disease in question were immune to vaccinia: —

Experiment No. 4: Sept. 18, 1903. — Cows Nos. 1 and 3 were vaccinated with commercial vaccine lymph. Both were killed three days after. Several small papules were found at the site of inoculation in each cow. Microscopical examination shows in both cow No. 1 and cow No. 3 typical early vaccine lesions. These lesions present the vacuolar degeneration of the epidermal cells and the parasitic protozoan *cytoryctes* peculiar to vaccinia.

Summary. — The mouth lesions and the vesicles occurring on the udders present a special type of necrosis, and represent a process entirely distinct from vaccinia.

The pustules obtained from cow No. 5 showed nothing indicative of vaccinia, but contained cocci in large numbers. Other pustular lesions represent suppuration about hair follicles.

The inoculation of rabbits' corneas with lymph from various lesions gave in all cases negative results, eliminating the possibility of vaccinia.

Two cows having passed through the eruptive disease described in this report were not immune to vaccinia, as has been shown by the inoculation of vaccine lymph and the subsequent microscopical study of the lesions.

In conclusion, it may be stated that no evidence of the presence of vaccinia in the diseased cows has been obtained either through experimental inoculation or through histological study of the various lesions. Lesions developing at the points vaccinated have been studied from both the calves vaccinated on July 31 on G. R. Tyzzer's estate, and from the calves vaccinated August 28 on the Newcomb estate. They all show a typical vaccine process. The fact that the calves inoculated on the Newcomb estate did not die, as did those inoculated four weeks earlier on the Tyzzer estate, may possibly be accounted for either by their age causing them to react in a different manner to the disease, or by the attenuation of the virus while being kept for four weeks on the ice.

It is evident, from the experiments carried on at the Newcomb estate, that a disease characterized by a rise of temperature, vesicles of the mouth, feet and udders, and which cannot be distinguished clinically from foot and mouth disease, has been traced to vaccine virus. The lesions do not resemble vaccine lesions microscopically, the lymph will not produce vaccine lesions in the rabbit, and the cows which have had the disease are not immune to vaccinia. The lesions correspond microscopically to the descriptions of the vesicles of the foot and mouth disease, and there is reason to believe that the process is foot and mouth disease.

E. E. TYZZER,
Assistant in Pathology, Harvard Medical School.

While these experiments were being carried on it was necessary to have some one present night and day to record the results in detail, to care for the animals and to keep off trespassers. The agent of the United States Bureau of Animal Industry in charge of the New England office, Dr. S. E. Bennett, assigned two of his assistants to this work, Drs. U. G. Houck and G. A. Johnson; while Dr. W. T. White, an agent of the Cattle Bureau of the State Board of Agriculture, was detailed to represent the State. They divided the day into watches of eight hours each, taking turns in sleeping on the premises.

At the conclusion of the experiments they made a full and detailed report of their observations to Dr. S. E. Bennett, a copy of which is on file in the office of the Cattle Bureau, together with a copy of a report of Dr. Tyzzer to Dr. Bennett; but for publication at this time it seems better to make use of Dr. Tyzzer's report to the Chief of the Cattle Bureau, without going into the matter at greater length.

It is perfectly evident, from the results of these experiments, that vaccine virus may become contaminated with the virus of foot and mouth disease, and convey the latter through the medium of animals used for the production of vaccine virus. This accidental discovery may be the solution of the cause of the original outbreak.

As nearly as can be ascertained, the first place for foot and mouth disease to make its appearance was upon the premises of the late Owen Clark, in Prattsville, just over the Revere line, either late in July or early in August, 1902. By the latter part of August it had spread to the premises of two or three of his neighbors, and thence was carried to various points where the disease prevailed during the autumn and winter of 1902 and 1903.

Prior to the time of the discovery and public announcement of foot and mouth disease, the middle of November, 1902, the New England Vaccine Company, of Chelsea, bought the young cattle it used for the production of vaccine virus from Mr. Clark, who would buy thrifty looking young cattle from various sources, and when they had been used at the New England Vaccine Company's establishment he would take them home to his place, where they were kept for a while until he could dispose of them.

The proprietor of the New England Vaccine Company states that the vaccine virus produced there during the last three or four years has retained its strength to a remarkable degree, and that it has not been necessary to introduce new "seed," as is often done at these establishments when the virus is found to be deteriorating; but it has been his custom when inoculating animals to put in a couple of "control" points of virus placed on the market by other producers, in order to compare the quality of his with theirs, and to be sure that his product was maintaining its standard of strength as compared with others.

During 1902 he used the product of six different American manufacturers of vaccine virus, among others the same establishment from which Dr. Tyzzer's supply was obtained, which was used in the Wakefield experiments.

During the summer of 1902 the proprietor of the New England Vaccine Company was in Europe, and little was done at that establishment; but in order to keep the vaccine virus from losing its vitality it was necessary for his assistant to inoculate an animal every month or six weeks, for the purpose of carrying the supply along at a standard strength. When one of these inoculations was made, "control" points were also put in for comparison. It does not seem unlikely that a heifer may have been inoculated in July, and control points used which were contaminated with foot and mouth disease virus, enabling the animal to convey the disease to Owen Clark's premises either late in July or early in August, without contaminating the vaccine virus produced by the New England Vaccine Company; as it has been shown by Dr. Tyzzer's investigations that the calves inoculated with a mixed vaccine and foot and mouth disease virus did not show easily recognizable symptoms of foot and mouth disease, yet they were capable of producing it in an unmistakable form among the cattle with which they were kept. At least, there is no history to show that animals used later at the New England Vaccine Company's establishment for the production of vaccine virus had any disease other than cow-pox. However, it is only fair to state that during September some experiments were undertaken at Bussey College, to see if vaccine virus, as put upon the market from the establishment whence Dr. Tyzzer's supply came, could produce foot and mouth disease. Some was procured from the manufacturer in small sealed capillary glass tubes ready for use, and two calves inoculated on the gums and lips, using a tube for each calf. These calves were kept with two young cows for a month, but no lesions other than those of cow-pox were observed in any of these animals.

In the report of the Chief of the Cattle Bureau to the State Board of Agriculture, made in January, 1903 (see page 350 of report of secretary of State Board of Agriculture for 1902), it is stated that it is a difficult matter to say positively just where the disease came from; but, as it first appeared in Prattsville, a locality in Chelsea, "and, as Chelsea is next to East Boston, where the foreign shipping comes in, it is not unlikely that the infection was brought over on a foreign steamer in hay or in straw used for packing merchandise, and in some way was carried to one of the places in this locality, and other herds near by were contaminated." But in view of the fact, as ascertained by Dr. Tyzzer's researches, that foot and mouth disease may be conveyed by means of impure vaccine virus, and from the information gained from the proprietor of the New England Vaccine Company, it does not seem unlikely that the source of the original outbreak may have been due to contaminated vaccine virus used for "control" points at the New England Vaccine Company's establishment, and that the animal thus infected carried it to Owen Clark's, whence it spread.

As foot and mouth disease prevails extensively in France, Italy, Austria and Switzerland, and also to a less degree in some of the other European countries, it does not seem impossible for the disease to have been imported from Europe in fresh "seed" brought over to some vaccine virus establishment in the United States, to renovate a product that was losing its vitality.

This seems an additional argument in favor of the establishment by the State of a vaccine-producing plant, as provided for by the Legislature of 1903, as the production of biological products of all kinds should be carried on only by the most thoroughly trained scientists, and all such material used in medicine should be under the direction and control of carefully educated experts employed either by the national or State government.

Statistics of Foot and Mouth Disease.

The following table gives the towns where the disease actually occurred, and the number of infected herds and animals, as well as the disposition made of them. In addition, a number of herds were quarantined early in the outbreak, thought to have been exposed by receiving cattle out of droves from Brighton, which had carried the disease in some cases. These were afterward released. Some were in towns where the disease did not appear. These towns are not mentioned in the table, but in the figures below the table the total number of animals quarantined because of the disease or for precautionary reasons is given.

Cities and Towns in which Foot and Mouth Disease existed, Number of Herds affected, and Disposition of the Animals in the Affected Herds.

CITY OR TOWN.	QUARANTINED.				KILLED BY UNITED STATES GOVERNMENT.			RELEASED.			DIED.
	Herds.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.
Acton,	11	178	–	11	158	–	8	20	–	3	–
Andover,	1	44	–	8	–	–	–	44	–	8	–
Arlington,	1	13	–	–	13	–	–	–	–	–	–
Attleborough,	3	52	–	2	47	–	2	5	–	–	–
Barre,	2	37	–	2	37	–	2	–	–	–	–
Billerica,	1	46	–	–	46	–	–	–	–	–	–
Boston,	1	10	–	–	10	–	–	–	–	–	–
Boxborough,	2	43	–	2	31	–		11	–	2	1
Braintree,	3	37	–	11	37	–	9	–	–	2	–
Bridgewater,	1	19	–	–	19	–	–	–	–	–	–
Burlington,	3	38	–	15	11	–	15	27	–	–	–
Carlisle,	6	79	1	4	73	–	–	5	1	4	1
Chelmsford,	2	73	–	10	59	–	10	–	–	–	14
Chelsea,	3	24	–	–	1	–	–	23	–	–	–
Cohasset,	1	2	–	2	2	–	–	–	–	2	–
Concord,	13	293	–	465	273	–	5	17	–	460	3
Danvers,	1	7	–	–	7	–	–	–	–	–	–
Dedham,	3	64	–	16	26	–	–	38	–	16	–
Dover,	3	56	5	5	56	5	5	–	–	–	–
Everett,	1	6	–	–	4	–	–	2	–	–	–
Foxborough,	1	29	–	–	29	–	–	–	–	–	–
Framingham,	4	84	1	14	83	1	14	1	–	–	–
Grafton,	1	10	–	16	10	–	10	–	–	6	–
Harvard,	1	6	–	–	5	–	–	–	–	–	1
Lawrence,	1	5	–	–	5	–	–	–	–	–	–
Leominster,	1	1	–	–	–	–	–	1	–	–	–
Lincoln,	8	170	–	16	162	–	16	7	–	–	1
Littleton,	9	160	–	15	99	–	–	61	–	15	–
Marlborough,	3	49	–	6	47	–	6	–	–	–	2
Medfield,	2	119	2	250	98	2	–	21	–	250	–
Methuen,	7	174	–	54	33	–	40	137	–	14	4
Milton,	1	2	–	–	–	–	–	2	–	–	–
Natick,	1	16	–	5	14	–	–	2	–	5	–

Cities and Towns in which Foot and Mouth Disease existed, etc. — Concluded.

CITY OR TOWN.	QUARANTINED.				KILLED BY UNITED STATES GOVERNMENT.			RELEASED.			DIED.
	Herds.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.	Sheep.	Swine.	Cattle.
Needham,	4	185	14	21	182	-	16	3	11	5	-
North Andover,	2	89	17	-	87	17	-	-		-	2
Pepperell,	1	2	-	-	2	-	-	-	-	-	-
Quincy,	5	57	-	-	57	-	-	-	-	-	-
Raynham,	1	3	-	-	3	-	-	-	-	-	-
Revere,	1	32	-	-	-	-	-	32	-	-	-
Sharon,	2	39	-	40	33	-	-	3	-	40	3
Southborough,	4	169	-	-	166	-	-	-	-	-	3
Stow,	1	30	-	2	30	-	-	-	-	2	-
Sudbury,	4	70	-	4	10	-	-	58	-	4	2
Walpole,	1	4	-	-	-	-	-	4	-	-	-
Watertown,	3	60	-	4	56	-	4	4	-	-	-
Wayland,	3	33	-	73	21	-	48	12	-	25	-
Westborough,	8	236	-	17	215	-	10	19	-	7	2
West Bridgewater,	3	97	-	2	97	-	2	-	-	-	-
Westford,	4	54	-	-	54	-	-	-	-	-	-
Weston,	3	72	25	14	71	25	14	-	-	-	1
Westwood,	2	123	-	-	123	-	-	-	-	-	-
Totals,	154	3,301	65	1,106	2,702	50	236	559	15	870	40

NOTE. — In addition to the above, there were 10 goats quarantined, scattered among 5 of the affected herds, 5 of which were killed by the United States government, — 3 in Lincoln and 2 in Needham.

During the continuance of the outbreak there were 220 herds quarantined on suspicion of having the disease, or on account of having been exposed to it. Of this number, 64 herds were released in the course of a few weeks, it having been found that they were not diseased, or in a very few cases a few animals had it mildly, and recovered; 130 herds were killed either wholly by agents of the United States Bureau of Animal Industry, or a portion of the animals killed; 26 herds were more or less affected, but recovered, and were released on the final lifting of the quarantine on July 15, 1903.

Total Number of Animals.

Total number of animals quarantined,	5,537
Total number of animals killed by the United States government,	2,993
Total number of animals died from the disease,	40
Total number of animals released early, as not diseased,	959
Total number of animals released on July 15, 1903,	1,545

Of the above number of animals, there were 127 sheep quarantined, 50 of which were killed; 1,210 swine quarantined, 236 of which were killed; 10 goats quarantined, 5 of which were killed.

In addition to the above, there were 19 herds, comprising 226 animals, quarantined as a matter of precaution, or in enforcing the regulations, all of which were soon released.

On the 5th of December, 1902, there were about 138 herds, comprising 2,915 animals, that were turned over to the United States Department of Agriculture to deal with as they saw fit; and it was not until after this date that any animals were slaughtered by the agents of the United States Board of Animal Industry.

Neat Cattle.

There were 4,190 head of neat cattle quarantined, as follows: —

Cows or heifers,	3,866
Bulls,	108
Oxen,	33
Calves,	183

The cattle quarantined were disposed of as follows: —

	Cattle.	Calves.	Totals.
Released early, as not diseased,	860	13	873
Killed by the United States government,	2,572	130	2,702
Died from the disease,	34	6	40
Released on lifting of the quarantine,	541	34	575

Between July 15, 1903, and Dec. 15, 1903, there were 8 cases reported as being suspicious, in 3 of these cases one or more animals being quarantined. The animals were promptly examined, and in no case was there any disease found, except in the case of George R. Tyzzer of Wakefield, who had 4 cows and 1 calf killed by the United States government on August 23.

The following figures, from the nineteenth annual report of the United States Bureau of Animal Industry, show the extent of the whole outbreak in New England, the number of animals killed, and the amounts paid for them by the United States government: —

The tables which follow show the number of herds and animals found affected with foot and mouth disease, the number slaughtered, the compensation paid, etc. These figures include all the animals in the infected herds, whether they showed symptoms of the disease or not. As in an outbreak of this disease all the animals exposed contract it in the course of a week or two, it was assumed that where one or more animals in a herd showed clear evidence of the disease all the rest were affected.

The difference between the number of cattle affected (4,712) and the number slaughtered (3,872) represents those that either died or recovered. Nearly all the recoveries were in the early cases, where the disease had run its course before the work of slaughtering was begun, or before those herds could be reached. After the commencement of the work of eradication no newly affected herds were allowed to be held for recovery.

Number of Herds and Cattle affected with Foot and Mouth Disease since the Beginning of the Outbreak, as reported by Months.

MONTH.	MASSACHUSETTS.		NEW HAMPSHIRE.		VERMONT.		RHODE ISLAND.		TOTALS.	
	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.	Herds.	Cattle.
November, 1902,* . .	62	1,219	–	–	4	47	7	234	73	1,500
December, 1902, . .	71	1,536	4	37	17	288	8	110	100	1,971
January, 1903, . .	9	225	–	–	–	–	–	–	9	225
February, 1903, . .	6	196	–	–	1	16	3	16	10	228
March, 1903, . . .	3	55	28	444	–	–	–	–	31	499
April, 1903, . . .	3	9	15	221	–	–	–	–	18	230
May, 1903, . . .	2	28	1	31	–	–	–	–	3	59
Totals, . . .	156	3,268	48	733	22	351	18	360	244	4,712

* These are the figures of official record, but it is known in a general way that there were more animals affected previous to November.

Animals slaughtered by the United States Department of Agriculture.

STATES.	Herds.	Cattle.	Hogs.	Sheep and Goats.	Total Animals.
Massachusetts, ...	129	2,708	229	55	2,992
New Hampshire, ...	48	733	68	100	901
Vermont, ...	22	351	55	74	480
Rhode Island, ...	6	80	8	-	88
Totals, ...	205	3,872	360	229	4,461

Appraised Valuations and Compensation paid for Animals slaughtered.

STATES AND ANIMALS.	Number.	Appraised Value on Health Basis.	Average per Head.	Net Compensation (70 Per Cent).	Average per Head.
Massachusetts.					
Cattle (not including calves), .	2,589	$131,238 58	$50 69	$91,867 00	$35 48
Calves, ...	119	1,021 79	8 59	715 25	6 01
All cattle, ...	2,708	$132,260 37	$48 84	$92,582 25	$34 19
Hogs, ...	229	2,269 43	9 91	1,588 60	6 94
Sheep and goats, ...	55	444 00	8 07	310 80	5 65
Totals, ...	2,992	$134,973 80	-	$94,481 65	-
New Hampshire.					
Cattle (not including calves), .	668	$28,704 00	$42 97	$20,092 80	$30 08
Calves, ...	65	539 00	8 29	377 30	5 80
All cattle, ...	733	$29,243 00	$39 90	$20,470 10	$27 93
Hogs, ...	68	574 50	8 45	402 15	5 91
Sheep, ...	100	497 00	4 97	347 90	3 48
Totals, ...	901	$30,314 50	-	$21,220 15	-
Vermont.					
Cattle (not including calves), .	301	-	-	$9,348 00	$31 06
Calves, ...	50	-	-	590 00	11 80
All cattle, ...	351	-	-	$9,938 00	$28 31
Hogs, ...	55	-	-	429 32	7 81
Sheep, ...	74	-	-	325 75	4 40
Totals, ...	480	-	-	$10,693 07	-
Rhode Island.					
Cattle (not including calves), .	79	$3,523 00	$44 59	$2,466 10	$31 22
Calves, ...	1	3 00	3 00	2 10	2 10
All cattle, ...	80	$3,526 00	$44 08	$2,468 20	$30 85
Hogs, ...	8	65 00	8 12	45 50	5 69
Totals, ...	88	$3,591 00	-	$2,513 70	-

Summary.

Animals.	Number.	Net Compensation.	Average per Head.
Cattle (not including calves),	3,637	$123,773 90	$34 03
Calves,	235	1,684 65	7 17
All cattle,	3,872	$125,458 55	$32 40
Hogs,	360	2,465 57	6 85
Sheep and goats,	229	984 45	4 30
Total compensation paid,	-	$128,908 57	-

It was not until about the middle of October that the United States Secretary of Agriculture issued the final order removing all quarantine restrictions from Massachusetts on account of foot and mouth disease, as follows: —

BUREAU OF ANIMAL INDUSTRY ORDER, NO. 119.

REMOVAL OF QUARANTINE ON RUMINANTS AND SWINE IN THE STATES OF MASSACHUSETTS AND NEW HAMPSHIRE.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
WASHINGTON, D. C., Oct. 14, 1903.

Whereas, All animals affected with foot and mouth disease in the States of Massachusetts and New Hampshire have been destroyed, and the premises occupied by them have been thoroughly disinfected, and the contagion of this disease has been eradicated;

It is hereby ordered, That the quarantine upon cattle, sheep and other ruminants and swine, imposed on account of the existence of foot and mouth disease, be removed, and the orders of this department relating to such quarantine are hereby revoked. The above-named animals or their products may, therefore, be shipped or be otherwise moved from said States without restrictions other than may be imposed by the authorities of the States to which such animals or products are destined.

JAMES WILSON,
Secretary.

Prior to this, however, the following order was issued, providing that shipments abroad of cattle and sheep from the port of Boston could be resumed with safety: —

BUREAU OF ANIMAL INDUSTRY ORDER, NO. 116.

SPECIAL ORDER, OPENING PORT OF BOSTON TO EXPORTATION OF ANIMALS.

UNITED STATES DEPARTMENT OF AGRICULTURE,
OFFICE OF THE SECRETARY,
WASHINGTON, D. C., July 20, 1903.

It is ordered, That the order of Nov. 27, 1902 (Bureau of Animal Industry Order, No. 100), prohibiting the exportation of cattle, sheep and other ruminants and swine from the port of Boston, on account of the existence of foot and mouth disease in the State of Massachusetts, be, and the same is hereby, revoked, and said animals may be allowed exportation from said port from and after this date.

Any other prior order or part of order inconsistent with this is modified in accordance herewith.

JAMES WILSON,
Secretary.

It was not, however, until nearly the end of September that the British government would allow any shipments of cattle or sheep to be landed in England. While a few shipments were made to Antwerp previous to this time, the port of Boston was practically closed to shipments of live animals to foreign ports for about ten months. As this business is worth at least $25,000 per week to the railroad companies having terminals in Boston, and as much more to the steamship companies which own vessels sailing from this port, it can readily be seen that the outbreak of foot and mouth disease cost the commerce of Boston about $2,000,000, — by far the largest individual item of the whole outbreak.*

While the stamping-out method is a very radical one in dealing with such a disorder as foot and mouth disease, yet under the circumstances it seems to have been the best, and the results obtained fully justify the means.

The last and only outbreak of foot and mouth disease in Massachusetts, previous to the one of 1902 and 1903, occurred in the fall and winter of 1870 and 1871. It was much

* The estimate given in the report of the Chief of the Cattle Bureau, that the loss of business cost the port of Boston $100,000 per day, upon careful inquiry proves to have been a great exaggeration; a loss of $2,000,000, however, is a sufficiently large sum to show the gravity of the situation.

more widespread than the one recently stamped out, being first imported into Canada, whence it was carried to the stock yards at Albany, N. Y., and spread from there to various points in New York State and western Connecticut, and was also more widely disseminated over Massachusetts than it was during the later outbreak. The Massachusetts Cattle Commissioners at that time closed the Brighton market to all cattle except those for immediate slaughter, and also prohibited moving cattle on the highways in certain towns. The Brighton yards were disinfected with carbolic acid and chloride of lime, and not reopened until April, three months earlier than in the recent outbreak, but beyond this no other measures were taken; yet the disease disappeared in the spring of 1871, and did not manifest itself again here for thirty-one years. It seems to be an exotic in this climate, and appears to have a tendency to disappear. On the other hand, we know it to have been imported into Great Britain in 1839, and it was not until 1894 that it was finally eradicated by means of quarantine measures alone. Since 1894 it has reappeared in England in 1900 and 1901, being reimported in some way from the continent; and in these later outbreaks the stamping-out process has been resorted to, with marked success.

It is said that of late years there has been a tendency for foot and mouth disease in Europe to assume a much more virulent type than formerly, and from all accounts it seems to have been much more severe during the recent outbreak than in the earlier one. This would make the disease more difficult to eradicate than when it appeared in a mild form.

At the time of the outbreak in 1870 and 1871, the great export business in live animals and the enormous cattle industry of the west were in an undeveloped state; and this renders the matter one of much greater importance and seriousness at the present time than it did thirty years ago. There are probably sections of the United States where this disease would not prove a tender exotic, because of different climatic conditions; and if it once obtained a foothold in these localities, it might prove to be much more difficult of eradication.

For these reasons, one cannot question the wisdom and propriety of the stamping-out method, or fail to approve of and admire the promptness and energy with which it was carried out.

The country is well rid of this scourge, and it is hoped that it will never appear here again. The cost to the community has been very heavy, as the following figures will show: —

Loss of commerce to the port of Boston, . . .	$2,000,000 00
Compensation paid owners by the United States government for animals destroyed, ...	128,908 00
Expense for inspectors, disinfecting corps, etc., of Bureau of Animal Industry, as much more at least, — say	130,000 00
Expense to State of Massachusetts for agents of Cattle Bureau, disinfecting corps, etc., ...	20,219 05
Amount paid by Massachusetts for quarantine claims,	9,699 40
Compensation paid by State to owners, of 30 per cent of the valuation of animals killed, ...	38,244 98
Total, ...	$2,327,071 43

These figures alone amount to over two and a quarter millions of dollars, to say nothing of the loss to individual farmers by being temporarily put out of business, and the loss and inconvenience to cattle men by having the Brighton market closed from Nov. 26, 1902, until the 22d of the following July.

The only excuse for writing such a full and detailed account of the recent outbreak of foot and mouth disease is that it is a matter of history, which ought to be published, as it may prove of value in years to come, if there should ever be another such visitation of this malady, to show what was done at this time. The discoveries in connection with the outbreak in Mr. Tyzzer's herd, and subsequent experiments, are also of great scientific interest, and should be made a matter of record. The report of the Chief of the Cattle Bureau upon foot and mouth disease, made to the State Board of Agriculture in January, 1903, together with the above report, gives a full and detailed history of foot and mouth disease in Massachusetts in 1902 and 1903.

It is hoped that this account shows that, while the greater part of the expense and much of the work fell upon the United States Bureau of Animal Industry, yet there is much that can be done by the State in co-operating with it, and supplementing the work of the national authorities, besides assisting in limiting the spread of the disease by quarantine methods, closing markets, forbidding auctions, and prohibiting moving certain animals and infected products in certain towns and districts.

Glanders.

More horses have been killed on account of glanders or farcy or have died therefrom during the year ending Dec. 15, 1903, than recorded in any previous year in Massachusetts. If there has been any such mortality heretofore, it was before a systematic attempt was made to have every case reported. At present it is thought that very few cases occur that are not brought to the notice of the Chief of the Cattle Bureau. If progress in combating this disease is not made to the extent that is desired, at least, under the system of obtaining reports from various sources that has been followed during the past three or four years, the gravity of the situation has been shown.

The total number of animals upon the books of the Cattle Bureau for the past year is 1,160 horses and mules: of the latter there are only 2 or 3. Of these animals, 860 have been killed (except a few which died), either by order of the Chief of the Cattle Bureau or that of the veterinarian of the Boston board of health, or with the owner's consent when informed by veterinarians of the nature of the malady. In addition, 169 cases were reported as suspicious, and later released as free from disease, after examination by an agent of the Cattle Bureau; and 131 horses have been tested with mallein in stables where glanders existed. All but 5 of the latter have been discharged as negative cases; the 5 remaining have reacted to mallein, and will have to be tested one or more times again, when, if they cease to react, they will be discharged, or if they develop physical signs of the disease they will be killed.

Most of the animals considered suspicious were quarantined by the local inspectors of animals. Some of them were released after a simple examination by an agent of the Cattle Bureau: but in many cases it was necessary to inoculate guinea pigs with material taken from the nose, or sores on the body. or to test them with mallein, before it could be definitely decided that they were free from disease. The increase over the preceding year in the number of cases of glanders or farcy where the animals were killed is 123, but this augmentation appears to have been in and around Boston. There were 95 more horses killed in Boston, 41 more in Cambridge and 12 more in Chelsea, than in the previous year, — a total of 148; deducting this from 860 leaves 712, or 25 less than in 1902. This shows a slight decrease for the State, outside of Boston, Cambridge and Chelsea.

The most noticeable decrease has been in the Connecticut valley, where the disease seems to have almost entirely disappeared. There seems also to be a marked diminution in Fall River, Brockton, Newton and Taunton, — cities where in previous years there has been a considerable number of cases of glanders or farcy. There has been a small outbreak in Dedham and Westwood, involving about 15 horses, and in Lowell there has been an increase of 12 cases over the previous year. In Worcester it remains the same. Very few animals with glanders are found in this State west of a line drawn through Fitchburg and Worcester. When cases do occur, it is frequently due to a farmer buying a cheap horse in Boston or Worcester to help in the spring and summer's work, which is found later to be diseased, and infects a few other horses before the outbreak is eradicated.

The annual reports of the Massachusetts Cattle Commission, and of its successor, the Chief of the Cattle Bureau, show an alarming prevalence of glanders and farcy in Massachusetts, — greater than in any other Commonwealth in the United States. At the same time, it is not impossible that as serious a condition of affairs may exist in some of the great cities of the country in other States, and that public attention is not called to it, for lack of a systematic effort to obtain reports of the cases.

The following table shows a list of the cases, or suspected cases, of glanders or farcy reported during the years 1902 and 1903, and also the increase or decrease of actual cases in the cities or towns in which they have occurred: —

CITY OR TOWN.	1902.		1903.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Abington, . .	–	1	–	2	–	–
Acton, . .	3	2	2	1	–	1
Acushnet, . .	–	–	1	–	1	–
Amesbury, . .	–	–	–	1	–	–
Amherst, . .	–	–	4	–	4	–
Andover, . .	4	3	–	–	–	4
Arlington, . .	10	14	8	7	–	2
Ashburnham, .	–	2	–	–	–	–
Ashby, . .	–	–	1	–	1	–
Ashfield, . .	–	–	1	–	1	–
Ashland, . .	–	–	1	–	1	–
Attleborough, .	–	–	2	2	2	–
Auburn, . .	6	–	3	–	–	3
Barnstable, . .	2	–	–	1	–	2
Barre, . .	2	–	1	–	–	1
Bedford, . .	–	1	1	3	1	–
Belchertown, .	–	1	–	–	–	–
Belmont, . .	1	–	1	–	–	–
Berlin, . .	–	–	1	–	1	–
Bernardston, .	1	1	–	–	–	1
Beverly, . .	3	–	3	21	–	–
Billerica, . .	–	–	2	1	2	–

CITY OR TOWN.	1902.		1903.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Blackstone, . .	–	1	–	–	–	–
Bolton, . .	–	–	1	–	1	–
Boston, . .	155	–	250	2	95	–
Bourne, . .	1	1	–	–	–	1
Boylston, . .	–	–	1	–	1	–
Braintree, . .	–	–	2	–	2	–
Brewster, . .	1	–	–	–	–	1
Bridgewater, .	–	1	–	1	–	–
Brockton, . .	18	8	9	4	–	9
Brookline, . .	6	–	6	–	–	–
Buckland, . .	–	1	–	–	–	–
Burlington, .	1	–	3	–	2	–
Cambridge, .	50	2	91	12	41	–
Canton, . .	–	–	–	2	–	–
Charlemont, .	3	–	–	–	–	3
Charlton, . .	1	1	1	–	–	–
Chelmsford, .	2	1	1	–	–	1
Chelsea, . .	12	–	24	2	12	–
Cheshire, . .	1	–	–	–	–	1
Chesterfield, .	–	–	–	1	–	–
Chicopee, . .	–	–	–	2	–	–
Chilmark, . .	–	–	1	–	1	–
Clinton, . .	1	1	1	–	–	–
Cohasset, . .	1	–	–	–	–	1
Concord, . .	–	1	–	–	–	–

CITY OR TOWN.	1902.		1903.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Conway, . .	–	–	–	1	–	–
Dalton, . .	–	–	1	–	1	–
Dartmouth, . .	2	–	–	–	–	2
Dedham, . .	1	–	8	–	7	–
Dennis, . .	1	1	–	–	–	1
Dighton, . .	1	–	1	–	–	–
Dover, . .	–	1	1	–	1	–
Dracut, . .	2	–	2	–	–	–
Dudley, . .	–	–	1	–	1	–
East Bridgewater,	–	–	2	–	2	–
Easton, . .	2	–	–	–	–	2
Everett, . .	8	1	9	44	1	–
Fairhaven, . .	–	–	1	–	1	–
Fall River, . .	43	4	30	5	–	13
Fitchburg, . .	3	2	5	1	2	–
Foxborough, .	–	–	–	1	–	–
Framingham, .	7	11	6	–	–	1
Franklin, . .	–	1	–	–	–	–
Freetown, . .	–	–	–	1	–	–
Gardner, . .	–	–	2	1	2	–
Grafton, . .	1	–	3	1	2	–
Greenfield, . .	1	–	–	–	–	1
Greenwich, . .	3	1	–	1	–	3
Gloucester, . .	1	2	1	2	–	–
Halifax, . .	–	–	–	3	–	–

CITY OR TOWN.	1902.		1903.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Hamilton, . .	–	–	3	7	3	–
Hanover, . .	1	1	–	–	–	1
Hanson, . .	1	–	–	–	–	1
Hardwick, . .	2	4	1	2	–	1
Harvard, . .	–	–	–	1	–	–
Harwich, . .	–	–	2	–	2	–
Haverhill, . .	2	1	2	–	–	–
Hingham, . .	1	–	–	–	–	1
Hinsdale, . .	–	1	–	–	–	–
Holbrook, . .	1	1	–	–	–	1
Holden, . .	–		2	–	2	–
Holliston, . .	–	–	4	–	4	–
Hopkinton, . .	–	–	–	1	–	–
Hubbardston, .	–	–	–	2	–	–
Hyde Park, . .	3	–	1	1	–	2
Ipswich, . .	–	–	1	–	1	–
Lawrence, . .	35	2	19	3	–	16
Leicester, . .	1	–	2	–	1	–
Leominster, .	1	1	–	3	–	1
Lexington, . .	4	2	7	3	3	–
Leyden, . .	–	1	–	–	–	–
Lincoln, . .	1	–	2	1	1	–
Littleton, . .	–	1	–	–	–	–
Lowell, . .	8	–	20	6	12	–
Lunenburg, .	2	–	–	–	–	2

CITY OR TOWN.	1902.		1903.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Lynn, . .	14	1	17	2	3	–
Lynnfield, . .	2	–	–	–	–	2
Malden, . .	6	–	6	–	–	–
Mansfield, . .	1	6	–	–	–	1
Marblehead, .	–	–	1	–	1	–
Marlborough, .	–	1	1	–	1	–
Maynard, . .	1	1	–	–	–	1
Medfield, . .	–	–	1	1	1	–
Medford, . .	10	11	6	2	–	4
Melrose, . .	1	–	2	–	1	–
Merrimac, . .	–	1	–	–	–	–
Methuen, . .	2	6	1	1	–	1
Middleborough, .	2	1	–	–	–	2
Milford, . .	3	–	2	1	–	1
Millbury, . .	–	–	1	–	1	–
Milton, . .	3	1	3	6	–	–
Monson, . .	1	1	–	–	–	1
Montague, . .	–	2	–	–	–	–
Nahant, . .	–	–	1	–	1	–
Needham, . .	4	1	–	–	–	4
New Bedford, .	6	2	6	3	–	–
New Salem, .	–	1	–	–	–	–
Newbury, . .	–	–	–	1	–	–
Newburyport, .	5	3	6	–	1	–
Newton, . .	24	56	15	43	–	9

CITY OR TOWN.	1902.		1903.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Northampton, .	3	22	–	1	–	3
North Adams, .	–	–	4	–	4	–
North Andover, .	1	–	6	–	5	–
Northborough, .	2	–	2	–	–	–
Northbridge, .	2	–	1	1	–	1
Norwell, . .	–	1	–	–	–	–
Norwood, . .	1	–	1	1	–	–
Oxford, . .	–	2	1	–	1	–
Palmer, . .	1	–	–	3	–	1
Paxton, . .	1	–	1	–	–	–
Peabody, . .	2	–	4	–	2	–
Pembroke, . .	–	1	1	2	1	–
Pepperell, . .	1	1	–	2	–	1
Phillipston, .	–	1	–	–	–	–
Pittsfield, . .	–	7	–	1	–	–
Plainfield, . .	–	1	–	–	–	–
Plymouth, . .	–	1	–	–	–	–
Prescott, . .	–	1	–	–	–	–
Princeton, . .	–	–	1	–	1	–
Quincy, . .	8	2	17	8	9	–
Randolph, . .	1	–	–	–	–	1
Raynham, . .	2	1	–	–	–	2
Reading, . .	–	–	3	–	3	–
Revere, . .	5	2	3	1	–	2
Rochester, . .	1	–	–	–	–	1

CITY OR TOWN.	1902.		1903.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Rockland, . .	4	2	–	–	–	4
Royalston, . .	–	–	–	2	–	–
Salem, . .	3	2	–	2	–	3
Saugus, . .	2	2	–	3	–	2
Sharon, . .	2	–	–	1	–	2
Sheffield, . .	–	–	1	–	1	–
Sherborn, . .	–	–	–	1	–	–
Shrewsbury, .	5	–	1	–	–	4
Somerset, . .	1	–	1	–	–	–
Somerville, . .	50	8	52	3	2	–
Southborough, .	–	–	2	1	2	–
Southbridge, .	5	–	2	–	–	3
Springfield, .	5	2	–	1	–	5
Sterling, . .	1	1	–	1	–	1
Stoneham, . .	–	–	3	1	3	–
Stoughton, . .	1	1	1	–	–	–
Sturbridge, . .	1	–	–	–	–	1
Sudbury, . .	2	2	2	–	–	–
Sutton, . .	–	1	–	1	–	–
Swampscott, .	1	–	1	–	–	–
Swansea, . .	–	–	–	1	–	–
Taunton, . .	8	–	1	–	–	7
Tewksbury, .	–	–	1	1	1	–
Tisbury, . .	–	–	–	1	–	–
Townsend, . .	–	–	1	1	1	–

CITY OR TOWN.	1902.		1903.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Truro, . .	–	1	–	–	–	–
Upton, . .	–	–	–	1	–	–
Wakefield, . .	1	–	2	2	1	–
Walpole, . .	–	–	1	–	1	–
Waltham, . .	5	30	7	3	2	–
Ware, . .	–	–	–	1	–	–
Wareham, . .	–	2	–	–	–	–
Warren, . .	–	–	–	1	–	–
Warwick, . .	–	–	1	1	1	–
Watertown, .	5	1	3	–	–	2
Wayland, . .	1	–	–	1	–	1
Wellesley, . .	–	–	1	5	1	–
West Boylston, .	1	–	–	–	–	1
West Bridgewater,	–	–	1	–	1	–
West Springfield,	1	1	–	–	–	1
West Tisbury, .	–	–	2	–	2	–
Westborough, .	–	–	1	–	1	–
Westhampton, .	2	–	2	4	–	–
Westminster, .	2	2	2	3	–	–
Westport, . .	4	2	1	1	–	3
Weston, . .	–	–	5	2	5	–
Westwood, . .	1	–	7	–	6	–
Weymouth, .	3	–	6	1	3	–
Whitman, . .	4	–	3	1	–	1
Wilmington, .	–	–	–	1	–	–

CITY OR TOWN.	1902.		1903.		Increase.	Decrease.
	Killed or died.	Negative.	Killed or died.	Negative.		
Winchester, .	–	–	1	–	1	–
Winthrop, . .	1	1	–	–	–	1
Woburn, . .	6	1	1	1	–	5
Worcester, . .	67	7	67	9	–	–
Wrentham, . .	–	1	1	–	1	–
Totals, . .	737	290	860	295	–	–

Five horses in Newton which have reacted to mallein remain to be retested, making 1,160 horses in all.

It is only fair to state, in connection with the above table, that the veterinarian of the Boston board of health reports but 206 authentic cases of glanders or farcy for the year 1903; the renderers report 195. There are names on their reports, however, which are not given by the agent of the Boston board of health; and, on the other hand, his report gives names that are not on the renderers' returns. Cases investigated outside of Boston, given on the renderers' returns, have in nearly every instance been found to be cases of glanders or farcy. These returns having proven so reliable in such instances, it is taken for granted that they are equally reliable in every instance. This being the fact, the cases reported by the veterinarian of the Boston board of health and the renderers have both been entered on the books, making the total number of horses killed as infected 250.

In doubtful cases the guinea pig test has been resorted to as a means of diagnosis, as extensively as in the past few years. This work has been done by Dr. Langdon Frothingham, at the Harvard Medical School, and in this way many uncertain cases have been decided.

Mallein has also been used quite extensively, occasionally as a method of diagnosing suspected cases, but more frequently for testing all the horses in an infected stable. Those that do not react are considered free from disease, and separated from those that do give a reaction. Reacting animals are retested every month or six weeks until they cease to react, or show physical evidence of disease and are killed. Mallein is supposed to have an immunizing and therapeutic value, as well as a diagnostic one. In stables where this method has been carried out it has been found possible to eradicate glanders in a number of instances, greatly to the benefit of owners as well as to the public at large. In several stables where this method has been pursued the horses have remained healthy, and no new cases have occurred for periods of over two years.

In this connection an experiment conducted by the British Board of Agriculture is interesting, as concurring with work carried on in this State. Their experiment indicates "that a horse that has ceased to react to mallein is incapable of spreading the infection of glanders. This conclusion, however, is subject to the qualification that there has been an interval of not less than two months between the last two mallein tests. In the horses that were used in this experiment the shortest period between the last two tests to which the animal had been subjected before it was purchased by the committee was ten weeks, but in most of the cases it was considerably longer than that. We consider that in practice the mallein tests should not be repeated oftener than every three months, when the object is to ascertain whether the animal has actually recovered from glanders." The report from which the above extract is quoted is signed by the following well-known veterinarians: Alexr. C. Cope, Wm. Hunting, J. McFadyean, James McI. McCall.

Again the sad necessity of recording deaths in the human family from glanders occurs, in order to make this report complete. The State Board of Health reports 3 deaths from this cause during the past year, — 1 each in Lawrence, Chelsea and Northborough.

In the Northborough case the horse from which the owner contracted the disease was examined and ordered killed by an agent of the Cattle Bureau prior to the death of the man owning it, but after he was taken ill. The Lawrence horse was ordered killed a day or two after the death of the owner. In the Chelsea case the horse died or was killed some time before the death of the owner, and no knowledge was had of it until the owner's death from this cause was reported.

The reports of renderers, as required by section 111, chapter 75 of the Revised Laws, continue to be of great value, as returns of many cases received at the establishments are the first reports, and often the only ones, received by the Cattle Bureau. When a case is reported as occurring outside the limits of the city of Boston, which has not previously been given, the inspector of animals in the town from which the horse came, or an agent of the Cattle Bureau, is immediately sent to examine any other horses kept upon the premises, and it is also seen that the disinfection of the stable is properly attended to. These measures undoubtedly are of great assistance in checking the spread of this malady. The following table shows the returns of renderers for the year ending Dec. 15, 1903: —

Rendering Companies.	Number of Reports.	Number of Cases.	Number in Boston.	Number out of Boston.	Number outside of Boston not previously reported.
Guy U. Barnes Rendering Company, Fall River.	18	27	-	27	5
J. J. Burke, Sherborn, ...	4	7	-	7	-
C. S. Bard, Haverhill, ...	1	1	-	1	-
William Higgins, Malden, . . .	4	4	-	4	3
Lowell Rendering Company, . .	3	5	-	5	-
W. C. Lawrence, Brockton, . .	9	12	-	12	3
Jas. E. McGovern, Lawrence, .	14	24	-	24	2
Muller Bros., North Cambridge, .	35	95	3	92	14
McQuade Bros., Auburn, . . .	3	5	-	5	-
N. E. Rendering Company, Brighton,	51	133	22	111	47
New Bedford Product Company, .	1	7	-	7	-
Parmenter & Polsey Fertilizer Company, Peabody.	21	28	-	28	3
A. K. Silloway, Newburyport, .	3	5	-	5	2
James P. Trainor, Auburn, . .	3	3	-	3	1
N. Ward & Co., Boston, . . .	46	219	170	49	11
Whitman & Pratt Rendering Company, Lowell.	4	6	-	6	2
Worcester Rendering Company, .	26	57	-	57	15
Fitchburg Rendering Company, .	4	6	-	6	1
Totals, ...	250	644	195	449	109

It will be seen from the above table that 109 cases of glanders or farcy were reported by the renderers that had not previously been recorded in the office of the Cattle Bureau, and in most instances no other notification of them was received.

The reason for reporting the number of cases in Boston separately is because the board of health has full jurisdiction over glanders and farcy, and this Bureau has nothing to do with investigating cases which occur in Boston.

Since last September the Cattle Bureau has hired a horse and wagon, with a man or men, as needed, to go to all premises in cities and towns within easy driving distance of Boston, to disinfect stables where cases of glanders or farcy occur. A great many owners are careless, or ignorant of proper methods of disinfecting, and it is hoped that by having experienced men to do this work it will help to check the spread of the disease. Since this work was inaugurated 92 stables in 18 cities and towns have been disinfected by an agent of the Cattle Bureau.

In Somerville the inspector of animals does the work for the board of health, and it is so thoroughly done that it has not been found necessary to send an agent there.

The State has also paid a man in Worcester for the past two years to disinfect premises for owners who did not seem capable of doing it properly; but this has not been done in stables where the owners were able to do it, — it has been done only in the lower class of stables, where the owners were in many instances foreigners, and could not be made to understand the importance of the work or the proper way of doing it.

The loss of property to owners from glanders and farcy in this State is a serious matter. Between $60,000 and $70,000 worth of animals, at the least calculation, are killed annually, to say nothing of the danger to human life.

At the present time it seems to be the most important problem with which the Cattle Bureau has to deal, and the question arises, What more can be done towards its eradication?

The following suggestions are given for making further headway towards decreasing it: —

First. — There should be one law for the whole State. At least, the Chief of the Cattle Bureau should have the same authority in Boston that he has elsewhere; this would not necessitate taking the power away from the veterinarian of the Boston board of health, to kill all horses reported to him in Boston that have glanders or farcy, but would give the Cattle Bureau equal power to deal with cases reported to it. It would also enable the Chief of the Cattle Bureau to keep up a proper inspection of cheap auction rooms and low sales stables if it was found necessary to do so, and would give him authority to look after the cleanliness of public water troughs if need be, and to order them closed in case it was advisable; also to organize a system of mallein testing in infected stables in Boston as well as elsewhere.

Second. — The State should thoroughly disinfect all stables where cases of glanders or farcy are found, unless properly done by the local board of health.

Third. — When a horse with glanders or farcy is killed, it should be ascertained where he was usually shod; and an agent of the State should go there and disinfect the place where the horses are tied, as soon after completing the disinfection of the stable as possible. If another horse shod at the same shop is later killed for glanders, the shop should be immediately disinfected again.

Fourth. — Greater attention should be paid to the cleanliness of public watering troughs. They should have larger supply and larger overflow pipes. If they were abolished, and public watering places established with faucets, and each teamster made to carry a pail for his horses, it would be better. Going without water, except what they receive at the home stable, is no hardship for the majority of horses except in the excessively hot and dusty weather of the summer months, when it is necessary to water horses on the road when taking long trips or making long hours at work without going home.

If more money were expended in the ways suggested, much good might be accomplished. It has been customary until recently to order the horse killed, and tell the owner he must disinfect. During the last two years a little disinfecting has been performed by the State, and a little work done with mallein; but with the appropriations available the tendency has been to economize as much as possible in every direction, in order to save every available cent for the purpose of paying for tuberculous cattle. If more liberal appropriations cannot be made, then would it not be better to change this system for a few years, and expend a larger proportion of the money for the eradication of glanders, as the most serious problem at present confronting us?

The law provides a penalty for any one removing, transporting or selling an animal with a contagious disease, if the person knows or has reasonable cause to believe such to be the fact. Persons disposing of glandered horses always deny that they knew or suspected the existence of a contagious disease, and it is therefore useless to prosecute cases unless proof is forthcoming to show there was good reason for believing the presence of glanders and farcy. There was but one case in 1903 where the Chief of the Cattle Bureau, with the assistance of the State police, prosecuted a man for disposing of a glandered horse. This occurred at Lowell, and a conviction was not secured, as it was not possible to prove that the man knew the horse had glanders or farcy when he sold it.

Most of the work in connection with glanders during the past year, as well as in the previous year, has been done by or under the direct supervision of Dr. Howard P. Rogers, an agent of the Cattle Bureau, and this opportunity is taken to say that his efficiency and the interest he has shown are most praiseworthy and commendable.

Contagious Diseases of Swine.

During the year 1903, 36 outbreaks of contagious diseases among swine upon as many different premises have been reported to the Cattle Bureau from 23 cities and towns in various parts of the State, scattered from Bristol and Essex counties on the east to Berkshire on the west. In 2 reported outbreaks no disease of a contagious character was found to be present. The rest were all of the hog-cholera type, as this portion of the report does not include swine exposed to or infected with foot and mouth disease, the figures for these being given under the statistics of foot and mouth disease.

The swine upon the premises where sickness resembling hog cholera has been found numbered between 700 and 800, of which 135 died, and the rest were released when the disease disappeared from among them. In some instances owners were allowed to kill for market, upon quarantined premises, pigs which were ready for the pork barrel and showed no symptoms of disease.

In a number of cases the swine were fed upon city swill or upon swill from hotels.

Hog cholera is a generic term, applied to diseases of an apparently contagious character among swine. As a matter of fact, these animals seem to have several diseases, resembling each other, but due to different causes. In addition to hog cholera and swine plague, diseases known to be due to a specific cause, pigs sometimes are made sick from washing powder used for cleaning dishes in hotels where the dish water is added to the swill. Recently the United States Bureau of Animal Industry has been investigating a malady among swine, which occurred in Iowa, the clinical symptoms of which resemble hog cholera, but in which neither the hog cholera nor swine plague bacillus was present, and for which the organism producing it has not yet been discovered. While this disease has been found thus far only in Iowa, it is not unlikely that it may exist in other localities.

In these outbreaks of disease resembling hog cholera among swine, the premises are quarantined until the sick pigs die or recover, and the pens have been disinfected. These measures seem sufficient to check the spread of the disorder and terminate the outbreak. In addition, changing the food and more attention to cleanliness seem to be beneficial.

Besides the reports of diseases grouped under the term hog cholera, there has been 1 case of tuberculosis quarantined, the animal being a sow owned in Wrentham. The inspector of animals in Wrentham made an autopsy upon her, and reported that she was badly tuberculous.

Rabies.

Rabies at present seems to be of very infrequent occurrence in Massachusetts; although it prevailed extensively in some localities a few years ago, it now seems to be practically eradicated. Since the case mentioned in the report of January, 1903, in a dog at Pittsfield, only a few cases of rabies or suspected rabies have been reported.

Three dogs with symptoms of rabies have been reported as having been killed, but, as rabbits were not inoculated from these animals, the diagnosis was not proved. Two other dogs showed suspicious symptoms, one in Cambridge in May, the other in Stoughton in September; but rabbits inoculated with material from the base of the brain from each have remained healthy, showing that the canines were not victims of hydrophobia.

There were two positive cases which are interesting, as the animals probably were infected outside of Massachusetts, and developed the disease after arrival in this State.

One of these was a green horse, bought at a sales stable in Boston a day or two after coming off the cars, and taken to Westborough May 26. Dr. W. M. Balmer of Westborough reported that the horse appeared to be feverish and ailing June 18, with a temperature of 104° F., and acted as though he had influenza. The following day, June 19, Dr. Balmer again saw his patient about 5 o'clock in the afternoon, and the only apparent improvement was a drop of two degrees in temperature. The animal still refused to eat, and objected strongly to the administration of medicine. Saturday forenoon, June 20, the horse was led out on the halter, when he ate quite a little grass, drank some water and was returned to his stall. Up to this time he showed no signs of viciousness. An hour later he would allow no one to approach his stall, and excitement seemed to increase his viciousness, he giving vent to it by kicking the sides of his stall.

About 7 o'clock in the evening Dr. Balmer was summoned in a hurry. He found the horse tearing at his breast, which he had laid open with his teeth, throwing himself down and biting at his forearm, jumping up and kicking. He kept this up until exhausted. He made no attempt to bite any one but himself, but would kick at the approach of a person. He exhausted himself in a short time, and was apparently dying; and, as he could not be controlled by any means, it was deemed best to kill him.

At the Harvard Medical School Dr. Frothingham succeeded in producing rabies in rabbits from portions of the brain sent by Dr. Balmer.

No history can be obtained of this horse having been bitten after his arrival in Massachusetts; the probability is that he was bitten while in the West, before shipment to this State.

The other case was that of a dog owned by a vaudeville actor performing at Keith's theatre, in Boston, early in September. The dog was noticed to be ailing, and was sent to the Boston Veterinary Hospital, where a diagnosis of rabies was made, and the animal reported to the Boston board of health. Dr. Alex. Burr, veterinarian to the Boston board of health, reports that the dog was killed, and rabbits inoculated from the base of his brain developed rabies. As the owner of this dog performed in various places, an engagement at one of these theatres being usually of a week's duration, and as there is no history of any cases of rabies among dogs elsewhere in Massachusetts, the probabilities are that he was bitten while outside of the State, and developed symptoms of the disease during his master's engagement in Boston.

This is an illustration of how readily rabies might be reintroduced into Massachusetts. If this dog had strayed away and bitten other dogs, instead of being sent to the hospital, a great deal of trouble might easily have ensued.

Miscellaneous Contagious Diseases.

The law relating to contagious diseases among animals in this Commonwealth is contained chiefly in chapter 90 of the Revised Laws, and section 28 reads as follows: —

Contagious diseases, under the provisions of this chapter, shall include glanders, farcy, contagious pleuro-pneumonia, tuberculosis, Texas fever, foot-and-mouth disease, rinderpest, hog cholera, rabies, anthrax or anthracoid diseases, sheep scab and actinomycosis.

There are other diseases of a contagious nature not mentioned in section 28, chapter 90 of the Revised Laws, over which it might be necessary to have the Cattle Bureau exercise some authority in case of their becoming troublesome, and for which the law does not seem to fully provide. Mange among cattle has recently been very troublesome in the far West and South-west, although no cases have as yet been reported in the East; a few cases reported as mange among young cattle were found to be ringworm. A few cases of mange in horses are reported to have occurred in North Attleborough early in the summer; but these cases yielded to ordinary treatment at the hands of the owners, and the trouble seems to have been limited to two stables there. A similar disease appeared in a stable in Foxborough, the owner of which runs a stable in Cottage City during the summer; the horses which he took to Cottage City developed some skin trouble, but recovered under treatment. This skin disease seems to have been carried to North Attleborough and Foxborough, as nearly as can be ascertained, by a horse used on the route of a tea company coming from Providence, which was baited at stables in these two towns.

Mange among dogs, particularly follicular mange, is a troublesome disease and a loss to dog owners. During the year several cases of follicular mange among dogs have been reported. Worthless animals with this disease should be killed, and kennels where it is bred should be quarantined until the disease has been eradicated from them. If dog fanciers or horse or cattle owners desire any legislation on mange, they should ask for it; the Cattle Bureau can enforce any laws applying to it that may be made. At present the only parasitic disease mentioned in the list of contagious diseases recognized by law is scabies in sheep. Sheep scab is a parasitic disease, and is the mange of sheep, being of the same character as mange in other animals, each species of animals having its own particular species of parasite.

Takosis is a new disease of an infectious character occurring in goats, more particularly the Angora goat, mentioned in the nineteenth annual report of the United States Bureau of Animal Industry. The investigations made have been conducted in Washington by Dr. John R. Mohler and Dr. Henry J. Washburn. At present the Angora goat industry in Massachusetts has not attained a size and importance to attract a very great amount of public attention; but if many persons should become interested, this disease would undoubtedly prove very troublesome, as a few of those who have already started flocks know to their cost. It is very fatal, and frequently causes the death of nearly all the animals in a flock.

Losses from *black leg* among young cattle during the past year seem to have been practically unknown; and, beyond giving protective inoculations to a few animals in Ashby, no measures for dealing with this disease have been necessary.

In making an estimate for the appropriation needed for the Cattle Bureau during the ensuing year, the sum of $100,000 will be necessary for carrying on the work properly; and this has been named as the amount needed, in sending an estimate to the State Auditor in December.

Respectfully submitted,

AUSTIN PETERS,
Chief of Cattle Bureau.

THIRTEENTH ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED UNDER

CHAPTER 89, SECTION 12, REVISED LAWS.

JANUARY 15, 1904.

DAIRY BUREAU — 1903.

C. D. RICHARDSON, WEST BROOKFIELD, *Chairman.*

JOHN M. DANFORTH, LYNNFIELD CENTRE.

A. M. LYMAN, MONTAGUE.

Secretary.

J. LEWIS ELLSWORTH, *Executive Officer and Secretary of the State Board of Agriculture.*

General Agent.

P. M. HARWOOD.

ADDRESS, ROOM 136, STATE HOUSE, BOSTON.

REPORT.

The character of the work of the Bureau has been more or less affected by recent national laws and the rulings of our superior court judges; more care and expense in securing evidence are now necessary; prima facie evidence is no longer as useful as formerly, and technical cases have disappeared almost altogether, actual fraud now usually appearing in the evidence, if not always in the complaint. Whatever has been necessary in the way of expense in obtaining evidence has not been spared, and it has served the purpose of indicating whether the sale was a practice or an accident, also of helping materially in securing conviction in the courts. The result has been most satisfactory, there having been but one violation of law prosecuted during the year which ultimately failed, and that simply because the party could not afterwards be found; the total convictions for the year being 34 more than in any previous year, and 72 more than the average for the three preceding years. About the usual amount of educational work has been done. The office of the general agent has been removed to the State House, and his entire time is given to the work.

The membership of the Bureau has been materially changed. The chairman, J. Lewis Ellsworth, retired July 1, to become secretary of the State Board of Agriculture, and executive officer of the Dairy Bureau. C. D. Richardson was elected chairman. F. W. Sargent was succeeded by John M. Danforth, and A. M. Lyman was appointed to fill the vacancy caused by the retirement of Mr. Ellsworth. At the annual meeting of the State Board of Agriculture, Jan. 14, 1903, P. M. Harwood was elected general agent. A. W. Lombard has been employed regularly as agent, and four others have been employed as occasion required. The chemical work has been done by Dr. B. F. Davenport of Boston and E. B. Holland of the Hatch Experiment Station, Amherst.

The work of the year has been as follows: —

Total number of inspections,	5,524*
Number of inspections where no samples were taken,	4,135
Number of samples of butter and oleomargarine, nearly all purchased,	1,379
Number of samples of milk and cream,	16
Cases in court,	289
Meetings addressed by the general agent,	20
Meetings addressed by the chairman of the Bureau,	7

Cases prosecuted † during the year, by months and courts, with law violated, and results, are as follows: —

Court.	Month.	Number.	Law violated.	Convicted.	Discharged.
West Newton,	January,	5	Milk,	5	-
Chicopee,	January,	2	Milk,	2	-
Worcester,	February,	2	Oleomargarine,	2	-
Lynn,	February,	6	Renovated butter,	6	-
Salem,	February,	1	Renovated butter,	1	-
Waltham,	February,	2	Renovated butter,	2	-
Cambridge,	March,	5	Renovated butter,	5	-
Newburyport,	March,	2	Renovated butter,	2	-
Newburyport,	March,	6	Oleomargarine,	6	-
Gloucester,	March,	2	Renovated butter,	2	-
Hudson,	March,	1	Renovated butter,	1	-
Marlborough,	March,	1	Renovated butter,	1	-
Quincy,	April,	2	Oleomargarine,	2	-
Quincy,	April,	3	Renovated butter,	3	-

* Six extra samples were taken during inspections, therefore this total is 6 less than the sum of the next three items.

† As this is a table of prosecutions, and not of cases entered in court, all *nol pros* cases — 10 in number — are eliminated.

Court.	Month.	Number.	Law violated.	Convicted.	Discharged.
Fitchburg, . .	April, . .	2	Renovated butter, .	2	–
Franklin, . .	April, . .	2	Renovated butter,	2	–
Athol, . .	April, .	2	Oleomargarine, .	2	–
Attleborough, .	April, . .	4	Renovated butter, .	4	–
Attleborough, .	April, . .	2	Oleomargarine, .	2	–
Lynn, . .	May, . .	2	Renovated butter, .	2	–
Lynn, . .	May, . .	4	Oleomargarine, .	3	1*
Taunton, . .	May, . .	4	Renovated butter, .	4	–
Amesbury, .	May, . .	2	Oleomargarine, .	2	–
Amesbury, .	June, . .	1	Oleomargarine, .	1	–
Amesbury, .	June, . .	2	Renovated butter, .	2	–
New Bedford, .	June, . .	4	Renovated butter, .	4	–
New Bedford, .	June, . .	6	Oleomargarine, .	6	–
Lowell, . .	July, . .	10	Oleomargarine, .	10	–
Lowell, . .	July, . .	10	Renovated butter, .	10	–
Provincetown, .	July, . .	2	Renovated butter, .	2	–
Cottage City, .	August, .	2	Renovated butter, .	2	–
Malden, . .	August, .	2	Renovated butter, .	2	–
Chelsea, . .	September, .	4	Renovated butter, .	4	–
Plymouth, . .	September, .	2	Renovated butter, .	2	–
Dedham, . .	September, .	2	Renovated butter, .	2	–
Dedham, . .	October, .	2	Renovated butter, .	2	–
Worcester, .	October, .	26	Renovated butter, .	26	–
Worcester, .	October, .	10	Oleomargarine, .	10	–
Somerville, .	October, .	4	Renovated butter, .	4	–
Lawrence, . .	November, .	10	Renovated butter, .	10	–

* In this case, reported as discharged, a husband testified that his wife was the owner of the place. The wife was afterwards complained of for the same offence, and convicted.

Court.	Month.	Number.	Law violated.	Convicted.	Discharged.
Fall River, .	November, .	56	Renovated butter, .	50	6*
Fall River, .	November, .	2	Oleomargarine, .	2	-
Dedham, . .	November, .	2	Renovated butter, .	2	-
Lynn, . . .	December, .	4	Renovated butter, .	4	-
Northampton, .	December, .	1	Renovated butter, .	1	-
Salem, . .	December, .	5	Renovated butter, .	5	-
Salem, . .	December, .	2	Oleomargarine, .	2	-
Holyoke, . .	December, .	12	Renovated butter, .	12	-
Pittsfield, . .	December, .	2	Renovated butter, .	2	-
North Adams, .	December, .	8	Renovated butter, .	8	-
Springfield, .	December, .	14	Renovated butter, .	14	-
Lowell, . .	December, .	4	Renovated butter, .	4	-
Lowell, . .	December, .	4	Oleomargarine, .	4	-
		279		272	7

The charges in the several cases in court for the year have been as follows: —

Selling renovated butter in unmarked packages, ...	226
Oleomargarine sold as and for butter, ...	23
Oleomargarine sold in unmarked packages, ...	14†
Oleomargarine sold from unmarked vehicle, ...	1
Oleomargarine sold in imitation of yellow butter, ...	3
Oleomargarine served in restaurants without notifying guests, .	15
Milk adulterated, ...	6
Milk below standard, ...	1
	289

* In 5 of these 6 cases, reported as discharged, complaint was afterwards brought against the clerks who actually made the sales, and all were convicted. In the sixth case our agents were unable to afterwards find the seller; this case, therefore, is the only violation of law prosecuted during the year where conviction was not finally secured.

† In 12 of these cases oleomargarine was sold as and for butter, but the cases were entered as above, for convenience.

The following is a list of inspections without samples and the number of samples taken since the organization of the Bureau. In 1891 and 1892 none were reported.

Year.	Inspections without Samples.	Samples taken.
1893,*	382	113
1894,	716	388
1895,	1,901	474
1896,	1,949	495
1897,	1,986	212
1898,	1,351	1,140
1899,	1,935	1,459
1900,	1,612	826
1901,	1,757	911
1902,	3,895	1,078
1903,	4,135	1,395
Totals,	21,619	8,491

* Stores.

The following is a list of the number of cases entered in court and also the number of convictions secured each year since the organization of the Bureau: —

Year	Total Cases.	Convictions.
1891,	–	–
1892,	–	–
1893,	48	30
1894,	104	71
1895,	82	42
1896,	76	51
1897,	26	24
1898,	60	59
1899,	87	70
1900,	178	144
1901,	252	218
1902,	285	238
1903,	289	272
Totals,	1,487	1,219

The following are averages of convictions since the establishment of the Bureau: —

First two years, ...	No convictions.
Average convictions per year for first seven years after prosecutions were begun, ...	50—
Average convictions per year for the next three years, ...	200
Convictions this year, ...	272
Average convictions per year since prosecutions were begun by Bureau, ...	111—

Oleomargarine.

Prior to the passage of the national law which went into effect July 1, 1902, and practically legislated oleomargarine containing foreign coloring matter out of our local markets, because of the tax of 10 cents per pound imposed, the profit of selling oleomargarine as and for butter was so great that violations of the Massachusetts anti-color law were frequent. The work of the agents of the Bureau in those days was very largely of a detective nature, months sometimes being consumed in working up cases against pedlers and others who were persisting in violating the law. Now all is changed. But few of the old stores, where the law was formerly violated, remain in the same hands, and a large number of the pedlers have gone out of business, rarely showing signs of prosperity as a result of money made from the illegitimate traffic. At the present time most of the goods are on sale by reputable grocers, are uncolored, and in the main, although by no means always, sold according to law; but the sales are light and the profits small. It seems to us that this reversal of oleomargarine interests has been brought about in no small degree by the oleomargarine men themselves. Oleomargarine may be clean and wholesome when properly made, and cheap; but the moment it is sold as and for butter it becomes a fraud, an imposition upon the public, and robs the butter maker of his legitimate market. Hence laws, State and national, have been enacted, until to-day oleomargarine seems to be forced back upon its own merits; and, unless the present laws are upset by supreme court decisions, it will have to remain there, winning whatever favor it can upon merit alone. This is as it should be. But it has not been brought about without a struggle.

Early in the year Judge Bishop of the superior court in

Boston made a ruling which was afterwards endorsed by Judge Stevens, and which practically nullifies the anti-color law except in cases where foreign coloration can be proved. Prior to July 1, 1902, most of the complaints for illegal sale of oleomargarine were brought under the anti-color law, and the complainant was rarely, if ever, called upon to prove foreign coloration in order to win his cases. This was so because all oleomargarine then made in imitation of yellow butter contained foreign coloring matter in forms easily detected, and therefore no oleomargarine manufacturer or dealer would or could successfully contest the point, and hence did not. But when the national law imposed a tax of 10 cents per pound on oleomargarine artificially colored in imitation of yellow butter, and allowed that not so colored to escape with a tax of $\frac{1}{4}$ of a cent per pound, the manufacturers tried their best to produce an imitation of yellow butter which would not be construed by the internal revenue officers to be "artificially colored." In the first place, an attempt is said to have been made to use a partially bleached cotton-seed oil: but this affected the flavor of the goods so unfavorably that it had to be given up. Then, it is claimed, a cotton-seed oil containing a small percentage of palm oil was used. This went along for some time, making a good imitation of light yellow butter, until a method was discovered by a government chemist whereby the palm oil could be detected, the revenue department ruling that palm oil was an artificial coloration. This ruling is what has finally placed the oleomargarine situation where it is. This last attempt to color their goods in imitation of yellow butter shows the animus of the manufacturers, and also how vitally they consider the point of color in the success of their business. A strenuous effort has been made by them to introduce oleomargarine to the general trade, and a large number of retail merchants have taken out licenses. This was auspicious for the makers and wholesalers, for they were thus able to trade with prosperous merchants and men of good financial standing. The result, however, was not all that had been expected. There seems to be a considerable prejudice yet in the public mind against oleomargarine.

Fifty-six cases for violation of oleomargarine laws have been entered in court during the year.

The number of persons who paid a United States tax the past four years is shown by the following table: —

Years ending June 30.	Wholesale.	Retail.
1900,	3	59
1901,	6	103
1902,	3	48
1903 (colored),	1	24
1903 (uncolored),	7	314
Current year (colored),	–	17
Current year (uncolored),	9	326

Notwithstanding the fact that the number of oleomargarine licenses has greatly increased since the passage of the national law of 1902, the total output has fallen off from 25 to 50 per cent in different sections of the country.

Renovated Butter.

With the partial disappearance of artificially colored oleomargarine there has gradually come to the front violations of the "process" or "renovated" butter law. Never before in the history of the Bureau have there been so many noticeable violations. There have been 226 cases entered in the various courts during the year. The tendency on the part of some retailers to palm these goods off as creamery or dairy butter is remarkable. The color of the goods and the wholesale price make this easy, especially where the butter is cut from tubs or boxes. It is worthy of remark, however, that but two wholesalers, one in the central and the other in the western part of the State, have thus far been detected by the Bureau in violating this provision of law relating to the marking of packages. We are compelled to report that one of these, a very serious violation, has been discovered this year. This is a case where all stamps, brands or marks which would indicate in any way that the contents of the tubs was renovated butter had apparently been removed, and the tubs were not stamped top, bottom and side, as our State law requires, and the goods were sold as "Hawkeye Creamery Butter." One retail dealer alone testified that he had sold several hundred tubs of this brand, under the impression that it was straight creamery butter; and we find indications that seven different stores were retailing this particular brand of goods. The wholesaler pleaded guilty, and was fined $100, the limit for first offences, most of the retailers being fined $25 each.

Preservatives have been conspicuously absent from the renovated butter sold in this State during the past year.

In prosecuting renovated butter cases the Bureau has adopted this year a somewhat different policy. No case has been entered in court except where a sufficient number of samples were previously purchased to indicate that the violation of the law was the habit of the dealer, and not an accident on either his part or that of his clerk. The result has been that all the violations of law entered in court since the adoption of this policy have finally been punished, with but the one exception elsewhere mentioned. As a rule, the proprietors or owners of stores are brought into court to answer these charges, whether the sales were made by them or their clerks, the Bureau believing this to be the correct policy.

There is one marked result in the prosecution of these renovated butter cases, in contrast with violations of the oleomargarine anti-color law, namely, that it is seldom that a man is found violating the law a second time after conviction.

The last Legislature changed the penalty for violation of the renovated butter law, making the fine $25 to $100 for the first offence, with heavier penalties for subsequent offences, the law going into effect June 20, 1903. Since that date but little difficulty has been experienced in securing the imposing and payment of fines. But two parties have appealed their cases during the year.

Educational Work.

The field for labor along the line of educational work, a duty imposed by statute upon this Bureau, is no less broad and of no less importance than is the police side. A better dairy product, put up in a better manner and in better condition, handled with greater care, and finally fed more wisely, will add not only to the enjoyment but also to the health of the consuming public, and incidentally to the financial benefit of the producers. The *best* dairy product, whether milk, cream, butter or cheese, has no competitor, no imitator. Were there no butter that needs "renovating," there would be no "renovated" butter. Were it not that butter is often of an inferior quality, oleomargarine would find little place in the markets of the world, and the possibility of palming it off "as and for butter" would be practically removed. It is along these lines that the Dairy Bureau is interested in its educational duties, and is working so far as the limited funds at its disposal will allow.

The general agent has addressed twenty meetings during the year, and the chairman of the Bureau seven meetings. Several of the more important milk depots and creameries have been inspected by the Bureau, and it is with pleasure that we note the interest in all matters appertaining to the betterment of dairy products, and especially the improvement noticeable in the handling of milk for the Boston market. It is but a few years since when milk brought to Boston was not as well cared for as it might have been, either at the farm or in transit. To-day the milk contractors insist on sanitary conditions at the farm where the milk is produced, and year by year there is improvement. There is also improvement at the handling end, as any one can see by inspecting the various milk depots. There is, however, still room for greater improvement. It is a long road to perfection, and the doctrine of "clean milk" needs to be impressed upon all, until this most useful and nourishing food, in whatever form, reaches the consumer in its highest state of perfection.

Butter.

Notwithstanding the fact that the average wholesale price of butter for the entire year has been slightly higher than for the seven years next preceding, the summer price was abnormally low, and this low price extended well into the autumn. The copious rains and a consequent large amount of green food were apparently responsible for this. Massachusetts creameries have been obliged, however, to sell their butter at lower prices than formerly. Report comes from the west just at the close of the year that there is a shortage of butter production in some sections.

The following table shows the extreme quotation for the best fresh creamery butter in a strictly wholesale way in the Boston market for the last eight years: —

	1903. Cents.	1902. Cents.	1901. Cents.	1900. Cents.	1899. Cents.	1898. Cents.	1897. Cents.	1896. Cents.
January,	28.0	25.0	25.0	29.5	21.0	22.5	22.0	26.0
February,	27.0	28.5	25.0	26.0	24.0	21.5	22.0	24.0
March,	27.0	29.0	23.0	27.0	22.5	22.0	23.0	24.0
April,	27.5	32.0	22.0	21.0	21.0	22.5	22.0	22.0
May,	22.5	25.0	19.5	20.5	19.0	18.0	18.0	17.0
June,	22.75	23.5	20.0	20.5	19.0	17.5	16.0	16.5
July,	20.5	22.5	20.0	20.5	19.0	18.5	16.5	16.5
August,	20.0	21.5	21.0	22.5	21.5	19.5	19.0	17.5
September,	22.0	23.5	22.0	22.5	23.5	21.0	22.0	17.5
October,	22.5	24.5	21.5	22.0	24.0	21.5	22.5	20.0
November,	23.5	27.0	24.0	25.0	26.5	21.0	22.0	21.0
December,	24.5	28.5	24.5	25.5	28.0	21.0	23.0	23.0
Averages,	26.23	25.0	22.3	23.5	22.4	20.5	20.6	20.4

The Chamber of Commerce's figures regarding the butter business in Boston for 1903 and the immediately preceding years are as follows: —

	1903. Pounds.	1902. Pounds.	1901. Pounds.	1900. Pounds.	1899. Pounds.	1898. Pounds.	1897. Pounds.
On hand January 1,	6,248,920	4,512,000	3,285,960	2,073,800	2,829,160	2,473,600	2,898,000
Receipts for the year,	54,347,056	54,574,429	57,499,836	51,502,840	49,757,606	50,609,552	51,107,033
Total supply,	60,595,976	59,086,429	60,785,796	53,576,640	52,586,766	53,083,152	54,005,033
Exports, deduct,	842,692	940,031	5,708,603	1,002,374	3,051,710	1,574,682	3,286,333
Net supply,	59,753,284	58,146,398	55,077,193	52,574,266	49,535,056	51,508,470	50,718,700
Stock on hand December 31, deduct,	7,567,360	6,248,920	4,512,000	3,285,960	2,073,800	2,829,160	2,620,680
Consumption,	52,185,924	51,897,478	50,565,193	49,288,306	47,461,256	48,679,310	48,098,020

Milk.

The milk market has been good throughout the year. Prices have ruled higher than before for many years. It is claimed by the Milk Producers' Union that in the bringing about of the increased price over four years ago the equalization of production and the holding in check of extension of territory have been important factors. In attempting to fix the price of milk (as is done twice each year), great struggles have occurred between the milk producers and the milk contractors, but each time serious trouble has been avoided.

But few prosecutions for violation of the milk law have been made during the year, a less number of complaints than usual having come in. Sixteen samples have been taken, six cases prosecuted for adulteration and one for milk below standard. The adulterations were, in one case, water; in two, formaldehyde; and in three, boracic acid.

The usual tables, with the 1903 prices added, are here given: —

Summer Price.

	Gross Boston Price. Cents.	"Straight Price," Boston. Cents.	Gross to Producer, Fifth Zone. Cents.	Straight Price to Producer, Fifth Zone.* Cents.
1893, April to October, .	33	-	22	-
1894, " " .	33	-	22	-
1895, " " .	33	-	22	-
1896, " " .	33	-	22	-
1897, " " .	31†	-	22	-
1898, " " .	31	-	22	-
1899, " " .	31	-	22	-
1900, " " .	33	-	24	-
1901, " " .	33	31	24	22
1902, " "	36 in April, July, August, September.	34 in April, July, August, September.	27	25
	35 in May, June.	33 in May, June.	26	24
1903, " " .	37½	35½	28½	26½

* The price in the fifth zone, *i.e.*, the middle territory, is approximately the average price which the producers receive for their milk.

† This is a nominal rather than an actual change. With the dropping of the Boston price 2 cents the distance discount-schedule was also lowered 2 cents, so that producers received the same price.

Winter Price.

	Gross Boston Price. Cents.	"Straight Price," Boston Cents.	Gross to Producer, Fifth Zone. Cents.	Straight Price to Producer, Fifth Zone.* Cents.
1893-4, October to April, .	37	-	26	-
1894-5, " " .	37	-	26	-
1895-6, " " .	37	-	26	-
1896-7, " " .	35	-	24	-
1897-8, " " .	33†	-	24	-
1898-9, " " .	33	-	24	-
1899-0, " " .	33	-	24	-
1900-1, " "	37 to January. 35 to April.	-	28 to January. 26 to April.	-
1901-2, " "	36 40 in December.	34½ 38½ in December.	27 31	25.5 29.5
1902-3, " " .	39½	37½	30½	29
1903-4, " " .	39½	37½	30½	28½

* The price in the fifth zone, *i.e.*, the middle territory, is approximately the average price which the producers receive for their milk.

† This is a nominal rather than an actual change. With the dropping of the Boston price 2 cents the distance discount-schedule was also lowered 2 cents, so that producers received the same price.

Creameries and Milk Depots in Massachusetts.

Location.	Name.	Co-operative or Proprietary.	Superintendent or Manager.
Amherst,	Amherst Creamery,	Co-operative,	F. J. Humphrey, agent.
Amherst,	Fort River,	Proprietary,	E. A. King.
Amherst,	Dairy School, Massachusetts Agricultural College,	Educational,	Prof. W. P. Brooks, director.
Ashby,	Ashby Creamery,	Co-operative,	C. Foster.
Ashfield,	Ashfield Creamery,	Co-operative,	Geo. G. Henry.
Belchertown,	Belchertown Creamery,	Co-operative,	M. G. Ward, president.
Boston, 394 Rutherford Avenue,	H. P. Hood & Son,	Proprietary,	H. P. Hood & Son.
Boston, 793 Boylston Street,	Walker-Gordon Laboratory,	Proprietary,	Walker-Gordon Laboratory Company.
Boston, 472 Rutherford Avenue,	D. Whiting & Sons,	Proprietary,	D. Whiting & Sons.
Boston, 388 Rutherford Avenue,	Boston Dairy Company,	Proprietary,	Boston Dairy Company.
Boston, 38 Huntington Avenue,	J. W. Hobart,	Proprietary,	J. W. Hobart.
Boston, 105 Holmes Avenue,	Hingham Dairy Association,	Proprietary,	Hingham Dairy Association.
Boylston,	Adelphia Creamery,	Proprietary,	E. M. Laws.
Bridgewater,	Plymouth County Creamery,	Proprietary,	H. A. Wilbor.
Brockton,	Brockton Dairy Company,	Proprietary,	Brockton Dairy Company.

Creameries and Milk Depots in Massachusetts — Continued.

Location.	Name.	Co-operative or Proprietary.	Superintendent or Manager.
Cambridge, 158 Massachusetts Avenue,	C. Brigham & Co.,	Proprietary,	C. Brigham & Co.
Charlemont,	Charlemont Creamery,	Proprietary,	T. M. Totman.
Cheshire (P. O., Adams),	Greylock Creamery,	Co-operative,	C. J. Fales.
Cheshire,	Highland Creamery,	Proprietary,	Clayton W. Prince
Cheshire,	West Shore Creamery,	Proprietary,	Seth W. Curtis.
Chester,	Chester Creamery,	Co-operative,	J. A. Lynn.
Conway,	Conway Creamery,	Co-operative,	W. A. Pease.
Cummington,	Cummington Creamery,	Co-operative,	S. W. Clark, president.
Easthampton,	Hampton,	Co-operative,	W. H. Wright, treasurer.
Egremont (P. O., North Egremont),	Egremont Creamery,	Co-operative,	H. O. Harrington.
Everett,	New England Creamery Company,	Proprietary,	N. E. Creamery Company.
Framingham (P. O., South Framingham),	Framingham Creamery,	Proprietary,	E. C. Cary.
Fitchburg, 26 Cushing Street,	Fitchburg Creamery,	Proprietary,	G. S. Learned.
Gardner,	Boston Dairy Company,	Proprietary,	Boston Dairy Company.
Groton,	Groton Creamery,	Proprietary,	Myron P. Swallow.
Haverhill,	Haverhill Creamery,	Proprietary,	G. H. McCormick.

Heath,	Heath Creamery,	Proprietary,	J. W. Stetson & Son.
Hinsdale,	Hinsdale Creamery,	Co-operative,	B. C. Bliss.
Lee,	Lee Creamery,	Proprietary,	P. A. Agnew.
Leominster,	Leominster Creamery,	Proprietary,	G. S. Wass.
Marlborough,	Este's Creamery,	Proprietary,	F. S. Este.
Monson,	Monson Creamery,	Proprietary,	W. C. Moulton.
Montague,	Montague Creamery,	Co-operative,	A. M. Lyman.
Monterey,	Berkshire Hill Creamery,	Co-operative,	Arthur Miner.
New Boston,	Berkshire Creamery,	Co-operative,	C. D. Sisson, Sandisfield.
New Salem (P. O., Millington),	Millington Creamery,	Co-operative,	W. A. Moore.
North Adams,	N. A. Milk Association,	Proprietary,	L. D. Pierce.
North Brookfield,	North Brookfield Creamery,	Proprietary,	H. A. Richardson.
Northfield,	Northfield Creamery,	Co-operative,	L. R. Smith.
Orange (P. O., North Orange),	North Orange Creamery,	Co-operative,	Jonathan Holt.
Oxford,	Cold Spring Creamery,	Co-operative,	C. H. Wellington.
Shelburne Falls,	Shelburne Falls Creamery,	Proprietary,	Rufus Covell.
Southborough,	Deerfoot Farm,	Proprietary,	S. H. Howes.
Southfield,	Maple Lawn,	Proprietary,	A. C. Lockwood.
Springfield,	Springfield Milk Association,	Co-operative.	F. B. Allen.
Springfield,	Tait Bros.,	Proprietary,	Tait Bros.
Uxbridge,	Blackstone Valley Creamery,	Proprietary,	G. M. Aldrich, treasurer.

Creameries and Milk Depots in Massachusetts — Concluded.

Location.	Name.	Co-operative or Proprietary.	Superintendent or Manager.
Uxbridge,	Farnum Creamery,	Proprietary,	Geo. A. Farnum.
Warren,	Worcester County Creamery Association,	Co-operative,	F. M. Lawrence, treasurer.
Westfield (P. O., Wyben),	Wyben Springs Creamery,	Co-operative,	C. H. Walcott.
West Newbury,	West Newbury Creamery,	Co-operative,	S. O. Ordway.
West Stockbridge (P. O., State Line),	State Line Creamery,	Proprietary,	Jas. Lee.
Williamsburg,	Williamsburg Creamery,	Co-operative,	E. T. Barrus, president.
Worthington (P. O., Ringville),	Worthington Creamery,	Co-operative,	W. R. Bates.
Worcester,	Wachusett Creamery,	Proprietary,	E. H. Thayer & Co.

Expenses.

The following is a classified statement of the expenses for the year: —

Bureau: compensation and travelling expenses,	$325 10
Agents: compensation,	1,542 50
Agents: travelling expenses and samples purchased,	2,387 98
General agent: travelling expenses, postage, telephone,	496 68
Chemists: analyses, tests, court attendance,	1,864 00
Supplies and printing,	175 69
Educational,	208 05
	$7,000 00

P. M. HARWOOD,
General Agent.

Accepted and adopted as the report of the Dairy Bureau.

C. D. RICHARDSON.
JOHN M. DANFORTH.
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BULLETINS

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FRUITS FOR THE HOME GARDEN: VARIETIES AND CULTURE.

BY PROF. F. A. WAUGH, PROFESSOR OF HORTICULTURE, MASSACHUSETTS AGRICULTURAL COLLEGE.

Fruit growing has unquestionably made great progress in the United States and Canada during the last decade. This progress has been not only scientific, but practical. We know more about the principles involved, and we also understand better why these principles should be applied.

Somewhat curiously, however, this improvement has been confined almost wholly to the growing of fruit in large quantities for market. The whole tendency of the time has been toward the cultivation of large orchards, consisting of only one or two varieties of fruit. All the methods of cultivation have been bent to this purpose. All the discussions of practical men and all the investigations of scientists have been faced in this direction. The growing of fruit in a small way in the home has been neglected and almost forgotten. This is quite a different matter, and one in which we have made no progress. In fact, we are not so well off now, on the whole, as were our fathers in the time of Marshall P. Wilder, Hovey and the Downings.

There are many indications, however, that we are coming back to a greater appreciation of the home fruit garden. It is much to be hoped that many farmers and suburban families will grow more fruit for themselves, and without an idea of making the business a profitable market venture.

In choosing varieties for a home garden, one must make his selection according to principles essentially different from those which govern him in setting out a commercial orchard. (1) In the first place, the home orchard requires a large number of varieties. The commercial growers now commonly confine themselves to two or three at the utmost, whereas every man would like to have his table supplied with a large variety and through a longer season. (2) This means that the selection of varieties for the home garden should be so arranged as to produce this required succession. (3) In the home garden quality will be considered chiefly, whereas in the commercial orchard prolificacy in bearing and high color of the fruit are primarily sought for. (4) Old favorites will be especially considered in the home garden. Every man has some particular apple which he especially fancies, perhaps on account of some old association or for some less obvious reason. All such varieties should be cherished in the home garden, although it would be a fatal mistake to plant them for profit. (5) As regards apples particularly, one more observation may be made, *i.e.*, that a much larger percentage of summer and autumn varieties may be planted in the home garden than could be justified in the market orchard.

With these principles in view, I will now name those fruits amongst which the grower would most naturally choose in making up a list for a small home garden in Massachusetts. It should be understood, of course, that I do not recommend the planting of this entire number, nor, indeed, do I insist upon any particular variety. I have already said that every man must follow his own preference and judgment very largely. When one is planting for commercial purposes, he has to meet the requirements of the market; when he plants for himself, he suits his own taste.

Apples. — Red Astrachan is perhaps one of the first apples to be ready for eating in this latitude. It is of very brisk and tart flavor, and answers the purpose for producing the yearly cases of apple colic so much required in a thriving family of farm boys. For this good work it should not be overlooked. It makes good apple-sauce, and is attractive for some other reasons, but its chief merit is its earliness.

Early Harvest is usually held to be an apple of much better quality than the last, although there is a difference of opinion on this point. It is a good eating apple, however, and fairly good for cooking, so that it falls into the succession very nicely.

Williams (Early Williams or Williams Favorite): This is one of the best apples of the season. Personally, I would almost as soon save my appetite until Williams is ready, as to spoil it with Red Astrachan and Early Harvest. Williams forms a good, hardy tree which bears well. The fruit is medium size, of good form and highly colored. This variety ought never to be overlooked in making up a family orchard.

Grimes (Grimes Golden) is highly regarded in the west, and, though comparatively less popular here, is still a favorite with many good, old-fashioned people. The tree is not a very thrifty grower, although it is not subject to diseases. It is a fairly prolific bearer. The fruit is medium size, bright, clear yellow, aromatic and of high quality. It is excellent for baking or for making pies.

McIntosh (McIntosh Red) is gaining in popularity in New England. It is now quite largely planted in the northern New England States, and is gaining friends in Massachusetts. The tree is remarkably thrifty and clean, an upright grower and an early and fairly heavy bearer. The fruit is large, fair, highly colored, with aromatic white flesh, very juicy and sprightly. It is considerably subject to the attacks of the apple scab, and requires thorough spraying in order to secure good results.

Gravenstein is one of the best of the autumn apples, and is suitable for every purpose. It is good to eat out of hand, excellent for pies and unsurpassed for baking. The tree is vigorous, thrifty and upright, and bears well. It succeeds in nearly all parts of Massachusetts.

Mother is a fine apple, which is rather rarely found, but which is worth the extra trouble required in its cultivation. It is rather shy in bearing, and somewhat subject to the attacks of the railroad worm.

Primate is another early fall apple of superior quality, which is rarely planted. It is somewhat difficult to cultivate, and the fruit is so tender that it cannot be sent to market, but it is a dessert fruit of the first rank.

Porter is a favorite apple in some parts of New England, and succeeds in certain localities in Massachusetts; in other localities it does not seem to be a success. It is especially good for cooking, although it is also an excellent dessert fruit.

Harvey (Fall Harvey) is an old Massachusetts apple, now most popular in Maine, but one well worth growing in many parts of this State also. It is a medium large, oblate-conic, rich yellow fruit, with a blush in the sun. It ripens in October, and is good for eating or for cooking.

Fall Pippin, in the localities where it succeeds, is one of the best of all autumn fruit. It is not highly colored and does not ship well, so that it is not a popular market variety; but when nicely grown and eaten at home it cannot be surpassed. It is one of the best of all apples for baking.

King (King of Tompkins County) is generally recognized as one of the standard market varieties, although not one of the leaders; still, it is a good variety for home use. Its fine color and aroma and its high quality recommend it to all fruit lovers. The tree is not very thrifty, and the variety does better if top-grafted on Spy, Ben Davis or Tolman.

Washington Royal (Palmer Greening): This variety is justly a favorite in many parts of its own State, — Massachusetts. In many localities it very properly supplants the better-known Rhode Island Greening. It is ready for use from the latter part of November till the middle of January, although with good storage it can be kept considerably longer. The tree is thrifty and vigorous, hardy and prolific.

Rhode Island Greening: This old favorite is losing ground not only in Massachusetts but in the home State as well. It is still extensively grown for market in certain especially favorable localities. It can be cultivated with success in the higher altitudes of Worcester, Berkshire and Franklin counties, but cannot usually be relied on elsewhere.

Sutton (Sutton Beauty) is another Massachusetts apple enjoying a deserved popularity. The tree is fine, thrifty, vigorous and upright, and bears early. When it comes into bearing the tree spreads and forms a round top somewhat like King. The fruit is highly colored and of good quality.

Baldwin: This is the old stand-by in Massachusetts, and requires no comment. The man who does not know all about Baldwin had better emigrate to Texas.

Spitzenburg is regarded by many as being the highest in quality of all our American apples; it is certainly one of the finest dessert fruits now grown. It is not adapted to Massachusetts, however, except on the higher lands in Worcester County and the western part of the State. Even in the localities generally adapted to it the tree is a poor grower, and much subject to disease. In order to overcome these difficulties, it is best to graft it in the tops of other trees.

Northern Spy is another great favorite, and one of many good qualities, which succeeds only on the higher lands in this State. It is always rather slow in coming into bearing, and frequently is a shy bearer throughout its life. Its high quality and the success with which it keeps late into the winter, however, make it almost a necessity in the home garden.

There are many other varieties, such as Westfield, Maiden Blush, Belleflower, Fameuse, Switzer, Swaar, etc., which might be mentioned in this list, and which would doubtless be chosen by many persons who have preferences for them. It is impossible, however, to name all the apples which might be used in a fruit garden in Massachusetts. The foregoing list completes those which seem to the writer to be most interesting.

No sweet apples have been named in the foregoing list. It is difficult to find a good sweet apple. Probably Tolman is the best, although Leicester Sweet and Orange Sweet are preferred by many. In the selection of sweet apples, one should be left entirely to his own preferences.

Pears. — The selection of pears is even more difficult than the selection of apples. There were more varieties named in the books up to a few years ago than there were of apples, and doubtless more varieties cultivated in Massachusetts. At the present time, however, the nurserymen propagate comparatively few. The principal ones will be named below.

Bartlett is doubtless the pear most known. It is a fruit of good color, good flavor and good tree. It can be generally recommended.

Clapp (Clapp's Favorite) is another good old-fashioned pear, planted by nearly all growers in this part of the country. It is ready for eating about the middle of September, and is of good quality.

Sheldon is not so highly colored as some of the other pears, but it is of fairly good quality and large size, and comes later in the season, about December 1.

Duchess (Duchess d'Angouleme) seems not to be very generally grown. There is a notion that it does not succeed very well in this climate. It is said to thrive better when budded on quince roots. When properly grown, it is one of the finest in quality of all the pears, and should not be dismissed from the fruit garden without trial.

Lawrence is a fine autumn pear for home use. It is a medium-sized, smooth-skinned, golden-yellow fruit, rather soft and juicy, very sweet and mild.

Howell is an excellent medium-sized pear, and a favorite with many.

Bosc is a medium autumn variety, ready for the table about November 1. It is roundish pyriform in shape, and rather dull colored.

Seckel is a small pear, but one of the finest in quality ever grown in America. It ought to be in every family collection.

Peaches. — Mountain Rose is the first of the early peaches which in my judgment is worth growing. There are several varieties which would come in a few days ahead of it, but they are small and poor. The fruit of the Mountain Rose is not large, but is excellent in quality. It is a white free-stone.

Early Crawford is probably the next variety of merit to ripen. It is a well-known yellow free-stone peach, and hardly need be described more particularly.

Elberta comes next in season of the leading varieties. It is comparatively new to Massachusetts, and many persons like the quality less than Early Crawford or Late Crawford. It is an early and prolific bearer, and well worth planting; yellow free-stone.

Late Crawford: This large, late, yellow free-stone variety is also well known in Massachusetts, and is a great favorite.

Crosby: This is a good yellow peach, of late season, commonly grown in this State.

Oldmixon is probably the standard white-fleshed peach in Massachusetts, although inferior, in the judgment of the writer, to the Belle of Georgia, which ripens at the same season.

Among these standard varieties already noted there are many promising and well-known sorts, many of which are worth while, but none of which can be safely recommended to the entire State. Among these varieties the writer is especially fond of the white-fleshed varieties of the Chinese cling-stone type. Hiley, Waddel and Belle of Georgia are the best of these, and are all white-fleshed free-stones of high quality.

Plums. — The introduction of the Japanese plums during the last few years has revolutionized plum-growing throughout the country. These new Japanese varieties, along with a few hybrids, have nearly, though not quite, supplanted the old-fashioned kinds. In the following list the old-fashioned plums and the Japanese will be given separately, the former first.

Green Gage: Under this name plums of several different varieties are grown. The two principally found are the true Green Gage and Bavay's, the latter often called Bavay's Green Gage, Reine Claude de Bavay, etc. The true Green Gage is smaller and earlier, while Bavay is larger and later. Both are of remarkably fine quality, — in fact, unsurpassed. They are especially good for canning. The skin and the flesh are green or greenish yellow, very firm, and the flesh clings to the stone.

McLaughlin is somewhat of the same character of Bavay, but softer fleshed, and inclined to have a pink cheek. The quality is very fine. The tree is not thrifty, and requires a good deal of petting in order to keep it in condition.

Bradshaw is a purple plum, large to medium sized, and good quality. It is a very desirable canning plum.

Fellenberg (Italian Prune, York State Prune): This is a good late blue plum, which bears heavily after the tree reaches maturity, which requires several years. It is not of high quality, but yet cans well, and is recommended by its late season and by the fact that it is a free-stone.

Quackenbos is a medium late, roundish blue plum of firm yellow flesh and fair quality. It should be especially recommended to those persons who wish to have a blue canning plum.

Damson: Under this name several different varieties are grown, all of which are considerably alike, however. The fruit is small, hard, sour, and fit only for culinary purposes. It is a great favorite with many housewives, however, and should be included or omitted on the recommendation of the cook.

Japanese Plums. — Abundance is one of the favorites in this class, especially for home use. It comes early, ripening here late in July, usually being eaten by the birds. It is good quality, but the skin is soft and easily broken.

Red June comes about the same time, or a little earlier. It is prolific and a good tree, but the fruit is not of high quality.

Burbank is probably the best of all the Japanese plums for this section. The tree is a sprawling grower, and very prolific. The fruit is round, slightly pointed, yellow, covered with red, firm and of good quality. It is an excellent canning plum.

Chabot has not been much planted in Massachusetts, but is an excellent variety, much like Burbank in fruit, but with a better, more upright tree.

Satsuma is a large, red-skinned plum, with very dark blood-red flesh. It is, however, regarded by many housewives as excellent for canning. It will not succeed in certain locations, but seems to do well in most parts of this State.

Wickson is commonly classed as a Japanese plum, although in reality it is a hybrid, and only half Japanese parentage. It is a large, handsome, red-and-yellow plum; the tree is upright, and comparatively slow in coming into bearing. In some places it seems to bear heavily, in others sparsely.

Cherries. — Nearly all the amateurs in this country are still trying to grow sweet cherries, but as a matter of experience it may be said that they do not usually pay for the ground they stand on. Black Tartarian, Elton, Windsor and a few others give half success at times, but even so much encouragement as that is exceptional. The only satisfactory varieties are the so-called sour Kentish or pie cherries. Of these there are three standard varieties. Early Richmond is the first in season, the fruit being light red. Montmorency comes next in ripening. It is a larger tree, and more satisfactory in bearing. Morello comes late, and is almost black and quite sour. The tree is dwarf, and very prolific. It is one of the most satisfactory garden trees in the list.

Apricots. — These fruits are grown to some extent in this country, but are not very popular. The tree is much like that of the peach, and the culture is the same. Some of the new Russian apricots are promising, but have not yet been sufficiently tested to make it safe recommending them. The varieties commonly planted are Early Moorpark and Alexander.

Nectarine. — This fruit is also very much like the peach, and in most respects is not superior to it. It makes a pleasing variety in the garden, however, and one who likes to have a large selection of fruit should not omit the nectarine. The varieties commonly grown are Downton and Newington.

Quince. — This fruit is always useful in its season, and particularly adapted to the household economies of every well-regulated farm family. It should usually be planted in rich, heavy, moist soil. The tree is awkward and wayward in its growth, so that it cannot be pruned into a shapely form. It is a fine bearing tree, however, and good crops can usually be secured with anything like reasonable attention. The best varieties of Massachusetts, according to our experience, are Orange, Champion and Rea's Mammoth.

Grapes. — The grape can be cultivated successfully in all parts of the State, although probably it will succeed better in the warmer portions. It prefers a gravelly or even a stony soil, considerable elevation, and a sunny, warm slope. We prefer to run the trellises east and west, because in that way the vines get the benefit of the sunlight. There are a good many different methods of pruning, which are very interesting. If any one good system is followed, however, it is enough. These systems of pruning cannot be described in a short article like this, but can be acquired best by observation. If one has an opportunity to go into a vineyard properly managed, and see the thing done once by a man who understands it, it will seem a simple matter ever afterward. The best varieties for this section are those which ripen the fruit early. The late varieties do not ripen well in this latitude. The following list does not by any means include all the good grapes for home growing, but does include the most popular.

Concord is by all means the most widely planted, and in many ways is one of the most satisfactory of all grapes. Many people prefer the fruit of that to any other variety. It is thrifty, hardy and prolific. In general, however, we believe that it is better to substitute for it the variety named next.

Worden: This is a seedling of the Concord, and has all the characteristics of the parent variety. Most persons would be unable to tell the one from the other, except that the latter is from one to two weeks earlier. This advantage in earliness is a strong recommendation for Worden, and, as the variety is equally as good as Concord in other respects, it may well be substituted for it.

Green Mountain (Winchell) is a fine, early variety, of comparatively recent introduction. The vine is not a very strong grower or a very heavy bearer. The bunches and berries are small, but the quality is very fine. The fruit is white. It ripens very early, — one of the first of the season, — and is especially to be recommended on that account.

Brighton is a favorite red grape, ripening in mid-season or a little earlier. The bunches are a bit loose, but the fruit is large and of good quality. It is an excellent amateur grape.

Delaware is one of the most popular of all red grapes, although it is a little difficult to grow. The fruit is small, but very fine.

Wilder and Herbert are two excellent black grapes, of large size and superior quality, originated by the late E. S. Rogers of Salem, Mass. Their good qualities are especially responsive to the careful attention of an enthusiastic amateur. They should be included in every private collection where grapes are much prized and carefully managed.

Blackberries. — Blackberries and other small fruits should always be cultivated in the home garden. Blackberries should be planted in rows six to eight feet apart, and four feet apart in the row. The rows will naturally fill in more or less by the growth of suckers, and after mid-season the rows would soon fill up, unless cultivation is practised. It is a good plan to follow a rotation of about six years with blackberries on ordinary soil. The same rule applies to raspberries. After this length of time plantations are inclined to run out, and the crops are not so good. It is best then to set a new plantation on fresh soil, and as soon as that comes into bearing pull up the old one. The blackberries which seem to do best in this State are Agawam, Snyder, Eldorado and Ancient Briton.

Raspberries. — This fruit ought to be planted and managed in much the same way as blackberries. It requires systematic pruning, which means chiefly the cleaning out of old wood and shortening back the new wood to the height of four or five feet. The varieties mostly grown in this section are the following: —

Cuthbert: This variety is grown much more than any other, and is probably, all things considered, the most desirable. The fruit is red.

Gregg is a late black variety, which succeeds admirably in some situations, and which when it does succeed is one of the best of its class.

Kansas is another good black-cap variety, ripening in mid-season. It is preferred by some growers.

Shaffer and Columbian are two varieties differing considerably from those previously mentioned, and new in cultivation. The color of the fruit is purplish, and not attractive. The quality, however, is excellent, and the fruit is very valuable for home use.

Loudon: A medium-sized, hardy and fine quality; red; not quite so productive as Cuthbert.

Currants. — These fruits are especially desirable for jelly making and similar culinary operations. The chief problem in growing is to combat the currant worm. For this purpose thorough spraying with Paris green is best. The best varieties are Fay, Red Cross and Victoria. White currants and black currants are sometimes grown, but are not in great demand.

Gooseberries. — In a few families the gooseberry is indispensable. It is usually not difficult to grow. The standard varieties are Houghton and Smith, although some of the newer introductions promise to be valuable.

Strawberries. — The strawberry bed should be renewed each year. The best practice is to set a new bed every spring, as soon as it can be done conveniently. This bed is enriched and highly cultivated during the year, in order to get the strongest possible growth from the plants. In some systems of cultivation the runners are kept removed, while in others they are allowed to grow in the middle of the row. Such a bed, properly managed, should be in condition to bear a large crop of fine berries the second spring. It may then be left during the third year to bear a second crop, if one insists on it; but the second crop is much inferior to the first, and those who cultivate strawberries extensively have found by experience that it does not pay to carry most plantations over longer than the second year.

There are many excellent varieties, almost any of which will answer for home use, and many of which are desirable. Glen-Mary, Clyde, Brandywine, Sample, Haverland, Marshall and Gandy are among the best, and should be relied on when the planter does not know, from personal local experience in his own garden, that other varieties are better.

In general, the management of the home garden should aim at a high culture, thorough cleanliness and the best enrichment of the soil. It has come to be almost a part of our language that a garden should be a spot exemplifying all the agricultural virtues herein specified. In actual fact, however, we know that very often the garden is the most neglected spot on the farm. Good results in growing of fruits cannot be expected from meagre feeding and slovenly cultivation. The trees and bushes should be always arranged in such a manner that good cultivation can be given with a horse and with horse tools. The mistake is often made of jumbling up a garden in such a way that hand cultivation is required, and this has a tendency to bring about the neglect of the garden concerning which we complain.

A word should also be said in regard to drainage. The garden should have good sub-drainage. Of course this is true of any other agricultural land, but it is more especially required for trees and vines, because they send their roots to great depths. If the sub-soil is cold and wet, therefore, a good growth of trees cannot be expected. In the matter of fertilizing the soil no general rule can be given. Barnyard manure is the best general amendment to most soils, but where humus can be supplied in sufficient quantity by other means, the liberal use of commercial fertilizers should be encouraged. A mixture containing equal parts of ground bone, muriate of potash and nitrate of soda may safely be applied at the rate of fifteen hundred to two thousand pounds to the acre annually. In case nitrogen is supplied by the growth of leguminous crops or the application of barnyard fertilizer, the amount of sodium nitrate may be materially cut down.

SUMMER MANAGEMENT OF THE DAIRY HERD.

BY PROF. F. S. COOLEY, PROFESSOR OF ANIMAL HUSBANDRY AND DAIRYING, MASSACHUSETTS AGRICULTURAL COLLEGE.

The severe early summer drought of the present season has served to emphasize the need of a better average among our dairy cows. It is apparent that some improvement has been made over the stock of half a century ago for dairy purposes, but it is doubtful if the quality has improved as fast as its need. It must be borne in mind that the world is moving, and that to stand still is ruin. Competition is strong, and the cost of production is on the increase. If the value of the product does not increase with the cost of production, then dairying ceases to be profitable.

Probably the average cow in Massachusetts yields about 2,000 quarts of milk, or 200 pounds of butter, worth from $50 to $60 at present prices. With feeds costing what they have for the past two seasons, this leaves little if any margin of profit; and where cows fall below this average, as half of them do, there must be very little compensation for the time expended by farmers in their care. Certainly the prevailing high wages offer strong inducements to sell the cows and enter other pursuits for a cash compensation.

The hope for dairy salvation lies in keeping a better class of cows. Where the average product is now 200 pounds of butter, or 2,000 quarts of milk, it should be 300 to 400 pounds, or 3,000 to 4,000 quarts. The feasibility of securing these higher yields has been amply demonstrated by many carefully kept records. Compare the value of the annual product of a dairy of 15 cows of average quality, which would amount to from $750 to $900, with the possible $1,400 to $1,800 from the same number of a better grade. Does any one believe that, after paying for the extra feed and care, there would not be left a handsome margin of profit from keeping the latter class?

The problem of securing the better grade of cows is for the breeder to solve, and both he and the dairyman who buys his cows all ready for business are too indifferent to the advantages of the better class for their own best interests. I believe that the most serious defect in the present breeding practice is lack of judicious care in the selection of the bull. It is in the sire that we look for superior qualities, and through him that we ought to expect improvement. It is well enough to select good cows for rearing heifers, but whether their progeny is inferior, equal or superior to themselves, depends on the sire. All too often the heifer is inferior to her dam because got by an inferior bull. This fact is not given the prominence it deserves, and even the use of pure-bred sires is not sufficient: for, unless the pure-bred bull inherits dairy qualities of superior order, he has no power to transmit such qualities, even though his blood be blue as the ocean and his pedigree long as the moral law. I would emphasize first the necessity of quality and inherited merit, afterwards the desirability of pure breeding and uniformity. Breeders should take more pains to secure only first-class bulls, and cow buyers should discriminate more sharply against offerings not up to standard quality.

Perennial Dairying.

Another phase which dairying has assumed in recent years is that of continued production throughout the year. Formerly summer dairying was prevalent, as it is now in the more remote localities where pasturage is good. In Berkshire County, Vermont, northern New York, and much of the northern Mississippi valley, the summer dairy product far exceeds that of the winter months. In olden times this was doubtless the best practice, if not indeed the only possible one. It was nature's plan, and husbandmen had not yet learned how to make artificial conditions enough like summer nature to secure a winter milk flow of commercial consequence. Moreover, the demand for dairy products, as well as means of transportation, favored summer dairying.

A great change has been witnessed in the dairy season in the last few decades. Large sections where formerly only summer dairies were kept now make winter the principal season for prosecuting this business. In some instances this amounts to entire suspension of dairying during the summer months. The Connecticut valley is a notable example of this transition. Here, on many farms where large winter dairies are kept, the number of cows is reduced to the minimum in summer, to allow the farmer the time needed for tillage operations and work on special crops, such as onions and tobacco. A more profitable system in most cases would appear to be that of perennial dairying, for which these reasons may be advanced.

First, where dairying does not continue throughout the year, the market is general, and the prices of its products, if not low, are not higher than those for the country at large. Producers cannot secure private trade at the flush season unless they are prepared to take care of their customers when the supply is short. It is a business principle that the time to secure valuable trade is when competitors find it difficult to provide for the wants of their customers. To be able to furnish the goods at such times is to demonstrate one's ability to do so at all times. So, in the butter business, our best creameries and private dairies are able to defy competition when they can furnish choice goods in uniform quantity throughout the year: while in proportion to the fluctuation in their supply they are handicapped in finding satisfactory markets for their products.

When the creamery, with a large private trade which pays several cents more than the general market, finds its cream supply cut down to a low figure, it must either drop a part of its trade, — which once lost is not easily regained, — or else supply this trade with purchased goods, — purchased at a high price in a short season. This latter method either reduces the profits on purchased products to very little, and perhaps even to a loss, or else entails the risk of dissatisfaction and loss of custom by the substitution of other and inferior goods for those with which customers are familiar.

If the creamery is co-operative, the patron's profit is less, because of a shrinkage in product when it is most needed; if it is proprietary, the price paid to patrons is regulated by the same idea. With milk companies contracts are often made whereby producers are paid for a regular product throughout the year, and a lower price for the variable product above this minimum. Obviously in this case the greater the fluctuation the larger the proportion of milk which will bring the lower price.

Farmers frequently fail to hold good contracts, simply because they do not take care of their customers in the pinch. Not only do they fail to reap the benefit of high prices in seasons of scarcity for a surplus product at that time, but are forced to accept lower prices at all times, because of inability to keep contracts in the pinch. Milkmen with private routes do better, but they also experience difficulties in holding trade without a regular uniform supply of milk. It must be obvious, to the dairyman who has carefully studied the possibilities of the business, that the highest success as measured by the balance sheet is achieved by a perennial supply of milk. To the careless and unprogressive farmer it must also be clear that the profits from keeping cows are far from satisfactory. It is my belief that far greater satisfaction than is now felt would follow an earnest effort to maintain a constant and regular milk flow throughout the twelve months.

In whole creamery districts in western Massachusetts I have found fluctuations of from 30 to 60 per cent between the output of the highest and the lowest months. The same fluctuation in a less degree is experienced by the large milk companies of our cities. This means that from one-third to one-half of the entire product must be sold at the general market price, determined by the receipts from the country at large. This price will rule from 15 to 25 per cent lower than that obtained by constant perennial trade; in other words, not far from one-half of our dairy product is sold at a price 20 per cent less than what might be obtained by a perfect distribution of the supply. This means an annual loss of 20 per cent of one-half of $13,000,000, or more than $1,000,000, which might be added to the farmer's profits by better management and very little additional expense.

It is, of course, generally understood that the surplus season occurs in May and June, while August and September are the dry months. The great problem in dairy feeding and management, it seems to me, is to transfer the June surplus to the September deficit.

Winter feeding, so serious a problem a half-century ago, carried on in the most primitive manner by the early settlers, has been solved in a very satisfactory manner by combined experience and scientific research. It has been so thoroughly systemized that pasturage, the main dependence of former generations, is by comparison a difficult method. It is needless, therefore, to dwell upon winter feeding and management at this time, but rather discuss the more uncertain summer conditions.

When severe drought overtakes us at the commencement of summer, as during the present season (1903), it finds stockmen unprepared, and their only way to overcome its effect is by drawing on reserve supplies, or the liberal expenditure of money for purchase of feeds. Such an unusual occurrence cannot be anticipated, and any preparations to meet the contingency inaugurated after its effects are apparent cannot bear fruit until too late, usually long after the drought is broken.

It emphasizes the need of reserve supplies at all times, and of not running too near the shore. It also brings out the advantage of "floating capital," which may be used in tiding over times of emergency. Farmers generally will appreciate the situation of one of the fraternity, who, in comment upon the desirability of floating capital, said, "I can't make the dum stuff float."

In recent years the winter feeding season has been lengthened out at both ends. Cows are brought in from the pastures earlier than formerly, and it is no longer the practice of the best dairymen to turn them out while late snows are still on the ground. Provision for feeding in the barn for a considerable time after cows go to pasture is now the rule. Hay and grain are fed after the cows come in from the pasture at night. Silage remaining from the winter supply may be used, and early spring forage, to be fed green, all serve to make the transition from "hay to grass" less of a shock than it used to be. Concerning forage crops for early spring in our climate there is very little new to write. Winter rye is a standard early crop, which may be fed between May 5 and 20. It is relished by cows until it begins to blossom, and does not occupy the land when needed for summer tillage. It may be used as a nurse crop for clover, or it is out of the way for corn planting. Some judgment is needed in feeding it, or a strong taste will be imparted to the milk. This taste seems to grow with heavy rye feeding as the blossoming stage approaches. Winter wheat and winter vetch may follow rye to the relish of cows, but the uncertainty of a stand of the former and the cost of seed of the latter, together with the abundance of pasture grass the latter part of May, make their general use of doubtful economy.

Clovers are also valuable feeds at this season, and should be grown to their fullest possible extent, for reasons too well known to require statement. If not needed at the season of their maturity as fodders, they are equally valuable to cure for winter forage. But we are discussing supplementary feeds for May and June, which in pasture sections are not needed. It is unusual to meet a shortage at this season, but more often the problem of disposal of surplus confronts us. The season of drought commonly begins in July, and its effects are most apparent between that time and October. At this season drought is not unusual, but the absence of a shortage in atmospheric moisture is the exception. We may safely anticipate a "dry spell" about four years out of five, and, even if it does not materialize, the first flush of pasturage is gone by mid-summer, and pastures no longer produce as abundantly as earlier.

Every dairyman should anticipate these conditions, and be prepared to meet them. Two general schemes may be considered by farmers in this connection, namely, soiling and summer silage. In a soiling scheme for late summer and early autumn, the principal crops for this section are oats, millet, corn, clover, peas, barley and rape.

Oats are sown in early spring on rich land, manured well the preceding season, and are ready to feed about July 1. A succession may be secured to last through July by sowing at intervals of a week or ten days from April 15 to May 15. If Canada field peas are sown with the oats, at the rate of about one bushel to the acre, the value of the feed is materially increased. One acre of land well managed should produce enough oats and peas to furnish two-thirds of the roughage required by 15 cows for a month. With a pasture capable of giving full feed to 15 cows in June, an acre of oats should make full supplement for July: but the dairyman need not fear to over-produce this crop. Any surplus not needed for summer feeding will be found equally valuable to cure as hay for winter use.

Millet follows oats and peas. Probably the most useful variety is the barnyard millet, although Hungarian and German millets make valuable catch-crops. Barnyard millet sown on rich land about the middle to last of May will be ready to feed by August 1, and be a very acceptable forage until corn has reached the milk stage. An acre of good millet ought to keep 15 cows nearly through August, supplemented by a moderate grain ration and what the pasture produces. I should not advise growing a surplus for hay, but should aim to feed the whole crop green, unless a part of it could be turned to account for seed. Its use as silage is permissible, but corn should be grown in preference for that purpose.

Corn, the king of all forage crops for the corn belt, is not likely to be supplanted by anything new, and its general use on dairy farms should be realized to the fullest extent, both for green forage and as a silage crop. Its culture and use are too well known to need extended discussion. Corn likes green farm manure better than almost any other crop, because its season of most rapid growth coincides with the season of most rapid nitrification of farm manures. They are well suited to each other. Liberal applications of potash to corn crops are profitable. Wood ashes and the potash salts are the standard sources of potash.

Clover enters into our late summer soiling scheme as a general utility crop, to be grown as largely as possible, to be fed green if needed in the absence of oats, millet or corn, or if they are in short supply to be fed in conjunction with them. Whatever clover is not needed in this connection is equally acceptable when hayed for winter use.

Barley sown with peas during the first half of August makes a good feed for late fall, after frosts have stopped the use of corn as green forage. We have experienced much difficulty in securing a satisfactory crop of barley; and, while it is relished by cows and good for forage, it is not always a profitable crop.

Rape, although a rank grower, and relished by cows, belongs to the cabbage, turnip and mustard family, which have been regarded with suspicion by milkmen, on account of the taste they impart to dairy products. It is our belief that, used in moderation, and fed after milking, it will not seriously affect the quality of milk, and it may become a valuable forage plant for fall feeding. It may be fed to dry cows, hogs, young stock and horses, to the saving of winter's stores, at all events.

Summer Silos.

There is much that might be said in favor of summer silos. Undoubtedly the invested capital is somewhat greater where provision is made for ensiling a sufficient quantity of forage to supply the dairy herd through the summer. Perhaps the summer silo will even cost more for a given capacity than will a winter one, inasmuch as summer feeding takes cognizance both of the lessened appetites of the cows and the greater rapidity of fermentation. It becomes necessary, therefore, for summer feeding to materially reduce the surface area from which silage is fed. One should so limit the surface area for summer feeding that one and one-half inches will be daily removed when the cow's appetite for silage is lightest, and that the average feed will remove about two inches. If this is not done, not only will there be a waste of fodder, owing to excessive fermentation, but the quality of the whole feed deteriorates, even to a point of imparting undesirable flavors to the milk.

Summer silage has a great advantage over green soiling crops in the cost of production. With a heavy-yielding silage crop like Indian corn, allowed to mature and reach its maximum growth and handled in a wholesale way by improved appliances, not only is the expense per feeding unit much less than in soiling crops, but the acre product is brought up close to the limit, and the rental for land is thereby raised.

Summer silage appears to have another marked advantage over green forage, in its uniform supply and quality. Properly cured silage from ripe corn is very uniform in quality, and its use favors a very regular and uniform milk flow. This is not a preconceived notion of "book farmers," but has been substantiated by experience. On the other hand, green crops are not only fed at a considerable expense for labor, but they fluctuate in supply and vary greatly in quality. One part of a field may be infested by weeds not relished by cows, which when fed cause a marked shrinkage in milk. Seasons vary, the weather is bad, it is inconvenient to take time for getting in green feed, and other reasons work against its practical value.

The use of silage in summer is an approach to perennial winter feeding, — a practice that is growing more and more common, but which needs no exposition in this paper.

That pastures have grown poorer in many sections appears to be a common opinion. Their uncertainty and irregularity of production are largely responsible for the demand of this discussion. The system that provides for supplementing our short pasturage will incidentally produce great improvement in the pastures themselves. By the use of supplementary forage, pastures may carry larger numbers of cattle which will check wild growth, and enrich the soil with droppings from additional feed. The farmer himself will be more progressive, and will manage his pastures with greater skill. Thus the prosperity of the farmer, which is the concern of the Board of Agriculture and of agricultural education, will be increased.

BEE KEEPING: ITS PLEASURES AND PROFITS.

BY JAMES B. PAIGE, PROFESSOR OF VETERINARY SCIENCE, MASSACHUSETTS AGRICULTURAL COLLEGE.

Forty or fifty years ago nearly every farmer kept a few swarms of bees. They furnished him and his family with a healthful article of food that was considered almost a necessity. To-day it is the exception rather than the rule that one sees about the farmer's home these producers of the most wholesome and delicious table delicacy that it is possible to obtain.

In addition to the production of honey, bees perform an invaluable service to the farmer and fruit grower by the fertilization and cross-fertilization of flowers. The value of what they do in this way cannot be estimated. Growers of hothouse cucumbers and melons make use of them to carry pollen from flower to flower. This work was formerly done by hand, by the use of a camel's hair pencil. It has been found that it can be more cheaply and as effectively done, at all times of the year, by allowing bees to circulate in the hothouse, visiting the flowers upon the vines as they develop.

Bee keeping not only serves as a source of profit to those who keep them, but they afford a vast amount of enjoyment to one interested in the study of insect life.

The Year Book of the United States Department of Agriculture for 1901 says, in part, of bees and production of honey and wax: "About one farm in nine in the United States was reported as keeping bees in 1900. The largest total value of honey and wax produced by any State in 1899 was by Texas, $468,527. Alaska made no report, and the value of the product in the District of Columbia was $56.

The next lowest total was $1,149, for South Dakota." Figures relative to this subject for the United States, with those of the five leading States in which the bee industry brings the largest returns, and Massachusetts, are given to show how generally they are kept throughout the country, and the income derived from them: —

Bees, Honey and Wax.

[From the Twelfth Census of the United States.]

States.	Number of Farms.	Number of Farms reporting.	Swarms of Bees June 1, 1900.	Value of Bees June 1, 1900.	Pounds of Honey produced in 1899.	Pounds of Wax produced in 1899.	Value of Honey and Wax produced in 1899.
The United States, . . .	5,739,657	707,261	4,109,626	$10,186,513	61,196,160	1,765,315	$6,664,904
Texas, ...	352,190	60,043	392,644	749,483	4,780,204	159,690	468,527
New York, ...	226,720	22,738	187,208	593,784	3,422,497	84,075	352,795
Missouri, ...	284,886	41,145	205,110	508,217	3,018,929	69,258	348,604
Illinois, ...	264,151	34,932	179,953	486,164	2,961,080	75,290	343,206
California, ...	72,542	6,915	129,444	363,885	3,667,738	115,330	331,939
Massachusetts, . . .	37,715	1,799	8,381	35,751	109,050	6,250	18,412

Among other things shown by the above table is that Massachusetts, with slightly more than one-half the number of farms that California has, reports only about one-sixth as many as having bees upon them. In Massachusetts we have only a total of one-fifteenth as many swarms of bees as California, yielding an annual income of $18,412 for honey and wax, against $331,939 for the latter State. In other words, the 6,915 bee keepers of California receive eighteen times as much income from their bees as do the 1,799 apiarists of Massachusetts. This difference can be accounted for in part by the slightly larger income derived from each swarm in California over that obtained from a Massachusetts colony. The California bees yield an income of about $2.57 per swarm; those of Massachusetts, $2.20.

Undoubtedly the flora and climate of some of the western and southern States are more favorable for bee keeping than are those of Massachusetts, but these conditions do not account for the great difference in the income derived or to be derived from bees.

A reference to the complete table printed in the Year Book of the Department of Agriculture shows that New York stands, of all the States and territories, second in value of honey and wax produced, $352,795, while eighth in number of swarms kept. The average money yield in 1899 for honey and wax (not including increase in swarms) was $1.88 per swarm. It would seem that our State is as well located, geographically, for successful bee culture as is New York. That we have as large a nectar-yielding flora there can be little doubt.

A comparison of the returns from Vermont and Massachusetts shows that the Vermont farmers keep a much larger number of swarms of bees than our farmers do. With practically the same number of farms reporting, Massachusetts having only 79 more than Vermont, Massachusetts farmers report only 8,381 hives, valued at $35,751, — $4.26 per hive; while Vermont has 12,836 swarms, valued at $46,953, — $3.58 per swarm. The total value of honey and wax to Vermont bee keepers in 1899 was $27,290, while our own farmers received only $18,412 for their bee products. Much of the Vermont honey is sold in Massachusetts.

The geographical situation of our own State is more favorable for bee keeping than is Vermont; and there seems to be no good reason why we should not produce sufficient honey for home consumption, instead of purchasing from neighboring States. Our cities are teeming with people of moderate means who are anxious to move into the country in order to enjoy more quiet and healthful surroundings and occupations. The great difficulty that confronts them is to find a locality not so remote from a large place as to debar them of all social privileges and the advantages of a market, yet at the same time sufficiently removed to enable them to purchase land at a price within their reach, capable of furnishing support for their families. From a lack of experience necessary for them to engage successfully in general farming, and the cost of equipping a farm with the required stock and tools to carry it on, these people must, if they leave the mills, stores and shops of the cities and take up a residence in rural sections, engage in a special branch of agriculture that they can familiarize themselves with through observation and the study of books.

Market gardening, the growing of small fruits or flowers, poultry raising and bee keeping are the agricultural specialties either engaged in alone or in combination that are best adapted for those who are compelled, on account of ill health or from other circumstances, to leave the cities and resort to the country to take up agricultural pursuits to gain a livelihood.

There are seasons, owing largely to climatic conditions, when bees in Massachusetts are unable to collect and store more honey than is required for the raising of brood and food for winter use. For this reason bee keeping for either comb or extracted honey may not yield a very large income. To provide against such an exigency it is not advisable for one to depend upon bee keeping as a sole source of income, but to combine with it some other specialty. Which of those specialties already mentioned to be selected should depend upon location, kind of soils, demands of the market, etc.

Suitably situated in a locality for the advantageous growing of poultry, in a vicinity where there exists a variety of honey-yielding plants, a combination of these two industries would go well together. Poultry requires almost constant care in winter, at a time when bees are inactive. During late spring, summer and early fall poultry needs little attention, except at morning and evening. During the middle of the day the time could be utilized in caring for bees. In fact, it is not possible to handle them except at this time. They resent interference except on warm days, then only during the latter part of the forenoon or early part of the afternoon. When bees are most busy at work and most numerous about the hive is the best time to handle them. On dark, cool days, or very early or late in the day, they are almost certain to attack one who disturbs them.

The July 9, 1903, number of the "Youth's Companion" contains a short article upon the topic, "The Woman and the Farm," which relates to the possibilities of gaining a livelihood by engaging in those specialties of agriculture to which reference has been made. The article says, in part: "Two essays read before agricultural societies in the central west suggest a wider and truer view of the situation. . . . The heroine of the other (second) essayist was a successful stenographer, who, wanting a house of her own, pitched upon a three-acre place which was far from cities, but within reachable distance of several summer hotels. By study, perseverance, tact and common sense, she presently found herself marketing every year five thousand pounds of honey, fifteen hundred ducks and quantities of fine fruit." In addition, the writer says: "Probably there is not a county in any State which does not offer similar opportunities for tired women to rest by change of occupation, and meantime earn a living; or for ambitious women to take up fruit growing, market gardening, poultry keeping or some other specialty, and carry it on at a profit."

There is hardly a locality in Massachusetts where there are not sufficient honey-yielding flowers to allow of successful bee keeping. This applies not alone to the country but quite as well to the cities. In rural districts, wild flowers and cultivated plants are to be depended upon for a honey supply. In cities the flowers of cultivated ornamental plants and those of the ornamental trees in the streets and parkways and about the residences often yield a bountiful supply of honey.

The writer has observed during the present year in the Public Gardens, on the Common and in the parkways in the city of Boston and vicinity large numbers of the best honey-producing plants and trees to be found anywhere. Last year he observed growing wild in great abundance along the shore near the city of Salem the sweet clover (*melilotus alba*) that is so attractive to bees, and a prolific honey producer, remaining in bloom for more than a month.

A large farm in a rural district is not essential for the successful keeping of bees. They thrive in towns, villages and even large cities. Says Frank Benton, in his bulletin entitled "Bee Keeping": "It even happens in some instances that bees in cities and towns find more abundant pasturage than in country locations which are considered fair." He cites Washington, D. C., as an example, owing to the presence of large numbers of linden trees that have been planted along both sides of many of the streets and avenues of the city.

Swarms of bees so situated that they are protected from strong winds and the extreme cold of winter will thrive in almost any locality in Massachusetts. It is best that the hive be placed near the ground, as it can be more easily reached by the bees returning heavily laden with honey from the fields. This is, however, not absolutely necessary, as swarms do well that are kept in attics of houses or barns or other buildings, the bees being allowed to enter and leave the hive through small openings in the walls of the buildings. In localities where there is not too great an exposure or winds too strong, hives of bees have been known to prosper when placed upon the flat roof of a city building.

In locating a hive of bees in a thickly settled community, it should never be so placed that the bees in leaving or approaching the home would be compelled to cross a path or walk frequented by people.

During the early part of July the writer examined a year-old swarm of bees, kept in the rear yard of a house in a country town, that had already during the season produced

60 pounds of surplus honey. He has upon his own three-quarters of an acre home lot in a country village six swarms of bees that have, up to date, stored more than 100 pounds of surplus comb honey of the finest quality. In addition to this, some have given off large early swarms, each of which should, under favorable conditions, store 20 pounds of honey in excess of that required to live upon during the coming winter.

Considering that a swarm of bees may be purchased, in a modern, movable, frame hive, complete, including a super for holding surplus honey boxes, in May or June for $6 or $7, the yield of 20 to 40 pounds of surplus honey, worth from 15 to 25 cents per pound, and the production of a swarm of bees that may, under favorable conditions, produce 10 to 20 pounds of surplus honey, or be sold without a hive for $1.50 to $2.50, the return for the money invested is most certainly a good one.

Such results can only be expected when the conditions for a good and continuous honey flow exist, and the bees are carefully looked after. It is the exception rather than the rule that conditions are so unfavorable for honey production that a swarm will not gather in excess of that required for brood rearing and winter food supply.

It is with bee keeping as with every other business, in that it is most successfully conducted when given intelligent and constant care. It usually happens, nevertheless, that with scarcely any care a few swarms of bees will, if favorably located, gather and store surplus honey, the only attention given them being to remove the filled honey boxes in the fall and replace them with empty ones in the early spring. New swarms may or may not be saved. The writer is acquainted with several parties, living in villages, each of whom keeps in his yard two or three swarms of bees under the conditions mentioned, and receive from each of them each year from 20 to 60 pounds of honey.

It is advisable for one not familiar with the business, who contemplates starting in with bee keeping, to at first start in a small way with only one or two swarms, and then with a variety of bees that is quiet and easily handled. For this purpose Italians are preferable to the common black bees. The latter are more restless, and easily angered when they are disturbed. With a good bee smoker and a veil one need have but little fear of stings, provided quiet, good-tempered bees are kept.

With one or two swarms to begin with, the natural increase will build up the apiary quickly. By working with a few at the beginning, one gets the experience needed to successfully manage a large number of swarms with little difficulty.

The cost of starting an apiary is comparatively small. The following list of articles, with average price of each, includes all things required : —

Swarm of bees in hive complete, ...	$7 00
Extra hive with foundation comb, including super for surplus honey, ...	3 50
Bee smoker, ...	85
Veil, ...	50
Porter bee escape, for clearing supers of bees, .	35
Freight, ...	1 00
Incidentals, ...	2 00
Total, ...	$15 20

This is the outfit required for producing comb honey. If extracted honey is desired, it would be necessary to add an extractor, costing from $8 to $10, according to size and pattern.

Brood frames, with full foundation comb, are recommended. In case these are not used, the combs will be built so irregularly that it will be found impossible to remove the frames without seriously breaking the combs, to the detriment of the brood and to the annoyance of the manipulator. Where full foundation sheets are used, they are built out in large, flat, regular combs, that allow of the removal of a frame from the brood chamber without disturbing or breaking other sheets of comb. Another distinct advantage of using full sheets of foundation is that more worker comb and less drone comb is built. As the drone bees do not add to the working capacity of a hive, it is advisable to prevent their production as much as possible. This can only be done by furnishing foundation stamped with worker cells upon the surface. These worker cells, outlined by the press, will be drawn out into full worker cells by the bees. On the other hand, if they are allowed or are compelled to build their own combs, without the guide furnished by the embossed sheet of foundation, drone comb will be constructed to a much greater extent than when the foundation is furnished.

In this short article it is not the intention of the writer to give full and explicit directions for the selection of supplies, the manipulation of bees or the conducting of an apiary. This information can be obtained from a study of the books enumerated at the end of this paper, also by visiting a well-conducted apiary and observing the apiarist at his work.

A few of the more common mistakes made by the novice may be avoided by observing the following directions: —

In selecting hives, always select one of the modern movable frame varieties, with super for surplus honey boxes. The old-fashioned box hive is so disadvantageous in so many respects that it should never be made use of. If bees are purchased in a box hive, they should be transferred to a movable frame hive at the earliest possible time.

As to the variety of the modern hive to be selected, it makes but little difference, provided it is strongly built, easy to obtain at short notice and convenient to manipulate. As a rule, the simpler the construction the better. There are many varieties on the market (each of which is praised by its inventor and advocated by certain bee keepers). Anti-swarming, double-ventilated and double-covered hives and those of similar description possess few or no advantages over the ordinary modern hive, except in the minds of the inventors.

It is always advisable to have all hives in the yard alike, in order that parts may be interchanged, as is frequently necessary.

Unless one has at his disposal wood-working machinery and plenty of spare time, it is better to buy hives of a dealer than to make them. To get the best results, they must be accurately and strongly made, to provide proper space for the bees and accurate fitting of all parts, to prevent excessive glueing by the bees and to allow an interchange of every fixture. For one wishing to economize in the purchase of hives, it is better to buy them unpainted in the "flat" and put them together and paint them, rather than to attempt to build them, running the risk of mistakes that are almost certain to be made.

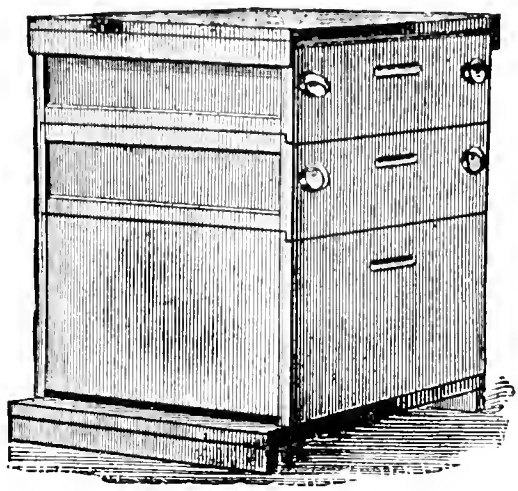


Fig. 1.

The accompanying illustrations show two of the many serviceable and practical hives. Both are similar, but vary somewhat in shape and construction, as will be seen by a study of the illustrations.

Fig. 1* shows the Cary simplicity hive, with two supers. As will be observed, the parts are halved together in such a manner that they overlap, making a rain and weather proof joint. These hives are interchangeable in every part, and are especially adapted to tiering up.

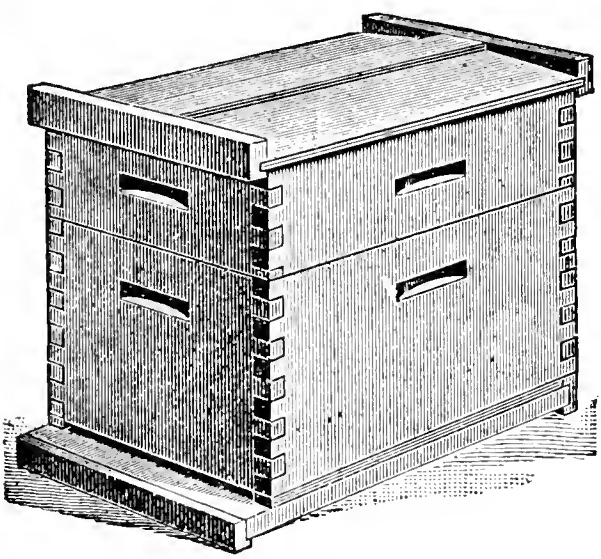


Fig. 2.

Fig. 2* represents the dovetailed or lock-corner hive, as made by A. I. Root Company, Medina, O. It is a strong, convenient and serviceable hive, but, unlike the Cary simplicity hive, does not have the edges rabbeted so that the parts overlap when placed in position. Each of these hives is

* These illustrations are from the catalogue of W. W. Cary & Son Lyonsville, Mass., manufacturers and dealers in bee supplies, and are used with their permission.

made in several patterns, with a variety of fixtures, to suit the fancy of the purchaser.

Much pleasure may be had and information gained by the study of bees kept in an observation hive. Such a hive is shown in Fig. 3. It is constructed with glass sides, and holds a single frame of comb. At B is a sliding box covered with wire cloth; this can be raised or lowered to open or close the entrance to the front of the hive. At A is shown a feeder, consisting of a bottle through the stopper of which is a glass tube one-half inch in diameter. The bottle, after being filled with a saturated solution of granulated sugar in water, is inverted, and the glass tube placed in an opening in the cover, protected on the inside by means of a piece of wire cloth. As fast as the bees remove the syrup from the end of the tube, air enters the bottle and more syrup runs down upon the wire cloth.

The hive should be arranged so that the sides may be covered to keep out the light when the bees are not under observation, otherwise the glass will be covered with wax and glue by the bees for the purpose of darkening the hive.

When a frame of brood covered with bees provided with a queen is placed in this glass-walled hive, it is possible to observe them at their work. The movements of the queen may be watched as she travels over the comb depositing eggs in the empty cells. The development of the eggs into larvæ and later pupæ, the capping of the brood and its escape from the cells when fully developed, the storing of the honey and pollen, — all may be studied at will. If the queen is removed, the process of queen cell building and the rearing of the new queen may be observed at every stage.

Such a hive may be placed in a living room, schoolroom or other place desired, and the bees allowed to fly to the fields through a convenient opening made in the wall, window sash or frame. Whenever the comb is fully built down and completely filled with honey and brood, it is necessary to replace it with a new sheet of comb upon which there is room for the bees to work, otherwise the queen, finding her quarters restricted, will leave the hive, taking most of the

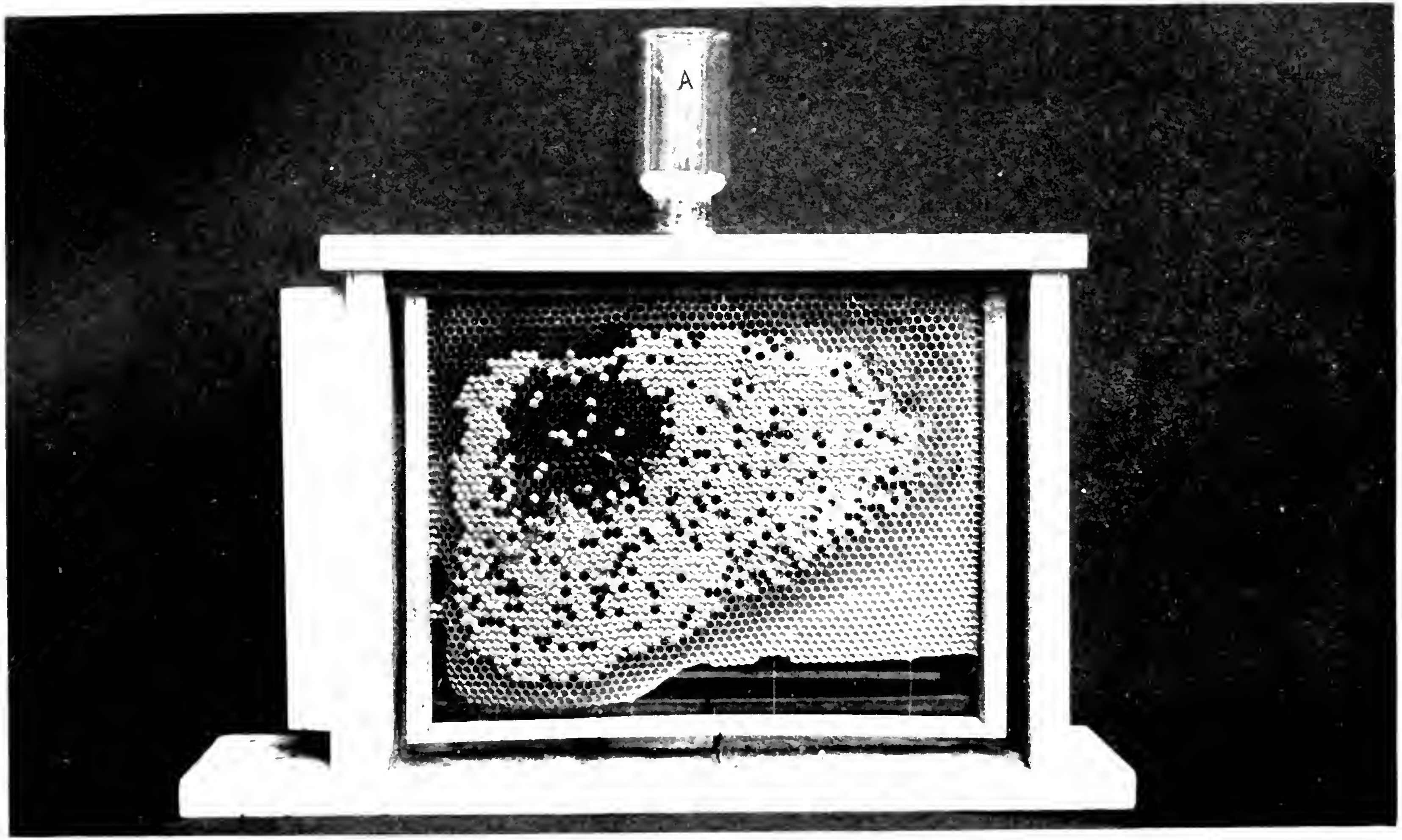


FIG. 3 — OBSERVATION HIVE.

bees with her, to go in search of a more commodious habitation. If a sufficient number of bees do not remain to mature the brood, or in case no newly laid eggs are present in the hive from which a new queen may be reared, the swarm will perish.

The writer is an enthusiast over bee keeping, having, during his few years' experience with bees, derived a small profit and a large amount of pleasure in working among the industrious little toilers, and in feasting upon the honey which they have produced.

To suggest to some one a pleasant means of recreation, coupled with a possible source of profit, is the main object of this paper.

If more information is desired concerning this particular industry, the reader is referred to the following publications: —

"Bees and Bee Keeping," Frank R. Cheshire. 2 vols. Vol. I., scientific; Vol. II., practical.

"The A B C of Bee Culture," A. I. Root.

"Langstroth on the Honey Bee."

"The Bee Keeper's Guide, or Manual of the Apiary," Prof. A. J. Cook.

"The Honey Bee, — a Manual of Instruction in Apiculture," Frank Benton, M.S., United States Department of Agriculture, 1899.

"Bee Culture," Dr. C. C. Miller. Bulletin No. 77, Pennsylvania Department of Agriculture.

The following are some of the leading journals relating to bee culture published in the United States: —

"Gleanings in Bee Culture," Medina, O.

"The American Bee Journal," Chicago, Ill.

"The American Bee Keeper," Falconer, N. Y.

"The Bee Keeper's Review," Flint, Mich.

The Massachusetts Agricultural College will offer the coming year a short course in bee culture, beginning the fourth Wednesday of May and continuing two weeks. For full particulars address Dr. H. H. Goodell, Amherst, Mass.

THE MANAGEMENT OF POULTRY ON SMALL FARMS.

BY JOHN H. ROBINSON, EDITOR "FARM-POULTRY," BOSTON, MASS.

A large farm offers the best opportunity to keep poultry with little labor and comparatively large profits, but the owner of the large farm is not often much interested in poultry. It is the small farmers, under necessity of making the most of every opportunity to make money on their land, who are attracted by the possibilities of poultry culture. As personally and through correspondence I have for the last six years come in contact with owners and renters of small farms in the eastern States, and especially in Massachusetts, Rhode Island and Connecticut, who are trying to make a specialty of poultry, I have found that the most troublesome impediment to the development of their plans was the want of a method suitable to their circumstances.

A very large percentage of the small New England farms are of such dimensions and proportions that the fowls kept cannot be given liberty except at the risk of their trespassing on the land of neighbors. Because of this, many small farmers interested in poultry have adopted the intensive methods which small poultry keepers in towns often find necessary, but which large poultry keepers and farmers ought to avoid.

Intensive methods make the care of poultry a grind and drudgery, monopolizing the keeper's time to such an extent that it is almost fully occupied in caring for a few hundred fowls. Indeed, I have seen a great many people keeping poultry by such intensive methods that they hardly dared leave home for an hour for fear of disarranging their carefully balanced system, and could never by any possibility make a living by their methods if it became necessary for them to try to make their living from poultry. Many farmers who have adopted intensive methods and found them for a while profitable have neglected other lines of farm work; while others, unwilling to give time to poultry to the neglect of other farm work, have reluctantly given up the idea of increasing their stock of fowls. The best solution of the problem of the small farmer who wants to keep a few hundred hens, and still give most of his time to and use most of his land for other things, will be found, I think, in the adoption of methods intermediate between the intensive methods of the town lot poultry keeper and the free and easy methods which work well on large farms.

For more than a decade now the interest of poultry keepers has been almost monopolized by intensive methods. Periodically the colony system has been illustrated and described, and has attracted some attention: but outside of localities where it was developed it has as yet made little impression, though within the last two years interest in the colony plan seems to be rather more general and more persistent. Intermediate methods have been used in a number of isolated instances, yet few in comparison with the number of poultry keepers; and I suppose any one who would take the trouble to look the matter up would find that intermediate methods had not been as much neglected by writers on poultry matters as the failure of readers generally to become interested in them would be presumed to indicate.

Just why more people have not been interested in the methods theoretically best adapted to their circumstances is to me something of a puzzle. Perhaps it is because most of us are imitative, and prone to do things the way we see most of those about us doing them, or as those who seem to be successful tell us they do them. For some years now poultrymen have been keenly interested in the development of great egg producers, and in making records of large average egg production. Intensive methods are required to secure high averages, as well as to enable one to closely watch individual performance of laying hens. It has been customary to estimate profits in poultry keeping on the average difference between cost of feed and value of eggs or poultry produced, and to make comparisons of the work of different flocks on this basis, no figures being furnished for and no account made of the time spent in caring for the fowls and of differences in value or cost of labor. It has generally been taken for granted that the man or woman who could get the largest individual egg yield or the highest average was the most successful poultry keeper. However that may appear at first glance, it is easily discovered, by any one in a position to investigate, that the large egg yield is often obtained at such cost of care and food that, while the average profit per hen figures large, the poultry keeper's pay for his time figures small. It is a general fact, easily verified, that the poultry keepers who get the most satisfactory net results in money in most cases get only very ordinary egg yields. Their results are satisfactory, their work is workmanlike, and their venture stands on a business basis, because their modest results give good pay for time and effort required to produce them.

The man who has only a little land and can use it all for poultry and could use none of it for anything else will find intensive methods of poultry keeping the best for him; but I am convinced, from what I have seen of such plants, that as a rule the proprietors work harder for what they get, and are more tied to their work by the inevitable daily routine, than if they had more room and could use an easier system; and I rarely find one of these poultry keepers who would not gladly change to a location where he could have more room and an easier system. But, having once adopted the intensive system, a man whose land does not furnish room for a change cannot often make a change of systems except by changing location and making sacrifices he cannot afford to make. So he goes on with the intensive system, keeping many fowls on a small plot of ground, and doing for the fowls or working to compel them to do many of the things they do for themselves under more natural conditions. It is only so that in his circumstances and by his methods he can make a day's wages by a day's work.

By the colony system the owner of a large farm will distribute his fowls over the farm, and, by giving them room and range, relieves himself of the necessity of doing for them many of the things which the poultry keeper who uses intensive methods must do daily.

To illustrate: When fowls are confined in small yards, the grass is so quickly killed out, or at best so soiled by the fowls, that they eat only a little of it, — and that little under protest, — and do not get green food in quality and quantity proportionate to their needs, unless it is especially given to them. To get green stuff for a considerable number of fowls so confined sometimes taxes the ingenuity of the keeper, besides consuming time and occasioning more or less cash outlay.

Similarly with meat food. Fowls confined to small yards — either yards that are actually small or those that are small for the number of fowls occupying them — soon exhaust the supply of worms and grubs near the surface, and the occasional flying insects which come within their reach are as nothing compared to what they would get if foraging over a good range. To compensate for this lack, the keeper must provide something. Whatever he provides costs something in time or money, — often in both.

Then, as to exercise. Fowls at liberty naturally and voluntarily take sufficient exercise to keep them in good condition. They may take more exercise than is consistent with economy of food consumed, but the error is on the right side when looked at from the point of view of one who is trying to save labor. Fowls in confinement usually have to be compelled to take exercise. The grain fed them is buried in litter, and to get it they must scratch it out. Various other expedients to assure the keeper that the fowls will get needed exercise are in vogue. When the fowls are confined, compulsory exercise seems to be needed to keep them in good condition, — some experiments made to determine comparative merits of exercise and no-exercise systems to the contrary notwithstanding. Volume of egg production for a short period is not the only standard to be applied in making such tests. In matters of this kind the consensus of opinion of many intelligent and observant poultrymen, noting for themselves the general differences in results by the two systems, is apt to be more nearly correct than the conclusions of experimenters. Experiments have generally indicated no noteworthy advantage from exercise, when comparison was made of results of keeping similar lots of fowls under such conditions that one lot got its food without exercise, and, being confined, took no exercise worth speaking of, and another lot worked busily all day long for what food the fowls in it got. But in some of these experiments it would appear that perhaps the exercised hens had to take too much exercise for their good. Experience has roughly demonstrated that exercise (compulsory, when it would not otherwise be taken) is a practical if not an absolute necessity. I know a poultry farmer who keeps fowls through the winter without exercise enough to keep them in good condition. He almost always has eggs in fair supply in early winter and in abundance through mid-winter, but his hens are very apt toward spring to get too fat, to their detriment both as layers and breeders; and, though that is not the only cause of his troubles in growing chickens, it is one reason why he is less successful in that branch of his work than in getting eggs, and finds it harder to produce layers than to get eggs after he has got the layers.

To keep hens in good productive condition throughout their natural lives of usefulness, which in the laying hen should be two seasons and in the breeding hen three or four, regular easy exercise is essential. To give it to hens in confinement, the keeper must provide litter of suitable material, leaves, straw and coarse hay being most commonly used; and, removing the worn-out and adding new litter as required, must give no little time to that item of work the year round. In most parts of this State all fowls are confined to the houses much of the time during winter, and are better off if made to take some exercise. But fowls which have good range get all the exercise they need, foraging over it through eight or nine months every year, and during those months the keeper does not need to make special provision for exercise for them.

Besides the things just mentioned which must be done directly for the fowls, whoever keeps poultry in close confinement needs to keep houses clean and to turn over the earth in the yards at frequent intervals, and in small yards this work has to be done mostly with spade or fork. In all these ways the average time per fowl devoted to the care of a flock of poultry is increased; so that, while we find many poultrymen using intensive methods fully occupying their time with the care of 400 to 500 hens, we find farmers keeping hens on large farms on the colony plan doing the routine work of caring for 1,200 or more hens as a part of the morning and evening chores, and making more money actually, and very much more for time consumed than intensive poultrymen do, though the latter can show averages per fowl that make the common averages by colony methods look small.

Another point of difference between the two systems which should be emphasized in this connection is that, to be successful, intensive methods require much greater skill and more experience than are needed to make poultry keeping profitable under less artificial conditions. So it happens that, while the poultryman using intensive methods finds that, even with land, capital and the wish to extend operations indefinitely, he is limited by the difficulty, often amounting to impossibility, of getting help it will pay him to use, the colony farmer's operations are, generally speaking, limited only by the number of fowls his land will carry by his system. He uses ordinary farm help, — men who do the poultry work as "chores," and work in the fields through the day. Some of these men are, of course, better "hands" with the poultry than others; but the advantages of natural conditions offset all ordinary consequences of inefficiency to such an extent that the close supervision required on intensive poultry plants where help is employed is not necessary, and the average farm hand makes an average good poultryman.

I have given this extended illustration of differences between the system appropriate for the poultryman under necessity of keeping fowls in close confinement and that used by farmers, who, with only such modifications or elaborations as the scale of operations requires, apply ordinary farm methods to a large stock of fowls, because it is desirable that, before explaining the intermediate methods which suit intermediate conditions, we should have clearly before us the leading contrasts of the systems between which we wish to strike the happy medium.

What we are seeking — what I suppose four out of every five small farmers who become especially interested in poultry want, even when they don't fully appreciate what it is they want — is a method by which the farmer can keep as much poultry as possible without giving the poultry the detailed attention which must be given when the land occupied is stocked to the limit of its capacity.

The problem is neither a deep nor a difficult one. That it has been so seldom solved, and that statements of the solutions have attracted so little attention, seems to me to be due to the preoccupation of poultry keepers with other methods. However that may be, it is a fact more self-evident in southern New England than in any other section of the country that small farmers undertaking to specialize in poultry have almost invariably adopted intensive methods, and almost invariably to their own detriment, handicapping their efforts to make poultry pay, and frequently also handicapping themselves heavily in their general work.

I have seen farms by the score on which were poultry buildings and yards unused, except as a few fowls went through or stayed in at will, and rapidly going to decay; and I have seen other farms by the score where it was plain that the effort to make poultry pay was being persisted in almost hopelessly, and at the expense of some or all other opportunities of the farm; and this in the section of the United States, which, in my judgment, is favored above all others in the all-important matters of climate and soil for poultry culture, and good markets for poultry products. When there is so much of this to be seen, what wonder is it that people are continually asking, "Is there money in poultry?" and, when told that there most certainly is, ask, "Then why are there so many poultry plants standing idle, and so many for sale?"

I don't want readers to infer that I attribute to the use of inappropriate methods all the failures to make poultry pay on these New England farms. A good many of these unused poultry plants are monuments to inexperience, lack of capital or utter lack of adaptability to the work. Many of them are the sepulchres of foolish expectations of city-bred men, full of ideas and theories, but with no knowledge of or training in any of the pursuits of country life. It is not such failures as these that we are now discussing; it is the failure — or, where failure has not yet come, but seems impending, the situation — of the farmer who might reasonably be expected to make his poultry profitable, that just now concerns us.

The common trouble in these cases has been that, whether few fowls or many were kept, when the owners could not let them run at large because they would trespass on the premises of neighbors, they have gone to the other extreme, and, adopting the methods of small city poultry keepers and of exclusive poultry keepers, have put themselves in a position where they could not properly look after both the fowls and the other farm work. Generally all the work on the farm has suffered, in consequence.

It must be admitted that intensive methods present some features which in practice as well as theoretically are alluring to most of us. The plant is compact, and is generally so arranged that most of the work of caring for the fowls can be done under cover. It saves the attendant from exposure, and it saves steps. It seems to place us in the zenith of comfort, and offer us the acme of economy in labor. Let us look into it a little more closely, from the small farmer's point of view, keeping in mind the extra burdens which intensive methods impose on the one who has care of the poultry.

When one begins to plan to keep fowls by intensive methods, he first decides how many fowls he will keep, in how many flocks, and how many in each flock. Then he plans his house to fit the flocks, and makes his yards of width to correspond with the divisions of the houses, generally making them no larger than is necessary to get the minimum allowance of yard room per fowl considered safe. The result is, that in nearly every case the yards, while sufficient if breeding pens of a few fowls each are kept in them, are entirely inadequate when the compartments of the house are stocked, as they usually are, to their full capacity.

The truth is that the parts of the system do not fit. The amount of yard room needed to keep fowls so that the poultryman can save on his labor cannot be had in connection with the pens in the long houses which are the principal feature of the intensive system. As the farmer who cannot let his poultry have free range must have yards, the obvious thing for him to do is to lay out and proportion his yards according to the size of his flocks, limit the total of fowls kept to the capacity of the land available for yards, make the houses of such dimensions as are required, and place them singly or in pairs, where they can be most conveniently reached by the attendant when making the rounds of the place.

This has been done here and there; but many who ought to use such a method have never given any attention to it, and quite a number who have been interested in it as they saw the system in satisfactory use have hesitated to adopt it for themselves, because they are reluctant to give up the compact, continuous-house plan, and because they think they cannot afford the expense of fencing large yards.

When large yards are used, the houses need not be very far apart. If, instead of a yard 18 feet wide by 75 to 150 feet long, which is about the way the yards range for a style of house which is quite common, and is usually rated as having a capacity of 25 to 30 fowls in each of its 10 by 18 feet sections, we make a yard two or three times as wide, the house arrangement would be either a separate house for each yard, or two-section houses placed so that the division fences between the yards with which the respective compartments connected would be on a line with the partition through the middle of the house.

Suppose we have yards 36 feet wide and 150 feet long: this will generally give ample yard room for 25 or 30 hens. If the lay of the land is such that the yard cannot be 150 feet long, the width must be increased to give the required area. With yards 36 feet wide and double houses, the distance between two houses is only 36 feet. If we have in a row four of these double houses, with eight yards, the distance from end to end of the row of houses is 252 feet, — 108 feet more than if the sections were all in one continuous house. If one builds houses that far apart, and makes the rounds of the plant as many times a day as some poultry keepers do, that 108 feet, doubled, because he must go to the end and return, can be made the basis of a calculation showing many miles traveled and much time lost because of the ground to be covered. But with the large yards it is not necessary to make these numerous daily circuits. Some poultry keepers who give ample yard room feed the grain to their fowls in hoppers in the houses, and, by using a hopper which needs replenishing only once or twice a week, find it necessary to visit the house at most only twice daily, and often make only one visit.

The method I am using on a three-acre place in a small town could be applied on a small farm, and make it necessary to go around only twice a day; though, because we have not far to go, we don't often try to combine the doing of several things when making one circuit. I will describe our way of feeding, a little farther on. Here I want to get back to the point of the expense of large yards. Four double houses, each accommodating 50 to 60 fowls, provide quarters for 200 to 240 fowls. To give these fowls the amount of yard room designated as sufficient will require no more cost for division and side fences than if the houses were all joined in one. The double yard area is secured by simply doubling the length of each end fence. Even supposing that the same height of fence was required, this extra cost of fencing would not be considerable, and would be insignificant when compared with the saving in labor effected by giving ample yard room; but it will be found that as yards are enlarged the height of the fence can be reduced, and thus it may be actually cheaper to make the larger yards. I have this year kept Dorkings with a fence only 3 feet high, and never had one of them attempt to go out, though they can easily fly a fence 5 or 6 feet high. Their yard is just as good as what lies beyond, and they are always fed there, so there is no temptation to go out.

When properly reckoned, the actual cost of large yards is not a heavy tax on the poultry keeper, and, comparatively, the smaller yard always costs more per enclosed surface. It costs a little more to build four two-section houses than to build one eight-section house, but the difference is not great. In yards of about the dimensions given as desirable, some a little larger, some a little smaller, I keep from 20 to 30 Light Brahmas, the number varying according to conditions and to the stock on hand. I aim not to have more hens in a yard than will leave it in this condition: for 15 to 25 feet from the house the ground will be quite bare; beyond this to about midway of the length of the yard the grass will be generally good, but short; the other half of the yard will have quite long grass, long enough to conceal grain thrown in it, and require the hens to hunt and scratch for their grain just as they do for the various wild seeds they find when foraging far and wide on open range. I am away from home nearly always through the day, and frequently not home until after feeding time in the evening. Occasionally I am away for two or three days or a week at a time, so I had to make such conditions for my fowls that they could be cared for with the least possible work, and would not suffer from inexperienced or irregular feeding. The hens get a mash in the morning, and often the noon feed of grain is scattered in the grass immediately after the mash is fed. That would be done regularly, were it not that the grain lying about attracts too many pigeons and sparrows. But whenever it would be inconvenient for the folks at the house to feed at noon, grain is given in the grass right after the morning mash, and, the hens having been given a supply of water for the day, there is no need of any one going near them again until evening. They can get along and keep in good condition without other green food and animal food than they get in the yards; but I like to give both hens and chicks all the meat they can stand, so feed beef scrap in mash regularly. The fowls at some time or other get all the waste green stuff from the garden; but in giving it I can consult my own convenience, knowing that they can get good green grass whenever they choose to pick it, and will not suffer if I find other things of more importance to do, and neglect giving them special feeds of vegetables for a long time. Quite a number of farmers I know handle fowls by methods very similar to those I use, the essential thing being to avoid conditions, a ration, or a routine that keeps the attendant constantly at the beck and call of some feature of the system.

In growing young chickens I cannot now make as satisfactory an application of the ideas described, because I have no guard against city cats, and keep chicks in coops while small; but a few years ago, when located where cats were no trouble, we gave the chicks the run of a small orchard, fed them a mash in the morning, kept cracked corn standing before them all the time, and gave other feed or not through the day, as happened to be convenient.

Given the right conditions, one can do this with both old and young fowls. The suitable conditions are found on almost all small farms, when either the fowls kept are given ample yard room, or the land which can be utilized for fowls is not stocked so heavily that its natural facilities fail.

I think we have disposed of the problem of feeding and watering, indicating how it can be done and the farmer left free to give the whole day between chore times to other farm and field work. Another problem that causes some trouble is keeping houses and yards clean. When the fowls are given large yards, the work of caring for them is very much reduced. The large yard on soil of the sandy character common throughout New England does not become foul. The droppings are well distributed over it, and the rains disintegrate them and leach them down into the soil, where they nourish the roots of the grass and trees. With the large yards, too, it is easier to take care of the houses, for the hens are in them less, droppings do not accumulate so rapidly, and it is not so necessary that there should be regular and frequent cleanings.

I use no droppings boards, and, by keeping the floors of the houses well littered with dry leaves, which absorb all the moisture in the droppings, find that I can let the droppings remain for weeks and yet leave the house free from bad smells, and, as the droppings are hidden in the leaves, cleaner to look at than half the houses I see that are cleaned daily. In winter I have let my houses go without removing the droppings for several months. I don't advise others either to do without droppings boards or to let their houses go so long uncleaned, unless they are sure they can control the situation. If there is much looseness among the fowls, it will not do at all to let droppings accumulate. With some kinds of litter the droppings cannot be allowed to accumulate. Dry leaves I have found better than anything else, if one has them in sufficient quantity to keep the litter always deep on the floor of the houses. In England many farmers use peat moss, and allow droppings to accumulate in it for nearly a year. In Rhode Island the colony-plan poultry farmers set a board on edge on the floor just forward of the outer roost, and throw dry earth, a few shovelfuls at a time, from the other side of the floor on the accumulating droppings. This accumulation of earth and droppings is removed once or twice a year. Poultry manure normally is of such character that if one takes proper care of it where it falls in the house it is not necessary that it should be promptly removed; and the small farmer, taking advantage of this fact, can arrange his roosts and their surroundings so that he can clean when convenient. He is not required to choose between taking time to clean the houses daily or having houses in condition to be ashamed of.

Poultry keeping ought to be an important feature on every farm, and a pleasant feature of farm work. It may be, if the farmer will only study to adapt his stock and his methods to the capacity of the farm under conditions satisfactory to him.

SOME IMPORTANT SCALE INSECTS.

BY DR. H. T. FERNALD, PROFESSOR OF ENTOMOLOGY, MASSACHUSETTS AGRICULTURAL COLLEGE.

During the past fifteen years injuries to plants, shrubs and trees by scale insects have become very noticeable, and several of the worst pests belonging to the group have made their appearance in this country and have caused the loss of millions of dollars, often because their small size enabled them to escape notice until it was too late to save the plants they had attacked. The destruction caused by these insects has attracted much attention recently, and in Massachusetts the demand for information concerning them has exhausted the entire edition of two previous articles on this subject, published in the Crop Report.* Since these articles were written additional facts about some of these pests have been learned, and we now know better how to keep them in check.

The San José Scale.

(*Aspidiotus perniciosus* Comst.)

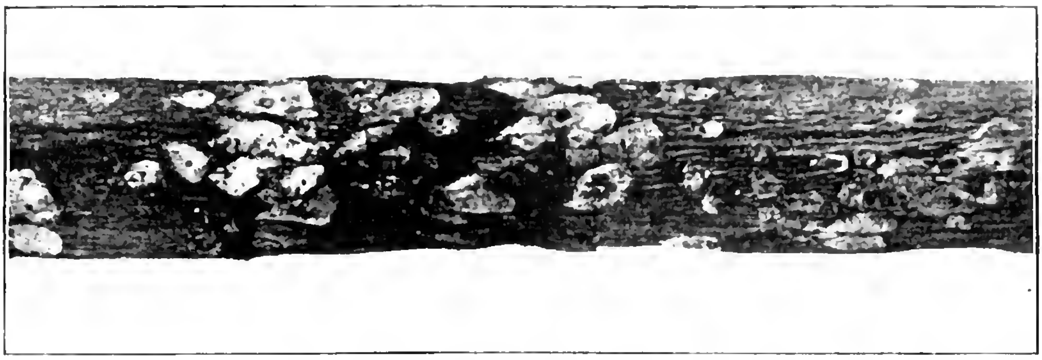
The home of this, perhaps the worst scale pest, was long unknown, but it now seems probable that it is a native of China. In the United States it was first discovered in California, where it seems to have appeared about 1870. In 1880, when it was first described, Professor Comstock, after giving a detailed description of the insect, wrote: "From what I have seen of it, I think that it is the most pernicious scale insect known in this country," and this opinion has certainly been sustained by its subsequent history in the United States.

* May, 1901, and June, 1902.

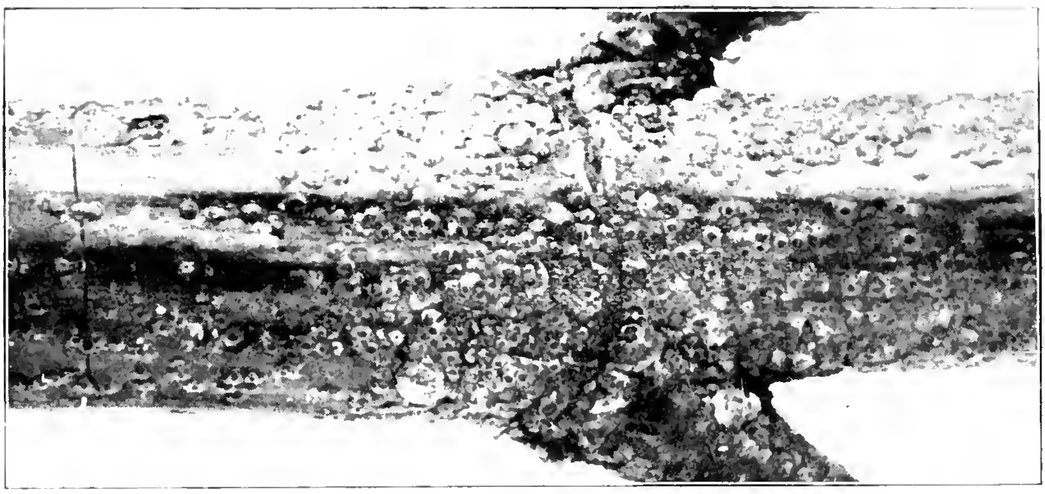
In 1893 the scale appeared in Virginia, having probably been received there from New Jersey, and two nurseries in the latter State proved on examination at this time to be infested with it. These nurseries had been experimenting with plum stock from California in the hope of finding a variety which would be "curculio proof," and the scale was probably brought east on this stock and spread all through the nurseries referred to, both of which did a large wholesale business in the eastern and middle States. Stock sent out was therefore infested by this scale, which spread in the nurseries to which it was sent, and thence went out in the retail sales to all parts of the country. With such methods of distribution it is no wonder that this scale is now working destruction in nearly every one of the United States, and in Canada and foreign countries. In Massachusetts it is now known to occur in over a hundred cities and towns, often causing much loss, and it is probably present in many other places from which it has not as yet been reported.

Food Plants.

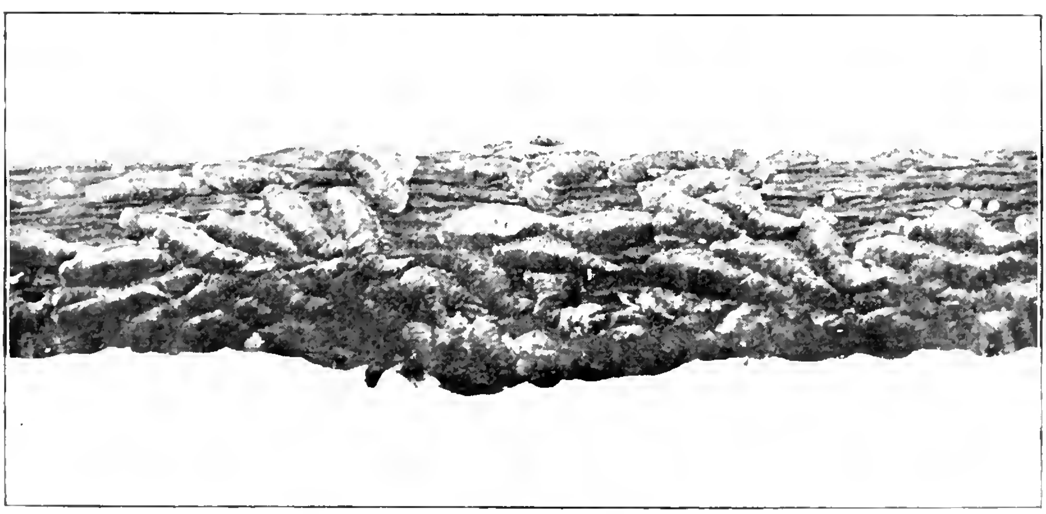
This scale seems able to live on almost any plant, but is of little importance on those which die to the ground each winter, as, when this happens, any scale on the dead part also dies, and it does not appear to locate below the ground. It seems to prefer for its food plants of the botanical family Rosaceæ, for it thrives best and becomes injurious to plants of that group, with a few exceptions, more quickly than on those of any other group. As the Rosaceæ includes most of our fruit trees, small fruits, roses, thorns and Spiræas, and as the scale is also a serious enemy to currants, gooseberries and grapes, nearly all our fruit-bearing trees and plants are included in the list of its favorite food plants. It is also found on elms, maples, birches, willows, poplars and many other trees and shrubs, and has once been reported on spruce and arbor vitæ, but in these cases it is doubtful if it often thrives sufficiently to kill the plant it is on. When it occurs on such food plants, however, it is no less a menace, as from them it may spread to other trees and shrubs in the neighborhood, less resistant to its attacks.



The Scurfy Scale.



The San José Scale.

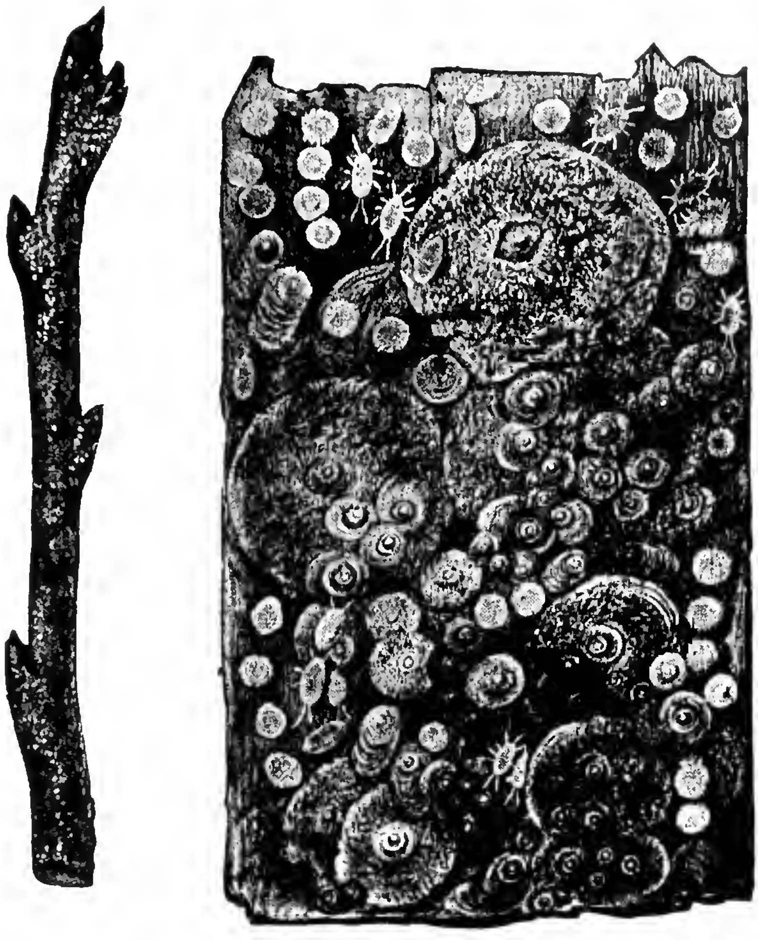


The Oyster-shell Scale.

THREE COMMON ORCHARD SCALES.—Twice Natural Size.

Description and Life History.

The adult female insect is lemon yellow in color, but is covered by a hard, dead scale, which is circular in outline, slightly raised in the centre, forming a sort of nipple, and is about the size of a pin head. Beneath the scale the insect lies, with its beak thrust into the plant till it reaches the sap on which it feeds. The scale being dead, and closely fitting



a *b*

FIG. 1. — San José scale: *a*, twig showing scale, natural size; *b*, portion of bark showing crawling young and scales in various stages. (Howard and Marlatt, Bull. 3, N. S., Div. of Ent., Dept. of Agr.)

the surface of the plant at its edge, it is impossible to reach and kill the insect beneath by any of the milder washes.

The winter is passed under the scale in this condition, but the very young and adult insects appear to die during this time. In the spring those which are alive begin sucking the sap, and about the first of June become adult. Reproduction now begins, the young being born alive at the rate of three or four or more nearly every day for about a month, after which the parent dies. By this time the first-born young are now adult and beginning to produce young, however, so that young scale insects may be found at almost any time from about the fifteenth of June till winter stops their production, though they are more abundant at certain times during this period than at others.

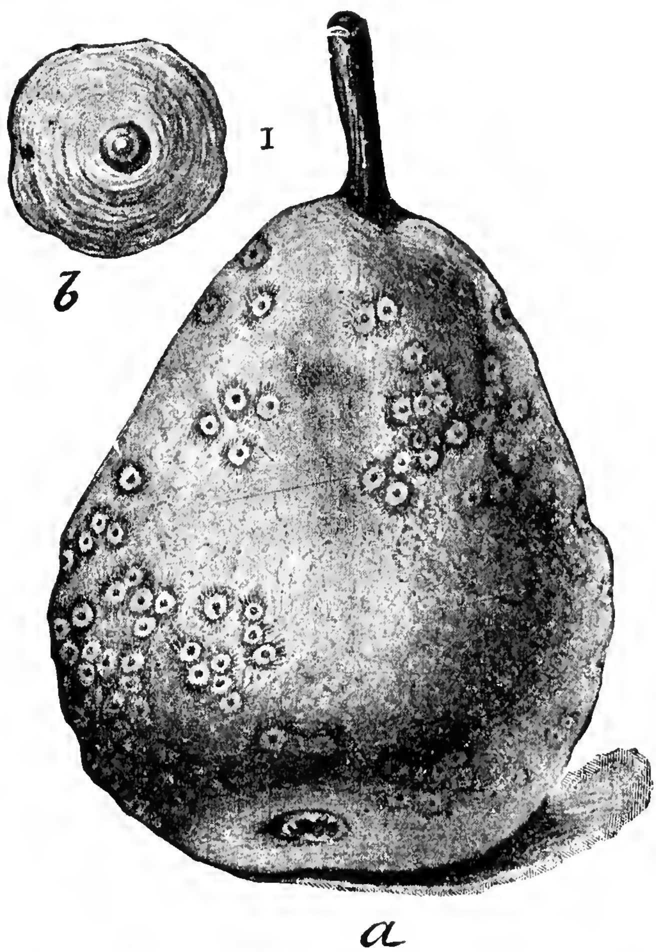


FIG. 2.—San José scale on pear: *a*, natural size; *b*, much enlarged. (Howard, Circ. 3, 2d ser., Div. of Ent., Dept. of Agr.)

That an increase in this way must result in the production of an enormous number of new scales is evident. It has been calculated that if all the progeny of a single female which begins breeding in June should survive and reproduce in their turn, the number of female descendants of this female when winter stops reproduction would be 1,608,040,200; and, while this is never the case, it is not strange that, with even a small proportion of this number of insects sucking the juices from the plant, severe injury should ensue and often cause its quick death.

The young scales are very small, oval, yellow insects, with six legs, which they use in crawling about in search of a place upon which to settle. It is probable that, while they may move about for four or five days before they locate permanently, in most cases it is less than two days.

Upon finding a satisfactory place on which to locate, the young insect inserts its beak in the plant and begins to suck its juices; while fine, waxy threads appear on the surface of the body, and soon unite to form the covering scale. This is circular in outline, white in color and highest in the middle. About ten days later the insect moults, and adds its moulted skin to this scale, which has now become darker, giving the entire scale thus formed a gray color, with a yellowish or whitish centre. Shortly after this the female insects moult again, adding the moulted skin to the scale, as before, and now soon become adult.

Distribution.

If, while the young scale insects are crawling about, a bird lights on the tree, it is not unusual for one or more of them to crawl on to its feet, and thus be carried some distance when it flies, before they can crawl off again at the bird's next resting place, thus establishing them in some other portion of the town or city. The larger insects, also, aid in scattering these insects in this way, while sudden gusts of wind may carry the young from tree to tree in an orchard.

The most usual method of distribution is by means of nursery stock infested with this pest, each infested plant sent out becoming a centre from which this insect spreads in all directions.

Enemies.

The chief foes of the San José scale are the lady-bugs or lady-birds. These are small beetles, nearly circular in outline and very convex. One of the most important of these is the "Twice-stabbed lady-bug," which is about an eighth of an inch long, shining black, with a small red spot on each side. A much smaller black beetle, known as *Pentilia misella*, also feeds upon the scale.

Recently a lady-bug very similar to the "Twice-stabbed lady-bug" has been found in China, destroying the San José scale there: and colonies of this insect have been brought to this country by the United States Department of Agriculture, in the hope that it may be of equal value here.

The results of this experiment cannot now be determined, as sufficient time has not yet elapsed.

Several parasites are also known, but they have not thus far shown their ability to control the scale; and a fungous disease which also attacks it has failed to accomplish much. Thus far, in this country, treatment by man has proved necessary, these natural enemies failing to do more than merely hold the insect slightly in check.

Treatment.

Many methods of treatment for the scale have been tested, and a number have proved to be of more or less value. The great difficulty in treating infested plants with sprays is that, as the insect obtains its food from the juices of the plant, no arsenical poison is of the slightest use, and it must be killed by something which touches it. This is extremely difficult, both because the insect is so small even when full grown, and because the scale over it is very hard and resistant. The only time at which the insect can be reached with mild sprays, such as kerosene emulsion, is when it is crawling and before it has formed a scale. But new young are constantly appearing from about the fifteenth of June till late in the fall, so that, if this method were adopted, spraying would have to be repeated every week during at least four months. It is therefore preferable to use stronger insecticides while the trees are dormant in winter, and the best results are obtained by spraying in February and March, and even later, till the buds begin to open.

Fumigation.

For small trees, which it is possible to cover with an air-tight tent, fumigation is the most reliable treatment which can be used, as the gas will reach all the insects when a spray would probably fail to do this; but the cost of a tent increases so rapidly with its size that only small trees can profitably be treated in this way. In the case of nursery stock, however, this is the best treatment to make use of. Certain cases have been reported in which destruction of the scale by fumigation has apparently not been a success. In every case this seems to have been due to failure in properly carrying out the directions for the work. Either the tent or box used was not air-tight; or the potassic cyanide was of the 50 per cent strength usually sold by druggists, instead of the 98 per cent or 99 per cent strength necessary; or the time during which the fumigation was continued was not sufficient. Failure to meet any one of these requirements would give a failure in the results.

Spraying.

Of the many materials used for spraying for the San José scale, few are of much value, and none may be expected to destroy all the scales, as some will in all probability fail to be touched. On the thoroughness of the work, then, depends the success of the treatment.

If but a few trees are to be sprayed, it is probable that potash whale-oil soap will cause the least trouble to apply, At the Hatch Experiment Station at Amherst several brands of this soap were tested in 1902, and the best results were obtained with Bowker's tree soap. Two pounds of this soap were dissolved in each gallon of water used, and the solution was sprayed warm, using an ordinary spray pump and a Vermorel nozzle with very small opening, giving a fine mist. All parts of trunk and limbs were covered by the spray, treatment of any portion being stopped the moment the spray began to drip or run down the bark.

Crude petroleum and kerosene were also used in the form of a mechanical emulsion with water. This emulsion was produced by the pump (Kerowater), which has two tanks, one for oil and one for water, with a line of hose from each to the nozzle where the two streams combine and are forced out together, the proportion of each being regulated by attachments of the pistons to the pump handle. The results with both of these materials were less satisfactory than with whale-oil soap. The strength of oil in the oil-water mixture should have been 20 per cent, but it varied greatly from that, and the whole apparatus was heavy and awkward to handle. As spraying with these materials requires a two-tank pump, it seems not to be the best method of treatment for small orchards or infested areas.

The lime, salt and sulphur wash, successfully used on the Pacific coast for the scale, when first tried in the east proved a failure. Recently it has been tried again, and with generally excellent results. At the Hatch Experiment Station it proved to be the best of over a dozen different treatments tried. It is somewhat difficult to prepare, however, which is its greatest drawback.

To make it, boil 10 pounds of fresh stone lime and 20 pounds of sulphur with 20 gallons of water in a farmer's kettle for an hour and a half, stirring frequently. Slake 30 pounds of lime in hot water, and stir in 15 pounds of salt till the last has dissolved. Now add the lime and salt to the lime and sulphur, and heat for half an hour. Strain this mixture through burlap into the spray pump, and apply to the trees while it is warm. A fuller description of the methods of making and applying these materials, together with their cost, has been published as Bulletin No. 86 of the Hatch Experiment Station, Amherst, Mass., which can be obtained by request. It now seems probable that the salt can be omitted from this mixture without affecting the result injuriously.

Where a tree is quite thoroughly covered with the scales, it is of little use to try to save it; the sooner it is destroyed, the better, for the sake of the other trees around.

The Oyster-shell Scale.

(*Lepidosaphes ulmi* Linn.)

This insect has been in the United States more than a hundred years, and is generally present in orchards and on many of our ornamental and forest trees and shrubs. The scale is much larger than the San José scale, and very different in form, being pointed at one end, rounded at the other, quite long and frequently curved to one side (Fig. 3 *b*), and is brown or gray in color.

If one of these scales be lifted in the fall or winter, beneath it from 20 to 100 yellow eggs will be found, besides the dead body of the mother insect under the pointed end of the scale. These eggs hatch about the first of June each year, and the tiny yellow young crawl about for a few days, seeking places at which to fix themselves. They then settle down and plunge their beaks into the bark to the sap and begin to feed. A covering scale is soon formed, protecting the insect beneath, and in the fall the eggs are deposited there, after which the insect dies. There appears to be but one brood each year in Massachusetts.

This scale has quite a list of food plants, including the apple, pear, plum, quince, poplar, willow, ash, lilac and elm. Individual trees are frequently killed by it, but it is

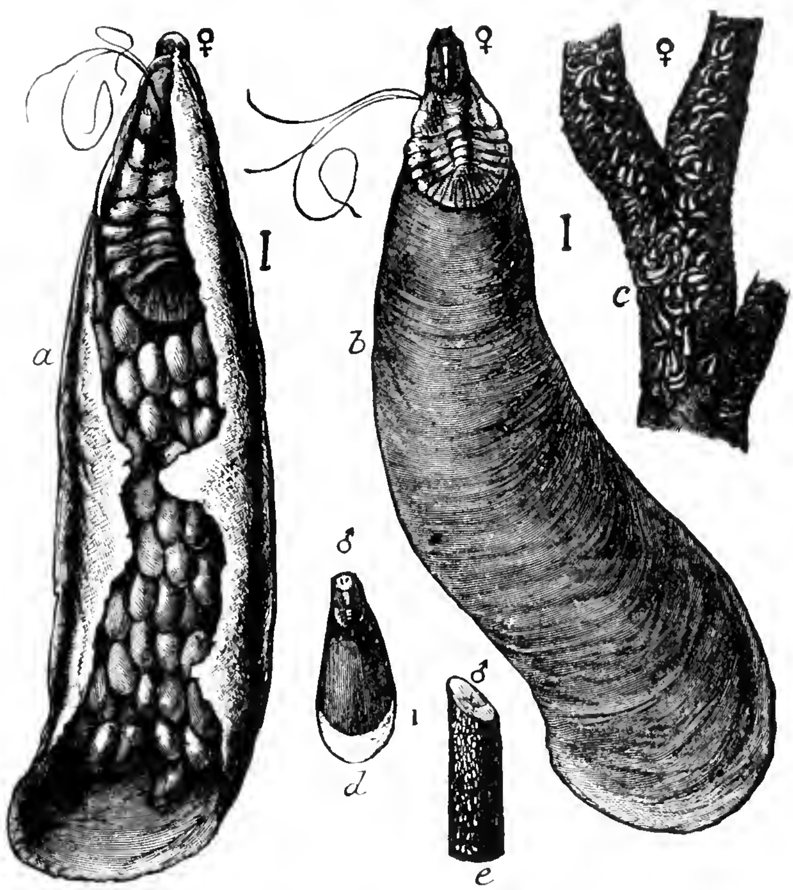


FIG. 3. — Oyster shell scale: *a*, under side of female scale, showing eggs; *b*, upper side of same, both much enlarged; *c*, female scales on a branch, natural size; *d*, male scale, much enlarged; *e*, male scales on branch, natural size. The fine lines to the right of *a*, *b* and *d* show the real length of the scales. (Howard, U. S. Dept. Agr., Yearbook, 1894.)

very rare that it spreads to the trees and shrubs around, killing them all, as is so often the case with the San José scale. It has enemies and parasites which aid in keeping it in check, and its low annual rate of increase renders it much less to be feared than the last-named pest.

Treatment.

Any treatment effective for the San José scale will also destroy this insect, but its life history is such as to provide an opportunity for easier methods as well. As all the young hatch about the same time, — about the first of June, — two sprayings at this season, about ten days apart, with kerosene emulsion or Bowker's insect emulsion, should be sufficient to keep this insect under entire control. Kerosene emulsion is made as follows: ½ pound hard soap, shaved fine, 1 gallon soft water, 2 gallons kerosene. Dissolve the soap in the water, which should be boiling; remove from the fire and pour it into the kerosene while hot. Churn this with a spray pump till it changes to a creamy, then to a soft, butter-like mass. Keep this as a stock, using one part in nine of water.

Bowker's insect emulsion comes ready prepared, needing only to be mixed with water, and is therefore convenient for those who do not wish to prepare the kerosene emulsion for themselves.

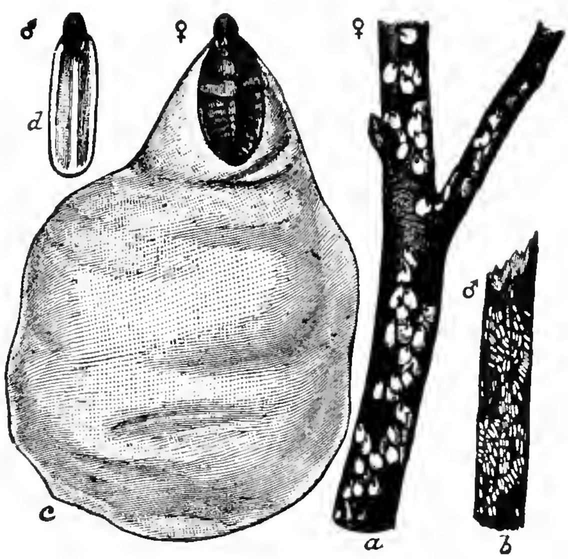


FIG. 4. — Scurfy scale: *a*, female, *b*, male scales, natural size, on twigs; *c*, female scales, much enlarged; *d*, male scale, much enlarged. (Howard, U. S. Dept. Agr., Yearbook, 1894.)

THE SCURFY SCALE.

(*Chionaspis furfura* Fitch.)

This is also a common scale in the United States, though it is apparently less common in Massachusetts than farther south.

The female is somewhat smaller than that of the oyster-shell scale, but is broader, and of a dirty white color (Fig. 4, *a* and *c*). The male scale (Fig. 4, *b* and *d*) is much smaller and narrower.

This insect, like the last, lays eggs beneath the scale in the fall. These eggs, which are from 10 to 75 in number, are purplish in color, and hatch about the first of June into purplish young, which crawl about, as do those of the oyster-shell scale, for a few days before settling down to feed. The remainder of the life history is similar to that of the last-named insect, and the treatment for both is the same.

The scurfy scale occurs on the apple, pear, quince, peach, currant, Japan quince, mountain ash and many other plants, but is not generally so abundant as to endanger the life of the plant.

Lecaniums, or Soft Scales.

These scales are very different in appearance from those already considered, being comparatively soft and easily crushed. Moreover, they are quite large as compared with most of the hard or "armored" scales, and when adult are

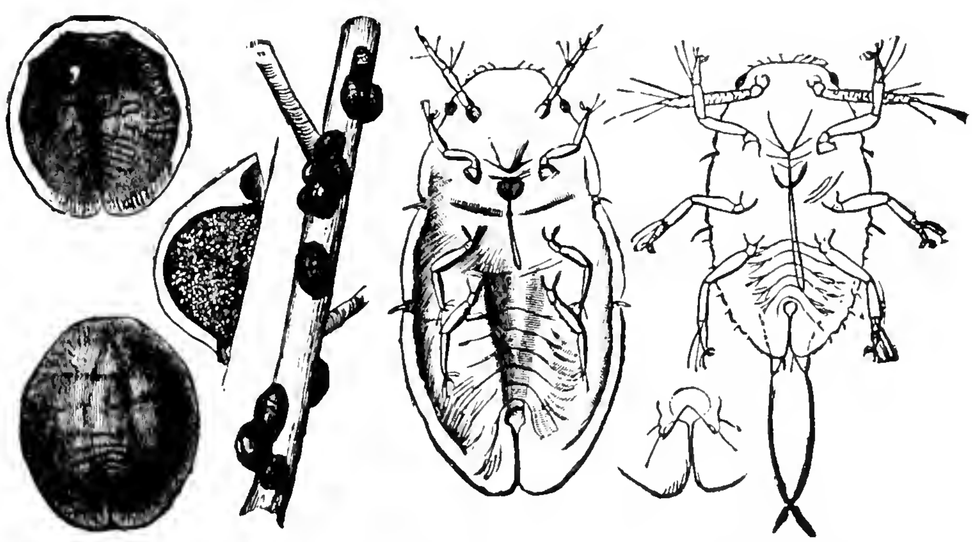


Fig. 5. — Peach soft scale: female scales, on twig, natural size; upper side of a scale in upper left corner, under side of same in lower left corner; scale cut lengthways in middle of left side; young, and full grown but still crawling scales, on right side; all much enlarged except the scales on the twig. (Howard, U. S. Dept. Agr., Yearbook, 1894.)

very convex, many having a nearly hemispherical form (Fig. 5). They feed on the juices of many plants, including palms and ferns in greenhouses, give trouble to fruit growers on plum and other fruit trees, and are often serious pests on maples, oaks, tulip trees, etc.

In many cases nature has established a sort of equilibrium for these insects which, after two or three years of great abundance, are overcome by their foes, and are not again abundant enough to be noticed for a number of years. Where treatment seems to be necessary, however, it must be adapted to the particular kind of soft scale concerned, as the best treatment for one species might not prove successful for another. In such a case, therefore, the particular kind to be treated and the best application to use should be learned by sending specimens to the experiment station of the State.

These scales, like the plant lice, produce a sweetish liquid, which falls from their bodies to the leaves, stems and ground, where it dries somewhat, becoming sticky. Of this "honey dew" ants are very fond, and often visit infested trees in large numbers to feed upon it. It also forms a good place for the growth of a fungus, which turns it black, giving to the leaves and stems it is on a smutty appearance.

Summary.

The San José scale is now generally distributed throughout the United States.

It feeds upon nearly all kinds of plants, but appears to be most destructive to those of the family Rosaceæ and a few others.

Those individuals which are alive in the spring become adult and begin to produce young about the middle of June, and young are continually being produced from that time till after frosts come late in the fall.

The enormous number of young produced quickly causes severe injury or even death to infested trees.

The crawling young are distributed by birds, insects and winds. Scales in all stages are distributed on infested nursery stock.

Though this pest has a number of enemies, none have as yet shown themselves able to keep it under control.

Treatment of small plants and trees is most successful by fumigation. This is not practicable for large trees on account of the cost, and spraying must be resorted to. This should be done between the first of February and the time the buds open.

The best spraying material for use on a small number of plants is probably Bowker's tree soap, because it is easy to prepare and needs no special kind of apparatus.

On a larger scale the lime, salt and sulphur wash has proved more effective, but is rather difficult to prepare.

When the tree is covered with the scale it is hardly worth treating, and should be destroyed at once.

The oyster-shell scale young hatch about the first of June, and may be destroyed at this time by spraying twice with kerosene emulsion or Bowker's insect emulsion.

The young of the scurfy scale also hatch about the first of June, and the best treatment for them is the same as for the oyster-shell scale.

Any of the treatments suggested for the San José scale will also destroy the oyster-shell and scurfy scales.

THE PREVENTION OF FUNGOUS DISEASES PECULIAR TO GREENHOUSE PLANTS.

BY DR. GEORGE E. STONE, PROFESSOR OF BOTANY, MASSACHUSETTS AGRICULTURAL COLLEGE.

The diseases to which plants are subject under glass require different methods of prevention than those in common use out of doors, since in greenhouses the crop conditions are largely under control, whereas in outdoor crops they are left to the mercy of the weather and the whims of the season. To meet the unforeseen seasonal conditions to which outdoor crops are subject it is necessary to resort to methods of prevention each year. Such methods consist of spraying crops, or applying other treatments before certain pests have made their appearance. There is, however, very little need of the application of spraying mixtures to greenhouse plants, since the conditions which give rise to diseases can be and are controlled by expert gardeners to a very large extent. The recommendations, therefore, for a general system of spraying for indoor crops, such as is expedient at the present time for outdoor crops, would be irrational, and would constitute a step in the wrong direction. Every skilled and intelligent grower realizes this, and the more skilled a gardener is, the fewer diseases he has to contend with. The gardener who can turn out a nearly perfect crop as regularly as a manufacturing establishment turns out its products is qualified for the severest tests of proficiency.

The increased production of high-grade greenhouse products in Massachusetts has been the means of training and developing a large class of men as efficient growers, and with this increased skill and knowledge there has come about a better understanding of the causes of diseases and methods of controlling them. The greater part of our knowledge concerning the control of greenhouse diseases has been derived from the intelligence and skill of the progressive gardeners, whereas, in the case of outdoor crops, the experiment stations have been foremost in offering suggestions for their control. The trained agriculturist can consistently give information in regard to the control of specific diseases affecting outdoor crops with which he is more or less familiar: but in cases of greenhouse crops the methods of treatment are so different, and require such an insight into the plant requirements, that it is almost necessary for one to be an expert grower, or at any rate to understand something about the normal conditions of the crop, before his judgment or advice is worth much. It is necessary, at least, that he should possess a thorough understanding of the influence on plants of the three cardinal factors, heat, light and moisture, and the role they play in the production of normal crops, together with their relationship to the development of disease-producing organisms. Such matters as soil texture and soil fertility also constitute important features which are necessary to understand. The great attention necessary to give to such matters as heat, moisture and light in greenhouse culture is only appreciated by the trained gardener. Some of the most troublesome and disastrous diseases are entirely controlled by the intelligent use of these factors, and others, which are more or less common, could no doubt be controlled or greatly alleviated if modifications in the method of growing certain crops were practicable.

The benefits which have resulted from spraying out-of-door crops have unfortunately been the means of inducing some to believe that spraying is the only method of treating plant diseases, and where spraying is not recommended as a remedy their enthusiasm diminishes. We have grown for some years many experimental crops in the greenhouse, and we have seldom had occasion to see the need, or possible benefit, to be derived from spraying. In the elimination of diseases from greenhouse crops the ultimate aim should be to select varieties of plants which are immune to disease, as well as to study and devise conditions which will not favor the development of fungi. The most perfect and the hardiest plant organism can become diseased in a remarkably short period of time, if the conditions that are suitable for its normal requirements are changed. For example, the geranium constitutes one of our most hardy greenhouse plants, nevertheless, if such a rugged plant is placed under a bell glass, it becomes sickly in a very short time, and in a few days it will succumb to disease, even when subject to light and supplied with all of the necessary elements of plant food. Such an experiment is interesting, as showing how quickly the healthiest organism can fall a prey to disease and become dilapidated.

The explanation of the appearance of some of our most troublesome diseases affecting plants at the present time can be found in part in the practice of increased forcing, and is also due to the fact that new parasitic organisms have been introduced from time to time from other countries through traffic. Some of these fungi, however, which have recently proven disastrous, have been with us for some years, if not always; and the reason of their becoming more troublesome at the present time can be attributed to the increased production of more succulent, tender plants, brought about by forcing, which enables these parasites to find more favorable conditions in which to thrive. With every modification and innovation in the growing of plants there are likely to occur new difficulties and obstacles to overcome.

Constitutional weaknesses, which develop in some varieties and are inherited in others, are unfavorable to immunity. Varieties of carnations inclined to succulency, or containing two or three per cent more water content in their leaves, have proven much more susceptible to rust than those containing less water.

There is little doubt but that many diseases could be prevented by modifications in the methods of growing plants, if such could be adopted. The so-called "drop" in lettuce would prove less disastrous if the plants could be elevated from the soil sufficiently to allow air and light to penetrate to the stem. This would result in producing firmer and more resistant tissues, Experiments have shown that a covering of coarse sand about lettuce plants materially reduced rots, simply from the fact that sand retains moisture much less readily than loam, thus offering less favorable opportunities for fungous infection; and no doubt a circulation of air about the stems would prove beneficial. In the same manner, sub-irrigation reduces stem rots by maintaining a smaller amount of moisture in the top layers of soil. The shutting out of light and air by planting too thickly constitutes a source of danger to disease. Watercress and parsley offer good examples of the effects of overcrowding, due to luxuriant growth. When these crops are allowed to grow high and become thick they produce weak stems, and become affected with the same fungus that produces "drop" in lettuce, whereas when closely cropped there is little loss from this disease. The exclusion of light and air necessarily arising from overcrowding is responsible for this. In most instances the stem rots of the chrysanthemums have been induced by overcrowding, and undoubtedly the carnation would suffer less if more light and air could reach the stems.

Various stem rots could undoubtedly be eliminated, to a large extent, by changing the soil conditions about the plants, such as by the application of coarse sand around the stems. In one case the stem rot in the parsley was greatly reduced by setting the plants well up above the soil, thus exposing the stem and crown to light and air, which resulted in the development of more resistant tissues. The matter of moisture on the foliage plays an important part in infection. The carnation rust has been largely reduced by sub-irrigation methods, and also by applying water absorbents, such as lime, to the foliage. In short, many fungous diseases peculiar to foliage can be much lessened, and in many instances prevented, by regulating the moisture conditions of the air. If it were possible to control the moisture conditions out of doors, the same would hold true there. For example, a cold, wet spring induces peach leaf curl, while a dry, warm spring is not favorable to the development of the fungus which causes curl, and many other cases might be cited where infection is due to weather conditions which cannot be controlled; whereas, in under-glass culture there is little difficulty in controlling these conditions and preventing such diseases. The application of the moisture absorbent to asparagus plants has in some instances very perceptibly reduced the rust; and even the cover of an apple tree is often sufficient to keep the dew off and render the plants free from infection. With this idea in mind, tent cloth crops have been tried with some degree of encouragement; although the expense of tent covers and the results obtained from the same do not at present appear to be such as to warrant their use except in special cases. Another element which has a great bearing on the health of plants, in general, is proper feeding. The influence which proper feeding and cultivation has on the susceptibility of crops to disease is quite marked. There is little doubt but that in many cases time and money could be better spent in securing robust crops by cultivation and feeding than in spraying sickly ones.

TOMATOES.

Blight or Mildew (Cladosporium fulvum, Cke.).

This mildew grows on both outdoor and greenhouse tomatoes. Infected plants show, on the under surface of the leaves, a velvety, brownish-colored, downy mass. The upper surface of the leaves turns yellowish and the edges become curled. It propagates quickly and freely by spores. The method of preventing mildew in the greenhouse is to keep down the moisture in the air and give the plants sufficient light and ventilation. Massey, in the North Carolina Station Bulletin No. 170, states that spraying with a weak solution of potassium sulphide, and dusting the pipes with a wash of sulphur and lime, completely prevented mildew. The latter treatment, however, is probably the most effectual. For out-of-door plants the best treatment would consist in spraying with some standard fungicide.

Eel Worms or Nematodes (Heterodera radicicola (Greef) Mull.).

Greenhouse tomatoes, like many other plants, are frequently troubled with root galls caused by eel worms or nematodes (see Fig. 1). These worms affect some plants much worse than others. The tomato, however, does not show the effect of gall-infested roots as much as the cucumber and muskmelon, the latter plant being especially susceptible to them. The remedy for eel worms consists in soil dessication, or either freezing or sterilizing. The latter method of treatment is the most effectual, and where conveniences are at hand for doing this work it is fully as cheap. Whatever treatment is employed, care should be taken to treat the manure, as our experiments have shown that the manure pile constitutes one of the greatest sources of infection for eel worms. This species of eel worm is not indigenous to our climate, and probably very rarely survives in our soil over winter: it does, however, winter successfully in unfrozen manure heaps.

Fig. 1.—Galls on tomato roots caused by eel worms.

Fruit Rots.

Under this head are included troubles caused by a number of organisms possessing different characters, such as bacteria and fungi, which cause a rotting of the fruit (see Fig. 2). Fruit rots are common to both greenhouse and outdoor tomatoes, and the general practice has been to spray tomato crops when grown out of doors. The results

Fig. 2.—Tomato rot.

from spraying experiments are not, however, entirely satisfactory in all cases, partly, no doubt, from the fact that a number of different organisms have been involved in fruit rots, some of which would appear to be more difficult to control than others. For greenhouse culture we recommend, as a partial means of prevention, the keeping of moisture from the fruit or foliage as much as possible; for in our experiments we have found 33 per cent less fruit rot where we did not practise syringing the plants than where we did syringe.

There are other troublesome diseases of the tomato, apparently more common in the south than in the north. Among these may be mentioned leaf blights (*Septoria*, *Alternaria*), tomato wilts (*Fusarium*, *Bacillus*), etc. There is also a functional disorder occasionally met with in greenhouse tomatoes, known as *Œdema*, or dropsy. This gives rise to a curling and rupturing of the cells of the leaf. *Œdema* is caused by excessive absorption of water from the soil, brought about by too high soil temperatures. The peculiar crinkling, curling and high coloration of tomato leaves, common to greenhouse culture, especially when grown in a rich soil and when severe pruning has been practised, must not be confounded with the dropsy. The latter peculiarity is a form of indigestion, and the same peculiar curling of leaves may be observed on young stump shoots of forest trees which have been cut. Unpruned tomato plants, grown under exactly similar conditions, seldom, if ever, exhibit these peculiar symptoms.

Cucumbers.

The diseases affecting greenhouse cucumbers are referred to more extensively in Bulletin No. 87, issued by the Hatch Experiment Station.

Downy Mildew (*Plasmopara Cubensis*, (B. & C.) Humphrey).

This mildew can be readily distinguished by the typical yellowish, angular spots on the leaves (see Fig. 3). It is likely to occur on greenhouse crops from August to November or December. If crops, however, are set in the house as late as October, they are apt to remain free from mildew during the rest of the year. Keeping the moisture down in the house, together with ventilation and light, is the best prevention of mildew. We have kept this mildew entirely in check on more than one occasion by simply keeping the moisture down in the house, and supplying the plants with sufficient light and air. Since mildew infection comes largely during the summer, one of the best ways to obviate it is to not set the plants until about October. The mildew can also be prevented by spraying with Bordeaux, as has been shown by experiments. In short, this is the only remedy that can be applied to outdoor crops of cucumbers.

FIG. 3.—Cucumber downy mildew, showing the characteristic angular spots.

Anthracnose (*Colletotrichum Lagenarium*, (Pass.) Ell. & Hals.).

This fungous disease causes a great deal of trouble to outdoor crops of melons and cucumbers (see Fig. 4). It has become well-nigh impossible during the past two or three years to grow melons out of doors. From our numerous correspondence with farmers each year relating to this disease, it would appear that it made little difference whether one sprayed or did not spray. The result has always been the same, namely, the plants would blight and most of the crop would be lost. *Anthracnose* occasionally attacks greenhouse crops during the spring and summer: although our experience in handling cucurbitaceous crops under glass, during every month in the year, without a trace of infection, has led us to believe that

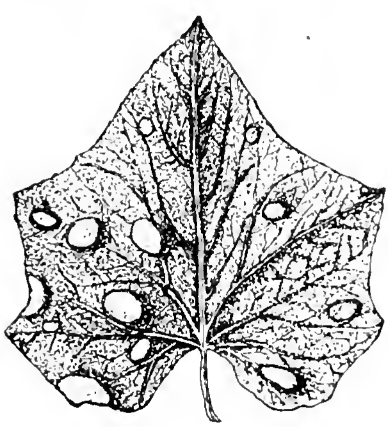


FIG. 4.—Cucumber leaf affected with anthracnose.

the same conditions are necessary for the prevention of *Anthracnose* as for the prevention of mildew, namely, absence of extreme moisture conditions in the house.

Timber Rot.

Timber rot is caused by the same fungus that produces lettuce drop. On the cucumber it causes canker-like growths on the stem, such growths being associated with black pustules about one-sixteenth or one-eighth inch in diameter (see Fig. 5). It does not cause excessive damage to cucumbers, as a rule, and the fungus can be entirely eliminated by applying the same methods as described under drop of lettuce.

FIG. 5.—Timber rot, cucumber.

Eel Worms.

These are very likely to infect cucumber roots, and if very abundant they greatly injure the crop. Many of our greenhouse growers have been more or less troubled with them for some years. For remedy, see "Tomatoes." Cucumbers are occasionally subject to other fungous diseases. The most important ones, however, have been touched upon.

LETTUCE.

There are various diseases common to greenhouse lettuce, which have been described in Bulletin No. 69, issued by the Hatch Experiment Station, Amherst, Mass.

FIG. 6.—A typical normal lettuce head.

FIG. 7.—Lettuce plant affected with drop caused by the fungus *Sclerotinia Libertiana*.

Drop (*Sclerotinia Libertiana*, Fckl.).

This constitutes the most destructive disease of lettuce, and is characterized by the plants wilting and dropping into an insignificant mass (see Figs. 6 and 7). This troublesome disease is caused by a sporeless soil fungus, which attacks the stem of the plant, and the only effectual remedy is found in soil sterilization.

Rhizoctonia.

This is the generic name of the fungus which causes a rotting of the lower leaves of lettuce plants, and occasionally works in the stem and head, much to the detriment of the crop. The fungus is a sterile or sporeless type of soil organism, and the same remedy is applicable to this as to the preceding trouble.

Downy Mildew (*Bremia Latucæ*, Regel.).

A whitish, downy, mildew growth frequently grows on the lower leaves of young lettuce plants and on the exterior leaves of the mature head. It seldom attacks the normal healthy portions of the plant, and does not appear to cause a great deal of damage to lettuce crops, consequently little complaint is made in regard to it. We have found that this mildew appears to be incapable of living over the summer season in a house which is empty for a time, and becomes more or less dry. The spores, or conidia, of this fungus are apparently of very little duration. It is seldom that the fungus is troublesome enough to call for remedial measures.

Top Burn, or Tip Burn.

The above trouble is not caused by any organism, but is due to a lack of proper conditions in the lettuce house. Top burn is merely a wilting of the young, tender leaf extremities, which causes them to dry up and turn brown or black. This greatly disfigures them, and injures to a considerable extent the sale of the produce (see Fig. 8). Amateurs and inexperienced growers are very likely to have top burn. It gives little or no concern, however, to expert handlers of lettuce crops. The whole matter is one dependent upon the absorption and giving off the water by the plant, together with the conditions which govern the formation of the texture of lettuce, namely, heat, light, etc. To obviate top burn, care must be taken not to allow high day temperatures during or directly after cloudy days, and low night temperatures should be maintained during cloudy weather. Skilled lettuce growers know the texture of their plants, and what treatment they are capable of standing. The temperature conditions are governed entirely by what they think the plant is capable of enduring. Where a rapid growth of lettuce takes place, in consequence of any form of stimulation, care should be taken to govern temperature conditions, especially those of night temperature. Lettuce plants, like all others, make most of their growth during the night, and the character or texture of that growth is dependent to a large extent upon temperature. High night temperature will cause rapid growth and a delicate texture, and lower temperature will give rise to less growth with a firmer texture.

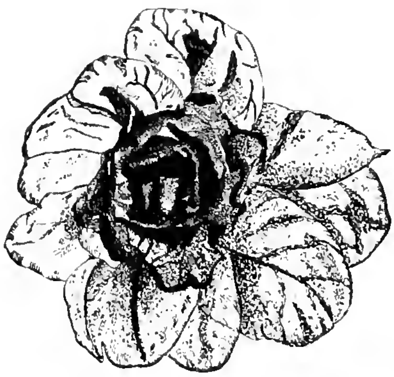


FIG. 8. — Top burn of lettuce, characterized by a browning or blackening of the edges of the leaves in the head.

CHRYSANTHEMUMS.

Powdery Mildew (*Erysiphe Cichoracearum*, DC.).

Mildew frequently shows itself to a slight extent on the leaves of chrysanthemums. It is of little consequence, however, to the careful grower. The mildew is similar to that found on the roses, and can be held in check by the same means.

Rust (*Puccinia Chrysanthemi*, Roze.).

The first appearance of the chrysanthemum rust in America occurred in this State during the year 1896, since which time it has spread over nearly the whole United States. The first two or three years of the outbreak proved the worst, and at present little is heard about it in this section, especially from our largest and best growers. Its disappearance appears to be due to two causes, namely, the discovery and application of cultural methods which render rust infection less common, and the limitation of the rust to a single stage (uredo) of existence. Professor Arthur of the Indiana station believes that the latter factor is largely responsible for its decline. That cultural methods have also had a great deal to do with its disappearance is evident from the fact that our most skilful gardeners have never had it but one or two years, while less skilful and less painstaking growers have been more or less subject to it every year. Inside culture of the chrysanthemum appears to render it free from rust. It is essential always to select healthy stock to start with, and care should be taken to keep all unnecessary water off the foliage in cultivating in the greenhouse. If rust appears on a few leaves they should be picked and destroyed immediately, and badly infested plants should be removed and burned.

Stem Rot.

More or less trouble with a stem rot caused by the fungus *Fusarium* has been experienced by chrysanthemum growers since 1900. This fungus attacks the stem and clogs up the tissues, thus shutting off the water and food supply, and causing the lower leaves to fade, wither and die. The disease occurs most commonly as the result of conditions favorable to damping off. Those plants grown in the centre of the bed, more remote from light, etc., are the worst affected. Cultural precautions which will obviate damping-off conditions, such as less crowding, etc., are at present the only recommendations that can be given as constituting a preventive.

Roses.

The cultivation of roses is carried on quite extensively in this State. The unsurpassed skill that is given to the production of this crop has resulted in reducing diseases to a minimum. Some of these establishments turn out superior produce year after year as regularly and as perfectly as any manufacturing establishment turns out its wares. The most important diseases of the rose are as follows: —

Powdery Mildew (*Sphærotheca pannosa*, (Wallr.) Lev.).

This occurs as a white, powdery mass on the upper surface of the leaves, causing them to curl and become distorted. The most skilled growers, however, succeed, as a rule, in handling the conditions of the house so intelligently that the mildew is prevented. In case it becomes troublesome, through lack of uncontrollable conditions, the standard remedy to apply, and one which is very effectual, consists in evaporating sulphur over a lamp. A more practical as well as a more efficient method of applying sulphur is to repeatedly paint the pipes with a mixture of sulphur and oil.

Black Spot (*Actinonema Rosæ*, (Lib.) Fr.).

Black spot occurs on the leaves, causing them to turn more or less yellow, and resulting in their falling off (see Fig. 9). Certain spraying mixtures have been recommended for black spot, but the most satisfactory method of treatment is to keep the leaves picked off, and avoid a close atmosphere at night and on wet, dull days.

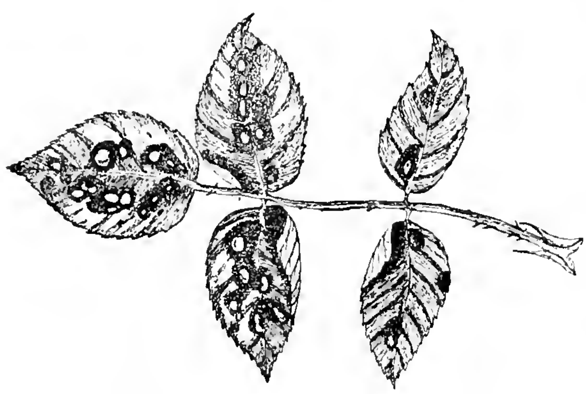


FIG. 9. — Black spot of rose.

Bronzing of Roses.

Rose leaves frequently become spotted and turn yellow, and drop off without being affected with the black spot fungus. This happens to those leaves near where the stem has been cut, and is a purely functional disorder, due, apparently, to the starvation of that particular leaf. It resembles somewhat the black spot, and is termed "bronzing." In all probability it is a correlated growth phenomenon resulting from pruning.

Eel Worms.

Rose growers are sometimes troubled with eel worms, and in some instances large losses have resulted (see Fig. 10). In one instance, to our knowledge, a rose establishment, which had produced $17,000 worth of roses annually, reduced its output for a few years to about $2,000 or $3,000, due to the disastrous results of eel worms. Other instances could be cited where rose growers have been almost forced out of business by the pests. In some establishments, where unusual care has been taken, the houses have never become infested with these worms. For remedies, consult "Tomatoes," etc.

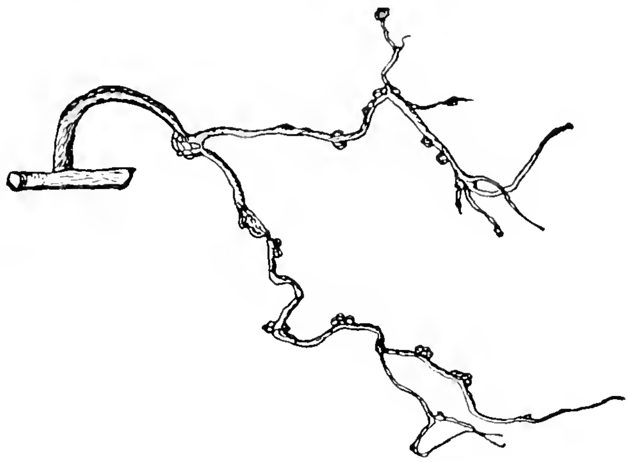


FIG. 10. — Root gall of rose.

CARNATIONS.

Rust (*Uromyces caryophyllinus*, (Schrank) Schrt.).

This fungous parasite, which is familiar to every one who grows carnations, is not dreaded so much as when it first made its appearance some years ago. It is decidedly less prevalent at the present time, by reason, perhaps, of less susceptible varieties being grown, and also because carnation growers have become more familiar with the conditions which succeed in reducing the rust. The practice of sub-irrigation and liming the foliage, together with attention to moisture conditions, has been responsible for a diminishing number of rusty plants. Spraying experiments have never proven satisfactory for the carnation rust, and the best and most rational remedies, here, as elsewhere, consist in paying attention to cultural conditions.

Stem Rots (*Fusarium*, *Rhizoctonia*).

There are at least two distinct types of stem rot caused by the above-mentioned fungi. These rots constitute perhaps the worst features which carnation growers have to contend with at the present time. The rot caused by the sterile *Rhizoctonia* can be controlled by sterilizing the soil; and that caused by *Fusarium*, in all probability, cannot be controlled by this method. Neither can we expect to control by sterilization any fungus which is freely propagated by spores. There are probably cultural methods that can be applied in the greenhouse which will alleviate the troubles caused by *Fusarium*, and experiments are now being conducted by us with that end in view. Undoubtedly, starting the plants in uninfested soil and cultivating on new land where *Fusarium* is likely to be less common will aid to overcome the rot to a large extent.

Among other diseases of the carnation which are more or less common is the *Stigmonose*, or *Bacteriosis*, as it has been called, which is believed to be due to insect stings, causing a small purplish spot on the leaves. There are also the *Anthracnose*, fairy ring, leaf spot, etc., which are more or less prevalent.

VIOLETS.

Leaf Spot (*Alternaria Violæ*, Dorsett).

More than one fungus was formerly believed to be the cause of the violet leaf spot (see Fig. 11). More recent investigations, however, would seem to indicate that most of these spots are caused by the above-named fungus. The application of fungicides has proven of little or no value as preventives, and the best authorities recommend strict adherence to the most careful cultural conditions, together with the selection of the strongest and healthiest plants for crop purposes.

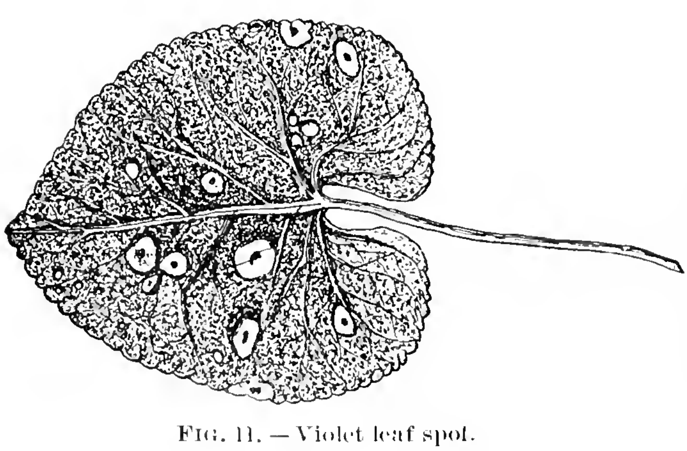


FIG. 11. — Violet leaf spot.

Eel Worms.

These are very troublesome to violets, because of minute galls on the roots, which are readily overlooked; and the same method of extermination holds here as elsewhere (see "Tomatoes"). Care must be taken, however, not to start the plants in soil infested with eel worms.

SPECIAL REPORT

ON THE

DESTRUCTION OF BIRDS BY THE ELEMENTS.

BY

EDWARD HOWE FORBUSH.

PREPARED UNDER THE DIRECTION OF THE MASSACHUSETTS STATE BOARD OF AGRICULTURE.

EVIDENCE OF A TRAGEDY.

The Body of an Unfledged Oriole entangled in the Fabric of a Wind-torn Nest.

THE DESTRUCTION OF BIRDS BY THE ELEMENTS IN 1903-04.

BY EDWARD HOWE FORBUSH, ORNITHOLOGIST TO THE BOARD.

There are many ways in which birds are destroyed by storms. The casualties resulting from local thunderstorms accompanied by high winds and heavy downpours of rain or hail are most commonly observed. Such storms affect all small birds that nest in places where they have no adequate protection from the fury of the elements; but the effects produced are not often widespread enough to constitute a serious check on bird increase over large areas. Long, cold storms coming in the breeding season may prove very destructive to bird life. Unseasonable storms occurring while birds are migrating sometimes prove equally fatal.

When cold snowstorms drive far south of their normal latitudes, great suffering among birds ensues. There are authentic records of such a calamity which occurred in the winter of 1898–99, when great numbers of birds were killed.

Cold waves, reaching far south, are sometimes fatal to birds either in fall or spring migrations or in the winter. In 1895 most of the bluebirds and tree swallows of a large section of New England perished while in the more southern States.

Wind storms sometimes sweep migrating birds into lakes or seas. Some such catastrophe may have occurred to the warblers of Massachusetts in the winter of 1902–03, for few were seen here in the ensuing May. This scarcity of migrating warblers was noticed by every field ornithologist with whom I have conversed on the subject. I was in the woods nearly every day, and never saw so few of these birds during the flight. Mr. Wm. S. Perry of Worcester writes that he was out almost every day, and never found birds, especially warblers, vireos and flycatchers, so scarce. He also states that birds of the warbler family were very scarce in Worcester County all the spring, and that he saw only one redstart, — a bird usually common.

Most of the warblers and vireos are believed to winter in, or near, the tropics. They are probably exposed to great perils in crossing the Gulf of Mexico. Until their southern range and the climatic conditions prevailing there become matters of accurate record, and the laws governing bird migration are better understood, the cause of the occasional scarcity of these birds in the spring migrations can only be conjectured.

Whatever may have been the cause of the general scarcity of birds during the spring flight, the meteorological conditions of the spring and early summer were very destructive to bird life.

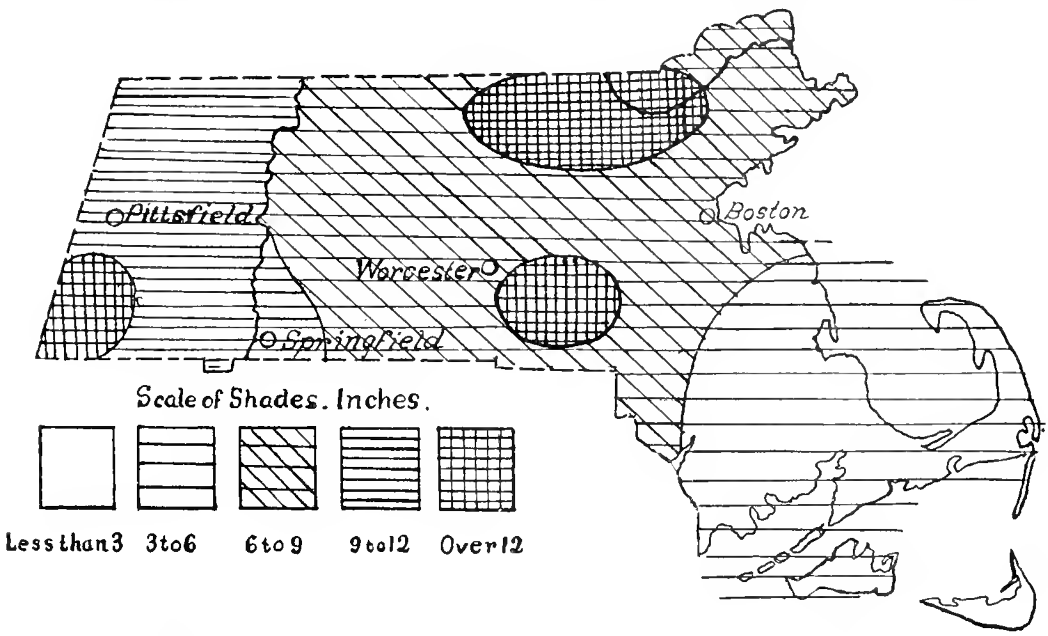
In seeking the cause of this mortality I have been greatly assisted by Director J. W. Smith of the New England section of the United States Weather Bureau at Boston, who has kindly offered me opportunity to inspect his records. I am indebted to Dr. C. A. Goessmann for meteorological reports of the Hatch Experiment Station of the Massachusetts Agricultural College at Amherst; also to many correspondents in Massachusetts and other New England and adjacent States who have contributed information. According to the climate and crop reports of the New England section of the United States Weather Bureau, the principal feature of the month of May, 1903, was a remarkable drought. No rain of any importance fell after the middle of April. There was much sunshine, unusually high temperatures and moderately high drying winds. The thermometer reached or passed 90°, at different dates, in all the New England States. During the last ten days of the month the temperature was cooler, with killing frosts in many localities, which injured vegetation, especially the blossoms of small fruits. In his summary Mr. Smith says: "It is probably safe to assume that the past May has left a record that will not soon be forgotten or equalled. Especially is this true as regards the element of precipitation, which is almost, if not quite, without parallel in the history of authentic records." The average normal rainfall (precipitation) of New England for May is 3.80 inches, while that for May, 1903, was only .68. The amount for the month at Boston, .32, is the lowest for May in the official record for thirty-three years. It is probably the lowest recorded since 1826, when at Salem it was only .20.

A large portion of central Massachusetts and much of the eastern and western sections of the State received only an inch of rain, or a trifle more, for the month. The rest of the State received less. This drought was continued for the first seven days of June, although a little rain fell in some localities on June 7. The drought was even more severe in the more northern States. These remarkable conditions are of interest in this connection mainly because of their effect upon the vegetation and insects on which birds feed, although some swallows may have been prevented from breeding until later, because of a lack of mud for their nests.

In the woods, meantime, the ground and its covering had become so dry that brush and forest fires which had broken out in many parts of New England spread rapidly, and in many cases escaped beyond control. They devastated large areas of wood and timber lands, destroying also many isolated farmhouses and hamlets. The village of Braggville, Me., was completely wiped out of existence. The amount of smoke and fine ashes suspended in the atmosphere caused so-called yellow days from June 3 to 7. The smoke was at times so dense in all the New England States as to obscure the stars at night, and during the day the sun appeared like a red ball in a yellow sky. The wind movement was light, and smoke hung like a pall over the country, while the odor of burning wood filled the air. Vast numbers of birds' nests, eggs and young must have been destroyed in these fires.

Then came a change. From June 8 to 30 the weather was cloudy or rainy, with some intermissions, throughout most of Massachusetts and southern New England, although there were localities where days passed with little or no rain. Twenty-seven stations report from nine to seventeen rainy days and from three to thirteen clear days for the month. Easterly winds, prevailing, brought fog, and low temperature was the rule, the mean temperature for New England, 59.5°, being the lowest for this month since the official records have been kept.

A severe storm of wind and rain occurred on the 12th. The wind reached a maximum velocity of seventy-two miles per hour at Block Island, and was very strong elsewhere in exposed localities. There was a heavy rain on the 15th and an extremely heavy and very cold easterly rain storm on the 21st. The 27th, 28th and 31st were generally without rain. The average precipitation was greater for the month in Mas-



Map showing the precipitation in Massachusetts for June, 1903.

sachusetts (7.44) than in any other New England State except Connecticut, and generally the storms in Massachusetts appear to have been more severe than in the more southern State.

A glance at the accompanying map will show that the greatest rainfall occurred in Berkshire County, a part of northern Worcester and Middlesex counties and the south-eastern part of Worcester County, while the least occurred in Nantucket and a part of Dukes County. Nantucket had only 1.1 inches of rainfall for the month. This places it outside the storm area. There were also cold storms in July, but they were not so severe as those of June.

It will be seen that the heat and drought often associated with July or August came in April, May and early June. The effect of these abnormal conditions on animal and vegetable life became apparent. The earlier birds, finding a food supply, began breeding very early. Notwithstanding the warm weather, the grass on uplands made very little growth, and wild vegetation in general was stunted or backward.

On June 2 the grass in south-eastern Massachusetts and Rhode Island was sparse and short, but well headed, and some farmers were cutting it to save what there was. It was generally feared that the crop would be a failure. Insects, with a few exceptions, appeared to be scarce.

Nevertheless, mosquitoes swarmed unusually early from the drying pools, plant-lice appeared on the fruit trees, and the invulnerable gypsy moth thrived as usual. Early in June the forest fires, and later the floods, must have destroyed incalculable numbers of insects; while the heavy rains swept the air clear of all flying insects, even mosquitoes, and also killed or benumbed many larvæ. Grasshoppers practically disappeared; some, a late brood, perhaps, had not reached the imago state when cold weather came. The Crop Report for May, issued by Secretary J. W. Stockwell of the Board of Agriculture, gives no serious general insect injury; but the tent caterpillar seemed to be on the increase.

In the June Crop Report most of the correspondents either fail to mention insects at all, report little or no damage, or that insects are scarce. The insects reported as doing injury are mainly those known to be very hardy, or such as are protected by their habits from the weather. Tent caterpillars evidently had subsided.

Dr. H. T. Fernald of the Massachusetts Agricultural College says that: "At Amherst the long dry period in April and May killed many insects, in some cases seemingly directly, in most cases by its effect on their food. Some, however, like the plant-lice, were greatly favored by the conditions, and became astonishingly abundant. Among these the cold June rains worked enormous destruction, but hardly reduced them to their normal numbers." He would place the chief responsibility for the scarcity of insect life on the drought.

This view of the case is corroborated in general by statements of the entomologist of the University of Maine, at Orono (where little rain fell during either May or June), who says that the scarcity of insects there was a matter of general comment. She also says that several of the more common pests were not especially troublesome, and that the scarcity of grasshoppers was generally noticed. She mentions, in addition to other possible causes of this mortality among insects, the late frost, but does not positively assign any cause.

Mr. A. H. Kirkland of Boston, who is well known for his connection with practical economic entomology, states that he has never seen a time when there was so little trouble from common native insect pests. He writes: "I presume the long period of drought had something to do with it. If it had not been for the gypsy moth and certain species of plant-lice, the year would have been practically featureless from an entomological stand-point, so far as this State is concerned."

Conditions similar to those prevailing here were widespread. Prof. L. O. Howard, chief of the Division of Entomology, United States Department of Agriculture, writes that the early drought and the June rains prevailed over a large part of the Atlantic seaboard, and there was generally a scarcity of insect life except for plant-lice, which thrived under the rainy conditions. He attributes the apparent thrift of the aphides to the fact that their natural enemies, especially the braconid parasites, cannot fly during rainy weather, and so the plant-lice breed unchecked.

Possibly no one in Massachusetts has made a careful study of the causes by which the general repressive effect on insect life was produced. Inquiry of the official entomologists in other New England States indicates that no special study of the subject has been made by them.*

* The general scarcity of insects here during the dry weather may have been largely responsible for the small number of warblers during the spring flight, for migrating birds will not usually stop long where food is not plenty.

Whatever may have been the cause of the scarcity of insects during the drought, the June rains finished the work thoroughly. Farmers reported that grasshoppers and crickets were absent from the fields. Beetles and bees lay dead upon the ground. There was no sound of insects in the air, and for a time many insect-eating birds, or their young, were actually starved.

Another effect was produced on the breeding of birds by the scarcity of insect food. Hawks, owls, crows, jays and squirrels, which ordinarily feed to a considerable extent on insects, and some of which feed on insect-eating mammals, are likely, if hard pushed for food, to turn to the smaller birds or their eggs or young. There is no doubt that crows and squirrels were very destructive to eggs and young birds last year. They were also unusually destructive to corn and other products. Several correspondents speak of this.

Turning next to the direct effects produced on birds by the abnormal and severe weather of June, a brief description of the conditions existing at Concord, Mass., which was then my post of observation, may not be out of place. From June 7 to 27 inclusive the temperature rose above 70° on only four days, and dropped below 50° on eight. It rained, more or less, sixteen days out of the twenty, but there was no severe storm until the 12th. At this time branches were broken from trees, birds' nests were blown down and the eggs or young destroyed, as they were elsewhere. On June 15 a heavy rain continued nearly all day, and 2.35 inches of rain fell. There was no rain on the 17th or 19th, but the weather was cloudy and cool until on Sunday, June 21, there came a severe easterly storm, with 3.16 inches of rainfall and a strong wind.

I was then at Ball's Hill, on the estate of Mr. William Brewster, in a cabin overlooking the rising river, which on the morning of the 21st had covered a large part of the great Concord meadows, rising three feet before night. The low temperature and the gale made heavy clothing necessary for comfort. By noon the river had covered all the meadows, and they resembled a lake surrounded by hills. Along the channel, white-capped waves were tossed against the current by the fury of the gale. The rain drove in misty sheets across the scene, always dimming and sometimes hiding the landscape beyond the trees at the edge of the meadow. Hay, lumber and a great variety of objects came floating down the turbulent stream, with here and there what appeared to be small islands covered with grass or button bushes, which had been lifted by the flood from their insecure moorings in meadow or swamp to be borne to new locations nearer the river's mouth. Barn swallows could be seen sweeping low along the waters, despite the high wind

Barn swallows seeking food in the storm.

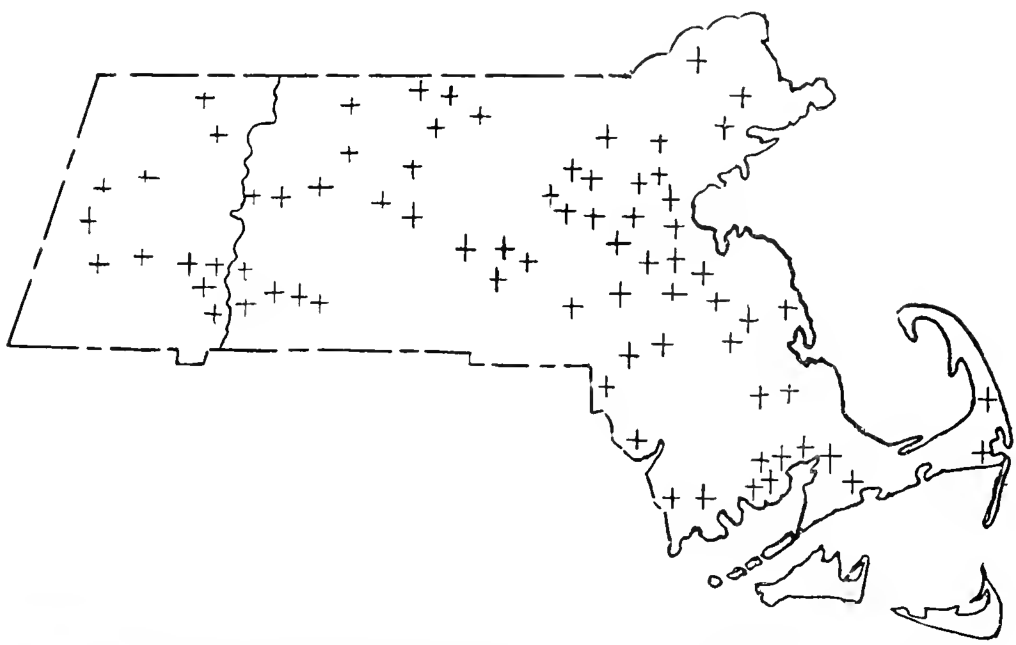
and driving rain, seeking insects among the few grassy tufts which still showed above the flood.

Insects driven from the air by the rain and from the earth by the flood had evidently crawled to the grass tops, and there the swallows found them. So all day, until the rising flood covered the last rush or grass blade, the swallows labored in the storm to keep the breath of life in their bodies or to feed their starving young. A few blackbirds were seen all the morning. Perhaps the flood had not yet reached their nests, but the water rose steadily, and a few days later it had risen about six feet, submerging the nests of song sparrows, rails, bitterns, blackbirds, bobolinks and all other birds breeding on the meadows or near the ground along the shore; it even reached the nests of kingbirds in bushes along the water front.

The next day I saw a single male purple martin flying wearily over the Concord woods, — possibly the last martin seen alive in Concord. After this storm, chimney swifts were found dead. The nests of robins, vireos and chipping sparrows were deserted. It was evident that, if the storm covered a wide area, much destruction of bird life must have resulted. On my calling at the rooms of the Board of Agriculture in the State House a few days later, Mr. J. L. Ellsworth, the incoming secretary of the Board, decided to send out a circular asking for information on this subject. This circular was accordingly sent to a list of two hundred correspondents, and seventy-eight persons gave information of more or less value. Twenty-eight of these replies gave much detailed information, the result of personal investigations. All but five of the seventy-eight gave evidence of a decrease of bird life.

Many localities were visited later, and more evidence was obtained by a voluminous correspondence, which was continued through the year. In this investigation every county of the State has been heard from except Dukes and Nantucket. It may be inferred, from these islands having escaped most of the rains, that birds there did not suffer so much as elsewhere. Several reports have been received from other States.

Floods seemed at first the most certain and obvious cause of the destruction of nests, eggs and young birds. No observers reported floods from the tidal rivers or near the sea, for in such localities most birds build their nests well above high-water mark, and there is ordinarily a free outlet; nor was there much injury along large reservoirs of water supply where the water is not allowed to rise above a certain point; but many reports were received of high water and great destruction wrought by rivers and lakes in the interior. While some ponds rose to a great height, in others no such rise was noted. This difference was due no doubt to a variation in the rainfall, a difference in overflow outlets, a diversity in the character of the soil, or all combined. Some rivers rose to the height of their spring freshets. It was found later that the headwaters of those rivers or some of their principal tributaries had received the heaviest rainfall. No rise equal to that on the Concord River is known to have occurred there in any other June within the memory of old residents. Near Springfield the Connecticut River was twice in flood; the highest rise is said to have been about six feet. Young birds in the nests were drowned, eggs were



Map of Massachusetts, showing localities from which reports have been received.

destroyed, and most of the birds having nests flooded were prevented from breeding again, as the floods did not subside for some time. In many localities lowland pastures were flooded. The copious rainfall running off the hills inundated the hollows, submerging the nests of ground-breeding and bush-dwelling sparrows. Many song sparrows thus lost their second broods. These miniature floods were perhaps most destructive in Worcester County, where the clayey soil is retentive, and least so in Plymouth, Barnstable and Bristol counties, where the soil is light and the rainfall was less.

The extent of the mortality from floods can never be accurately estimated, for nests, eggs and young birds were washed away. One could sail a boat over the meadows along the Concord or Ipswich River. The water rose into the neighboring lowlands, in one instance, at least, flooding a truck garden and destroying the sparrows' nests in low fields near the river.

It has been difficult to get much information concerning the results of the storm in Berkshire or Franklin County. Most of the correspondents there have not noticed any unusual suffering among birds, but, as the rainfall was quite as heavy west of the Connecticut as east of it, probably some injury was done. The storms of the 12th and 21st were not generally so severe, however, in Berkshire as farther east; still, Mr. J. Alden Loring writes from Pittsfield that many lowland pastures were flooded, and he noticed that the young in three birds' nests that he happened to have under observation all perished, and that a nest of the chimney swift fell; and Mr. Wesley B. Barton of Dalton says a good many young birds died from exposure. The rise and fall of the rivers there are very rapid. Some of them rose considerably, but the injury done to birds by flood seems not to have been noticed.

The after-effects of the storm on bird life generally along the overflowed rivers in eastern and central Massachusetts were very noticeable. Rails and marsh wrens disappeared from the Concord meadows; bobolinks became scarce; swamp sparrows and song sparrows took to the woods, and bitterns to the fields and brooksides.

Mr. Bailey writes that along the Concord River in Billerica and Bedford, and Miller's River in Ashburnham and Winchendon, red-winged blackbirds lost all their broods. He has not seen a young bird in either section, or heard of any having been seen. Many nests of bitterns, rails and swamp sparrows and one of the black duck were submerged.

Mr. C. E. Ingalls of East Templeton, Worcester County, writes that the rise of water on the Otter and other rivers must have destroyed many young blackbirds. Very few young have been seen this season near his place. On August 2 there seemed to be no blackbirds, as he did not see a single flock in a trip by rail and trolley from East Templeton to Springfield. He reports that song sparrows have been much less abundant than usual, and that he has not seen a bobolink since the rain. Mr. Walter B. Randall of Newton Upper Falls, on the Charles River, says the marshes along the river were under water. He had not noticed bobolinks or song sparrows where heretofore they had been plentiful. He saw blackbirds' nests under water.

Mr. Chester A. Reed says the waters of Lake Quinsigamond at Worcester rose to an unusual height, entirely submerging the breeding places of red-winged blackbirds at the height of the breeding season. He found scores of their nests submerged. Mr. F. A. Bates writes from South Braintree, Norfolk County, that the waters of the Monatiquot River rose as they did about thirty years ago, when all the nests in the grass tussocks were submerged and deserted.

Other observers report a scarcity of song sparrows, blackbirds and bobolinks where heretofore, in many cases even in the spring before the rains, they were abundant. Only one correspondent, Mr. S. S. Symmes of Winchester, reports an abundance of blackbirds: but there the ponds and reservoirs, having ample outlet to the sea, do not rise above a certain limit. Possibly blackbirds driven from flooded localities may have gone there.

Great as was the loss of bird life by the floods, their area was necessarily limited, and their fatal effect was therefore local when compared with that caused by the storm on the eastern seaboard in other ways.

The storm of June 12 came at a time when the young of many of the smaller insectivorous birds had recently hatched, and many that survived this storm were still in the nest, or but just out of it, when the storm of the 21st destroyed them.

Mr. Bailey writes that the storm of the 12th exterminated nearly all nestlings of the red-eyed and yellow-throated vireos, Baltimore orioles and chipping sparrows within a mile of his place. He counted fourteen nests of the red-eye and seven of the yellow-throat that were destroyed. One brood of orioles weathered the storm until the 20th, but were all dead on the 24th.

Mr. C. A. Reed writes: "Yellow warblers, redstarts, prairie and chestnut-sided warblers were unable to get food for their young, and the results were apparent on inspecting the nests. In some cases the skilfully woven nests of the red-eyed vireos had made water-tight baskets, and the dexterity of the birds had been the cause of the death of their little ones. Out of twenty-one nests that I had located as being in particularly desirable situations to make photographs but one escaped destruction. Twenty nests out of twenty-one destroyed; seventy-five out of eighty young birds and eggs that the nests contained perished. The one nest which escaped out of the number was that of a house wren. As many other localities throughout the country suffered a great deal worse than this, it is probable that this mortality among young birds is not in excess of what the average will be. As these twenty-one nests were but a fraction of those that were in the locality, and as this locality is but an infinitesimally small part of the territory which was invaded by storm and flood, it can be readily imagined that the sum total of young birds which perished will amount to hundreds of thousands." *

Mr. Reed believes that about Worcester the warblers suffered most. Sixteen observers in different parts of the State report that nests containing young birds or eggs were broken down, and twenty-four report the death of young birds. The robins, orioles, vireos, chipping sparrows, warblers and flycatchers appear to have suffered most in this way. Starvation probably had much to do with their death in many cases. Mr. Mosher writes that many robins' and chipping sparrows' nests were blown down and the young or eggs destroyed, and that flycatchers also suffered severely. Professor Hodge speaks particularly of robins and chipping sparrows. Rev. Geo. Love of Springfield tells of the destruction of sparrows' nests by the wind in the Connecticut valley. Mr. Outram Bangs states that at Wareham many robins' nests were blown down, and some chipping and song sparrows' nests, but believes that the young birds had left in most of the cases that he observed. Mr. Reed writes: "So far as I have

* American Ornithology, Vol. III., No. 8, August, 1903.

observed, all insect-eating birds suffered excessively for lack of food." Mr. C. K. Reed corroborates this, enumerating the different species found dead.

Probably warblers, thrushes, flycatchers, vireos, swallows, swifts, night hawks and martins especially suffered most from this cause. The enormous destruction among the warblers will never be appreciated, as few people observed the warblers breeding at this time, for the woods and shrubbery (as I know by experience) were so wet as to drench completely any one going into their breeding places. I knew of but one case in which a warbler brought her young out safely during this period. They left the nest on the 20th, but were not seen after that date. The nest was in a sheltered location on the ground, on a dry hillside in thick woods. I was out during the heaviest rain of the 21st to observe its effect on birds. Hardly a bird could be seen in the woods. Evidently they were making no attempt to feed their young at that time. Mr. Bangs saw kingbirds on the ground trying to pick up dead bees or other insects. The flycatchers, except phœbes, probably raised very few young. Bluebirds and wrens were more fortunate, while woodpeckers did very well. Woodpeckers had the advantage over all other insectivorous birds, their young as well as their insect food being sheltered from the storm. Bluebirds did not all escape. Many sets of eggs were lost, but on the whole they bred very well, for most of them had already attempted to rear one brood, many with success, and in many cases the second brood did not hatch until the storms were over.

Many observers report that ground-nesting birds, other than those having their nests overwhelmed by the floods, lost eggs or young. They seem to have suffered as severely as those nesting in trees or shrubbery. Mr. H. W. Tinkham of Swansea, Bristol County, states that the meadow larks, which were quite common in his vicinity, lost nearly all their first broods. The bobwhite or quail he believes did not suffer so much, as some had raised young before the storm; but such as had eggs or young at the time lost them.

The destruction of the nests, eggs and young of brown thrashers, towhees, ground sparrows and ovenbirds is reported by the Messrs. Reed and others. Mr. Bangs states that about Wareham pheasants and grouse suffered severely. Throughout the State sportsmen and ornithologists found an unusual scarcity of young grouse and bobwhites at this time. In Concord I judged the mortality among five broods of young grouse to average about seventy per cent, but others appear to find it much greater elsewhere. The effect of the storm was most severe on the grouse, as many of the quail reared second broods later. The mortality among grouse probably extended from western Maine southward and westward throughout most of the area of heavy rainfall in southern New England.

Mr. Herbert Moulton of Hiram, Me., says that a brood of twelve or thirteen young grouse was seen almost daily by his neighbor. When the cold rains set in they lost numbers rapidly, and when last seen only two were left, so weakened that they could be readily picked up in the hand. In the shooting season no young birds could be found.

Many reports of this nature have come in. Mr. Perry of Worcester states that "there are no young of the ruffed grouse."

This destruction of the grouse is now so well known and so generally acknowledged that it is unnecessary to dwell on it here. The rain seems to be the chief cause. The young birds which I examined were not infested with ticks, but were wet and nearly helpless. There may be a disease among the young grouse that is favored by wet weather. Possibly grouse will now be most plenty in northern and eastern Maine and in northern Vermont, where the storms were not severe, provided the young birds were not destroyed by forest fires.

Strange as it may seem, the disaster to the insectivorous birds did not end with the destruction of the nests, eggs or young. From either the scarcity of insects, the flooding of the breeding places or some other cause, most of them did not attempt to breed again, so that many species raised hardly any young during the season. This alone might be expected to result in a scarcity of such species this year. But the destruction wrought by the elements went even further than this, for many adult birds were overcome and perished from exposure and starvation combined.

Four correspondents report finding adult robins or vireos dead. Others report a significant disappearance of adult birds of several species. Mr. Mosher found a male bluebird exhausted on June 25. The bird was picked up and cared for, recovered, and later with its mate brought off a second brood.

Swallows, martins and swifts perished by hundreds in eastern Massachusetts. In some sections the swifts appear to have been exterminated. Practically all of the young of the purple martins died, while in a large section of the State from Buzzard's Bay to the New Hampshire line most of the adult birds seem to have perished. Only four correspondents report seeing any living martins in Massachusetts since the end of the storm period, and those four saw only a few birds each.

The mortality among barn swallows seems to have been greatest in Plymouth and Barnstable counties. Many young barn swallows starved to death in these and other counties. Miss Isabel B. Holbrook of Rockland, Plymouth County, states that a resident of Hanover counted eighty dead barn swallows, mostly young, around his farm buildings; and that Albert E. Vinton, while at Chatham on Cape Cod, noticed that barn swallows were dying, and counted ten washed up on the shore by the waves. Mr. J. H. Bourne of Marshfield, Plymouth County, saw the usual numbers of swallows in the spring, but after the storm only a few. Mr. William R. Lord of Rockland asserts that the young barn swallows died, and that "the old birds seem to have gone to the coast for beach flies."

Mr. Marcus M. Porter of Stoughton, Norfolk County, saw no barn swallows after the storm, but Mr. Chas. F. Curtis of the same town reports the same number in his barn as usual. Mr. F. P. Hammond of Mashpee states that very few swallows returned when the storm was over. Mr. Bangs says that at Wareham all the young barn swallows perished. He picked up several a few days out of the nest, but in a dying condition. At the Mosher place in Dartmouth all the young barn swallows died. They cried piteously for food, but the old birds came to the nests only at night. One pair of adult birds in his barn survived and brought out another brood. In Westport Mr. J. H. Sullivan reports that a pair of these swallows safely reared two broods in his barn. This is the most southerly town on the mainland, and adjoins the Rhode Island line. North of Boston no direct evidence has been found that adult barn swallows perished in the storm, but several observers report an unusual scarcity of these birds after the storm period.

Mr. Ingalls reports them as not scarce August 2 in Worcester and Hampden counties. Mr. N. B. Douglas of Sherborn, Middlesex County, reports them as fairly plenty. Mr. J. A. Gilmore at Westborough and Mr. Harry Maynard at Shrewsbury, both in Worcester County, report them scarce since the storm. Mr. H. R. Kinney at Worcester sees very few. Mr. H. C. Russell of North Hadley, Hampshire County, reports a noticeable absence of swallows. Mr. A. C. White of North Orange, Franklin County, gives corroborative evidence.

On the other hand, Mr. Wesley Barton of Dalton and Mr. Wm. H. Snow of Becket, Berkshire County, report swallows as plenty as ever. I noted no great diminution of barn swallows in Concord, and Mr. Farley saw little change in their numbers in Lynnfield.

Reports on the tree swallow indicate the destruction of both young and old, but there are still many birds left locally. Mr. Farley gives them as occurring in their usual numbers at Lynnfield after the storm. Mr. Charles Kohlrausch, Jr., writes from North Billerica that "The barn and tree swallows were not much in evidence after the storm of the 21st." Mr. Bangs, an excellent observer, reports that he believes the tree swallows perished, both old and young.

Observers in other counties of eastern Massachusetts report their disappearance. Mr. Kinney at Worcester says the tree swallows were very plenty in the spring, but all disappeared. Prof. Clifton F. Hodge notes the disappearance of two pairs which had been nesting in his bird houses. Mr. Robert O. Morris at Springfield reports that the tree swallows that were unsuccessful in raising their broods "did not return to breed;" but he found one brood which had weathered the storm period. Mr. Loring could find only two or three of these birds about Pittsfield last summer, and none breeding. Apparently many of these birds either perished or left the State without breeding.

This inquiry has brought to light, again, the fact that swifts nest or at least roost in large colonies. Years ago such a colony existed in Millbury, Mass. The birds came at nightfall in a great swarm, settling in a large hollow tree, where they passed the night. Three instances where these birds swarm into chimneys are mentioned by correspondents.

Where chimney swifts were most numerous at the time of the storm they, apparently, suffered most. Mr. Kohlrausch says that a colony of about two hundred swifts that inhabited a disused chimney in North Billerica succumbed; also that a large colony that lived in a great chimney or stack at the Talbot Mills was destroyed. He states that three wheelbarrow loads of dead birds were removed from the base of the stack after the storm. Mr. Bailey corroborates this statement, and says that the dead birds were removed on June 21, thus fixing the date as that of the heaviest rainfall. He says that the swifts were nearly exterminated in that vicinity. All through that region these birds were comparatively scarce after the storm. He believes that the swifts lost two-thirds of their number in a section between Boston and the New Hampshire line and along the Concord and Merrimack rivers. At the time of this storm and for a week afterwards he had a good opportunity to observe its effects in that region.

Reports from Norfolk, Barnstable and Bristol counties tell of dead swifts dropping down the chimneys into fireplaces, being picked up on lawns, or disappearing during the storm.

Mr. Porter took out twenty-four dead birds from a chimney in Stoughton. Mr. Isaac Alger writes that, as far as he has observed, the chimney swifts are all dead in Attleborough. Mr. Ingalls reports that he saw no swifts on the way from East Templeton to Springfield on August 3 until he reached Hampden County, where between Holyoke and Springfield he saw over two hundred.

From Worcester, Professor Hodge reports that swifts died in great numbers June 19 and 20, and were found dying on lawns. From one locality two hundred and fifty dead birds were reported. Later he writes that there was a large colony in a chimney of Clark University, — he thinks two thousand birds would be a low estimate of its numbers. The watchman informed him that he took out "bushels" of dead birds when cleaning out the pit at the bottom of the chimney. The swifts in the adjoining town of Millbury also suffered severely.

Mr. Maynard of Shrewsbury reports no swifts seen since the storm, although they were plenty before it. Mr. White of North Orange noticed a scarcity of swifts; but from the Connecticut valley west nearly to the New York line only three reports out of seventeen mention the destruction of these birds or their nests.

The best local report in regard to the destruction of purple martins by the storm is given by Mr. J. A. Farley. It is so full and accurate in detail, and is so nearly typical as to the general effect produced on these birds by the storm in eastern Massachusetts, that most of it is here given: —

In regard to the destruction of martins at the colony on the estate of E. G. Russell, Esq., in Lynnfield Centre, during the week of June 21, 1903, I have to report that the weather was exceedingly cold for the time of year on the night of Saturday, June 20, and on Sunday, June 21. It began raining rather heavily at 7.30 P.M., June 20, and continued through the night. It rained steadily, and most of the time heavily, from Saturday night through Sunday and into Sunday night. Presumably the rain continued through the night, for on Monday, June 22, it rained early. It did not rain for the major part of the forenoon of the 22d, but was cloudy and cool until noon, when the sun attempted to break through the clouds. The sun shone to some extent in the afternoon, and it was warmer, but there was no definite clearing weather.

Of course no martins, or practically any other birds, were seen on Sunday during such a rainfall. Our supposition was that the martins were within their houses. On Monday (22d) I noticed nothing of the martins until noon, when I heard one overhead. In the afternoon I saw several hawking over the meadow one-half mile away with the barn swallows. The sight of these few martins led me to infer that the entire colony had "weathered" the storm.

As I was not near the bird boxes in the afternoon of the 22d, I cannot say how many martins were to be seen there.

I was not in Lynnfield Centre for several days after the 22d, but the following facts have been furnished me by Mr. Carl Russell, in whose father's yard the martin colony was located. On Tuesday, June 23, the weather was cool and more or less misty. It rained at 9 A.M. and at other times during the day. The weather might be best described as "heavy." On Wednesday, June 24, the weather continued cool or even cold. It rained hard in the morning before 8. A fine, drizzling rain began falling at 11.45 A.M., and continued more or less through the rest of the day. "On Wednesday morning," says Mr. Russell, "I found the feathers and other remains of a male martin on the piazza. This was the cat's work. I do not know whether the cat picked up the martin alive or dead. After dinner I found a dead male martin on the ground near the hen coop. Inside the hen yard I found another male, just alive; he was quite wet and could not stand. I took him into the house and put him near the stove, and fed him pieces of worm. He did not eat very much. Unless I put the food way down his throat, he would throw it up. In about half an hour, after drying off, he seemed to be much brighter and stronger. He could stand up (which he could not do before, apparently because he was so weak), and could run around the floor; but in a little while he died. About this time I noticed that the cat was eating a female martin on the piazza. Cannot say whether she got it alive or dead. Shortly after I looked out of the window and saw another male martin lying on the grass. I picked him up. He could not fly, apparently being too weak, but flapped his wings and kicked. He ate pieces of a worm, but did not seem very hungry. He was quite wet, but after getting dry in the kitchen he flew all around the room. I took him out of doors and he flew across the yard and alighted on the fence. He could not fly very well, and I brought him back into the house. He seemed all right for the rest of the day, and when we went to bed we left him perching on a chair, but the next morning we found him dead. On this day (25th) we found another dead martin in the yard. The cat also picked up another one somewhere."

On June 29 I investigated the interiors of the two martin boxes. In one of the little rooms were seven dead adult birds packed closely together, — four females and three males. The inference was that, like human beings in a similar case, they had huddled together for the sake of warmth. In another room were four small dead young birds, and in a third a dead adult female.

These dead birds in the box, together with the birds picked up on the ground and others found by neighbors, account for practically all the adult martins in this small colony, which did not number over a dozen. Some rooms in the two boxes were not cleaned out, which will probably account for the small number of young birds found.

The colony appears to have been exterminated, for no martins have since been seen at the boxes. A few martins (an offshoot of the Russell colony) were domiciled at a neighbor's box not far away; a similar casualty occurred there, dead birds, both young and old, being found in the box or on the ground.

A few martins have occupied for some years past a box at the farm of Mr. J. Herrick in West Peabody. On July 1 I inspected this box, and found in one room one egg and one dead young bird, in another room three dead young birds, and in a third two dead adult females and one dead young bird. If the remainder of this small colony died outside the box, they might have been lying anywhere out of sight in the tall grass or among the vegetables in the kitchen garden. Mr. Herrick stated that no martins had been seen at the box for some time.

A colony of martins on the estate of Mr. A. B. C. Dakin at Concord suffered a similar fate, as did still another at Concord Junction. In every case that I have personally investigated the martins, both old and young, are believed to be dead.

Mr. Kohlrausch had a colony of about forty or fifty pairs at Billerica. He recovered thirty-five bodies of adult birds, nearly all of which died on June 21 and 22. They were very much emaciated. Later he wrote that five or six birds were seen about the house on the 23d and 24th, and then disappeared. He hopes that some survived, but probably, as in other cases, they dropped dead in the fields. Mr. Bailey, who was looking out for martins for a week, did not see one alive after the 22d. He reports one colony in Chelmsford all lost, and two colonies in Winchendon all lost but five birds. Mr. Walter Steele of Stoneham, who had a sixteen-room martin box, which had been occupied for years, says the birds are all gone. Miss M. S. Doran of Lexington says the martins there are all gone. We have not a single report of a living martin in Middlesex or Essex County after June 25.

Turning now to the country south of Boston, we find similar reports. Mr. William R. Lord of Rockland states that all the martins of that town and Hanover are dead. Several people report the number of dead adults, as well as young. The bodies were found in the bird boxes and in the fields. A colony in Wareham, one in Carver and two in Marion are believed to have succumbed. Martins have disappeared from Stoughton, South Walpole, Hanson and Mashpee; but Mr. Bangs reports seeing one or two birds at Wareham after the storm, and Mr. Mosher thinks that some survived at Dartmouth.

Mr. Ingalls reports from Worcester County that two large colonies disappeared, and no birds have since been seen. Mr. C. K. Reed at Worcester made inquiries of several people who had martin boxes, and they all reported no martins left. Mr. C. A. Reed reports "young in one house of ten pairs all died, one old bird dead in the house." Mr. Loring Coes reports that the martins have all disappeared. Mr. Perry reports "no martins bred." Mr. Jesse Allen at Oakham says that one brood of martins matured. All this would seem to indicate that in Worcester County a few martins may have survived.

Mr. Robert O. Morris of Springfield says he knows of none that were nesting late last season. Most other observers from western Massachusetts report few or no martins, and in some cases none have been seen for years.

The catastrophe which has befallen the martins of eastern Massachusetts has no parallel in recent years. So far as records are concerned, it appears to be unprecedented in severity.

In 1864 Prof. John L. Russell of Salem wrote that the purple martin was then very rare in that vicinity, as a long, cold rain storm, together with a consequent lack of food, had killed them by scores, and very few were seen afterward.* Possibly this storm may have been generally destructive.

* Report, United States Department of Agriculture, 1864, p. 351.

Bank swallows and eave swallows were not generally common in this State before the storm; they have been less common since. It has been said there are no bank swallows in Essex County. Large numbers of bank swallows were seen on the Charles River, flying low during the rain, but were not noticed afterward.

No reports of the destruction of eave swallows by the June storms have been received, but several reports say they have disappeared. Mr. R. B. Pike of Topsfield, Essex County, says they were uninjured there. Mr. F. C. Richards of Williamsburg, Hampshire County, writes that he has seen no chimney swifts, and desires to know if the eave swallows and night hawks are extinct. Mr. Owen Durfee of Fall River, Bristol County, speaks of ten pairs of eave swallows which sought a new nesting place in July. This may or may not indicate that their nests were broken up by the June storms. I neither saw nor heard a whippoorwill after the storm, and night hawks appeared to be almost equally scarce, although I had seen more than ever before in the spring migration.

The information received on these matters in reply to circular letters, as well as by correspondence and personal investigations, would fill a small volume; but the space allotted to this report precludes the possibility of publishing more of it here. A list of the persons who furnished information in reply to the circular letters is appended.

In the midst of all these pessimistic reports there are some optimistic ones, which seem to indicate that the more common birds are still plenty in some localities.

Prof. Wm. P. Brooks of Amherst says: "Birds of all kinds seem to me to have been unusually abundant in Amherst this year." Prof. C. H. Fernald and Dr. H. T. Fernald, also of Amherst, were inclined to corroborate this statement. Dr. Flavel S. Thomas of Hanson says: "I never saw birds so numerous as this year, and in so good condition." (The disappearance of the martins from Hanson has been hereinbefore noted.) Mr. Charles Curtis of Stoughton, while he cannot find on inquiry that there are any martins left, thinks he never saw so many birds on his farm as in 1903. Mr. Geo. L. L. Allen of Medfield states that birds are plenty there.

Mr. A. A. Smith of Colrain and Hon. J. W. Stockwell of Sutton have spoken of birds as numerous in their localities.

I do not question the accuracy of these statements. No doubt there are some favored localities; but there is one condition arising from the scarcity of insects which had some influence on the numbers of certain birds as seen locally. The fruit-eating birds, finding their usual insect food failing them in June and early July, crowded into the fruit gardens, and therefore in such localities were more numerous and injurious than usual. Crops of strawberries, cherries, raspberries and currants suffered severely in some cases, while in other localities birds are reported as so few that they did little injury; but the lack of insect food was probably the main reason for the unusual number of blackbirds, robins, cedar birds and orioles that flocked to the fruit.

The strawberry and cherry crops were not large, and so the inroads of the birds on the crops were serious in some cases. This led to much agitation in New Jersey for legislation against birds, and a similar movement is said to be on foot in Maine.

If, in such a case, a few acres of green sward could be turned over, the birds might be attracted away from the fruit, in their search for the exposed worms, white grubs and terrestrial insects. Thus the farmer might get protection for his fruit and secure the services of the birds at the same time. Legislation will not cure the evil, for the birds will probably be much needed within a year.

Inquiry has been made as to the reasons why birds of certain species perished in one locality and lived in another. This difference appears to have been due mainly to a dissimilarity in local conditions. For example, although the temperature did not vary greatly in different localities, there was much variation in the force of the wind, and the consequent exposure to driving rain. A locality well wooded or with wooded hills to the north and east would be protected against the easterly gales, while an open coast would feel its full force.

This may explain the great loss of swallows along Cape Cod, and their apparent safety in certain localities among the

Berkshire hills. It is especially noticeable, notwithstanding the comparatively light rainfall on the Cape, that many insectivorous birds perished there where exposed to the sweep of the wind. Mr. David D. Nye of Bourne says it is the general opinion that the birds did not suffer very much there, as there was plenty of shelter.

There was a great difference in the amount of rainfall, also, at different stations. During the gale of June 12, 2.5 inches of rain fell at Rutland and only .25 of an inch at Hyannis. On the 21st the precipitation was 1.53 inches at Mt. Tom, and only .58 of an inch at Middleborough and .78 of an inch at Fall River.

The martins apparently suffered least in localities well protected from the wind, and where the rainfall was at its minimum during the storm. In such places more insects survived. Another factor in the preservation of individual birds or species was their ability to adapt their food habits to adverse conditions. Individual swifts or martins that had learned to take insects from the trees or shrubbery, as some of them certainly do, would be more likely to weather the storm than the majority of these birds that take their food only in the air.

There were chances for life for the bird that knew how to take advantage of them. Insects benumbed or dead lay upon the ground or floated on the water. Honey bees, having good shelter and food, survived, and whenever they came out of the hives were exposed to the attacks of kingbirds and martins.

The excessive mortality among swifts and martins, as compared to that among the swallows, was due largely to the difference in hardiness between these families of birds, as well as to a better adaptability of the swallows to the prevailing conditions. The swifts and martins seem unable to endure the wet and cold, and so huddle together in their nesting places until they starve. Barn swallows, on the other hand, when pressed for food will breast the storm in search of it, and either find it or die in the search. They will take insects from the grass, the water or the ground, and, if hard pressed, will take berries or seeds when they can get them. They thus have much advantage over the swifts and martins, which are believed to be entirely insectivorous.

The safety of birds that nested on the ground, in shrubbery or on trees depended mainly on the kind of shelter they had. In many cases the mother birds stuck to their posts. Mrs. Emily B. Young watched two robins' nests on Marblehead Neck, — a very exposed situation. One contained eggs, the other young. The birds kept them covered most of the time, and apparently no harm was done. Possibly the dead adult robins, viroes and song sparrows that were found died from exposure and starvation in the attempt to shield their young.

It is of interest to know whether the destruction of birds has been general in other States, and also whether there are martins left in adjacent States to replenish the depleted supply here. Reports received from Pennsylvania to Maine indicate that the mortality among young birds has been considerable in all the middle and northern Atlantic States. Mr. W. H. Brownson, in the "Portland Daily Advertiser," asserts that, of ten or fifteen pairs of martins inhabiting a box in Scarborough, all perished excepting one or two of the old birds. The young of the barn swallows also died. A small colony of martins in another part of the same town survived, and later he wrote me that he had found another colony alive in Westbrook. Mr. Herbert Moulton of Hiram says nearly all if not all of his young martins died. Mr. Fred Pike of Cornish states that his martins survived the storm and stayed later than usual; but the young birds were killed in all the other houses there, and the parent birds left and were not seen again. In one house of about twenty pairs the young in one nest were raised.

The lesser mortality among the martins in Maine, as compared to that in Massachusetts, is believed to be due mainly to a lesser rainfall. The average precipitation for the month in that State was only 4.49 inches, although that at Bemis, 14.6 inches, was greater than at any other point in New England. No report has been received on the effect of the storm upon birds at Bemis. Less than 3 inches of rain fell during the month on nearly the entire north-eastern half of the State. Probably the only unusual loss of bird life in that section was by forest fires.*

While the average precipitation for the month in the south-eastern half of the State nearly equals that in Massachusetts, there was no single storm so severe generally as those in our State. The greatest storm was on the 12th and 13th. The birds of south-eastern Maine were exposed to only one severe storm, while those of Massachusetts suffered from three.

Prof. Clarence M. Weed of the New Hampshire College of Agriculture and the Mechanic Arts, Durham, writes: "In a general way . . . I have followed the relation of the weather to the birds, and have become convinced that there was extraordinary suffering and destruction among them. In my neighborhood there was a very remarkable dry spell during April and part of May. This was almost as trying on the birds as the wet weather later in the season. It was pitiable to see the robins hunting for worms over the dry ground, and there was a very unusual scarcity of insects at that time."

Professor Weed reports that he was told by Col. Richard M. Scammon, Stratham, N. H., who has been establishing the only colony of purple martins of which he knew in his immediate vicinity, that the wet weather caused the death of a large part of the young birds.

Mr. G. W. Lane of Chichester reports that the martins are all dead or have disappeared.

Mrs. William C. Horton writes from Brattleboro, Vt., that a colony of purple martins there, of about thirty birds, was nearly exterminated; thirty-two young birds and two adults were found dead, and the house was deserted. Later a few

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* Since the above was written, Mr. J. Merton Swain of Skowhegan writes that he was "burned out" by one of these fires, which cleared the ground of everything, and must have destroyed many birds' nests. He said the birds there suffered more by drought and fires than by storms; and that all the colonies of martins and swallows that came under his observation in Kennebec, Somerset and Piscataquis counties reared their young and left as usual, late in August. He has heard that several colonies died nearer the coast, because of the drought, but these were probably within the storm area. Advices from Orono indicate no unusual mortality among birds there. The precipitation for the month at Orono was only 2.09 inches.

adult birds occasionally were seen, but did not enter the house.*

Mrs. Elizabeth B. Davenport of Brattleboro, Vt., says that a martin house was abandoned, and that dead young and eggs were found inside.

Miss Abby P. Churchill of Fitchburg, Mass., asserts that thirty or forty young martins and three adults were found dead in their nests at Bellows Falls, Vt., after the storm of June 21.

These reports come from southern Vermont, where the meteorological conditions prevailing in June approximated those in the nearer parts of Massachusetts; but the storm of the 15th was not so severe there as in eastern Massachusetts. The greatest precipitation reported on any one day was at Jacksonville, near Brattleboro, — 3.45 inches on June 12. The next heaviest was 3 inches on the 21st, at the same station.

All that portion of Vermont lying north of Woodstock and Manchester, and comprising about four-fifths of its area, received less than 3 inches of rainfall for the month. In all this region probably no unusual bird mortality occurred. Dr. Perkins, State entomologist at Burlington, has not noted anything unusual there.

The storms in Rhode Island were not generally so severe as in Massachusetts, and the average precipitation for the month was 6.52 inches. The storms appear to have been most severe in the north-eastern part of the State, and less so in the south-eastern part. Mr. H. W. Tinkham of Swansea, Mass., who lives on the Rhode Island line, makes a full report of the destruction of young birds and eggs there; and Prof. John Barlow of the Rhode Island College of Agriculture and the Mechanic Arts, at Kingston, states that one colony of purple martins in that locality was not injured; but Prof. Cooper Curtice noted that the storm "broke down many trees and tipped out the birds."

The average precipitation in Connecticut for the month of June, 7.44 inches, was greater than that of any other State. Unfortunately, very little information has been received from

* "Bird Lore" for September-October, 1903, p. 165.

that State in regard to the effect on bird life produced by the June storms. Mr. Robert W. Curtiss of Stratford says that the martins there gradually disappeared for about four days; the last were seen on June 22. It was cold, wet and stormy there until June 25, as it was in Massachusetts. One resident took down his bird boxes and found fifteen young birds dead. No martins were seen alive after the storm, and not over ten or fifteen per cent of the usual number of chimney swifts were seen flying about. Swallows were perhaps seventy-five per cent less abundant than usual; but one pair of barn swallows reared two broods in his barn.

As against this, Mrs. Mabel Osgood Wright asserts that the destruction of bird life was not appreciable at Fairfield, but many robins' nests were water-soaked and destroyed. At Norwalk, the nearest weather observers' station to Fairfield, there were only two days of heavy rain during the month, — the 8th and 29th. These were far apart, but there were fifteen days on which rain fell.

Mr. B. S. Bowdish of New York City read a paper before the last congress of the American Ornithologists' Union at Washington, D. C., in which he described the destruction of young birds in the Middle States. This paper has not been published, but Mr. Bowdish has kindly sent me some of the correspondence he received in relation to the matter. From this correspondence and my own some interesting facts have been gathered.*

Mr. John Lewis Childs of Floral Park, N. Y., finds no evidence that an unusual number of young birds perished on Long Island; but he says that Mr. John Burroughs examined many nests on the Hudson, and believes that large numbers of nestlings died there. Mr. J. H. Clark of Paterson, N. J., gives a detailed account of bird fatalities.

Mr. Henry Hales of Ridgewood, N. J., notes the rise of the Saddle River and the flooding of birds' nests. He says that humming birds, tanagers and flycatchers that usually build in his garden were unable to breed at all, and notes a great scarcity of barn swallows and bobolinks where

* Since the above was written, some correspondence on this subject has been published by Mr. Bowdish in the "Auk" for April, 1904, p. 284.

they have been numerous. Cliff swallows also failed to breed, and were not seen.

Mr. T. S. Jackson of Westchester, Pa., estimates that fifty per cent of the young of the smaller species failed to mature in the nests.

Mr. J. Warren Jacobs of Waynesburg, Pa., states in "Bird Lore" that only one brood of young martins in his bird houses escaped death up to June 15. He took eighty-four dead young and three adult birds from two houses, but the remaining birds later reared other broods.

Space will not permit more evidence of this character. It seems clear that in the States north, east and south of Massachusetts many martins have survived, and that some have been able to rear their young. As these colonies overflow, the young birds may be expected in the natural order of things to migrate in different directions in search of new homes, and this will eventually assist the remnant remaining in Massachusetts to repopulate the State. But they will be met by the English sparrow, which has already established itself in many of the vacated martin boxes; and unless the sparrows are shot, poisoned or kept out of the boxes, the martins may never be able to regain their foothold in the State. Those who do not wish to kill the sparrows may drive them away, in time, by persistently removing all their eggs from the nests. After this is accomplished the martins may return, if the sparrows' nests are first cleaned out.

The destruction of birds, their eggs or young, or their inability to breed, would naturally tend to greatly reduce the number of birds in the early fall flight to the south, for this flight is very largely composed of young birds. I was in the woods nearly every day through August and September and out of doors nearly every evening, and I have never heard or seen so few warblers in flight at that time. In the daytime the woods were almost deserted by birds, and at night very few were heard passing overhead. I saw no night hawks or martins. Phœbes and bluebirds were plenty. Swallows passed in August in considerable numbers. Chipping, swamp and Savannah sparrows were common, but I saw no large flight of them. Mr. William Brewster, who was in New Hampshire and eastern Maine at the time, wrote me that birds were scarce there. On Monday, September 4, I saw for the first time a few warblers in the woods. Every day a watch was kept on an old field grown up to birches that were swarming with plant-lice, with the expectation that warblers would be seen there if any flight came. On September 17 an ovenbird and about thirty black-poll warblers were seen there. From that day until October 29 the warblers were found in the birches in moderate numbers, but they were mostly black-polls, and very few were seen that breed in central or southern New England. Only three redstarts and only one black-and-white warbler were observed. Either these warblers were very scarce last fall, or they passed me unnoticed. Probably the fires, the drought, the heavy rains and the scarcity of insects all combined to prevent their breeding. A great flight of pine grosbeaks began to arrive in Massachusetts about October 25. It was the first "sign" of a severe winter.

Mortality among Birds during the Winter.

In New England the winter of 1903–04 was of almost unequalled severity, and Massachusetts received more than her full share of storm and cold. Mr. T. R. Rodman of New Bedford, who has a record of the temperature there, which has been kept for ninety-nine years, writes, "I believe the past winter is the coldest in my record." There was cold weather enough in November to lock up many of the ponds and rivers. December was unusually cold, with the exception of the second week. Ice cutting was begun earlier than for many years. The Wareham River was frozen solid in December, — a rare occurrence. There was a thaw on Christmas Day, but the thermometer fell immediately afterward, reaching 10° to 40° below zero at points back from the coast. A north-east snowstorm began on the 26th, and the last week of the month was very cold.

Birds were unusually plentiful in south-eastern Massachusetts until Christmas, and on that day and the next the following birds were seen within five miles of my house at Wareham: twenty-eight herring gulls, two red-breasted mergansers, fifty golden-eye ducks, one ruffed grouse, six ring-necked pheasants, one screech owl, one belted kingfisher, five flickers, two thousand two hundred crows (estimated), fourteen blue jays, nine meadow larks, seventeen English sparrows, three song sparrows, two fox sparrows, thirty-one tree sparrows, five goldfinches, six red crossbills, twelve myrtle warblers, two red-breasted nuthatches, twenty-one chickadees, one brown creeper, four golden-crowned kinglets and one robin.

On the 24th wild geese were flying south, and sixteen were shot not far from Plymouth. On the 27th the thermometer at my house registered 6° below zero, and the month closed with cold and snow.

Most of the ducks, crows, robins and crossbills then disappeared, but there was no indication that there was any unusual suffering among the birds in December. "January," says Mr. Smith, "may safely be considered one of the most severe months that has occurred during the last century. The mean temperature for the month, 15°, is the lowest since the weather service was established here." The first week of the month was extremely cold, and snow fell generally on the 2d and 3d. On the 5th and 6th authentic records in Massachusetts give readings from 16° to 28° below zero, and from some localities 40° was reported. The temperature remained low nearly all the month, with extreme cold on the 19th and 20th and again on the 26th and 30th.

Mr. W. S. Clark of Cummington, Mass., reports this as the coldest month in his record, which goes back to 1860. Mr. Geo. Douglas of Burlington, Conn., reports that the trunks of apple trees were split by the intense cold. Mr. F. A. Tower of Concord, Mass., says that the previous record of —20° for December and January was broken four times during the month.

The average precipitation of Massachusetts during the month (4.39 inches) was greater than that of any other New England State. This was mainly snow, of which 18 to 44 inches fell in the northern part of the State, 21 to 36 inches in a wide belt of a breadth sufficient to reach from Cape Ann to Boston harbor and extending to south-western Berkshire

County, and 31 to 48 inches in the south-eastern part of the State.

Even Nantucket and Martha's Vineyard received their share, 40 inches being recorded from part of Nantucket. Cold north-west winds prevailed for the month, reaching a maximum velocity of sixty-six miles per hour at Block Island on the 4th.

Buzzard's Bay froze over so that it was said a man could walk on the ice from New Bedford to Wood's Hole. The ice did not break up until March, and navigation up the bay was suspended for the winter. It was reported that for the first time a man had crossed Wood's Hole on the ice. There was an ice pack much of the time along the shores of Cape Cod and in Vineyard and Nantucket sounds, which kept the ducks off shore, and isolated Nantucket and Martha's Vineyard for weeks.

Early in January it became evident that birds were suffering from both cold and hunger. Many birds that remain in New England for the winter had left the more northern States and crowded into the southern coast region of Massachusetts, Rhode Island and Connecticut, where there is usually comparatively little snow and less cold than in the country back from the salt water.

An opportunity now offered to study the effect of a subarctic winter on these birds. Birds are usually quite plenty about my house in winter, for they are fed there, as well as at other houses in the neighborhood. About forty juncos and eighteen chickadees were observed near the house the first week in January. Soon one of the chickadees was seen to be suffering from the cold, and a little later it disappeared. Four fox sparrows had been about the house during December; two had now disappeared, but the others remained, and, though suffering much in the coldest weather, survived the winter. January 4 was very cold. On the 5th my thermometer went to 25° below zero, and 24° to 28° were reported from other parts of the town. January 6 my thermometer was at 29.5° before daylight, and 40° below was reported from Bourne.

During these three days nearly half of the chickadees disappeared. They never have returned. The flock of juncos was reduced to thirty, though only one was found dead. This bird appeared to be well fed, and uninjured except by the frost. There was still food in its stomach. A pair of red-breasted nuthatches appeared to suffer much on the coldest mornings, when all the birds shivered with cold, and seemed with difficulty to keep their feet from freezing; but the nuthatches survived the winter. The flock of tree sparrows was soon reduced to six. Some of these birds were no doubt killed by cats and a hawk which was in the vicinity for a time. The blue jays, a flock of which usually winters here, were soon reduced to five birds. One of these was struck by the hawk, but escaped, as a dog came to the rescue. It seems quite probable that a number of the birds that disappeared at this time may have succumbed to the cold. Meadow larks, song sparrows and flickers were reported as plenty about Dartmouth up to January 15. In Swansea and the adjoining town of Warren, R. I., these birds were also common, and horned larks and Bohemian waxwings were reported.

Bayberries were quite plenty at Wareham during the first part of the month. These enabled the flickers, myrtle warblers and crows to subsist so long as the berries lasted. On January 22 and 23 a southerly rain cleared the ground of snow in many places, and gave the sparrows and quail that were left an opportunity to find seeds.

An inspection of the country about Wareham at this time showed that the bayberries were nearly all gone, and with them the birds had become scarce. One robin and one flicker were seen, but no myrtle warblers. Kinglets and creepers were not seen again during the winter. The storm, which cleared the ground here, only made conditions worse in some other parts of the State, crusting the snow and covering the trees with ice. It was immediately followed by more snow and cold, and so the month closed.

A few grouse and quail were still alive here in December, but after the cold, snowy weather of January I was unable to find a single track on or near my place. I have seen no quail and only four grouse within five miles of the place this spring. Eight meadow larks which wintered well up to the cold weather in January disappeared then, and not one has been seen here since to date (March 27). By feeding the birds about the house daily, most of the birds that remained were kept safely through the winter.

Mr. Smith remarks that February "was a fitting climax to a winter that, so far as mean temperatures are concerned, is unprecedented in the records of the New England climate and crop service. The weather of the month was characterized by severe and persistent storms along the coast, during which the winds blew with great violence. The month will go on record and be long remembered as one of great and unusual severity." It began with a gale from the northwest that reached a maximum of seventy-eight miles per hour.

In this month the average precipitation in Massachusetts was greater than any other New England State except Rhode Island, while eastern Massachusetts and eastern Maine received a greater snowfall and rainfall than any other section of New England. The birds which were wintering in Plymouth, Bristol and Barnstable counties, and which had already withstood the severity of January, were exposed to another trying experience. Many of them were unable to withstand it. At this time there were some birds about. Robins were reported in Plymouth on the 2d and bluebirds on the 5th by Miss L. A. Knapp. Later, Mr. Tinkham reported robins and bluebirds in small numbers in Swansea. Reports began to come in that birds were dying of cold and hunger. Appeals in the daily press requesting people to feed birds were published quite generally by the Audubon societies and Mr. Ernest Harold Baynes.

Desiring to make a personal examination of existing conditions and to secure facts for this report, I travelled through central Massachusetts February 9, 10, 11 and 12, visiting Berkshire County, stopping at Lenox, Pittsfield, Holyoke, Amherst, Springfield and Worcester, learning as much as possible on the way by personal observation, as well as by calling on observing people. The month closed in a snowstorm.

The first part of March was cold and blustering. Having been informed that many birds were believed to be dying in south-eastern Massachusetts, I started on March 6 on a tour through this section. Letters requesting information were also sent out to correspondents. Mr. C. E. Bailey, who had been looking up conditions in Middlesex and Essex counties, called on me later. From these sources the following report is made up.

Comparatively few dead birds were found, but this was explained by the fact that their bodies were either buried in the snow or picked up by crows, hawks, foxes, cats or weasels, that, spurred by hunger, searched the woods and fields almost continually. Probably where people found one dead bird a hundred escaped notice.

The general opinion, among those best qualified to judge, is that most of the birds that usually winter here, but disappeared, are dead, — either starved or frozen. Even where birds have been fed regularly, some have been found frozen.

Probably the bobwhites suffered most. Many had reared second broods after the June storms. These broods did well until the shooting season opened, when they were exterminated from some localities by gunners.

There were many small coveys and a few large ones that escaped, nevertheless, so that it was generally believed in some localities that the birds were increasing; but the sleet storms in January followed immediately by freezing weather imprisoned many coveys under the snow, while most of the birds that escaped this fate probably succumbed one by one to exposure or starvation, or were killed by hawks, foxes or cats, or when driven by necessity to farmhouses were shot or trapped by some of the foreign farm "help" that is now so common. Some of the evidence of their fate may be briefly given.

Mr. Bailey had observed three flocks of six, nine and eleven birds respectively in the neighborhood of his home in North Billerica. Another flock of thirteen was enticed near his house and there fed through the winter. On each of the five coldest days in January a single bird was missing. The eight birds that weathered the extreme cold lived through the winter. Mr. Bailey was out on snowshoes or otherwise after every fresh snowfall, but no trace of the other flocks could be found after January 20. Mr. John Kingsbury Burgess of Dedham fed a flock all winter, but only four or five birds survived. Mr. Perry writes that the "quail are exterminated."

Many dead birds have been found. Members of the Springfield Fish and Game Protective Association, while engaged in feeding the birds, have learned of dead birds being found or found them in their own search. Messrs. L. and A. Hill of Shaker Station are reported to have found twelve by means of their dogs. I saw only one person in western Massachusetts in February who had recently seen a large covey. They were everywhere reported then as very scarce.

In south-eastern Massachusetts bobwhites were comparatively plenty in the fall in some sections, but since March 1 I have been unable to find a single bird in the towns visited. Mr. Alger writes from Attleborough that "At least three large flocks of quail were killed by the severe winter." Mr. Tinkham wrote March 5 that he had protected twenty-two birds on his place, but that "now they are all gone." Mr. Mosher wrote in February that his cat had brought in one bird, and that by following her trail he found others dead in the snow. Farmers and woodcutters in Dartmouth and Westport when questioned had seen no quail since spring opened, though it was thought a few had wintered about certain hay or corn stacks. A few birds were reported as seen during March in Marion and Rochester, where they had managed to pick up a living on roads used much by wood teams. Mr. B. F. McKechnie reports that "the winter has practically exterminated the quail about Ponkapog."

The ruffed grouse or partridge is considered to be perfectly hardy, and able to withstand any winter. It can live on buds, leaves, winter-cured berries and broken twigs. It is ranked in hardiness with the red squirrel, which, all other nutriment failing, will gnaw the outer bark from trees, as it has had to do this winter. Nevertheless, both grouse and red squirrels have succumbed to the rigors of the past winter.

Several correspondents mention the death of the grouse with that of the bobwhite. Mr. Robert O. Morris has known of a flock of quail being found dead, and another being so tame "you could almost catch them." (This was a starving flock. Such quail were caught by hand, and found to be weak and emaciated.) He also speaks of three ruffed grouse having been found dead with their crops *empty*.

Mr. W. F. Hammond writes from Mashpee that the "quails, partridges (and most of the smaller birds)" have been killed by the winter or have gone elsewhere, "for it is certain that they are not here."

Many reports show a scarcity of grouse, but this may be attributed largely to the destruction of the young birds in summer and the adult birds by gunners. Mr. Ernest Harold Baynes reports that the remains of eight grouse have been found in the Middlesex Fells Reservation. Their bones had been picked, and the superintendent of the reservation believes they were killed by hawks. The "New England Farmer" of February 27 says that "five partridges" were seen in different sections of Pittsfield February 5, having evidently found it difficult to get food in the woods. They were so nearly starved that two of them were killed by dogs while trying to pick up crumbs.

A few reports have been received regarding the introduced ring-necked or Mongolian pheasant. A flock of fourteen which was seen near my place in Wareham was reduced to seven in February. There are at least five yet living. The reduction in their numbers appears to please the gentleman on whose land they were last seen, for he says they destroyed four-fifths of his potatoes in the fall. Mr. Bailey reports seeing a pheasant in Malden that was evidently near death, and Mr. Baynes reports one dead in Stoneham. Mr. J. E. Bosworth of Lee says that it is reported that the pheasants on the Wm. C. Whitney estate have been starved to death.

It seems probable that the meadow larks that winter in southern New England have been among the greatest sufferers. Mr. Tinkham states that from twenty to forty of these birds could be seen around his farm at any time early in the winter, but since January 15 he had not seen ten all told.

When I was there in March they were all gone. Mr. Mosher says it is reported that they have nearly all died in Westport, and I have not seen a single bird in any of the towns visited to this date, March 25, although the first flight of fox sparrows, robins, bluebirds and red-winged blackbirds has gone.

Flickers are usually common in winter in southern Plymouth, Barnstable and Bristol counties. They were as plenty as usual in December, but disappeared in January and February. Mr. Tinkham estimates the mortality among them as at least seventy-five per cent. I found very few anywhere in February or March except in northern Dartmouth. Here a large crop of bayberries had enabled flickers and myrtle warblers to live through the winter in more than normal numbers, but the remains of several dead flickers were found, perhaps killed by a pigeon hawk which was seen there. Mr. McKechnie records the finding of a dead flicker in January.

There is little by which we can measure the death rate among the smaller birds. Mr. Ingalls, who has travelled considerably over the State, reports the common winter birds in nearly normal numbers. My own experience indicates that nearly all birds were scarce except where they were fed. Many people were feeding them and they were attracted to these feeding places, so that they appeared at such places to be in their normal numbers. In February the only bird I saw in the woods in central and western Massachusetts was a lone crow.

Birds were seen occasionally by lumbermen, woodchoppers and teamsters. One man in Amherst stated that the birds came to him when he was eating his lunch in the woods, and that one tried to take the food from his hand. Mr. Bailey found birds very scarce in north-eastern Massachusetts, where he saw but one downy woodpecker, three crows and one hawk during the winter. On February 15 he found two blue jays in a shed in North Billerica, so cold they could not fly. He took them to the house and tried to revive them. They recovered sufficiently in a warm room to fly a little, but were too weak to eat, and died before 1 P.M. of the same day. These birds were very much wasted from starvation. He says that from January 10 to 20 the thermometer at his house averaged about 15° below zero at daylight, and the days were very cold. Five tree sparrows came into the barn at this time for shelter, and remained there day and night. When driven out they came back, and would come around his feet to feed on crumbs thrown down for them. At this time he was also feeding twelve chickadees. When the cold weather passed there were only five left.

Most reports indicate that where birds were well fed, nuthatches and downy woodpeckers wintered very well; elsewhere they have had a hard time. The trees were frozen so hard that drilling into them for insects was difficult, and the woodpeckers have been operating on dry cedar rails and posts, and under the eaves of log and slab shanties in the woods.

Many chickadees were undoubtedly frozen during the coldest weather. In my recent tramps through the woods only three to five of these birds per day have been seen. Professor Hodge reports that of two nuthatches and four chickadees which he fed, only one chickadee was left on March 4. They disappeared during the winter, and one chickadee was found dead in the snow. He had kept all manner of bird food out about the place, and the downy woodpeckers fared well all winter. Mr. Loring reports finding a dead chickadee, and Mr. McKechnie reports finding two which he believes died from exposure, for he was feeding the birds. Mr. Baynes reports one chickadee and one junco found by the roadside. Here, owing to his efforts and to those of the superintendent of the Middlesex Fells Reservation, an abundance of food was provided. Others report finding dead chickadees, myrtle warblers, juncos, song sparrows and goldfinches.

The crows suffered least, for, with their usual sagacity, they left the colder and more snowbound regions of the State for the southern shores of New England. In some colder sections of the State people report seeing no crows after December. A few crows remained about Wareham during the winter, probably attracted by food that was put out for them. When the ice began to break up in the spring they had plenty of food, as thousands of fish had died in the rivers and ponds, and were floating, or cast up on the shore. During the winter a crow was killed by a cat in Wareham.

Out of the large number wintering along the coast, a few died. I found two of these. Mrs. Wright says that in southern Connecticut the winter destruction of birds by cold or storms has been chiefly among the crows and recently introduced starlings. Mr. Curtiss had seen no starlings in March, but one had been picked up in a dying condition. If any starlings survived we may find them to be, in time, nearly as great a pest as the English sparrow, which also has been much reduced in numbers by the past winter.

As this goes to press, reports continue to come in regarding the discovery of dead birds, such as grouse, jays and owls, as well as smaller birds. Much destruction of birds and game is also reported from northern Vermont and New Hampshire, where many deer are said to have died during the winter.

Below is a list of those species that have been specially reported as suffering from the elements during the past summer and winter.

LISTS OF BIRDS REPORTED DESTROYED BY THE ELEMENTS.

Adult Birds.

Herring Gull.
*Ruffed Grouse.
*Bobwhite.
*Ring-necked Pheasant.
*Crow.
*Blue Jay.
*Meadow Lark.
*European Starling.
*Flicker.
Downy Woodpecker.
Saw-whet Owl.
*Night Hawk.
*Chimney Swift.
*Song Sparrow.
English Sparrow.
*Goldfinch.
Junco.
*Purple Martin.
*Barn Swallow.
*Tree Swallow.
Yellow-throated Vireo.
*Chickadee.
Robin.

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* Adult birds reported also as missing.

Nests and Eggs or Young.

*Pied-billed Grebe.	Towhee.
Black Duck.	Scarlet Tanager.
Virginia Rail.	Purple Martin.
*Spotted Sandpiper.	Barn Swallow.
Bobwhite.	Tree Swallow.
Ruffed Grouse.	*Eave Swallow.
Ring-necked Pheasant.	Yellow-throated Vireo.
Marsh Hawk.	Red-eyed Vireo.
Flicker.	Black-and-white Warbler.
Downy Woodpecker.	Myrtle Warbler.
Chimney Swift.	Yellow Warbler.
Kingbird.	Chestnut-sided Warbler.
Least Flycatcher.	Prairie Warbler.
*Bobolink.	Ovenbird.
*Red-winged Blackbird.	Maryland Yellow-throat.
Meadow Lark.	*Redstart.
Baltimore Oriole.	Catbird.
Rose-breasted Grosbeak.	Brown Thrasher.
Chipping Sparrow.	House Wren.
Field Sparrow.	Long-billed Marsh Wren.
Song Sparrow.	*Bluebird.
Swamp Sparrow.	*Robin.

As this report must go to press before the general spring migration of birds sets in, no statement can be made as to the number of birds breeding here in 1904. If we assume, however, that the evidence submitted approximates the facts, we may be justified in believing that the bobwhite has been reduced generally at least ninety-five per cent, that grouse will be scarce this spring, and that purple martins will be generally absent, although a few individuals or colonies probably will appear locally in Massachusetts. There probably will be also an unusual local scarcity of many of the species mentioned in the above list, and possibly of more not mentioned.

Robins, bluebirds, phœbes, downy woodpeckers and crows may be expected in their usual numbers generally, unless they have suffered unusual mortality in the south; but it seems probable that most of the warblers will again be scarce.

* Adult birds reported also as missing.

It is safe to say that the birds of eastern Massachusetts, at least, have received a blow from which they cannot immediately recover, although undoubtedly there will be localities where no serious reduction in bird life will be evident.

In view of the extreme reduction of our force of insect-eating birds, the question arises: May we not now expect immediately a great increase of injurious insects generally? Probably not, as the season was fatal to both birds and insects; but under the prevailing condition it seems quite possible that the increase of insects will outrun that of birds within one or two years; for birds are so persecuted by man that their increase cannot be expected to keep proportionate pace with that of insects.

Measures for protecting Birds and increasing their Numbers.

It is self-evident that no general measures can be taken to prevent such a destruction of birds as that caused by the conditions of last May and June; but it may be possible for some who are interested, and can spare the time for it, to save a brood or two of young martins or swallows, and preserve a nucleus from which the bird houses may, in time, be filled again. Professor Hodge saved a brood of young bluebirds by feeding them meal worms, and in this his children took an active part.* Martins will not pick up insects from the ground, but may be taught to catch, in the air, insects thrown up to them. Those who have martin colonies might experiment in this way. Grasshoppers, striped cucumber beetles and rose beetles are all eaten by these birds. Canker worms or meal worms might be tried when the birds have learned to accept food in this way. The old birds might feed living insects to their young, if the insects were put into a box attached to the bird house. These are mere suggestions. Professor Hodge tells in "Nature Study and Life" how to handle and rear young birds that are forsaken by their parents.

All nesting boxes should be weatherproof, and when possible should have the entrance to the south or west, that cold,

* See "Bird Lore" for March–April, 1904.

north-east rains may not drive in. A few gimlet holes in the bottom will allow any water that may come in to escape. Small nests built on the ground may be protected from the north-east storms by nailing a broad shingle to a small stake, and driving the stake into the ground at an angle at the north-east side. A little ingenuity will enable one to devise a shelter for a nest built in a tree. Nests with young may be rescued from floods by fastening them securely in sheltered bushes or trees above the reach of the waters.

Reports that have come in from all sections of the State lead to the conclusion that large numbers of birds have been saved from starvation during the winter by people who have fed them.

The mortality seems to have been least among those familiar species that seek the habitations of man, thus finding the food exposed for them, and greatest among those like the quail and meadow lark, that have most reason to fear man, and therefore usually keep at a safe distance from human habitations.

If we can provide birds sufficient food and shelter in winter, there will be comparatively little mortality among them. For chickadees, woodpeckers, nuthatches and jays, suet is commonly put out. This is probably sufficient in ordinary winter weather, for it supplies heating food, and they can usually secure enough muscle-forming food in their daily search for hibernating insects and insects' eggs. It is probable, however, that such food has not been so plentiful as usual during the past winter, and there are some days in every winter when snow or ice so cover the trees that the natural food of these birds can only be obtained with great difficulty. If such days happen to be severely cold, there will be much suffering among the birds; therefore, an extra supply of food should be put out at such times. It may be well to have some sheltered under a veranda, or in a box or shed which will keep off the wind. Meat of any kind, either chopped or in shreds, should be provided where dogs and cats cannot get to it. A little "trolley" by which a box may be run out between a window and a tree is useful for this purpose.

When we once begin feeding birds in winter, there should be a constant supply, else they may starve when exposed to a cold storm. Those who throw food out on the snow and then allow it to become covered with snow and remain so for days had better not feed the birds at all, for they most need to have food provided during (and after) cold snow-storms. If chaff, hay seed and cracked grain are put out in open sheds, facing the south, sparrows and snowbirds will always be able to find food. The bobwhites may be readily provided for, and there need be little mortality among them. Mr. Henry J. Duke of Shippenburg, Pa., traps the coveys of quail, after the snow falls, in a coop supported by a figure 4 or in a set net. He then nails four boards, ten feet long and ten inches wide, together, and places the box so formed on the lawn, covering it first with boards and next with corn stover, to keep out the wind, leaving a space a foot wide at one side, which is covered with wire netting to give light and a place to feed the birds. The ground beneath the box is strewn with chaff, in which grain and seed are mixed. The birds are then put in. Scratching their food out of the chaff gives them exercise, and they are fed and kept in this box until the worst storms of the winter are past. He states that he has thus kept one hundred in a box twelve feet square, and "never lost a bird." *

Probably trapping the birds in this way would be considered illegal in this State. A lean-to shelter may be made of old rails and brush, and covered with corn stalks. This need not be more than a few feet from the ground at its highest point. It should slope to the north, and be left open on the south. Food can be thrown under this every few days, or into an old barrel lying on the ground with its open end to the south. Such makeshifts may serve in ordinary winters, but in severe seasons like the one just ended the birds must be confined to save many of them.

The large, vigorous bobwhite of New England has been exterminated, partly by the gunner and partly by the introduction of the smaller southern birds, which have interbred

* Bulletin 10, Division of Zoölogy, Pennsylvania State Department of Agriculture.

with the few survivors, producing a smaller but less hardy race, which cannot withstand severe weather.

The present inquiry has brought unsought testimony from Cape Cod to the Connecticut valley that birds of all kinds have been growing less numerous for years, because of the inroads made on their numbers by sportsmen and gunners of all degrees, from the city sportsman with his modern guns and high-bred dogs to the poor foreigner with his hired gun and the small boy with his "air rifle." Now, if ever, there should be a check put on this excessive destruction of birds, that seems to be growing with the increasing population and the manufacture of firearms; for, if birds are not now protected and given opportunities to breed unmolested, an increase of insects is sure to come. Countless thousands of birds are killed by gunners every winter in the southern States, and our only hope for the preservation of birds is to protect them in their northern homes.*

A List of Correspondents who furnished Information in Response to the Circular Letter of July 10, 1903.

Massachusetts.

J. A. Clark, Eastham.
W. F. Hammond, Mashpee.
David Nye, Bourne.
Wm. C. Winter, Mansfield.
Owen Durfee, Fall River.
F. H. Mosher, Dartmouth.
H. W. Tinkham, Swansea.
H. M. Thompson, Easton.
James H. Sullivan, Westport.
Isaac Alger, Attleborough.
J. H. Bourne, Marshfield.
William R. Lord, Rockland.
Outram Bangs, Wareham.
Isabel B. Holbrook, Rockland.
Flavel S. Thomas, M.D., Hanson.
Charles F. Curtis, Stoughton.
Marcus M. Porter, Stoughton.
C. M. Allen, Franklin.
N. B. Stone, Medway.
John Kingsbury Burgess, Dedham.
Walter B. Randall, Newton.
A. D. Wheeler, Hyde Park.
Frank A. Bates, Braintree.
Geo. L. L. Allen, Medfield.
Eben Webster, Haverhill.
B. P. Pike, Topsfield.
N. B. Douglas, Sherborn.
W. S. Kennedy, Belmont.
Samuel S. Symmes, Winchester.
Ernest Harold Baynes, Stoneham.
Walter Steele, Stoneham.
C. B. Lyman, Southampton.
Harold Bowditch, Boston.
A. A. Smith, Colrain.
N. B. Baker, Savoy.
Wm. H. Snow, Becket.

* A bulletin on the means of protecting and attracting birds is now in process of publication by the Hatch Experiment Station of the Massachusetts Agricultural College.

Wesley B. Barton, Dalton.
M. S. Doran, Lexington.
J. A. Farley, Malden.
C. S. Wheeler, Lincoln.
Chas. W. Jenks, Bedford.
L. H. Maynard, Maynard.
C. E. Bailey, Billerica.
Chas. H. Kohlrausch, Jr., Billerica.
Loring Coes, Worcester.
N. J. Anderson, Worcester.
H. R. Kinney, Worcester.
Prof. C. F. Hodge, Worcester.
C. A. Reed, Worcester.
C. K. Reed, Worcester.
W. S. Perry, Worcester.
John S. Preston, Harvard.
A. C. White, Orange.
Chas. E. Ingalls, Templeton.
Abby P. Churchill, Fitchburg.
Jesse Allen, Oakham.
Robert O. Morris, Springfield.
J. N. Bagg, Springfield.
Rev. Geo. S. Love, Springfield.
J. H. Kendrick, Springfield.
Emily B. Adams, Springfield.
R. W. Bemis, Chicopee.
Edgar C. Clark, Wilbraham.
F. C. Richards, Williamsburg.
John L. Brewer, Pelham.
H. C. Russell, North Hadley.
Dr. H. T. Fernald, Amherst.
Prof. Wm. P. Brooks, Amherst.
H. A. Parsons, Northampton.
Geo. E. Taylor, Jr., Shelburne.
Daniel Ballard, New Salem.
J. Alden Loring, Pittsfield.
J. E. Bosworth, Lee.
F. B. McKechnie, Ponkapog.

Maine.

W. H. Brownson, Portland.
Prof. C. D. Woods, Orono.
Herbert Moulton, Hiram.
J. Merton Swain, Skowhegan.
Fred Pike, Cornish.

New Hampshire.

G. W. Lane, Chichester.
Prof. C. M. Weed, Durham.

Vermont.

Dr. G. H. Perkins, Burlington.
Elizabeth B. Davenport, Brattleboro.

Rhode Island.

Prof. John Barlow, Kingston.
Prof. Cooper Curtice, Kingston.
J. M. Southwick, Providence.

Connecticut.

Robert W. Curtiss, Stratford.
Mabel Osgood Wright, Fairfield.

New Jersey.

Henry Hales, Ridgewood.

FINANCIAL RETURNS

AND

ANALYSIS OF PREMIUMS AND GRATUITIES

OF THE

INCORPORATED SOCIETIES,

WITH MEMBERSHIP AND INSTITUTES,

FOR THE YEAR 1903.

FINANCIAL RETURNS OF THE INCORPORATED

	SOCIETIES.	When incorporated.	Amount originally raised by Contribution. (R. L. 124, Sects. 1 and 3.)	Amount now held invested as a Capital Stock. (R. L. 124, Sects. 3 and 12.)	Estimated Market Value of Property.	Total Assets.
1	Amesbury and Salisbury (Agricultural and Horticultural), .	1881	$1,002 32	[2] $8,130 27	$8,126 77	$8,130 27
2	Barnstable County, ...	1844	1,740 00	[3] 8,300 00	8,300 00	8,606 30
3	Blackstone Valley, ...	1884	3,000 00	[4] 4,500 00	4,500 00	4,586 07
4	Bristol County, ...	1823	3,240 00	[4] 32,000 00	32,400 00	32,400 00
5	Deerfield Valley, ...	1871	4,094 01	[4] 9,200 00	9,450 00	9,450 00
6	Eastern Hampden, ...	1856	3,000 00	[5] 7,000 00	7,000 00	7,041 65
7	Essex, ...	1818	4,547 20	[6] 23,684 21	23,684 21	23,684 21
8	Franklin County, ...	1850	3,768 00	[7] 8,004 70	8,000 00	8,004 70
9	Hampshire, ...	1850	3,255 26	[2] 4,352 43	4,352 43	4,502 11
10	Hampshire, Franklin and Hampden, ...	1818	8,141 29	[8] 3,000 70	3,000 70	3,000 70
11	Highland, ...	1859	3,262 00	[4] 3,200 00	3,200 00	3,234 10
12	Hillside, ...	1883	3,113 32	[9] 5,883 00	. 5,883 00	6,056 95
13	Hingham (Agricultural and Horticultural), ...	1867	17,406 15	[4] 22,000 00	22,000 09	22,756 28
14	Hoosac Valley, ...	1860	2,006 00	[4] 16,800 00	16,800 00	17,249 24
15	Housatonic, ...	1848	6,335 33	[10] 24,659 53	25,084 53	25,471 65
16	Marshfield (Agricultural and Horticultural), ...	1867	3,755 43	[4] 14,050 00	14,050 00	14,050 00
17	Martha's Vineyard, ...	1859	4,552 17	[9] 4,259 17	4,259 17	4,259 17
18	Massachusetts Horticultural, .	1829	525 00	[11] 564,524 70	844,883 52	831,335 52
19	Massachusetts Society for Promoting Agriculture,[1] . . .	1792	–	–	–	–
20	Middlesex North, ...	1855	3,000 00	[4] 50,300 00	50,300 00	50,423 07
21	Middlesex South, ...	1854	3,000 00	[4] 12,200 00	12,200 00	12,224 65
22	Nantucket, ...	1856	3,500 00	[5] 3,200 00	3,200 00	3,315 64
23	Oxford, ...	1888	4,400 00	[2] 9,390 09	9,390 09	9,390 09
24	Plymouth County, ...	1819	9,550 00	[12] 1,525 27	1,503 21	1,525 27
25	Spencer (Farmers' and Mechanics' Association), ...	1888	4,034 00	[4] 8,950 00	8,950 00	9,011 09
26	Union (Agricultural and Horticultural), ...	1867	4,447 23	[4] 9,000 00	9,000 00	9,029 50
27	Weymouth (Agricultural and Industrial), ...	1891	10,270 00	[4] 11,270 00	11,270 00	11,283 03
28	Worcester, ...	1818	7,730 00	[9] 91,888 68	91,888 68	91,888 68
29	Worcester East, ...	1890	2,296 23	[2] 7,914 98	7,914 98	7,914 98
30	Worcester Northwest (Agricultural and Mechanical), . . .	1867	3,400 00	[4] 13,600 00	13,600 00	13,813 24
31	Worcester South, ...	1855	3,127 40	[4] 8,838 00	8,838 00	8,838 00
32	Worcester County West, . . .	1851	3,175 00	[4] 13,600 00	13,600 00	13,640 73
			$138,673 34	$1,005,225 73	$1,286,629 29	$1,276,116 89

[1] Represented on the Board by special enactment, and makes no returns.

[2] Invested in real estate, cash, crockery, tables, etc.

[3] Invested in real estate and bonds.

[4] Invested in real estate, crockery, tables, etc.

[5] Invested in real estate.

[6] Invested in real estate, stocks, cash, crockery, tables, etc.

[7] Invested in real estate, stocks and cash.

Societies for the Year ending Dec. 31, 1903.

Real Estate.	Notes.	Stocks and Bonds.	Bank Funds.	Bills due and unpaid.	Crockery, Tables, etc.	Cash on Hand.	Total Liabilities.	
$7,721 49	–	–	–	–	$405 28	$3 50	$2,321 49	1
7,500 00	–	$800 00	–	–	–	306 30	–	2
4,400 00	–	–	–	$37 00	100 00	49 07	1,937 25	3
32,000 00	–	–	–	–	400 00	–	17,500 00	4
9,200 00	–	–	–	–	250 00	–	27 19	5
7,000 00	–	–	–	4 00	–	37 65	6,223 12	6
15,300 00	–	8,180 00	–	–	200 00	4 21	9,702 95	7
7,000 00	–	1,000 00	–	–	–	4 70	6,060 00	8
4,200 00	–	–	–	–	152 43	149 68	1,373 00	9
100 00	–	–	$1,929 24	–	900 00	71 46	–	10
3,000 00	–	–	–	–	200 00	34 10	90 00	11
5,000 00	–	–	533 00	–	350 00	173 95	[14] 25 00	12
20,000 00	–	–	–	600 00	2,000 00	156 28	700 00	13
16,300 00	–	–	–	–	500 00	449 24	10,000 00	14
22,000 00	–	1,000 00	1,659 53	25 00	425 00	362 12	7,412 00	15
13,300 00	–	–	–	–	750 00	–	2,654 70	16
2,750 00	$200 00	–	1,059 17	–	250 00	–	108 38	17
516,172 36	–	245,420 50	–	3,488 76	[13] 50,722 88	15,530 02	6,360 00	18
–	–	–	–	–	–	–	–	19
50,000 00	–	–	–	–	300 00	123 07	19,010 00	20
12,000 00	–	–	–	–	200 00	24 65	7,850 00	21
3,200 00	–	–	–	–	–	115 64	572 94	22
7,600 00	–	–	–	–	200 00	1,590 09	–	23
–	–	–	1,466 21	–	37 00	22 06	24 00	24
8,000 00	–	–	–	25 00	950 00	36 09	2,250 00	25
8,000 00	–	–	–	–	1,000 00	29 50	1,300 25	26
11,000 00	–	–	–	–	270 00	13 03	2,000 00	27
52,000 00	–	–	38,000 00	–	1,464 50	424 18	4,233 95	28
7,297 88	–	–	–	–	75 00	542 10	–	29
13,000 00	–	–	–	–	600 00	213 24	3,300 00	30
8,500 00	–	–	–	–	338 00	–	2,100 00	31
12,600 00	–	–	–	–	1,000 00	40 73	400 00	32
$886,141 73	$200 00	$256,400 50	$44,647 15	$4,179 76	$64,040 09	$20,506 66	$115,536 22	

[8] Invested in real estate, bank funds, cash, crockery, tables, etc.
[9] Invested in real estate, bank funds, crockery, tables, etc.
[10] Invested in real estate, stocks and bank funds.
[11] Invested in real estate, library, furniture, bonds and other securities.
[12] Invested in bank funds, cash, crockery, tables, etc.
[13] Including library.
[14] Estimated.

Financial Returns of the Incorporated Societies

	Societies.	Premiums due and unpaid.	Outstanding Bills.	Mortgages or Like Liabilities.	Total Receipts.	Bounty.	Income from Notes and Bank Funds.
1	Amesbury and Salisbury (Agricultural and Horticultural), .	$385 00	$236 49	$1,700 00	$1,923 17	$600 00	-
2	Barnstable County, ...	-	-	-	4,641 45	600 00	-
3	Blackstone Valley, ...	-	137 25	1,800 00	2,064 40	600 00	-
4	Bristol County, ...	-	-	17,500 00	23,217 71	600 00	-
5	Deerfield Valley, ...	-	27 19	-	2,221 76	600 00	-
6	Eastern Hampden, ...	125 24	618 88	5,479 00	3,830 39	600 00	-
7	Essex, ...	-	-	9,702 95	2,218 28	600 00	$0 94
8	Franklin County, ...	60 00	-	6,000 00	6,299 76	600 00	-
9	Hampshire, ...	-	-	1,373 00	1,893 64	600 00	-
10	Hampshire, Franklin and Hampden, ...	-	-	-	5,225 80	334 91	14 61
11	Highland, ...	-	-	90 00	1,716 01	600 00	-
12	Hillside, ...	-	[2] 25 00	-	1,732 80	600 00	20 00
13	Hingham (Agricultural and Horticultural), ...	-	-	700 00	2,501 53	600 00	700 00
14	Hoosac Valley, ...	-	-	10,000 00	1,138 00	600 00	-
15	Housatonic, ...	-	[2] 50 00	7,362 00	10,812 79	600 00	95 54
16	Marshfield (Agricultural and Horticultural), ...	53 60	-	2,601 10	3,952 69	600 00	-
17	Martha's Vineyard, ...	5 00	[2] 103 38	-	1,064 35	600 00	54 29
18	Massachusetts Horticultural, .	6,300 00	60 00	-	20,505 64	600 00	226 25
19	Massachusetts Society for Promoting Agriculture,[1]	-	-	-	-	-	-
20	Middlesex North, ...	165 00	45 00	18,800 00	3,227 14	600 00	-
21	Middlesex South, ...	-	-	7,850 00	1,745 06	600 00	-
22	Nantucket, ...	-	-	572 94	1,304 65	600 00	-
23	Oxford, ...	-	-	-	3,918 86	600 00	-
24	Plymouth County, ...	-	24 00	-	320 86	275 00	28 00
25	Spencer (Farmers' and Mechanics' Association), ...	-	250 00	2,000 00	3,448 13	600 00	-
26	Union (Agricultural and Horticultural), ...	25	-	1,300 00	2,226 26	600 00	-
27	Weymouth (Agricultural and Industrial), ...	-	-	2,000 00	4,291 06	600 00	-
28	Worcester, ...	538 00	3,695 95	-	11,888 94	600 00	876 50
29	Worcester East, ...	-	-	-	10,089 25	600 00	1 70
30	Worcester Northwest (Agricultural and Mechanical), . . .	-	-	3,300 00	8,714 94	600 00	-
31	Worcester South, ...	-	-	2,100 00	5,450 32	600 00	-
32	Worcester County West, . . .	-	-	400 00	3,439 55	600 00	158 97
		$7,632 09	$5,273 14	$102,630 99	$160,025 19	$18,009 91	$2,176 80

[1] Represented on the Board by special enactment, and makes no returns.

[2] Estimated.

[3] And assessments.

FOR THE YEAR ENDING DEC. 31, 1903 — *Concluded.*

Income from Stocks and Bonds.	Received from New Members.	Received as Donations.	Received from All Other Sources.	Total Expenditures.	Premiums and Gratuities paid.	Current Running Expenses.	Interest.	All Other Expenses.	
-	-	-	$1,323 17	$2,116 27	$196 60	$1,853 67	$66 00	-	1
$20 00	-	$51 00	3,970 45	4,335 15	1,883 55	1,139 10	62 50	$1,250 00	2
-	$15 00	-	1,449 40	2,103 47	520 60	1,345 83	130 00	107 04	3
-	-	-	22,617 71	23,217 71	5,388 75	10,858 47	639 86	6,330 63	4
-	27 00	22 41	1,572 35	2,221 76	1,086 69	786 28	19 06	329 73	5
-	61 00	123 57	3,045 82	3,719 17	555 93	2,166 72	215 76	780 76	6
484 60	27 00	-	1,105 74	2,624 40	[4] 1,555 50	678 74	324 22	65 94	7
40 00	-	16 00	5,613 76	6,295 06	1,242 85	4,507 00	310 80	234 41	8
-	40 00	140 45	1,113 19	1,743 96	600 00	1,102 14	41 82	-	9
-	94 00	10 00	4,772 28	3,799 63	1,053 50	240 00	-	2,506 13	10
-	7 00	-	1,109 01	1,681 91	676 05	975 86	4 00	26 00	11
-	137 00	9 20	966 60	1,617 45	932 75	566 89	-	147 81	12
-	-	29 85	1,171 68	2,357 02	646 95	697 42	-	1,012 65	13
-	-	-	538 00	696 20	-	196 20	500 00	-	14
50 00	208 67	-	9,858 58	10,450 67	2,063 50	3,586 45	375 50	4,425 22	15
-	15 00	200 25	3,137 44	3,452 91	[4] 1,198 20	1,749 89	[6] 504 82	-	16
-	4 00	4 95	401 11	1,146 83	658 72	325 00	-	163 11	17
10,812 00	[3] 1,038 00	50 00	7,779 39	22,732 67	[4] 7,333 32	15,399 35	-	-	18
-	-	-	-	-	-	-	-	-	19
-	-	-	2,627 14	4,679 89	705 00	993 13	774 53	2,207 23	20
-	16 00	50 00	1,079 06	1,570 41	675 30	810 28	84 83	-	21
-	14 00	2 00	688 65	1,189 01	603 25	585 76	-	-	22
-	22 00	6 75	3,290 11	2,328 77	1,341 37	551 07	-	436 33	23
-	-	-	17 86	298 80	200 00	98 80	-	-	24
-	36 00	388 00	2,424 13	3,515 72	2,294 41	1,211 31	10 00	-	25
-	10 00	5 00	1,611 26	2,196 76	1,155 24	870 24	71 28	100 00	26
-	-	10 00	3,681 06	4,278 03	722 05	150 00	123 90	3,282 08	27
-	45 00	500 00	12,867 44	12,977 23	4,640 31	-	-	8,336 92	28
-	57 00	383 00	9,047 55	10,258 04	[5] 1,550 20	8,517 94	-	189 90	29
-	5 00	-	8,109 94	9,187 63	3,122 20	5,819 75	245 68	-	30
-	86 00	-	4,764 32	4,929 22	2,170 99	1,740 27	95 00	922 96	31
-	15 00	23 45	2,642 13	3,049 18	1,719 45	933 23	46 50	350 00	32
$11,406 60	$1,979 67	$2,055 88	$124,396 33	$156,800 93	$48,493 23	$70,456 79	$4,646 06	$33,204 85	

[4] Awarded in 1902. [5] Awarded in 1902-03. [6] And principal paid.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP AND

	SOCIETIES.	Total Amount offered in Premiums.	Total Amount awarded in Premiums and Gratuities.	Total Amount paid in Premiums and Gratuities.	Amount offered under Head of Farms, etc.	Amount awarded under Head of Farms, etc.	Amount paid under Head of Farms, etc.	Amount offered under Head of Farm and Pet Stock.
1	Amesbury and Salisbury (Agricultural and Horticultural),	$1,236 80	$580 88	$196 60	$20 00	$20 00	$18 00	$876 75
2	Barnstable County,	2,372 25	1,883 55	1,883 55	48 00	-	-	624 25
3	Blackstone Valley,	900 00	540 90	520 60	45 00	42 00	42 00	625 00
4	Bristol County,	6,125 00	5,425 65	5,388 75	28 00	25 00	25 00	1,250 00
5	Deerfield Valley,	1,396 00	1,109 10	1,086 69	-	-	-	834 00
6	Eastern Hampden,	1,033 25	623 50	555 93	98 00	6 00	6 00	676 00
7	Essex,	2,272 00	1,533 55	[2] 1,555 50	-	-	-	1,284 00
8	Franklin County,	1,656 00	1,242 85	1,242 85	-	-	-	1,100 00
9	Hampshire,	1,112 25	600 00	600 00	-	-	-	652 25
10	Hampshire, Franklin and Hampden,	1,478 50	1,104 25	1,053 50	50 00	-	-	925 00
11	Highland,	840 15	676 05	676 05	-	-	-	405 00
12	Hillside,	1,103 50	950 95	932 75	30 00	15 00	15 00	688 00
13	Hingham (Agricultural and Horticultural),	1,461 65	646 95	646 95	92 75	-	-	-
14	Hoosac Valley,[1]	-	-	-	-	-	-	-
15	Housatonic,	2,848 50	2,063 50	2,063 50	-	-	-	1,672 50
16	Marshfield (Agricultural and Horticultural),	1,857 50	1,262 95	1,198 20	110 00	12 00	12 00	451 50
17	Martha's Vineyard,	850 00	678 75	658 72	22 00	20 00	20 00	446 25
18	Massachusetts Horticultural,	6,829 50	5,363 70	[2] 7,333 32	562 00	535 00	555 70	-
19	Massachusetts Society for Promoting Agriculture,[1]	-	-	-	-	-	-	-
20	Middlesex North,	1,263 00	870 00	705 00	-	-	65 00	4 -
21	Middlesex South,	1,400 00	706 85	675 30	45 00	-	-	827 00
22	Nantucket,	1,366 00	603 25	603 25	96 00	9 00	9 00	690 00
23	Oxford,	1,800 00	1,371 75	1,341 37	78 00	44 50	44 50	874 00
24	Plymouth County,	200 00	200 00	200 00	-	-	-	90 00
25	Spencer (Farmers' and Mechanics' Association),	2,500 00	2,294 41	2,294 41	27 00	27 00	27 00	4 -
26	Union (Agricultural and Horticultural),	1,509 35	1,195 16	1,155 24	-	-	-	769 00
27	Weymouth (Agricultural and Industrial),	1,155 65	740 55	722 05	-	-	-	679 00
28	Worcester,	6,208 25	5,153 75	4,640 31	-	-	-	3,589 00
29	Worcester East,	2,500 00	1,498 75	[3] 1,550 20	25 00	23 00	23 00	1,771 00
30	Worcester Northwest (Agricultural and Mechanical),	3,712 00	3,163 10	3,122 20	22 00	16 00	16 00	1,318 00
31	Worcester South,	2,509 25	2,007 92	2,170 99	135 00	40 00	40 00	939 50
32	Worcester County West,	2,034 70	1,742 90	1,719 45	57 00	17 00	17 00	786 50
		$63,531 05	$47,835 47	$48,493 23	$1,590 75	$851 50	$870 20	$24,843 50

[1] Held no fair and made no report.

[2] Awarded in 1902.

Institutes, for the Year ending Dec. 31, 1903.

Amount awarded under Head of Farm and Pet Stock.	Amount paid under Head of Farm and Pet Stock.	Amount offered under Head of Field and Garden Crops.	Amount awarded under Head of Field and Garden Crops.	Amount paid under Head of Field and Garden Crops.	Amount offered under Head of Farm and Garden Products.	Amount awarded under Head of Farm and Garden Products.	Amount paid under Head of Farm and Garden Products.	Amount offered under Head of Dairy Products.	Amount awarded under Head of Dairy Products.	
$241 00	$62 00	–	–	–	$168 30	$168 30	$84 90	$8 25	$8 25	1
391 25	391 25	$182 00	$14 00	$44 00	321 00	220 05	220 05	10 00	8 00	2
367 00	350 00	–	–	–	120 00	98 50	96 25	15 00	–	3
1,050 45	987 05	–	–	–	250 00	206 50	206 50	50 00	32 00	4
590 15	570 29	–	–	–	138 00	107 80	106 30	12 00	6 00	5
472 00	472 00	62 00	12 75	12 75	102 50	72 75	72 75	18 00	5 00	6
794 00	783 00	64 00	8 00	69 00	500 00	384 00	446 00	16 00	1 00	7
901 40	901 40	–	–	–	200 00	174 25	174 25	22 00	14 00	8
337 25	337 25	–	–	–	148 50	101 75	101 75	13 00	3 00	9
845 50	807 25	101 00	25 00	24 50	183 50	139 50	133 50	36 00	8 00	10
404 00	404 00	35 00	7 50	7 50	63 50	58 55	58 55	7 50	7 50	11
581 00	581 00	60 00	48 00	48 00	87 00	74 90	74 90	11 00	11 00	12
–	–	131 00	6 00	6 00	951 65	473 35	473 35	3 50	3 50	13
–	–	–	–	–	–	–	–	–	–	14
1,096 50	1,096 50	268 00	235 00	235 00	353 00	307 50	307 50	42 00	42 50	15
288 10	256 70	–	–	–	315 00	145 85	136 20	12 50	7 00	16
259 15	259 15	121 50	68 15	68 15	86 00	100 35	100 35	10 00	8 50	17
–	–	–	–	–	6,267 50	4,828 70	6,741 65	–	–	18
–	–	–	–	–	–	–	–	–	–	19
[4] –	375 50	[4] –	[4] –	65 00	[4] –	[4] –	169 25	–	–	20
139 50	107 95	42 00	–	–	180 20	65 65	65 65	–	–	21
341 00	341 00	174 00	36 00	36 00	127 00	30 50	30 50	16 00	–	22
556 50	540 75	38 25	23 25	20 89	78 50	32 75	30 20	12 00	9 00	23
90 00	90 00	–	–	–	35 00	35 00	35 00	–	–	24
1,038 50	1,038 50	–	–	–	[4] –	120 70	120 70	25 00	25 00	25
502 00	471 64	–	–	–	68 50	48 75	46 79	13 25	9 75	26
403 95	398 20	46 00	3 00	3 00	210 00	169 05	163 40	5 50	–	27
2,635 50	2,635 50	–	–	–	516 50	445 00	445 00	29 00	21 00	28
960 00	960 00	–	–	–	335 75	250 75	250 75	21 00	8 00	29
933 00	917 25	–	–	–	274 10	177 50	168 00	18 00	5 00	30
600 50	600 50	–	–	–	183 25	131 10	131 10	20 00	14 00	31
650 00	638 00	–	–	–	130 45	93 50	83 80	15 00	8 00	32
$17,469 20	$17,373 63	$1,324 75	$516 65	$639 79	$12,297 70	$9,262 85	$11,274 89	$461 50	$265 00	

[3] Awarded in 1902-03.

[4] Not reported.

ANALYSIS OF PREMIUMS AND GRATUITIES, MEMBERSHIP AND

	SOCIETIES.	Amount paid under Head of Dairy Products.	Amount offered under Head of Domestic Manufactures.	Amount awarded under Head of Domestic Manufactures.	Amount paid under Head of Domestic Manufactures.	Amount awarded under Head of Miscellaneous.	Amount paid under Head of Miscellaneous.
1	Amesbury and Salisbury (Agricultural and Horticultural),	$8 25	$112 75	$98 33	$23 00	$50 75	$50 75
2	Barnstable County,	8 00	183 00	216 25	216 25	104 00	104 00
3	Blackstone Valley,	–	75 00	33 40	32 05	–	–
4	Bristol County,	32 00	300 00	228 70	228 70	130 00	130 00
5	Deerfield Valley,	6 00	99 20	92 35	91 30	60 80	60 80
6	Eastern Hampden,	5 00	76 75	45 00	45 00	–	–
7	Essex,	5 00	204 00	153 05	119 00	183 50	208 50
8	Franklin County,	14 00	150 00	133 00	133 00	20 20	20 20
9	Hampshire,	3 00	55 50	38 75	38 75	120 50	120 50
10	Hampshire, Franklin and Hampden,	8 00	135 00	38 25	38 25	48 00	47 00
11	Highland,	7 50	81 05	75 85	75 85	43 65	43 65
12	Hillside,	11 00	100 00	93 55	93 55	67 50	67 50
13	Hingham (Agricultural and Horticultural),	3 50	178 75	124 30	124 30	39 80	39 80
14	Hoosac Valley,[1]	–	–	–	–	–	–
15	Housatonic,	42 50	513 00	382 00	382 00	–	–
16	Marshfield (Agricultural and Horticultural),	7 00	220 00	64 95	63 85	80 05	69 45
17	Martha's Vineyard,	8 50	98 10	114 95	114 95	54 20	54 20
18	Massachusetts Horticultural,	–	–	–	–	–	–
19	Massachusetts Society for Promoting Agriculture,[1]	–	–	–	–	–	–
20	Middlesex North,	–	[2] –	[2] –	76 50	–	–
21	Middlesex South,	–	106 00	41 00	41 00	31 70	31 70
22	Nantucket,	–	128 00	44 50	44 50	34 25	34 25
23	Oxford,	9 00	76 50	58 75	49 03	–	–
24	Plymouth County,	–	40 00	40 00	40 00	35 00	35 00
25	Spencer (Farmers' and Mechanics' Association),	25 00	[2] –	99 00	99 00	94 75	94 75
26	Union (Agricultural and Horticultural),	9 75	112 25	116 40	108 80	118 26	118 26
27	Weymouth (Agricultural and Industrial),	–	165 15	114 70	109 35	49 85	48 10
28	Worcester,	21 00	49 25	34 75	34 75	117 50	117 50
29	Worcester East,	8 00	192 50	109 25	109 25	137 75	139 75
30	Worcester Northwest (Agricultural and Mechanical),	5 00	81 25	68 40	56 95	18 00	18 00
31	Worcester South,	14 00	64 50	55 32	55 32	237 00	237 00
32	Worcester County West,	8 00	68 75	60 25	58 50	14 15	14 15
		$269 00	$3,666 25	$2,775 00	$2,702 75	$1,891 16	$1,904 81

[1] Held no fair and made no report.
[2] Not reported.
[3] And gratuities.
[4] About.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1903 — *Concluded.*

Amount paid for Trotting.	Number of Persons receiving Premiums.	Number of Persons receiving Gratuities.	Number of Cities and Towns where Premiums were paid.	Amount paid to Parties Outside the State.	Number of Male Members.	Number of Female Members.	Total Membership.	Number of Institutes held.	Average Number attending Institutes.	
–	380	–	20	[6] $130 90	197	40	237	3	51	1
$900 00	125	300	10	–	268	219	487	3	40	2
–	[2] –	[2] –	12	–	297	285	582	2	12	3
3,750 00	170	10	[4] 25	200 00	605	109	714	3	125	4
252 00	260	–	21	–	896	252	1,148	3	107	5
1,150 00	[3] 101	–	31	–	267	192	459	3	50	6
–	415	–	27	–	1,166	13	1,179	3	105	7
1,080 00	300	2	[4] 20	–	[7] 1,200	[7] 200	[7] 1,400	3	151	8
485 00	122	5	17	–	400	200	600	3	117	9
322 50	185	35	28	–	725	275	1,000	4	119	10
80 00	146	2	18	3 00	253	122	375	4	66	11
60 00	[4] 300	1	29	1 00	676	28	704	4	92	12
–	81	59	17	50	422	177	599	6	155	13
–	–	–	–	–	954	15	969	–	–	14
1,415 00	380	–	20	–	1,490	51	1,541	3	80	15
665 00	61	232	23	–	538	292	830	3	70	16
–	275	50	6	–	97	83	180	3	30	17
–	152	106	80	401 50	768	100	868	8	111	18
–	–	–	–	–	–	–	–	–	–	19
[2] –	399	41	12	50	1,125	460	1,585	4	169	20
425 00	71	34	7	–	363	216	579	3	133	21
100 00	105	36	1	–	231	368	599	3	20	22
647 00	[2] –	[2] –	18	40 00	333	283	616	3	67	23
[2] –	[5] –	[5] –	[5] –	[5] –	735	565	1,300	4	91	24
845 00	[2] –	[2] –	24	–	470	417	887	3	79	25
400 00	171	61	25	36 25	635	784	1,419	3	258	26
–	[4] 300	[4] 200	17	–	480	10	490	3	42	27
1,900 00	255	2	33	519 50	1,660	186	1,846	3	112	28
1,252 00	234	42	36	470 50	452	284	736	3	87	29
1,470 00	215	5	25	30 00	679	384	1,063	4	161	30
930 00	100	50	20	–	764	780	1,544	3	67	31
900 00	154	29	31	95 50	405	66	471	3	47	32
$19,028 50	5,760	1,302	653	$1,929 15	19,551	7,456	27,007	103	[8] 102	

[5] Premiums paid through Marshfield Agricultural and Horticultural Society.

[6] Awarded. [7] Estimated. [8] General average of attendance.

DIRECTORY

OF THE

AGRICULTURAL AND SIMILAR ORGANIZATIONS IN MASSACHUSETTS.

May, 1904.

State Board of Agriculture, 1904.

Members ex Officio.

His Excellency JOHN L. BATES.
His Honor CURTIS GUILD, Jr.
Hon. WM. M. OLIN, *Secretary of the Commonwealth.*
H. H. GOODELL, M.A., LL.D., *President Massachusetts Agricultural College.*
C. A. GOESSMANN, Ph.D., LL.D., *Chemist of the Board.*
AUSTIN PETERS, M.R.C.V.S., *Chief of the Cattle Bureau.*
J. LEWIS ELLSWORTH, *Secretary of the Board.*

Members appointed by the Governor and Council.

	Term Expires
WILLIAM R. SESSIONS of Springfield,	1905
FRANCIS H. APPLETON of Peabody,	1906
WARREN C. JEWETT of Worcester,	1907

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agr'l and Hort'l),	J. J. MASON of Amesbury,	1906
Barnstable County,	JOHN BURSLEY of West Barnstable,	1907
Blackstone Valley,	SAMUEL B. TAFT of Uxbridge,	1906
Bristol County,	WILLIAM A. LANE of Norton (P. O. Barrowsville),	1905
Deerfield Valley,	ARTHUR A. SMITH of Colrain (P. O. Lyonsville),	1905
Eastern Hampden,	O. E. BRADWAY of Monson,	1906
Essex,	JOHN M. DANFORTH of Lynnfield (P. O. Lynnfield Centre),	1905
Franklin County,	JOHN S. ANDERSON of Shelburne,	1907
Hampshire,	HENRY E. PAIGE of Amherst,	1907
Hampshire, Franklin and Hampden,	J. F. BURT of Easthampton,	1906
Highland,	C. K. BREWSTER of Worthington,	1905
Hillside,	J. W. GURNEY of Cummington,	1905
Hingham (Agr'l and Hort'l),	EDMUND HERSEY of Hingham,	1906
Housatonic,	CHARLES H. SHAYLOR of Lee,	1906
Marshfield (Agr'l and Hort'l),	HENRY A. TURNER of Norwell,	1906
Martha's Vineyard,	JOHNSON WHITING of West Tisbury,	1907
Massachusetts Horticultural,	WM. H. SPOONER of Jamaica Plain,	1906
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1906
Middlesex North,	H. S. PERHAM of Chelmsford,	1907
Middlesex South,	ISAAC DAMON of Wayland (P. O. Cochituate),	1905
Nantucket,	H. G. WORTH of Nantucket,	1906
Oxford,	W. M. WELLINGTON of Oxford,	1907
Plymouth County,	AUGUSTUS PRATT of North Middleborough,	1905
Spencer (Far's and Mech's Assoc'n),	H. H. LEACH of North Brookfield,	1907
Union (Agr'l and Hort'l),	ALBERT H. NYE of Blandford (P. O. Russell),	1907
Weymouth (Agr'l and Ind'l),	QUINCY L. REED of South Weymouth,	1906
Worcester,	WALTER D. ROSS of Worcester,	1905
Worcester East,	W. A. KILBOURN of South Lancaster,	1906
Worcester Northwest (Agr'l and Mech'l),	ALBERT ELLSWORTH of Athol,	1907
Worcester South,	C. D. RICHARDSON of West Brookfield,	1907
Worcester County West,	J. HARDING ALLEN of Barre,	1905

ORGANIZATION OF THE BOARD.

OFFICERS.

President, . . HIS EXCELLENCY JOHN L. BATES, *ex officio*.
1st Vice-President, WILLIAM R. SESSIONS of Springfield.
2d Vice-President, . AUGUSTUS PRATT of North Middleborough.
Secretary, . . J. LEWIS ELLSWORTH of Worcester.

Office, Room 136, State House, Boston.

COMMITTEES.

Executive Committee.

Messrs. W. A. KILBOURN of South Lancaster.
ISAAC DAMON of Wayland.
JOHN BURSLEY of West Barnstable.
WM. H. SPOONER of Boston.
FRANCIS H. APPLETON of Peabody.
AUGUSTUS PRATT of North Middleborough.
C. D. RICHARDSON of West Brookfield.
EDMUND HERSEY of Hingham.

Committee on Agricultural Societies.

Messrs. W. A. KILBOURN of South Lancaster.
Q. L. REED of South Weymouth.
O. E. BRADWAY of Monson.
J. HARDING ALLEN of Barre.
J. F. BURT of Easthampton.

Committee on Domestic Animals and Sanitation.

Messrs. ISAAC DAMON of Wayland.
JOHNSON WHITING of West Tisbury.
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MASSACHUSETTS AGRICULTURAL COLLEGE.

Location, Amherst, Hampshire County.

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Massachusetts Horticultural,	Dr. Henry P. Walcott, Cambridge.	Wm. P. Rich, Boston.	C. E. Richardson, Brookline.
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* And horticultural.

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Agricultural Societies, etc. — *Concluded.*

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Hampden County, ...	Springfield, ...	Jacob C. Lutz, Springfield.	William F. Gale, City Hall, Springfield.
Houghton, ...	Lynn, ...	William Stone, Lynn.	Miss Ruth S. Wood, Lynn.
Lenox, ...	Lenox, ...	Edwin Jenkins, Lenox.	R. A. Schmid, Lenox.
Massachusetts, ...	The State, ...	Dr. Henry P. Walcott, Cambridge.	Wm. P. Rich, Boston.
North Shore, ...	Manchester, ...	- -	James Salter, Manchester.
Springfield Amateur, ...	Springfield, ...	W. T. Hutchins, Indian Orchard.	Chas. L. Burr, Springfield.
Worcester County, ...	Worcester, ...	O. B. Hadwen, Worcester.	Adin A. Hixon, Worcester.

Farmers' and Mechanics' Associations.

Bolton,	Bolton,	William N. Felton, Bolton.	William M. Brigham, Bolton.
Middlesex and Worcester,	Hudson,	Oliver Sawyer, Hudson.	Josiah S. Welsh, Hudson.
Needham,	Needham,	Merritt S. Keith, Wellesley Hills.	John F. Mills, Needham.
Oakham,	Oakham,	H. A. Crawford, Oakham.	H. W. Lincoln, Oakham.
Princeton,	Princeton,	J. C. F. Mirick, Princeton.	J. E. Merriam, Princeton.
Westminster,	Westminster,	Judson Foster, Westminster.	H. J. Partridge, Westminster.

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Ashby,	Ashby,	W. O. Loveland, Ashby.	W. J. Smith, Ashby.
Belchertown,	Belchertown,	D. F. Shumway, Belchertown.	Geo. H. B. Green, Belchertown.
Groton,	Groton,	Wm. A. Lawrence, Groton.	L. H. Sheedy, Groton.
Holden,	Holden,	Levi Howe, Holden.	A. F. Newell, Holden.
Pepperell,	Pepperell,	L. A. Boynton, Pepperell.	F. T. Marston, Pepperell.
Shirley,	Shirley,	H. S. Hazen, Shirley Centre.	M. W. Longley, Shirley Centre.
Shrewsbury,	Shrewsbury,	E. A. Bartlett, Shrewsbury.	F. J. Stone, Shrewsbury.

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Chamberlain District,	Worcester,	Pliny Moore, Worcester.	Silas A. Burgess, Worcester.
East Charlemont,	East Charlemont,	W. W. Smith, East Charlemont.	Geo. H. Wheeler, East Charlemont.
Easthampton,	Easthampton,	E. H. Clark, Easthampton.	C. W. Smith, Easthampton.
Franklin,	Franklin,	C. H. Prince, Franklin.	L. W. Daniels, Franklin.
Halifax,	Halifax,	Van Buren Grover, Halifax.	Mrs. Geo. W. Hayward, Halifax.
Lancaster,	Lancaster,	George F. Morse, South Lancaster.	F. A. Hanaford, South Lancaster.
New Braintree,	New Braintree,	Luther Crawford, New Braintree.	Mrs. Horatio Moore, New Braintree.
Rehoboth,	Rehoboth,	Dr. C. H. Raymond, Rehoboth.	C. W. Goff, South Rehoboth.
Rowley,	Rowley,	J. D. Dodge, Rowley.	T. P. Hale, Rowley.
Rutland,	Rutland,	George F. Goldthwaite, Rutland.	Mrs. H. J. Davis, Rutland.
South Bristol,	New Bedford,	Franklyn Howland, Acushnet.	Allen Russell, Jr., Acushnet.
Tatnuck,	Worcester,	H. W. Moore, Worcester.	H. R. Kinney, Worcester.
Upton,	Upton,	Geo. H. Stoddard, Upton.	Francis T. Nelson, Upton.
West Brookfield,	West Brookfield,	W. R. Smith, West Brookfield.	S. H. Reed, West Brookfield.
West Newbury,	West Newbury,	Lewis Knight, West Newbury.	Parker H. Nason, West Newbury.
Wilbraham,	Wilbraham,	B. F. Green, North Wilbraham.	Henry M. Bliss, North Wilbraham.

Poultry Associations.

Adams Poultry Association,	Adams,	Dr. F. I. Wilder, Adams.	John J. Caley, Adams.
Amesbury Poultry and Pet Stock Association.	Amesbury,	W. E. Tibbets, Amesbury.	M. H. Sands, Amesbury.
Athol Poultry and Pet Stock Association,	Athol,	- -	J. E. Burt, Athol.
Brockton Poultry Association,	Brockton,	M. E. Holmes, Campello.	C. A. Brown, Brockton.
Essex County Poultry Association,	Beverly,	Frank A. Woodbury, North Beverly.	Arthur Elliott, Peabody.
Falmouth Poultry Association,	Falmouth,	E. P. Davis, Falmouth.	R. E. Small, Falmouth.
Fitchburg Poultry and Pet Stock Association.	Fitchburg,	Frank A. Wood, Fitchburg.	J. Lee Frost, Fitchburg.
Green Field Score Card Poultry Club,	Greenfield,	E. C. Wilcox, Greenfield.	H. L. Moody, Greenfield.
Lawrence Poultry and Pet Stock Association.	Lawrence,	B. D. Todd, Lawrence.	Asa L. Harris, Lawrence.
Lynn Poultry Association,	Lynn,	J. Fred Bessom, Lynn.	Chas. E. Hunt, Lynn.
Methuen Grange Poultry Association,	Methuen,	- -	J. S. Crosby, Methuen.
Milford Poultry Association,	Milford,	J. E. Nolan, Milford.	W. H. Pyne, Milford.
New Bedford Poultry Association,	New Bedford,	Jas. B. Hamlin, Acushnet.	Norman Barstow, New Bedford.
North Abington Poultry Association,	North Abington,	Chas. W. Pratt, North Abington.	Jas. H. Dwyer, North Abington.
Northampton Poultry Association,	Northampton,	Dr. J. B. Paige, Amherst.	C. E. Hodgkins, Northampton.
Plymouth Poultry Association,	Plymouth,	T. Allen Bagnell, Plymouth.	F. C. Chandler, Kingston.
Springfield Poultry and Pet Stock Association.	Springfield,	E. L. Smith, West Springfield.	W. R. Graves, Springfield.
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MISCELLANEOUS.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
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Bristol Co. Fruit Growers' Association,	Dighton,	Dwight F. Lane, Segregansett.	Wm. P. Eddy, Dighton.
Brockton Agricultural Society,	Brockton,	Henry W. Robinson, Brockton.	Baalis Sanford, Brockton.
Cranberry Growers' Association,	Cape Cod District,	Emulous Small, Harwichport.	Franklin Crocker, Hyannis.
Farmers' and Cattle Owners' Association,	The State,	- -	J. L. Harrington, Lunenburg.
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Hampden Harvest Club,	Connecticut Valley,	The members alternately.	C. A. Judd, South Hadley Falls.
Massachusetts Creamery Association,	The State,	W. N. Wright, Easthampton.	A. M. Lyman, Montague.
Massachusetts Forestry Association,	The State,	Dr. Henry P. Walcott, Cambridge.	Edwin A. Start, Boston.
Massachusetts Fruit Growers' Association,	The State,	A. G. Sharp, Richmond.	S. T. Maynard, Northborough.
Wakefield-Reading Fair Company,	Wakefield,	George A. Shackford, Reading.	B. F. Calley, Jr., Wakefield.
Ware Agricultural Society,	Ware,	F. F. Gilmore, Ware.	E. P. Lovett, Ware.
Westborough Agricultural Society,	Westborough,	John B. Fitch, Westborough.	George M. Howe, Westborough.
Worcester County Harvest Club,	Worcester,	Chas. E. Prouty, Auburn.	Chas. R. Russell, Worcester.
Worcester County Bee-keepers' Association,	Worcester,	B. W. Potter, Worcester.	Mrs. W. C. Jewett, Worcester.
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"Granite" of South Worthington, No. 49.	Milo Bates, Ringville.	Mrs. Rufus Adams, Ringville.	Mrs. Emma Thrasher, So. Worthington.
Sterling, No. 53,	Louis A. Stuart, Pratt's Junction.	Wm. A. Dingley, Pratt's Junction.	Mrs. Wm. A. Dingley, Pratt's Junction.
Springfield, No. 54,	E. T. Davis, Springfield.	Mrs. Sophie Carr, Springfield.	Miss Bertha E. Baker, Springfield.
Cummington, No. 56,	Edward I. Clark, Cummington.	Charles E. Clark, Worthington.	W. E. Ford, Cummington.
Auburn, No. 60,	Wm. E. Barrows, Auburn.	Mrs. Charles N. Freeman, Auburn.	Mrs. Eleanor W. Barrows, Auburn.
"Union" of Belchertown, No. 64,	F. L. Stebbins, Belchertown.	Mrs. M. G. Ward, Belchertown.	Miss Ella Stebbins, Belchertown.
Brimfield, No. 65,	Cheney F. Newton, Brimfield.	Dr. R. V. Sawin, Brimfield.	Miss Julia A. Newton, Brimfield.
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Shelburne, No. 68,	W. O. Long, Shelburne.	Mrs. D. P. Bardwell, Bardwells.	Geo. E. Taylor, Jr., Shelburne.
Ashfield, No. 69,	Albert L. Howes, South Ashfield.	Miss Mary E. Sears, Ashfield.	Mrs. C. L. Dyer, Ashfield.
Phillipston, No. 70,	D. W. Baker, Athol, R. F. D., Route 3.	Rev. I. A. Burnap, Phillipston.	Mrs. L. M. Goddard, Phillipston.
Leyden, No. 71,	C. F. Severance, Leyden.	Mrs. G. H. Denison, Leyden.	Mrs. W. A. Campbell, Leyden.
"Prescott" of Pepperell, No. 73,	Frank T. Marston, East Pepperell.	Geo. A. Mahoney, East Pepperell.	Carrie L. Dennen, Pepperell.
Colrain, No. 76,	J. E. Davenport, Colrain.	Miss Ethel L. Cary, Lyonsville.	Royal W. Davenport, Colrain.

Massachusetts Patrons of Husbandry — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Windsor, No. 77,	Harry A. Ford, West Cummington.	Mrs. Belle Miner, East Windsor.	Jessie A. Miner, East Windsor.
Holden, No. 78,	A. A. Metcalf, Holden.	Mrs. R. D. Rice, Holden.	Mrs. C. M. Stanhope, Holden.
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MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

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Haverhill, No. 154,	G. Howard Smith, Haverhill.	Miss Susan A. Eastman, Haverhill.	Mrs. Grace A. Merrill, Ayer's Village.
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Winchendon, No. 192,	Leslie B. Gregory, Winchendon.	Miss Ida Beals, Winchendon.	Charles W. Brooks, Winchendon.
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Townsend, No. 194,	George T. Powell, Townsend.	Mrs. F. J. Knight, Townsend Harbor.	George A. Wilder, Townsend.
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Uxbridge, No. 200,	Howard W. Phœnix, Uxbridge.	Mrs. C. B. Davis, Millville.	Mrs. Kate M. Thom, Uxbridge.
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Massachusetts Patrons of Husbandry — *Concluded.*

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"Oak Hill" of Attleborough, No. 212.	O. S. Thayer, Attleborough.	Miss Luella E. West, Attleborough.	Mrs. Malvina P. Smith, Attleborough.
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SIXTEENTH ANNUAL REPORT

OF THE

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

JANUARY, 1904.

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The State Board of Publication.

HATCH EXPERIMENT STATION

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE,

AMHERST, MASS.

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——— ———	*Assistant Horticulturist.*
FRED. F. HENSHAW,	*Observer.*

The co-operation and assistance of farmers, fruit-growers, horticulturists and all interested, directly or indirectly, in agriculture, are earnestly requested. Communications may be addressed to the "Hatch Experiment Station, Amherst, Mass."

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No. 35. Agricultural value of bone meal.

No. 41. On the use of tuberculin (translated from Dr. Bang).
No. 54. Fertilizer analyses.
No. 57. Fertilizer analyses.
No. 64. Analyses of concentrated feed stuffs.
No. 67. Grass thrips; treatment for thrips in greenhouses.
No. 68. Fertilizer analyses.
No. 69. Rotting of greenhouse lettuce.
No. 70. Fertilizer analyses.
No. 72. Summer forage crops.
No. 75. Fertilizer analyses.
No. 76. The imported elm-leaf beetle.
No. 77. Fertilizer analyses.
No. 78. Concentrated feed stuffs.
No. 79. Growing China asters.
No. 81. Fertilizer analyses; treatment of barnyard manure with absorbents; trade values of fertilizing ingredients.
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No. 83. Fertilizer analyses.
No. 84. Fertilizer analyses.
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No. 87. Cucumbers under glass.
No. 89. Fertilizer analyses; ash analyses of plants; instructions regarding sampling of materials to be forwarded for analysis.
No. 90. Fertilizer analyses.
No. 91. Injuries to shade trees from electricity.
No. 92. Fertilizer analyses.
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Special bulletin, — The coccid genera Chionaspis and Hemichionaspis.
Technical bulletin, No. 1, — Greenhouse Aleyrodes; strawberry Aleyrodes.
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ANNUAL REPORT

Of George F. Mills, *Treasurer* of the Hatch Experiment Station of Massachusetts Agricultural College.

For the Year ending June 30, 1903.

Cash received from United States Treasurer,		$15,000 00
Cash paid for salaries,	$6,829 37	
for labor,	3,216 52	
for publications,	860 08	
for postage and stationery,	360 32	
for freight and express,	130 65	
for heat, light, water and power,	355 77	
for seeds, plants and sundry supplies,	810 76	
for fertilizers,	716 85	
for feeding stuffs,	587 17	
for library,	56 18	
for tools, implements and machinery,	196 13	
for furniture and fixtures,	35 03	
for scientific apparatus,	87 90	
for travelling expenses,	105 50	
for contingent expenses,	121 00	
for building and repairs,	530 77	
		$15,000 00
Cash received from State Treasurer,	$11,200 00	
from fertilizer fees,	4,215 25	
from farm products,	2,298 12	
from miscellaneous sources,	3,291 04	
		$21,004 41
Cash paid for salaries,	$10,303 59	
for labor,	2,446 47	
for publications,	353 03	
for postage and stationery,	254 39	
for freight and express,	45 41	
Amount carried forward,	$13,402 89	

Amount brought forward,	$13,402 89	
Cash paid for heat, light, water and power,	605 03	
for chemical supplies,	1,025 44	
for seeds, plants and sundry supplies,	378 43	
for fertilizers,	14 38	
for feeding stuffs,	700 36	
for library,	27 91	
for tools, implements and machinery,	39 54	
for furniture and fixtures,	1 50	
for scientific apparatus,	195 41	
for live stock,	61 45	
for travelling expenses,	694 94	
for contingent expenses,	245 86	
for building and repairs,	412 71	
Cash on hand,	3,198 56	
		$21,004 41

I, Charles A. Gleason, duly appointed auditor of the corporation, do hereby certify that I have examined the books and accounts of the Hatch Experiment Station of the Massachusetts Agricultural College for the fiscal year ended June 30, 1903; 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, and the corresponding disbursements $15,000; for all of which proper vouchers are on file and have been by me examined and found correct, thus leaving no balance in the treasury.

CHARLES A. GLEASON,
Auditor.

AMHERST, Sept. 2, 1903.

REPORT OF THE METEOROLOGIST.

J. E. OSTRANDER.

The close of the present year completes a period of fifteen years of meteorological observations at this station. From the records obtained during this time the mean values of the several weather elements for each month have been computed, and the results will be used as the normals of this station for the purpose of comparison. Charts showing the more important meteorological data are being prepared for the exhibit of this division at the St. Louis Exposition.

Last year, when this station arranged to furnish the United States Weather Bureau with the usual voluntary observer's records, the advisability of changing our times of observation from 7 A.M., 2 P.M. and 9 P.M. to 8 A.M. and 8 P.M., to conform to the times of observation at other stations, was considered, and it was thought best not to make the change at that time. Our printed forms for permanent record being all used, it was thought best to provide for the above change in preparing new record books. This has accordingly been done, and the change from tri-daily to semi-daily observations will be made at the close of a five-year period, on Jan. 1, 1904. The records being largely controlled by our self-registering instruments, the change should not appreciably affect our results for comparison with the normals already deduced.

The usual 4-page bulletins, giving the more important daily records, with the monthly means and summary of the weather, have been issued the first of each month. An annual summary will be prepared and published as a part of the December bulletin.

The local forecasts sent out by the New England section of the United States Weather Bureau have been received during the year, and the signals displayed from the flagstaff on the tower. These forecasts having come this year by the Postal Telegraph and Cable Company, instead of the Western Union Telegraph Company, as formerly. Our telegraph line to the college has been out of service most of the year, and the predictions have been obtained by telephone, causing considerable inconvenience and delay in displaying the signals. Arrangements were finally made with the Postal Company, whereby they connect with our line to the college at the corner of Amity Street and Lincoln Avenue, they maintaining a line from their office to that point, and this division controlling the line from that point to the tower. The receipt of the forecasts by telegraph at the tower was resumed about December 1.

At the request of the section director of the Weather Bureau, the weekly snow reports are being sent to the Boston office, as in previous years.

Two standard thermometers, reading to one-fifth degree F., were purchased during the year, to replace others broken in use. Three new clocks for the Draper instruments in the tower were also bought, to replace others that were worn out.

REPORT OF THE BOTANISTS.

G. E. STONE AND N. F. MONAHAN, ASSISTANT.

Besides the general correspondence work relating to the diseases of plants, which is constantly increasing each year, this division has continued its usual experimental work in the greenhouse on various market garden and floricultural problems.

During the past year this division has published two bulletins, entitled, "Cucumbers under Glass," issued as Bulletin No. 87; and "Injuries to Shade Trees from Electricity," which was issued as Bulletin No. 91.

From the pathologist's point of view, the past season has shown some resemblance to the preceding one. Both seasons have been peculiar, as demonstrated by the second blossoming of a large number of plants and the general upsetting of their seasonal habits. There has been an absence of some fungi, which usually occur more or less commonly, and a predominance of others which generally do not cause much damage. Some indications of the pink mold, a so-called attendant of apple scab, which made its appearance last year for the first time in this State, has shown itself again, although trouble from this fungus has not been serious in this State. The sooty mold of greenings, etc., has been unusually abundant the past two years where spraying has not been properly attended to, causing much disfiguration of the fruit. Considerable damage was done to pear trees by lice, which profusely secreted honey dew on the foliage and stems, thereby furnishing conditions for the luxurious development of a black mold on the stems and leaves, causing much injury to the latter.

The raspberry cane blight, recently described by Prof. F. C. Stewart,[1] has been noted in this State, and specimens have been sent to Professor Stewart, who has reported upon them. How common this disease is, or is likely to become, we are at present not able to say. There has been, moreover, an unusual amount of winter-killing of raspberry canes, resulting from the unusual conditions of the fall of 1902.

Some complaint has been made in regard to a potato stem rot, a disease which is apparently more common in Vermont, where it, with other potato diseases, is receiving serious attention by Prof. L. R. Jones.

An unusual leaf spot disease for this region was noted on corn. This was caused by the fungus *Helminthosporium inconspicuum* C. and E., which gave the leaves a badly spotted appearance, and in one instance rendered the crop practically useless. Probably the extremely abnormal corn weather during the past summer was responsible for this.

A fungus known as *Vermicularia trichella* Fr. caused considerable spotting and damage to the leaves of the English ivy (*Hedera helix*, L.). There has been a minimum number of the usual shade tree fungous blights, although the blight of the horse-chestnut leaves, caused by the fungus *Phyllosticta sphæropsoidea* Ell. and Ev., was troublesome, and a considerable amount of defoliation occurred to maples from sun scorch. The Norway maple leaves were also greatly lacerated by the winds at the time of unfolding, and they were literally covered with honey dew, which in some cases resulted in the development of a black mold on them.

The stem rot diseases of the carnation, aster, campanula, etc., have been rather common on out-of-door plants. The usual blights of the melon and cucumber were present, but these crops did so poorly that the fungus had little material to work on. The general consensus of opinion among growers of melons and cucumbers is that spraying does little or no good when the anthracnose and alternaria are present. This is especially true of the melon, where all attempts at spraying, even when frequently attended to, failed to hold these fungi in check.

[1] Geneva, N. Y., Experiment Station, Bulletin No. 226, December, 1900.

The most general complaint, however, during the spring and summer, was in regard to winter-killing. It is seldom one finds so many varieties of plants injured from this cause, which can be traced back to the unusually prolonged warm weather, characteristic of the fall of 1902, and the sudden freeze following in early December. Among the plants that have suffered to a considerable extent are the following: —

The Californian privet (*Ligustrum ovalifolium*) and *Ligustrum ibota* were in many cases killed outright. Yellow and crimson rambler roses and certain honeysuckles were killed to the ground. The climbing ivy (*Ampelopsis veitchii*) was badly damaged, so much so, in fact, that buildings that were tolerably well covered with this beautiful ivy were almost bare in mid-summer. Wistarias, deutzia, spiraea thunbergii, spiraea vanhouttei and forsythia had their flower buds injured so severely that they made little show in the spring. The Japanese clematis was in most cases killed to the ground. Euonymus radicans suffered badly, as did many of the viburnums. Many of the choicer aquilegias were killed outright. The fruit buds of cherries, peaches and Japanese plums were practically killed; in some cases the wood was much injured. Grape vines were in some cases killed to the ground, and strawberries, blackberries and raspberries were much injured. Such wild plants as the beech, plum and buckthorn, and many of the wild roses, had their wood severely injured. Many of these plants appeared to come through the winter successfully, and threw out strong shoots in the spring, when they suddenly collapsed. Blackberries and raspberries showed a marked tendency to die back after having blossomed and fruited. In some other instances plants not supposed to be hardy, such, for example, as the crimson clover and alfalfa, have gone through the winter without trouble. It would appear that, while the severe frost in December, following the unusually prolonged warm spell, was the means of doing great injury to plants that are supposed to be tolerably hardy, those like the crimson clover, etc., which are not hardy, were not affected. The limited amount of frost in the ground, due to the snow cover, eventually proved advantageous to such plants as the crimson clover and alfalfa. It is probable that the unusually slight amount of moisture present in the soil during the past spring had much to do with weakening many plants which might have made some recovery under other conditions.

We append to this report some experiments relating to the influence of electricity on the growth of plants, which have been carried on by us and students in a minor way for some years. Notwithstanding the considerable accelerated growth that electrical stimulation is capable of giving rise to, these experiments are not presented with any idea in mind that they furnish evidence of legitimate lines of forcing, or that the matter will be taken up by practical growers as a means of increasing their crops, especially at the present time. There are many legitimate lines of increasing and improving crops of which growers have not as yet made full use, and, so long as such exist, the wisest policy to pursue is to pay little attention to the so-called freak farming methods. This subject is, moreover, an especially complicated one, and it is a question whether it would be of much value to those who are following commercial methods, even if considerable gain could be obtained. All stimuli to plants are by no means advantageous from the commercial point of view, inasmuch as they do not always induce acceleration in the right direction, since the law of correlation holds good in the plant kingdom, as elsewhere. Whether the scarcity of forcing elements or the development of more refined methods of the gardening of the future will induce gardeners to utilize the various cosmic forces which act as stimuli, and which are not employed at the present time, remains to be seen.

THE INFLUENCE OF CURRENT ELECTRICITY ON PLANT GROWTH.

BY G. E. STONE.

Since 1747, when Dr. Mainbray of Edinburgh electrified two myrtle plants, various experiments have been made to test the effects of electricity on the growth of plants. Many marvelous results have been reported from time to time that have arisen from electrical treatment, and, as a rule, the more ignorance the experimenter displayed in his knowledge of plant physiology, the more startling and marvelous have been the results.

At the time our experiments were undertaken we were unable to find instances where any attempt had actually been made to study, in a methodical way, the influence of current electricity on plants; and in practically all of the previously recorded experiments the data were scant and the scope of the work was extremely limited. In the various haphazard results that had been reported from time to time there had been no attempt made to measure the current or resistance, or to ascertain the electro motive force employed in any of the experiments from which remarkable deductions had been drawn. One of the criticisms which can be made in regard to all of the earlier work, as well as most of the later work, is that, with a very few exceptions, only a few plants were employed in experimenting, — frequently only one or two. As a consequence, the errors arising from individual variation were entirely ignored, since enough plants were not employed to eliminate them. Indeed, in numerous cases the results obtained were nothing more than would be obtained from individual variation, or would naturally arise from a slight difference in environment. The limited amount of current which we have shown to act as a stimulus to plant growth would indicate that in some cases they were not in the range of acceleration (see Fig. 1). That plants respond to electrical stimuli in various ways is well known. The effect, however, which electricity has upon the growth of plants has not been well understood, and the results obtained by various experiments have not been convincing, for reasons already pointed out. The fact has been definitely established that

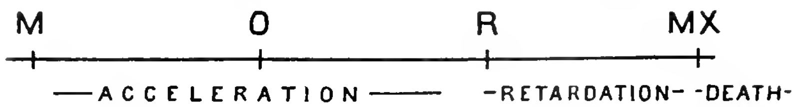

FIG. 1.—Diagram showing range of electric current affecting plants. M, minimum; O, optimum, or current producing greatest stimulus; MX, maximum, or death current; R to MX, retardation current.

electrical currents exist in the soil, and also in the plant; in fact, wherever chemical activity occurs electric currents are likely to be present, although these currents may be comparatively insignificant, and require delicate instruments for their detection.

The following experiments in stimulating plants with electricity have been carried on in this department for some years, and previous to undertaking this work many thousands of plants have been experimented with, and the minimum, optimum and maximum currents have been established by us in a general way. We therefore had more or less a definite idea in mind as to what strength of current we wished to apply at the beginning of our work. The experiments we are about to describe, therefore, represent only a small part of those which we have made, and these were made under conditions resembling those employed for commercial purposes. We shall, however, interpret the results of these experiments in the light of those obtained from our long study given to the subject, rather than from what these particular tables show.

The work was carried on in the greenhouse, during the summer months. The plants utilized were radishes and lettuce, which were selected for special reasons as being suitable for our work. The plants were grown in wooden boxes, 53 inches long, 32 inches wide and 7 inches deep. These boxes were placed on movable trucks, or in some cases on supports 18 inches from the floor. In all cases they were insulated. The soil employed was of a uniform quality and texture, and has been used for these experiments alone for some years. Previous to using the soil it was sifted through a sieve of $\frac{3}{8}$-inch mesh, and thoroughly mixed. After using the soil for a few experiments, it was taken out, resifted and thoroughly incorporated again; and occasionally the boxes were shifted about, that is, the normal or untreated boxes were substituted or changed for those which had been treated. With a

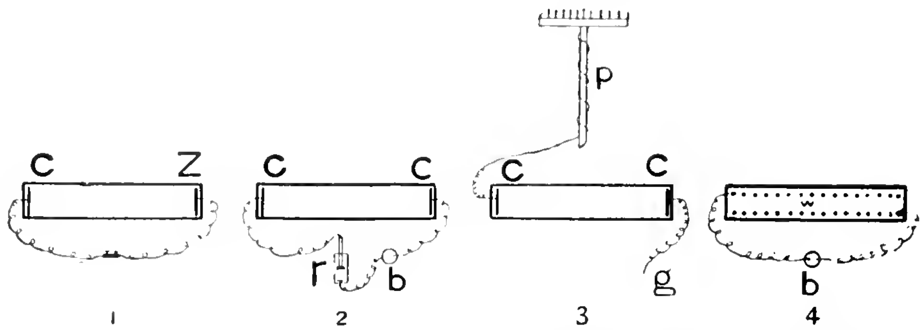

FIG. 2.— Longitudinal section of boxes employed in the electrical experiments, showing different methods of treatment. Size of boxes, 53 by 32 by 7 inches. 1, copper and zinc electrodes connected; 2, direct current with rheostat; 3, atmospheric; 4, wire electrodes. C, copper electrodes; Z, zinc electrodes; r, rheostat; b, gravity cells; w, wires; g, ground wire; p, collecting pole, 47 feet high.

few exceptions, copper or zinc plates were used for electrodes. These were made the same size as the ends of the boxes, and in a few exceptional cases two series of wires, strung on a frame about three inches apart, were employed instead of the plate electrodes. One of these frames of wires was buried near the surface, the other being buried near the bottom of the box. The current, therefore, had to pass from one frame to the other in a vertical direction through the soil. The strength of the currents was in most cases obtained with the aid of a Weston milammeter, capable of reading $\frac{1}{20}$ of a milliampere, or about $\frac{1}{20000}$ of an ampere. The interrupted induced currents were estimated, and represent only approximate determinations.

In the radish experiment the seed was sown directly in the treated boxes, whereas in the case of the lettuce the plants were transplanted into the treated boxes when of suitable size to make good growth; the latter plants, therefore, were not stimulated during the whole period of development. Gravity cells were used in all cases except with the interrupted induced current, in which case sal-ammoniac cells were employed.

Experiments with Radishes.

Table I. — *Showing the Effect of Current Electricity upon the Growth of Radishes (Raphanus sativus* L.). *Normal Plants taken as the Standard at 100.*

[Duration of experiment, 38 days.]

No.	Treatment.	Number of Plants.	Average Weight, in Grams, of — Roots.	Average Weight, in Grams, of — Tops.	Per Cent. Gained in Weight of — Roots.	Per Cent. Gained in Weight of — Tops.	Total Per Cent. gained.
	Average of three normals, .	112⅔	4.83	10.55	-	-	-
1	Direct current; one gravity cell; copper plate electrodes, ...	81	4.89	12.58	.012	19.24	13.60
2	Direct current; three gravity cells; wire electrodes, .	110	4.63	9.26	[1] 4.140	[1] 12.22	[1] 9.68
3	Interrupted induced current; copper plate electrodes, .	114	5.85	11.22	21.110	6.35	10.98

[1] Loss.

Total average weight, in grams: —	Normal.	Treated.	Per Cent. gained.
Of roots, ...	4.83	5.12	6.00
Of tops, ...	10.55	11.02	4.45
Of whole plant, ...	15.38	16.14	4.93

In Table I., in which six experiments are shown, three normal and three treated, the results are not in every way satisfactory. The current strengths were determined only once or twice in each instance, and these were estimated by means of the electro-motive force of the cell and resistance of the soil, and also by a milammeter. The current strengths given, therefore, represent only those which were found at the time of the measurements; and, since the resistance of soil is constantly changing with the movements of the water currents and with the ever-changing moisture conditions, due to watering, the figures giving strengths of current must not be considered as averages. The strengths of current employed in the experiments shown in the first five tables vary, probably from .05 to 1 milliampere.

In the interrupted induced current experiments the current had a duration of only about ten seconds per hour. This was accomplished with a clock arrangement and with a Du Bois-Reymond induction apparatus. It should be pointed out, however, that with the use of this apparatus only approximate current strengths can be obtained, as it does not constitute a particularly favorable type of instrument for obtaining uniform currents of a definite strength. Our extensive use of the apparatus in other work has enabled us, nevertheless, to use it with some degree of certainty of securing optimum strengths of current. The three gravity cells with wire electrodes apparently furnish too much current, hence we obtained a loss with these. We were beyond the optimum and in the retardation zone (see Fig. 1). This method of applying current was not considered a satisfactory one, and it was subsequently abandoned.

Nos. 1 and 3 showed a gain in both roots and tops, the total gain being 13.60 and 10.98 per cent. respectively. At the bottom of the table is given the total gain from electrical treatment; for example, the weights of the plants from three treated boxes are compared with the weights of those in the three normal boxes. The total gain of 4.93 per cent. is of little significance.

TABLE II. — *Showing the Effect of Current Electricity upon the Growth of Radishes (Raphanus sativus L.). Normal Plants taken as the Standard at 100.*

[Duration of experiment, 39 days.]

No.	TREATMENT.	Number of Plants.	AVERAGE WEIGHT, IN GRAMS, OF—		PER CENT. GAINED IN WEIGHT OF—		Total Per Cent. gained.
			Roots.	Tops.	Roots.	Tops.	
	Average of three normals, .	220⅔	5.29	5.55	–	–	–
4	Direct current; one gravity cell; copper plate electrodes, ...	205	6.22	12.65	17.58	127.92	74.07
5	Direct current; one gravity cell; wire electrodes, . .	250	5.88	7.47	11.15	34.59	23.15
6	Atmospheric electricity; copper plate electrodes, . .	180	6.60	10.06	24.76	81.26	53.61
7	Copper and zinc plate electrodes, connected, . .	109	14.01	16.61	164.84	199.28	182.38
8	Interrupted induced current; copper plate electrodes, .	220	6.17	6.17	16.63	11.17	13.83

Total average weight, in grams:—	Normal.	Treated.	Per Cent. gained.
Of roots, ...	5.29	7.77	46.88
Of tops, ...	5.55	10.59	90.85
Of whole plant, ...	10.84	18.36	69.54

In Table II. is shown a similar series of experiments, with modifications in the strengths of currents and methods of treatment. The currents, however, are reduced in all instances with favorable results. Nos. 6 and 7 received different treatment from those shown in the preceding table. In No. 6, termed atmospheric electricity, the current was obtained from a pole 35 feet above the ground; from the top of this pole there projected 24 small copper points, distributed in two circles, the outer arc having a radius of 30 inches. The arrangement was similar to that shown in Fig. 2, but not identical. The copper points were all connected with a single wire leading to the copper plate electrode of Box No. 3, the other electrode being grounded, as shown at G. The electrical potential was not determined in this experiment, but the deflection of the needle of a sensitive galvanometer showed that a current was present in the soil.

In No. 7, copper and zinc plate electrodes were simply connected together with a wire; this formed a cell in itself, and generated a current, usually about the optimum, which could be readily read with the milammeter. The results of the experiments are shown in the last column at the bottom of the table.

TABLE III. — *Showing the Effect of Current Electricity upon the Growth of Radishes (Raphanus sativus L.). Normal Plants taken as the Standard at 100.*

[Duration of experiment, 36 days.]

No.	Treatment.	Total Weight, in Grams, of— Roots.	Tops.	Per Cent. Gained in Weight of— Roots.	Tops.	Total Per Cent. gained.
	Normal,	700	2,700	–	–	–
9	Direct current; one gravity cell; copper plate electrodes,	800	2,900	14.28	7.40	8.82
10	Amospheric electricity; copper plate electrodes,	900	3,000	28.59	11.11	14.70

Total weight, in grams:—	Normal.	Treated.	Per Cent. gained.
Of roots,	700	850	21.42
Of tops,	2,700	2,950	9.25
Of whole plant,	3,400	3,800	11.76

TABLE IV. — *Showing the Effect of Current Electricity upon the Growth of Radishes (Raphanus sativus L.). Normal Plants taken as the Standard at 100.*

[Duration of experiment, 38 days.]

No.	TREATMENT.	Number of Plants.	AVERAGE WEIGHT, IN GRAMS, OF —		PER CENT. GAINED IN WEIGHT OF —		Total Per Cent. gained.
			Roots.	Tops.	Roots.	Tops.	
	Normal,	291	3.09	2.74	-	-	-
11	Direct current; one gravity cell; copper plate electrodes,	294	2.65	2.72	[1]14.23	[1].72	[1]7.89
12	Atmospheric electricity; copper plate electrodes,	281	3.20	4.27	3.55	55.83	28.13
13	Copper and zinc plate electrodes, connected,	289	2.94	5.53	[1]4.85	101.82	45.28

Total average weight, in grams: —	Normal.	Treated.	Per Cent. gained.
Of roots,	3.09	2.93	[1]5.50
Of tops,	2.74	4.17	52.19
Of whole plant,	5.83	7.10	21.78

[1] Loss.

TABLE V. — *Showing the Effect of Current Electricity upon the Growth of Radishes (Raphanus sativus L.). Normal Plants taken as the Standard at 100.*

[Duration of experiment, 40 days.]

No.	TREATMENT.	Number of Plants.	AVERAGE WEIGHT, IN GRAMS, OF —		PER CENT. GAINED IN WEIGHT OF —		Total Per Cent. gained.
			Roots.	Tops.	Roots.	Tops.	
	Normal,	273	3.29	4.02	-	-	-
14	Direct current; one gravity cell; copper plate electrodes,	275	4.00	4.18	21.58	3.98	11.90
15	Atmospheric electricity; copper plate electrodes,	277	3.61	3.97	9.72	[1]1.24	3.69
16	Copper and zinc plate electrodes, connected,	278	3.74	3.95	13.67	[1]1.74	5.19

[1] Loss.

Total average weight, in grams: —	Normal.	Treated.	Per Cent. gained.
Of roots,	3.29	3.78	14.86
Of tops,	4.02	4.03	.02
Of whole plant,	7.31	7.81	6.84

The experiments shown in tables III., IV. and V. followed one another in succession, and were conducted in a similar manner. Some of the data shown in Table III. was unfortunately mislaid or lost, hence it is incomplete.

No. 11, in Table IV., shows a loss, but the average percentage gained by treatment in other cases is important. The gain shown in Table V. as a result of treatment is comparatively small.

TABLE VI. — *Showing the Effect of Current Electricity upon the Growth of Radishes (Raphanus sativus L.). Normal Plants taken as the Standard at 100.*

[Duration of experiment, 30 days.]

No.	TREATMENT.	Number of Plants.	Average Current, in Milliamperes.	AVERAGE WEIGHT, IN GRAMS, OF— Roots.	Tops.	PER CENT. GAINED IN WEIGHT OF— Roots.	Tops.	Total Per Cent. gained.
	Normal,	241	-	5.1	3.2	-	-	-
17	Direct current; one gravity cell; copper plate electrodes,	215	.10 (.05-.24)	6.1	4.1	19.60	28.12	22.88
18	Direct current; two gravity cells; copper plate electrodes,	242	.43 (.22-.90)	5.9	5.5	15.68	71.87	37.34
19	Copper and zinc plate electrodes, connected,	198	-	7.4	5.2	45.09	62.50	51.80

Total average weight, in grams:—	Normal.	Treated.	Per Cent. gained.
Of roots,	5.1	6.46	26.66
Of tops,	3.2	4.93	54.06
Of whole plant,	8.3	11.39	37.22

TABLE VII. — *Showing the Effect of Current Electricity upon the Growth of Radishes (Raphanus sativus L.). Normal Plants taken as the Standard at 100.*

[Duration of experiment, 36 days.]

No.	TREATMENT.	Number of Plants.	Average Current, in Milliamperes.	AVERAGE WEIGHT, IN GRAMS, OF— Roots.	Tops.	PER CENT. GAINED IN WEIGHT OF— Roots.	Tops.	Total Per Cent. gained.
	Normal,	217	-	10.80	4.14	-	-	-
20	Direct current; one gravity cell; copper plate electrodes,	264	.197 (.10-.33)	12.30	6.60	13.88	59.42	26.50
21	Direct current; two gravity cells; copper plate electrodes,	292	.516 (.23-1.0)	12.20	7.50	12.96	81.16	31.19
22	Copper and zinc plate electrodes, connected,	272	.305	11.20	4.96	3.71	19.80	8.16

Total average weight, in grams:—	Normal.	Treated.	Per Cent. gained.
Of roots,	10.80	11.90	10.18
Of tops,	4.14	6.35	53.14
Of whole plant,	14.94	18.25	22.15

The concluding experiments with radishes are shown in tables VI. and VII. In this series the atmospheric experiments were omitted, and two direct current experiments were run in each series, in which different strengths of currents were employed. In these experiments, and all others which follow, an attempt was made to regulate more carefully the current strengths, and to make daily readings of the same. For this purpose a water rheostat was introduced in the circuit in the two direct current experiments; this enabled us to modify resistance, and to maintain a tolerably uniform current throughout. Current records in all the remaining radish experiments are averages for the whole period, and are based on four readings each day. The minimum and maximum currents are given in parentheses. In the direct current series we endeavored to maintain .2 and .4 milliamperes respectively. In No. 17, however, it only averaged .1 milliampere; in Nos. 19 and 22 readings were made every three days, but no attempt was made to modify the current strengths, inasmuch as these boxes generally maintained the desired current.

The results shown in these tables are more uniform than in the preceding ones, as might be expected from the greater care we gave in maintaining a more or less uniform stimulus. No loss is shown by the treated ones; on the other hand, there is considerable acceleration shown by treatment.

SUMMARY. — *Showing the Results with Radishes (Raphanus sativus L.) given in Tables I., II., IV.–VII.*

TREATMENT.	Number of Plants.	PER CENT. GAINED IN WEIGHT OF — Roots.	PER CENT. GAINED IN WEIGHT OF — Tops.	Total Per Cent. gained.
Direct current (weak); copper plate electrodes; Nos. 1, 4, 11, 14, 17, 20,	1,334	9.73	39.66	23.67
Direct current (stronger); copper plate electrodes; Nos. 18, 21,	534	14.32	76.51	34.26
Direct current; wire electrodes; Nos. 2, 5,	360	3.50	11.18	6.73
Interrupted induced current; copper plate electrodes; Nos. 3, 8,	334	18.87	8.76	12.40
Copper and zinc plate electrodes, connected; Nos. 7, 13, 16, 19, 22,	1,146	44.49	76.33	58.56
Atmospheric electricity; copper plate electrodes; Nos. 6, 12, 15,	738	12.67	45.28	28.47

Average per cent. of weight gained, in grams: —
Of roots, ... 17.26
Of tops, ... 42.95
Of whole plant, ... 27.34

The results of electrical treatment of various kinds and of different strengths of currents, in which 3,446 treated radish plants were compared with 2,022 normal or untreated ones, are shown in the summary. These comparisons are based on the growth of the normal plants with which the treated were grown, and not on the total normals, since the duration of experiments in one table does not correspond with those in another; or, in other words, there existed some difference in the degree of maturity of the various crops. This method of comparison is necessary, since the treatment varied in time, and the experiments in each table were not parallel throughout. The results show, however, appreciable gains; and, as they are averages, the percentages represent more accurately the influence of electrical treatment, the total gain for roots and tops being 27.34 per cent. A notable feature is seen in acceleration of tops, which showed about two and a half times more growth than that shown by the roots. In the case of the two interrupted induced-current experiments the reverse holds true, there being more than twice as much growth of roots as tops. This current exerts a different physiological effect on plants than the direct current.

Experiments with Lettuce.

The tendency of electrical stimuli to accelerate the growth of the tops of radish plants more than the roots suggested the idea of substituting lettuce. Lettuce possesses a different and more desirable habit of growth, it would seem, for electrical stimulation. The variety of lettuce grown in all cases was that known as the Boston head type, so commonly used by market gardeners in Massachusetts. The plants were grown according to the customary manner of growing lettuce; namely, the seed was sown in a small box of soil. When the seedlings were an inch or two high they were transplanted into larger boxes containing loam; and when they had formed three or four leaves two or three inches long, they were carefully selected, as regards vigor and size, and transplanted into the experimental boxes, as in the radish experiments. The loam in which they were started was of uniform quality and similar texture to that used in the boxes. Twenty-four plants were set in each box, which allowed room for their full development. In transplanting, however, there was little or no loam attached to their roots. We have handled lettuce so extensively in our greenhouse that we were familiar with its characteristic requirements, and usually had on hand an ample supply of material from which to select. The strengths of currents in all lettuce experiments where gravity cells were used are based on four daily records. The minimum and maximum currents are also given in parentheses in all cases. In the copper and zinc electrode connections the currents were recorded every three days and the tables show the averages obtained.

TABLE VIII. — *Showing the Effect of Current Electricity upon the Growth of Lettuce (Lactuca sativa L.). Normal Plant taken as the Standard at 100.*

[Duration of experiment, 31 days.]

No.	TREATMENT.	Number of Plants.	Current, in Milliamperes.	Total Weight, in Grams, of Plants.	Average Weight, in Grams, of Plants.	Per Cent. gained in Weight.
	Normal, ...	23	-	798	34.69	-
23	Direct current; copper plate electrodes, ...	23	.183 (.05-.25)	1,233	53.60	54.22
24	Direct current; copper plate electrodes, ...	22	.395 (.15-1.0)	1,226	55.72	60.62
25	Copper and zinc plate electrodes, .	22	.286 (.1-.5)	1,126	51.18	47.53

Total average weight, in grams: —
Normal, ... 34.69
Treated, ... 53.50
Total per cent. gained, ... 54.22

TABLE IX. — *Showing the Effect of Current Electricity upon the Growth of Lettuce (Lactuca sativa L.). Normal Plants taken as the Standard at 100.*

[Duration of experiment, 42 days.]

No.	TREATMENT.	Number of Plants.	Current, in Milliamperes.	Total Weight, in Grams, of Plants.	Average Weight, in Grams, of Plants.	Per Cent. gained in Weight.
	Normal, ...	24	-	681	28.12	-
26	Direct current, ...	24	.199 (.10-.35)	818	34.08	21.19
27	Direct current, ...	24	.342 (.20-.50)	816	34.00	20.91
28	Copper and zinc plate electrodes, connected, ...	24	.296 (.05-.60)	725	30.20	7.39

Total average weight, in grams: —
Normal, ... 28.12
Treated, ... 32.73
Total per cent. gained, ... 16.39

In the two preceding tables are shown the results of electrical treatment upon lettuce. The current was set at .2 milliamperes in experiments 23 and 26, and at .4 milliamperes in experiments 24 and 27. The experiments in both tables show the effect of electrical treatment, and where the resistance was modified the results are tolerably uniform. The gain by all treatment is 16.29 and 54.52 per cent. respectively.

TABLE X. — *Showing the Effect of Current Electricity upon the Growth of Lettuce (Lactuca sativa L.). Normal Plants taken as the Standard at 100.*

[Duration of experiment, 50 days.]

No.	TREATMENT.	Number of Plants.	Current, in Milliamperes.	Total Weight, in Grams, of Plants.	Average Weight, in Grams, of Plants.	Per Cent. gained in Weight.
	Normal,	24	–	619	25.79	–
29	Direct current,	23	.171 (.02-.25)	575	25.00	3.06
30	Atmospheric electricity,	23	–	784	34.08	32.14
31	Copper and zinc plate electrodes, connected,	24	.06 (.01-.09)	688	28.66	11.13

Total average weight, in grams:—

Normal,	25.79
Treated,	29.24
Total per cent. gained,	13.37

TABLE XI. — *Showing the Effect of Current Electricity upon the Growth of Lettuce (Lactuca sativa L.). Normal Plants taken as the Standard at 100.*

[Duration of experiment, 60 days.]

No.	TREATMENT.	Number of Plants.	Total Weight, in Grams, of Plants.	Average Weight, in Grams, of Plants.	Per Cent. gained in Weight.
	Normal,	24	710	29.58	–
32	Direct current,	24	800	33.33	12.67
33	Copper and zinc plate electrodes, connected,	24	1,355	56.45	90.83
34	Atmospheric electricity,	24	1,000	41.66	40.83

Total average weight, in grams:—

Normal,	29.58
Treated,	43.81
Total per cent. gained,	48.10

Tables X. and XI. show experiments arranged similar to the two preceding tables, except that atmospheric electricity is substituted for one of the direct currents. The atmospheric experiments were conducted with some modification from those previously described with radishes. The principal difference, however, consisted in the pole being 47 feet from the ground, instead of 35 feet, and the number of copper points was 121, instead of 21. (See Fig. 2, No. 3.) In the latter case we also used a 28-inch metal bicycle wheel to support the points at the top of the pole; in the former arrangement an inverted umbrella frame was used. In No. 29 we endeavored to maintain a current of .2 milliamperes; Nos. 31 and 33 gave the usual current, but no attempt was made to obtain averages in the latter. A sensitive galvanometer usually showed a deflection of the needle when in circuit with the atmospheric electrodes; and when the wire from the pole was attached to a Thomson self-recording electrometer it was usually sufficient to deflect the needle and to charge slightly a glass case of 30 cubic feet capacity. Only occasional observations were made of the strength of the current in experiments shown in Table XI.

SUMMARY. — *Showing the Results with Lettuce (Lactuca sativa L.) given in Tables VIII.–XI.*

TREATMENT.	Number of Plants.	Average Current, in Milliamperes.	Total Per Cent. gained.
Direct current (weak); copper plate electrodes; Nos. 23, 26, 29, 32,	94	0.184	22.78
Direct current (stronger); copper plate electrodes; Nos. 24, 27,	46	0.367	40.76
Copper and zinc plate electrodes, connected; Nos. 25, 28, 31, 33,	48	0.214	36.48
Atmospheric electricity; copper plate electrodes; Nos. 30, 34,	47	–	39.22

Average per cent. of weight gained, in grams, ... 34.81

The average percentage of gain shown by lettuce is slightly higher than that given by radishes, although the acceleration is not so great as that shown in the growth of radish tops over roots. There are, however, no instances in the lettuce treatment where the normal plants have excelled in growth the treated ones, although in No. 21 there is a difference of only 3 per cent. between normal and treated.

Conclusions.

The foregoing experiments with lettuce and radish plants show, in all instances except two, a total gain by the use of electrical stimuli. Those experiments where an attempt was made to maintain a strength of current within narrow limits showed the best results from treatment. Could an absolutely definite strength of current be utilized throughout the period of duration much closer results could be obtained, and the optimum current be more closely determined. Such an arrangement suggested itself to us quite early in our work, but the necessary equipment was not at hand. Since the variations in current strength depend largely upon the variations in soil moisture, tolerably constant currents might be obtained by regulating the water supply; but some automatic resistance appliance would undoubtedly constitute the best mechanism for getting absolutely constant currents. The effect which electricity has in accelerating the growth of plants and on the germination of seeds is positive; and in hundreds of experiments, conducted in a different manner, we have seldom obtained any negative results. We have, moreover, conclusively shown from our experiments that the alternating current is much superior to the direct as a stimulator; therefore the alternating-current experiments, Nos. 3 and 8, given in this series, should by no means be considered as typical, as we have apparently failed to get the optimum strength in these cases.

The question naturally arises, in what manner does electricity stimulate plants; or, in other words, how are accelerated growth and accelerated germination to be explained? There are numerous agencies which act as stimuli to seeds and plants about which little is known in regard to how they stimulate the plant. There are, to be sure, many theories advanced for the purpose of explaining the response of plants to various stimuli.

We know perhaps as much about the rationale of electrical action on plants as we do about the effects of light in producing heliotropic bendings, or of gravity in producing geotropic bendings. Some of the various theories pertaining to electrical action, however, possess interest and are worthy of citation. Frecke held the idea that electricity was the great moving force of animate creation, and identical with nervous influence. Marat was of the opinion that electricity exerted a marked influence on the fertility of the soil, and similar ideas have been advanced by others in more recent times. Fichtner and Sohne claimed to have found that electricity rendered soluble the constituents of the soil; and the same opinion was advanced by Tschinkel, who believed that acceleration and growth were brought about by the action of electricity upon the salts and other constituents of the soil. Jodro attached a double function to the action of the soil current: first, it acts chemically on soil, in dissolving those constituents necessary for plant nourishment; and second it acts mechanically, in setting the particles of the soil into a state of molecular vibration, thus loosening the earth. These views relating to the decomposition of the certain salts in the earth by passing a current of electricity through it have not been confirmed by Wollny. He made a series of careful analyses of soil, electrically treated and untreated, and found absolutely no difference, which could be attributed to the effects of electricity, in the percentages of potassium, ammonia, phosphoric acid, potassium nitrate and carbonic acid gas. The action of electricity upon oxygen, as is well known, gives rise to ozone; and some botanists have believed that the production of ozone in the seed by electric currents is the prime factor in accelerating germination and growth.

Most of these theories are very fanciful, and all inadequately explain the stimulating effect of electricity upon plants, nor is there any reason to believe that this phenomenon can be explained by simple mechanical theories. There may exist a fundamental basis for the theory that electricity is capable of decomposing certain constituents of the soil and rendering them more available, but in all probability the strength of current which is capable of advantageously stimulating plants would produce little effect on the soil; at any rate, it would produce little effect during the short space of time it requires to mature most crops. Moreover, when it is considered that moist seeds and seedlings respond to electrical stimuli in quite a remarkable manner when sown and allowed to develop on moist filter-paper cloth or in porous clay dishes, etc., the complicated soil theory of electrical action falls to the ground.

Electricity affects the protoplasm of the plant, and it is to the effect on the protoplasm that we must look for the solution of the problem, and not to its influence on the soil. This can be seen in plants that show protoplasm movements, such as Chara, etc. It has long been known that weak currents stimulate protoplasm, and induce an accelerated movement; whereas strong currents retard or stop such movements, or, if too strong, they kill the protoplasm.

Current electricity likewise induces bendings in the roots (galvanotropism) when grown in water between electrodes. In such cases weak currents produce negative bendings, — that is, towards the cathode; while strong currents produce positive bendings, — towards the anode. Similar effects are seen in the movements exhibited by many microscopic animals, such as paramœcia and other protozoa.

Plants respond to light, gravity, moisture, etc., in a positive and negative manner; and it is also known that a negative electrotropic irritability exists in certain plants (Phycomyces in this case), or a sensitiveness to Hertz waves which induces negative bendings. The plant organism, whether in the embryonic or adult stage, responds in a positive and negative manner to various cosmic forces which act as stimuli. There is a positive geotropism which induces roots to grow downwards, and a negative geotropism which induces shoots to grow upwards. The force which accomplishes this is termed gravity. Our comprehension of gravity, however, is scarcely more intelligible than that of electricity, and for all we know they may be the same or similar manifestations of force. The results of electrical stimulation to plants are quite similar in their effects to those exhibited by other forms of stimuli.

There is a minimum, optimum and maximum current which gives rise to reactions similar to those obtained from other forms of stimuli. There is also a well-defined latent period, such as we find associated with heliotropic and geotropic stimuli, etc. Moreover, there exists a definite relationship between current intensity and perception, or reaction of the organism, as in chemotactic stimulation.

It was observed by early experimenters that there existed a difference in the growth of plants when subjected to what is termed positive and negative charges. Our limited experiments in this respect have shown that when seeds were treated with a positive charge the growth of the roots was greatly accelerated, while the stems were much less so; and conversely, when treated with a negative charge, the stem showed a greater accelerated growth than the roots. Germination — that is, radical development — was greatly accelerated when seeds were charged positively, although when charged with a negative charge germination at first was much less accelerated than in untreated seed. Thus we have a positive charge stimulating organs which react in a positive manner, and a negative charge stimulating organs which react in a negative manner; also the effect of a positive charge acting as a slight stimulus or retarding organs which act in a negative manner, and the negative only slightly stimulating or retarding positive reacting organs.

It would also appear as if positive charges had a tendency to produce attenuated or elongated root development. In regard to this point, it would be interesting to ascertain whether positive charges increase geotropic irritability. One of the recent conceptions of solutions is that they contain ions which are atoms or groups of atoms positively or negatively charged. It has been observed that solutions with a predominant positive charge, such as acids, and those with a predominant negative charge, bases and salts, have a certain definite effect upon protoplasm which is identical with those produced by positive and negative electrical stimulation. There is also reason to believe that protoplasm consists of particles which are charged positively and negatively. It is possible that in the protoplasm of roots and stems (hypocotyls, as well) of plants there exist opposite predominant charges, — the root carrying predominant negative charges, the stem predominant positive charges. When roots are stimulated with positive charges, acceleration results; and when stimulated with negative charges, acceleration is less marked. In other words, stimulation may arise by changing the predominant charge of the organ, and those organs respond most favorably to electrical stimuli in which opposite charges predominate. In subjecting roots to a positive charge, the predominant negative charges are overpowered or neutralized by the charges, and stimulation results; likewise, in subjecting stems to negative charges, the predominant positive charges are overpowered or neutralized by the negative charges, and stimulation likewise results; but reinforcing predominant positive or negative charges by electrical stimulation causes only a slight stimulus or retardation.

From these experiments it would appear that direct currents appear to stimulate most organs which possess predominant positive charges (radish tops), while interrupted induced currents appear to stimulate most organs which possess predominant negative charges. There is known to exist a difference between the "make" and "break." In the latter current, which is capable of giving rise to a modified physiological reaction, the effects of the opening are always more marked. The effects of the direct current noted above are not so readily accounted for on the basis of this theory.

These experiments have suggested other lines of investigation, and a further report will be made concerning them. It is possible that prolonged stimulation gives rise to different effects than brief stimuli. In prolonged stimulation with direct currents the positive electrode may have a toxic effect, causing inhibition, as is the case with solutions with positive ions. Physiologists have noted that the negative stimulates where the positive current prevents stimulation, although such does not hold in the case of plants, at least when charges of a brief duration are employed.

THE INFLUENCE OF THE ATMOSPHERICAL ELECTRICAL POTENTIAL ON PLANTS.

BY N. F. MONAHAN.

While electrical currents have such an important influence upon the growth and development of plants, as shown in the preceding pages, so also does the electrical potential of the atmosphere have an appreciable influence upon plant life. The atmosphere is always charged to a higher or lower electrical potential, either positive or negative. This has been clearly shown by experiments conducted by the Weather Bureau, United States Department of Agriculture, by Alexander McAdie of the Blue Hill Observatory, and by A. C. Monahan of this station. The conditions governing the amount of electrical potential of the air are not clearly understood, but Monahan found, in a series of experiments extending over nearly a year's time, that the air was charged positively about 90 per cent. of the whole time at a height of 30 feet from the ground. It is enough for us to know, however, that the air is always charged to a higher or lower potential. It is the purpose of this paper to show in a brief way some of the results of preliminary experiments on the effects of atmospherical electrical potential on germination, and the growth and development of plants. Fuller accounts will be published later.

Methods of Experiments and Apparatus used.

In all our experiments we have kept careful records of the exact electrical potential. These records were made by the use of a quadrant electrometer, designed by Sir William Thomson for observations in atmospherical electricity, and built by Eliot Bros. of London. In brief, the instrument consists of a delicate quadrant galvanometer and a self-registering apparatus. A full description of this instrument may be found in the twenty-eighth annual report of the Massachusetts Agricultural College, for 1891.

We used a large glass case, with a wooden frame, 4 feet 3 inches long, 2 feet 9 inches wide, and 2 feet 11 inches high, with a detachable door in the middle of one side, from which every part of the case was accessible. The door was made to fit tightly by a band of rubber around the edge, and was securely held in place by levers. When closed, the case was practically air tight, and was insulated from the stand by glass and rubber insulation. In one corner of the case a small water-dripping apparatus was placed. This apparatus consisted of a light eight-quart copper tank, with a projecting pipe which ended in a fine orifice; the water passing through the pipe immediately broke into drops, and was caught in a glass dish below. An insulated wire connected the case with the electrometer near by. A short time after the dripping started the tank was found to be electrified, presumably to the same potential as the air at the point of the projecting tube. The potential was imparted through the conductors to the electrometer, and a deflection of the needle ensued.

In the case was also placed a self-recording hygrometer (Richard Bros., Paris) and a self-registering thermometer. The case was charged in some instances through a wire at one end leading from a Holtz influence machine. Immediately after charging, the wire was withdrawn from the case, and the hole through which it was inserted was tightly plugged. At other times the case was charged from a Leyden jar through the same wire. This seemed necessary in order to get the required small potential. The air in the case would hold a part of its charge for about three hours; at the end of that time we could find no trace of any electrical potential. The growth of the plants was measured in some instances by a modified Pfeffer-Baranetzky self-registering auxometer, and in other cases by the use of a horizontal microscope with a micrometer scale attachment.

Effect on Germinating Seeds.

Two lots of one hundred seeds of each kind were taken. These seeds were placed in porous clay dishes and soaked for six hours. The first lot was placed in Case 1, and subjected to an electrical charge every eight hours, induced into the air of the case from the Holtz machine. The second lot was placed in Case 2, — a small glass case, where no electrical charge was allowed. In all instances the clay dishes were set in basins of water, so that the seeds were moist at all times. The conditions of the temperature and moisture were practically the same, the former varying from 18° to 20° C., the latter from 76 to 85 per cent. Both cases were closed, and under similar conditions.

Table 1. — *Showing Effect of a Positive Charge upon Germinating Seeds.*

[N, normal; C, charged.]

Kind of Seed.		Total Number of Seeds germinated in —				
		24 Hours.	48 Hours.	72 Hours.	96 Hours.	120 Hours.
White clover,	N,	–	–	56	67	76
	C,	2	59	72	79	80
Onion,	N,	5	23	30	34	40
	C,	3	41	47	51	51
Onion,	N,	–	3	13	18	44
	C,	–	5	17	28	37
Lettuce,	N,	–	34	48	56	77
	C,	–	55	82	85	85
Red clover,	N,	–	7	18	35	66
	C,	–	74	88	92	92
Total per cent. acceleration in charged seeds,		–	55.4	23.1	17.11	–

Table 2. — *Showing Effect of a Positive Charge upon Seeds that have lost Vitality.*

Kind of Seed.		Total Number of Seeds germinated in —				
		24 Hours.	48 Hours.	72 Hours.	96 Hours.	120 Hours.
Musk melon,	N,	–	–	–	–	–
	C,	–	1	1	1	1
Onion (Red Globe),	N,	–	1	–	2	2
	C,	1	2	2	3	3
Onion (Belden),	N,	9	25	33	33	33
	C,	7	18	20	20	20

Table 2 shows that atmospheric electricity does not increase the total number of seeds germinated over the total germination of those not charged, and that it does not bring to life seeds that have lost their vitality. Seed of a very low per cent. of germination were used.

The results obtained from these experiments confirmed the work done in 1896 at this station by Asa S. Kinney, on "Electro-Germination."[1] Kinney found that: first, electricity exerts an appreciable influence upon the germination of seeds; second, the application of certain strengths of current to seeds for a short period of time accelerates the processes of germination; third, the application of electrical currents to seeds does not increase the total percentage of germination. This latter result shows a direct opposition to the results obtained by Paulin. Paulin claimed that the application of electrical currents awakened to life seeds which had apparently lost vitality, and gave an increased percentage of germination in all seeds thus stimulated.

Effects on Plant Growth.

In some of our experiments three young tomato plants were placed in the large glass case and allowed to stand for eight hours. This was done in order that the plants might become accustomed to the changed conditions and to their new environment before being experimented upon. In these experiments the air in the case was charged every eight hours (at 7 A.M., 3 P.M. and 11 P.M.) to a potential of from 100 to 2,000 volts, as recorded by the electrometer and the growth of the plants recorded by the Pfeffer-Baranetzky self-registering apparatus. This method of measuring the growth proved unsatisfactory and was soon abandoned, and the following method, which proved more satisfactory, was tried. One plant at a time was placed in the case and allowed to stand for a few hours, as above; the plant was then set up near the glass on one side of the case, and the growth measured by means of a horizontal microscope with a micrometer scale attachment, the microscope being placed on the outside

[1] "Electro-Germination." Bulletin No. 43, Hatch Experiment Station.

of the case and focused upon the apex of the plant, measurements being taken every fifteen minutes.

The following figure shows the results of one experiment. A small tomato plant about four inches high was placed in the case, and treated as before described. Measurements of

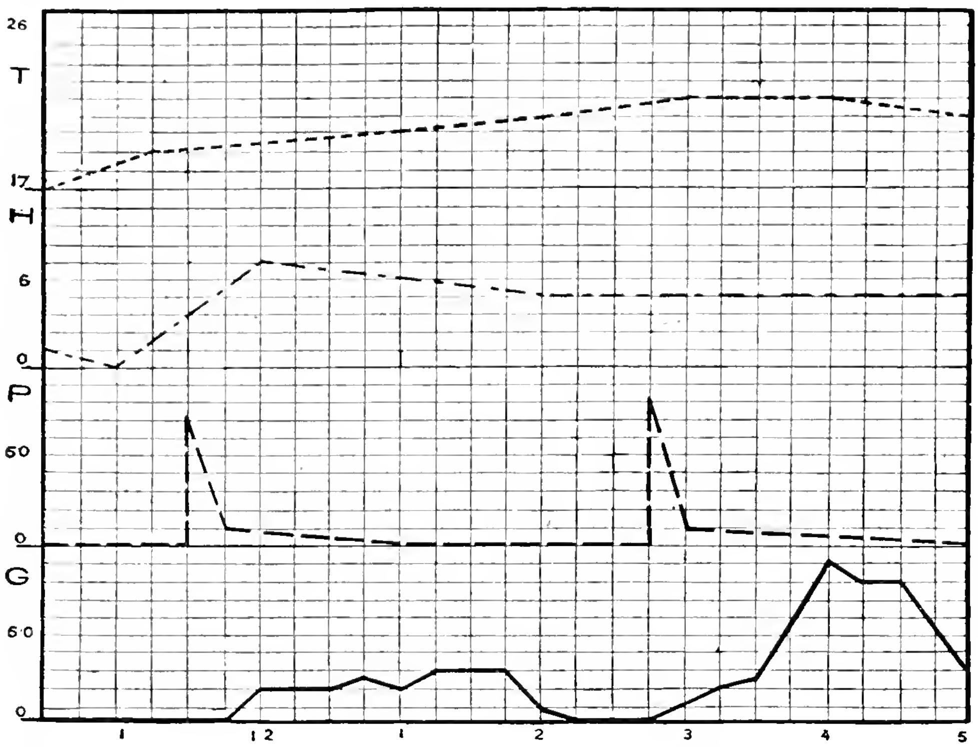

Fig. 1.—Growth curve of tomato plant. The horizontal divisions represent periods of fifteen minutes in time; the vertical divisions represent degrees of temperature, also humidity, electrical potential and increments of growth. T, temperature; H, humidity; P, electrical potential; G, growth.

growth were recorded every fifteen minutes, from 10.15 A.M. to 5 P.M. From 10.15 until 11.30 there was no perceptible growth. At 10.30 the air in which the plant was growing was charged to a potential of 70 volts. Half an hour later, at 12 o'clock, the plant had grown two spaces on the micrometer scale; and at 12.15 had grown two more spaces; and so on until 2.15, when no growth was recorded. At 2.45 the air in the case was recharged to 80 volts, and a greatly increased growth resulted, the maximum acceleration taking place at 1.15 and 4 o'clock respectively, as a result of the two stimuli.

This is but one of many similar figures showing the results of our experiments, tomato plants, corn cotyledons and bread moulds (*mucor* and *Phycomyces nitens*) being used. In all of these experiments the latent period varied from fifteen to thirty minutes.

In several of the experiments where the conditions of temperature and moisture were practically the same, and a large potential was employed, a serious retardation was shown, and in some instances death ensued: in other cases, where a very small potential was employed, no appreciable acceleration was shown.

From these facts we are led to believe that there is a maximum, optimum and minimum voltage: and, from the fact that different potentials were required to stimulate the growth of plants of different species, — and, in fact, of plants of the same variety and apparently of the same size, — it is evident that the maximum, optimum and minimum potentials vary with different varieties and species of plants, and also with plants of the same variety, depending upon the size, structural differentiation, development, etc., of the individual plant.

Summary.

1. Atmospheric electricity exerts an appreciable influence upon the germination of seeds.

(*a*) It accelerates the processes of germination. (In the experiments tried, those seeds charged with electricity show an acceleration in germination of 55.4 per cent. in forty-eight hours, 23.1 per cent. in seventy-two hours, and 17.11 per cent. in ninety-six hours.)

(*b*) It does not increase, to an appreciable extent, the total germination of charged seeds over the normal.

(*c*) It does not awaken to life seeds which have lost vitality.

2. Atmospheric electricity has an appreciable influence upon the growth of plants.

(*a*) From the results of these experiments we are led to believe that there is a maximum, optimum and minimum potential, but these have not yet been accurately determined.

(*b*) That the maximum, optimum and minimum voltages vary not only with the different varieties or species of plants, but with different individuals of the same varieties, and species depending largely upon the size, structural differentiation and degree of development of the plant.

REPORT OF THE CHEMIST.

DIVISION OF FOODS AND FEEDING.

J. B. LINDSEY.

Chemical Assistants: E. B. HOLLAND, P. H. SMITH, W. E. TOTTINGHAM.
Inspector of Feeds, Babcock Machines and Dairy Tester: ALBERT PARSONS.
In Charge of Feeding Experiments: JOSEPH G. COOK.
Stenographer: MABEL SMITH.

PART I. — OUTLINE OF YEAR'S WORK.

- A. Correspondence.
- B. Extent of chemical work.
- C. Character of chemical work.
  - (*a*) Water.
  - (*b*) Dairy products and feed stuffs.
  - (*c*) Chemical investigation.
- D. Cattle feed inspection.
- E. Execution of the dairy law.
- F. Testing dairy herds.
- G. Work in progress and completed.
- H. Addition to staff.

PART II. — DAIRY AND FEEDING EXPERIMENTS.

- A. Effect of feed on the composition of milk and butter fat, and on the consistency or body of butter.
- B. Digestion experiments with sheep.
- C. Raising dairy calves without milk.

Part I. — Outline of Year's Work.

J. B. LINDSEY.

A. Correspondence.

The correspondence of this department has considerably increased over previous years, due to the execution of the new feed law. The general character of the information desired has been much the same as heretofore. The total number of letters sent out during the year has been about 3,000.

B. Extent of Chemical Work.

The work in the laboratory has been of the same general character as formerly. The number of determinations of butter fat in cream has considerably increased.

There have been sent in for examination 132 samples of water, 229 of milk, 1,766 of cream, 8 of pure and process butter and 170 of feed stuffs. In connection with experiments by this and other divisions of the station, there have been analyzed, in whole or in part, 235 samples of milk and 585 of fodders and feed stuffs. There have also been collected and tested under the provision of the feed law 772 samples of concentrated feed stuffs. This makes a total of 3,897 substances analyzed during the year, as against 3,240 last year and 3,622 in the previous year. Work on moisture, fiber and fat, and on the availability of organic nitrogen, not included in the above, has been done for the Association of Official Agricultural Chemists, and required considerable time for its proper execution. In addition, 17 candidates have been examined and given certificates to operate Babcock machines, and 2,240 pieces of glassware have been tested for accuracy, of which 57 pieces, or 2.54 per cent., were condemned.

C. Character of Chemical Work.

(a) *Water.*

In accordance with instructions from the experiment station committee, a charge of three dollars has been made for each sample of water examined by this department during the past year. The reasons for this charge were explained in a small circular sent to each applicant, a copy of which was printed in the last report, page 50. Most applicants have cheerfully paid the fee, while others have refused to send the sample for examination because of the charge. The number of samples examined has been 132, considerably less than formerly; but it is believed that the charge has resulted in holding in check those who have heretofore sent from 4 to 20 samples annually, as well as those who have sent largely out of curiosity, because an analysis could be had free of cost.

Instructions for securing an analysis of water: —

Those wishing to secure a sanitary analysis of water must first apply, whereupon a glass bottle securely encased, accompanied by full instructions for collecting and shipping the sample, will be forwarded by express. The return expressage must in all cases be prepaid. Because of the smallness of the sum involved, no account will be opened. Remittance by check, P. O. money order, or money at the owner's risk, must be strictly in advance.

Application may be made and money sent to

Dr. J. B. Lindsey,
Hatch Experiment Station.

(b) *Dairy Products and Feed Stuffs.*

The number of samples of milk and cream sent largely for the purpose of determining their butter fat content is increasing from year to year. The increase in the number of cream samples comes largely from creameries, while the milk comes from farmers desirous of ascertaining the quality produced by the several animals in the herd. This latter is a very satisfactory sign, and should meet with every encouragement. Printed circulars are sent in answer to inquiries, giving concise information concerning the quality of the milk produced by different breeds, as well as full instructions relative to the best methods to be employed in determining the butter-producing capacity of dairy herds. Comparatively little analysis has been done for the Dairy Bureau, because of the pressure of other lines of work.

The number of feed stuffs sent for examination was about the same as usual. They are examined at once, and the results forwarded promptly, with such suggestions as circumstances may advise. Numerous samples are received from dealers, who avail themselves of the station facilities to make sure the materials they are offering are as claimed.

(c) *Chemical Investigation.*

So far as time and facilities permit, this department continues its work of investigating the various problems connected with the chemistry of dairying and animal nutrition. A good deal of attention has been given to the composition and digestibility of feed stuffs, as well as to the effect of feeds and feed combinations upon the quantity and quality of milk. A study of methods of analyses has been referred to elsewhere.

D. Cattle Feed Inspection.

In October and November, 1902, quite a thorough canvass of the State was made, some 320 samples of feeds collected, examined, and the results published in Bulletin No. 85. Because of the limited funds available, a few samples only — principally of cotton-seed meal — were collected in the late winter. The Legislature at its session of 1903 passed a new feed law (chapter 122, Acts of 1903) ; the full text of this law may be found in Bulletin No. 93, recently issued by this department. A brief synopsis of the law is as follows : —

Section 1 defines statements to be attached to all packages of feed stuffs.

Section 2 specifies feed stuffs included in the law.

Section 3 defines feed stuffs exempt from the law.

Section 4 states the penalty for violations of previous sections.

Section 5 mentions duties of director or deputy with reference to collecting and analyzing samples, and states penalty for interference.

Section 6 declares against the adulteration of whole or ground grain or standard by-products, and fixes penalty.

Section 7 requires the director to prosecute violations of the act.

Sections 8, 9 and 10 define the term importer, state the sum to be allowed for carrying out the provisions of the act, etc.

It is believed that the law will prove of great benefit to farmers, and they are to be congratulated upon its enactment. Similar laws are now in force in all of the other New England States, as well as in New York, New Jersey, Pennsylvania, Maryland, North Carolina and Wisconsin.

The new feed law went into effect July 1. Mr. Albert Parsons was appointed inspector, and has made a thorough canvass of the State, collecting some 700 samples. It is proposed to keep the inspector at work in different sections of the State a considerable portion of the year; in this way the station can be kept thoroughly informed concerning the character of the feeds offered. As would naturally be supposed, many feeds were found unmarked and without a guaranty, and it will require some time and considerable patience to bring about a complete conformity to the law. On the whole, it may be said that dealers appear ready and willing to conform to its requirements, and are constantly addressing letters of inquiry to the station concerning the character and value of the manifold feeds offered by manufacturers and jobbers. The station stands ready to co-operate with consumer, local dealer, jobber and manufacturer, to the end that all may be benefited.

The details of this inspection will be found in Bulletin No. 93.

E. Execution of the Dairy Law.

This department issued a special bulletin on the subject in July of the present year, entitled "The Dairy Law and its Results." The bulletin gave the text of the law, an account of the inspection of glassware, of the inspection of Babcock machines, very full information concerning the method of manipulating the Babcock milk test, together with as complete a list as possible of the creameries and milk depots in Massachusetts. This bulletin was sent in lots of from 10 to 100 to all milk depots and creameries in the State.

Inspection of Glassware. — All glassware found to be correct is marked "Mass. Ex. St.," by means of sand blast. During 1902 there was examined 2,344 pieces, of which 56 pieces, or 2.39 per cent., were found incorrect. There have been examined the present year (1903) 2,240 pieces, of which 57 pieces, or 2.54 per cent., were not correctly graduated. Manufacturers are now very careful concerning the accuracy of the glassware put out by them.

Examination of Candidates. — Mr. E. B. Holland has continued as heretofore to have charge of this work. During 1901, 45 candidates were examined; in 1902, 13 candidates; and the present year, 17 have been given certificates of competency. It is believed that practically all parties now operating Babcock machines under the law have a good understanding of the principles of manipulation, and are capable of doing accurate work.

Inspection of Babcock Machines. — The inspection of machines the present year has been in charge of Mr. Albert Parsons, who makes the following report: —

The third annual inspection of Babcock machines was made in November and December, 1903. Fifty-two establishments were either visited or heard from, 37 being creameries and 15 milk depots. Twenty-four, or half the number, were co-operative, 18 were proprietary, and 10 were managed by stock companies. Forty machines were inspected. Of these, 1 was condemned and 6 needed slight repairs. A few overheated the tests, and a few required additional steam to warm them. All but two of the machines were run by steam power, one was run by hand and one by electricity. About three-fourths of the machines have frames of cast iron, while the other fourth is equally divided between galvanized iron and copper. Of the cast-iron machines, 22 are "Facile," and 9 are "Agos." As a rule, the glassware was found in good condition, although in some cases it was very dirty, in a few cases it was not tested, and a few pieces bore the mark of another State.

F. Testing Dairy Herds.

During the year this department has tested cows at the request of the Jersey, Guernsey and Holstein cattle clubs. Fifteen seven-day tests and 6 yearly tests have been completed and 38 yearly tests are in progress. The tests are made under the rule and regulations of the several clubs. It requires at the present time the services of a man during two weeks in each month, and in addition involves considerable clerical work.

G. Work in Progress and completed.

At the present time, experiments are in progress to note the value of specially prepared dried blood and digester tankage for milk production. It is believed that material of this kind will be used considerably in the near future as a source of protein for farm animals. Other experiments now in operation are: (*a*) to test the efficacy of a well-known condimental or medicated food, for which extravagant claims are made; (*b*) digestion experiments on a variety of coarse and concentrated feeds.

Experiments were also continued with summer-forage crops; but, owing to the very unusual summer conditions, definite results were not obtained, and they will be continued. An experiment is about to be undertaken to see if it is economically possible for the average dairy farmer to get along without the use of wheat bran, using silage as a diluter for the more concentrated by-products. Experiments have been completed with distillers' by-products, — malt sprouts, dried brewers' and distillers' grains, — and the results will soon be published in bulletin form. These experiments emphasize the nutritive and economical value of these several feeds as sources of digestible protein for milk production.

H. Addition to Staff.

Messrs. W. E. Tottingham, Albert Parsons and Joseph G. Cook have been recently added to the staff of this department. Mr. Tottingham serves as assistant chemist, taking the place made vacant by T. M. Carpenter, who secured a more lucrative and responsible position at the Pennsylvania experiment station. Mr. Parsons fills, in a sense, a new position, rendered necessary by the increasing work placed upon the department. He is acting as inspector of feed stuffs under the new feed law, as inspector of Babcock machines under the dairy law, and as dairy herd tester. Mr. Cook has charge of the experiments in animal nutrition at the feeding barn. These several young men have taken hold of the work earnestly and have proved themselves most efficient and satisfactory.

Part II. — Dairy and Feeding Experiments.

A. Effect of Feed on the Composition of Milk and Butter Fat, and on the Consistency or Body of Butter.

J. B. LINDSEY.[1]

Experiment VIII.

A general outline of experiments of a similar character will be found in the thirteenth and fourteenth reports of this station.

Object of the Experiment. — During the autumn and winter of 1901–02 a series of experiments was undertaken, for the purpose of noting, respectively, the effect of corn gluten meal with a minimum percentage of oil, of gluten meal with the addition of corn oil, and of corn meal, upon the relative proportions of the several ingredients in milk and butter fat, and upon the body of butter.

Plan of the Experiment. — Ten cows were divided into two lots of five each. Seven of the cows had calved in the late summer and early autumn, one in the preceding April, and two had been in milk about a year. The average milk product of each cow at the beginning of the trial was about 21 pounds daily. During the first period, both herds received the so-called standard grain mixture; during the three subsequent periods, Herd I. continued to receive the standard grain ration as in the first period; and in case of Herd II., a portion of the standard ration was replaced by gluten meal, by gluten meal and corn oil, and by corn meal, respectively.

[1] With E. B. Holland and P. H. Smith.

TABLE I. — *Duration of Experiment.*

PERIODS.	Character of Rations.	Dates.	Length of Periods (Weeks).
1, . .	Herd I., standard grain ration, Herd II., standard grain ration,	Oct. 20 through Nov. 9, .	3
2, . .	Herd I., standard grain ration, Herd II., gluten meal ration, .	Nov. 23 through Dec. 27,	5
3, . .	Herd I., standard grain ration, Herd II., gluten meal + corn oil,	Jan. 2 through Feb. 28, .	7
4, . .	Herd I., standard grain ration, Herd II., corn meal ration, .	Mar. 16 through Apr. 19,	5

Feeding and Care of the Animals. — The animals were fed twice daily. The corn oil was weighed out each day and carefully mixed with the grain ration, and was eaten without any trouble. Water was supplied constantly, by the aid of the Buckley self-watering device. Each cow was kept in a well-bedded, roomy stall, and was turned into a protected yard during the warmest part of each day when the weather was not actually stormy or severely cold. The feeding barn was heated to a temperature of 50–55° F. during the cold weather, kept clean and well ventilated. The animals were thoroughly cleaned daily, and before milking the udders were brushed and then wiped with a wet cloth. The milkers wore white duck suits.

Disturbances during the Experiment. — Just before the beginning of the second period, cow Folly of Herd II. was taken severely ill, and had to be permanently removed. It was thought best to continue the experiment as planned, using four cows in Herd II., rather than to begin again. In the third period, Red II. of Herd II. suffered an attack of indigestion. For this reason, samples of milk were not taken for two weeks, and butter making was omitted for one week. These interferences will be referred to again under "Composition of the milk," "Composition of the butter fat," etc.

TABLE II. — *Average Daily Rations for Each Cow (Pounds).*

First period: both herds, standard ration.

HERDS.	Standard Grain Ration.	Chicago Gluten Meal.	Corn Oil.	Corn Meal Mixture.	First Cut Hay.	Rowen.
Herd I., ...	8.6	-	-	-	12.4	10.1
Herd II., ...	8.4	-	-	-	12.8	10.0
Second period: Herd I., standard grain ration; Herd II., gluten meal ration.						
Herd I., ...	7.9	-	-	-	11.1	10.0
Herd II., ...	5.3	2.7	-	-	11.5	10.0
Third period: Herd I., standard grain ration; Herd II., gluten meal and corn oil ration.						
Herd I., ...	7.9	-	-	-	10.9	9.9
Herd II., ...	4.7	2.1	.6	-	9.2	9.8
Fourth period: Herd I., standard grain ration; Herd II., corn meal mixture.						
Herd I., ...	7.2	-	-	-	10.9	10.0
Herd II., ...	-	-	-	7	10.5	10.0

Character of the Rations and Feeds. — The standard grain mixture consisted of 3 pounds of wheat bran, 5 pounds of ground oats and ½ pound each of cotton-seed and gluten meals. It is not to be inferred that this so-called standard ration is superior to all other rations, but simply that it was thought to be a safe and desirable ration, and likely to produce normal milk and butter.

The corn meal mixture was similar to the standard grain ration, excepting that the 5 pounds of ground oats were replaced by an equal amount of corn meal. It is to be understood that the figures given in Table II. represent the average feed consumed daily by each cow in each herd. For example, theoretically each herd in the first period was to consume an equal amount of feed per cow, namely, 8 pounds of grain, 10 pounds of rowen and 12 pounds of first cut hay; but, because of the individual requirements of the several cows, there was a slight difference in case of the average consumed by the two herds.

The spring wheat bran and cotton-seed meal were of good average quality. The oats were of standard quality, purchased whole and ground by the local miller. The Chicago gluten meal contained 40 per cent. of protein and 3.91 per cent. of fat in dry matter, thus furnishing a high percentage of corn gluten and a minimum percentage of corn oil. The corn was grown upon the station grounds, likewise the hay and rowen. The first cut hay was largely timothy, with a small admixture of red-top and clover. It contained 8.24 per cent. of protein in dry matter, and the rowen 14.20 per cent. The corn oil, procured of the Glucose Sugar Refining Company of Chicago, had a golden-yellow color, was clear, and had a marked odor of Indian corn. It was regarded as a very satisfactory sample.

TABLE III. — *Average Dry Matter and Digestible Nutrients in Ration of Each Cow.*

First period: both herds, standard grain ration.

HERDS.	Total Dry Matter.	DIGESTIBLE ORGANIC NUTRIENTS.			Nutritive Ratio.
		Protein.	Carbo-hydrates.	Fat.	
Herd I., ...	27.37	2.55	13.33	.68	1:5.8
Herd II., ...	27.12	2.52	13.22	.67	1:5.8

Second period: Herd I., standard grain ration; Herd II., gluten meal ration.

Herd I., ...	25.39	2.39	14.42	.63	1:6.6
Herd II., ...	25.87	2.92	14.04	.59	1:5.3

Third period: Herd I., standard grain ration; Herd II., gluten meal and corn oil ration.

Herd I., ...	25.34	2.39	12.32	.63	1:5.7
Herd II., ...	23.41	2.55	11.13	1.14	1:5.4

Fourth period: Herd I., standard grain ration; Herd II., corn meal ration.

Herd I., ...	24.97	2.30	12.17	.61	1:5.9
Herd II., ...	24.55	2.10	13.12	.59	1:6.9

TABLE IV. — *Average Quantity of Milk produced by Each Cow.* (*Pounds.*)

First Period.		Second Period.		Third Period.		Fourth Period.	
Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
448.56	458.41	635.75	684.22	924.34	998.27	620.59	636.62

During the first period both herds produced essentially the same average quantity of milk per cow; during the second and third periods, presumably because of the increased supply of protein in the daily ration, Herd II. showed a slightly larger average yield.

Purity of the Milk. — A number of samples of the mixed milk were taken immediately after milking, placed in sterilized glass-stoppered bottles, and kept cold until examined for bacterial content. The number of bacteria varied from 200 to 3,600 to the cubic centimeter, showing the milk to be especially clean. Objectionable odor or flavor could not be detected.

Sampling the Milk. — Composite samples of the mixed milk from each herd were taken for five days in each week, and tested for total solids, fat and nitrogen. The solids were determined by drying in sand, the fat by extracting the dry material with ether, and the nitrogen by the Kjeldahl method. In securing a sample, the milk from each herd was carefully mixed, and a small dipperfull taken immediately.

TABLE V. — *Composition of Milk (Per Cent.).*

First period: both herds, standard ration.

Samples.	Total Solids.		Fat.		Solids not Fat.		Nitrogen.	
	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
Oct. 26–30,	14.25	14.10	5.13	5.12	9.12	8.98	.573	.565
Nov. 1–4,	14.63	14.43	5.33	5.32	9.30	9.11	.584	.580
Nov. 4–9,	14.58	14.50	5.43	5.38	9.15	9.12	.576	.569
Average,	14.49	14.34	5.30	5.27	9.19	9.07	.578	.571

TABLE V. — *Composition of Milk* — Concluded.

Second period: Herd I., standard ration; Herd II., Chicago gluten meal ration.

Samples.	Total Solids.		Fat.		Solids not Fat.		Nitrogen.	
	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
Dec. 11-16,	14.97	14.67	5.50	5.28	9.47	9.39	.594	.600
Dec. 17-22,	15.05	14.80	5.59	5.29	9.46	9.51	.599	.616
Dec. 22-27,	14.75	14.50	5.49	5.17	9.26	9.33	.600	.613
Average,	14.92	14.66	5.53	5.25	9.39	9.41	.598	.610
Third period: Herd I., standard ration; Herd II., Chicago gluten meal and corn oil ration.								
Dec. 28-Jan. 3,[1]	14.79	14.64	5.40	5.43	9.39	9.21	-	-
Jan. 5-Jan. 10,[1]	14.61	14.49	5.35	5.37	9.26	9.12	-	-
Jan. 12-17,	14.69	14.16	5.29	5.10	9.40	9.16	.586	.567
Jan. 19-24,	14.76	14.23	5.31	5.12	9.45	9.11	.604	.580
Jan. 16-31,	14.74	14.11	5.27	4.97	9.47	9.14	.597	.586
Feb. 2-7,	14.66	14.07	5.29	5.02	9.37	9.05	.597	.579
Feb. 9-14,	14.79	14.13	5.31	4.99	9.48	9.14	.599	.577
Feb. 23-28,	14.75	14.08	5.38	4.97	9.37	9.11	.587	.566
Average,	14.73	14.13	5.31	5.03	9.42	9.12	.595	.576
Fourth period: Herd I., standard ration; Herd II., corn meal ration.								
Mar. 3-8,[1]	14.68	13.69	5.25	4.43	9.43	9.26	.589	.576
Mar. 9-14,[1]	14.59	14.29	5.34	5.18	9.25	9.11	.590	.576
Mar. 16-21,	14.93	14.27	5.42	5.11	9.51	9.16	.606	.586
Mar. 23-28,	14.70	14.28	5.27	4.99	9.43	9.29	.597	.586
Mar. 31-Apr. 4,	14.82	14.52	5.19	5.10	9.63	9.42	.610	.597
Apr. 6-11,	15.00	14.37	5.36	5.12	9.64	9.25	.620	.603
Apr. 13-18,	14.84	14.29	5.13	5.03	9.71	9.26	.619	.608
Average,	14.86	14.35	5.27	5.07	9.58	9.28	.610	.596

[1] Preliminary.

TABLE VI. — *Relation of Fat to Solids not Fat.*

First Period.		Second Period.		Third Period.		Fourth Period.	
Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
1:1.73	1:1.72	1:1.70	1:1.79	1:1.77	1:1.81	1:1.82	1:1.83

It is desired at this point to again call attention to the important fact that cow Folly in Herd I. became suddenly ill between the first and second periods, and had to be permanently removed from the experiment. It was thought best, however, to continue the experiment as planned, rather than attempt to start again.

It will be seen, in observing the above tables of analyses, that in the first period, with five cows in each herd and both herds receiving the same ration, the composition of the milk was quite similar. This was, of course, due to the fact that the two herds had been evenly matched. The milk yield of both herds in this period was also essentially the same, namely, 2,243 pounds for Herd I. and 2,292 pounds for Herd II.

In the second period, because of the loss of Folly, it was not possible to make a comparison of the composition of the milk produced by the two herds; hence it was sampled only during the last three weeks, in order to secure a basis of comparison for the two following periods. In this period the relation of fat to solids not fat was 1 : 1.70 and 1 : 1.79 for herds I. and II. respectively.

In the third or corn oil period the composition of the milk produced by both herds is given for the two preliminary weeks as well as for the period proper, although the former is not included in the average. The results show that the milk produced by Herd I. remained quite constant in composition during the entire period. A slight decrease only in the fat percentage is noted, the relation of the fat to solids not fat being as 1 : 1.77. In case of Herd II. the fat percentage suddenly increased from an average of 5.25 to 5.40 during the preliminary period of two weeks, when the corn oil was being added to the ration. The relation of fat to solids not fat during the preliminary period was as 1 : 1.72. The effect of the corn oil appeared to have been lost after two weeks, for during the first week of the period proper the percentage of fat was 5.10, and it declined slightly during the period, with an average of 5.03 and a relation of fat to solids not fat of 1 : 1.81. While the total solids did not change during the preliminary period, they showed a decrease at the close of the period proper of .53 per cent. It is to be noted that the nitrogen during this period was .034 per cent. lower than in the previous period. A similar decrease was noticed when linseed oil was fed.[1]

The percentage of solid matter in both herds suffered a slight decline during the third period, possibly due to winter weather conditions; but it was greater in case of Herd II., due largely to the decrease of the solids not fat.

In the fourth or corn meal period the milk of Herd I. increased a little in total solids, perhaps due to advanced lactation or to warmer weather. In case of Herd II., the sudden removal of the corn oil caused a temporary decrease of .54 per cent. of fat and a slight increase in the nitrogen. The so-called fat equilibrium, however, was gradually restored; for in the second week of the preliminary period it was equal to that yielded during the last week of the former period, and the percentage continued quite regular during the entire period. The percentage of nitrogen gradually increased for several weeks, and during the last week of the period it was equal to the average percentage found during the second period. Similar conditions were observed in former experiments.[2]

Attention is called to the evenness in the composition of the milk produced by Herd I., which had the same feed for a period of six months, the only change worthy of notice being the gradual increase of the solids not fat from 9.19 to 9.58 per cent.

Table VII. — *Composition of the Butter Fat.*[3]

First period: both herds, standard ration.

Number Samples, Each Herd.	Saponification Equivalent.		Reichert-Meissl Number.		Melting Point (Degrees C.).		Iodine Number.	
	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
2 samples, . . .	231.5	230.6	30.03	29.52	33.78	33.43	29.07	30.29
2 samples, . . .	231.1	231.0	29.74	29.56	34.43	33.70	29.31	29.75
2 samples, . . .	231.1	231.9	29.48	30.25	34.13	33.48	27.76	29.06
Average, . .	231.2	231.2	29.75	29.78	34.11	33.54	28.71	29.70

[1] Thirteenth report of this station, pp. 107–109. [2] *Loc. Cit.*

[3] Methods of the Association of Official Agricultural Chemists.

TABLE VII. — *Composition of the Butter Fat* — Concluded.

Second period: Herd I., standard ration; Herd II., Chicago gluten meal ration.

NUMBER SAMPLES, EACH HERD.	SAPONIFICATION EQUIVALENT.		REICHERT-MEISSL NUMBER.		MELTING POINT (DEGREES C.).		IODINE NUMBER.	
	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
2 samples, . . .	231.6	231.9	29.20	29.17	34.53	33.13	26.66	28.63
2 samples, . . .	232.2	232.3	29.52	29.91	34.40	33.43	27.42	29.50
2 samples, . . .	231.1	232.3	29.03	28.66	34.55	32.93	26.91	28.99
2 samples, . . .	232.7	233.7	29.39	28.48	34.58	33.08	26.95	29.59
Average, . .	231.9	232.6	29.29	29.06	34.52	33.17	26.96	29.18
Third period: Herd I., standard ration; Herd II., Chicago gluten meal and corn oil ration.								
2 samples, . . .	230.6	226.0	28.80	28.30	33.83	33.33	26.89	36.68
2 samples, . . .	230.2	224.7	30.20	27.80	33.90	32.93	27.47	37.35
2 samples, . . .	229.5	221.9	28.75	24.85	33.73	34.28	28.34	38.58
2 samples, . . .	230.5	219.6	28.55	23.20	34.05	34.40	28.18	40.23
2 samples, . . .	230.5	220.9	28.22	23.61	34.33	34.03	27.94	39.00
Average, . .	230.3	222.6	28.90	25.55	33.97	33.79	27.76	38.37
Fourth period: Herd I., standard ration; Herd II., corn meal ration.								
2 samples, . . .	229.7	229.0	27.83	26.88	34.18	33.58	28.80	29.51
1 sample, . . .	227.8	229.4	26.64	27.47	34.15	33.70	29.55	29.14
1 sample, . . .	228.4	229.6	26.61	27.43	34.10	33.65	29.68	28.86
2 samples, . . .	229.6	232.4	27.35	27.17	34.28	33.58	29.02	28.84
2 samples, . . .	231.5	231.2	27.14	27.53	34.48	33.98	29.59	28.69
Average, . .	229.4	230.3	27.11	27.30	34.24	33.70	29.33	29.01

In the first period the butter fat produced by both herds showed a very similar composition, trifling variations only being noted in the melting point and iodine number.

In the second or gluten meal period it is difficult to note any change in the composition of the butter fat which may be attributed to the influence of the gluten meal. In a former experiment[1] no striking differences between the butter fat produced by the standard grain ration and a gluten meal ration could be noted. The iodine number of the fat produced by Herd I. showed a noticeable drop during this period, gradually returning during the next two periods to the number indicated in the first period. The reason for this temporary depression is difficult to explain. It is not to be overlooked that the cow Folly was removed during this

[1] Thirteenth and fourteenth reports of this station, pp. 110, 165.

period, and did not again enter the experiment; it is doubtful, however, if her loss in any way affected the composition of the fat.

In the third period Herd II. was still receiving a trifle over 2 pounds of gluten meal daily, so that the ration was essentially the same as in the second period, excepting for the addition of .6 pound of corn oil. It is in this period that a noticeable modification of the butter fat took place with Herd II., while the character of the fat produced by Herd I. remained constant. The difference consisted in the decrease of the saponification equivalent by 10 points, a decrease of the Reichert-Meissl number of $3\frac{1}{2}$ points, and an increase in the iodine number of a trifle over 9 points. The melting point of the fat, on the other hand, showed no marked change. Similar conditions were noted when cotton-seed and linseed oils were fed,[1] excepting that the two latter oils also raised the melting point of the fat.

In the fourth or corn meal period, when the rations of both herds were similar, excepting that corn meal took the place of ground oats with Herd II., the butter fat produced by the latter herd returned to its normal condition, *e.g.*, similar to that produced in the first and second periods, and closely resembling the fat produced by Herd I. during all four periods.

The only noticeable change in the fat of Herd I during the entire experiment,[2] extending from October 20 through April 19, — a period of six months, — consisted in the slight gradual decline in the Reichert-Meissl number, due to advancing lactation. It is interesting to observe the uniformity in the character of butter fat produced by a herd of five cows having the same feed during such a long period of time.

The Opinion of Experts on the Character of the Butter. — Two lots of cream from each herd, raised by the Cooley process, were ripened and made into butter each week. The ripening process generally lasted twenty-four hours, and some commercial starter was employed. The full details of

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[1] Thirteenth and fourteenth reports of this station, pp. 110, 165.

[2] Excepting the temporary depression in the iodine number in the second period already referred to.

the process are on file, but it is hardly considered necessary in this connection to publish them, other than to state that the most approved methods were followed.

Pound samples from each lot were sent to Mr. O. Douglass of Boston and Mr. W. A. Gude of New York, who scored them, each being entirely ignorant of the nature of the experiment or of the feeds employed.

TABLE VIII. — *Douglass Butter Scores.*

Flavor.		Body.		Color.		Salt.		Style.		Total.	
Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
First period: both herds, standard ration.											
44.0	43.5	20	20	15	15	10	10	5	5	94.0	93.5
45.0	44.5	20	20	15	15	10	10	5	5	95.0	94.5
45.0	43.0	20	20	15	15	10	10	5	5	95.0	93.0
43.0	43.0	20	20	15	15	10	10	5	5	93.0	93.0
43.0	44.0	20	20	15	15	10	10	5	5	93.0	94.0
Av., 44.0	43.6	20	20	15	15	10	10	5	5	94.0	93.6
Second period: Herd I., standard ration; Herd II., Chicago gluten meal ration.											
43.0	44.0	20	20	15	15	10	10	5	5	93.0	94.0
43.0	43.5	20	20	15	15	10	10	5	5	93.0	93.5
46.0	45.5	20	20	15	15	10	10	5	5	96.0	95.5
45.0	41.0	20	20	15	15	10	10	5	5	95.0	91.0
41.0	43.0	20	20	15	15	10	10	5	5	91.0	93.0
39.0	40.0	20	20	15	15	10	10	5	5	89.0	90.0
Av., 42.8	42.8	20	20	15	15	10	10	5	5	92.8	92.8
Third period: Herd I., standard ration; Herd II., Chicago gluten meal and corn oil ration.											
44.0	46.0	20	19	15	15	10	10	5	5	94.0	95.0
43.5	45.0	20	19	15	15	10	10	5	5	93.5	94.0
44.5	43.5	20	20	15	15	10	10	5	5	94.5	93.5
45.0	46.5	20	20	15	15	10	10	5	5	95.0	96.5
44.0	45.0	20	20	15	15	10	10	5	5	94.0	95.0
45.5	46.5	20	20	15	15	10	10	5	5	95.5	96.5
43.0	45.0	20	20	15	15	10	10	5	5	93.0	95.0
42.0	44.0	20	20	15	15	10	10	5	5	92.0	94.0
44.0	43.5	20	20	15	15	10	10	5	5	94.0	93.5
44.5	45.0	20	20	15	15	10	10	5	5	94.5	95.0
Av., 45.0	45.0	20	20	15	15	10	10	5	5	94.0	94.8
Fourth period: Herd I., standard ration; Herd II., corn meal ration.											
43.0	44.0	20	20	15	15	10	10	5	5	93.0	94.0
42.5	45.0	20	20	15	15	10	10	5	5	92.5	95.0
42.0	43.0	20	20	15	15	10	10	5	5	92.0	93.0
40.0	41.0	20	20	15	15	10	10	5	5	90.0	91.0
45.0	43.0	20	20	15	15	10	10	5	5	95.0	93.0
45.0	40.0	20	20	15	15	10	10	5	5	95.0	90.0
42.0	43.0	20	20	15	15	10	10	5	5	92.0	93.0
43.0	41.0	20	20	15	15	10	10	5	5	93.0	91.0
Av., 42.8	42.8	20	20	15	15	10	10	5	5	92.8	92.5

Table IX. — *Gude Butter Scores.*

Flavor.		Body.		Color.		Salt.		Style.		Total.	
Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
First period: both herds, standard ration.											
35.0	31.0	24.0	23.0	14.5	15.0	10	10	5	5	88.5	84.0
35.0	32.0	25.0	24.0	15.0	15.0	10	10	5	5	90.0	86.0
35.0	30.0	25.0	25.0	15.0	15.0	10	10	5	5	90.0	85.0
30.0	37.0	22.0	22.0	15.0	15.0	10	10	5	5	82.0	89.0
38.0	32.0	24.0	23.0	15.0	15.0	10	10	5	5	92.0	85.0
Av., 35.0	32.0	24.0	23.0	14.9	15.0	10	10	5	5	88.5	85.8
Second period: Herd I., standard ration; Herd II., Chicago gluten meal ration.											
37.0	35.0	24.0	22.0	15.0	15.0	10	10	5	5	91.0	85.0
37.0	36.0	24.0	24.0	15.0	15.0	10	10	5	5	91.0	90.0
32.0	36.0	23.0	24.0	15.0	15.0	10	10	5	5	85.0	90.0
35.0	33.0	25.0	23.0	15.0	15.0	10	10	5	5	90.0	86.0
36.0	36.0	24.0	23.0	15.0	15.0	10	10	5	5	90.0	89.0
28.0	28.0	23.0	23.0	15.0	15.0	10	10	5	5	81.0	81.0
Av., 34.1	34.0	23.8	23.1	15.0	15.0	10	10	5	5	88.0	86.8
Third period: Herd I., standard ration; Herd II., Chicago gluten meal and corn oil ration.											
37.0	40.0	25.0	24.0	15.0	15.0	10	10	5	5	92.0	94.0
37.0	40.0	25.0	24.0	15.0	15.0	10	10	5	5	92.0	94.0
37.0	38.0	24.0	24.0	15.0	15.0	10	10	5	5	91.0	92.0
39.0	40.0	24.0	25.0	15.0	15.0	10	10	5	5	93.0	95.0
42.0	36.0	24.0	24.0	15.0	15.0	10	10	5	5	96.0	90.0
38.0	41.0	24.0	25.0	15.0	15.0	10	10	5	5	92.0	96.0
38.0	40.0	23.0	25.0	15.0	15.0	10	10	5	5	91.0	95.0
38.0	38.0	23.0	23.0	15.0	15.0	10	10	5	5	91.0	91.0
36.0	39.0	25.0	24.0	15.0	15.0	10	10	5	5	91.0	93.0
36.0	39.0	25.0	24.0	15.0	15.0	10	10	5	5	91.0	93.0
Av., 37.8	39.1	24.2	24.2	15.0	15.0	10	10	5	5	92.0	93.3
Fourth period: Herd I., standard ration; Herd II., corn meal ration.											
37.0	37.0	24.0	24.0	15.0	15.0	10	10	5	5	91.0	91.0
37.0	37.0	24.5	24.0	15.0	15.0	10	10	5	5	91.0	91.0
35.0	36.0	25.0	24.5	15.0	15.0	10	10	5	5	90.0	90.5
30.0	33.0	23.0	25.0	15.0	14.0	10	10	5	5	83.0	87.0
41.0	39.0	25.0	25.0	15.0	15.0	10	10	5	5	96.0	94.0
40.0	36.0	25.0	24.0	15.0	15.0	10	10	5	5	95.0	90.0
39.0	39.0	24.0	24.0	15.0	15.0	10	10	5	5	93.0	93.0
38.0	38.0	25.0	24.5	15.0	15.0	10	10	5	5	93.0	92.5
Av., 37.1	36.9	24.4	24.1	15.0	14.9	10	10	5	5	91.5	91.1

As will be seen from the above scores, Mr. Douglass considered the butter produced by both herds during the several periods of good average quality. The flavor he scored a trifle higher in the first and third periods. He found no fault with the body excepting in case of Herd II. in the third period ; this butter he repeatedly pronounced as "light bodied, but acceptable in any market."

Mr. Gude appeared to have been much more critical. He often mentioned a "tainted off flavor, as from stale milk," in the butter produced by both herds during the first and second periods. This defect, in our judgment, was due to the starter, with which considerable trouble was experienced, and could in no way be attributed to the feed. The flavor of the butter produced by both herds during the third period was more satisfactory, although it was occasionally referred to as having only a "faint aroma." Mr. Gude several times mentioned the product of Herd II. during this third or corn oil period as having a "fine aroma," and the average score is rather higher than for Herd I. In the fourth period no particular difference in the flavor was observed.

The body of the butter made from Herd I. during all four periods was repeatedly pronounced "short and crumbly;" the body of that produced by Herd II. in the second and fourth periods was also frequently referred to as being crumbly ; while that produced by the same herd in the third or corn oil period was sometimes spoken of as satisfactory and sometimes as rather light and rather soft, but suitable for market. It was evident that Mr. Gude liked the flavor and body of the butter produced by the corn oil ration. The same fact was noticed when King gluten meal, containing 14 per cent. of corn oil, was fed.[1]

Personal Observations on the Body of the Butter. — The writer made no attempt to pronounce critical judgment on the flavor of the butter, but endeavored to note particularly the character of the body. No difference could be observed in the body of the butter produced by both herds in the first period. It might be characterized as being hard and firm.

In the second period, pound samples of the butter produced by each herd were allowed to reach a temperature of 57° F. The butter from Herd I. at this temperature appeared noticeably harder and firmer than that produced by Herd II. This conclusion was reached as a result of pushing a glass rod into the mass at different points, and by

[1] Thirteenth report of this station, p. 120.

touching the same with the finger. The same differences were noted at a temperature of 70° F. As the temperature was gradually increased, Herd II. butter showed a tendency to lose form more quickly than Herd I. butter. When the interior of the lumps had reached 83° F., Herd II. butter had lost form, and collapsed into a shapeless, slushy mass; while Herd I. butter still stood up in print form, although showing a tendency to lose its shape. When the room temperature reached 95° F., and the interior temperature of the butter 85° F., Herd I. butter also lost form. It is quite possible that, if this latter butter had been held at 85° F., or even lower, for a considerable time, it would also have fallen into a slushy condition. It will be understood that it is quite difficult to control the exact temperature of a mass of butter. The temperature of the room may be 95° F., while the temperature of the interior of the lump of butter may be 10° lower.

Though the butter produced by Herd II. was softer, lost its form and became slushy more quickly than that produced by Herd I., but little of the fat actually melted until a higher temperature had been reached.

While the differences in the body of the butter produced by the two herds was quite marked, it was probably not sufficient to effect its commercial value, at least during the cooler portion of the year.

Similar observations to the above were made on the two lots of butter produced in the third or corn oil period, the results being even *more pronounced*. At a temperature of 44° F., Herd I. butter was very hard and firm; Herd II. butter, while being hard, had rather a greasy, salvy look, and yielded more easily to the touch. After standing over night at a temperature of 70° F., this difference was very pronounced, the Herd I. product being still firm, while the Herd II. was yielding and soft to the touch. At 82° F., Herd I. butter still retained its print form, while Herd II. butter lost form and was quite slushy. It is believed that the corn gluten and corn oil rations produced rather a softer butter than did the cotton-seed oil ration.[1]

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[1] Fourteenth report of this station, page 167.

But little difference could be noted in the body of the butter produced by both herds during the fourth or corn meal period. At an interior temperature of 60° F. it was not possible to detect any variation. After the butter had stood twenty-four hours in the same room, and showed an interior temperature of 76° F., Herd II. butter appeared to be a trifle softer than Herd I. butter. The difference was certainly not at all pronounced; both lots would be said to possess a hard, firm body.

TABLE X. — *Degrees of Penetration (Millimeters).*

[Each number represents results with one print.]

First Period (32° F.).		Second Period (65° F.).		Third Period (57° F.).		Fourth Period (67° F.).	
Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.	Herd I.	Herd II.
4.35	4.05	8.39	11.70	6.45	13.30	12.10	13.17
4.15	4.65	8.60	10.80	6.40	13.15	13.96	14.05
4.35	4.50	9.45	11.90	5.95	12.60	15.50	19.08
4.40	4.55	9.10	12.55	5.95	15.10	16.20	15.75
4.25	4.85	11.00	13.10	7.40	14.65	16.15	16.15
-	-	11.10	16.30	7.05	14.70	15.25	16.50
-	-	10.20	15.50	6.30	14.20	15.79	18.46
-	-	-	-	6.55	13.25	16.40	17.75
-	-	-	-	6.00	13.05	-	-
-	-	-	-	6.95	16.15	-	-
Av., 4.30	4.50	9.69	13.12	6.50	14.02	15.17	16.36

By degrees of penetration is meant the number of millimeters a small glass plunger loaded with mercury will penetrate into butter when dropped for a definite height. Unfortunately, through a misunderstanding, the tests of the butter produced by the two herds in the first period were made a temperature of 33° F., so that the plunger had little opportunity to penetrate. In the other periods the butter was taken from the refrigerator and allowed to stand in the dairy room until it had acquired the room temperature. It will be seen that both in the second and third periods, and particularly in the latter, the butter produced by Herd II. was noticeably softer and more yielding than the product of Herd I. In the fourth period little difference was observed. This method of testing has been criticised, on the ground that different portions of the same lump or print would show widely different degrees of firmness. This claim may be to an extent true. In each case, however, a definite number of tests were made in different parts of each print, and results averaged. The variations were not wide, and the differences in the firmness of the butter are quite striking.

Effect of Feed on the Time of Churning the Cream and on the Quantity of Fat left in the Skim Milk and Buttermilk. — The only noticeable difference in the time of churning was in the third period. One-fifth more time was required to bring the butter from the cream produced by Herd II., receiving the corn oil, than from Herd I., receiving the standard ration.

A number of samples of cream, skim milk and buttermilk were taken in each period and the fat percentages determined, the results being tabulated below: —

TABLE XI. — *Fat in Cream, Skim Milk and Buttermilk.*

First Period.						Second Period.					
Herd I.			Herd II.			Herd I.			Herd II.		
Cream.	Skim Milk.	Butter-milk.	Cream.	Skim Milk.	Butter-milk.	Cream.	Skim Milk.	Butter-milk.	Cream.	Skim Milk.	Butter-milk.
15.50	0.11	0.11	16.88	0.07	0.10	18.88	0.23	0.02	16.13	0.34	0.05
17.13	0.08	0.02	16.38	0.13	0.02	17.63	0.24	0.06	16.63	0.34	0.06
18.50	0.18	0.05	16.88	–	0.05	18.50	0.18	0.04	16.88	0.33	0.08
–	–	–	–	–	–	–	–	0.10	–	–	0.12
Av., 17.12	0.12	0.06	16.71	0.10	0.06	18.34	0.23	0.06	16.55	0.34	0.08
Third Period.						Fourth Period.					
17.63	0.20	0.05	18.75	0.15	0.28	–	–	0.41	–	–	0.38
18.18	0.20	0.08	18.50	0.13	0.27	–	0.39	–	–	0.40	–
17.88	0.16	0.09	19.63	0.14	0.24	–	0.43	–	–	0.28	–
18.13	0.20	0.09	17.13	0.23	0.30	–	–	–	–	–	–
18.25	0.24	0.05	18.83	0.20	0.24	–	–	–	–	–	–
18.25	0.20	0.10	16.63	0.23	–	–	–	–	–	–	–
17.63	0.25	0.13	18.75	0.26	0.31	–	–	–	–	–	–
–	–	0.19	–	–	0.40	–	–	–	–	–	–
Av., 17.99	0.21	0.10	18.32	0.19	0.29	–	0.41	0.41	–	0.34	0.38

The results indicate that there was no particular difference in the percentage of fat left in the skim milk or buttermilk produced by the two herds, excepting in case of the buttermilk obtained from the butter produced by Herd II. in the third period, when .20 per cent. more fat was found than in that produced by Herd I. As the period of lactation became advanced, more fat was left in the skim milk produced by both herds. This, however, is a well-established fact with cream raised by the gravity process.

Conclusions. — The fact must not be overlooked that this experiment, on which the following conclusions are based, extended over a period of six months, with periods varying from three to seven weeks in length; the period proper was always preceded by a preliminary period of two weeks.

1. The immediate effect of the addition of .6 pounds of corn oil to the corn gluten meal ration was to increase the fat percentage in the milk .23 of 1 per cent. (5.17 to 5.40); at the end of two weeks the effect of the corn oil had disappeared, and the milk had returned to its normal fat content.

2. The removal of the corn oil from the daily ration caused a sudden drop of .54 per cent. in the fat (4.97 to 4.43), but after the first week the normal fat per cent. was again present.

3. Corn oil appeared to have depressed the nitrogen percentage in the milk by .034 per cent. (.610 to .576); the nitrogen gradually returned to its normal percentage after the feeding of the corn oil had ceased.

4. It is not considered practicable to feed large amounts of oil to cows, it having a tendency to derange the digestive and milk-secreting organs.

5. Corn meal was without effect on the composition of the milk.

6. There was but little change in the composition of the milk produced by Herd I. for a period of six months, during which time the herd received the same or so-called standard ration: a gradual increase in the percentage of solids not fat only was noted.

7. Corn gluten meal and corn meal were without noticeable influences on the chemical composition of the butter fat.

8. The addition of corn oil to the corn gluten meal ration caused a depression of 10 points in the saponification equiva-

lent, a decrease of $3\frac{1}{2}$ points in the Reichert-Meissl number, and an increase of 9 points in the iodine number, while the melting point of the fat remained unchanged.

9. An analysis of the butter fat will seldom give positive knowledge concerning the firmness or body of the butter.

10. A high iodine number is indicative of a soft or "light-bodied" butter; but a high melting point is not a sure indication of a hard, firm butter.

11. It seems probable that neither the proteid or carbohydrate groups, when fed in normal amounts, have any noticeable influence in changing the proportions of the several milk ingredients, or in modifying the chemical character of the butter fat; such changes, so far as they occur, are due to the presence of the oil in the feed stuff.

12. Corn gluten meal with a minimum percentage of oil produced rather a soft, yielding butter; this condition was noticeably increased by the addition of corn oil to the ration.

13. The flavor of butter depends primarily on the cleanliness of the milk, stage of lactation of the animal, method of butter manufacture, and especially upon the character of the starter employed. Normal feeding stuffs are of secondary importance in establishing butter flavor.[1]

14. The present and previous experiments indicate that starchy feeds produce a hard-bodied butter, vegetable oils a soft butter; some proteids a hard-bodied butter, others butter of a softer, lighter body.

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[1] A possible exception to the above may be made in the case of young, clean pasture grass.

B. Digestion Experiments with Sheep.

J. B. LINDSEY.[1]

Digestion experiments with sheep were begun at this station in 1893, and a full description of the method employed will be found in the eleventh report of the Massachusetts State Experiment Station. The following experiments were made in the autumn of 1902 and during the winter and spring of 1903. The full data is given in this report, with the exception of the daily production of manure and the daily water consumption, in which case, to economize space, averages only are presented.

The periods extended over fourteen days, the first seven of which were preliminary, collection of fæces being made during the last seven. Ten grams of salt were fed each sheep daily, in addition to the regular ration. Water was before the animals at all times. Sheep III. throughout the series gave evidence of strong digestive powers, while Sheep II. and particularly Sheep I. showed at times evidence of weak digestion, and in several cases the results from these two latter sheep were omitted, and the tests will be repeated. The sheep were full-grown grade Southdown wethers, and have been used for a number of years.

Composition of Feed Stuffs (Per Cent.).

[Dry matter.]

Feed Stuffs.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Digestion hay,	7.63	12.03	31.60	45.89	2.85
Apple pomace,	3.93	5.06	16.17	70.00	4.84
Biles XXXX distillers' grains,	1.77	37.75	14.56	34.15	11.77
Merchants distillers' grains,	2.10	34.52	13.71	35.25	14.42
Brewers' grains,	3.83	26.02	17.48	45.30	7.37
Malt sprouts,	4.97	28.27	16.24	49.02	1.50
Soy bean meal,	5.18	41.93	4.40	29.43	19.06
Hominy meal,	3.38	12.23	4.97	69.43	9.99
Waste, Sheep III., Period XXV.,	7.63	12.03	31.60	45.89	2.85

[1] With E. B. Holland and P. H. Smith.

Composition of Fæces (Per Cent.).

Sheep I.

Period.	Fæces from—	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
XX., .	Digestion hay, ...	10.63	11.65	31.88	42.46	3.38
XXI., .	Apple pomace, ...	9.57	13.98	29.32	42.40	4.73
XXII., .	Biles XXXX distillers' grains,	10.26	18.28	26.85	41.40	3.21
XXIII., .	Merchants distillers' grains, .	10.63	18.34	27.04	40.81	3.18
XXIV., .	Brewers' grains, . . .	9.94	11.65	28.73	46.98	2.70

Sheep II.

Period.	Fæces from—	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
XX., .	Digestion hay, ...	12.08	12.10	28.74	43.45	3.63
XXI., .	Apple pomace, ...	10.58	14.23	26.89	42.70	5.60
XXII., .	Biles XXXX distillers' grains,	10.80	19.13	24.54	42.29	3.24
XXIII., .	Merchants distillers' grains, .	11.79	18.78	23.90	41.94	3.59
XXIV., .	Brewers' grains, . . .	11.46	12.59	26.14	46.78	3.03
XXVII., .	Soy bean meal, ...	13.41	14.22	24.83	43.40	4.14

Sheep III.

Period.	Fæces from—	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
XX., .	Digestion hay, ...	12.34	13.71	26.72	43.29	3.94
XXI., .	Apple pomace, ...	11.08	15.63	25.75	42.08	5.46
XXII., .	Biles XXXX distillers' grains,	10.88	19.60	23.92	42.25	3.35
XXIII., .	Merchants distillers' grains, .	11.64	19.53	23.61	41.76	3.46
XXIV., .	Brewers' grains, . . .	11.18	12.29	25.19	48.00	3.34
XXV., .	Malt sprouts, ...	12.82	15.06	24.35	44.27	3.50
XXVII., .	Soy bean meal, ...	12.75	14.28	26.81	41.67	4.49
XXVIII., .	Hominy meal, ...	13.06	14.88	24.06	43.41	4.59

Dry Matter Determinations made at the Time of Weighing out the Different Foods, and Dry Matter in Air-dry Manure (Per Cent.).

Sheep I.

Period.	Digestion Hay.	Apple Pomace.	Biles XXXX Distillers' Grains.	Merchants Distillers' Grains.	Brewers' Grains.	Malt Sprouts.	Soy Bean Meal.	Hominy Meal.	Waste.	Air-dry Manures.
XX., .	85.59	-	-	-	-	-	-	-	-	90.50
XXI., .	86.60	18.56	-	-	-	-	-	-	-	90.48
XXII., .	86.75	-	90.10	-	-	-	-	-	-	94.66
XXIII., .	87.22	-	-	91.23	-	-	-	-	-	93.24
XXIV., .	87.60	-	-	-	84.31	-	-	-	-	93.12

Dry Matter Determinations made at the Time of Weighing out the Different Foods, and Dry Matter in Air-dry Manure (Per Cent.) — Concluded.

Sheep II.

Period.	Digestion Hay.	Apple Pomace.	Biles XXXX Distillers' Grains.	Merchants Distillers' Grains.	Brewers' Grains.	Malt Sprouts.	Soy Bean Meal.	Hominy Meal.	Waste.	Air-dry Manures.
XX., .	85.59	-	-	-	-	-	-	-	-	90.32
XXI., .	86.60	18.56	-	-	-	-	-	-	-	90.21
XXII., .	86.75	-	90.10	-	-	-	-	-	-	94.74
XXIII., .	87.22	-	-	91.23	-	-	-	-	-	93.15
XXIV., .	87.60	-	-	-	84.31	-	-	-	-	93.00
XXVII., .	87.82	-	-	-	-	-	-	-	-	93.23

Sheep III.

Period.	Digestion Hay.	Apple Pomace.	Biles XXXX Distillers' Grains.	Merchants Distillers' Grains.	Brewers' Grains.	Malt Sprouts.	Soy Bean Meal.	Hominy Meal.	Waste.	Air-dry Manures.
XX., .	85.59	-	-	-	-	-	-	-	-	90.12
XXI., .	86.60	18.56	-	-	-	-	-	-	-	89.78
XXII., .	86.75	-	90.10	-	-	-	-	-	-	94.02
XXIII., .	87.22	-	-	91.23	-	-	-	-	-	93.11
XXIV., .	87.60	-	-	-	84.31	-	-	-	-	93.32
XXV., .	89.12	-	-	-	-	85.55	-	-	73.50	93.56
XXVII., .	87.82	-	-	-	-	-	86.62	-	-	93.40
XXVIII., .	88.25	-	-	-	-	-	-	88.48	-	92.91

Average Daily Amount of Manure excreted and Water drank (Grams).

Period.	Character of Ration.	Sheep I.			Sheep II.			Sheep III.		
		Manure excreted Daily.	Sample Air Dry.	Water drank Daily.	Manure excreted Daily.	Sample Air Dry.	Water drank Daily.	Manure excreted Daily.	Sample Air Dry.	Water drank Daily.
XX.,	Digestion hay,	680	31.96	1,815	590	30.49	1,451	628	30.07	1,640
XXI.,	Apple pomace,	703	29.14	518	528	27.69	382	501	25.78	313
XXII.,	Biles XXXX distillers' grains,	654	28.38	1,690	595	27.98	1,097	671	27.41	1,410
XXIII.,	Merchants distillers' grains,	632	27.46	1,758	600	26.72	1,091	722	26.88	1,531
XXIV.,	Brewers' grains,	741	32.86	2,214	707	30.81	1,142	636	29.04	1,694
XXV.,	Malt sprouts,	1,090	31.33	1,623	933	31.51	1,053	721	26.83	1,286
XXVII.,	Soy bean meal,	674	27.78	2,500	617	24.58	2,208	638	26.05	2,316
XXVIII.,	Hominy meal,	700	28.73	2,500	825	26.25	2,017	637	23.14	2,198

Weights of Animals at Beginning and End of Period (Pounds).

Period.	Character of Ration.	Sheep I.		Sheep II.		Sheep III.	
		Beginning.	End.	Beginning.	End.	Beginning.	End.
XX.,	Digestion hay,	158.75	155.00	150.25	146.25	140.00	139.00
XXI.,	Apple pomace,	153.00	152.00	144.75	146.25	138.00	138.50
XXII.,	Biles XXXX distillers' grains,	152.50	153.50	147.00	146.75	139.50	137.00
XXIII.,	Merchants distillers' grains,	152.50	153.00	148.50	148.25	136.75	139.25
XXIV.,	Brewers' grains,	161.25	155.75	153.25	150.50	144.75	142.75
XXV.,	Malt sprouts,	159.75	156.75	155.25	152.50	145.50	146.25
XXVII.,	Soy bean meal,	154.25	152.00	154.75	154.50	149.00	146.50
XXVIII.,	Hominy meal,	156.75	152.00	157.25	156.50	150.25	149.00

Digestion Hay. — Period XX.

Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
900 grams hay fed,	770.31	58.77	92.67	243.42	353.50	21.95
319.59 grams manure excreted,	289.23	30.75	33.70	92.21	122.81	9.78
Grams digested,	481.08	28.02	58.97	151.21	230.69	12.17
Per cent. digested,	62.45	47.68	63.63	62.12	65.26	55.44

Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
900 grams hay fed,	770.31	58.77	92.67	243.42	353.50	21.95
304.86 grams manure excreted,	275.35	33.26	33.32	79.13	119.64	10.00
Grams digested,	494.96	25.51	59.35	164.29	233.86	11.95
Per cent. digested,	64.25	43.41	64.04	67.49	66.16	54.44

Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
900 grams hay fed,	770.31	58.77	92.67	243.42	353.50	21.95
300.70 grams manure excreted,	270.99	33.44	37.15	72.41	117.31	10.68
Grams digested,	499.32	25.33	55.52	171.01	236.19	11.27
Per cent. digested,	64.82	43.10	59.91	70.25	66.81	51.34
Average per cent. digested (three sheep),	**63.84**	**44.73**	**62.53**	**66.62**	**66.08**	**53.74**

Average nutritive ratio of rations for three sheep, 1 : 7.29.

Apple Pomace. — Period XXI.

Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams hay fed,	519.60	39.65	62.51	164.19	238.44	14.81
1,200 grams apple pomace fed,	222.72	8.75	11.27	36.01	155.90	11.79
Total consumed,	742.32	48.40	73.78	200.20	394.34	26.60
291.36 grams manure excreted,	263.62	25.23	36.85	77.29	111.77	12.47
Amount digested,	478.70	23.17	36.93	122.91	282.57	14.13
Minus hay digested,	332.54	17.84	39.38	110.01	157.37	8.00
Apple pomace digested,	146.16	5.33	–	12.90	125.20	6.13
Per cent. digested,	65.63	60.91	–	35.82	80.31	51.99

Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Total consumed as above,	742.32	48.40	73.78	200.20	394.34	26.60
276.90 grams manure excreted,	249.79	26.43	35.55	67.17	106.66	13.99
Amount digested,	492.53	21.97	38.23	133.03	287.68	12.61
Minus hay digested,	332.54	17.84	39.38	110.01	157.37	8.00
Apple pomace digested,	159.99	4.13	–	23.02	130.31	4.61
Per cent. digested,	71.83	47.20	–	63.93	83.59	39.10

Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Total consumed as above,	742.32	48.40	73.78	200.20	394.34	26.60
257.81 grams manure excreted,	231.46	25.65	36.18	59.60	97.40	12.64
Amount digested,	510.86	22.75	37.60	140.60	296.94	13.96
Minus hay digested,	332.54	17.84	39.38	110.01	157.37	8.00
Apple pomace digested,	178.32	4.91	–	30.59	139.57	5.96
Per cent. digested,	80.06	56.11	–	84.95	89.53	50.56
Average per cent. digested (three sheep),	**72.51**	**54.74**	–	**61.57**	**84.48**	**47.22**

Average nutritive ratio of rations for three sheep, 1 : 12.02.

Biles Distillers' Grains. — Period XXII.

Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
650 grams hay fed,	563.88	43.02	67.83	178.19	258.76	16.07
250 grams Biles distillers' grains fed,	225.25	3.99	85.03	32.80	76.92	26.51
Total consumed,	789.13	47.01	152.86	210.99	335.68	42.58
283.76 grams manure excreted,	268.61	27.56	49.10	72.12	111.20	8.62
Amount digested,	520.52	19.54	103.76	138.87	224.48	33.96
Minus hay digested,	360.88	19.36	42.73	119.39	170.78	8.68
Biles distillers' grains digested,	159.64	–	61.03	19.48	53.70	25.28
Per cent. digested,	70.87	–	71.77	59.39	69.31	95.36

Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Total consumed as above,	789.13	47.01	152.86	210.99	335.68	42.58
279.77 grams manure excreted,	265.05	28.63	50.70	65.04	112.09	8.59
Amount digested,	524.08	18.38	102.16	145.95	223.59	33.99
Minus hay digested,	360.88	19.36	42.73	119.39	170.78	8.68
Biles distillers' grains digested,	163.20	–	59.43	26.56	52.81	25.31
Per cent. digested,	72.45	–	69.39	80.98	68.66	95.48

Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Total consumed as above,	789.13	47.01	152.86	210.99	335.68	42.58
274.09 grams manure excreted,	257.70	28.04	50.51	61.64	108.88	8.63
Amount digested,	531.43	18.97	102.35	149.35	226.80	33.95
Minus hay digested,	360.88	19.36	42.73	119.39	170.78	8.68
Biles distillers' grains digested,	170.55	–	59.62	29.96	56.02	25.27
Per cent. digested,	75.71	–	70.12	91.34	72.83	95.32
Average per cent. digested (three sheep),	**73.01**	**–**	**70.59**	**77.24**	**70.43**	**95.39**

Average nutritive ratio of rations for three sheep, 1:4.34.

Merchants Distillers' Grains. — Period XXIII.

Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
650 grams hay fed,	566.93	43.26	68.20	179.15	260.16	16.16
250 grams merchants distillers' grains fed,	228.08	4.79	78.73	31.27	80.40	32.89
Total consumed,	795.01	48.05	146.93	210.42	340.56	49.05
274.64 grams manure excreted,	256.07	27.22	46.96	69.24	104.50	8.14
Amount digested,	538.94	20.83	99.97	141.18	236.06	40.91
Minus hay digested,	362.84	19.47	42.97	120.03	171.71	8.73
Merchants distillers' grains digested,	176.10	1.36	57.00	21.15	64.35	32.18
Per cent. digested,	77.21	28.39	72.40	67.64	80.04	97.84

Sheep II.

Total consumed as above,	795.01	48.05	146.93	210.42	340.56	49.05
267.16 grams manure excreted,	248.86	29.34	46.74	59.48	104.37	8.93
Amount digested,	546.15	18.71	100.19	150.94	236.19	40.12
Minus hay digested,	362.84	19.47	42.97	120.03	171.71	8.73
Merchants distillers' grains digested,	183.31	-	57.22	30.91	64.48	31.39
Per cent. digested,	80.37	-	72.68	98.85	80.20	95.44

Sheep III.

Total consumed as above,	795.01	48.05	146.93	210.42	340.56	49.05
268.76 grams manure excreted,	250.24	29.13	48.87	59.08	104.50	8.66
Amount digested,	544.77	18.92	98.06	151.34	236.06	40.39
Minus hay digested,	362.84	19.47	42.97	120.03	171.71	8.73
Merchants distillers' grains digested,	181.93	-	55.09	31.31	64.35	31.66
Per cent. digested,	79.77	-	69.97	100.00	80.04	96.26
Average per cent. digested (three sheep),	**79.12**	-	**71.68**	**88.83**	**80.09**	**96.51**

Average nutritive ratio of rations for three sheep, 1:4.78.

Dried Brewers' Grains. — Period XXIV.

Sheep I.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
500 grams hay fed,	438.00	33.42	52.69	138.41	201.00	12.48
400 grams brewers' grains fed,	337.24	12.92	87.75	58.95	152.77	24.85
Total consumed,	775.24	46.34	140.44	197.36	353.77	37.33
328.61 grams manure excreted,	306.00	30.42	35.65	87.91	143.76	8.26
Amount digested,	469.24	15.92	104.79	109.45	210.01	29.07
Minus hay digested,	280.32	15.04	33.19	92.73	132.66	6.74
Brewers' grains digested,	188.92	.88	71.60	16.72	77.35	22.83
Per cent. digested,	56.02	-	81.60	28.36	50.63	89.36

Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Total consumed as above,	775.24	46.34	140.44	197.36	353.77	37.33
308.06 grams manure excreted,	286.50	32.83	36.07	74.89	134.02	8.68
Amount digested,	488.74	13.51	104.37	122.47	219.75	28.65
Minus hay digested,	280.32	15.04	33.19	92.73	132.66	6.74
Brewers' grains digested,	208.42	-	71.18	29.74	87.09	21.91
Per cent. digested,	61.80	-	81.12	50.45	57.01	88.17

Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Total consumed as above,	775.24	46.34	140.44	197.36	353.77	37.33
290.43 grams manure excreted,	271.03	30.30	33.31	68.27	130.09	9.05
Amount digested,	504.21	16.04	107.13	129.09	223.68	28.28
Minus hay digested,	280.32	15.04	33.19	92.73	132.66	6.74
Brewers' grains digested,	223.89	1.00	73.94	36.36	91.02	21.54
Per cent. digested,	66.39	-	84.26	61.68	59.58	86.68
Average per cent. digested (three sheep),	**61.40**	-	**82.33**	**46.83**	**55.74**	**88.24**

Average nutritive ratio of rations for three sheep, **1:4.14**.

Malt Sprouts. — Period XXV.

Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
700 grams English hay fed,	623.84	47.60	75.05	197.13	286.28	17.78
42.14 grams waste hay,	30.97	2.36	3.73	9.79	14.21	.88
Total hay consumed,	592.87	45.24	71.32	187.34	272.07	16.90
200 grams malt sprouts fed,	171.10	8.50	48.37	27.79	83.87	2.57
Total consumed,	763.97	53.74	119.69	215.13	355.94	19.47
268.33 grams manure excreted,	251.05	32.18	37.81	61.13	111.14	8.79
Amount digested,	512.92	21.56	81.88	154.00	244.80	10.68
Minus hay digested,	379.44	20.36	44.93	125.52	179.57	9.13
Malt sprouts digested,	133.48	1.20	36.95	28.48	65.23	1.55
Per cent. digested,	78.01	–	76.39	102.50	77.78	60.31

Nutritive ratio of ration for Sheep III., 1:5.16.

Soy Bean Meal. — Period XXVII.

Sheep II.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
700 grams hay fed,	614.74	46.90	73.95	194.26	282.10	17.52
200 grams soy bean meal fed,	173.24	8.97	72.64	7.62	50.98	33.02
Total consumed,	787.98	55.87	146.59	201.88	333.08	50.54
245.80 grams manure excreted,	229.16	30.73	32.59	56.90	99.46	9.49
Amount digested,	558.82	25.14	114.00	144.98	233.62	41.05
Minus hay digested,	393.43	21.11	46.59	130.15	186.19	9.46
Soy bean meal digested,	165.39	4.03	67.41	14.83	47.43	31.59
Per cent. digested,	95.46	44.93	92.80	194.62	93.04	95.67

Sheep III.

Total consumed as above,	787.98	55.87	146.59	201.88	333.08	50.54
260.47 grams manure excreted,	243.28	31.02	34.74	65.22	101.37	10.92
Amount digested,	544.70	24.85	111.85	136.66	231.71	39.62
Minus hay digested,	393.43	21.11	46.59	130.15	186.19	9.46
Soy bean meal digested,	151.27	3.74	65.26	6.51	45.52	30.16
Per cent. digested,	87.32	41.70	89.34	85.43	89.29	91.34
Average per cent. digested (two sheep),	**91.39**	**43.32**	**91.07**	**140.03**	**91.17**	**93.51**

Average nutritive ratio of rations for two sheep, 1:4.11.

Hominy Meal. — Period XXVIII.

Sheep III.

	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
600 grams hay fed,	529.50	40.40	63.70	167.32	242.99	15.09
300 grams hominy meal fed,	265.44	8.97	32.46	13.19	184.29	26.52
Total consumed,	794.94	49.37	96.16	180.51	427.28	41.61
231.44 grams manure excreted,	215.03	28.08	32.00	51.74	93.34	9.87
Amount digested,	579.91	21.29	64.16	128.77	333.94	31.74
Minus hay digested,	338.88	18.18	40.13	112.10	160.37	8.15
Hominy meal digested,	241.03	3.11	24.03	16.67	173.57	23.59
Per cent. digested,	90.80	34.67	74.03	126.55	94.18	88.95

Nutritive ratio of ration for Sheep III., 1:8.32.

Summary of Coefficients.

Ration.	Sheep Number.	Dry Matter.	Ash.	Protein.	Fibre.	Nitrogen-free Extract.	Fat.
Hay,	Sheep I.,	62.45	47.68	63.63	62.12	65.26	55.44
	Sheep II.,	64.25	43.41	64.04	67.49	66.16	54.44
	Sheep III.,	64.82	43.10	59.91	70.25	66.81	51.34
Average,		**63.84**	**44.73**	**62.53**	**66.62**	**66.08**	**53.74**
Apple pomace,	Sheep I.,	65.63	60.91	–	35.82	80.31	51.99
	Sheep II.,	71.83	47.20	–	63.93	83.59	39.10
	Sheep III.,	80.06	56.11	–	84.95	89.53	50.56
Average,		**72.51**	**54.74**	–	**61.57**	**84.48**	**47.22**
Biles distillers' grains,	Sheep I.,	70.87	–	71.77	59.39	69.31	95.36
	Sheep II.,	72.45	–	69.39	80.98	68.66	95.48
	Sheep III.,	75.71	–	70.12	91.34	72.83	95.32
Average,		**73.01**	–	**70.59**	**77.24**	**70.43**	**95.39**
Merchants distillers' grains,	Sheep I.,	77.21	28.39	72.40	67.64	80.04	97.84
	Sheep II.,	80.37	–	72.68	98.85	80.20	95.44
	Sheep III.,	79.77	–	69.97	100.00	80.04	96.26
Average,		**79.12**	–	**71.68**	**88.83**	**80.09**	**96.51**
Dried brewers' grains,	Sheep I.,	56.02	–	81.60	28.36	50.63	89.36
	Sheep II.,	61.80	–	81.12	50.45	57.01	88.17
	Sheep III.,	66.39	–	84.26	61.68	59.58	86.68
Average,		**61.40**	–	**82.33**	**46.83**	**55.74**	**88.24**
Malt sprouts,	Sheep III.,	**78.01**	–	**76.39**	**102.50**	**77.78**	**60.31**
Soy bean meal,	Sheep II.,	95.46	44.93	92.80	194.62	93.04	95.67
	Sheep III.,	87.32	41.70	89.34	85.43	89.29	91.34
Average,		**91.39**	**43.32**	**91.07**	**140.03**	**91.17**	**93.51**
Hominy meal,	Sheep III.,	**90.80**	**34.67**	**74.03**	**126.55**	**94.18**	**88.95**

Discussion of the Results.

Digestion Hay. — The hay was largely Kentucky blue-grass (*Poa pratensis*), cut in bloom, and was employed in all of the several tests herein reported. It showed a high degree of digestibility.

Apple Pomace. — The pomace was taken fresh from the cider mill, and contained 18.56 per cent. of dry matter. It is the first digestion test of such material on record, either in Europe or the United States. The sheep did not digest it as evenly as could be desired, although they ate it satisfactorily, and no digestion disturbances were noted. The percentage of crude protein (5.06 in dry matter) was small, and no coefficients were obtained. This, in all probability, was partly due to the "digestion depression" known to take place when feeds especially high in carbohydrates are added to a hay ration, the effect being particularly noticeable in the protein, and to a less extent in the fiber. The pomace contained fully as much digestible matter as silage made from the smaller varieties of corn. Whether, per unit of dry matter, it is as valuable a feed as corn silage, is rather uncertain. This point will be ascertained later.

Distillers' Dried Grains. — Considerable has been said concerning the source, composition and digestibility of distillers' grains in the thirteenth report of this station. Briefly stated, these feeds represent the residue in the manufacture of alcohol, spirits and whiskey from the several cereals, and are composed chiefly of the hull, germ and protein matter of the grains. In the better class of such material, containing 28 or more per cent. of protein, the residue consists largely of corn. In the most modern plants, the distillery slop, hot from the stills, is dried immediately in especially constructed driers, and has a slightly sour taste and smell. One of the two samples herein reported — the merchants — had a slightly burned taste, which is not to be desired. The grains are now sold in Massachusetts markets under the following names: Biles XXXX Grains, Ajax Flakes, Merchants Grains, Hall's AAAA Grains, Atlas Gluten Meal and Corn Protegran.

Both samples here reported showed a high degree of digestibility. The sample of Merchants grains proved about 6 per cent. more digestible than the "Fourex" brand, due probably to the character of the cereals used in the mash. The difference was principally in the extract matter. Comparing the coefficients obtained with Sheep III., the difference in case of the total dry matter is reduced to 4 per cent. Marked differences are observed in the digestibility of the fiber. Such variations in fiber digestibility are characteristic of all grains and grain by-products. This matter will be referred to farther on.

In this connection it will doubtless prove of interest to summarize the results obtained at this station with 7 different samples of distillers' grains: —

Composition of the Grains (Per Cent.).

Brand.	Water.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Biles X,	8.91	1.68	29.15	9.58	40.03	10.65
Biles XX,	9.53	2.44	25.49	11.22	41.80	9.52
Biles XXX,	7.46	2.05	29.86	10.28	38.52	11.83
Biles XXXX,	8.83	1.70	34.76	11.40	33.50	9.81
Biles XXXX,	9.45	1.55	35.46	13.00	29.87	10.67
Merchants,	8.77	1.92	31.49	12.51	32.15	13.16
Atlas,	8.96	.94	38.80	8.86	28.08	14.36
Average,	8.84	1.75	32.14	10.98	34.85	11.43

The percentage of ash is low, as would naturally be expected. Its exact character has not been determined. The protein percentage is relatively high, and varies considerably, depending upon the material used. The brands offered in Massachusetts have been guaranteed to contain 33 and 34 per cent. Considerable fiber is present, as a result of the incorporated grain hulls. The fiber and extract matter must show a very considerable amount of pentosans, although determinations have not been made. The fat percentage is quite high, being similar in quantity to that contained in the corn gluten feed, before the corn oil was extracted.

Digestion Coefficients of Distillers' Dried Grains (Per Cent.).

[All experiments.]

Number of Sheep.	Brand.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract.	Fat.
Sheep I.,	Biles X grains,	86.50	20.24*	65.51	130.11	93.12	93.94
Sheep III.,	Biles X grains,	87.07	–	80.05	127.56	85.15	97.60
Sheep I.,	Biles XX grains,	88.53	13.91	79.94	122.75	88.22	94.45
Sheep VI.,	Biles XX grains,	79.77	–	76.50	97.22	79.77	94.87
Sheep II.,	Biles XXX grains,	79.88	–	73.41	108.91	78.03	91.78
Sheep VI.,	Biles XXX grains,	71.41	–	74.01	66.03	72.69	93.95
Sheep I.,	Biles XXXX grains,	79.82	–	72.08	102.77	81.12	96.99
Sheep VI.,	Biles XXXX grains,	73.47	–	69.22	81.78	76.73	98.45
Sheep I.,	Biles XXXX grains,	70.87	–	71.77	59.39	69.31	95.36
Sheep II.,	Biles XXXX grains,	72.45	–	69.39	80.98	68.66	95.48
Sheep III.,	Biles XXXX grains,	75.71	–	70.12	91.34	72.83	95.32
Sheep IV.,	Merchants grains,	77.21	28.39	72.40	67.64	80.04	97.84
Sheep V.,	Merchants grains,	80.37	–	72.68	98.85	80.20	95.44
Sheep VI.,	Merchants grains,	79.77	–	69.97	100.00	80.04	96.26
Sheep III.,	Atlas gluten meal,	79.53	–	73.04	94.88	84.00	92.43
Sheep IV.,	Atlas gluten meal,	79.75	–	72.56	116.50	84.91	90.06
Average,	. . . . . .	78.88	–	72.67	96.67	79.68	95.01

As a result of 16 single digestion trials with 6 different samples, several points may be noted : —

(*a*) The dry matter coefficients differed considerably, but the grains showed a high average digestibility.

(*b*) The ash was apparently little digested. Whether this was literally true, or whether a portion of it was substituted for the digestible ash of the hay, is not clear.

(*c*) The protein in the several brands was quite evenly digested, except in the first two samples.

(*d*) The fiber showed marked variations in digestibility, in common with all feeds of similar character. While it has been generally held that nitrogenous feed stuffs do not affect the normal digestibility of the coarse fodders they supplement, it certainly seems reasonable to conclude that the addition of 200 to 250 grams of the distillers' grains to the hay ration, giving a nutritive ration of 1 : 4, has resulted in increasing the digestibility of the fiber in the hay; which accounts, in the majority of cases, for the apparently very high digestion coefficients obtained. Admitting this to be the case, the fact still remains that, while the digestion coefficient for the fiber is rather of an uncertain quantity, it must be regarded as relatively high.

(*e*) The extract matter digested in the several samples differed to a noticeable extent, depending probably upon the nature of the material composing it, the way in which it is united with the crude fiber, and also upon the digestive capacity of the sheep. Other things being equal, animals in normal condition should digest substantially equal quantities of the same feed stuff, when fed under similar conditions. It often happens, however, that one or the other animal will be a trifle out of condition without giving any external evidence of it, and hence will digest rather more of one fodder group and less of another.

Attention is called to the fact that the higher the digestion coefficients obtained for the fiber, the higher are those obtained for the extract. This is undoubtedly due to the intimate chemical and physiological relations known to exist between these two fodder groups.

(*f*) The fat was quite evenly and largely digested.

Dried Brewers' Grains. — These were grains of good quality, and of a fresh, bright color. Sheep I. showed its inability to digest the fiber and extract matter as well as the other sheep, and even Sheep II. did not utilize the fiber as well as Sheep III. The average coefficients for the three sheep corresponded quite well with former experiments made at this station, and also with German experiments; excepting that in case of the American tests the coefficients for the protein and fiber are somewhat higher, and the extract matter 4 per cent. lower.

Malt Sprouts. — These were of average quality. They contained an exceptionally large portion of their nitrogen, 42.29 per cent., in the form of amids. The experiment was conducted with three sheep, but Sheep I. and Sheep II. digested so much less fiber and extract matter than is customary that the results with these two sheep were discarded, and the test will be repeated. Only one other American test with a single animal is on record, and showed considerably less fiber and extract matter digested than that obtained in the present experiment. The present single test agrees fairly well with the seven German trials reported.

Soy Bean Meal (*Brook's Medium Green*). — This variety is by far the best suited to northern conditions. The sample was grown upon the station grounds, and was coarsely ground before being fed. The seed is green in color, and similar in size to dwarf garden peas. The bean contained 61 per cent. of protein and fat, and these two ingredients are shown to be 91 and 93 per cent. digestible. The extract matter, 29.43 per cent., was 91 per cent. digested. The coefficients of digestibility obtained for the fiber are, of course, incorrect, due probably to the favorable influence of the soy bean, a nitrogenous feed stuff, in increasing the digestibility of the hay carbohydrates. It can be assumed that the fiber contained in the soy bean has a high rate of digestibility. The small amount present, 4.40 per cent., renders a knowledge of the exact percentage digestible of minor importance.

The three American digestion trials, with an unnamed variety, reported in Lindsey's compilation, show the protein and fat to have been nearly as well digested as those in the present trial. The fiber and extract matter, on the other hand, had noticeably lower digestion coefficients (33 and 71). In the two German trials reported the protein and fat are respectively 87 and 94 per cent., and the extract matter 62 per cent. digestible, while the digestibility of the fiber is not stated.

It is evident, from all trials thus far made, that the protein and fat, comprising from 50 to 60 per cent. of the bean is very fully digested. Whether the high digestibility of the fiber and extract in the present experiment is due to the variety of the bean, or is a peculiarity of the sheep employed, will be determined by further tests.

Hominy Meal, or Chop. — As used for cattle feeding this consists of the hull, germ and some of the gluten and soft starch. The sample tested for digestibility was of good average quality. The present trial was made with three sheep, but Sheep I. and Sheep II. digested so unevenly that the results were discarded, it being evident that their digestion powers had become weakened by continued use. The results with Sheep III. show the hominy to be fully as digestible as corn meal. The addition to the hay of even a carbohydrate feed, such as hominy, seemed to have increased the digestibility of the fiber in the hay, judging from the coefficients obtained for the hominy fiber.

C. Raising Dairy Calves without Milk.

J. B. LINDSEY.

With plenty of skim milk available, the rearing of calves intended for the dairy is a comparatively simple matter. There is, however, a constantly increasing demand in Massachusetts for whole milk, and the amount available for butter production is likely to diminish from year to year. With little or no skim milk at his disposal, the dairyman desirous of growing his own young stock is in need of a milk substitute to feed the calf during the first four to six months of its life. The brief experiment here reported was made to test the efficacy, for such a purpose, of Hayward's and Blatchford's calf meals.

(1) *Hayward's Calf Meal.*

Hayward of the Pennsylvania experiment station studied the question of providing a cheap and suitable milk substitute, and published his results in Bulletin No. 60 of that station. He succeeded in rearing ten unselected grade Guernsey calves without the aid of milk after the first fourteen to eighteen days. Most of the calves weighed from 150 to 250 pounds when from four to five months old, and were produced at a food cost of from $8 to $9 each. He concluded that the calf meal was a fairly satisfactory milk substitute, if used judiciously by careful feeders, but that it was not equal to whole milk.

The formula proposed by Hayward for the meal was as follows: —

	Pounds.
Wheat flour,	30
Cocoanut meal,	25
Nutrium,	20
Linseed meal,	10
Dried blood,	2

Hayward employed whole wheat, grown at the station and ground by the local miller. In the test about to be reported St. Louis flour at a cost of 2 cents a pound was used.

Cocoanut meal is a by-product in the manufacture of cocoanut oil, and was obtained of the India Product Food Company, 50 Chatham Street, Boston, Mass. It has a decided cocoanut odor, and tested 21.11 per cent. of protein and 19.23 per cent. of fat. Cocoanut oil is likely to become rancid after a brief period. Hayward believed it to have quite a favorable effect as a part of the calf meal.

Nutrium is a powder prepared by the National Nutrient Company of Jersey City, N. J., and is simply skim milk evaporated at a low temperature. It was very dry and fine, and kept well. This company also puts out the same article in granular form, but the powder is to be preferred.

Dried blood, especially prepared for feeding purposes, is offered by the Armour Fertilizer Works and by Swift & Co. of Chicago. It is also to be had of the agricultural warehouses in the large cities. It was employed by Hayward to check scours.

Cost per Pound of Each Ingredient and of the Mixture.

	Pounds.	Cost (Cents).	Total.
Wheat flour,	30	2	$0 60
Cocoanut meal,	25	1½	38
Nutrium,	20	10	2 00
Linseed meal,	10	1½	15
Blood,	2	4 [1]	08
	87	-	$3 21

[1] In small quantities.

The cost per pound figures 3.7 cents, and to this must be added the freight charges on the nutrium, cocoanut meal and blood. Those who are desirous of trying this mixture would, of course, purchase these ingredients in larger quantities than the above, but it is doubtful if the meal could be prepared for much less than 4 cents a pound.

Method of Feeding the Meal. — This station tested the calf meal, using two unselected thrifty grade Jersey calves, a bull and a heifer. The several ingredients were in such good mechanical condition that it was not necessary to grind the mixture. It may not be out of place to add that the meal should be fine, and free from any coarse particles.

One pound was thoroughly stirred into 8 pounds of very hot water, and allowed to stand until milk-warm, in which condition it was fed. Hayward used 6 pounds of water to a pound of meal, and employed a calf feeder; but in our case it was considered better to teach the animals to drink at once.

The calves were fed whole milk for the first nine to fourteen days, and then skim milk and calf meal gradually substituted, whole milk being entirely taken away at the end of three weeks. Three quarts of skim milk were fed daily, in addition to the calf meal, until the calves were four or five weeks old, when both calves were placed upon an entire diet of calf meal. Hayward used the calf meal entirely after the first ten days, but it seemed wiser to the writer to allow some milk for a longer period, and thus give the animals a better start. Three-fourths of a pound of the meal was fed at first, and the amount gradually increased, until at the close of the experiment Calf I. was receiving 3 pounds and Calf II. 2 pounds of the meal daily.

Average Daily Record of Each Calf.

	Days entirely on Milk.	Average Amount Daily (Quarts).	Days partly on Milk, partly on Meal (Amount Daily).		
			Days.	Milk (Quarts).	Meal (Pounds).
Calf I., ...	14	5.7	19	4.3	1
Calf II., ...	9	5.3	15	4.3	1

Average Daily Record of Each Calf — Concluded.

	Days entirely on Meal (Amount).		Days partly on Milk after feeding Meal as Entire Ration.		Total consumed.	
	Days.	Amount (Pounds.)	Days.	Milk (Quarts).	Milk (Quarts).	Meal (Pounds).
Calf I., . .	143	2.50	2	4.0	152 [1]	374.0
Calf II., . .	101	2.20	44	2.6	229 [2]	306.5

[1] Whole milk, 93 quarts; skim milk, 59 quarts.
[2] Whole milk, 69 quarts; skim milk, 160 quarts.

Effect of the Calf Meal. — No serious trouble was experienced with either calf until February 12, when Calf II. suffered a bad attack of indigestion, which rendered it necessary to take away a considerable portion of the meal and substitute skim milk; and this animal was still receiving some milk when the experiment terminated, although she recovered and made good gains. On January 5 the supply of cocoanut meal became exhausted, and flour middlings was used in its place until March 10. The continued use of the middlings may have been a partial cause of the trouble. Calf I. was rather more robust, and experienced only a slight digestion disturbance about the middle of February, when a portion of the meal was replaced by skim milk for two days. While the calves did not have as sleek an appearance as animals raised on a whole milk diet, they were certainly in a thrifty growing condition, and at the close of the trial appeared especially vigorous.

Weekly Weights of Calves (Pounds).

DATES.	Calf I.	Calf II.	DATES.	Calf I.	Calf II.
November 10,	95 [1]	85 [2]	February 2,	190	182
November 17,	105	95	February 9,	203	191
November 24,	110	97	February 16,	210	177 [3]
December 1,	115	105	February 23,	222	185
December 8,	122	112	March 2,	235	185
December 15,	130	120	March 9,	247	197
December 22,	142	130	March 16,	252	218
December 29,	147	135	March 23,	263	225
January 5,	157	145	March 30,	277	235
January 12,	–	–	April 6,	295	250
January 19,	167	152	April 13,	310	260
January 26,	170	170			

[1] Just after beginning calf meal, three weeks after birth.
[2] Just after beginning calf meal, two and one-half weeks after birth.
[3] Ill with indigestion.

It will be seen from the above tables that the calves made a fair growth during the experiment, especially during the last month of the trial. Calf I. weighed 310 pounds when six months old, and made an average daily growth of 1.4 pounds while receiving the calf meal; while Calf II. weighed 260 pounds when five and one-half months old, and gained 1.1 pounds daily on the calf meal.

Cost of Feed Consumed. — Allowing 3 cents a quart for the whole milk, ½ cent a quart for the skim milk and 4 cents a pound for the calf meal, the food cost in case of Calf I. was \$20.20, and in case of Calf II. \$15.11. If the calves had been fed largely calf meal at the end of the second week, this cost would have been somewhat reduced. Again, the calves might have been transferred a month earlier to a hay and grain diet. The object, however, in the present test was not to ascertain the minimum cost of raising the calf, but rather to note the effect of the calf meal during the first five or six months of the animal's life.

Conclusions. — 1. It is evident that, with reasonable care and cleanliness, calves can be successfully reared on Hayward's calf meal.

2. The meal is to be preferred only when a supply of skim milk is not available, or as a substitute for a portion of the milk.

3. The cost[1] is likely to be somewhat greater than when skim milk can be had at two cents a gallon. The expense of the meal is largely due to the nutrium, yet it is doubtful if a mixture as satisfactory for young calves could be obtained without the use of this substance.

4. The meal is evidently better utilized by calves after they are three months old than before that period.

5. The best method to be employed would probably be to allow the calf to suck the cow for the first two days, then feed whole milk for five days, to be followed by half whole and half skim milk for a week, gradually reducing the whole milk, so that at the beginning of the fourth week the diet may consist of 3 quarts of skim milk and $\frac{3}{4}$ to one pound of the meal, dissolved in the necessary hot water. At the end of the fourth week the skim milk may be dropped, and the calf put upon a diet of 2 pounds of the calf meal a day. Slight modifications may be made in this method depending on the condition of the animal.

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[1] The writer has grown seven unselected young calves, having an average weight when three days old of 73 pounds, to an average weight when ten weeks old of 173 pounds, on skim milk, together with such common grains as corn meal, wheat flour, flour middlings and gluten feed, at an average food cost of \$4.80 each. By this method of feeding, calves ought to be produced that will weigh 200 to 300 pounds when five months old, at a food cost not exceeding \$9 or \$10. (See eleventh report of Massachusetts State Experiment Station, p. 125.)

6. It may be possible to modify the meal by replacing the cocoanut meal with some more common feeding stuffs, although Hayward did not succeed in finding a satisfactory substitute.

(2) *Blatchford's Calf Meal.*

This material, put out by the Barwell Mills, at Waukegan, Ill., is highly recommended by the manufacturers as a milk substitute. It is composed principally of linseed meal, beans, carob beans, cotton-seed meal and fenugreek, and retails at $3\frac{1}{2}$ cents a pound. It has a very pronounced odor and flavor.

How the Meal was fed. — This article was tested by feeding it to one rugged grade Holstein calf, dropped Dec. 11, 1902. Unfortunately, the detailed record of the early part of this test has been lost, although some notes are on hand. The calf was first fed whole milk, a little later whole and skim milk, and at the end of two or three weeks the calf meal gradually substituted. The calf at first objected to the odor or taste of the meal, and never seemed to thoroughly relish it, although no serious difficulty was found in inducing the animal to take it. One pound of the meal was added to 6 pounds of hot water, thoroughly stirred and fed milk-warm. It was not possible to place the calf entirely upon the meal for a considerable time, hence the daily feed consisted of 4 quarts of skim milk and 2 pounds of the calf meal with the necessary water. On March 23, when a little over three months old, the calf was receiving $2\frac{3}{4}$ pounds of the meal daily, and continued to take this quantity without other food until the experiment terminated, May 4, the calf then being approximately four and one-half months old.

Weight of the Calf.

	Pounds.
March 23 (first record),	203.5
March 30,	205.0
April 6,	214.5
April 13,	221.0
April 20,	232.0
April 27,	242.0
May 14,	251.0

The animal did not suffer any serious digestion disturbances, and certainly grew well, as the above weights indicate, making an average increase of 1.15 pounds daily during the last forty-two days of the test.

Conclusions. — The above single trial is not sufficient to enable one to draw any absolute conclusions. The writer, however, observed the calf closely during the trial, and believes he is justified in making the following statements: —

1. Blatchford's calf meal is hardly as satisfactory as the Hayward mixture during the first three months of the calf's life, and it will probably prove necessary to feed one-third skim or whole milk and two-thirds meal during this period.

2. Used as above indicated, it proved quite satisfactory in the present single trial, can undoubtedly be depended upon as a partial milk substitute for calves under three months of age, and can be used as the entire food after that time and until the animal is ready for hay and the more common grains (five to six months).

3. It is possible that delicate calves would not thrive as well upon the meal as the one in the present trial.

4. The Blatchford meal was in good mechanical condition, and cannot be considered especially expensive.

REPORT OF THE CHEMIST.

DIVISION OF FERTILIZERS AND FERTILIZER MATERIALS.

CHARLES A. GOESSMANN.

Assistants: HENRI D. HASKINS, JAMES E. HALLIGAN, RICHARD H. ROBERTSON.

PART I. — Report on Official Inspection of Commercial Fertilizers.
PART II. — Report on General Work in the Chemical Laboratory.

PART I. — REPORT ON OFFICIAL INSPECTION OF COMMERCIAL FERTILIZERS AND AGRICULTURAL CHEMICALS DURING THE SEASON OF 1903.

CHARLES A. GOESSMANN.

The total number of manufacturers, importers and dealers in commercial fertilizers and agricultural chemicals who have secured licenses during the past season is 64; of these, 35 have offices for the general distribution of their goods in Massachusetts, 8 in New York, 8 in Connecticut, 3 in Vermont, 1 in Rhode Island, 3 in Canada, 1 in New Jersey, 1 in Maryland, 2 in Ohio, 1 in Illinois and 1 in Arkansas.

Three hundred and six brands of fertilizer, including chemicals, have been licensed in the State during the year. Five hundred and eighty-four samples of fertilizer have thus far been collected in the general markets by experienced assistants in the station.

Five hundred and twelve samples were analyzed at the close of November, 1903, representing two hundred and ninety distinct brands of fertilizer. These analyses were published in two bulletins of the Hatch Experiment Station of the Massachusetts Agricultural College: No. 90, July, and No. 92, November, 1903.

During the year 1903 a larger number of fertilizers have been licensed in the State of Massachusetts than for any previous year in the history of our fertilizer inspection laws. This necessitates an increased amount of work in the official inspection of commercial fertilizers. Twenty-three more brands of fertilizers were licensed and eighty more collected during the past season than in the previous year.

Below will be found an abstract of the results of analyses of official commercial fertilizers for the years 1902 and 1903: —

	1902.	1903.
(*a*) Where three essential elements of plant food were guaranteed: —		
Number with three elements equal to or above the highest guarantee,	7	7
Number with two elements above the highest guarantee, . . .	20	19
Number with one element above the highest guarantee, ...	83	91
Number with three elements between the lowest and highest guarantee,	183	207
Number with two elements between the lowest and highest guarantee,	87	118
Number with one element between the lowest and highest guarantee,	54	42
Number with three elements below the lowest guarantee, . . .	3	2
Number with two elements below the lowest guarantee, ...	18	24
Number with one element below the lowest guarantee, ...	67	100
(*b*) Where two essential elements of plant food were guaranteed: —		
Number with two elements above the highest guarantee, . . .	10	2
Number with one element above the highest guarantee, ...	22	17
Number with two elements between the lowest and highest guarantee,	16	31
Number with one element between the lowest and highest guarantee,	13	13
Number with two elements below the lowest guarantee, ...	4	1
Number with one element below the lowest guarantee, ...	19	14
(*c*) Where one essential element of plant food was guaranteed: —		
Number above the highest guarantee, ...	9	11
Number between lowest and highest guarantee, ...	14	13
Number below lowest guarantee, ...	20	18

From the above table it will be seen that there is no material change in the quality of the fertilizers which have been examined, when compared with the results of the previous year. Where a discrepancy has occurred between the results of analysis and the manufacturers' guarantee, we are of the opinion that poor mixing is responsible, rather than a disposition on the part of the manufacturer to furnish an inferior article. As proof of this, we find in most cases that wherever a fertilizer shows a low test in any one ingredient, a corresponding high test is shown on some other element of plant food in the same brand; this usually corrects any difference in commercial value of the fertilizer.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals, 1902 and 1903 (Cents per Pound).

	1902.	1903.
Nitrogen in ammonia salts,	16.50	17.50
Nitrogen in nitrates,	15.00	15.00
Organic nitrogen in dry and fine-ground fish, meat, blood and in high-grade mixed fertilizers.	16.50	17.00
Organic nitrogen in fine bone and tankage,	16.00	16.50
Organic nitrogen in medium bone and tankage,	12.00	12.00
Phosphoric acid soluble in water,	5.00	4.50
Phosphoric acid soluble in ammonium citrate,	4.50	4.00
Phosphoric acid in fine-ground fish, bone and tankage,	4.00	4.00
Phosphoric acid in cotton-seed meal, castor pomace and wood ashes,	4.00	4.00
Phosphoric acid in coarse fish, bone and tankage,	3.00	3.00
Phosphoric acid insoluble (in water and in ammonium citrate) in mixed fertilizers.	2.00	2.00
Potash as sulfate (free from chlorides),	5.00	5.00
Potash as muriate,	4.25	4.25

A comparison of the above trade values of fertilizing ingredients for the years 1902 and 1903 shows a higher market cost of nitrogen in form of ammonia salts and in the higher grades of organic substances for the year 1903 than for the previous year; this is, however, largely offset by a corresponding decrease in the market cost of the better forms of phosphoric acid.

The schedule of trade values for 1903 was adopted by representatives of the Massachusetts, Connecticut, Rhode Island, Maine, Vermont and New Jersey experiment stations, at a conference held during the month of March, 1903; it is based on the condition of the fertilizer market in centres of distribution in New England, New York and New Jersey during the six months preceding March, 1903, and refers to the current market prices of the leading standard raw materials which furnish nitrogen, phosphoric acid and potash, and which enter largely into the manufacture of our commercial fertilizers.

Table A, following, gives the average analysis of officially collected fertilizers for 1903; Table B gives a compilation of analyses, showing the maximum, minimum and average percentages of the different essential elements of plant food in so-called special crop fertilizers put out by different manufacturers.

TABLE A. — *Average Analysis of Officially Collected Fertilizers for 1903.*

Nature of Material.	Moisture.	Nitrogen in One Hundred Pounds.		Phosphoric Acid in One Hundred Pounds.							Potassium Oxide in One Hundred Pounds.	
							Total.		Available.			
		Found.	Guaranteed.	Soluble.	Reverted.	Insoluble.	Found.	Guaranteed.	Found.	Guaranteed.	Found.	Guaranteed.
Complete fertilizers,	10.70	2.96	2.77	4.43	3.81	2.33	10.57	8.87	8.24	7.44	5.48	5.19
Ground bones,	7.69	3.23	2.85	-	9.88	14.86	24.74	22.54	9.88	-	-	-
Tankage,	8.04	4.59	3.93	-	10.68	7.54	18.22	17.96	10.68	10.00	-	-
Dissolved bone-black,	12.80	-	-	12.09	3.21	1.56	16.86	16.00	15.30	15.00	-	-
Acid phosphate,	10.30	-	-	14.90	1.70	-	16.60	-	16.60	-	-	-
Wood ashes,	13.05	-	-	-	-	-	1.44	1.50	-	-	5.56	5.00
Cotton-seed meal,	7.41	6.73	7.00	-	-	-	-	-	-	-	-	-
Flax meal,	9.42	5.73	6.08	-	-	-	-	-	-	-	-	-
Nitrate of soda,	2.06	15.41	15.41	-	-	-	-	-	-	-	-	-
Sulfate of ammonia,	.78	20.40	19.00	-	-	-	-	-	-	-	-	-
High-grade sulfate of potash,	1.15	-	-	-	-	-	-	-	-	-	48.88	48.12
Muriate of potash,	2.69	-	-	-	-	-	-	-	-	-	48.98	-
Kainit,	2.70	-	-	-	-	-	-	-	-	-	11.20	12.00

TABLE B. — *Compilation of Analyses of Commercial Fertilizers for the Year 1903.*

NAME OF FERTILIZER.	Moisture.	NITROGEN IN ONE HUNDRED POUNDS.			TOTAL PHOSPHORIC ACID IN ONE HUNDRED POUNDS.			AVAILABLE PHOSPHORIC ACID IN ONE HUNDRED POUNDS.			POTASSIUM OXIDE IN ONE HUNDRED POUNDS.		
		Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.	Maximum.	Minimum.	Average.
Corn fertilizer,	10.70	3.70	1.25	2.24	14.82	8.92	11.29	12.88	5.34	8.85	9.56	1.52	3.64
Fruit and vine fertilizer,	9.94	2.69	2.00	2.48	12.98	9.10	10.99	10.34	7.24	8.78	11.28	6.06	8.11
Grain fertilizer,	10.28	8.13	1.25	3.94	18.04	7.52	11.74	12.88	4.32	8.69	14.60	2.06	5.78
Grass fertilizer,	9.03	8.13	2.23	4.24	18.04	4.22	9.88	11.84	2.68	6.86	14.60	2.18	6.04
Market-garden fertilizer,	9.82	4.54	2.08	3.45	13.90	6.12	10.63	10.85	5.32	8.06	10.82	2.30	6.81
Potato fertilizer,	10.25	5.02	1.07	2.51	13.90	7.08	10.43	9.69	5.02	8.24	10.58	2.12	5.51
Tobacco fertilizer,	9.42	5.94	.59	3.41	13.38	4.22	10.00	10.56	2.94	7.54	17.34	1.66	7.96
Onion fertilizer,	9.26	4.36	1.16	2.64	12.26	6.38	8.72	9.70	5.10	6.56	7.76	4.04	5.76

A careful study of Table B teaches the following lessons. The trade name of a fertilizer is a poor criterion in ascertaining the efficiency of a fertilizer. Many farmers depend too much on trade names in making their selection of fertilizers. With the great variety of fertilizers now found upon the market, it becomes no easy matter for the average farmer to make an intelligent and judicious selection of his fertilizers, unless he is in possession and makes use of the fertilizer bulletins which are issued from time to time. In making a selection of a fertilizer for growing special crops, the needs of the soil and the requirements of the crop should receive careful consideration, and a fertilizer should be selected which will supply the wants of the soil in the most suitable and economical manner. In deciding what brands of fertilizers to purchase for general use, it is self-evident that those fertilizers should be selected which furnish the greatest amount of nitrogen, phosphoric acid and potash in a suitable and available form for the same money.

List of Manufacturers and Dealers who have secured Certificates for the Sale of Commercial Fertilizers in the State during the Past Year (May 1, 1903, to May 1, 1904) and the Brands licensed by Each.

The American Agricultural Chemical Co., Boston, Mass.: —
- High-grade Fertilizer with Ten Per Cent. Potash.
- Grass and Lawn Top-dressing.
- Tobacco Starter and Grower.
- Brightman's Fish and Potash.
- Fine-ground Bone.
- Columbia Fish and Potash.
- Abattoir Bone.
- Dissolved Bone-black.
- Muriate of Potash.
- Double Manure Salt.
- High-grade Sulfate of Potash.
- Nitrate of Soda.
- Dry Ground Fish.
- Plain Superphosphate.
- Sulfate of Ammonia.
- Kainit.

The American Agricultural Chemical Co. (Bradley Fertilizer Co., branch), Boston, Mass.: —
- Bradley's Complete Manure for Potatoes and Vegetables.
- Bradley's Complete Manure for Corn and Grain.
- Bradley's Complete Manure with Ten Per Cent. Potash.

The American Agricultural Chemical Co. (Bradley Fertilizer Co., branch), Boston, Mass. — *Con.*
- Bradley's Complete Top-dressing for Grass and Grain.
- Bradley's X L Superphosphate.
- Bradley's Potato Manure.
- Bradley's Potato Fertilizer.
- Bradley's Corn Phosphate.
- Bradley's Eclipse Phosphate.
- Bradley's Niagara Phosphate.
- Bradley's English Lawn Fertilizer.
- Church's Fish and Potash.
- Bradley's Seeding-down Manure.

American Agricultural Chemical Co. (H. J. Baker & Bro., branch), New York, N. Y.: —
- Baker's A A Ammoniated Superphosphate.
- Baker's Complete Potato Manure.

The American Agricultural Chemical Co. (Clark's Cove Fertilizer Co., branch), Boston, Mass.: —
- Clark's Cove Bay State Fertilizer.
- Clark's Cove Bay State Fertilizer G. G.
- Clark's Cove Great Planet Manure.
- Clark's Cove Potato Manure.

The American Agricultural Chemical Co. (Clark's Cove Fertilizer Co., branch), Boston, Mass. — *Con.*
- Clark's Cove Potato Fertilizer.
- Clark's Cove King Philip Guano.

The American Agricultural Chemical Co. (Crocker Fertilizer and Chemical Co., branch), Buffalo, N. Y.: —
- Crocker's Potato, Hop and Tobacco Phosphate.
- Crocker's Corn Phosphate.
- Crocker's A A Complete Manure.

The American Agricultural Chemical Co. (Cumberland Bone Phosphate Co., branch), Boston, Mass.: —
- Cumberland Superphosphate.
- Cumberland Potato Fertilizer.

The American Agricultural Chemical Co. (L. B. Darling Fertilizer Co., branch), Pawtucket, R. I.: —
- Darling's Blood, Bone and Potash.
- Darling's Complete Ten Per Cent. Manure.
- Darling's Potato Manure.
- Darling's Farm Favorite.
- Darling's General Fertilizer.

The American Agricultural Chemical Co. (Great Eastern Fertilizer Co., branch), Rutland, Vt.: —
- Northern Corn Special.
- Vegetable Vine and Tobacco.
- Garden Special.
- General.
- Grass and Oat Fertilizer.

The American Agricultural Chemical Co. (Pacific Guano Co., branch), Boston, Mass.: —
- Pacific High-grade General.
- Pacific Potato Special.
- Soluble Pacific Guano.
- Pacific Nobsque Guano.

The American Agricultural Chemical Co. (Packers' Union Fertilizer Co., branch), Rutland, Vt.: —
- Gardners' Complete Manure.
- Animal Corn Fertilizer.
- Potato Manure.
- Universal Fertilizer.
- Wheat, Oats and Clover Fertilizer.

The American Agricultural Chemical Co. (Quinnipiac Co., branch), Boston, Mass.: —
- Quinnipiac Market-garden Manure.
- Quinnipiac Phosphate.
- Quinnipiac Potato Manure.
- Quinnipiac Potato Phosphate.
- Quinnipiac Corn Manure.

The American Agricultural Chemical Co. (Quinnipiac Co., branch), Boston, Mass. — *Con.*
- Quinnipiac Climax Phosphate.
- Quinnipiac Havana Tobacco Grower.
- Quinnipiac Onion Manure.

The American Agricultural Chemical Co. (Read Fertilizer Co., branch), New York, N. Y.: —
- Read's Practical Potato Special.
- Read's Farmers' Friend.
- Read's Standard.
- Read's High-grade Farmers' Friend.
- Read's Vegetable and Vine.

The American Agricultural Chemical Co (Standard Fertilizer Co., branch), Boston, Mass.: —
- Standard Complete Manure.
- Standard Fertilizer.
- Standard Special for Potatoes.
- Standard Guano.

The American Agricultural Chemical Co. (H. F. Tucker & Co., branch), Boston, Mass.: —
- Tucker's Original Bay State Bone Superphosphate.
- Tucker's Special Potato.

The American Agricultural Chemical Co. (Williams & Clark Fertilizer Co., branch), Boston, Mass.: —
- Williams & Clark's High-grade Special.
- Williams & Clark's Americus Potato.
- Williams & Clark's Potato Phosphate.
- Williams & Clark's Potato Manure.
- Williams & Clark's Corn Phosphate.
- Williams & Clark's Royal Bone Phosphate.
- Williams & Clark's Prolific Crop Producer.

The American Agricultural Chemical Co. (M. E. Wheeler & Co., branch), Rutland, Vt.: —
- Corn Fertilizer.
- Potato Manure.
- Havana Tobacco Grower.
- Superior Truck Fertilizer.
- Bermuda Onion Grower.
- Grass and Oats Fertilizer.

W. H. Abbott, Holyoke, Mass.: —
- Abbott's Animal Fertilizer.
- Abbott's Eagle Brand.
- Abbott's Tobacco Fertilizer.

Abbott and Martin Rendering Co., Columbus, O.: —
- Harvest King.
- Abbott's Tobacco and Potato Special.

The American Cotton Oil Co., New York, N. Y.: —
- Cotton-seed Meal.
- Cotton-seed Hull Ashes.

The American Linseed Co., New York, N. Y.: —
- Cleveland Flax Meal.

Armour Fertilizer Works, Baltimore, Md.: —
- Grain Grower.
- Bone, Blood and Potash.
- High-grade Potato.
- All Soluble.
- Ammoniated Bone with Potash.
- Bone Meal.

H. J. Baker & Bro., New York, N. Y.: —
- Baker's Pure Castor Pomace.

Berkshire Fertilizer Co., Bridgeport, Conn.: —
- Berkshire Complete Fertilizer.
- Berkshire Ammoniated Bone Phosphate.
- Berkshire Potato and Vegetable Phosphate.

T. H. Bunch, Little Rock, Ark.: —
- Cotton-seed meal.

Beach Soap Co., Lawrence, Mass.: —
- Beach's Advance Brand.
- Beach's Universal Brand.

Joseph Breck & Sons, Boston, Mass.: —
- Breck's Lawn and Garden Dressing.
- Breck's Market-garden Manure.

Bowker Fertilizer Co., Boston, Mass.: —
- Stockbridge Special Manures.
- Bowker's Hill and Drill Phosphate.
- Bowker's Farm and Garden Phosphate.
- Bowker's Lawn and Garden Dressing.
- Bowker's Potato and Vegetable Manure.
- Bowker's Fish and Potash (Square Brand).
- Bowker's Potato and Vegetable Phosphate.
- Bowker's Sure Crop Phosphate.
- Gloucester Fish and Potash.
- Bowker's High-grade Fertilizer.
- Bowker's Bone and Wood Ash Fertilizer.
- Bowker's Fish and Potash (D Brand).
- Bowker's Corn Phosphate.
- Bowker's Bone, Blood and Potash.
- Bowker's Early Potato Manure.
- Bowker's Soluble Animal Fertilizer.
- Bowker's Tobacco Starter.
- Bowker's Tobacco Ash Fertilizer.

Bowker Fertilizer Co., Boston, Mass. — *Con.*
- Bowker's Market-garden Manure.
- Bowker's Potash Bone.
- Bowker's Ten Per Cent. Manure.
- Bowker's Kainit.
- Bowker's Complete Mixture.
- Bowker's Ammoniated Food for Flowers.
- Bristol Fish and Potash.
- Bowker's Fine-ground Fish.
- Bowker's Tobacco Ash Elements.
- Bowker's Ground Bone.
- Bowker's Wood Ashes.
- Bowker's Superphosphate.
- Sulfate of Ammonia.
- Nitrate of Soda.
- Dissolved Bone-black.
- Muriate of Potash.
- Sulfate of Potash.
- Dried Blood.

Chicopee Rendering Co., Springfield, Mass.: —
- Pure Ground Bone.
- Tankage.
- Complete Animal Fertilizer or Lawn and Garden Dressing.

Chas. M. Cox & Co., Boston, Mass.: —
- Cotton-seed Meal.

E. Frank Coe Co., New York, N. Y.: —
- E. Frank Coe's High-grade Ammoniated Bone Superphosphate.
- E. Frank Coe's Gold Brand Excelsior Guano.
- E. Frank Coe's Bay State Phosphate.
- E. Frank Coe's Tobacco and Onion Fertilizer.
- E. Frank Coe's Excelsior Potato Fertilizer.
- E. Frank Coe's Fish Guano and Potash (F. P.).
- E. Frank Coe's Columbian Corn Fertilizer.
- E. Frank Coe's Columbian Potato Fertilizer.
- E. Frank Coe's New Englander Corn Fertilizer.
- E. Frank Coe's New Englander Potato Fertilizer.
- E. Frank Coe's Columbian Ammoniated Bone Superphosphate.
- E. Frank Coe's Red Brand Excelsior Guano.
- E. Frank Coe's Ground Bone.
- American Farmers' Market-garden Special.
- American Farmers' Complete Potato.
- American Farmers' Corn King.

John C. Dow & Co., Boston, Mass.: —
- Dow's Pure Ground Bone.

Eastern Chemical Co., Boston, Mass.: —
Chemicals for Imperial Liquid Plant Food.
Chemicals for Liquid Grass Fertilizer.

Wm. E. Fyfe & Co., Clinton, Mass.: —
Canada Ashes (Star Brand).

R. & J. Farquhar & Co., Boston, Mass.: —
Clay's London Fertilizer.

F. E. Hancock, Walkerton, Ontario, Can.: —
Pure Unleached Canada Hard-wood Ashes.

The Hardy Packing Co., Chicago, Ill.: —
Hardy's Tankage, Bone and Potash.
Hardy's Tobacco and Potato Special.
Hardy's Complete Manure.

Hargraves Manufacturing Co., Fall River, Mass.: —
Fine-ground Bone and Tankage.

C. W. Hastings, Jamaica Plain, Mass.: —
Ferti Flora.

Thomas Hersom & Co., New Bedford, Mass.: —
Bone Meal.
Meat and Bone.

John Joynt, Lucknow, Ontario, Can.: —
Canada Hard-wood Ashes.

Lister's Agricultural Chemical Works, Newark, N. J.: —
Lister's Success Fertilizer.
Lister's Special Corn Fertilizer.
Lister's Special Potato Fertilizer.
Lister's Potato Manure.
Lister's High-grade Special for Spring Crops.
Lister's Animal Bone and Potash.

Lowell Fertilizer Co., Boston, Mass.: —
Swift's Lowell Potato Phosphate.
Swift's Lowell Potato Manure.
Swift's Lowell Bone Fertilizer.
Swift's Lowell Animal Brand.
Swift's Lowell Ground Bone.
Swift's Lowell Lawn Dressing.
Swift's Lowell Market-garden Manure.
Swift's Lowell Nitrate of Soda.

Mapes Formula and Peruvian Guano Co., New York, N. Y.: —
Potato Manure.
Tobacco Starter Improved.
Tobacco Manure Wrapper Brand.
Economical Potato Manure.
Average Soils Complete Manure.

Mapes Formula and Peruvian Guano Co., New York, N. Y. — *Con.*
Vegetable Manure or Complete Manure for Light Soils.
Corn Manure.
Complete Manure (A Brand).
Cereal Brand.
Complete Manure Ten Per Cent. Potash.
Top-dresser Improved, Half Strength.
Tobacco Ash Constituents.
Grass and Grain Spring Top-dressing.
Complete Manure for General Use.
Fruit and Vine Manure.
Cauliflower and Cabbage Manure.
Lawn Top-dressing.

D. M. Moulton, Monson, Mass.: —
Ground Bone.

National Fertilizer Co., Bridgeport, Conn.: —
Chittenden's Complete Fertilizer.
Chittenden's High-grade Special for Tobacco.
Chittenden's Market Garden.
Chittenden's Potato Phosphate.
Chittenden's Ammoniated Bone.
Chittenden's Fish and Potash.

New England Fertilizer Co., Boston, Mass.: —
New England Corn Phosphate.
New England Potato Fertilizer.

Olds & Whipple, Hartford, Conn.: —
Complete Tobacco Fertilizer.
Vegetable Potash.

The Ohio Farmers' Fertilizer Co., Columbus, O.: —
Corn, Oats and Wheat Fish Guano.
Tobacco and Potato Special.
High-grade Truck Guano.

Parmenter & Polsey Fertilizer Co., Boston, Mass.: —
Plymouth Rock Brand.
Special Potato.
Star Brand.
P. & P. Potato.
A. A. Brand.
Lawn Dressing.
Special Fertilizer for Strawberries.
Grain Grower.
Acid Phosphate.
Muriate of Potash.
Nitrate of Soda.
Sulfate of Potash.

R. T. Prentiss, Holyoke, Mass.: —
Complete Fertilizers.

Benjamin Randall, Boston, Mass.: —
Randall's Market Garden.
Randall's Farm and Field

Rogers Manufacturing Co., Rockfall, Conn.: —
- All Round Fertilizer.
- Complete Potato and Vegetable.
- High-grade Complete Corn and Grain.
- Fish and Potash Fertilizer.
- High-grade Soluble Tobacco and Potato.
- High-grade Fertilizer for Oats and Top-dressing.
- High-grade Grass and Grain.
- High-grade Soluble Tobacco Fertilizer.
- Pure Fine-ground Bone.

Rogers & Hubbard Co., Middletown, Conn.: —
- Hubbard's Oats and Top-dressing.
- Hubbard's Grass and Grain.
- Hubbard's Soluble Corn Manure.
- Hubbard's Soluble Potato Manure.
- Hubbard's Soluble Tobacco Manure.
- Hubbard's All Soils and All Crops.
- Hubbard's Corn Phosphate.
- Hubbard's Potato Phosphate.
- Hubbard's '02 Top-dressing.
- Hubbard's Raw Knuckle Bone Flour.
- Hubbard's Strictly Pure Fine Bone.

Ross Brothers, Worcester, Mass.: —
- Ross Brothers' Lawn Dressing.

Russia Cement Co., Gloucester, Mass.: —
- Essex Dry Ground Fish.
- Essex Complete Manure for Potatoes, Roots and Vegetables.
- Essex Complete Manure for Corn, Grain and Grass.
- Essex Market-garden and Potato Manure.
- Essex Corn Fertilizer.
- Essex A. I. Superphosphate.
- Essex X X X Fish and Potash.
- Essex Odorless Lawn Dressing.
- Essex Tobacco Starter.
- Essex Special Tobacco Manure.
- Essex Rhode Island Special Fertilizer.
- Essex High-grade Sulfate of Potash.
- Essex Nitrate of Soda.

Chas. Stevens, Napanee, Ontario, Can.: —
- Beaver Brand Ashes.

Salisbury Cutlery Handle Co., Salisbury, Conn.: —
- Pure Ground Bone.

Sanderson's Fertilizer and Chemical Co., New Haven, Conn.: —
- Sanderson's Formula A.
- Sanderson's Formula B.
- Sulfate of Potash.
- Sanderson's Old Reliable.
- Sanderson's Potato Manure.
- Sanderson's Corn Superphosphate,
- Sanderson's Special with Ten Per Cent. Potash.

Thomas L. Stetson, Randolph, Mass.: —
- Bone Meal.

W. H. Warren, Northborough, Mass.: —
- Fine-ground Bone.

Wilcox Fertilizer Works, Mystic, Conn.: —
- Wilcox Potato, Onion and Tobacco Manure.
- Wilcox Potato Manure.
- Wilcox Complete Bone Superphosphate.
- Wilcox Fish and Potash.
- Wilcox High-grade Tobacco Fertilizer.
- Wilcox Dry Ground Fish.

Sanford Winter, Brockton, Mass.: —
- Pure Ground Bone.

The Whitman & Pratt Rendering Co., Lowell, Mass.: —
- All Crops.
- Potato Plowman.
- Corn Success.
- Ground Bone.

J. M. Woodard & Bro., Greenfield, Mass.: —
- Tankage.

A. H. Wood & Co., South Framingham, Mass.: —
- Special Fertilizer for Corn, Potatoes, etc.
- Special Manure for Market Gardening, Top-dressing, etc.

Part II. — Report on General Work in the Chemical Laboratory.

C. A. GOESSMANN.

1. Analyses of materials forwarded for examination.
2. Notes on soil analyses.
3. Notes on wood ashes and lime ashes.
4. Notes on Peruvian guano.
5. Notes on sugar-beet refuse.
6. Notes on city garbage products.

1. Analyses of Materials forwarded for Examination.

During the season of 1903, 235 samples of fertilizing materials and miscellaneous substances have been received from farmers within our State for analysis. Many of these materials are refuse or by-products from some manufacturing industry. Some of these by-products contain only nitrogen, some contain phosphoric acid or possibly potash compounds, others contain two, and many of them contain all, of the essential elements of plant food. In either case the material possesses a distinct commercial value, which can be ascertained only by a careful chemical analysis.

As in the past, the investigation of materials for general fertilizing purposes has been carried on free of charge to farmers within our State. Our practice has been to analyze this class of materials in the order in which the samples arrive at this office. Beginning about April 1 and continuing through the summer and early fall, work of this nature has to give place to our official inspection work on commercial fertilizers. For this reason we would advise those sending samples for analysis free of charge to send as early in the season as possible. The winter season usually offers more time to attend to this kind of work, and therefore enables us to furnish results of analysis more promptly than at any other period of the year.

During the year we have taken an active part in the work of the Association of Official Agricultural Chemists, which aims to investigate any new modes of analysis in agricultural chemistry. The result of our labors along this line, as well as other investigation work of a technical nature, does not appear in our publications, as its chief value is in the establishment of new methods of analysis.

Following is a list of materials received during the past season: —

Wood ashes,	41	Dry ground fish,	6
Complete fertilizers,	34	Ground bones,	6
Soils,	70	Minerals,	12
Lime ashes,	10	Phosphatic slag,	4
Cotton-seed meal,	8	Nitrate of soda,	4
Dissolved bone-black,	2	Peat,	2
Tankage,	3	Tannery lime waste,	2
Cotton hull ashes,	2	Muriate of potash,	3
Superphosphate,	1	Cotton-seed dust,	1
High-grade sulfate of potash,	2	Cotton-seed droppings,	1
Cocoanut fiber pith,	1	Refuse ashes,	1
New York horse manure,	1	Sulfate of ammonia,	1
Sheep manure and wool waste,	1	Belgian phosphate,	1
Lime refuse,	1	Cassava waste,	1
Garbage tankage,	1	Manure,	1
Waste lime, plastering,	1	Mill refuse,	1
Acid phosphate,	1	Peruvian guano,	1
Coal and wood ashes,	1	Granite,	1
Sugar-beet refuse,	1	Bat guano,	1
Cotton waste,	1	Dried blood,	1
Lime,	1	Wool waste,	2

2. Notes on Soil Analyses.

In the above list of materials which have been forwarded for analysis during the season we would call attention to the increased number of samples of soil which have been received, as compared with previous years. The information desired by parties sending soil samples for analysis is, in most cases, What are the necessary fertilizing ingredients to be applied to this particular soil, and in what proportion in order to produce successfully any given crop? We are trying to aid in answering this inquiry by every means within our power, and shall continue, as in the past, to analyze samples of soil; yet we must insist that the samples of soil forwarded for investigation are taken according to our instructions, which are of late published in every March bulletin of this division (see Bulletin No. 89, March, 1903), otherwise the analysis can be of little practical value. The information furnished by a chemical analysis of soil is still of an arbitrary nature, and furnishes only the amount of the various ingredients of plant food present in the soil, without reference to their availability to any particular plant. Knowing that our present methods for the determination of the availability of plant food in soils is not as satisfactory as could be desired, we are studying the subject continually, believing that more satisfactory ones can be secured only by a constant attention to the questions involved.

3. Notes on Wood Ashes and Lime Ashes.

(*a*) *Wood Ashes.* — During the season of 1903, 17.4 per cent. of the materials forwarded for analysis consisted of wood ashes, as against 24 per cent. for the year previous. The following compilation shows their general chemical character: —

Analysis of Wood Ashes.	Number of Samples.
Moisture from 1 to 10 per cent.,	11
Moisture from 10 to 20 per cent.,	14
Moisture from 20 to 30 per cent.,	9
Moisture above 30 per cent.,	3
Potassium oxide above 8 per cent.,	2
Potassium oxide from 6 to 7 per cent.,	4
Potassium oxide from 5 to 6 per cent.,	8
Potassium oxide from 4 to 5 per cent.,	12
Potassium oxide from 3 to 4 per cent.,	8
Potassium oxide below 3 per cent.,	3
Phosphoric acid from 1 to 2 per cent.,	34
Phosphoric acid below 1 per cent.,	3
Average per cent. of calcium oxide (lime), 29.39.	
Insoluble matter below 10 per cent.,	7
Insoluble matter from 10 to 15 per cent.,	12
Insoluble matter from 15 to 20 per cent.,	9
Insoluble matter above 20 per cent.,	8

Table showing the Maximum, Minimum and Average Per Cents. of the Different Ingredients found in Wood Ashes for the Season of 1903.

	Maximum.	Minimum.	Average.
Moisture,	37.34	2.27	15.23
Potassium oxide,	8.15	1.68	4.76
Phosphoric acid,	1.80	.46	1.37
Calcium oxide,	35.75	22.33	29.39
Insoluble matter,	28.85	1.40	15.07

We advise farmers, before buying ashes, to ascertain if the party of whom they are to purchase is on record as having complied with our State laws, and holds a license for the sale of his article in Massachusetts. Protection by our State laws is only secured by patronizing dealers and importers who have complied with our laws for the regulation of the trade in commercial fertilizers.

There are indications that more care is taken by some of our importers in the collection and shipment of ashes than has been the case in the past. In some cases as high as 8 and 9 per cent. of potassium oxide has been guaranteed in carloads of ashes imported from Canada; this is 3 or 4 per cent. higher than the usual guarantee of this element. The importance of buying ashes on a specified guaranteed composition of each of the essential elements, — potash, phosphoric acid, and also lime — cannot be too strongly urged upon our farmers.

(*b*) *Lime Ashes.* — Judging from the increased number of samples of lime ashes that have been received during the season for analysis, this material is used more commonly than heretofore to furnish lime to those soils which require an application of this ingredient. Although being a valuable source of lime, it is well to remember that lime ashes are a refuse product in the production of burned lime, and are therefore apt to vary widely in chemical composition (see following table), depending largely upon the mode of handling as well as exposure to the weather. Lime ashes should therefore be bought on a statement of guarantee of the quantity of lime, potash and phosphoric acid which they contain. The small quantity of phosphoric acid in lime ashes is derived from the wood that is used in charging the kiln; the potash is derived partially from this same source and partially from the limestone; both of these elements are therefore apt to vary widely in different samples.

Table showing the Maximum, Minimum and Average Per Cents. of the Different Ingredients found in Lime Ashes for the Season of 1903.

	Maximum.	Minimum.	Average.
Moisture,	23.16	10.47	15.66
Potassium oxide,	3.32	.76	1.86
Phosphoric acid,	1.66	.03	.63
Calcium oxide,	55.44	32.42	41.15
Insoluble matter,	26.50	1.10	6.46

4. Notes on Peruvian Guano.

Analysis of Peruvian Guano recently introduced into our Markets.

	Per Cent.
Moisture,	17.10
Total phosphoric acid,	21.26
Soluble phosphoric acid,	2.81
Reverted phosphoric acid,	10.47
Insoluble phosphoric acid,	7.98
Potassium oxide,	4.20
Nitrogen,	3.23

The above-stated article has of late been again introduced into our markets; it is evidently a genuine sample of Peruvian guano, and of a valuable composition as a general fertilizer. As Peruvian guanos are known to vary more or less in regard to their chemical composition, they should always be bought and sold on a statement of their guaranteed composition. A detailed discussion of the occurrence of Peruvian guanos, their merits as a fertilizer and their historic importance with reference to the introduction of commercial fertilizers, will be found in the annual report of the inspector of commercial fertilizers to the Massachusetts State Board of Agriculture for the years 1875–76.

5. Notes on Sugar-beet Refuse.

Analysis of Sugar-beet Refuse forwarded for Investigation.

	Per Cent.
Moisture,	7.70
Phosphoric acid,	none
Total potassium oxide,	9.72
Water soluble potassium oxide,	8.36
Total nitrogen,	6.39
Nitrogen as nitrates,	3.86
Nitrogen as ammoniates,	.05
Nitrogen in organic form,	2.48
Calcium oxide,	none
Sodium oxide,	7.00
Sulphuric acid,	2.82
Chlorine,	1.87
Carbonic acid,	none

The above material is a waste product from the sugar-beet industry: it is produced in the process of manufacturing alcohol from the beet-sugar molasses; it is rich in potash and nitrogen, and deserves special attention in the production of tobacco and other industrial crops. The successful introduction of the beet-sugar manufacture as a home industry already benefits our agricultural interests in many ways, as was predicted by the friends of the sugar-beet industry years ago.

6. Notes on City Garbage Products.

Sample No. 1 represents what is known as garbage tankage: sample No. 2 represents the ashes from the cremation of city garbage.

Analysis of Garbage Products.

	Per Cent.	
	Sample No. 1.	Sample No. 2.
Moisture,	7.42	3.01
Potassium oxide,	none.	5.13
Total phosphoric acid,	6.06	8.77
Available phosphoric acid,	4.40	–*
Insoluble phosphoric acid,	1.66	–*
Nitrogen,	5.96	none.

* Not determined.

The above-mentioned materials are products obtained by hygienic treatment of city garbage. Sample No. 1 was obtained by heating the selected garbage in vats under pressure; by this method the fats are recovered; and the organic nitrogenous matter is preserved for use as a nitrogen source in fertilizers. In this process, however, the greater part of the potash and other salines are leached out. Sample No. 2 represents the product obtained by the cremation of city garbage. In this material the nitrogen has been sacrificed, but the potash is retained in the ashes. The products from both of these processes furnish valuable material for fertilizing purposes; they should always be bought and sold on a statement of guaranteed composition.

REPORT OF THE ENTOMOLOGISTS.

C. H. FERNALD, H. T. FERNALD.

The entomological division during 1903 has continued its work along lines similar to those of preceding years. The correspondence has received careful attention, but has been less than usual, probably because fewer insects have made their presence felt, owing to the peculiar weather conditions of the spring and summer.

The experiments to determine a simple and successful treatment for the San José scale have been continued according to a plan which promises well, and which, so far as can be learned, has not been tried elsewhere in this country. Certain difficulties have arisen, however, and whether it will be possible to proceed with these experiments during 1904 cannot now be determined.

Much attention has been given to the collections of insects at the insectary during the year, and, as a result, they are now more nearly expressive of our present knowledge than ever before.

The card catalogue has now entirely outgrown the cases intended to contain it, thus rendering it less useful for reference, but it is hoped that this difficulty may be soon overcome.

It is a generally recognized fact that original investigation and publication are among the most important functions of an experiment station. That the entomological division of the station has not fallen behind in this portion of its duties is seen by the following list of articles on entomology published during the present year by persons working at the insectary, either for the station, or by those fitting themselves for that work: —

C. H. Fernald: "The Brown-tail Moth" (with A. H. Kirkland), under direction of the State Board of Agriculture, Boston, March, 1903; "Colour Blindness in Entomologists," Canadian Entomologist, July, 1903.

H. T. Fernald: "Orchard Treatment for the San José Scale," Bulletin No. 86, Hatch Experiment Station, February, 1903; "How shall we arrange our Collections?" Entomological News, April, 1903; "First Annual Report of the State Nursery Inspector," Agriculture of Massachusetts for 1902, June, 1903; "Plant Lice," Nature Leaflet No. 18, Massachusetts Board of Agriculture, July, 1903; "Some Important Scale Insects," Massachusetts Crop Report for September, October, 1903; "Notes on the Species of Isodontia," Canadian Entomologist, October, 1903; "The Plum Webbing Saw Fly" (with E. A. Back), Entomological News, November, 1903; "Two New Species of Sphex," Psyche, October–December, December, 1903.

Mrs. M. E. Fernald: "Notes on the Coccidæ," Canadian Entomologist, January, 1903; "Lepidosaphes *versus* Mytilaspis," Canadian Entomologist, April, 1903; "Catalogue of the Coccidæ of the World," Bulletin No. 88, Hatch Experiment Station, July, 1903.

H. J. Franklin: "Notes on Acanthothrips," Psyche, October–December, December, 1903.

A. W. Morrill: "Life History and Description of the Strawberry Aleyrodes," Canadian Entomologist, February, 1903; "Notes on some Aleyrodes from Massachusetts, with Description of New Species," Psyche, April, 1903; "Notes on the Early Stages of Corylophodes marginicollis Lec," Entomological News, May, 1903; "New Apoidea from Montana," Canadian Entomologist, August, 1903; "Notes on the Immature Stages of Some Tingitids of the Genus Corythuca," Psyche, August, 1903; "The Greenhouse Aleyrodes and the Strawberry Aleyrodes," Technical Bulletin No. 1, Hatch Experiment Station, August, 1903.

Besides these, several other papers are either in press or well advanced in preparation, and will soon be published.

Insects of the Year.

The present year has seen the great abundance of a few kinds of insects, but taken as a whole the season has been unfavorable for their rapid increase. The early spring was apparently normal in its character, but about the first of May a period of drought began, which continued well into June. During this period the grass dried up and in many places became brown and dead, and large numbers of insects were found clinging to it, having seemingly died of starvation. The result was that the hay crop, though late, was but little affected by insects; and similar results were more or less evident with nearly all crops, as regards their insect foes.

In a few cases, however, these weather conditions were favorable to insect life. The plant lice, which are usually destroyed in large numbers by cold spring rains, were this year almost entirely unchecked, and, increasing rapidly, did much injury to trees and plants already suffering from the lack of rain. The damage caused by plant lice was particularly noticeable on fruit stock, elms and maples, many of which suffered severely; and even when the heavy rains came later, destroying myriads of the lice, so many were present that large numbers survived, thus continuing the injury to more than an ordinary amount till quite late in the fall.

The spring weather also seemed to be unusually favorable for root maggots of various kinds, the onion maggot causing a large amount of loss to the onion growers in the Connecticut valley in particular, while the work of the cabbage maggot was seen everywhere. During the year more inquiries were received by this division about maggots than during the preceding eight years taken together.

The apple-tree tent-caterpillar was more abundant last spring than for a number of years, but whether the peculiar season has had the effect of destroying these insects sufficiently to prevent their appearance in large numbers in 1904 cannot now be determined.

The elm-leaf beetle began the season actively, and by May 21 their egg clusters were very abundant everywhere, but particularly on those trees which were not treated in 1902. Later in the season, however, their work was less noticeable than usual, and, in fact, there were many places where spraying seemed unnecessary. Whether the nature of the season or factors yet undiscovered were the cause of their slight importance is not known.

The San José scale has increased rapidly during the year, wherever it occurs. Crawling young were found last spring on June 9, nearly two weeks earlier than the year before, and during the summer and fall this insect seemed to increase in abundance more rapidly than usual.

During the year 1902 a new plum pest appeared in the Connecticut valley, spinning its webs entirely over the trees in May and early June. On investigation it proved to be a saw fly hitherto known only from South Dakota and Manitoba. Of this insect, which is known as *Neurotoma rufipes* Marl., the life history has been worked out at this station during the present year and published. While this insect has already shown great possibilities as a serious pest on the plum, it is too soon to predict that it will actually become such; but the results of the studies made here show that, if treated when it first appears, it should be easily controlled.

The plum curculio is always in evidence on the plums, and to some degree on the apples; but this year it has paid particular attention to the latter fruit, and by its punctures has reduced many thousands of bushels of apples from first class to a lower grade. Whether the unusually large amount of injury to apples by the curculio this year was due to a greater number of the insects which succeeded in passing through the preceding winter alive, or whether it was due to an insufficient supply of plums for them to attack last spring, is difficult to determine; possibly both factors occurred.

For several years the imported willow-borer (*Cryptorhynchus lapathi*) has been present in great abundance. The injuries which it causes to willows, poplars and similar soft-wooded trees are frequently serious; and it is now almost impossible to raise these trees in some localities, thus greatly reducing their value for planting as holders of the soil in such places as on sandy beaches. No satisfactory method of combating this insect has as yet been discovered.

The brown-tail moth has continued to enlarge its area of occupation, and it is only a question of time how soon it will be a pest all over New England.

The gypsy moth has now to a considerable extent recovered from the attacks made upon it by the State, which ceased in 1899, and in many places is as abundant as it ever was. A careful examination of a large part of the infested territory shows one change from former conditions; then, in towns not generally badly infested, the insect would be found in colonies, while elsewhere the trees and plants were not infested; at the present time the colonies in such towns are not as populous perhaps as formerly, but the insects are generally scattered, a few here and a few there, thus producing what may be termed a general distribution. This probably settles the possibility of extermination in the negative for the future. The State has lost its opportunity, and must abide by the results. No new important parasitic or predaceous foes have appeared thus far, and man must depend almost entirely on his own exertions to control this pest.

REPORT OF THE AGRICULTURISTS.

WM. P. BROOKS; ASSISTANT, F. R. CHURCH.

The agricultural department during the past season has followed up the main lines of inquiry pertaining to the selection of manures and fertilizers for the various crops of the field and garden previously undertaken. It is recognized that the inevitable variations due to seasonal and other conditions beyond control make necessary numerous repetitions of an experiment before results justify general conclusions. It is comparatively easy, for example, to determine whether a given fertilizer is useful to a given crop upon a given field in any one year. One is not, therefore, justified in concluding that it will prove useful every year; one does not know that it will prove useful in other combinations of fertilizer materials, nor even that its continued use may not ultimately prove harmful in certain directions.

Results must be tested by experiments again and again, and yet again, before the conditions affecting them can be estimated at their true value, safe deductions drawn therefrom that will be generally useful, or advice founded upon them. The past season, so exceptional in character, affords striking illustration of the necessity of such repetition in the nature of the results from the use of a number of materials which it was believed we quite fully understood. As a means of testing the results in plot experiments in the open field, where numerous conditions are beyond control, we have the past season continued the system of closed plot and vegetation experiments.

We have begun a series of experiments with asparagus, for which we have been making preparation for the past two years, having laid out forty-two plots for that purpose, with a view to seeking light as to the manurial needs of the crop, both as regards the selection and amount of materials required and the time of application. One-year-old plants of our own growing were set last spring, and have made a good start.

Forty-eight new varieties of potatoes have been given a preliminary trial, but will not be reported until after another year.

Our grass garden, with forty-eight species and seven varieties, has been thoroughly cared for, and one-half the plot of each species lawn-mowed throughout the season.

Exclusive of these plots of grass, our work has involved the care of two hundred and twenty-three plots in the open field and one hundred and fifty closed plots, while our vegetation experiments have required the care of two hundred and fifty-four plots.

The work with poultry has been of practically the same amount as in recent years, as we some time ago reached the limit with our present equipment. The study of the relations of feeds to egg production has engaged the greater share of the time devoted to this line of work.

In this report will be presented a statement of results obtained in a portion only of the plot experiments pertaining to the use of manures and fertilizers. Other results are reserved for discussion in bulletins which it is hoped may be published within the near future. A brief statement only will be made in this report of the general results obtained in our experiments with poultry.

The nature of the principal subjects of inquiry and the more important conclusions will be made clear by the following statement: —

I. — The relative value of barnyard manure, nitrate of soda, sulfate of ammonia and dried blood as sources of nitrogen. Soy beans, the crop of this year, gave yields on the basis of which the materials rank in the following order: barnyard manure, nitrate of soda, dried blood, sulfate of ammonia. The nitrate of soda ranks relatively lower this year than in most previous years, but the general average to date ranks the materials as follows, on the basis of increases in the crops as compared with the no-nitrogen plots: nitrate of soda, 100; barnyard manure, 77.8; dried blood, 65.1; sulfate of ammonia, 63.6.

II. — The relative value of muriate and high-grade sulfate of potash for field crops. The results of this year indicate the sulfate to be superior to the muriate for potatoes. For the soy beans the two salts gave nearly equal yields, while the crops of cabbages and onions were practical failures on both salts, largely, it is believed, because of the unfavorable season.

III. — *A.* The relative value of nitrate of soda, sulfate of ammonia, and dried blood, used in connection with manure, as sources of nitrogen for garden crops. The results indicate these materials used in amounts furnishing equal nitrogen to rank for this year in the following order: for the early crops, — including dandelions, strawberries, peas and beets, — dried blood, nitrate of soda, sulfate of ammonia; for the late crops, nitrate of soda ranks first, followed by dried blood and sulfate of ammonia. *B.* Relative value of sulfate and muriate of potash for garden crops. The results of the year indicate the sulfate of potash to be the better for strawberries, tomatoes, cucumbers, celery and turnips; while the muriate has given slightly superior results with dandelions, peas and beets.

IV. — The relative value of different potash salts for field crops. The salts under comparison are high-grade sulfate, low-grade sulfate, kainite, muriate, nitrate, carbonate and silicate. The crop of this year was clover, mixed with timothy. As indicated by the yields of clover, the best results were obtained on the high-grade sulfate; while the silicate, carbonate, low-grade sulfate and nitrate gave results almost as good. The yield of timothy was heaviest on the kainite and muriate. As last year, one of the most striking results of the experiment was the injury to the clover due to potash salts containing chlorine, — especially to the kainite.

V. — The relative value of phosphates used in quantities furnishing equal phosphoric acid to each plot. The crop of this year was cabbages, and those which gave satisfactory growth and yield in the order of their rank are: dissolved bone meal, South Carolina rock phosphate, raw bone meal, phosphatic slag, steamed bone meal, and dissolved bone-black. Three phosphates gave results much inferior to any of the others, viz., Tennessee phosphate, apatite, and Florida soft phosphate.

VI. — *A*. Soil test with corn. The crop of this year was very small on all plots, owing to the unfavorable season; but the potash increased the crop to a far greater extent than any other plant-food element. *B*. Soil test with mixed grass and clover. The results demonstrate the close dependence of the grass crop upon the supply of nitrate of soda. They indicate also the increased tendency of continued use of nitrate and muriate of potash to bring the soil into an acid condition. Another marked result is the effect of an application of lime in increasing the proportion of timothy in a mowing sown to a mixture of timothy, red-top and clover.

VII. — To determine the economical result of using in rotation on grass lands: the first year, barnyard manure; the second year, wood ashes; and the third year, ground bone and muriate of potash. The average yield of hay, all three systems of manuring being represented, is at the rate of 8,104 pounds per acre in two crops. The average on that portion of the field reseeded last summer is on one plot at the rate of 8,546.5 pounds for the reseeded portion; for the portion not reseeded, 6,243 pounds. On another plot the average yield on the reseeded portion is at the rate of 10,003 pounds, and on the portion not reseeded 5,642 pounds, per acre.

VIII. — Winter compared with spring application of manure. The field where this experiment is tried slopes moderately lengthwise of the plots. The crop this year was soy beans, and the crops under the two systems of application were not far from equal, but with the advantage slightly in favor of the winter over spring application. This result appears to have been due to the fact that the ground beneath its covering of snow remained unfrozen throughout the winter, and that there was practically no wash over the surface.

IX. — To determine the best nutritive ratio or the best mixture of feeds for laying hens. The results of the year appear to indicate that it is not essential to feed a mixture of feeds giving a narrow nutritive ratio for satisfactory egg production. They indicate, further, that the proportion of fat in the ration is a matter of much importance, a large proportion favoring egg production; and that, on the other hand, a large proportion of fiber in the ration, such as would be furnished when grains like oats and barley are largely used, is unfavorable to egg production. A ration in which corn is prominent has given results considerably superior to those obtained with the ration in which wheat is prominent; and the economic results in feeding corn largely in connection with a suitable amount of animal food are much superior to the similar results with wheat.

I. — Manure and Fertilizers furnishing Nitrogen compared. (Field A.)

A full description of the plan of the experiment on Field A was given in the twelfth annual report of the Hatch Experiment Station. There are two objects in view: first, to compare the efficiency (as measured by crop production) of a few of the standard materials that may be used on the farm as sources of nitrogen; second, to determine to what extent the introduction of a crop belonging to the clover family is capable of rendering the application of nitrogen to a succeeding crop of another family unnecessary. The materials furnishing nitrogen under comparison are barnyard manure, nitrate of soda, sulfate of ammonia, and dried blood. There are eleven plots in the field, and with few and practically unimportant exceptions each has been manured in the same way since 1899. All plots are liberally manured each year with materials supplying phosphoric acid and potash, and in quantities to furnish these elements in equal amounts. Manure or fertilizers supplying nitrogen are applied yearly to eight of the eleven plots, and in quantities to furnish nitrogen at the rate of 45 pounds per acre to each. Barnyard manure is applied to one plot, nitrate of soda to two, sulfate of ammonia to three, and dried blood to two plots. Three plots have had no nitrogen applied to them since 1884. The potash applied to these plots is supplied in the form of muriate to six plots, viz., 1, 3, 6, 7, 8 and 9. It is supplied in the form of low-grade sulfate to four plots, viz., 2, 4, 5 and 10. The crops grown in this experiment previous to this year in the order of their succession have been: oats, rye, soy beans, oats, soy beans, oats, soy beans, oats, oats, clover, potatoes, soy beans, potatoes. The crop of this year was the medium green soy bean.

It will be generally understood that, if the object in view in an experiment should be simply the determination of the relative value of different materials applied as sources of nitrogen, such a crop as the soy bean (which belongs to the clover family, and which therefore under the right conditions can draw upon the air for a portion or perhaps for all of its nitrogen) would not be selected; but we are testing not simply the relative value of the different nitrogen manures, but also the effect of the legume grown on the no-nitrogen plots upon the succeeding crop. Accordingly, the soy bean, which is one of the most successful of the legumes grown as a hoed crop, was our choice, as it has been several other years, during the progress of this experiment.

The crop was planted on May 20, and was well cared for throughout the season. No accident or inequality in extent of insect or other damage on the several plots interfered with the normal results of the experiment; but the season was highly unfavorable to the growth of the crop, which is one requiring protracted warm weather.

Although the yield on the plots to which the nitrate of soda was applied was fairly satisfactory, attention is here called to the fact that this fertilizer seems to exert an adverse influence upon the early development of the soy bean. It has been repeatedly noticed that where nitrate of soda is the source of nitrogen, the leaves, especially in the early stages of growth, assume a crinkled or wrinkled appearance, and fail to reach full size and normal development. This crinkling appears to be due to the death of the marginal tissues of the leaf, and such death is supposed to be due to an accumulation of nitrates in injurious amounts in these tissues. The margin of the leaf ceasing to grow, while its main body still continues to develop, the inevitable consequence is the crinkling effect which has been alluded to. As the season advances, the soy bean plants as a rule show a more normal leaf development; and, although the crinkling this season was excessive, the yield on the nitrate of soda plots does not appear to have been materially decreased, as a consequence.

Attention is here called, with regret, to the fact that there was undoubtedly an error made in determining the weight of the straw on Plot 10. Close observation throughout the season leads to the conclusion on the part both of my assistant and myself that the relative growth of vines as compared with seed on this plot was quite as large as on any other in the field, and yet the weight as reported shows it to have been in proportion to seed less than on any other plot.

The yields obtained on the several plots and the sources of nitrogen on each are shown in the following table:—

Yield of Soy Beans per Acre.

Plots.	Nitrogen Fertilizers used.	Beans (Bushels).	Straw (Pounds).
0, .	Barnyard manure (most of potash used contained in the manure).	23.8	2,010
1, .	Nitrate of soda (muriate of potash), ...	20.5	1,700
2, .	Nitrate of soda (sulfate of potash), ...	24.8	2,080
3, .	Dried blood (muriate of potash), ...	16.7	2,015
4, .	No nitrogen (sulfate of potash), ...	17.1	1,705
5, .	Sulfate of ammonia (sulfate of potash), ...	16.9	1,480
6, .	Sulfate of ammonia (muriate of potash), ...	11.6	1,160
7, .	No nitrogen (muriate of potash), ...	11.1	1,125
8, .	Sulfate of ammonia (muriate of potash), ...	14.8	1,390
9, .	No nitrogen (muriate of potash), ...	8.8	745
10, .	Dried blood (sulfate of potash), ...	21.7	1,225

It will be noticed that the crop, even on the best plot, this year is small. In 1901, when the same crop was grown, the yield on the poorest plot was at a higher rate (25.86 bushels of seed) than that on the best plot this year; while the average yield on all plots, including those to which no nitrogen was applied, was at the rate of 29.9 bushels per acre in 1901. The inferiority of the crop of this year was undoubtedly largely the consequence of the unfavorable season, although there is some evidence that this soil may once more need an application of lime. It has received no lime since 1898, when this material was applied at the rate of one ton to the acre. An abundance of lime in the soil is well known to be highly important to nearly all legumes.

The average yields of this year, as affected by the fertilizers used, are clearly shown in the following table: —

Fertilizers used.	Beans (Bushels).	Straw (Pounds).
Average of the no-nitrogen plots (3),	12.3	1,192
Average of the nitrate of soda plots (2),	22.7	1,890
Average of the dried blood plots (2),	19.2	1,620
Average of the sulfate of ammonia plots (3),	14.4	1,343

As the result of all experiments previous to this year, it is found that the materials furnishing nitrogen have produced crops ranking in the following order: —

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	93.10
Sulfate of ammonia,	92.00
Dried blood,	90.80
No nitrogen,	73.80

Similar averages for this year are shown below: —

Fertilizers used.	Beans (Per Cent.).	Straw (Per Cent.).
Barnyard manure,	100.00	100.00
Nitrate of soda,	95.38	94.03
Dried blood,	80.67	80.60
Sulfate of ammonia,	60.50	66.82
No nitrogen,	51.68	59.30

The nitrate of soda, as last year, stands relatively lower than it usually has done. It is believed that the excessive rains of the past two seasons have caused the loss of some of the nitrate of soda; which may well have washed through the soil and been carried away in the drainage waters.

The average yield of all the nitrogen plots, as compared with the average of those receiving no nitrogen, is shown below: —

	Beans (Bushels).	Straw (Pounds).
Average, 8 nitrogen plots,	18.85	1,633
Average, 3 no-nitrogen plots,	12.33	1,192

It will be noticed that the no-nitrogen plots give only about 65 per cent. as much seed as the plots receiving nitrogen, and about 73 per cent. as much straw. The nodules in which are found the bacteria connected with the assimilation of atmospheric nitrogen were very abundant upon the roots of the plants upon all plots, as was determined by frequent examination. In spite of this fact, the supply of nitrogen at the disposition of the plants on the no-nitrogen plots appears to have been inadequate for even fairly vigorous growth. No reason can be assigned, unless it be that the acid condition of the soil prevented the normal action of the agencies connected with the assimilation of atmospheric nitrogen.

In conclusion, attention is called to the fact that nitrate of soda must be regarded as one of the most desirable of the materials that can be purchased as a source of nitrogen. The cost of nitrogen in this form is lower than in most other materials, and in this as well as in other experiments upon our grounds it usually shows itself to be more effective than any other nitrogen fertilizer. Its superiority to the other materials used in this experiment is made more evident if in place of comparing total yields we compare the increases in yields produced by the several nitrogen fertilizers. On this basis, including all crops raised to date, but taking into account the seed only for this year, the different materials rank as follows: —

Relative Increases in Yields, Average for Fourteen Years.

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	77.80
Dried blood,	65.10
Sulfate of ammonia,	63.60

II. — The Relative Value of Muriate and High-grade Sulfate of Potash. (Field B.)

The experiments on this field are in continuation of work which has been in progress since 1892, and I cannot do better in introducing what is to be reported for this year than to quote from my last annual report. The object of this experiment "is to determine the relative value for different crops of the two leading and cheapest sources of potash, viz., muriate and high-grade sulfate. These salts are used in equal quantities continuously upon the same land. The field contains eleven plots, of approximately one-eighth of an acre each. Of these, six have been yearly manured with muriate of potash and five with the high-grade sulfate. From 1892 to 1899 inclusive these salts were used at the rate of 400 pounds per acre; since 1900 the rate of application has been 250 pounds per acre. Fine-ground bone at the rate of 600 pounds per acre has been yearly applied to all plots. Various crops have been grown in rotation, including potatoes, field corn, sweet corn, grasses, oats and vetch, barley and vetch, winter rye, clovers of various kinds, sugar beets, soy beans and cabbages. Most of these crops have been grown during several years. All have with few exceptions given uniformly large yields. The results to date may be summarized as follows: among the crops grown, the potatoes, clovers, cabbages and soy beans have usually done much the best on sulfate of potash; the yield of corn, grasses, oats, barley, vetches and sugar beets has been about equally good on the two salts; the quality of the potatoes and sugar beets produced on the sulfate of potash plots has been distinctly better than that of the crops produced on the muriate of potash."

The crops of the past year have been potatoes, cabbages, onions, and soy beans, while on two plots perennial garden crops and small fruits, viz., rhubarb, asparagus, raspberries and blackberries have been started. The crops both of onions and cabbages were practically failures: in both cases, it is believed, largely on account of the abnormally cold and otherwise very unfavorable season. The onion crop throughout this entire section was in general the poorest known for years. The cabbages made a healthy growth, but, as the season proved, were started much too late. With average summer temperatures the crop would have matured, but under the conditions of the past season few heads reached marketable development. The number of such heads on the muriate of potash was considerably more than on the sulfate, and the total weight of the crop on the muriate was at the rate of about 4,400 pounds per acre greater than on the sulfate. In the case of the onions the total weight of crop produced, including scallions and tops, was at the rate of about 1,000 pounds per acre greater on the muriate than on the sulfate, but there were only 5 bushels more of good onions. In view of the nature of the results with these two crops, further details concerning them will not be given.

1. Soy Beans (Sulfate v. Muriate of Potash).

The variety of soy beans grown in this experiment was the medium green. This crop occupied two plots (17 and 18), which last year produced a crop of cabbages. The yield of cabbages last year on the sulfate of potash was at the rate of about 5 tons to the acre more than on the muriate. The crop this year suffered from no accidental conditions affecting results, but owing to the unfavorable season the yields were very small. The results are shown in the table: —

Muriate v. High-grade Sulfate of Potash. — Medium Green Soy Beans, Yields per Acre.

Fertilizers used.	Beans (Bushels).	Straw (Pounds).
Muriate of potash,	11.20	1,000
Sulfate of potash,	10.73	689

It will be noted that the yield of beans is slightly greater on the muriate than on the sulfate; the difference, however, is exceedingly small, and no especial significance can be attached to it. In previous years the sulfate of potash has usually given the better crop of this variety of beans, and I am still inclined to advise its selection. The greater depletion of the soil as a result of the heavy yield of cabbages last year on the plot receiving the sulfate of potash may in part account for the fact that the sulfate of potash this year fails to show its usual superiority.

2. *Potatoes (Sulfate v. Muriate of Potash).*

The potatoes in this experiment were of the Beauty of Hebron variety; the seed was grown in northern Maine. This crop occupied two plots (11 and 12), which last year produced a mixed crop of timothy and clover. The sod was broken this spring, and the seed, which had been previously treated with formalin for destruction of scab spores, and budded, was planted on May 16. An effort was made to protect the crop from insects and blight by the use of prepared insecticides and fungicides offered in our markets. These proved fairly satisfactory in the destruction of the potato beetle, but were not entirely effective in preventing blight. The vines began to show signs of blight on July 18, but its progress was slow; there was but very little rot, and the yield was fairly satisfactory. The potatoes were dug after the vines were entirely dead, and the yields were as shown below.

Muriate v. High-grade Sulfate of Potash. — Potatoes, Yield per Acre (Bushels).

FERTILIZERS USED.	Merchantable.	Small.
Muriate of potash,	171.71	29.94
Sulfate of potash,	194.58	29.09

It will be noticed that the yield of small tubers was practically identical on the two potash salts, but that the sulfate of potash gave a yield of merchantable tubers at the rate of nearly 23 bushels per acre greater than the muriate. This result is in exact agreement with the results of many other experiments which have been tried upon our grounds; and it seems to be impossible to doubt that sulfate of potash should be generally selected for the potato, rather than the muriate, for all soils which have a fair capacity to retain moisture.

Farmers raising the crop on such soils should demand potato fertilizers in which this salt has been used as the source of potash. Not only is the crop almost invariably larger on the sulfate, but it is of superior eating quality. Previous experiments here have shown that it almost invariably contains from 2 to 3 per cent. more starch, and that when cooked the potatoes are whiter, of better flavor, and more mealy.

III. — Fertilizers for Garden Crops. (Field C.)

The object in this experiment is to study the influence of a few standard fertilizers used continuously upon the same land upon the yield of garden crops. The experiments were begun in 1891, and from that date to 1897 inclusive fertilizers alone were applied to the land. During the past six years stable manure also has been applied in equal quantities (at the rate of 30 tons per acre) to each of the plots, while the fertilizers have been used in the same amounts and applied to the same plots as at first. The original number of plots in the experiment was six, of about one-eighth of an acre each. On all of these fertilizers were used. When we first began to apply manure as well as fertilizers, we introduced into the experiment a seventh plot of the same area as the others, but which had had different previous manurial treatment. To this we have since applied manure only at the above-named rate. This plot was introduced in order that we might have a basis for determining whether the materials used were in any degree beneficial when added to the somewhat liberal quantity of manure employed. It was found that at first the yields of almost all crops on the manure alone were almost as good as those where the fertilizers also were used. In a few cases the manure alone gave the better crops. It is not believed that we are justified in concluding that the fertilizers have been used without beneficial effect, for the no-fertilizer plot introduced in 1898 had, previous to that year, been more heavily manured than the other plots. The superiority of the plot receiving manure alone seems to be gradually decreasing, and this plot will doubtless ultimately serve as a basis for making fair comparisons between the results obtainable with manure alone and results obtained with equal manure and fertilizers. Up to the present time it is not considered to have furnished such a basis, and no reference accordingly will be made in this report to the yields upon this plot.

All the prominent out-door garden crops in this locality have been grown in rotation upon each plot, and each crop during several years. The list of crops so far grown includes spinach, lettuce, onions, garden peas, table beets, early and late cabbages, potatoes, tomatoes, squashes, cucumbers, turnips, sweet corn, celery, and one small fruit, — strawberries. Asparagus and rhubarb were set in 1902, but no cuttings have yet been made, and these will not therefore be referred to in this report.

As stated in my last annual report, these "experiments have been planned with reference to throwing light especially upon two points: *A*. The relative value of nitrate of soda, sulfate of ammonia and dried blood used as sources of nitrogen. *B*. The relative value of sulfate of potash and muriate of potash. These two points will be separately discussed."

A. — The Relative Value of Nitrate of Soda, Sulfate of Ammonia and Dried Blood as Sources of Nitrogen.

The three fertilizers compared as sources of nitrogen have from the first been applied in such amounts as to furnish equal nitrogen to each plot (at the rate of 60 pounds per acre), and each fertilizer is always applied to the same plot. An application supplying per acre the amount of nitrogen above named requires the annual application of materials at about the following rates per acre: —

	Pounds.
Nitrate of soda,	375
Sulfate of ammonia,	300
Dried blood,	850

Each of these nitrogen fertilizers is used on two plots, on one with sulfate of potash, on the other with muriate, — in both cases in such quantities as to furnish equal actual potash.

The results with some of the crops, especially where sulfate of ammonia is the source of nitrogen, have been widely different on these two potash salts, the yields on the sulfate being greatly superior to those on the muriate. The potash salts are applied in such quantities as to furnish potash at the rate of 120 pounds per acre, which requires the use of about 240 pounds of commercial muriate or high-grade sulfate of potash. Dissolved bone-black is used on all plots as the source of phosphoric acid, and in such quantity as to furnish phosphoric acid at the rate of about 50.4 pounds per acre. To furnish this, dissolved bone-black is applied at the rate of about 320 pounds per acre.

The results previous to this year may be summarized as in our last annual report. For the early crops, *i.e.*, the crops making most of their growth before mid-summer, including onions, lettuce, table beets, garden peas, spinach, early cabbages and strawberries, the nitrate of soda has been found the most effective source of nitrogen. The relative standing of the different nitrogen fertilizers, as measured by the total yields, including leaves, vines and tops as well as the marketable product, is as follows: —

	Per Cent.
Nitrate of soda,	100.00
Dried blood,	93.70
Sulfate of ammonia,	57.30

For the late crops, including late cabbages, turnips, celery, tomatoes and squashes: —

	Per Cent.
Nitrate of soda,	100.00
Dried blood,	99.00
Sulfate of ammonia,	78.40

The crops grown in this experiment this year for which results will be reported include strawberries, followed by celery; dandelions, followed by cucumbers; tomatoes; beets; and garden peas, followed by turnips. The weather conditions have been highly unfavorable to the normal growth and development of some of these crops, especially tomatoes, but a small proportion of which ripened, and cucumbers. The excessively dry weather of the month of May, followed by the equally excessively wet weather of the month of June, gave us conditions no doubt extremely unfavorable to the action of all the nitrogen fertilizers, but apparently particularly so in the case of the nitrate of soda. Moreover, considerable damage was done both to dandelions and strawberries through the burning of the leaves, caused by the application of the nitrate of soda and the sulfate of ammonia. The application of either of these chemicals as a top-dressing to a growing crop requires the utmost care. It was not the belief of the assistant applying the materials that these chemicals adhered to the leaves when applied in such quantity as to prove injurious; but the result proved that he was mistaken in his judgment, for the injury through burning of the leaves both of the dandelions and the strawberries where nitrate of soda and sulfate of ammonia were applied was very serious. Doubtless as a consequence chiefly of the conditions to which attention has been called, the dried blood, as compared with the other nitrogen fertilizers, ranks this year relatively higher than in any previous year.

The average rate of yield per acre obtained with each of the nitrogen fertilizers, used it will be remembered in addition to the manure, for the present season is shown in the following table: —

Nitrogen Fertilizers for Garden Crops. — Rate of Yield per Acre (Pounds), Average of Two Plots.

Fertilizers used.	Dandelions.	Strawberries.	Peas.		Beets.	
			Pods, Green.	Vines, Green.	Roots.	Tops.
Sulfate of ammonia, .	37,857	5,010	11,210	9,758	37,866	43,507
Nitrate of soda, . . .	35,098	5,489	9,880	8,710	44,319	49,643
Dried blood, . . .	48,312	10,072	11,694	11,129	46,429	41,689

Nitrogen Fertilizers for Garden Crops, etc. — Concluded.

Fertilizers used.	Tomatoes.			Cucumbers.		Celery.	Turnips.		
	Ripe.	Green.	Vines.	Fruit.	Vines.		Large.	Small.	Leaves.
Sulfate of ammonia.	8,613	26,891	18,293	2,772	5,979	16,870	33,442	12,662	29,221
Nitrate of soda,	8,293	24,726	16,768	4,701	8,016	34,553	44,351	7,598	33,442
Dried blood, .	8,171	23,842	12,805	2,718	4,076	24,797	48,701	3,896	27,923

The relative influence of the nitrogen fertilizers has differed widely for the different crops, as is evident on examination of the above tables, and each must therefore be separately discussed.

Dandelions. — This crop was started in the summer of 1902. The fertilizers this year were applied evenly on April 14. The leaves, as above stated, were badly burned whereever nitrate of soda or sulfate of ammonia was used. The crop was cut May 6, at which time it was judged that the leaves had reached their maximum development. The plants were in blossom, and of course somewhat beyond the stage at which the crop is commonly cut for market. On the basis of the yields obtained, the relative standing of the different nitrogen fertilizers was as follows: —

	Per Cent.
Dried blood,	100.00
Sulfate of ammonia,	78.36
Nitrate of soda,	72.66

There can be no doubt that, as a result of the burning effect alluded to, both the sulfate of ammonia and nitrate of soda actually decreased the yield.

Strawberries. — The vines from which the fruit harvested this year was picked were set in the spring of 1902. The fertilizers used were evenly spread broadcast on April 14. Within a few days the leaves began to show marked injury on the nitrate of soda and sulfate of ammonia plots. On the basis of total weights of ripe fruit, the nitrogen fertilizers ranked in the following order: —

	Per Cent.
Dried blood,	100.00
Nitrate of soda,	54.50
Sulfate of ammonia,	49.74

Without doubt both the nitrate of soda and the sulfate of ammonia proved actually injurious.

Garden Peas. — The fertilizers applied to this crop were spread broadcast after plowing on April 30, and harrowed in. On the basis of weights of pods and vines harvested, the nitrogen fertilizers take the following relative rank: —

Fertilizers used.	Pods (Per Cent.).	Vines (Per Cent.).
Dried blood,	100.00	100.00
Sulfate of ammonia,	95.86	87.68
Nitrate of soda,	84.55	78.26

The yields on the sulfate of ammonia were slightly greater than where no fertilizer was added to the manure. On the nitrate of soda they were considerably less, and there is no evidence that the latter benefited the crop.

Table Beets. — The fertilizers for this crop were applied at the same time and in the same manner as for the peas. As indicated by the yields, the relative standing of the different nitrogen fertilizers for this crop is as follows: —

Fertilizers used.	Beets (Per Cent.).	Tops (Per Cent.).
Dried blood,	100.00	83.97
Nitrate of soda,	95.47	100.00
Sulfate of ammonia,	83.50	87.62

The fertilizers were apparently moderately beneficial to this crop, but the nitrate of soda stands relatively much lower than in previous years.

Tomatoes. — Fertilizers were applied as in the case of garden peas. The relative standing of the nitrogen fertilizers, as indicated by the yields (ripe and green fruit and vines), is as follows: —

Fertilizers used.	Ripe Fruit (Per Cent.).	Green Fruit (Per Cent.).	Tops (Per Cent.).
Sulfate of ammonia,	100.00	100.00	100.00
Nitrate of soda,	96.28	91.97	91.67
Dried blood,	94.86	88.66	70.00

Cucumbers. — The cucumbers were planted on June 30, being put in to replace squashes, which had been killed by too heavy an application of kerosene emulsion. The relative standing of the nitrogen fertilizers, as indicated by the weights of the fruit and vines, is as follows: —

Fertilizers used.	Fruit (Per Cent.).	Vines (Per Cent.).
Nitrate of soda,	100.00	100.00
Sulfate of ammonia,	58.96	74.53
Dried blood,	57.80	50.81

The vines in this experiment were somewhat affected by fungi, which doubtless influenced both yield of fruit and growth. The nitrate appears to have exerted a very favorable influence, but the reasons, in view of the character of the season and the lateness of the crop of cucumbers, are not evident. Both the amount of fruit, however, and the weight of the vines produced where the nitrate was used were materially greater than where no fertilizers were employed.

Celery. — This crop followed the fruiting strawberries, and the manure applied this year to these plots was turned in with the strawberry vines. The fertilizers called for on the several plots had been applied in the spring as a top-dressing to the strawberries. The relative standing of the different nitrogen fertilizers, as indicated by the total weight of the crop when dug in the fall and the roots freed from earth, is as follows: —

	Per Cent.
Nitrate of soda,	100.00
Dried blood,	71.76
Sulfate of ammonia,	48.94

Turnips. — This crop was sown on July 30, following garden peas. The variety was the White Egg. The relative standing of the nitrogen fertilizers, as indicated by the weights of roots of the different qualities and leaves, is as follows: —

Fertilizers used.	Merchantable (Per Cent.).	Culls (Per Cent.).	Leaves (Per Cent.).
Dried blood,	100.00	30.61	83.33
Nitrate of soda,	91.20	60.20	100.00
Sulfate of ammonia,	68.80	100.00	87.21

The relative standing of the different nitrogen fertilizers for the early crops of this year, including dandelions, strawberries, peas and beets, as indicated by the combined weights of merchantable products, tops and vines, is: —

	Per Cent.
Dried blood,	100.00
Nitrate of soda,	83.13
Sulfate of ammonia,	82.67

For the late crops, including tomatoes, cucumbers, celery, cabbages and turnips, the relative standing determined in the same manner is: —

	Per Cent.
Nitrate of soda,	100.00
Dried blood,	95.20
Sulfate of ammonia,	85.74

Combining the results of 1903 with the twelve previous years, the relative standing of the nitrogen fertilizers is: —

	Per Cent.
For the early crops: —	
Nitrate of soda,	100.00
Dried blood,	95.42
Sulfate of ammonia,	60.03
For the late crops: —	
Nitrate of soda,	100.00
Dried blood,	98.76
Sulfate of ammonia,	78.96

B. — The Relative Value of Sulfate and Muriate of Potash for Garden Crops.

The general conditions under which these experiments have been tried have been already outlined. It will be remembered that these salts are under trial in connection with the sulfate of ammonia, nitrate of soda and dried blood as sources of nitrogen when used in addition to manure for garden crops. The crops grown on these two potash salts, therefore, are the same as those which have been named in discussing the relative value of the different nitrogen fertilizers. Each potash salt is used on three plots, *i.e.*, with each of the three nitrogen fertilizers. The results for the past year are shown by the following table: —

Sulfate and Muriate of Potash compared as Fertilizers for Garden Crops. — Yield per Acre (Pounds), Average of Three Plots.

FERTILIZERS USED.	Dandelions.	Strawberries.	PEAS.		BEETS.	
			Pods, Green.	Vines, Green.	Roots.	Tops.
Muriate of potash,	41,385	6,531	11,586	9,570	44,502	45,541
High-grade sulfate of potash,	39,459	7,183	10,269	10,162	41,840	44,351

Sulfate and Muriate of Potash compared, etc. — Concluded.

FERTILIZERS USED.	TOMATOES.			CUCUMBERS.		Celery.	TURNIPS.		
	Ripe.	Green.	Vines.	Fruit.	Vines.		Large.	Small.	Leaves.
Muriate of potash.	8,069	24,797	14,431	2,699	4,982	24,119	42,208	7,143	28,918
High-grade sulfate of potash.	8,648	25,508	17,480	4,094	7,065	26,694	42,121	8,961	31,472

Examination of the table reveals the fact that the results for this season are the precise opposite of the results which have been obtained in most of our previous experiments. The muriate of potash gives the greater yield in the case of all the early crops, and the sulfate of potash the larger yield in the case of all the late crops. It is well understood that muriate of potash dissolves and diffuses through the soil somewhat more readily than sulfate, and, further, that it makes soils more retentive of moisture; and it may be that the great deficiency in rainfall which prevailed during the season until early in June left the soil so dry that the sulfate of potash did not become sufficiently dissolved and diffused to become available to the early crops.

The relative average standing of these two salts, as indicated by the total yields of all crops grown previous to this year, is shown in the following table: —

FERTILIZERS USED.	Early Crops (Per Cent.).	Late Crops (Per Cent.).
Sulfate of potash,	100.00	100.00
Muriate of potash,	93.20	102.90

The relative average standing for this year, determined upon the same basis, is as follows : —

Fertilizers used.	Early Crops (Per Cent.).	Late Crops (Per Cent.).
Muriate of potash, ...	100.00	92.66
Sulfate of potash, ...	98.36	100.00

Combining these results with those of the twelve previous years, the average standing, as indicated by total yields, is as shown in the following table : —

Fertilizers used.	Early Crops (Per Cent.).	Late Crops (Per Cent.).
Sulfate of potash, ...	100.00	97.97
Muriate of potash, ...	93.84	100.00

The total rainfall during the past season from April 17, the date when the fertilizers were applied to the dandelions and strawberries, to June 7 was .48 inches. Such a rainfall must have been quite insufficient to bring the less soluble fertilizers into circulation, and the failure of the sulfate of potash to produce its usual effect on the early crops is not surprising. It has been repeatedly noticed in experiments here that in excessively dry seasons the muriate of potash usually excels the sulfate for all crops, even those which ordinarily do better on the sulfate. Following this period of excessive drouth came a period extending from the 7th of June to the end of the month with equally excessive rainfall, the total precipitation for that period amounting to 7.79 inches. July was also a comparatively rainy month, and it seems probable that the more soluble muriate of potash may have been largely carried into the subsoil. In this position it would not be equally available to the late crops as the less soluble sulfate.

It is not the belief of the writer that the fact that the relation of the two potash salts for this season to early and late crops respectively is exactly the reverse of what it has been in previous years, should lead to a modification of the advice which has been previously given, viz., that the sulfate should generally be preferred for the early crops and the muriate for the late on all soils with a fair capacity to retain moisture.

IV. — Comparison of Different Potash Salts for Field Crops. (Field G.)

The experiment for comparison of different potash salts was begun in 1898. The field contains forty plots, of about one-fortieth of an acre each. The plots are fertilized in five series of eight plots each, each series including a no-potash plot and one plot for each of the potash salts under comparison. Those salts are kainite, high-grade sulfate, low-grade sulfate, muriate, nitrate, carbonate and silicate. Each is applied annually to the same plot, and all are used in such amounts as to furnish equal potash to each plot. In the quantities employed the different salts supply annually actual potash at the rate of 165 pounds per acre. All plots are equally manured with materials furnishing fairly liberal amounts of nitrogen and phosphoric acid. The crop of the past season was mixed clover and timothy. This is the second year that this crop has occupied the land. The table which follows, showing yields, does not quite accurately show the effect of the fertilizers. It was out of the question to separate weeds and grasses from the clover in an experiment conducted on the scale of this. Most careful examination often repeated during the season made the following points self-evident: —

1. That on the no-potash plots the clover was very thin, but the weeds of various kinds were relatively abundant.

2. That on the plots to which kainite was applied the clover was weaker than on any of the other plots receiving potash. The timothy, on the other hand, was more abundant and apparently more vigorous on the kainite plots than on the others.

3. On the muriate of potash plots the clover was inferior to all other plots receiving potash except the kainite, and here also timothy was relatively abundant and vigorous.

4. The clover on the low-grade sulfate of potash plots was distinctly inferior to that on the high-grade sulfate.

The fact that the differences above noted were repeated with little variation in each of the series of plots leaves no room to doubt the highly unfavorable influence on the development of the clover of the kainite and the muriate, and the moderately unfavorable effect of the low-grade sulfate.

The field was cut twice, the hay carefully cured, to a considerable extent in cocks, and without much loss of leaf or head. The table shows the rates of yield per acre for both first and second cut, as well as the total for each plot: —

Clover. — Yield per Acre (Pounds).

Plots.	Potash Salt.	Hay.	Rowen.	Total.
1,	No potash,	3,462	1,653	5,115
2,	Kainite,	3,462	3,592	7,054
3,	High-grade sulfate,	3,307	1,586	4,893
4,	Low-grade sulfate,	3,150	2,100	5,250
5,	Muriate,	3,441	2,368	5,809
6,	Nitrate,	2,927	2,234	5,161
7,	Carbonate,	2,882	2,011	4,893
8,	Silicate,	3,128	2,279	5,407
9,	No potash,	3,239	1,698	4,937
10,	Kainite,	4,424	2,435	6,859
11,	High-grade sulfate,	4,021	2,011	6,032
12,	Low-grade sulfate,	3,977	1,921	5,898
13,	Muriate,	3,753	2,055	5,808
14,	Nitrate,	3,977	2,100	6,077
15,	Carbonate,	3,462	2,011	5,473
16,	Silicate,	4,155	1,988	6,143
17,	No potash,	3,753	1,720	5,473
18,	Kainite,	4,357	1,698	6,055
19,	High-grade sulfate,	4,066	1,698	5,764
20,	Low-grade sulfate,	4,200	2,190	6,390
21,	Muriate,	4,379	2,145	6,524
22,	Nitrate,	3,843	1,899	5,742
23,	Carbonate,	4,021	1,609	5,630
24,	Silicate,	3,999	1,966	5,965
25,	No potash,	2,458	1,609	4,067
26,	Kainite,	4,021	2,122	6,143
27,	High-grade sulfate,	3,753	1,519	5,272
28,	Low-grade sulfate,	4,446	1,966	6,412

Clover. — Yield per Acre (Pounds) — Concluded.

Plots.	Potash Salt.	Hay.	Rowen.	Total.
29, ...	Muriate, ...	3,820	1,765	5,585
30, ...	Nitrate, ...	3,664	1,430	5,094
31, ...	Carbonate, ...	3,664	1,452	5,116
32, ...	Silicate, ...	4,021	1,787	5,808
33, ...	No potash, ...	3,619	1,519	5,138
34, ...	Kainite, ...	4,088	1,921	6,009
35, ...	High-grade sulfate, ...	3,709	1,631	5,340
36, ...	Low-grade sulfate, ...	4,111	1,564	5,675
37, ...	Muriate, ...	3,932	1,832	5,764
38, ...	Nitrate, ...	3,441	1,698	5,139
39, ...	Carbonate, ...	3,753	1,810	5,563
40, ...	Silicate, ...	3,887	1,787	5,674

The influence of the different potash salts is somewhat more clearly brought out by the table below, which gives the average results for each of the potash salts employed : —

Clover. — Average Yield per Acre (Pounds).

Potash Salt.	Hay.	Rowen.	Total.
No potash (plots 1, 9, 17, 25, 33), ...	2,066	1,025	3,091
Kainite (plots 2, 10, 18, 26, 34), ...	2,544	1,471	4,015
High-grade sulfate (plots, 3, 11, 19, 27, 35), . . .	2,357	1,056	3,413
Low-grade sulfate (plots 4, 12, 20, 28, 36), . . .	2,485	1,218	3,703
Muriate (plots 5, 13, 21, 29, 37), ...	2,416	1,271	3,687
Nitrate (plots 6, 14, 22, 30, 38), ...	2,232	1,170	3,402
Carbonate (plots 7, 15, 23, 31, 39), ...	2,223	1,112	3,335
Silicate (plots 8, 16, 24, 32, 40), ...	2,399	1,226	3,625

The average yield on the plot receiving no potash is much lower than on the other plots, in spite of the fact that weeds helped to a considerable extent to make up the deficiency in clover and timothy. The kainite gives the highest total yield of hay. This was doubtless in part due to the fact that the large mixture of timothy enabled the crop to stand up better during the heavy rains of the month of June than on those plots where the clover so largely predominated. The plots receiving high-grade sulfate of potash lodged very badly, — more seriously than any other plots in the field; and, as bad weather necessitated cutting the crop somewhat late, the vigor of the plants was undoubtedly lowered, as shown by the relatively low yield of rowen on these plots. They without doubt exhibited the highest average development of clover during the early part of the season, and with a more normal season should have given the heaviest rowen.

What is true of the high-grade sulfate of potash plots is doubtless also true in somewhat lesser degree of the plots manured with the silicate, carbonate and nitrate.

The experiment of this year lends additional support to the advice which has previously been given, viz., that "on soils with good retentive qualities sulfate of potash should generally be preferred to muriate or kainite for clovers," in spite of the fact that the total yields, including timothy, are heavier on these plots.

V. — Comparison of Phosphates on the Basis of Equal Application of Phosphoric Acid.

In this experiment, which has now been in progress seven years, we are endeavoring to determine by means of the growing crops the relative availability of a number of different phosphates. Those under comparison are as follows: apatite, South Carolina rock phosphate, Florida soft phosphate, phosphatic slag, Tennessee phosphate, dissolved boneblack, raw bone, dissolved bone, steamed bone, and acid phosphate.

All phosphates under comparison are used in amounts sufficient to furnish actual phosphoric acid at the rate of 96 pounds per acre, and each is applied annually in finely ground form to the same plot. The field contains thirteen plots, of about one-eighth of an acre each. Three of these plots have received no application of phosphoric acid since the beginning of the experiment. One of these is at either end, and the other in the middle, of the field. All plots are supplied alike with materials furnishing nitrogen and potash in available forms in liberal amount and in equal quantities to each. The materials used as sources of nitrogen and potash furnish nitrogen at the rate of 52 pounds and potash at the rate of 152 pounds per acre. With some crops a supplementary application of a quick-acting nitrogen fertilizer has been made to all plots alike. The crops which have been grown in this field during the progress of the experiment are as follows: corn, cabbages, corn, in 1900 two crops, — oats and Hungarian grass (both for hay), onions, and onions. With the exception of the onions, all the crops previously grown in this field have given good yields, even on the three plots in the field which have received no phosphate.

The soil of the field at the beginning of the experiment was not quite even in quality throughout. Plot 1 surpassed any other in the field in fertility at the start, and on the whole (although the difference is not very marked) there appears to be a gradual natural decline in productiveness from this end of the field toward the other.

The crop of the present season was cabbages. The variety is the Danish Ball-head. The seed was sown at the usual time for the crop in this locality, but so abnormally cold was the season that the crop was far from mature when cold weather set in. Still, the yields (which include weight of stumps, loose leaves and soft heads, as well as the weight of hard heads and totals) make it possible to estimate the relative availability of the different phosphates to the crop grown. The rates of yield per acre are shown in the following table: —

Cabbages on Plots with Equal Amounts of Phosphoric Acid.

Plots.	Fertilizers used.	Number of Hard Heads.	Hard Heads (Pounds).	Soft Heads, Leaves and Stumps (Pounds).	Total Crop (Pounds).
1,	No phosphate,	1,184	4,040	9,360	13,400
2,	Apatite,	776	3,560	17,360	20,920
3,	South Carolina rock phosphate,	2,928	12,040	24,480	36,520
4,	Florida soft phosphate,	816	3,840	21,840	25,680
5,	Phosphatic slag,	2,232	9,920	28,040	37,960
6,	Tennessee phosphate,	440	1,720	29,160	30,880
7,	No phosphate,	104	400	14,120	14,520
8,	Dissolved bone-black,	2,336	8,392	31,520	39,912
9,	Raw bone,	2,304	11,800	32,440	44,240
10,	Dissolved bone meal,	2,384	12,760	29,320	42,080
11,	Steamed bone meal,	1,632	8,720	28,200	36,920
12,	Acid phosphate,	1,296	6,200	24,120	30,320
13,	No phosphate,	120	440	8,080	8,520

The most important points to which it seems desirable to call attention are the following: —

1. The no-phosphate plots give very low yields both of hard heads and total, indicating the marked dependence of the cabbage upon the supply of phosphoric acid.

2. Apatite and soft Florida phosphate are the least effective among the phosphates employed.

3. South Carolina rock gives a surprisingly good return, being exceeded in yield of hard heads by only one plot, — the one receiving dissolved bone, — while in total yield it is materially exceeded by but few.

4. The phosphatic slag ranks among the best of the phosphates used. It is exceeded in yield of hard heads by the dissolved bone-black, the South Carolina rock and the raw bone, in the order named: while in total weight of crop it is exceeded by the dissolved bone, the raw bone and the dissolved bone-black.

5. The most valuable crop in the field is that produced by the dissolved bone, although it is slightly exceeded in total yield by the crop on the raw bone.

6. Particular attention is called to the fact that this year, as in preceding years, the raw bone meal gives a crop much superior to that obtained by the use of steamed bone meal.

The differences in the development of the cabbages on the different plots in the field, as affected by the phosphates applied, became manifest at a very early date. The plants were scarcely a week old before marked differences could be seen: and the relative development throughout the season, as recorded after several examinations, was in about the order indicated by the final yields, although most observers ranked the crop on the phosphatic slag while growing relatively higher than indicated by the final result.

In estimating the significance of the results upon this field, it is important to keep in mind the facts as regards the character of the soil. It is what would be called a strong and moderately heavy loam, and has great capacity to retain moisture. The relatively insoluble phosphates are known to give better results on soils of this character than on those which are lighter and drier.

Our experiments indicate that the cabbage is one of those crops most closely dependent upon the supply of available phosphoric acid, and yet this crop gives us a good return upon phosphates ordinarily regarded as very slowly available. The opinion in general held concerning the necessity for acidulated phosphates may need modification. We have not, it is true, raised on the South Carolina rock or the raw bone crops of the highest rank, as measured by the number and weight of hard heads. The total yields are excellent, and the weights of hard heads in a more normal season would without doubt have been much higher. It appears reasonable to believe that on soils of the character of this field the farmer may safely depend for a considerable portion at least of the phosphoric acid needed by his crops upon the cheaper natural phosphates, such as finely ground South Carolina rock and finely ground bone, while phosphatic slag also promises to prove a most useful fertilizer upon soil of this character.

VI. — Soil Tests.

Two soil tests, both upon our own grounds and both in continuation of previous work upon the same fields, have been carried out during the past season. Fertilizers have been applied in accordance with the co-operative plan for soil tests, with one or two small exceptions. Lime and plaster have been applied to the plots calling for these fertilizers in double the usual soil test amounts. Each plot annually receives an application of the same kind or kinds of fertilizers. Such experiments are not adapted to securing the production of heavy crops, but rather to throwing light upon the general question as to the particular plant food requirements of different crops. By study of the results, the effects of the different leading elements of plant food on the several crops can be determined with much accuracy.

Every fertilizer used, whether applied by itself or in connection with one or both of the other fertilizer materials, is always applied in the same quantities. Both fertilizers and manure (where the latter is introduced for purposes of comparison) are always applied broadcast after plowing, and harrowed in. The kinds and the amounts per acre are as follows: —

Nitrate of soda, 160 pounds, furnishing nitrogen.
Dissolved bone-black, 320 pounds, furnishing phosphoric acid.
Muriate of potash, 160 pounds, furnishing potash.
Land plaster, 400 pounds.
Lime, 400 pounds.
Manure, 5 cords.

A. — *Soil Test with Corn (South Acre).*

This acre has been used in soil tests for fifteen years, beginning in 1889. The crops in successive years have been as follows: corn, corn, oats, grass and clover, grass and clover, corn (followed by mustard as a catch crop), rye, soy beans, white mustard, corn, corn, grass and clover, grass and clover, corn, and corn. Since 1889 this field has therefore borne seven corn crops, and during this time it has been four years in grass. The crop last year was corn, following grass; this year, corn follows corn. The season was the most unfavorable for this crop which has been known within the lifetime of most men now living, and the crop of this year was exceedingly poor, even on the land which has for fifteen years received an annual application of manure at the rate of 5 cords per acre. Last year, although the season then also was somewhat unfavorable, this plot gave a yield almost double that of this year. It is not surprising, therefore, that the yield on most of the plots receiving fertilizers was very low. Four of the plots have received neither manure nor fertilizer throughout the entire fifteen years, and these now show a degree of exhaustion amounting to almost absolute sterility. Allowing 90 pounds of ears as husked to the bushel of shelled grain, the average product of these plots was at the rate of about $1\frac{1}{2}$ bushels to the acre. The average yield of stover on these plots is at the rate of 560 pounds per acre. The table shows the manuring of the several plots, the rate of yield, and the gain or loss per acre compared with the nothing plots: —

Corn. — South Acre Soil Test, 1903.

Plots.	Fertilizers used.	Yield per Acre.		Gain or Loss per Acre, compared with Nothing Plots.	
		Corn (Bushels, 90 Pounds).	Stover (Pounds).	Corn (Bushels 90 Pounds).	Stover (Pounds).
1, .	Nitrate of soda, ...	.56	360	—.44	—390
2, .	Dissolved bone-black, . .	.94	360	—.06	—390
3, .	Nothing, ...	.94	300	-	-
4, .	Muriate of potash, . . .	16.61	1,880	15.61	1,130
5, .	Lime, ...	.15	160	—.85	—590
6, .	Nothing, ...	1.06	1,200	-	-
7, .	Manure, ...	37.39	3,600	36.39	2,850
8, .	Nitrate of soda and dissolved bone-black.	3.89	800	2.36	430
9, .	Nothing, ...	1.28	340	-	-
10, .	Nitrate of soda and muriate of potash.	18.00	2,200	16.47	1,830
11, .	Dissolved bone-black and muriate of potash.	20.39	2,320	18.86	1,950
12, .	Nothing, ...	1.78	400	-	-
13, .	Plaster, ...	2.06	400	.53	30
14, .	Nitrate of soda, dissolved bone-black and muriate of potash.	25.56	3,040	24.03	2,670

In view of the highly unfavorable season, the development of the corn was far from normal, and extended discussion of the results does not seem called for. It will be noticed that, as in previous years, the potash among the fertilizer elements used is the one exercising by far the greatest effect in increasing the crop. The addition of either nitrate of soda or phosphoric acid, as shown by the results on plots 10 and 11, does not very materially increase the yield produced on potash alone (Plot 4). The addition of nitrate of soda to the mixture of potash and dissolved bone-black used on Plot 11 caused a considerable increase, — greater this year than in previous years, as shown by the yield on Plot 14. This difference in effect may very well be due to the gradual exhaustion of the supply of humus in the soil on these plots, which for so many years have been manured with fertilizers alone, and subjected to tillage throughout most of the time.

Though no combination of fertilizers gives what can be considered a good crop, the lesson is just as clear this year as in previous years, viz., that fertilizers for corn should be rich in potash.

B. — Soil Test with Mixed Grass and Clover (North Acre).

The field on which this test was carried out has been used in similar tests with various crops for fourteen years, beginning in 1890. The fertilizers have been applied in accordance with the system regularly used in soil tests, save as regards amounts. During the years when potatoes or onions have been grown, double the usual quantities have been employed. One other peculiarity in treatment must be reported. In the spring of 1899 one-half of each plot received an application of freshly slaked lime, at the rate of 1 ton per acre. This lime was spread after plowing, and worked in with a harrow. The crops in order of succession have been: potatoes, corn, soy beans, oats, grass and clover, grass and clover, cabbages and ruta-baga turnips, potatoes, onions for four years (1898 to 1901 inclusive), potatoes, and grass and clover. The crop upon which we are reporting followed potatoes. The seeds sown included the following varieties: timothy, red-top, and mammoth red and alsike clover. The seeds of the timothy (18 pounds), red-top (8 pounds), red clover (5 pounds) and alsike clover (4 pounds) were mixed and sown broadcast Sept. 15, 1902. The date of sowing was so late that the grass made relatively little growth during the autumn months and the clover winter-killed. The winter was, however, favorable for the grasses, and they came through without injury, and 15 pounds of red clover seeds were sown on April 4.

As has been pointed out in another connection, there was less than one-half inch of rain from the middle of April to the 7th of June. The conditions, therefore, were most unfavorable for the germination of the clover and for the growth of the young and therefore very shallow-rooted grass plants. The yields, therefore, were small, but the results are nevertheless of considerable interest. The fertilizers applied to the several plots and the rate of yield per acre with the gain or loss where the different fertilizers were employed are shown in the following table: —

Grass and Clover. — North Acre Soil Test, 1903.

Plots.	Fertilizers used.	Yield per Acre.		Gain or Loss per Acre, compared with Nothing Plots.	
		Unlimed (Pounds).	Limed (Pounds).	Unlimed (Pounds).	Limed (Pounds).
1,	Nothing,	360	1,150	-	-
2,	Nitrate of soda,	1,520	3,140	1,096.7	2,036.7
3,	Dissolved bone-black,	950	1,560	463.3	503.3
4,	Nothing,	550	1,010	-	-
5,	Muriate of potash,	660	950	135.0	50.0
6,	Nitrate of soda and dissolved bone-black,	1,830	3,180	1,330.0	2,390.0
7,	Nitrate of soda and muriate of potash,	1,820	2,190	1,345.0	1,510.0
8,	Nothing,	450	570	-	-
9,	Dissolved bone-black and muriate of potash,	620	920	177.5	207.5
10,	Nitrate of soda, dissolved bone-black and muriate of potash,	2,330	2,830	1,895.0	1,975.0
11,	Plaster,	430	480	2.5	—517.5
12,	Nothing,	420	1,140	-	-

Examination of the table makes the fact evident that it is the nitrate of soda chiefly which determined the rate of yield. It is further evident that this is able to exert its full influence only on the half of the plot which received the application of lime that has been referred to. Nitrate of soda alone on the limed half of the plot after fourteen years continuous use still gives a crop of hay at the rate of rather over 1½ tons per acre; used with dissolved bone-black, it gives almost exactly the same yield; used with muriate of potash, it gives a smaller yield, — only a little over 1 ton to the acre.

Much evidence is afforded, by a study of the relative proportions of the different species on the different plots and on the limed and unlimed portions of the several plots, that the soil in some parts of this field is once more becoming acid. It is likely that this is the case on Plot 7, for to that plot have been applied large quantities both of muriate of potash and nitrate of soda, both of which tend to aggravate the conditions leading to development of a sour condition of the soil. To Plot 10 dissolved bone-black has been added, as well as the nitrate of soda and muriate of potash, and this, because of the lime it contains, has helped to lessen the tendency to the development of acidity; but even on this plot the yield is less than on the nitrate of soda alone, and probably because of the acid condition induced by the continued use of the fertilizers the plot has received.

A careful determination of the relative proportions of the timothy, red-top and clover in the product of a square yard on both the unlimed and limed portions was made. On the unlimed portion of every plot the red-top was more abundant than the timothy. There was practically no clover on the unlimed portion of any plot. Timothy exceeded red-top on the limed portion of all plots except Plot 7. This is the plot to which both the nitrate of soda and muriate of potash have been applied; and here, in spite of the lime which was put on in 1899, the soil is undoubtedly again acid, as shown by the fact that the red-top exceeds the timothy. Clover was found in appreciable quantities only on the limed portion of plots 9 and 10. The lessons of the experiment, it seems to me, are clear, the following being the most important points: —

1. Nitrate of soda, as in many previous experiments, proves the controlling element in the production of grass; but this exerts the full effect of which it is capable only on soils which are not excessively acid.

2. Whenever, in a mowing seeded with a mixture of timothy and red-top, the latter largely predominates, it is an evidence that the productivity of the field would be increased by an application of lime.

3. Clover cannot be made to thrive in a soil unless it is free from acidity; and in those cases where on seeding clover fails, acidity may reasonably be looked for.

VII. — Experiment in Manuring Grass Lands.

In this experiment, which has continued since 1893, the purpose is to test a system of using manures in rotation for the production of grass. The area used in the experiment is about nine acres. It is divided into three approximately even plots. The plan is to apply to each plot one year barnyard manure, the next year wood ashes, and the third year fine-ground bone and muriate of potash. As we have three plots, the system of manuring has been so arranged that every year we have a plot illustrating the results of each of the applications under trial. The rates at which the several manures are employed are as follows: barnyard manure, 8 tons; wood ashes, 1 ton; ground bone, 600 pounds, and muriate of potash, 200 pounds, per acre. The manure is always applied in the fall, ashes and the bone and potash in early spring. A portion of the land was broken up as described in the annual report for last year, on account of having become somewhat infested with weeds, and reseeded. That portion which was plowed after the removal of the first crop in the summer of 1902, repeatedly harrowed, and then seeded on August 15, has this year produced a very heavy crop. This, no doubt, may be in part attributed to the very thorough preparation which the land received before seeding, although the liberal manuring which it has received for so many years was no doubt also a most important factor. The past season, although it promised at the start, on account of the excessively dry weather from the middle of April to about the 10th of June, to be a very poor one for the hay crop, eventually proved decidedly favorable, as the frequent rains during the last three weeks in June produced a heavy growth. Conditions for the rowen crop were also exceptionally favorable. The yields of hay and of rowen and the totals for each system of manuring were at the following rates per acre: —

Fertilizers used.	Hay (Pounds).	Rowen (Pounds).	Totals (Pounds).
Barnyard manure,	5,886	2,664	8,550
Bone and potash,	4,648	3,333	7,981
Wood ashes,	5,188	2,591	7 779

The average total yield of the entire area for this year is 8,104 pounds. The average for the entire period (1893 to the beginning of the present year) was 6,413 pounds. The average to date is 6,597 pounds. The average yield when top-dressed with manure has been 6,827 pounds; when top-dressed with wood ashes, 6,427 pounds; when top-dressed with bone and potash, 6,562 pounds. The average yields for this year, as will be seen, are much above the general average to date.

Old and New Seeding compared.

As has been stated, the yield on the part of the land reseeded last summer was very exceptionally heavy. The advantage of reseeding is made evident by comparison of the yields on that portion of plots 1 and 2 not reseeded with the yield on the portion which was reseeded. These comparisons are shown by the following table: —

	Yield per Acre (Pounds).		
	Hay.	Rowen.	Totals.
Plot 1, wood ashes: —			
Not reseeded,	4,305.0	1,938.0	6,243.0
Reseeded portion,	5,629.5	2,917.0	8,546.5
Plot 2, barnyard manure: —			
Not reseeded,	3,966.0	1,676.0	5,642.0
Reseeded portion,	6,845.5	3,157.5	10,003.0

The yields obtained on the reseeded portion, amounting to rather over $4\frac{1}{4}$ tons on one plot and to almost exactly 5 tons on the other, are certainly exceedingly satisfactory.

The Seed sown.

An effort is being made to render the results of the experiments on this land more valuable by comparing two different mixtures of grass seeds. As the result of experience, it has been found that on this land, under the system of manuring followed, timothy, and to a lesser degree red-top, tend to die out, and are replaced to a considerable extent by Kentucky blue-grass, — a species far less valuable for mowings. Tall and meadow fescue will, it is believed, prove more persistent, and it is hoped they may be able to hold the ground against the Kentucky blue-grass. With a view to testing these species as regards this point, equal areas of the reseeded portions of plots 1 and 2 have been sown with each of the two mixtures shown below : —

Fescue Mixture (Pounds per Acre).

Timothy,	6
Red-top,	8
Red clover,	5
Alsike clover,	4
Kentucky blue-grass,	4
Meadow fescue,	6
Tall fescue,	4

Timothy Mixture (Pounds per Acre).

Timothy,	18
Red-top,	8
Red clover,	5
Alsike clover,	4

These mixtures may be for convenience called respectively fescue mixture and timothy mixture. The relative yields in the first year on the two different seed mixtures is shown below : —

	Hay (Pounds).	Rowen (Pounds).	Totals (Pounds).
Plot 1: —			
Fescue mixture,	5,042	2,648	7,690
Timothy mixture,	6,217	3,186	9,403
Plot 2: —			
Fescue mixture,	6,521	2,921	9,483
Timothy mixture,	7,129	3,394	10,523

It will be seen that the timothy mixture has given the larger crops this year on both plots, both at the first and second cuttings. During the past dozen years many mixtures of grass seeds have been tried on different parts of the college estate, but none has been found which, everything considered, exceeds in value a mixture substantially that which is so generally used of timothy, red-top and clover. This mixture in the first year is clearly superior to the other, but whether it will maintain its superiority cannot of course be determined at present.

VIII. — Experiment in the Application of Manure.

The experiment upon which the results for the past year are to be reported was begun in 1899. The object in view is to determine whether it is better to spread fresh manure during late fall and winter, allowing it to remain upon the surface until spring, or to put the manure when hauled out into large heaps, to be spread just before plowing the land in the spring. A full account of the plan of this experiment will be found in the thirteenth annual report of this experiment station. The field contains five plots, each subdivided into two sub-plots, on one of which the manure is spread when hauled out during the winter and on the other put into a large heap from which it is hauled out and spread in the spring. We have in reality five parallel experiments yearly, the area of each sub-plot being about one-quarter of an acre. The crop last year was ensilage corn. On three plots the yield where the manure was spread in the spring was considerably greater than where it was spread in the winter; on the other two plots the yields under the two systems of application were practically equal. Rye was sown in the standing corn on August 20, to furnish winter cover. This rye had made considerable growth, which was fairly even on all the plots when it was plowed under, the middle of May. The crop of this year was soy beans, five different varieties being planted, each kind in equal area on all the plots. Owing to the cold weather, the growth was not altogether satisfactory, and the yield even of the earliest varieties was small. It was seen that one variety would not ripen, and accordingly it was cut when in ensilage condition and put into the silo. We have, therefore, to report for each plot the rate of yield per acre of dry beans and straw, and of green forage for the silo. The rates of yield per acre and the relative standing of the several plots are shown in the tables: —

Actual and Relative Yields of Green Forage.

Plots.	Manuring previous to 1889.	Actual Yields (Rates per Acre, Pounds).		Relative Yields (Per Cent.).	
		North Half, Winter Application.	South Half, Spring Application.	North Half, Winter Application.	South Half, Spring Application.
1, .	Barnyard manure, . .	10,785	9,729	100	90.21
2, .	Wood ashes, . . .	9,821	8,811	100	89.72
3, .	No manure, ...	9,041	9,408	100	104.06
4, .	Fine-ground bone and muriate of potash.	9,546	11,519	100	120.67
5, .	Fine-ground bone and sulfate of potash.	10,509	11,840	100	112.66

Actual and Relative Yields of Soy Beans and Straw.

Plots.	Manuring previous to 1889.	Actual Yields (Rates per Acre).			
		Beans (bushels).		Straw (pounds).	
		North Half, Winter Application.	South Half, Spring Application.	North Half, Winter Application.	South Half, Spring Application.
1, .	Barnyard manure, . .	14.56	15.56	1,021	1,212
2, .	Wood ashes, . . .	16.27	15.50	1,272	1,319
3, .	No manure, ...	15.04	14.42	1,232	1,119
4, .	Fine-ground bone and muriate of potash.	15.22	12.55	1,284	1,045
5, .	Fine-ground bone and sulfate of potash.	14.26	15.21	1,252	1,269

Actual and Relative Yields of Soy Beans and Straw — Concluded.

Plots.	Manuring previous to 1889.	Relative Yields (Per Cent.).			
		Beans.		Straw.	
		North Half, Winter Application.	South Half, Spring Application.	North Half, Winter Application.	South Half, Spring Application.
1, .	Barnyard manure, . .	100	106.87	100	118.71
2, .	Wood ashes, . . .	100	95.27	100	103.69
3, .	No manure, ...	100	95.88	100	90.83
4, .	Fine-ground bone and muriate of potash.	100	82.46	100	81.39
5, .	Fine-ground bone and sulfate of potash.	100	106.66	100	101.36

In previous years the south half (spring manured) of each plot has, with two insignificant exceptions, above noted in the case of the ensilage corn of last year, given a greater yield than the north half. The yield of the winter-manured portion for each year being considered 100 for the several plots, the yields of the spring-manured portion of the same plots has varied in the different years as follows: in 1900, from 103 to 125; in 1901, from 118 to 177; in 1902, from practical equality in two cases to 150. This year, it will be noted, there is but little difference in the yields under the two systems of manuring, and the advantage is on the side of the winter application. The winter application considered as 100 as in previous years, the yields for the spring application of manures has varied as follows: for the beans, 82.46 to 106.87; for the straw, 81.39 to 118.71; and for the green forage, 89.72 to 120.67.

In attempting to understand the reasons for such differences as have been noted in the different years, we find, on a study of the weather conditions, that those of the winter of 1902 and 1903 were for this locality quite exceptional. A heavy snowfall came during the first week in December, at which time the ground was not frozen. This snow, with occasional additions from time to time, though sometimes wasting to some extent, lay upon the ground throughout the winter in sufficient amount to prevent the ground from freezing. The winter was without those frequent sudden thaws, accompanied by heavy rains, which with frozen ground lead to excessive washing. So remarkable was the winter that the roots of one of our exceptionally hardy summer crops, dwarf Essex rape, came out in the spring uninjured, and with the approach of warm weather sprouted and made vigorous growth. Under such conditions it is not strange that loss of the soluble plant food constituents of the manure spread upon the surface took place to a very slight extent, if at all. Could we depend upon such winters as the last, the practice of spreading manure and leaving it upon the surface during the winter would undoubtedly be wise, as it saves on the cost of handling; but, as every one familiar with our climate understands, such winters cannot be depended upon, and accordingly the weight of evidence in our experiments is still in favor of hauling the manure into heaps, to remain over winter and to be spread in the spring.

IX. — Poultry Experiments.

In our experiments with poultry during the past year our attention has been confined almost exclusively to questions connected with the feeding of fowls for eggs. We are endeavoring to obtain light on the question as to the proper relation between the different nutrients in the ration fed. Our work during the year may be summarized as follows: —

1. We have compared two rations, in one of which corn is prominent, in the other wheat, using animal meal as a source of animal food. The nutritive ratio of the ration including wheat has been 1 : 4.34: for the one including corn, the ratio has been 1 : 6.24.

2. We have compared two rations in which respectively corn and wheat are prominent, with milk albumin as the source of animal food in each, and with an addition of corn oil as a source of fat, in which the milk albumin is very poor. The nutritive ratio of the ration including wheat is 1 : 4.44: for the ration including corn, 1 : 6.48.

3. We have compared two rations in one of which wheat is prominent, in the other rice, with milk albumin as the source of animal food in each. Both of these rations were very low in fat. The nutritive ratio of the first (in which wheat is prominent) is 1 : 4.3; of the second (in which rice is prominent), 1 : 6.4.

The most important points in connection with the results appear to be as follows: —

1. In the comparison of wheat with corn, where animal meal was the source of animal food, the egg production for the entire period from December 14 to September 4 was practically equal. For the winter period, December 14 to April 1, the corn ration produced eggs at an average rate of .3005 per hen day; the wheat ration, at the rate of .2792 per hen day. In other words, 100 hens on the corn ration would have given an average daily yield of a slight fraction over 30 eggs, while the wheat ration would have given from the same number of hens almost 28 eggs per day. For the summer period, April 1 to September 4, the corn ration gave an average of .4365 eggs per hen day; the wheat ration,

.4541; or, in other words, the average daily product from 100 hens would have been for the wheat ration 44.4 eggs; for the corn ration, about 43.7. The average food cost per egg produced was on the wheat ration, a very slight fraction over 1 cent; on the corn ration it was .85 of a cent.

2. In the comparison of wheat with corn, with milk albumin as the source of animal food in each, and with corn oil added as a source of fat, the egg product was considerably better than in the first experiment. For the entire period the hens receiving corn produced more eggs, — an average at the rate of .4166 eggs per hen day. For the wheat the similar average was .3570. For the winter period, December 14 to April 1, similar averages were: for the wheat ration, .2606; for the corn ration, .2862. For the summer period, April 1 to September 4, the averages were: for the wheat, .4251; for the corn, .5107. For the entire period the average food cost per egg laid was for the wheat ration 1 cent, for the corn ration .8 cent. The product obtained in this experiment, at the rate respectively for the wheat of 35.7 eggs per day and for the corn at the rate of 41.66 eggs per day, for 100 hens is considered good, for fowls kept in close confinement, especially in view of the fact that the pullets used in the experiment were rather late hatched, and laid but few eggs until the first of February, viz., 125 for the fowls receiving wheat and 48 for the fowls receiving the corn ration.

3. In the comparison of wheat with rice, with milk albumin as the source of animal food in each, the results were decidedly in favor of the ration including the rice. For the entire period the product of these fowls was at the rate of .3732 eggs per hen day; for the fowls receiving the wheat, at the rate of .3328 eggs per hen day. For the winter period, December 14 to April 1, the averages were: for the rice ration, .3097; for the wheat ration, .2241 eggs per hen day. For the summer period, April 1 to September 4, similar averages were: for the rice, .4188; for the wheat, .4080. The production in this experiment is inferior on both rations to that obtained in either of the other experiments; and, although the yield on the rice is fairly good, this cannot be

regarded as a practical food for ordinary use, on account of its high cost. The food cost for the eggs produced in this experiment was at the rate of about $1\frac{1}{5}$ cents for the wheat ration, and nearly 2.1 cents per egg for the rice ration.

As the result of experiments in previous years, corn had been found superior to wheat rations when animal meal was used as the source of animal food, while with scraps the two rations gave nearly equal numbers of eggs. In previous experiments, with milk albumin as the source of animal food, the egg production has usually been unsatisfactory when wheat has been the principal grain. These facts had led to the belief that possibly the amount of fat in the ration played an important part in determining the egg yield; and the experiments of this year were planned with a view to throwing light upon this point. In some particulars they seem to confirm this theory. The production of eggs on milk albumin, which is very low in fat, has in previous years been quite unsatisfactory. This year, with the addition of fat, more eggs have been produced. Further, in other experiments the egg production where corn is the principal grain has much exceeded that where wheat is the principal grain, when animal meal is used as the source of animal food. The results this year were very similar. On the other hand, the ration lowest in fat of all, viz., that including rice, has given many more eggs than the ration including wheat, which furnishes a far greater quantity of fat.

A study of the rations of this year shows an apparent relation between the quantity of fiber in the food and the egg production. The rations furnishing exceptionally large amounts of fiber, derived principally from such grains as oats and barley, have given very inferior yields of eggs.

In conclusion, we are justified in saying that our experiments do not lend support to the belief that the nutritive ratios of rations fed to hens must necessarily be narrow to produce a satisfactory product. We have obtained more eggs in winter in all experiments this year on the combinations of foods with the wider nutritive ratios, and in two out of three experiments the result was the same for the summer period. I am still inclined to the belief that the amount of fat in the ration is a matter of much importance. I believe, further, that care should be taken that the ration does not include too large a proportion of fiber, as this without doubt increases the labor of digestion, and probably decreases the proportion of the various nutrients digested and assimilated. It is well understood that animal matter of some kind is essential to good egg production. Our earlier experiments have shown the great superiority of animal to vegetable protein in rations for laying hens. It is believed, however, that suitable animal feeds, under which class may be included all such as are well preserved and sweet and palatable, may be wisely used in connection with a large proportion of our cheapest grain, — corn.

REPORT OF THE DEPARTMENT OF HORTICULTURE.

F. A. WAUGH, HORTICULTURIST; GEO. O. GREENE, ASSISTANT.

The work of the department of horticulture during the year just closing has been devoted largely to reorganization, and to the beginning of new lines of experiment and new systems of record. The various experiments undertaken will be reported upon as fast as valuable results develop. Meanwhile, the department continues to find a large part of its public service in answering various inquiries from all over Massachusetts and neighboring States. Such inquiries, touching all the subjects connected with fruit and vegetable growing, arboriculture and landscape gardening, are answered promptly, and as fully as circumstances permit.

The work of testing new and old varieties of fruits and vegetables has been considerably abated, but has not been suddenly nor inconsiderately abandoned. The comparison of varieties of strawberries, for example, which has long been a feature of the department work, has been continued for the present on a somewhat different plan, and some report of results is a part of the present publication.

Mr. George A. Drew, who has been assistant horticulturist and in charge of various lines of experimental work for several years, resigned that position in September, to take up more remunerative work elsewhere. The vacancy was filled October 1 by the appointment of Mr. George O. Greene, assistant horticulturist of the Kansas Experiment Station. The high character of the service performed by Mr. Drew during his term as assistant should be a matter of special recognition and record here.

Strawberry Experiments.

Experiments with strawberries, which have been carried on for many years in the department of horticulture, have been continued for the present. This work has been under the direct charge of Mr. George A. Drew, and the following notes have largely been made up by him.

Season and Soils.

The season of 1903 was a disappointment in many respects to strawberry growers. To start with, a number of the early varieties were damaged by spring frosts; then, when the later fruit was about ready to mature, a severe drought set in, lasting practically throughout the fruiting season, and very naturally reducing the yield.

While disappointing from the commercial grower's standpoint, the season was not without some instructive features as regards behavior of varieties and the ability of certain soils to retain moisture. Where the soil had been very thoroughly prepared, and there was an abundance of vegetable matter present, the strawberry plant withstood the dry weather without very serious damage; on the other hand, where the soil was of a gravelly nature, and the amount of vegetable matter limited, the plant easily succumbed to the effects of the drought.

It cannot be emphasized too much or repeated too often how great a part thorough preparation of the soil takes in the yields obtained. The strawberry naturally has a very limited root system, and any means that will induce the fibers to penetrate deeper is labor well spent.

A medium deep loam is, all things considered, about the ideal soil. If one depends on a sandy or gravelly soil, irrigation facilities must be provided, and, taken one year with another, some system of irrigation will undoubtedly pay. If one does not feel justified in the outlay this would necessitate, and one has several kinds of soil to choose from, it is well to select two different types: one gravelly, light and early; the other more loamy, heavier and later. Then, after a series of years, one could balance up accounts, so to speak, and find which was the most profitable in the long run.

Notes on Varieties.

Many new and old varieties have been compared on different soils, ranging from rather dry gravel to fine rich loam. Those varieties which, on account of their novelty, their special value or other interest, seem worthy of report, are described and commented on below.

August Luther. — Fruit: oblong; size, small; core, melting; external color, scarlet; color of flesh, light pink; flavor, sweet; season, early; calyx, small, loose; texture, medium; seeds, yellow, imbedded; quality, good; shipping quality, good. Blossom, perfect; plant, fairly vigorous; foliage, fair; runners, many; rust, none.

Sets a large amount of fruit, but has no special points of merit.

Belmont. — Fruit: oblong, flattish, irregular; size, very large; core, slightly hollow; external color, crimson; color of flesh, red to core; flavor, slightly acid; season, medium to late; calyx, large, loose; texture, firm; seeds, yellow, imbedded; quality, good; shipping quality, good. Blossom, perfect; runners, numerous; rust, very slight.

Not very productive, but attractive in appearance, and one of the good old kinds.

Bismarck. — Fruit: roundish; size, medium large; core, small, hard and closed; external color, scarlet; color of flesh, light pink; flavor, sweet; season, early to medium; calyx, medium loose; texture, medium; seeds, yellow, prominent; quality, very good; shipping quality, fair. Blossom, perfect; plant, vigorous; foliage, good; runners, numerous; rust, none.

A good home berry, and fairly productive.

Blonde. — Fruit: conic, regular; size, medium large; core, slightly open; external color, light crimson; color of flesh, reddish; flavor, acid; season, late; calyx, large, loose; texture, firm; seeds, brownish, prominent; quality, fair; shipping quality, good. Blossom, imperfect; plant, vigorous; foliage, good; runners, numerous; rust, slight.

Brandywine. — Fruit: round, conic, tapers to sharp point; size, large; core, slightly open; external color, dark crimson; color of flesh, red throughout; flavor, acid; season, medium to late; calyx, green, loose and prominent; texture, firm; seeds, yellow, prominent; quality, good; shipping quality, fair. Blossom, a good pollenizer, perfect; plant, vigorous; foliage, dark, large and regular; runners, numerous; rust, slight.

Productive generally, but the fact of berry turning black where exposed to the air proves a great drawback; erratic in different localities.

Brunette. — Fruit: round, conic; size, large; core, slightly hollow; external color, crimson; color of flesh, crimson; flavor, insipid; sea-plant, vigorous; foliage, good; runners, numerous; rust, non

A valuable home variety.

Bubach. — Fruit: flat, conical; size, large; core, hollow; color, dark scarlet; color of flesh, scarlet; flavor, insipid; early to medium; calyx, medium; texture, medium; seeds, g prominent; quality, fair; shipping quality, fair. Blossom, plant, deficient in vigor; foliage, medium dark, medium larg ners, medium; rust, slight.

Deficient in vigor, and, like the Marshall, succeeds only in localities, where one can get a fine healthy stock of plants.

Bush Cluster. — Fruit: usually conical; size, medium larg slight; external color, scarlet; color of flesh, light scarlet; acid; season, medium; calyx, medium loose; texture, medium imbedded; quality, poor; shipping quality, fair. Blossom, in plant, fairly vigorous; foliage, large, medium dark; runners ous; rust, slight.

A disappointment in all respects.

Clyde. — Fruit: irregular, conic; size, large to very larg slight; external color, scarlet; color of flesh, scarlet; flavor, s season, early; calyx, loose, large; texture, medium; seeds, in quality, fair; shipping quality, fair. Blossom, perfect; plant, in vigor; foliage, medium, large, light; runners, very nu rust, slight.

Extremely productive, and tends to set more fruit than it is of maturing; somewhat subject to disease.

Cobden Queen. — Fruit: round, irregular, conic; size, mediu external color, dark scarlet; color of flesh, scarlet; flavor, a son, medium; calyx, medium; texture, firm; seeds, promin side; quality, good; shipping quality, good. Blossoms, rat imperfect; runners, numerous; rust, slight.

Foliage unhealthy; fruit seedy.

Corsican. — Fruit: round to roundish, conic; size, mediu slightly hollow; external color, scarlet; color of flesh, pinkish insipid; season, early to medium early; calyx, medium; textu seeds, yellow, outside; quality, fair; shipping quality, poo som, perfect; plant, vigorous; foliage, inclined to discolor; fair; rust, slight.

Too soft for commercial use; always a disappointment here

Darling. — Fruit: round, conic; size, medium; core, medi ternal color, scarlet; color of flesh, light scarlet; flavor, season, medium; calyx, medium; texture, medium; seeds, prominent; quality, fair. Blossom, perfect; plant, deficient i rust, slight.

Too poor for commercial use.

Delaware. — Fruit: flat, conical, irregular; size, medium; core, medium to large; external color, crimson; color of flesh, crimson; flavor, acid; mid-season; calyx, rather prominent; texture, firm; seeds, yellow, prominent; quality, poor; shipping quality, very good. Blossom, perfect; plant, medium in vigor; foliage, medium; runners, medium; rust, little.

Rather unproductive, but set some fine fruit of good color and shipping quality.

Dewey. — Fruit: long, conic; size, medium large; core, small, hard; external color, scarlet; color of flesh, scarlet; flavor, acid; season, medium; calyx, medium; texture, firm; seeds, yellow, prominent; quality, fair; shipping quality good. Blossom, perfect; plant, fairly vigorous; foliage, medium green; runners, medium; rust, slight.

Inclined to be deficient in vigor, and nothing of special merit to recommend it.

Dole. — Fruit: irregular, conical; size, medium large; core, medium large; external color, scarlet; color of flesh, light scarlet; flavor, sweet; season, medium; calyx, medium; texture, rather soft; seeds, yellow, imbedded; quality, good; shipping quality, poor. Blossom, imperfect; plant, vigorous; foliage, good; runners, many; rust, little.

Unproductive; possesses no special advantage over others.

Drought King. — Fruit: round, conical, and irregular; size, medium; core, slight, hard; external color, scarlet: color of flesh, whitish; flavor, very acid, sour; season, medium; calyx, medium; texture, firm; seeds, brownish, prominent; quality, very good; shipping quality, good. Blossom, imperfect; rust on plant, slight.

Unworthy of its name; very poor.

Gibson. — Fruit: flat, conical; size, large to very large; core, small, hollow; external color, dark crimson; color of flesh, red throughout; flavor, slightly acid; season, medium; calyx, medium large; texture, firm; seeds, yellow, prominent; quality, fair; shipping quality, good. Blossom, perfect; plant, fairly vigorous; foliage, healthy, vigorous; runners, few; rust, slight.

Unproductive here, but very fine fruit, and worthy of further trial.

Gladstone. — Fruit: irregular, conic, like Glen Mary; size, large to very large; core, hard; external color, scarlet; color of flesh, pinkish; flavor, acid; season, medium; calyx, loose medium; seeds, yellow, imbedded; quality, fair; shipping quality, good. Blossom, perfect; plant, vigorous; foliage, large, medium green; runners, numerous; rust, slight.

Resembles Glen Mary closely.

Glen Mary. — Fruit: irregular, conical; size, large; core, hard; external color, crimson; color of flesh, crimson; flavor, acid; season, medium; calyx, medium; texture, firm; seeds, yellow, prominent; quality, poor; shipping quality, good. Blossom, perfect; plant, very vigorous; foliage, large, vigorous; runners, numerous; rust, slight.

Greatest fault in uneven ripening of tips of berries, but large and productive.

Haverland. — Fruit: long, conical; size, medium large to large; core, slight; external color, scarlet; color of flesh, scarlet; flavor, sweet; season, early; calyx, medium; texture, medium; seeds, slightly imbedded; quality good; shipping quality, good. Blossom, imperfect; plant, very vigorous; foliage, large, long; runners, many; rust, slight.

Very productive, and one of the best for commercial and domestic use; one of the leaders still.

Hawaii. — Fruit: long, conic; size, medium; core, slight; external color, scarlet; color of flesh, light scarlet; flavor, sweet; season, early; calyx, medium; texture, medium; seeds, yellow, slightly imbedded; quality, good; shipping quality, good. Blossom, perfect; plant, vigorous; foliage, resembles Haverland; runners, numerous; rust, slight.

Resembles Haverland closely, but not so productive nor so large fruit.

Hero. — Fruit: flat, conical; size, medium large; core, medium; external color, dark scarlet; color of flesh, red to core; flavor, acid; season, medium; calyx, medium; texture, firm; seeds, yellow, prominent; quality, good; shipping quality, good. Blossom, perfect; plant, fairly vigorous; foliage, good; runners, few; rust, slight.

Not very vigorous or productive, and a disappointment here.

Howard 7. — Fruit: irregular, inclined to be in two parts; size, large; core, large, open, hollow; external color, crimson; color of flesh, crimson to core; flavor, acid; season, medium; calyx, large, upturned; texture, firm; seeds, yellow, imbedded; quality, poor; shipping quality, good. Blossom, imperfect; plant, vigorous; foliage, dark, medium large; runners, average; rust, slight.

Worthy of further trial.

Howard 14. — Fruit: very long, tapering at each end; size, large; core, slight, slightly hollow; external color, dark scarlet; color of flesh, scarlet; flavor, sweet; season, early to medium; calyx, medium large; texture, firm; seeds, yellow, imbedded; quality, good; shipping quality, good. Blossom, imperfect; plant, very vigorous; foliage, very tall, long leaf stalks; runners, many; rust, little.

Inclined to run small after first few pickings.

Howard 36. — Fruit: long, flat, conical, somewhat tapering at point; size, large; core, slight; external color, dark scarlet; color of flesh, scarlet; flavor, slightly acid; season, medium to early; calyx, medium loose; texture, firm; seeds, yellow, imbedded; quality, fair; shipping quality, good. Blossom, imperfect; plant, vigorous; foliage, medium large, vigorous; runners, many; rust, little.

One of the most productive and profitable varieties on our ground.

Howard 103. — Fruit: round, conical; size, large; core, closed, slight; external color, crimson; color of flesh, crimson; flavor, acid; season, very early; calyx, medium, rather loose; texture, rather soft; seeds, yellow, deeply imbedded; quality, fair; shipping quality, fair.

Blossom, imperfect; plant, fairly vigorous; foliage medium, dark and vigorous; runners, medium; rust, none.

A good, productive, very early berry, and for this purpose excels.

Howard's Clyde 3. — Fruit: round, conic, slightly irregular, often divided; size, large; core, slight, closed; external color, scarlet; color of flesh, scarlet; flavor, slightly acid; season, early; calyx, medium large, loose; texture, slightly soft; seeds, light yellow, imbedded; quality, good; shipping quality, good. Blossom, perfect; plant, vigorous; foliage, medium dark, large; runners, numerous; rust, none.

Does not set as much fruit as Clyde, but matures it better; an improvement on Clyde, and valuable.

Joe. — Fruit: round, conic; size, large to very large; core, slight; external color, scarlet; color of flesh, scarlet; flavor, sweet; season, medium; calyx, loose, medium large; texture, firm; seeds, yellow, prominent; quality, good; shipping quality, good. Blossoms, medium in number, large, perfect; plant, vigorous; foliage, large, dark; runners, fair; rust, slight.

Not very productive, but promising as a large, juicy berry; fancy.

Jucunda. — Fruit: roundish; size, large; core, medium; external color, crimson; color of flesh, crimson; flavor, acid; season, medium; calyx, green; texture, firm; seeds, yellow, prominent; quality, good; shipping quality, good. Blossom, perfect; plant, vigorous; foliage, large, dark, on short stalks; runners, medium; rust, slight.

Still worthy of cultivation, though deficient in vigor.

Kansas. — Fruit: round, conic; size, medium; core, slightly hard; external color, scarlet; color of flesh, light scarlet; flavor, sub-acid; season, early to medium; calyx, medium loose; texture, medium; seeds, yellow, imbedded; quality, fair; shipping quality, fair. Blossom, imperfect; plant, vigorous; foliage, medium vigorous; runners, very numerous; rust, slight.

Not to be recommended, according to its behavior on our grounds.

Klondike. — Fruit: irregular, conic; size, very large; core, slight; external color, dark scarlet; color of flesh, scarlet; flavor, insipid; season, medium; calyx, large; texture, medium; seeds, brown, imbedded; quality, poor; shipping quality, fair. Blossom, perfect; plant, vigorous; foliage, light; runners, numerous; rust, slight.

Inclined to ripen unevenly, and too soft for transportation a long distance; valuable home variety.

Latest. — Fruit: irregular, conic; size, large to very large; core, hard; external color, dark scarlet; color of flesh, whitish; flavor, insipid; season, late; calyx, loose; texture, medium firm; seeds, brown, deeply imbedded; quality, fair; shipping quality, fair. Blossom, imperfect; plant, medium vigorous; foliage, medium; runners, few; rust, slight.

Plants stock up well and are fairly productive; promising late variety.

Leheman 2. — Fruit: irregular, conical; size, large; core, hard; external color, dark scarlet; color of flesh, light scarlet; flavor, acid; midseason; calyx, small; texture, firm; seeds, yellow, prominent; quality, poor; shipping quality, fair. Blossom, perfect; plant, vigorous; foliage, leaves long, medium large; runners, numerous; rust, slight.

Productive and reliable.

Lester. — Fruit: conical; size, large; core, slight; external color, dark scarlet; color of flesh, scarlet; flavor, acid; season, medium; calyx, large, loose, prominent; texture, firm; seeds, prominent; quality, good; shipping quality, good. Blossom, perfect; plant, fairly vigorous; foliage, thick; runners, fair; rust, none.

Lyon. — Fruit: long, conic; size, large; core, slight; external color, dark scarlet; color of flesh, scarlet; flavor, sweet; season, early to medium; calyx, loose; texture, medium; seeds, prominent; quality, good; shipping quality, good. Blossom, thrifty, imperfect; plant, vigorous; runners, numerous; rust, slight.

Very productive, medium-sized berries.

M. A. C. Seedling 24. — Fruit: round, conic; size, large to very large; core, inclined to be hollow; external color, crimson; color of flesh, light crimson; flavor, insipid; season, early to medium; calyx, medium; texture, rather soft; seeds, brown, imbedded; quality, fair; shipping quality, fair. Blossom, not very vigorous, perfect; plant, only fair in vigor; foliage, medium large; runners, fair; rust, considerable.

Inclined to be soft for long transportation, but otherwise very good.

Margaret. — Fruit: irregular, conic; size, large; core, slight; external color, crimson; color of flesh, pinkish; flavor, sweet; season, early to medium; calyx, loose, prominent; texture, very firm; seeds, prominent; quality, good; shipping quality, good. Blossom, perfect; plant, fairly vigorous; foliage, medium green; runners, fair; rust, slight.

Not very productive, but occasionally to be recommended.

Marshall. — Fruit: irregular, conic; size, large; core, slight; external color, crimson; color of flesh, crimson; flavor, sweet; season, medium; calyx, loose, prominent; texture, firm; seeds, yellow, prominent; quality, standard; shipping quality, good. Blossom, perfect; foliage, large, dark, heavy; rust, slight.

Not productive, but fine for home use; success with this variety depends mainly on selection of plants and favored localities and on high cultivation.

McFarland's Seedling. — Fruit: elongated; size, very large; core, slight; external color, dark scarlet; color of flesh, light scarlet; flavor, rather insipid; season, medium; calyx, large, loose; texture, firm; seeds, brownish, imbedded; quality, fair; shipping quality, fair. Blossom, perfect; plant, vigorous; foliage, large, dark; runners, numerous; rust, slight.

Very productive and promising, where large fancy fruit is desired.

McKinley. — Fruit: irregular, long, flat; size, large to very large; core, slight; external color, dark scarlet; color of flesh, light scarlet; flavor, insipid; season, medium; calyx, loose, large, prominent; texture, rather soft; seeds, golden, imbedded; quality, fair; shipping quality, fair. Blossom, perfect; plant, vigorous; foliage, vigorous; runners, fair; rust, slight.

Greatest fault is soft fruit and uneven ripening; similar to Meggansett Dew Drop.

Mead's Seedling. — Fruit: round, conic; size, medium large to large; core, slight; external color, scarlet; color of flesh, scarlet; flavor, sub-acid; season, medium; calyx, medium, loose; texture, medium; seeds, yellow; quality, fair; shipping quality, fair or rather poor. Blossom, perfect; plant, vigorous; foliage, medium dark; runners, numerous; rust, slight.

Originated by H. O. Mead of Lunenburg, Mass. Inclined to become soft on standing.

Meggansett Dew Drop. — Fruit: long, irregular, conical; size, large to very large; core, slight; external color, scarlet; color of flesh, whitish; flavor, insipid; season, early to medium; calyx, loose; texture, medium fine; seeds, yellow, imbedded; quality, fair; shipping quality, fair. Blossom, perfect; plant, very vigorous; foliage, dark; runners, numerous; rust, none.

General tendency to color unevenly, and rather soft for shipping; resembles McKinley somewhat; productive.

Morgan. — Fruit: long, flattish; size, large to very large; core, slight; external color, scarlet; color of flesh, light scarlet; flavor, insipid; season, medium early; calyx, large, rather loose; texture, medium firm; seeds, yellow, prominent; quality, fair; shipping quality, fair. Blossom, perfect; plant, vigorous; foliage, medium dark; runners, numerous; rust, slight.

Greatest fault is general tendency to color unevenly; productive.

Nettie. — Fruit: long, irregular, conic; size, very large; core, slight; external color, scarlet; color of flesh, scarlet; flavor, acid; season, late; calyx, loose, large; texture, firm; seeds, yellow, imbedded; quality, fair; shipping quality, fair. Blossom, imperfect; plant, vigorous; foliage, dark, large; runners, fair; rust, slight.

Appears to be a promising late variety, where size and appearance count; fancy.

New York. — Fruit: long, irregular, conic; size, large; core, medium; external color, scarlet; color of flesh, light scarlet; flavor, insipid; calyx, medium loose; texture, medium firm; seeds, imbedded; quality, fair; shipping quality, fair. Blossom, perfect; plant, vigorous; foliage, fair; rust, slight.

Inclined to be too light colored, otherwise a productive fancy berry.

Nick Ohmer. — Fruit: roundish; size, large; core, slight; external color, scarlet; color of flesh, whitish; flavor, sweetish; season, medium; calyx, medium, rather loose; texture, firm; seeds, imbedded; quality, good; shipping quality, good. Blossom, perfect; plant, fairly vigorous; foliage, diseased; runners, numerous; rust, slight.

Plant deficient in vigor, and not productive; some very good fruit, but not to be relied upon.

Pacific. — Fruit: broad, flattish, conical; size, medium large; core, slight; external color, crimson; color of flesh, light crimson; flavor, acid; calyx, medium loose; texture, firm; seeds, yellow, imbedded; quality, fair; shipping quality, good. Blossom, imperfect; plant, vigorous; foliage, medium; runners, numerous; rust, slight.

Productive, and a good early berry.

Paris King. — Fruit: long, irregular, conic; size, medium large; core, slight; external color, scarlet; color of flesh, light scarlet; flavor, rather acid; season, early; calyx, medium loose; texture, firm; seeds, yellow; quality, fair; shipping quality, good. Blossom, perfect; plant, fairly vigorous; foliage, medium green; runners, numerous; rust, slight.

A good, productive, early berry.

Parson's Beauty. — Fruit: irregular, conic; size, large; core, slight; external color, crimson; color of flesh, crimson; flavor, acid; season, early to medium; calyx, medium loose; texture, firm; seeds, yellow, imbedded; quality, good; shipping quality, good. Blossoms, numerous, perfect; plant, vigorous; foliage, dark, medium thick; runners, very numerous; rust, slight.

Productive, but berries not uniform, and hence not very attractive in appearance.

Pennell. — Fruit: flattish, irregular, conic; size, large; core, hard; external color, crimson; color of flesh, crimson; flavor, acid; mid-season; calyx, loose; texture, firm; seeds, very prominent, numerous; quality, rather poor; shipping quality, good. Blossom, perfect; plant, fairly vigorous; foliage, fair; runners, numerous; rust, slight.

Prominent seeds on outside give unattractive appearance, otherwise a valuable addition.

Plymouth Rock. — Fruit: roundish; size, medium large; core, slight; external color, crimson; color of flesh, light crimson; flavor, sweet; season, medium; calyx, loose; texture, firm; seeds, prominent; quality, good; shipping quality, good. Blossom, vigorous; plant, fairly vigorous; foliage, fair; runners, fair; rust, slight.

Fairly productive, but fruit not uniform.

Pocomoke. — Fruit: irregular, conical; size, large to very large; core, medium; external color, crimson; color of flesh, crimson; flavor, acid; mid-season; calyx, loose; texture, firm; seeds, yellow, prominent; quality, fair; shipping quality, good. Blossom, vigorous, perfect; plant, has good vigor; foliage, medium large; runners, fair; rust, slight.

Productive and promising; a good commercial variety, to be recommended.

Pomona. — Fruit: round, conic; size, medium large; core, slight;

external color, dark scarlet; color of flesh, light scarlet; flavor, insipid; season, early to medium; calyx, medium loose; texture, medium; seeds, imbedded; quality, fair; shipping quality, fair. Blossom, full, perfect; plant, fairly vigorous; foliage, fair; runners, numerous; rust, slight.

Averages favorably with the commercial sorts.

Porto Rico. — Fruit: long, conical, small neck; size, medium large; core, slight; external color, crimson; color of flesh, light crimson; flavor, sub-acid; season, medium; calyx, loose, upturned; texture, firm; seeds, brownish; quality, good; shipping quality, very good. Blossoms, medium in number, imperfect; plant, fairly vigorous; foliage, fair; runners, average, or below; rust, slight.

Parker Earle type; productive, and worthy of more extended trial.

Premium. — Fruit: conical; size, medium large; core, slight; external color, scarlet; color of flesh, scarlet; flavor, acid; season, early to medium; calyx, medium; texture, firm; seeds, imbedded; quality, rather poor; shipping quality, good. Blossom, imperfect; plant, fairly vigorous; foliage, medium dark; runners, numerous; rust, slight.

Good average berry, but inclined to run small by mid-season.

Pride of Cumberland. — Fruit: round, conic; size, medium large; core, slight; external color, light crimson; color of flesh, light crimson; flavor, sub-acid; mid-season; calyx, medium loose; texture, very firm; seeds, yellow, protruding; quality, very good; shipping quality, very good. Blossoms, medium in number, perfect; plant, fairly vigorous; foliage, fair; runners, comparatively few; rust, slight.

Not very productive on our soil, but otherwise a good commercial berry.

Putnam's Seedling X. — Fruit: round, conic; size, large; core, medium; external color, scarlet; color of flesh, scarlet; flavor, acid; season, late; calyx, large; texture, very firm; seeds, yellow, slightly imbedded; quality, good; shipping quality, very good. Blossom, vigorous, imperfect; plant, has good vigor; foliage, medium; runners, average; rust, slight.

Fine, firm, regular late berry.

Rochester. — Fruit: irregular, conic; size, medium large; core, slight; external color, crimson; color of flesh, crimson; flavor, sweet; season, medium; calyx, medium; texture, firm; seeds, yellow, protruding; quality, poor; shipping quality, good. Blossoms, many, perfect; plant, fairly vigorous; foliage, medium; runners, numerous; rust, slight.

Not to be recommended for commercial planting, from its behavior on our grounds.

Rough Rider. — Fruit: irregular; size, medium large; core, hard; external color, crimson; color of flesh, crimson; flavor, acid; mid-season; calyx, rather loose, medium; texture, firm; seeds, yellow, imbedded; quality, rather poor; shipping quality, good. Blossoms, medium in number, perfect; plant, poor in vigor; foliage, fair; runners, fair; rust, slight.

Nothing to recommend it, according to its behavior here.

Sample. — Fruit: round, conic, regular; size, large; core, slight; external color, scarlet; color of flesh, light scarlet; flavor, sub-acid; mid-season; calyx, medium; texture, medium; seeds, brownish; quality, fair; shipping quality, fair to good. Blossom, vigorous, imperfect; plant, has good vigor; foliage, medium green; runners, numerous; rust, slight.

A fine, productive, uniform commercial berry, inclined at times to be a little soft; still the most reliable, under various conditions.

Sawyer's Seedling. — Fruit: round, conic; size, medium large; core, slight; external color, scarlet; color of flesh, light scarlet; flavor, sub-acid; season, medium to late; calyx, medium; texture, firm; seeds, yellow, imbedded; quality, fair; shipping quality, good. Blossom, fairly vigorous, perfect; plant, very good in vigor; foliage, large, vigorous; runners, average; rust, slight.

Satisfactory on our grounds; productive and valuable.

Shuster's Gem. — Fruit: round, conic; size, large; core, slight; external color, crimson; color of flesh, lightish; flavor, sub-acid; mid-season; calyx, large; texture, medium; seeds, yellow, protruding; quality, fair; shipping quality, fair. Blossom, perfect; plant, has good vigor; foliage, medium dark; runners, average; rust, slight.

An old reliable berry, and worthy of culture.

Springdale Beauty. — Fruit: irregular, roundish; size, medium to large; core, slight; external color, scarlet; color of flesh, light scarlet; flavor, sub-acid; season, early to medium; calyx, loose; texture, medium; seeds, yellow, slightly imbedded; quality, fair; shipping quality, fair. Blossom, vigorous, perfect; plant, vigorous; foliage, medium dark; runners, average in number; rust, slight.

A good general-purpose berry.

Uncle Jim. — Fruit: long, conical; size, large to very large; core, slight; external color, dark scarlet; color of flesh, light scarlet; flavor, rather insipid; season, medium; calyx, medium loose; texture, firm; seeds, yellow, imbedded; quality, fair; shipping quality, fair. Blossom, perfect; plant, very good in vigor; foliage, resembles Marshall; runners, numerous; rust, none.

Sets moderate amount of fruit, and matures it; one of the most promising newly introduced varieties; fancy.

Uncle Sam. — Fruit: round, conic; size, large; core, slight; external color, scarlet; color of flesh, light scarlet; flavor, insipid; season, medium late; calyx, large, loose; texture, firm; seeds, brown, imbedded; quality, fair; shipping quality, good. Blossom, perfect, and good pollenizer; plant, vigorous; foliage, dark; runners, comparatively few; rust, slight.

Stocks up well in hill system, but rather light color for a market berry, and only moderately productive.

Cultural Methods.

The department has constantly experimented with methods of cultivation; and, since this work has covered many years and a diversity of soils, some general remarks on the management of strawberry plantations may appear to be in place. While the cultural methods of growing the strawberry vary widely, and each system has its special devotees, nearly all methods have merits and demerits worth considering.

Shall the strawberry plant be allowed to fruit one or two years? Nearly all the best growers now practise the former method. By this quick rotation fungous and insect pests are avoided to a greater extent, and the fruit is generally considered enough better to warrant the extra labor and expense.

Shall the plants be set in the early spring, or in autumn? Generally speaking, our experience has shown that spring setting is best, as the root system gets a better chance to develop, and the crown to store up nutriment for fruit bearing the following year. However, in special cases good results are obtained by selecting vigorous plants in July and August, setting in beds close together, and allowing no runners to form.

There are four general systems, modified more or less to suit special conditions; these are commonly practised with spring setting: the hill system, hedge-row system, narrow matted row and wide matted row systems.

The hill system is more generally advocated by amateur than commercial growers. The plants should be set out about two and one-half by two feet, and no runners allowed to form. Everything that will aid the crown to increase in size and strength should be provided. The larger and more vigorous the crowns, the greater the results; the strength of the plants goes to building up a fruit-producing organism alone. Another great advantage is the exposure to air and sunlight on all sides, and the consequent production of better-colored, better-flavored and firmer fruit, worthy of a fancy price.

The hedge-row system is a modification of the hill system in many respects. The plants should be set out about the same distance apart, or possibly in rows three feet apart. The first vigorous runners are then trained in a line with the parent plants, but not detached from them. When this line is filled out so as to make one continuous row, with plants about four or five inches apart, no more runners should be allowed to form. This system possesses nearly all the advantages of the former, and besides gives larger yields. Some varieties, like Clyde, which are naturally light-colored and rather soft, gave surprisingly better results as regards color and firmness the past season when grown in this way. The mass of fruit on one side of the rows, fully exposed to the air and sun, was a sight worth seeing.

The wide matted row and narrow matted row are really a modification of one system. By this plan the plants are set some three and one-half or four feet wide by one and one-half feet in the rows. No runners are allowed to grow until the parent plant has become well established, and then all or a limited number of runners, according to the wide or narrow row system, are allowed to root. The general tendency of this system is to grow vines at the expense of the fruit. Large yields are sometimes obtained, but generally of smaller and poorer fruit.

Whatever the system adopted, or the character of the soil on which the plants are grown, it is of the utmost importance to start with plants of unimpaired vigor, and keep them thus. Feed liberally, and spray with Bordeaux mixture occasionally. Cultivate frequently. Experiment, and study the varieties and adaptation to soil.

Marketing Apples in Boxes.

A feeling has been steadily gaining ground among the growers of good apples that some package smaller and neater than the common barrel should be used in marketing the fruit. It seems unnecessary to here review all the considerations which have influenced fruit growers in coming to this conclusion. There are many things to be said in favor of smaller packages. There are also some few objections and many qualifications to be made. The movement toward the use of boxes has been emphasized during the shipping season of 1903 by the great scarcity and unreasonably high price of barrels. Inquiries regarding the use of boxes have accordingly been frequent; and on this account it has been thought that a brief note of our experience in the department of horticulture would prove of general interest.

Bushel boxes of two common patterns have been used during the two shipping seasons of 1902 and 1903, though not in large numbers. Both early apples and winter varieties were shipped in these packages. In every case the results were gratifying. The apples always brought as much money, or more, than the same quantity of fruit in barrels; in fact, the cash returns were nearly always greater, and sometimes surprisingly so. In one instance, in 1902, Gravensteins were shipped both in barrels and in bushel boxes on the same day and to the same dealer, the fruit being from the same trees, and graded precisely the same throughout; the apples in boxes, however, were wrapped in papers. In this instance the barrels sold at $2 each, and the boxes at the same price. Since the boxes hold very nearly one-third of a barrel, the price was approximately three times as much for the fruit in boxes.

This case, however, is extreme; no such greatly disproportionate price was secured in any other instance for box apples. Still, every shipment of apples in boxes showed a fair margin in favor of the package, and several times the difference was a handsome one.

According to our experience, it seems that the bushel box is especially advantageous for early apples, — say up to the end of the Gravenstein season. Fancy grades of all varieties, however, may be expected to show good results in boxes. Sutton Beauty, shipped as late as Christmas time, realized high prices.

Our experience also favors the use of wrapping papers on fancy apples, more especially on highly colored and on soft-fleshed early varieties. These papers are best bought ready cut for the purpose, and are supplied by various dealers.

There are several forms of boxes in use. Those which we have specially examined are as follows: —

The vegetable box in use throughout the State for potatoes, beets and similar garden truck has been considerably tested for apples. We have used it ourselves to some extent, but do not consider it suitable. This box is 18 inches square and 8 inches deep, thus having a capacity of 2,592 cubic inches, or considerably more than a standard bushel (United States standard bushel contains 2,150.42 cubic inches). The ends of this box are of $\frac{3}{4}$-inch lumber, and the sides, top and bottom of $\frac{1}{2}$-inch stuff.

The box most used and recommended by large apple shippers is represented in our collection by samples bought from a New York manufacturer. This is the box which we have chiefly used, and which we prefer. The inside dimensions are 10 by 11 by 20 inches, thus giving a capacity of 2,200 cubic inches, — very nearly the exact measure of the standard bushel. It weighs a trifle over 50 pounds, filled. The ends are of $\frac{7}{8}$-inch stuff, and the sides, top and bottom of $\frac{1}{4}$-inch stuff. It will be seen that the sides, top and bottom are very light, thus allowing a considerable spring. There is a difference of opinion among shippers as to whether this elasticity is desirable, or objectionable. Some favor it strongly; others insist that a perfectly rigid box is better. Our own opinion is that the rigid box is better for long shipments, as, for example, to Europe; but that the box with plenty of spring is better for near-by markets.

Another box, having exactly the same interior dimensions, is manufactured in Wisconsin, and is represented in our collection by a sample. We have not used this box, but are pleased with its appearance. It is better made and more attractive than the New York box, just described. The ends are of $\frac{7}{8}$-inch stuff, the top and bottom are of $\frac{1}{4}$-inch stuff, and on the sides at each corner is a strip of $\frac{3}{8}$-inch lumber, about $2\frac{1}{2}$ inches wide. This holds in place a sheet of thin veneer, which forms the principal portion of the side. The box is light and strong, as well as good looking.

These boxes can all be bought in the knock-down, and made up at home. The price is about $15 per hundred.

Another box, used in Ontario, Can., is very well made and attractive, but too expensive for the domestic trade. It measures $10\frac{1}{2}$ by $11\frac{1}{2}$ by 22 inches inside, giving a capacity of $2,656\frac{1}{2}$ cubic inches, or considerably over a bushel, — in fact, more nearly five pecks. This box is made with ends of $\frac{1}{2}$-inch lumber, sides, top and bottom of $\frac{3}{8}$-inch wood, the whole being firmly dovetailed at the corners. It forms a fine package for the foreign trade, though it is larger and more expensive than necessary.

We would not recommend any one to undertake the use of the bushel box for apples on a large scale without considerable preliminary experiment; but we consider it well worth trying. We shall be glad to answer any inquiries on this subject, so far as our experience and information allow.

Notes on Quinces.

One of the most profitable crops during the last two years on the farm of the horticultural department has been furnished by the quince orchard. This consists of about 250 trees, of all sizes, ages and varieties. The larger part of them are growing on a springy slope at the base of a hill. The soil is good, rich alluvium, excellent for garden crops when dry enough. The particular spot where these trees stand has been partially drained by tile some time ago, but these drains have now become so much clogged that the land is quite wet during a considerable part of the year.

Under these conditions the plantation gave an abundant crop of very fine fruit in 1902, and a very fair crop of nearly as good quality in 1903. These were sold mostly at wholesale, — that is, to market men and dealers, or through commission men in Boston, Worcester and Springfield.

In 1902 the No. 1 fruit, which constituted by far the bulk of the crop, sold for \$2 a bushel. In most cases this price was received for the fruit *f. o. b.* at Amherst, though that shipped on commission to the three cities named sold for \$2 in those markets, and charges had to be deducted. The No. 2 fruit sold for 75 cents, \$1, \$1.25 and \$1.50 a bushel, averaging about \$1.25.

In 1903 quinces were very scarce, but at the same time the crop on the trees was not so large nor of quite such good quality. The No. 1 fruit brought \$2 and \$2.25 (mostly the latter figure), net. The No. 2 fruit brought various prices, averaging about $1.25.

In both years the profit from the trees was considered very satisfactory. The good prices secured were attributed largely to the method of marketing the fruit. In the first place, it was well ripened; the fruit was allowed to remain on the trees until it had attained a bright, rich color. In the second place, it was very rigidly graded, only prime specimens being put into the first grade. Next, each specimen was carefully wrapped in clean fruit paper, specially cut for the purpose. These fruits were then packed in fresh, clean, attractive bushel boxes. A few were sold, some wrapped and some unwrapped, in 16-quart peach baskets, but the box was thought to be much the better package.

The use of the bushel box, or some similar small package, and the wrapping, are thought to be essential points in marketing fancy quinces, except when the fruit is delivered direct to the consumer. Quinces bruise very easily, and even the slightest bruise on a ripe quince quickly becomes discolored, and the fruit presents a highly unattractive appearance. Quinces packed in barrels and shipped some distance to market come out with nearly every specimen bruised; but the wrapping and the small package both prevent such injury.

The small package is desirable on another account, namely, because very few customers care for more than a bushel of quinces at a time; even market men with a very fair trade prefer to buy in bushel lots.

The character of the soil on which the college quince trees grow has been mentioned. Wet clay land is frequently recommended for quinces, but the trees do better on well-drained soil. Even fairly light loam will sometimes support thrifty trees for some years, though the ideal soil is moderately heavy clay. Light and sandy soils give small prospect of success.

The quince tree grows slowly, and does not require rigorous pruning. If only reasonable and seasonable attention is given to keep the head open and well balanced, nature will do the rest.

No diseases or insects of any consequence have troubled us. The trees have been sprayed with Bordeaux mixture, and this has probably helped to hold in check the scab, a fungous disease which attacks the leaves and fruit to some extent nearly every year, but which, with us, does not assume serious proportions.

The principal varieties grown are Orange, Champion and Rea (Rea's Mammoth). All succeed perfectly, and we have found them all equally acceptable in the market.

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