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FIFTY-SEVENTH

ANNUAL REPORT OF THE SECRETARY

OF THE

MASSACHUSETTS

STATE BOARD OF AGRICULTURE,

TOGETHER WITH THE

TWENTY-SECOND ANNUAL REPORT OF THE MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

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TABLE OF CONTENTS.

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Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1912
Middlesex North,	GEO. W. TRULL of Tewksbury (P. O. Lowell, R. F. D.),	1911
Middlesex South,	ISAAC DAMON of Wayland (P.O. Cochituate),	1911
Nantucket,	JOHN S. APPLETON of Nantucket,	1912
Oxford,	WALTER A. LOVETT of Oxford,	1913
Plymouth County,	AUGUSTUS PRATT of Middleborough (P. O. North Middleborough),	1911
Spencer (Farmers' and Mech.'s Ass'n),	WALTER C. BEMIS of Spencer,	1913
Union (Agricultural and Hort'l),	SYLVESTER H. PEEBLES of Blandford,	1913
Weymouth (Agricultural and Ind'l),	THERON L. TIRRELL of Weymouth (P. O. South Weymouth),	1912
Worcester,	B. W. POTTER of Worcester,	1911
Worcester East,	GEO. F. MORSE of Lancaster,	1912
Worcester Northwest (Agricultural and Mechanical),	ALBERT ELLSWORTH of Athol,	1913
Worcester South,	WILLIAM E. PATRICK of Warren,	1913
Worcester County West,	JOHN L. SMITH of Barre,	1911

THE FIFTY-SEVENTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

STATE BOARD OF AGRICULTURE.

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

The year just closed was one marked with a great deal of advance and improvement in agriculture, and mainly along new lines. The great Fruit Show, held in Boston in October, with the months of preparation for it, and the publications of this Board and other interested organizations along the line of information in horticulture, particularly apple growing, did more to call the attention of the outside world, and indeed of New Englanders themselves, to the possibilities of New England agriculture than anything in recent years. One of the encouraging features in connection with this movement was the interest taken by the Boston Chamber of Commerce, both in the Fruit Show and in agriculture in general. This progressive body of merchants, under intelligent leadership, and consolidated into a strong organization, has come to realize, to a greater extent than ever in the past, the importance of agriculture, commercially as well as economically. I am fully assured that it is their purpose to do everything possible to help build up agriculture in New England, realizing that a prosperous agriculture forms the best foundation for a prosperous business interest. The city of Boston forms the natural center for the greater part of New England, and is bound to reflect the conditions in the outlying districts which are feeders to it. This the Boston Chamber of Commerce realizes, and, I am assured, intends to act in accordance with that view. When we add this force, exerted for the first time, to all that the State and United States governments are doing for agriculture and the agricultural population, through the boards of agriculture, agricultural colleges and experiment stations, and indirectly through a great many other channels, such as the schools, libraries and so on, most of which are supported to a greater or less degree by the State governments, there would seem to be no good reason why the farmers should not take courage, and, in particular, avail themselves more fully of these opportunities.

There was practically no legislation of importance during the winter for the benefit of agriculture, other than the passage of the routine appropriation bills, carrying substantial increases in some cases. The session was more noted for what was killed than for what was enacted. Several bills were introduced along different lines, some of merit and others without it, which failed of enactment, and which will be discussed under the proper headings elsewhere in this report.

Generally speaking the season was a good one for farmers from the business point of view. The prolonged drought, severe as its effects were upon wells and streams, had surprisingly little effect upon crops in general, due in the main to timely showers, which relieved its worst features. Pasturage suffered severely in almost all sections, but cultivated crops came out remarkably well, and prices were good in the main, thus making up for any shortage in yield. Precipitation for the year was but two inches below the average precipitation for the past thirty-eight years, and probably the fact that this slight shortage followed the lowest rainfall of that period, that of 1908, had much to do with its effect on streams, springs and wells.

The corn crop was a very poor one in most cases, the cool weather of midsummer holding it in check; and but for the extremely late date of the first killing frost it would have been a total failure, so far as grain is concerned. Owners of silos complain that the ensilage secured was not of as much value as usual, owing to the absence of ears, or their immature condition when harvested, and many fields grown for grain gave almost no yield of mature ears.

Dairy products brought better prices than ever before, but this was offset, and indeed the increase was mainly forced, by failing pastures, obliging milk producers to feed at the barn and making serious inroads into the winter's supply of roughage. The price of milk is still below what it should be at the farm. Whether the solution of this question lies with the increase of the price to the consumer or with the increase of price paid by the middleman is a question. The recent report setting forth the findings of the expert employed to examine into the accounts of the milk dealers of New York City, with the great profits shown to have been piled up on eight-cent milk, would indicate that perhaps it might lie along the latter line. I would urge that the Legislature be requested to consider whether such an examination and general inquiry into the conditions surrounding the production, transportation and sale of milk is not in order in this State. Certainly the farmers would be the last to urge an increase to the consumers, many of whom can ill afford to meet such an increase, if it be shown that too large a proportion of the cost of handling milk between the producer and consumer is in the form of undue profits. I am not prepared to say just what form this proposed action by the Legislature should take, or whether there is not some other method by which this result can be secured in Massachusetts, but I would recommend that the Board and the Legislature consider this matter carefully, and take such action as may seem wise.

Butter has brought unusually good prices and dairy sections devoted to this branch of the business were generally prosperous. Grain and hay continue to command high prices, and those growers who depend on feeds which they cannot raise are more than ever at a disadvantage. The dairyman should, under all except the most extraordinary conditions, endeavor to raise all of his roughage and as much of the grain he feeds as possible. Clover hay, either as silage or roughage, will do more towards keeping down grain bills than any other crop the farmer can raise. If one-half the energy were expended in growing clover that is put into the other branches of the dairyman's work his financial standing at the end of the year would be bettered by many dollars.

The apple crop, like last year, was better than was expected in the early part of the season, and brought unusually good prices. Our apple growers, therefore, are in a prosperous condition. If they will give the attention to packing and sorting that they should, the fancy apple trade will pass from the western growers and remain at home. I hope to see the day when the shipping of Colorado and Oregon apples beyond Chicago shall be a thing of the past, except in times of local scarcity and for European export. Other fruits gave good average yields and brought good prices. Cranberries were a light to medium yield.

The problem of damage from wild deer is becoming a very serious one, especially to the orchardist. Approximately $10,000 will be paid when the bills for damage by deer for 1909 are all settled. In many sections it is impossible to plant an orchard with any hope of bringing the trees to bearing age, unless the grower is prepared to go to the almost prohibitive expense of providing a fence high enough to keep these animals out. I submit that deer serve no useful purpose in an agricultural community. They furnish a certain variety to the landscape and look very pretty, feeding on some other man's land, but we can hardly allow this menace to continue if we intend to attempt to build up the orchard industry of Massachusetts. The Fish and Game Commission estimates that there are 8,000 wild deer in Massachusetts, and that they are increasing at the rate of 40 per cent per year. With $10,000 damage money paid the past year, and the immense damage caused by the animals which cannot be paid for in dollars and cents considered, the continuation of the present policy of protection presents, in the light of the above estimates, an outlook that is positively appalling from the standpoint of the farmer and the orchardist. I would recommend that the protection now enjoyed by these animals be absolutely withdrawn.

The San José scale, as I have frequently pointed out in the past, is also a great menace to our orchards. The present nursery inspection restricts its spread from the nurseries to the lowest possible point. A serious problem is presented in the spread of the scale from orchard to orchard. Many owners of fruit and shade trees refuse to clean up the scale, even when their attention is called to the necessary result of its presence, and their trees form a breeding ground from which it spreads to those of their neighbors. There appears to be sufficient authority at present in the hands of the State Nursery Inspector to deal with this problem. The only question is one of sufficient funds to handle the work. I would recommend a sufficient appropriation to employ a permanent inspector, whose duty it shall be, especially, to look after the condition of orchards and compel negligent owners to clean them up.

Market gardeners had a very good year, the best of the last three. Crops were not remarkably good nor prices remarkably high, but there has seldom been a season when the general average of both was maintained at so uniformly satisfactory a level throughout the year.

Onions were generally an average crop and brought very satisfactory prices. Tobacco was an unusually good crop, and was secured in good condition, with very little damage from hail, wind or insects.

Poultry and eggs were uniformly high in price throughout the year. The high prices of grain led many small poultry keepers to reduce their flocks or give up the business, with a consequent curtailment in the supply of eggs and poultry. Those who had the courage and foresight to stick to the business have generally been able to show as good average returns as before the increase in the price of grain. Where the farmer can raise his own grain and clover he should find that the keeping of poultry will be his most profitable branch, where it is retained at its proper limits.

Milk Legislation.

The change in the milk standard, enacted by the Massachusetts Legislature of 1908, did little to quiet the agitation for the abolishment of the milk standard. A large number of bills were introduced into the last Legislature, covering almost every phase of the milk question. Some of these, such as the law relating to milk inspection, were enacted into law. The committee on agriculture considered carefully those relating to the abolishment or modification of the standard, approaching the question with a great deal of care and giving it an intelligent study, which reflects great credit on the committee. After several months of hearings and deliberations they recommended a bill, the idea of which originated with the general agent of the Dairy Bureau of this Board. In effect it provided that where milk was taken from a producer and analysis of subsequent samples of known purity showed that the first milk was pure, unadulterated milk, as it came from the cow, no prosecution should follow. It also provided for the same exemption from prosecution for the dealer who could prove that the milk was the milk of a certain producer and in the original container. This latter feature I believe to have been a mistake, as it is my opinion that the milk dealer and peddler is amply able to safeguard himself, and that such exemption gives too much of a loophole for escape from responsibility under the standard law. This bill had a somewhat turbulent passage through the Legislature, the Senate reversing itself several times on the matter, but was finally killed on the enactment stage, an unusual proceeding. If enacted into law it would have practically removed the principal objection which milk producers have to the milk standard, that they are liable to be brought into court and branded with a criminal record without the slightest intent to do wrong, and in many cases without the slightest suspicion that their milk was not up to legal requirements. In my judgment it would, in its working out, have settled the milk standard question for twenty years, if not for all time, and without the least injury to the consuming public.

I do not believe that the milk standard should be abolished at this time, as it forms the only protection of the consumer and producer alike against a certain amount of commercial fraud. There is a widespread impression that the milk standard is a protection to the public health. Nothing can be further from the truth. It is simply a commercial standard designed to protect the consumer against fraud by the addition of water and skimmed milk to whole milk in such quantities that they cannot conclusively be shown to have been added, to the satisfaction of our courts. It is exactly on the same footing as the law prohibiting the coloring of oleomargarine to resemble butter, or that prohibiting the sale of renovated butter unless it is properly stamped. Neither water nor skimmed milk is injurious to the public health, and their addition to whole milk is simply a fraud on the consumer. It is a fraud also on the producer, in that by just so much it takes the place in the market of the whole milk which he produces, and renders his legitimate product less salable. Until such time as the science of milk inspection and analysis shall have advanced to the point that allows of the detection of skimmed milk or water, except in the most minute proportions, when added to whole milk, the standard is necessary to both producer or consumer.

Nevertheless, the attempts to inflame the minds of the consumers against legislation aimed to reduce the evils of this necessary system, on the ground of danger to the public health, are pure buncombe, and cannot be too severely condemned. The rigid enforcement of the milk standard law would, on the other hand, form a much more serious menace to the public health than a reasonable exemption from prosecution of honest producers. It is well known that standard milk cannot be fed to infants or to some invalids, but must be diluted and rectified to meet the requirements of their delicate digestive organs. Cartoons which represent that legislation such as that of last winter is an attack upon the health of infants are not only false but absolutely criminal in their recklessness, as they lead the uninformed portions of our city population to believe that milk as now sold in the market is a proper infant food. I would urge temperance, fairness and judgment in the discussion of milk questions, on both sides, and that all the agencies of the State having to do with the milk problem, from any point of view, unite in an attempt to show the consuming public the true situation of the milk standard, and the function which it was designed to serve and should serve.

I would recommend that this Board instruct its secretary to draft a bill along the general lines of this legislation of last year and present the same to the Legislature as the unanimous action of the Board, and that the Board further, as a body, through its committees and as individuals, do all possible to secure its favorable consideration.

I would further recommend that the Board instruct its secretary to again introduce the bill of last year, providing for the payment by the State to the producer for all milk kept from the market as a result of contagious disease on his farm. I urge this measure more in the interest of the public health than in that of the milk producer, as I believe that it would lead to the prompt reporting of all such cases to the proper authorities, and thus minimize the danger of the spread of contagion.

Further, I would call to the attention of the Legislature that the business of milk production has at present all the burdens that it can bear, and would say that further restrictive legislation is not at this time in order, but rather that something should be done for the encouragement of the producer, instead of his further discouragement. Dairying in Massachusetts is not on such a profitable basis that we can afford to impose further burdens upon the industry. The only effect of such action will be to drive the business of the production of milk outside Massachusetts, so that the milk supply of Boston will eventually come almost entirely from other States, where the producers are beyond the reach of regulation by our Massachusetts authorities.

Changes in the Board.

The changes in the membership of the Board during the year came about entirely through the expirations of the terms of various members. Members retiring because of expiration of term of service are: Henry E. Paige of the Hampshire Agricultural Society, after ten years of service; W. J. Heffernan of the Spencer Farmers' and Mechanics' Association, after one year of service; George O. Millard of the

Union Agricultural and Horticultural Society, after three years of service; and C. D. Richardson of the Worcester South Agricultural Society, after twelve years of service.

Meetings of the Board.

On June 5, 1909, the Board held a summer field meeting at the grounds of the Hillside Agricultural Society, in Cummington, pursuant to the policy inaugurated last year of holding such meetings in remote sections, where the people, on account of poor facilities of transportation, cannot conveniently attend the summer field meetings of the Board. The attendance was drawn from the towns in the immediate section, and was very satisfactory in numbers and interest shown. The points of the dairy cow, and how to select and breed for best results, proper methods of handling and hiving bees, with observation hive, the latest methods in forestry, with instructions as to care of woodlands, and the proper methods of planting, budding, grafting and pruning fruit trees were the subjects demonstrated.

The regular summer field meeting of the Board was held at Whalom Park, near Fitchburg, on Aug. 4, 1909. The attendance was the largest ever recorded for one of these meetings, with perhaps the exception of the meeting at the same place two years ago. An entirely new programme was arranged for, three new subjects being taken up, the demonstration of how to produce and put up certified and steamer milk, the best method of selecting apples for exhibition, the proper methods of judging fruit and box packing, and the best methods of selecting, breeding and judging corn. The meeting was held with the Massachusetts State Grange, and there was excellent speaking in the afternoon under its direction.

The public winter meeting of the Board was held at Dracut, on the invitation of the Middlesex North Agricultural Society. The programme was an excellent one, the attendance very satisfactory and the quality of the lectures delivered superior. The Board has often had meetings where there were a number of lectures of merit, but not in recent years one where the matter and form of presentation was as uniformly excellent as at Dracut. The Lowell board of trade tendered an excellent banquet to the Board and others attending the meeting on Wednesday evening. The principal speakers were Dr. David Snedden, Commissioner of Education, who made his first public appearance in Massachusetts on this occasion, and Harold Parker, the chairman of the Massachusetts Highway Commission. The lectures and selections from the discussions at the Dracut meeting will be found elsewhere in this volume.

The annual business meeting of the Board was held at Boston, on Jan. 11 and 12, 1910, and special business meetings were held at the summer meeting at Fitchburg and at the public winter meeting.

Agricultural Societies.

The agricultural societies generally enjoyed a prosperous year. Only a few suffered from bad weather, and most of them made some money, while a few were remarkably successful financially. The exhibits were of the customary high standard, the hall exhibits apparently suffering very little from the dry weather. Perhaps one reason for this is that the exhibitors at our fairs are among the more up-to-date members of our farming population, and likely to give their crops and orchards better and more careful attention than their less progressive neighbors, all of which has its effect on the products which they exhibit.

The Board, at its last meeting, made certain changes in its rules governing the payment of premiums by agricultural societies. It would appear from the reports of the inspectors that these rules were fully observed by the several societies. The inspectors report most of the societies to be in good financial condition, with good grounds and buildings, and their criticisms of the management of the fairs are of a very minor character. All report that there were no objectionable features or improper shows among the attractions provided for the entertainment of the public.

The societies deserve great credit for the way in which they responded to the request of the Board for financial assistance for the New England Fruit Show. All but a few of the societies, which felt that their financial condition would not justify the diverting of any funds, however small, from their treasury for this purpose, contributed sums ranging from $15 to $100, and aggregating upwards of $800. To that we must add $300 from the Massachusetts Society for Promoting Agriculture, which is represented on this Board, and $300 and the use of their building from the Massachusetts Horticultural Society. Altogether the societies having representation on the Board contributed about $1,500 in cash towards the funds of the New England Fruit Show. It is no exaggeration to say that without these contributions it would have been impossible to hold the exhibition. The success of the show reflects credit on the agricultural societies, and should be a source of satisfaction to all their officers and members. I confidently expect that they will be found equally liberal in their attitude toward the coming New England Corn Exposition, and would recommend that the Board make the same request to the societies for the benefit of that organization.

Farmers' Institutes.

The institute work is one of the most popular and valuable branches of the work of the Board. These meetings were the first forms of vocational instruction for farmers, outside regular educational institutions, which were ever put in force. Massachusetts was in the front rank of the institute work at its beginning, and has remained a State where the work is wisely conducted and has far-reaching results for good. Other States spend many times the amount of money on this work that we do in Massachusetts, but none can show a better return per dollar of expense than can we. Our system necessarily differs from that of the great agricultural States of the west, but is well adapted to the needs of our farming population and our local conditions. Frequent meetings for a single day seem to serve our purposes better than meetings of several days in duration, allowing of a wider distribution of the benefits of this work throughout the State in each year. The societies contribute their full share to this work, providing halls, advertising, etc., and their officers in the main show a commendable desire to make these meetings a success.

One hundred and forty meetings were held during the year, with 192 sessions. All the societies on the Board held 3 or more meetings, except the Spencer and Hoosac Valley societies, where the holding of more than 2 meetings seemed inadvisable from local causes, and which societies sought and obtained permission from your secretary to omit them. The Massachusetts Society for Promoting Agriculture is not required to hold these institutes. Ten societies held 4 or more meetings, while 26 meetings were held in sections not covered by societies represented on the Board, or by organizations devoted to special interests in agriculture and with membership covering the State or large portions of it.

The average attendance for the year is the largest ever attained in the State, being 137 per session. The attendance in 1908 was 111, in 1907 it was 118, in 1906 it was 127, and in 1905 it was 125. Figures for attendance before that date range from 94 in 1899 to 109 in 1904. The increase from year to year suffered a slight check in 1908, but in 1909 resumed its upward movement with an increased momentum.

We do not plan to arrange any circuits of institutes this year, but Dr. Geo. M. Twitchell of Maine will make Boston his headquarters from February 10 to March 15, and will be available for institute work between those dates. The committee on institutes and public meetings carefully revised the list of speakers and subjects this year, with the result that we are offering a better list than ever before. Some speakers were dropped from the list and others added, care being taken that only those of established reputation should be added to the list. We doubt if there is a State in the Union where there are so many good speakers to choose from. This is due in a large measure to the near proximity of the agricultural colleges and experiment stations of New Hampshire, Connecticut and Rhode Island from which institutions we are able to draw the best of speakers, in addition to those located with the agricultural educational institutions of our own State.

On Aug. 16 and 17, 1909, your secretary attended the annual meeting of the American Association of Farmers' Institute Workers, at Portland, Ore. Being president of the association I felt bound to make the trip, and I may say that I was amply rewarded by the information in relation to agricultural conditions on the Pacific slope, particularly fruit growing, which I was able to glean by a somewhat hurried inspection of some of the important fruit-growing sections, notably the Hood River valley in Oregon. In addition I may say that the meeting of the association was a very interesting one, and that I profited greatly by my association at that time with the institute workers and managers from other parts of the country.

Beekeeping in Massachusetts.

The Board has done everything possible to foster the business of beekeeping in Massachusetts during the year, holding a number of meetings with associations devoted to the business, and co-operating with them in other ways. The magnitude of this industry is little understood, and it does not receive the attention which it deserves. The "foul brood" disease problem is an important one with Massachusetts beekeepers. This disease has wiped out the industry in large areas in other States, and will always do so where allowed to spread unchecked. The disease is present in many sections of Massachusetts. As in every other industry, the intelligent, wide-awake beekeepers are largely at the mercy of the careless and indifferent, and some relief is needed if the apiaries of the State are to be saved. New York has an excellent statute calling for inspection of apiaries, with power in the hands of the inspector to compel the owner to take proper measures to abate the nuisance, much as the gypsy and brown-tail moth superintendent may do with those insects. A bill modeled along similar lines was introduced at the last session of the Legislature, but failed to be reported by the committee on agriculture. The matter did not receive the careful attention which it should have been accorded. I would recommend that your secretary be instructed to prepare a bill along the same line and introduce the same at this session, and that the Board urge its enactment upon the Legislature.

Nursery Inspection.

As a result of the conference of Governors, held at Boston in November of 1908, a conference of those interested in the enforcement of nursery inspection laws was held at this office in December of that year. At that meeting a form of bill was agreed upon to be introduced into the Legislatures of all the New England States, to the end that there might be uniformity of laws throughout the section on this important line of work. Such a bill was introduced at the session of the Massachusetts Legislature of 1909, and passed substantially in the form in which it was presented. I am not informed as to what action was taken in the other New England States, but so far as Massachusetts was concerned the end aimed at was achieved. Our Massachusetts law was largely used as a basis for forming the proposed legislation, and the changes brought about were more a matter of form than substance.

The work of the year has been carried on judiciously and thoroughly. The work is constantly increasing, both by reason of the large number of insect pests and their increase, and by reason of the somewhat stricter interpretation and enforcement of the law so far as it concerned the common carriers. The State Nursery Inspector framed an excellent set of regulations, as he was empowered to do under the act of last winter, defining what is and what is not regarded as nursery stock, and consequently liable to inspection before it can lawfully be shipped by railroads and express companies. This did away with much of the confusion previously existing and was of exceeding value. The Board approved these regulations at the special meeting at Fitchburg.

If the Legislature should see fit to go into the matter of compelling owners to clean up their property where infested with the San José scale, as previously suggested in this report, this work should unquestionably be placed under the control of the State Nursery Inspector. The present incumbent, Dr. H. T. Fernald, finds that the physical work of nursery inspection has been such a tax on his health that he must give up the work. As the law now stands he can receive no compensation for any other sort of work. While it would perhaps be possible to replace him so far as the actual field work is concerned, I know of no one who could fill the place that he does in the details of the work, requiring judgment and poise. The questions of the enforcement of the law in regard to common carriers and private owners of property, as well as many of those in the inspection of the commercial nurseries, require a man at the head with maturity of judgment and experience in dealing with men. That we may not lose Dr. Fernald's services on these points I recommend further that the Board instruct its secretary to draft and present a bill to the Legislature providing a proper compensation for other work than that of field inspection.

Dairy Bureau.

The details of the work of the Dairy Bureau are given in the annual report of its general agent, which appears elsewhere in this volume. I need only say, therefore, that the work has been carried on with judgment, moderation and a due regard to the interests of the whole people. The enforcement of the law should be carried on in the spirit of justice. Where the enforcing authority is certain that the violation of the law was due to ignorance or carelessness, and was without criminal intent, a sharp warning will usually have all the deterrent effect of a prosecution in the courts. Mere technical violations of the law should not be held too rigidly to account. The value of an officer charged with the enforcement of any law is not measured by the number of convictions he secures but by the number of offenders who subsequently repeat their offence. A record for judgment is greatly to be preferred to one for convictions. The work of the Dairy Bureau has been characterized by this care in handling the question involved, and by a scrupulous attempt to hold the scales of justice evenly. The result has been a record during the past year which cannot be surpassed, and has never, to my knowledge, been equalled. Two hundred and two offenders have been brought into court, and every case has resulted in a conviction. That the work has been carefully and well done needs no further assertion.

Cattle Bureau.

The report of the Chief of the Cattle Bureau will be found printed elsewhere. The law requires that he report to this Board, but there is no other relation between the two departments, though it is called a bureau of the Board of Agriculture. Its work has been well administered, but the system is an extraordinary one. The work of inspection and prevention of animal diseases should all be under the charge of the responsible agricultural department of the State. To this end I recommend that the Legislature make such changes in the law as, in their judgment, will best place this work in the hands of this Board.

State Forester.

The State Forester is a member of this Board, ex officio, and his report is required by law to be printed in this volume. I am not familiar with the details of the work, but am convinced that it has been carried on in a way to reflect credit on the State and the Forester. His responsibilities and duties have been greatly increased during the year, by the addition of the work against the gypsy and brown-tail moths. This work has been put on a very businesslike basis, and thoroughly reorganized in many important respects. I am glad to note this change, and anticipate that the results in the future will be superior to those of the past few years. The forestry work proper is fully explained in the Forester's annual report, and has been very satisfactory during the year.

State Ornithologist.

The State Ornithologist has come to be a recognized factor in the work of the Board of Agriculture. Elected by the Board, and with his headquarters at this office, he is one of the busiest members of our staff. That the salary he receives, $500 per annum, is entirely out of proportion to the work he performs, is entirely clear to any one familiar with the facts. I trust that soon the time will come when it will be felt advisable to put this work on a basis which will require all the time of the Ornithologist, with a salary sufficient to justify him in giving it all his time.

He has been engaged in collecting an immense amount of information on the game birds of Massachusetts. He will soon be in a position to issue a report on that subject, of the same general nature and scope of his recent report on "Useful Birds and their Protection." I would recommend that the Board instruct its secretary to urge the passage of a resolve by the Legislature providing for the publication of this material in book form. The sale of "Useful Birds and their Protection" continues, and there is no evidence that the demand will fall off in the near future. A considerable number of copies of the third edition remain on hand, so that we can supply demands for some time to come without another reprint.

The State Ornithologist has carried on a careful investigation during the past two years of the question whether birds are killed by reason of the heavy spraying with arsenical poisons against the gypsy and brown-tail moths. He has obtained some results which he believes are fairly conclusive, and they will appear in his annual report.

Gypsy and Brown-tail Moths.

The work against these pests has been carried on as well as it could be with the faulty system now in vogue. Attempted suppression means gradual extension. The only practical suppression is by attempted extermination. This our present system does not allow for, but the force at work has done the best that it could with the means at hand. That the United States government should take charge of this work is evident. With infestation in four States it has become an interstate matter, and with Massachusetts the only State doing anything like effective work the situation is a serious menace to the prosperity of the rest of the country. Of what avail is it to promote and protect our forests if the gypsy moth is to be allowed its way with them?

Massachusetts Agricultural College.

Many improvements and additions have been made at the college during the year. The entomological department has a new building, and the Legislature appropriated large sums for maintenance, repairs and the extension of the curriculum. There is a teaching force at the college to-day that would make the graduate of the early 90's open his eyes if he has not been in touch with the developments of the past ten years along this line. Specialization is the order of the day, and with even increased classes the individual attention which the different students receive is greatly increased over former years. This Board will, as in the past, support all appropriations asked for by the board of trustees along college lines.

The New England Fruit Show.

The gentlemen gathered together to consider changes in the laws affecting horticulture, at the suggestion of the conference of Governors, held in 1908, went beyond that, and the result of their meeting was the formation of the organization known as the New England Fruit Show, which held the great show at Horticultural Hall in October. That show was an eye opener for a great many people, and I feel confident that it was a tremendous impetus to New England horticulture, particularly apple growing. Our consumers have come to believe that the only good fruit is that from the far west, a belief encouraged by the superior methods of sorting and packing practiced there. A look at the great banks of splendid fruit at this show, all grown in New England, would have driven that idea from the mind of any person. Here could be seen all the varieties of apples which have originated in New England and some of the western varieties, the latter attaining even greater perfection than in their native surroundings. The display of plates of fruit showed many splendid specimens, but the greatest impression upon the eye was made by the exhibits of box fruit in the main hall. They showed to better advantage than the barrels, though the fruit packed in the barrels was fully equal to that shown in boxes, proving conclusively that the box is the best package for the grower to use, and the coming fruit package in New England as well as the west.

It would have been impossible to have held this show if it had not been for the support tendered it by the Board of Agriculture and the agricultural societies represented thereon. Their generous contributions have been mentioned in another place in this report. They were fully appreciated by the officers of the Fruit Show, and I have been asked to express their gratitude to you members who represent the societies.

The generous space which the Boston press gave to the reports of the show were also very gratifying. One very pleasant feature of the week was a complimentary dinner tendered to the officers of the Fruit Show, the members of the Board of Agriculture and the exhibitors at the show by the Boston Chamber of Commerce. It was an extremely interesting occasion, and one that will long be remembered by those in attendance. It marked also the awakening of this organization to the possibility of their working for the advancement of agriculture, and to their duty along this line. That much good will come of their active participation is assured.

I have been asked to estimate the value of the Fruit Show to New England, and have set it at not less than $1,000,000. That is not an extravagant estimate. The advance it gave to apple growing — an industry for which we are peculiarly well situated and our soils well fitted — was not all of the advantage derived. At the same time it showed that an up-to-date, progressive New Englander could beat the westerner at his own game, in agriculture at least, and must have a far-reaching effect on the outlook of every person who attended the show.

The New England Corn Exposition.

The people interested in corn growing in New England wished to hold a show last year, but very generously gave the right of way to the Fruit Show, which was first in the field. That there was a great field for development in corn breeding and growing was pointed out in my annual report of last year. Since that time I have come to know of at least two individuals who have worked along this line, and who have made substantial sums of money from their developing early, prolific and valuable strains of corn. That there is room for more of this work there is no question. The Corn Exposition to be held this fall should give this movement a great start, and should show our New England farmers the possibilities in corn growing. With the high price of grain something of the sort is necessary, and I think that it comes at just the right time. I bespeak for this Corn Exposition the same hearty co-operation that was given the Fruit Show, and recommend that the Board request the societies to make the same donations to its funds that they did for the Fruit Show.

Crop Reports.

The monthly crop reports of the Board were issued as usual, from May to October, during the year. The special articles included in these reports were: "The farmer's interest in game protection," by Edward Howe Forbush; "Economy of labor in poultry keeping on farms," by John H. Robinson; "Live stock in Massachusetts," by Prof. J. A. Foord; "Western methods in New England orcharding," by Prof. F. C. Sears; "The culture of the pear," by George T. Powell; and "The farm census for 1910," by Whitman Osgood. The popularity with which these reports continue to be received was attested by the increase in the number of requests for copies received. The edition for September and October was 5,900, as compared with 5,600 for October of 1908. The edition is exhausted for all except the report for October, a few copies of which are still on hand. The enormous demand for the August report depleted the file so quickly, and the subsequent call was so urgent, that it was deemed advisable to have a reprint of 2,000 copies made at once. Reprints of all other articles will be issued when in print for the annual report.

Publications.

The following publications were issued by this office in 1909, most of which may be obtained on application: —

	Pages.	Number.
Agriculture of Massachusetts, 1908,	726 [1]	15,000
Crop Report No. 1,	35	5,800
Crop Report No. 2,	36	5,800
Crop Report No. 3,	38	5,800
Crop Report No. 4,	36	5,800
Crop Report No. 5,	36	5,900
Crop Report No. 6,	41	5,900
Nature Leaflet No. 2 (reprint),	4	1,000
Nature Leaflet No. 4 (reprint),	4	1,000
Nature Leaflet No. 5 (reprint),	4	1,000
Nature Leaflet No. 8 (reprint),	4	1,000
Nature Leaflet No. 15 (reprint),	6	1,000
Nature Leaflet No. 16 (reprint),	8	1,000
Nature Leaflet No. 22 (reprint),	7	1,500
Nature Leaflet No. 23 (reprint),	7	1,500
Nature Leaflet No. 24 (reprint),	6	1,500
Nature Leaflet No. 25 (reprint),	6	1,500
Nature Leaflet No. 33 (reprint),	6	1,500
Nature Leaflet No. 39 (reprint),	8	1,500
Nature Leaflet No. 42,	7	1,500
Massachusetts Agriculture, Bulletin No. 2,	136	2,000
Farmers' Institute pamphlet,	14	800

There were issued in pamphlet form the following excerpts from the "Agriculture of Massachusetts," 1908: "Artificial hatching and rearing of chickens, as applied to 'south shore roasters;'" "Renovating old orchards;" "Strawberry culture;" "Some sheep topics for Massachusetts farmers;" "Potato-growing suggestions;" and "Drainage;" also, the annual reports of the Chief of the Cattle Bureau, the Dairy Bureau, the State Nursery Inspector and the first annual report of the State Ornithologist.

[1] Including twenty-first annual report of the Massachusetts Agricultural Experiment Station, 217 pages.

Legislation.

The legislation of 1909 having reference to the Board of Agriculture or to the agricultural societies was as follows: "An Act making appropriations for salaries and expenses in the office of the State Board of Agriculture, and for sundry agricultural expenses" (chapter 56); "An Act to regulate the payment of bounties to agricultural societies" (chapter 133); "An Act to authorize the State Board of Agriculture to collect and circulate information relating to idle or partly improved farms and farm lands" (chapter 212); "An Act to authorize the State Board of Agriculture to appoint a State Nursery Inspector and to provide for the protection of trees and shrubs from injurious insects and diseases" (chapter 444).

Extracts from the Trespass Laws.

The demand for these printed extracts from the trespass law was exceeded only by that of 1908. The records show that during the year 758 individuals applied for copies of the extracts, either by mail or at the office. The number supplied individuals, on request, since the law took effect, is as follows: 1905, 2,234; 1906, 3,468; 1907, 2,439; 1908, 3,715; 1909, 3,595. Prior to April 1 last in order to comply with the law, 870 copies printed on paper were supplied post-offices for public posting.

While the law limits to five the number that may be supplied any one individual in any one year, and makes no provision for the sale of additional copies, and while it would appear that this number would be inadequate to properly post large estates, it would seem allowable and feasible for owners or caretakers of such large estates to have copies to any number made by their local printer. Testimony given at this office goes to show that the posters are considered very efficacious in the protection especially of kitchen and fruit gardens and other small holdings. However, if properly posted in conspicuous places they undoubtedly act as a deterrent on large estates as well as small.

Bulletins of Massachusetts Agriculture.

The second number of the series of bulletins, of which that on "Poultry culture," published in November, 1908, was the first, was issued in April. This is known as Bulletin No. 2, "Orcharding," and comprises a compilation of articles bearing on the various phases of apple growing in New England. This and its companion, the August Crop Report on "Western methods in New England orcharding," heretofore spoken of, have met a strong and timely demand for material on this industry. Bulletin No. 3 will treat on grasses and forage crops, and will be issued within the ensuing year.

Respectfully submitted,

J. LEWIS ELLSWORTH,
Secretary.

Jan. 11, 1910.

Summary of Crop Conditions, 1909.

Vegetation was fully up to the normal in May, but farm work was from a week to ten days behind, owing to unpleasant weather. Grass started slowly, but was reported thick at the bottom and promising well. Late seeding did not winter well. The fruit bloom was heavy, except for winter apples, and was not injured by frosts. Very little damage from insects was reported. Planting began early and progressed slowly, owing to unpleasant weather. Farm help was in fair supply, with wages about as in 1908, and relatively lower than in preceding years. There was a marked increase in the acreage of corn and a slight increase in that of potatoes. There was a slight decrease for tobacco and a slight increase for onions.

Insects were present in the usual numbers in June, with plant lice more than usually prevalent. The acreage of Indian corn was considerably increased, 86 out of 119 correspondents so reporting. The crop was planted late and was backward. A normal crop of hay was promised, except on old mowings, which had not recovered from the drought of last year. Potatoes were generally backward, but germinated and promised well; few early potatoes grown. Early market-garden crops were held in check by cool weather; asparagus a short crop; later market-garden crops promised well. Dairy products were in full supply, with prices the same, except for butter, where they were slightly increased. Dairy cows were short and bringing good prices. Feed in pastures was late in starting, but recovered and was in average condition. The strawberry crop was late; the berries bloomed full. Apples and pears bloomed light, and plums were not more than average. Cherries generally good; cranberries backward and not in bloom.

There was less complaint of insects than usual in July. The corn crop was backward, but growing fast and promising well. The hay crop was uneven, probably three-fourths of a normal crop for the State as a whole, but it was generally secured in excellent condition. The usual acreage of forage crops was put in, corn being the favorite. Market-garden crops suffered somewhat from drought, but prices ruled above the average. Practically no potatoes had been dug. Apples promised a light crop; pears and plums rather light; peaches light; grapes generally very good; cranberries set well. Pasturage suffered severely from dry weather. Rye was a good crop in most sections. Oats were short and badly rusted. The interest in beekeeping seemed to be increasing.

In August corn promised an excellent yield if it should mature, but was about two weeks behind the normal. There was little rowen, except on fertile, new seeded fields. Very few late potatoes had been dug, and a light crop was expected. There was no rot reported, but much blight. The acreage of tobacco showed a slight but general decrease; reports of conditions were almost all favorable, and cutting had commenced. Pastures suffered severely from drought, but were improved by the rains of the 16th and 17th. Apples were even lighter than anticipated; pears better than expected; peaches light; quinces a fair crop; grapes very good; cranberries small, but a good crop expected. Oats were short, but heading fairly well; barley little raised except as a late forage crop, and not in good condition. Late market-garden crops were backward, and the acreage of celery seemed likely to be decreased.

Indian corn came forward slowly during September, but an average crop was promised, barring immediate and killing frosts. There was very little rowen. The showers kept feed in pastures green, but there was little growth. Very much less than the usual amount of fall seeding was done, owing to droughty conditions. That done in corn developed well, but seeding germinated poorly and made slow progress. Onions were generally an average crop in the Connecticut valley, but late in maturing. The potato crop was considerably better than was expected, backward, but a fair average crop of good-sized tubers. Root crops were hardly normal, also celery, but improvement was expected. Late market-garden crops were checked by drought and not in very good condition. Apples a light crop and generally small in size; pears did well; peaches a good crop, better than anticipated; grapes generally a heavy crop; cranberries a light to medium crop on the Cape. There were several light frosts, but not much injury to the principal farm crops in any section.

The final report of the season, at the end of October, showed that the value of the corn crop was considerably under the normal in proportion to the acreage planted, especially for grain. Planted late, it germinated well, but was checked by drought and cool weather to such an extent that in many cases the ears did not ripen, in spite of the late dates of killing frosts. The crop grown for ensilage was also less valuable than usual, because of the undeveloped condition of the ears. The warm weather and fall rains made root crops close to the normal. Potatoes were one of the best crops on record for the State as a whole, but prices ruled low. Pastures were very short and dry, many having practically no feed for a long period, a condition only partially relieved by the fall rains. Young stock, therefore, came to the barns rather thin in flesh. Milch cows were generally fed both grain and roughage at the barn from the middle of the summer, and were generally in good condition. Much less than the usual amount of fall seeding was done, owing to drought, and that put in was backward. Seeding in corn gave the best results, owing to the shade afforded by the corn plants.

Prices for farm crops averaged higher than usual, largely because of short crops. Fifty-five correspondents consider prices to have been higher than usual, 57 average and only 7 lower than usual. Milk, butter and meat, especially pork, have commanded high prices. Apples brought unusually high prices, owing to scarcity.

Concerning which crops have proved most profitable and which crops have proved unprofitable or least profitable, 51 correspondents, less than a majority, considered hay to have been among the most profitable crops; 43, potatoes; 40, corn;

9, apples; 8, tomatoes; 7, onions; 7, tobacco; 7, cabbages; 6, sweet corn; and 5, cranberries; while 29 correspondents, an unusually small leading number, consider potatoes to have been among the least profitable crops; 17, corn; 15, apples; 9, hay; 8, squashes; 7, oats; 6, beans; 6, tomatoes; and 5, milk.

There was a marked divergence of opinion as to the profits of the season, but the majority of the correspondents were against the view that it was a profitable year. Among the reasons given are drought, short crops, low prices and the high price of grain and labor. Of the 124 correspondents answering the question, 2 said that the season was above the average for profit; 12, that it was an average season for profit; 56, that it was profitable; 16 that it was fairly profitable; 7, that it was below the average for profit; and 31, that it was an unprofitable season.

PUBLIC WINTER MEETING

OF THE

BOARD OF AGRICULTURE

AT

DRACUT.

DECEMBER 7, 8 AND 9, 1909.

PUBLIC WINTER MEETING OF THE BOARD, AT DRACUT.

The annual public winter meeting of the Board, for lectures and discussions, was held at Grange Hall, Dracut, on Tuesday, Wednesday and Thursday, December 7, 8 and 9. The attendance was above the average for these meetings, the lectures uniformly good, being both instructive and interesting, and the discussions spirited and intelligent.

The meeting was called to order at 10 A.M., on Tuesday, by Secretary Ellsworth, who introduced Mr. George H. Stevens, chairman of the Board of Selectmen, who delivered the address of welcome.

ADDRESS OF WELCOME, BY GEORGE H. STEVENS, ESQ.

It gives me great pleasure, this beautiful winter morning, to greet you here, and in behalf of the citizens of the town of Dracut, the Middlesex North Agricultural Society and the Dracut Grange, I bid you a hearty welcome. It is very pleasing at this time for the farmers and citizens of this community to have the State Board of Agriculture hold its winter session here. It has been said in years gone by that the Middlesex North Agricultural Society was growing weaker, and was gradually on the decline, but I am glad to be able to say that such is not the case to-day. The Middlesex North Agricultural Society is on the gain, and we find that it is now growing stronger; and that this is so we attribute to the co-operation of the State Board of Agriculture, to the work that is being done by the farmers' institutes, and to the effort that is being made by the various granges, — and we call that part of it very important. Education has been put to the front, and the officials of these institutions by their hard work have put the Middlesex North Agricultural Society where it is to-day. At this time I would pay a tribute of respect to one of our late officers, the late Mr. A. H. Cluer, who was a noble worker, a valuable man, a man of high character, and one of the best men we have ever had in the Middlesex North Agricultural Society. His work has always been of the very best. What he did, he did well. And in him the Middlesex North Agricultural Society and the Dracut Grange, and I might say the Commonwealth at large, have lost a valuable friend.

A speaker at one of your winter meetings a few years ago said that we were liable to boast of what the grange has been and what the grange has done in the past; but, he said, what should concern us most is what the grange is to do in the future, — that a good, strong grange would make a good, strong agricultural development; and we agree with him to-day in Dracut Grange Hall. Dracut Grange is the second largest grange in this Commonwealth, and we are proud of it. We can boast of what it has done in the past, and we are proud of what it is going to do in the future. It is strong because it has had at its head strong men, — men who have done their work faithfully and honestly, and on educational lines. And these men have put a great deal of work into Dracut Grange.

The town of Dracut bids you welcome here to-day. We have no millionaires here, we have no millionaire farmers, we have no hundred-thousand-dollar farmers; but we have a good, clean, clear set of farmers, who have some of the best of farms, well cultivated and well stocked, and whose products are sold in the markets of Lowell and Boston. And they greet you here to-day. In behalf of the citizens of the town of Dracut and the members of the Dracut Grange and the Middlesex North Agricultural Society, I bid you most hearty welcome, and we hope that your stay with us will be pleasant, as we know it will be productive of much good.

Secretary Ellsworth then presented Mr. John Bursley, second vice-president of the Board, as the presiding officer for the morning session. Mr. Bursley delivered the following response, on behalf of the Board, to the address of welcome.

RESPONSE FOR THE BOARD, BY VICE-PRESIDENT BURSLEY.

Mr. Chairman of the Board of Selectmen, in behalf of the State Board of Agriculture I thank you for your words of welcome, so fittingly spoken. We are sure that we, as members of the State Board of Agriculture, shall go away feeling this to be one of the best meetings we have ever held. Possibly I may be excused if I touch a little on personal recollections, knowing the Middlesex North Agricultural Society and its people and the people of Dracut Grange. Somewhere back in the early nineties I was associated on the Board with your then delegate, the late A. C. Varnum of Lowell, later with Mr. Joshua Clark of Tewksbury, whose work I well remember, then with the late Mr. Henry S. Perham of Chelmsford, and with your present delegate, Mr. George W. Trull; and I assure you it is always a pleasure to meet here and see the work that these men have done for the Middlesex North Agricultural Society.

It was my pleasure within a few years to visit the fair of the society, held on these surrounding grounds and in this hall, and it was a revelation to me that so many people would come to an agricultural fair, where there was nothing that was not purely agricultural. Then I realized, as I never had before, what it was to have an agricultural fair with everything open and everybody coming. These grounds here were black with carriages and people, all interested in the welfare and success of the Middlesex North fair.

Later it was my good fortune to be the guest of Dracut Grange in this room, with something over half the membership of over three hundred present on a particularly stormy night. I then realized what that meant for the encouragement and success of the Middlesex North Agricultural Society.

I think it is something over twenty-five years since the last meeting of the Board was held in Lowell, and we appreciate your invitation to meet here, and your entertaining us so hospitably. And my wish and the wish of the Board is that you may receive a goodly proportion of inspiration from this visit and the lectures we shall have on certain lines. You realize that we shall have representatives here during this session from the utmost bounds of the Commonwealth, from the hills of Berkshire and the islands of the sea, who come here to exchange ideas for the benefit of the people present, and, through publication, for the benefit of the people at large.

Therefore, thanking you again for your hearty welcome, Mr. Chairman, I beg you to excuse me in favor of others who will give you solid information on various subjects, — men who are leaders in their lines. And now, ladies and gentlemen, it is my pleasure to introduce as the speaker for this session Mr. H. B. Fullerton, superintendent of agricultural development for the Long Island Railroad, who will speak to you on "Market gardening."

MARKET GARDENING.

BY H. B. FULLERTON, DIRECTOR AGRICULTURAL DEVELOPMENT OF THE LONG ISLAND R.R. CO., LONG ISLAND, N. Y.

Market gardening, in the true sense of the term as used in Europe, is but little known in the United States, for only within the last few years has it become a regular business. It is true we have the "truck farmer," and once in a while we read of the "small farmer," and there are specialists galore in all sections of the United States; but still the real market gardener or vegetable grower on the intensive plan is very rare indeed. There are a few who practice it on Long Island to supply the great demand of New York City, there are a few round about Boston, and there are a few also near San Francisco. About the city of the Golden Gate it is the Chinaman who raises big varieties of vegetables and daily delivers them to the consumer. On Long Island it is the European, principally the German, who practices the intensive gardening of the Rhineland. About Boston I understand both German and French people are represented in this work, and invariably the results are the same, for these intensive gardeners, no matter whence they hail, make money with astounding rapidity and become well-to-do in a very few years, and all this upon an acreage so small that the old-time farmer generally sneers at them as "little truck patches." The reason for this success is due not to the foreigner, but the principle that he employs, and this principle is invariably successful in every walk of life. Summed up, it is simply the concentration of effort, instead of the scattering of effort which the average farmer pursues. With this concentration is linked another thing, the knowledge that all foreigners bring to the United States in regard to the fundamental necessity for quick growth and quality, — and that is, an abundance of vegetable matter. Not a falling leaf is burned; not a cast-off cabbage leaf or the trimmed-off foliage of a bunch of carrots is permitted to go to waste; not a return trip from the delivery of a load of produce is made with an empty wagon. The wagon is invariably filled with barnyard manure, no matter what the labor or cost to secure it may be. Concentration and a liberal supply of vegetable matter are the main secrets of success. As an adjunct to concentration comes a possibility of raising two, three and even four crops to each acre, instead of the regulation one crop or occasionally one and a little over, usually secured by broadcasting turnip seed in a slipshod way. Hence this new departure, or old, old story, according to your point of view, offers an unequalled opportunity for the young men and also the young women of the United States; unequalled not only from a sentimental point of view, not alone from the point of view of the man or woman who can by following the profession of agriculture be monarch of all surveyed, but the strictly commercial or dollars-and-cents point of view; for there is no investment of any description which returns the percentage of profit on the dollar invested that intensive or common-sense market gardening returns. In the manufacturing trades large sums of money must be locked up in buildings and machinery, and a market must be obtained at heavy and unceasing annual outlay; raw material must be purchased elsewhere, and deterioration of machinery goes on with stupendous rapidity at the present day. In commercial business, high rentals and constant loss from unsalable stock occurs and increases each year. In the agricultural profession alone can a man or woman gain a livelihood, a competence, or riches, in accordance with each individual's personal equation. The biggest kind of returns are secured by very inexpensive and simple utensils; a plow, a harrow, a combination hand seeder and cultivator and a wheelbarrow or two-wheeled truck are all the machinery necessary to carry on a successful market garden. Even harrows, drags and rollers are oftentimes homemade. Two horses are far better than one, for many reasons; but one frequently is all that the intensive gardener uses. Manual labor has been boiled down from ten to one by destroying the old-time hoe and replacing it with a Planet Junior or Iron Age hand cultivator. The most successful raisers of high-quality vegetables take no chances on seeds. They carefully select and perfect the strains of vegetables which they find have the highest quality and are pleasing in shape and uniform in size. They learned long ago not to pin their faith to the quack medicines of agriculture; hence they use chemical fertilizers in exceedingly small quantities, if at all, relying absolutely on nature's great preventer of abandoned farms, — humus or decaying vegetable matter; and of this they raise every pound possible, keeping horses, cows, pigs and chickens for the extremely valuable animal waste; and hence the milk, the pork, the poultry and the eggs are practically "velvet," or an extra source of profit.

The follower of agriculture alone has a real home. No other walk in life affords the opportunity for man and wife to be real partners, to work together and rejoice with all sincerity in the season's successes, and to bear each other up when the season proves unfavorable for some of their crops; to have with them children, and see them gain in health, strength and self-reliance as only country children can gain these prime necessities of the truly happy life.

Regarding plant life we are beginning to learn something, but regarding how or why plants grow we absolutely know as little to-day as we do regarding the beginning and end of animal life. Common sense, keen observation and scientific investigation have taught us much; yet many things once considered definitely settled have been apparently proven absolutely erroneous. Analysis of plants in chemical laboratories has proven that they contain many things. Minerals of many kinds are found, and gases likewise. The items found most often in greatest quantities are nitrogen, potash and phosphoric acid; hence various compounds of these items have been manufactured and sold to agriculturists as cure-alls, as the only thing necessary; and from this mistaken commercial policy have developed many changes in agricultural methods, the greater part of them extremely beneficial, yet many of them frightfully disastrous, — for minerals and chemicals alone cannot support plant life, nor will the seed germinate where only these are present. The coming of the chemical fertilizers, in the United States most noticeably, meant the going of fertility. The fertility disappeared gradually; it hung on until the last vestige of the forest leaves upon which the pioneers raised their great crops, and the animal waste from the cow yard, the hog pen and the chicken house, with which our grandfathers kept up the humus content or vegetable matter of the soil, had all disappeared by decay, by plant utilization and by washing and blowing away. Then crops began to drop. New Englanders and New Yorkers gave up their homes and went into the west, where the land was new, where the cleared forest land was filled with the leaves that had fallen for countless ages, or where the prairie was feet deep in humus made up of the grasses which had been laid low by countless winters. As this humus began to run low, and crops in consequence decreased, much money and great physical effort was expended to bring it back by the use of chemicals alone. This failed, and a pilgrimage to the "new lands" further west began. This happened in spite of all that man had learned through the writings of Mago, the first agricultural maker of books, who wrote seven hundred years before Christ; in spite of Columella, whose books, written fifty-five years after the birth of Christ, still exist. Each nation apparently is forced to learn in that very potent but very painful school of learning, — experience. The foreigner comes to our shores lacking knowledge of our language, of our climate, of our ways and of our likes and dislikes. He buys a piece of land in New England or in New York State, paying with alacrity the abnormally high price asked him because he is a foreigner, settling down with little or no capital after his land is paid for, living a life of hardship for one or at the most two years, and then builds a comfortable house, makes his dooryard a thing of beauty with flowers and shrubs, wins prizes at the local fair, and becomes a prominent citizen; while his neighbors sit around and sneeringly refer to his methods as bound to fail, because he has pinned his faith to manure and used little or no chemical fertilizer. Yet they do not see that in dodging weeds which come with manure, in dodging the dirt and difficulty in handling it, they are gradually bringing their lands to a barren condition, which some modern writer has delicately dubbed "abandoned farms."

After having brought the land of his birth into a run-down, humus-denuded condition, it is unfortunately the American method of procedure to move westward, and repeat this performance with other fertile, humus-laden lands. In this way we leave great cities, the readily accessible markets of the east, with thousands of acres of undeveloped land, land just as full of mineral fertility as it ever was, and settle in regions far remote from the market to which our produce will be sent, far remote from transportation facilities, subjected to climatic conditions absolutely new and even atrocious. We are forced to pay as high as $30 an acre annually for the privilege of using the irrigation canal without which many much-boomed western territories would remain deserts for all time. The man who remains in the east, in New England, for example, can purchase, at a far lower figure than he can in the west, acreage capable of producing far finer fruit than the far west, on land which is absolutely unsuitable for market gardening. He can produce grapes or berries, and in the low lands he can raise for his local markets a big range of vegetables and flowers. He can live under conditions normally congenial to him. He can follow, if he will, the example of his ancestors, and subdue the untamed lands with which New England as well as New York State and Pennsylvania are filled. On Long Island alone there are still over 200,000 acres of land suitable for the most intensive cultivation practices of Europe. The soil is without surface boulders, rolling on the north shore and in the middle section, running, by the best of all tests — the spade — from 3 to 4 feet deep, and drained by the most perfect system of natural drainage. It is coarse gravel, filled with sea-wash sand, a combination that brings about a slow drainage, yet holds the moisture so that the summer sun brings it up through the capillary tubes, and, with the great bodies of water lying around the island, giving unfailing nightly precipitation, makes drought an unknown factor. This soil is early and friable, and with rational, natural, overhead irrigation, — a condition which is ideal. Below every square foot of the island's soil runs an immense volume of fresh water which is reached on an average of about 40 feet, and in the higher sections along the Sound shore at from 100 to 200 feet, — an unfailing source of water of absolute purity, for it is protected from surface drainage of any description by a layer of hardpan.

In 1905 these idle acres, long known as waste lands, were tackled by direction of Mr. Ralph Peters, president of the Long Island Railroad Company. Stumps of the big trees once covering it were blown out with dynamite; and, although only started on the 7th of September, 10 acres were plowed, harrowed and planted to rye in a little over sixty days. In 1906, 380 varieties of plant growth were doing splendidly. Fruit trees, berries, grapes and vegetables of all descriptions known in the United States, and many foreign favorites new to America, were successfully grown. The methods of procedure in bringing this land into the dividend-paying column are shown by the photographs taken as the work progressed, — from the desolate standing timber, destroyed by fire, through the civilization of dynamite, the modern methods of handling, utilization of Yankee inventions, the growing plants, the crops as they were gathered, common-sense methods of marketing and delivering to the consumer before it becomes stale and unprofitable. No deep knowledge was necessary to turn forbidding desolation into a commercial success; nor were vast sums of money necessary to accomplish the object. Common-sense methods were the only secret to be credited with this accomplishment. Having made a success with the development of the so-called "scrub oak waste" on the Sound shore of Long Island, precisely the same method of procedure was followed in the once dubbed "pine barrens," and the success was equally great in the central section of Long Island. The result has been to develop many sections of the island, and all sorts and conditions of men have made a success, because the condition of the soil and the climate are conducive to this success, and to these natural conditions are added the many unsupplied local markets and the tremendously increasing demand of the great cities of New York and Brooklyn, within 50 or 60 miles of these market gardens. Many of the newcomers are foreigners, from Germany, France, Belgium, Italy, Norway, Sweden, Poland and Russia. All have been successful, and the descendants of the Slav races settled near the county seat of Suffolk County have inside of five years built a big church and a fine hall, erected fences, reconstructed houses and built barns, until prosperity quickly achieved is marked by even the most unobserving of observers. Fruit trees are being set out by men who recognize the fact that western fruit, while handsome to look upon and big because filled with water, has no flavor, — a fact which is rapidly being discovered by even the city dweller, who has had no opportunity to learn the taste of fresh vegetables or high-class fruits except by an occasional visit to some country cousin or a summer vacation spent in the country.

The Long Island Railroad experiment stations have further demonstrated that there are many extremely valuable vegetables, well known in Europe and imported from there at heavy expense, that can be grown with ease under Long Island conditions. Sea kale, earlier than asparagus, coming at a time when human nature craves fresh green things, is an extremely valuable addition to the limited number of vegetables known generally to Americans. Udo, a Japanese favorite, can be cut in the open in December and January, if protected by a mulch. The Sakurajima radish, a mammoth fellow, as delicate as our best spring radish, with firm, fine flesh, is an excellent addition to our bill of fare, either raw or cooked. There is also Pe-tsai, the most delicate of the cabbage family, more like a solid-headed lettuce in appearance, and with three times the amount of leaves (beautifully blanched) ever found in the finest Big Boston grown. Then we have Saxony potatoes, the only potato that makes real potato salad, sweet potatoes, just as sweet and firm or just as mealy as you wish. The Spanish onion, sweet as an apple, is delicious when eaten raw and equally good cooked, making bulbs from seed weighing over 2 pounds apiece, and selling as high as two for 35 cents. The famous French cantaloupe, sold for $2.50 apiece in the markets of Paris, is one-third the size of the big, coarse Montreal melon, and ten times as good. There are others, many others, for the list is a very long one. So the opportunities presented for the young man or young woman are unequalled. Deep scientific knowledge is not necessary, nor is big capital needed to get a start. A living to all tillers of the soil is assured for the first season, and beyond that the success of each and every one depends in agriculture, as in anything else, entirely upon the personal equation, which simply means individuality and common sense combined.

Let me say that we know very little about market gardening in this country; perhaps you do and I do, but our people as a whole do not. Over in Paris a man on 3 acres of land will dress wife and children well, will send the children to school, and will be able to take trips out into the country on Sunday and drink wine every day. He can do this because there is no machinery in the business; there is no dispute as to whether 28 inches or 36 inches is the best for corn or potatoes; their idea is to plant their crops as closely as they can, and so close do they get them that in cultivating the man working among them walks on his toes, stepping over the plants, and not finding room enough to put his whole foot down. Every square inch of his land is working. When cold weather comes, he just covers it with glass and keeps it working. Seven different crops a year they take from the same land, — a pretty good rotation. Whenever a European comes to this country, he buys land and pays whatever he has to for it. I always like to watch him when I can, as he has market gardening down fine. What does he buy after he begins to work? Manure. What does he pay for it? Whatever he has to. He never says he will not pay over so much; he gets it, and pays the market price, whatever it is. If he has money enough, he tills 10 acres; if he has only money enough for 6 he tills 6 acres, because he knows there is no use spreading his manure out over 60 acres just because he has 60 acres. The Frenchman just outside of Paris raises a melon that he gets $2.50 for, instead of 10 cents, as we do. It is called the Dives melon, and has the big Montreal melon beaten, and anything ever raised at Rocky Ford simply left out of sight.

I want to tell you a little more about what we have been doing on Long Island. There is a big tract of land right in the middle of the island that has always been said to be of no value agriculturally. There has been a tradition that the soil is only 2 inches deep. When Ralph Peters came there from the Pennsylvania Railroad he found a little tract of land, with no iron, no coal, no wood, or in fact anything of value on it. It depended on two things, — the summer boarder, and a few people who wanted to live in the country and do business in New York. The railroad had not paid expenses since it was built. He called me in and asked, "Don't you think anything would grow out there in Suffolk County?" I said, "Yes." "What do you base it on?" he asked. I said, "The growth is there now, a great many magnificent chestnuts and white pine stumps, and where they grew I think radishes and cabbages will pull through." He asked me how many acres were needed to make the experiment, and I told him 10 acres were enough; I read a book somewhere that said that, but it was really a great deal too much.

We picked out the worst piece of land we could find, — one that the old residents all agreed was absolutely worthless. The people there had let their land burn over for years before the railroad came, and the railroad had started a good many fires since. This tract was near a village settled one hundred and sixty-five years ago, which at one time had 350 inhabitants, and now has about 310, with not a house built for a hundred years. The Sound is full of clams and fish, and nobody worked. They never wanted to go anywhere, and so were perfectly contented. They told me there were not over 3 inches of soil there. I knew better than that, for I found a seven-foot chestnut, a 5½ and a 6½ foot white oak, and I knew that they grew on that soil. There was really only one thing the soil needed, — humus; there was no vegetable matter in the soil, it had been burned over every year for years and years. The problem was to get humus into the soil, and this I proposed to do by sowing rye and plowing it under. We made a start on the 7th of September, and to get the land plowed and seeded that fall we had to resort to dynamite to blow out the stumps. We began because it was the quickest way, and kept it up because we found it was the cheapest. The first blast wiped out the tradition of 250 years, for it showed 3 feet of the prettiest market garden soil in the world, barring no spot.

As fast as we got the stumps blown out we sprinkled wood ashes over the soil, to sweeten it. Then they said, "Now I suppose you are going to use 5 or 6 tons of commercial fertilizer?" I said "Not a bit, because the soil is full of minerals, potash, phosphoric acid, and so on." Somewhere I read that one body of scientists claims that our soil contains enough minerals to last seventeen thousand years, and another that it contains enough to last twenty-four thousand. That doesn't interest me, because, if I live to be as old as my grandfather, who died at ninety-eight, there are still quite a few years left on either reckoning. The trouble with all this mineral matter is, that it isn't available, so the fertilizer manufacturer sells you something that is. When vegetable matter decomposes, that decomposition generates gas, and that releases the mineral matter, — makes it available. So, no vegetable matter, New England, New York and Ohio abandoned farms, and the boys all gone west. The wonderful, fertile land of the west is just like your land, except that you have eaten up the vegetable matter in the soil. In the first year we planted everything we could think of on that bad land, with the little manure and wood ashes we put on, and that rye that they said wouldn't grow. Never would grow, they said; but it came up in spite of them, and how it did grow! Then they said, "You ought to sell that for straw;" but I said, "I can buy straw anywhere, but I can't buy that anywhere." We raised 380 varieties of plant growth on that bad land. One man assured me that there was frost on that land every day in the year, and he never told a lie in his life. He had always heard that, and he believed it; but we found no frost, but an extremely long season, probably five or six weeks longer than you have.

We tried irrigation, with a common garden hose and a 50-cent sprinkler, with an acre of cauliflower, one half watered and the other unwatered. We got $4.25 a barrel for the watered lot and the other brought $1.50 per barrel. That irrigation would have paid, in that one year, for the best irrigation plant I could have put in. We watered with the sun on the plants, just as I have seen showers come many a time, and the result was the same as with the showers, — the plants thrived on it. We found the same thing with onions. I was shipping spring onions all through July, and getting a low price for them, so I went to sprinkling them, and was able to put them into the market so that they brought the top price and went into the market as Bermudas. I didn't call them Bermudas, and they were better than Bermudas; but that is what they were sold for in the market.

But I noticed that, while the consumer paid from 2 to 5 cents an onion, I didn't get any such price. I had paid 40 cents a head for cauliflower in Brooklyn, but the concern that handled our crops only allowed $1.50 for a barrel of 22, 26 or 28 heads. The men raising tomatoes in New Jersey were getting 17 cents a bushel for them, and they must have lost considerable every time they shipped. Tomatoes at the same time were selling for 5 cents apiece to the people who ate them. I looked into the matter, and found an agent who was one of five standing between our crops and the ones who ate them, and all his expenses were for a new hat occasionally, for that was where he had his office. He had no knowledge in particular, no expenses for a stenographer or anything of that sort; but he had a house overlooking Prospect Park, a bungalow at Watch Hill, a big steam yacht and three automobiles, — all out of the farmer and the consumer. You know that in a New York apartment they have to buy a little at a time, because they have no place to store things. So we tried to see what we could do for New York. We decided on a hamper we liked the looks of, and filled it with all sorts of things, just enough for a small family. You see this one here. This cauliflower would cost 25 cents a head in New York. This vegetable is used for salad, and the restaurants call it all kinds of names. I should estimate that the quantity we have here would cost anywhere from 75 cents to $1.50 in the market. All that is sold in the market comes from Belgium in the steamers, and there is a big demand for it. Here is a basket of potatoes, — you know they have no place for a bushel or a barrel, and must buy from hand to mouth. Here is a little cabbage, small, to be sure, but they bring good money this way. That lot of stuff would bring us from 12 to 14 cents in a New York commission house; we get $1.50 for it this way, and the families save from 50 to 75 cents on each hamper. We are giving them good vegetables cheaper than they can get them otherwise, and we are getting the money, instead of the five men who formerly got it. The hamper costs us about 14 cents, and we pay the express; other expenses perhaps 35 cents; that makes the cost inside 50 cents. We need one commission man, or one big public market; but there is no reason why we should support four or five men, who do absolutely nothing, simply because it is the custom to do so.

One of those hampers was sent to Fort Wayne, Ind., to a meeting which I attended. It got lost on the road somewhere, was five days out, but fell into the hands of the president of the railroad in some way, and he appropriated the contents. He wrote me a letter, asking if there was any way he could get those hampers each week for his family, because the vegetables were so good and fresh. The paraffine paper they are wrapped in is the secret. Each one of these vegetables before you is as damp as if the dew were on it, and they were shipped yesterday morning. I undertook, with the aid of the paraffine paper, to ship sweet corn to Paris, and it came through splendidly. Now all Europe is going into sweet corn; they didn't believe what we said about it until they saw it, — now they know.

We took up the tomato question, and put them up in these baskets, 6 to the common crate. They are approximately 4 quarts each, but of course the approximation is always under; we never call them anything except a package or a basket. I sent the tomatoes in, and followed them. The commission man spent the morning telling me that they couldn't sell them, they must be shipped in bushel crates, and in showing me why. He showed me thousands of crates leaking tomato ketchup or soup. When we got back to his place of business, we found that the crates we sent in had been sold for $1.50 a crate. When I got home he telephoned to ask for 25 crates in the morning, and finally we were shipping him 175 a day, and we were getting $1.50 each, and the other growers from 50 to 75 cents a bushel, according to the supply.

You can do just the same as we did. There are plenty of people in Boston who will take all the stuff you can raise;

they are sick and tired of the fruit and vegetables from the far west and the far south; they want the home-grown article.

There are a great many other things you can raise. We used to have gooseberries to eat; now you can't get them. Currants are the same way, and there is nothing better for a dessert or for an appetizer in the morning. They are much cheaper than grape fruit, and much better. There is a big market for celery, and you can make $1,000 an acre from acres and acres. There is no locality that has any monopoly on a particular crop. The grape belt started because somebody wanted to grow grapes there, and found that grapes did well. Down in Illinois they wanted to raise corn, and it did well, and they shouted about the corn belt. Why, we got 92 bushels of corn on Long Island, without an ounce of fertilizer; but what is the use of raising corn at 50 cents a bushel, when you can raise these other things?

Don't try to sell the poor consumer a Ben Davis apple or an Elberta peach, just because he doesn't know any better; the same with pears and quinces. Raise the best; the others will not pay in the long run, — you will not get the price. The man who raises Bartlett pears gets any price he asks.

Whenever we heard of a new thing that promised well, we tried it, and if it suited our soil and climate, particularly the climate, we kept at it. In Japan we heard of a radish, the Sakurajima, which we heard weighed 30 pounds, and we tried that. The best we could do was 20 pounds this year. It is a winter radish, with flesh like an apple, and is very fine to eat raw. It also cooks beautifully with a little cream sauce, and the tops are used as greens, — three plants in one. My children and their friends ask for a Sakurajima, just as they would for an orange or banana. We can get 5 cents a pound for all we can raise, and they are as easy to raise as the ordinary radish. The Japanese plum is just the same; it matures in three years, and sells for 5 cents apiece, all you can ship to New York.

We heard of the Venetian squash, butter-colored, sweeter and finer than the ordinary squash, and we tried that. A little Japanese friend sent me the seed of a pumpkin which is just as good as those I had when I was a boy, — full-flavored, sweet and round, small in size.

I heard the Gibraltar onion could not be grown this side of Texas, so of course I tried it. It matured in September, and our yield was 1,035 bushels to the acre. It is a tremendous onion, with a very big neck, and far sweeter than any onion I have ever tasted. Many things we thought we couldn't grow until we planted the seed, and then we found they did very nicely.

Sometimes we try things that are of no value, but some are extremely valuable. The Savoy cabbage is harder to raise than others, but it brings a great deal more money. You can grow a poor potato, like the Irish Cobbler, or you can get one that is just as good as the old Early Rose, and get whatever price you choose for it. For me, I prefer a potato like the Quick Lunch, for we got $2.50 a bushel for them this year. You see we got them the first of July, and nobody else got potatoes until the first of September. For three years I got cauliflower into the New York market ahead of Maryland.

I once attended a meeting in Chicago that was all west. The spellbinders got up and praised their country, and the cry was that they must pull out from under the domination of the east. The man who did the best came from Texas, the most Godforsaken spot on earth, and you would have thought it was the Garden of Eden, with the snakes left out. Why, I have cut the spineless cactus in Texas long before Burbank invented it, to get water for myself and my horse, — or rather for my horse and myself, for when you lose your horse down there, you are gone, you can't get out. That was in 1893, so I don't believe Burbank created it in 1907. Man can help along, he can cross animals and plants and improve them, but not create anything, — never, never! They pay $30 an acre for irrigation in the west, and our boys are going out there to take up that land. They can do better here, if they will remember to keep the soil sweet with lime, and grow green crops to furnish the humus that we lack. The finest crop of cabbages I ever raised was on $1.20 worth of clover seed, but I had a hard time to prevent that clover from being cut for the horse. Don't forget wood ashes, either; they are slow, awfully slow, but when the leaves finally come out, the wood ashes do their work, and you have a corn crib full of corn.

I think I have given you enough for the present, and I won't guarantee to answer all your questions. I am no expert at all, — I just grow things because I love to.

QUESTION. What was the expense of sending sweet corn to Paris?

Mr. FULLERTON. I just mentioned that incidentally. The expense was no consideration, and I don't know what it was. An American over there wanted to show his French friends what American sweet corn on the cob was, and a friend of his asked me to try and get it through to them. I had shipped ripe raspberries 380 miles, with nine transfers, each box wrapped in paraffine paper, and the pint boxes came through perfectly; so I thought I could do the same thing with sweet corn. I was afraid it would heat in the paraffine paper, on account of the long time; so I made a cylinder of blotting paper to go around each ear, put about seven ears in a basket, and wrapped each basket in paraffine paper. I had it put in the cold room, where the temperature is kept at from 36° to 40°, instead of in the ice box, where it would have frozen. It took time to get it through the custom house, but the man giving the dinner was so enthusiastic that he cabled, "American sugar corn arrived in excellent condition; just as sweet as it used to be when I was a boy." All over Paris they are preparing to raise sweet corn this year; it has gone all over Europe and all over England, just because somebody in this country had nerve enough to ship some American sweet corn to France.

Mr. T. F. PALMER. From what I have heard, I gleaned you are not a great believer in commercial fertilizer.

Mr. FULLERTON. No, sir; I am not.

Mr. PALMER. Do you believe plowing rye under and cultivating will take the place of manure?

Mr. FULLERTON. No; it will supplement it. I should get all the manure I could, and supplement it with the green crops. What you don't get in your green crops, you do in the animal waste. Plow in your green crop, and supplement it with your animal waste, and you will get your nitrate of soda.

Mr. Palmer. Then you think plowing in rye or clover and applying some nitrate of soda would do the work?

Mr. Fullerton. I know it would; I don't think, — I know it.

Mr. Palmer. Suppose you plow in rye; does that have the same effect as clover?

Mr. Fullerton. No; it is not a legume. Use rye one year, and the next clover or cow peas, or something of that description.

Mr. Palmer. You don't use any fertilizer alone?

Mr. Fullerton. Except for a test. I have tested it every year since I have been in business, some twenty-six years. I use it if they want me to try it, but buy none. When I find I need it, I will buy it; but it will be after the twenty-seven thousand years have gone by.

Mr. W. C. Jewett. How much lime do you use to an acre?

Mr. Fullerton. I have never found that more than 800 pounds was necessary. You can always tell whether lime is needed, by use of the litmus paper. I sometimes forget my money, and often my watch, but never my litmus paper. Half the failures with crops are because the grower did not know the condition his soil was in. Way back in the time of Cato, who wrote one hundred and seventy-five years before Christ, and Crescenzi, thirteen hundred years after Christ, they knew that they must sweeten their soil with lime. They knew also that by plowing in a green crop, particularly the legumes, they could raise any crop they had. There are only two plants I know of that will thrive on a sour soil, and they are raspberries and Lima beans; and I believe they will fail, in time.

Speaking again of chemical fertilizers, I have never handled them, and never intend to. If I wanted to get a quick crop, I should use nitrate of soda; but I should not let the hired man apply it, for I have seen more crops killed by the careless use of that strong chemical than by anything else. And put it where the plants can get at it easily; there is no use in sprinkling that high-priced stuff between rows 3 feet apart, and leaving it to dissolve and disappear.

QUESTION. How can we tell where and how to get pure seed?

Mr. FULLERTON. I am glad you brought that up. We have our experiment stations, testing seeds and analyzing fertilizers, and then they publish that No. 16 contained so and so. Well, who is No. 16? Why isn't it published in every newspaper that Bill Smith sold dodder and called it alfalfa? If he sold rat poison, it would be. I have been told foxtail is a good thing. Perhaps it is; but when I buy alfalfa I want alfalfa, and not foxtail. I once wanted to plant 10 acres of alfalfa, and I got seed from all over the world and from Europe. I had it tested by three separate institutions, and their results tallied wonderfully. Then I published the results. I said "Bill Smith's alfalfa seed contained not alfalfa, but 9 parts dodder." I was asked if I was not afraid of being sued for libel; but, as I had 30 pounds of that seed left, I wasn't badly scared. That should be done with all seed. Let the world know what Smith's seed really is, and he will make it better, and give you what you order. You want to raise all round-headed cabbage, not some flat and some loose-leafed and some nothing. Let them guarantee everything. It can be done. I have done it; Burpee did it. The present condition has grown out of the fact that a great many want to get rich about three years sooner than they are entitled to.

Mr. THOMAS BARNARD. I would like to inquire if you have a remedy for stump root on cabbage?

Mr. FULLERTON. The only remedy I know of is to stop raising cabbages on that ground, and stop for years. The long-continued raising of any particular thing on any particular soil will fill that soil full of the enemies of that particular plant or vegetable. Whole communities in the south have been put out of condition for potato growing, with infected tubers. Our main trouble is lack of rotation. In the south certain sections have been ruined for celery. On Long Island we are planting more cauliflower and leaf crops on our ground, to get rid of the stump root. But you can't always account for it. For instance, I plowed a 6-acre field adjoining the farm on which I was born, and so far as I know there had never been a cabbage on it, but I got less cabbages than I should ordinarily get on an acre.

Mr. Barnard. What I am after is the remedy. Of course lime will do it sometimes, but not always.

Mr. Fullerton. We can prevent disease on beans by spraying with Bordeaux mixture as soon as the bean opens. The trouble is that the microbe is in the seed. Probably you could do the same with the cabbage seed, if you could get inside of it. When your first leaves come up, perhaps if you tackle it then and there you can head it off by the use of Bordeaux. I will try it myself next year.

Mr. Bursley. We would like to hear from Mr. Hitchings.

Mr. Hitchings. I came to listen. Our work is mostly fruit and greenhouse work, and we can't get a rotation of crops very well. We have one house we have been growing lettuce in for the last twenty-three or twenty-four years, and it grows a fine crop to-day.

Mr. Fullerton. Is it the same soil, and do you sterilize?

Mr. Hitchings. It is the same soil, and we have not sterilized. One thing we are very particular about is not leaving any of the old vegetable matter that comes off the plants there. By keeping it cleaned up, we keep out the fungous diseases. If you put it in a pile and let it rot, it is all right, and does finely under the fruit trees. I think it is all right on our high land, but letting the vegetable matter from crop after crop lie on low ground does a great deal of injury, I believe. I know we plowed in a lot of burned celery one year, and where that celery was, the seed would hardly come up the next year. You can't follow any set rule; things vary from year to year; but in greenhouses we try to get things about in one way, as the days are short before we get weather for out-door crops, which throw out our greenhouse stuff. I have never sterilized much, because throwing water on the soil in bad weather knocks us out.

Mr. H. S. Turner. I live in a locality called the South Shore, where a great many fowl are kept, and a good deal of their droppings is used as manure. Some say if you use it for potatoes it makes the potatoes scabby. What I want to ask is, if there is any harm is using the droppings for any crop?

Mr. Fullerton. In the old times all the fertilizer we got was from the cow stable and bird droppings, which were called guano. It is the best of fertilizers, and can't be beat, but, like everything else, it should be supplemented with green crops turned under. I don't believe there will be any trouble with it then, as it is one of nature's own fertilizers.

Mr. Foster. Has anything been discovered that will prevent the fly from laying the egg the maggot from which attacks the root of the cabbage?

Mr. Fullerton. No; he is the hardest of all to deal with. We have the best success with the use of wood ashes and lime combined. He is the hardest creature to fight that I have found.

Question. Is there any way to kill wire worms in the earth?

Mr. Fullerton. They are very difficult. As a rule, the only way really to do it is to stop growing any crop, and starve them out by constantly turning the soil over.

Question. How about the fly that stings your grapes?

Mr. Fullerton. We shall have to do just as they do in Europe. There, every bunch of grapes, every peach, every pear, every plum and every quince is bagged with a common paper bag. They run a fine wire through the bag and draw it tight, so that it keeps everything out. We will come to it here, because it pays; it paid us last year. There was a question whether you should bag them before the grapes set, or not; so I bagged half before they set, and left the others unbagged. Those I bagged were magnificent. The others I bagged later, after the rose bugs had blighted some of the blossoms, but they were never as good as those bagged in the first place. It seems wonderful that grapes will mature after being bagged; but they will, and you will get more money for the perfect fruit. You can't have the old-fashioned 75-foot or 80-foot apple trees; you will have to bring them down where you can get at them.

Question. Do you leave them on after the rose bugs go away?

Mr. Fullerton. Yes; all the way through.

Question. One year I spent three days bagging, and it was so much work I thought it would be better to let the bugs have them.

Mr. Fullerton. You would be no man to bag grapes.

Mr. Tower. I notice the lecturer spoke of forwarding cauliflower fourteen days by irrigation. I would ask if he had the same success in forwarding other crops? Have you tried it on sweet corn and potatoes?

Mr. Fullerton. We have only tried it experimentally. Next year I shall have 5 acres under irrigation. We have tried it on carrots, onions, radishes, lettuce, cabbages, cauliflower and celery. The effect on celery was tremendous, over three weeks; on onions, nearly three weeks; on strawberries it increased the yield nearly three times. I think it would be particularly good on tomatoes. There are a great many crops I haven't tried. This year I shall try the Skinner irrigation system. But of course there is a great difference in people; not all will do well with the same methods. I have planted onions one morning which proved a success, and with the same seed and same soil planted some the next morning, and had no success.

Question. Do you believe in signs?

Mr. Fullerton. Why, yes; out west, if a man pulled a 44 gun we always put up both hands.

Afternoon Session.

The meeting was called to order at 2 p.m. by Secretary Ellsworth, who presided throughout the session.

Secretary Ellsworth. I am pleased to introduce to you Prof. Eugene Davenport, dean of the College of Agriculture of the University of Illinois, and director of the Illinois Agricultural Experiment Station.

THE DEVELOPMENT OF AGRICULTURE BY ORGANIZED EFFORT.

BY EUGENE DAVENPORT, DEAN OF THE COLLEGE OF AGRICULTURE OF THE UNIVERSITY OF ILLINOIS, AND DIRECTOR OF THE ILLINOIS AGRICULTURAL EXPERIMENT STATION.

American agriculture is rapidly assuming proportions which call for much more than individual industry, frugality and skill. It has become in essence one vast manufacturing enterprise, and many of the methods and principles of the manufacturing business must be employed for its further and final development. Among these, I take it, none will rank higher or be productive of more substantial results than co-operative effort, through organized bodies of practical farmers and business men.

That agricultural prosperity is based upon something more enduring and far-reaching than mere individual success, is a principle long ago recognized; and much has been accomplished by boards of agriculture, by State, district and county fairs, by the farmers' institute, by the farmers' alliance and by the grange. The object of these organizations, however, has largely been to stimulate individual activity and skill, to improve the social conditions of the open country, to secure a defensive alliance, or to reduce the cost of commodities by shortening and straightening the road between the door of the farm and the warehouse of the manufacturer.

All these are good in their way, and all have benefited agriculture; but it is strange that so little has been done, especially in the east and the middle west, toward stimulating and developing trade in the products of the farm, — in other words, toward educating and stimulating the buying power of our constituency. I repeat that it is passing strange that thirty years ago we attempted to regulate the handling of goods that we purchase, but we have not yet done much toward systematizing the handling of goods that we sell. We have only commenced what all successful manufacturers must accomplish, namely: develop the selling end of the business, and establish such settled practices and channels of trade as shall constitute what might be called a permanent asset of the business, insuring the individual a kind of initial guaranty of profit.

Let me illustrate: thirty years ago the people of southern California undertook the production of citrous fruits upon a large scale; but they soon learned that something further was needed beyond producing large crops of high-class oranges and lemons. Their nearest market of adequate dimensions lay in the Mississippi valley and eastward, 2,500 to 3,000 miles away, over difficult mountain railroads, and with 1,000 miles of unconsuming but burning desert haul between. It is not strange that under conditions such as these a car of fruit was largely rotted by the time it reached Baltimore, Boston, or even Chicago or St. Louis, and that what was left would rarely sell for enough to pay the freight. If this were true of car lots, it was doubly true of small shipments; and under conditions such as these all but the largest growers were put out of business before they had fairly begun.

And so they learned their bitter lesson, these fruit growers, namely: that it is one thing to grow a crop, and another to market it; one thing to anticipate a demand, and another thing to cater to it profitably. They were literally forced into co-operation of some sort, and ultimately the so-called fruit growers' exchanges were organized. They each employ a manager, — not at $1,000 a year, but at $4,000 and sometimes $5,000 or $6,000. This manager is an expert salesman, who knows and can invent ways of reaching the consuming public and of stimulating its buying power.

One of the first results of co-operation was the rule that no man should sort his own fruit, whether he had a car load or a wagon load of fruit. His responsibility ends when it is delivered at the warehouse, where it is sorted, packed and shipped by the officers and employees of the association of which he is a member. It is therefore at once standardized and the quality guaranteed to the consumer, whoever may have grown the fruit; and the farmer gets his share of the returns, according to the amount and quality of his contribution. These returns are immensely increased not only by the fact that the final market is developed as no individual could afford to develop it, and as few would have the skill to develop it, but by the further fact that from the moment the car leaves the track at Riverside, for example, until it is delivered in Pittsburg or Boston, it is in the hands of the agent of the exchange, who controls its icing in transit, knows where it is every day, and, furthermore, may change its destination while en route, as market conditions fluctuate.

Three points are involved in a business so established: first, it increases the net returns for any given year, making enormously profitable a business that under the individual basis brought only loss and eternal vexation of spirit; second, such an organization, with its established reputation and settled business methods, constitutes a kind of permanent asset or perpetual annuity to every member; third, the existence of such an organization in any locality insures to every new man seeking to engage in fruit production a market and an assured profit from the first, — all of which is an additional asset to the community and a substantial addition to land values, for who would not pay a higher price either for a bearing orchard or for raw land in a neighborhood where such an exchange is established, than in one where none exists? It is not strange that in certain localities, therefore, orchards sell for $1,000, $1,500 and even $2,000 per acre, where without the exchange and its methods they would be an expensive luxury as a gift.

I have taken this as a convenient illustration of a general principle that should be made to figure more largely in our affairs. Each of us begins his farm life *de novo,* and works alone, putting his products upon the open market, organized, if it is organized at all, in the interest of parties other than the producer. It is as if the maker of shoes should put them up at auction, or dump them upon the market for what they would bring. Do they do this? No. How long would they be in the business, if they did? Instead, they exhaust human ingenuity in inventing new and attractive styles, and they employ another and a special kind of ability to sell the produce; for, mind you, the manufacturer sees to it that his goods go upon the market to the best advantage, and to this end he handles the selling himself, through his own agents.

In contrast to this, the majority of farm products are put upon an unorganized and undeveloped market, and the farmer parts company with his product as quickly as may be, avoiding as much as possible all responsibility as to quality or guaranty. In this way he absolutely surrenders his best advantage, — a business opportunity that no manufacturer could surrender and live.

I do not undertake to say that all the business of the farm can be standardized and organized on the larger plan, but much of it can be, and our failure to do it wherever possible is a tribute to our business shortsightedness, which is the natural heritage and consequence of our intense individualism overshadowing the larger vision.

For example, I know a dairy association that has for years been devoting its energies to missionary work, trying to induce more men of the State to engage in the dairy business. Long ago they affirmed as a fundamental fact that milk would never go above 4 cents a quart, or butter over 25 cents a pound. I am sure that the energies of this association would have been better exerted long ago in the effort to study the consumers' needs and buying power; to put milk and its products upon the market of better quality and in more attractive condition.

There is no better illustration of the business shortsightedness of the protective as against the development policy than in the history of the anti-oleomargarine legislation of a decade and more ago; because, if the makers of butter had shown as much skill and determination in making a good and uniform product, putting it upon the market in attractive forms and developing demand, as did the manufacturers of butterine, the interests of the two would never have collided; for no substitute or compound ever did or ever can successfully compete with the best butter, and any attempt by main strength to prevent competition with that brand of axle grease in the back room of the country store that by courtesy is sometimes called butter is not only unfavorable to the public good, but in the long run not favorable to butter itself. I do not say that the makers of butterine and other substitutes should be permitted to sell their products as butter, but such a thing was possible only in the presence of so much poor butter dumped upon an undeveloped market with nobody to vouch for its pedigree.

It is to be remembered that when we buy a box of exchange fruit, *every* apple or orange is what it pretends to be and what the label says it is. That is the chief reason why you eastern consumers often pay 5 and sometimes 10 cents apiece for Hood River apples. We raise as good apples as these in Illinois, but we do not pack them that way, nor has butter been handled on that plan.

It was aggressive and not protective measures that were needed a decade ago, and are needed yet, in the butter business; and everything that offends or disturbs the public sense about butter, or about anything that looks like or is used for butter, directly and indefinitely injures the price and the demand for the genuine article.

I call your attention to another agricultural situation that is little short of pathetic, and which, because of its lack of organization, has never yet been put upon a business basis. I refer to the certification and sale of improved live stock for breeding purposes. Associations for most of the breeds exist, it is true, but what do they do? Receive and record pedigrees which in substance assert the sex, age and ownership of the animal, and state that its blood is not mixed. But the association guarantees nothing as to the quality of the individual, nor does it touch the selling end of the business, or even give information on which the prospective buyer may base an opinion. For this he must go to records of sales and showrings, and to all sorts of unauthorized sources, for the information which he needs in order to make an intelligent purchase. Much of the traditional history of not a few famous animals is little else than the idle gossip of herdsmen and stable boys. What an unsubstantial basis for values in an important business!

No wonder breeders are suffering from a surplus of unsold stock, and no wonder that the herds of the country are so largely headed by scrubs. No sales business on earth could prosper with this lack of organization for selling purposes. Of course a few individual breeders, by the employment of modern business methods, do push sales and make money; but their sales are for the most part to smaller breeders, and not to the farmers, where, after all, the breeding stock is most needed.

Why do not the breeders in their organized capacity go after this undeveloped market for sires, which, if developed, would absorb and put to use at good prices every worthy pedigreed male in all the herds of the country? Why do they not develop this market, instead of selling back and forth to each other at prices which the farmer from his standpoint cannot understand, and which represent in many cases not so much the earning power of the individuals, as the prices which men of means are willing to pay for the satisfaction of ownership? With all that can be done by the most able and progressive individuals, it does not take a modern financier to understand that, if organized effort were devoted to the selling of bulls, for example, as it is to boots and oranges, both the breeder and the farmer would be better off, and the cattle of the country would suddenly and substantially improve.

The rule of the commercial world is that the seller seeks the buyer, and agriculture is no exception. Many a man, however, can raise, feed and condition good cattle, horses, sheep and hogs, who cannot sell them except upon the open market. Such a man should look to his associates to make his sales.

What the breeding business needs is not a few sales at fabulous values, but rather a steady and reliable market at compensating prices. To secure this, the selling side should be put into the hands of professional salesmen who are responsible to the association. The stock may be owned, as now, by individuals, and consigned to the association for sale; or in some instances the association may own the sires, and pay the individuals for furnishing approved females and raising the young to the selling age.

Another co-operative feature in the live stock business is what might be called community breeding; meaning by this that the people of a given community should largely engage in breeding the same class of animals, — whether horses, cattle, sheep or swine, — instead of as now, each man raising what fancy may dictate or caprice or chance may inspire. The advantage of this would be twofold: first, the community would learn this particular enterprise thoroughly, as have the two little German villages where practically all the good canaries of the world are bred. The second advantage is the reputation which such a community can acquire for high quality, and the certainty that within a narrow region the buyer can find what he wants. Such a reputation constitutes an attraction to purchasers, and it means dollars to every member of the community. For this reason it is better that a given individual should breed horses, if all the rest are breeding horses, than that he should indulge his personal preference, perhaps, and breed cattle.

There is another way in which the assets and profits of farming may be substantially increased, and that is by what may be called a general increase in agricultural values and prosperity, through legitimate agitation and the increase of general interest. This principle is being recognized in towns, and every village, not to say city, that counts itself at all progressive, has its live commercial club or chamber of commerce, whose business it is to do any and all things that shall increase the business prosperity of that particular town. These clubs mean that the commercial world has learned that the business interests of a city demand something more than good order and municipal government, or even individual success, and that is, business organization of an aggressive character. These clubs go beyond what their members can do each in his individual capacity and business, and they occupy that larger field of common interests, on which, after all, the prosperity of the whole very largely depends, — a field, moreover, that cannot be occupied and developed by individualistic interests.

We of agriculture have a lesson to learn from all this. The people of the far west have commenced to learn it, and we of the middle west and you of the east will do well to begin to sit up and take lessons. If we do not, it will be the worse for us and for the interests we represent. All over the west there is the most thoroughly organized attempt to boom the country, and it is backed by apparently unlimited means. I asked why it is done, and the answer invariably was, "We want more people here, so as to develop the country and increase both its producing and its buying power." The people of the Pacific slope understand that their present population is not enough for the highest economic efficiency, and to bring more people there is not only to afford an opportunity for them, but it is also to increase the profits of those already there. Hence the Alaska-Yukon Exposition; hence the acres of literature published; hence the attractive views; hence many things that we of the east may well copy. If one-tenth the attempt had ever been made to develop New England agriculturally that has been made to develop it in manufactures, or that is being made to develop the agriculture of the far west, it would now blossom as the rose, abandoned farms and all.

There is an undeveloped agriculture of the east. There are some things that can be done in close proximity to population centers more advantageously than elsewhere; and whenever the older portions of the country undertake their agricultural development in an organized way, they and everybody will be astonished at the results. I commend to your attention, therefore, the development of the agricultural interests of the east by the employment of modern business methods through organized effort.

The CHAIRMAN. Perhaps President Butterfield of our Agricultural College will say a word on this line.

President K. L. BUTTERFIELD. It seems to me that Dean Davenport has struck a blow which should come home to us here in New England with special force. I have been wondering, while he was talking, why we cannot here in Massachusetts begin to act immediately on these suggestions. It seems to me that so far as the general proposition is concerned the case is perfectly clear. Dean Davenport, very fortunately, I think, has used the apple illustration constantly through his lecture. The testimony of the State Board of Agriculture, the agricultural college people and the agricultural committee of the Boston Chamber of Commerce is that the recent New England Fruit Show has stirred an unwonted interest in the development of the commercial apple orchard all over New England. It is very evident that to get best results from that fruit show, and others that are to follow, it is necessary to organize the movement that is to result. At the college we are already having more inquiries than Professor Sears can answer, and more applications than we can respond to, for men to go out and advise with respect to locations for orchards. These inquiries naturally come as to the location of orchards and their care and methods of protection. Perhaps the time has not come when we can emphasize to the full this question of selling; and yet it has been pointed out again and again, as Dean Davenport has done to-day, that if we confine our efforts merely to the question of production, we have not fought even half the battle. And so I have been wondering if the time has not come when we should do something. Is it not possible for the Board of Agriculture, with the assistance of our boards of trade — we have forty of them in Massachusetts — and the help of the agricultural societies and colleges and experiment stations, to work out during the next few years a progressive plan for handling the apple product of New England?

It seems to me that what Dean Davenport has said has a very definite application here. Tens of thousands of apple trees are going to be set out in the next few years, and if they succeed they will be followed by tens of thousands of others. If we neglect this market end, then the impetus that is given by the work already started will be discounted, because it will result in the failure of a great deal of individual effort. This can be done with apples, — perhaps not in the same way, — as it can be done with other things. It seems to me that we are on the road to a more complete organization of our industry, — an organization that is necessary, if New England agriculture is to be what it ought to be and what it may be.

Mr. Wilfred Wheeler. I would like to ask how the associations of the west were started, — whether they were started by an individual, or by a community?

Dean Davenport. A community entirely. That leads to another proposition, — that organization works best where the whole community is interested in one thing. Such a common interest is desirable, from its own standpoint. We have pushed individualism so far in this country that each farmer does the things he desires to do, without regard to what his neighbors are doing. A saddle horse is worth more money if bred in a region where other saddle horses are bred, than another horse raised in a different locality; for when a region gets a reputation, it is all the better for the individual producer. If this region is raising apples, you have fifty or a hundred men all interested in having this crop sold to the best advantage; therefore, they meet and organize. Two things must then be provided; a man who can sell fruit, sell fruit to a graven image, make him think he must have it; and a man to standardize that fruit, and assort it so carefully that no man can tell what orchard it comes from. Put 120 apples into a box, and maybe they all came from one farm, and maybe they didn't. And the men who sort them don't know where they came from, and don't care. I used the apple as an illustration, because it is convenient, and I thought it was one of the coming things in New England. The Hood River apple is said to be the only apple sold in the London market without opening the box. If you get that reputation, you can make any demand. It is only occasionally that a man can make his own name known by mere strength; it must be by organized effort. When they get a barrel of Illinois apples in the market, they knock in the head with a hatchet to see what they look like, and they find they are not the same in the middle as at the top and bottom, and that reduces the value.

The community is the first thing, and when the label goes on, it has back of it the guarantee of the association of that community. An individual's guarantee doesn't carry much weight, but an association's does. I know a big orange grower who was in the habit of throwing away his ill-shaped oranges. Others had tried to work them off under fancy names, but he conceived the idea of calling them by a plain name, and he then put on the label, "These oranges are just as good as any and just as bad-shaped as any; if you eat one, you will want another." That year he sold them for two-thirds the price of his good-shaped fruit, and the next year found he had quite a special demand for them. You see the buyer is satisfied if he knows what he is getting; he doesn't always want the first quality.

There is a German village in the Hartz Mountains where they have been raising canaries for thousands of years, and have learned more about canaries than all the world knows; and we pay $4 apiece for those canaries, because we know that they know about them. Everybody raises canaries, and the children learn as they grow up, because everybody talks about them. Nearly all the violets in this country are raised along the Hudson River; it is done by the women and children, and they all learn how to do it. In the Rocky Mountains they are giving up violets, because they say they cannot raise as good violets, and certainly cannot compete in price with the Hudson River growers. That is what we can do by a community going into one thing. It applies to fruit, flowers, vegetables, saddle horses, Jerseys, — anything.

Mr. Wheeler. How do you start in?

Dean Davenport. It is hard to get started, but after that it is easy. If you find a good orchard location and go into apples yourself, in a little time you get the people around you interested, and they get their friends interested, and you soon have enough to form an association. The Salem people sent a man to France to study up the subject, where it is done in the best way; and that saves time, for you get the benefit of years of other people's experience. It is better to get the information second hand than to take years to learn it first hand.

Mr. Wheeler. Do you suppose it could be done anywhere?

Dean DAVENPORT. The natural nucleus is essential, to do it successfully. In the communities where this is done, they can't do general farming, — they are driven to specialties; and that is what we should do here, only we can get along without it, but not as well. I visited a farm in Kansas City where a man is making a name for a community with the White Orpington. Very likely his next-door neighbor raises Buff Cochins. What they should do is, to all go into White Orpingtons, for that man will die some day, and that community ought not to lose the reputation he has made for it. The community should specialize, rather than the individual; the individual is too small, and doesn't live long enough.

The CHAIRMAN. Perhaps Mr. John H. Robinson will give us a word about poultry.

Mr. ROBINSON. We have here in New England two poultry-producing communities, that to some extent furnish illustrations of the conditions Dean Davenport has described. They are the South Shore section in Massachusetts about Norwell, Rockland and Hingham, and the section of Rhode Island about Tiverton. The South Shore section produces what I believe to be the best chickens that go onto the market anywhere, and they retail at from $3 to $4 apiece. There are just two middlemen, instead of four or five, practically all the product of this locality is handled by two firms, and the producer gets all he is entitled to for his product, which is taken at his door alive. There are more poultrymen making money in that section than anywhere else. In the Rhode Island section the production end has been developed, but the selling end is still in the hands of the individual; each man's product goes into the general market, and he gets an ordinary price for it.

QUESTION. Suppose Jones's apples are inferior to Smith's, — does he get the same money as Smith?

Dean DAVENPORT. No; they are handled carefully. Every box Jones delivers is credited to him, and is assorted. He has so many boxes of firsts, running 120 to the box; so many boxes of seconds, running 96 to the box; so many boxes of firsts and seconds, running so and so to the box. His apples are credited to him for just what they will make. He doesn't do the sorting, however. It is written in the Scriptures that no man can sort his own fruit. The sorters are hired to do the work, and don't know one man's product from another's. I know of one man who did something to his strawberries that couldn't be detected by the sorters, that gave him an unfair advantage. He was expelled from the association, could not get into the other local association, and was obliged to sell his farm and leave that district. If these people on the South Shore had an association and elected their own seller, it could be perpetuated, and they would not be subject to their present buyers going out of business, or anything of that kind.

Mr. B. W. Potter. I would like to ask whether there is more than one association in the Hood River valley, and whether there are not some individual growers?

Dean Davenport. There is only one exchange in that valley, though there might of course be two. The individual in these localities almost always belongs to the association, except where he is big enough to be an association himself. I know of one such case at Riverside, — a firm of three or four men, who have developed such a large business that they can get along by themselves.

Mr. John Bursley. As you know, Cape Cod is one of the largest cranberry sections in the country. A company was organized to sell the crop direct from the growers to the people, and the man at the head of it was one of the smartest fruit salesmen in Chicago. Cranberries must be assorted near the place of growth, and they are packed and inspected by an inspector, who receives a small sum per barrel, and each barrel is marked with its grade. This took the crop away from the commission dealers of Boston, New York and Philadelphia, and placed it right at the distributing points, largely in carload lots. This was very successfully done last year and the year before. All the growers got the same price for the same grade of berry. So successful did this scheme prove, that the cranberry king, who is packing 50,000 barrels, has organized a smaller sales company, and these two companies have frozen out most of the commission houses. We have a great many small growers, but practically three-fourths of them are in this scheme. One of my neighbors last night said he didn't think he could get here, as he had to get off a car of berries he had promised to have shipped to San Francisco on Tuesday or Wednesday. He is getting something like $5.50 per barrel, f.o.b. The first year one car went to Texas, another to the British Provinces, a third to California and a fourth to the middle west. These sales companies have been a great help to our large growers.

Dean Davenport. I wondered why it was we can get cranberries now, and a few years ago we couldn't. The dealers would say, "No; we can't get them;" but now you can get beautiful berries anywhere.

Question. How do these questions apply to the retail milk proposition?

Dean Davenport. I do not see any reason why the milk producers shouldn't manage the selling end of the product just as well as the selling end of any other ordinary product is managed by the producers. If any of the big milk companies should go to pieces, if they ever do, the business must be readjusted again. The milk producers' rules and regulations are made by another company, and they have to follow them. If they make their own agreements and appoint their own salesmen, then they are nearer the consumer. It seems to me that the same principle applies to any thing that can be standardized close to the producer. The same is true of the butter business; the producers can manage it themselves, if they will. Of course it is another question whether they want to do it.

Evening Session.

Secretary Ellsworth. Ladies and gentlemen, it is my pleasure to introduce to you the man you tried to equal during the New England Fruit Show, and who represents the Massachusetts Horticultural Society on the Board, Mr. Wilfrid Wheeler, who will preside this evening.

The Chairman. Mr. Secretary, ladies and gentlemen, this afternoon Dean Davenport tried to impress upon us that we were to educate the consumer to take the best quality, and in order to do that, we must have the best varieties in all lines.

Professor Sears is here this evening, to tell us the best varieties of apples to grow in New England. He is very well qualified to speak on this subject, having not only taught pomology for many years, but being also in the apple-growing business, and I take great pleasure in introducing Prof. F. C. Sears of the Massachusetts Agricultural College.

VARIETIES OF APPLES FOR MASSACHUSETTS ORCHARDS.

BY F. C. SEARS, PROFESSOR OF POMOLOGY, MASSACHUSETTS AGRICULTURAL COLLEGE.

I wish to disclaim at the outset any notion that the following list comprises *all* the varieties of apples which ought to be grown in Massachusetts. There are doubtless many others which might be added, and no doubt some people will think that some which have been included might be omitted in favor of some which are left out. But, in general, I believe the list includes most of those varieties which are most suitable either for commercial plantations or for private orchards within the State. Arranged in approximately the order of their ripening, the list which I propose to discuss is as follows: Yellow Transparent, Red Astrachan, Williams Early, Oldenburg, Gravenstein, Wealthy, Fall Pippin, McIntosh, Hubbardston, Westfield, Blue Pearmain, Palmer Greening, Sutton, Rhode Island Greening, Baldwin, Spy, Roxbury. Arranged as nearly as may be in the order of their commercial value in the State, they would stand as follows: Baldwin, McIntosh, Rhode Island Greening, Wealthy, Hubbardston, Williams, Oldenburg, Roxbury, Red Astrachan, Sutton, Gravenstein, Fall Pippin, Westfield, Spy, Yellow Transparent, Blue Pearmain.

Before taking up this discussion of special varieties, I should like to call attention to some general points or principles on the subject which I think ought to be carefully considered by the intending planter before he makes his selections. If the orchards are to be grown for commercial purposes, the precise type of market to which it is the intention to cater ought to be considered and its demands studied, in order to meet the requirements. As a general principle, we may say that markets are of two types, and that a very different list of varieties would be selected for these two types.

There is first the general or wholesale market, where the apples are handled in large quantities, and where the producer never comes in touch with the consumer. The orchardist growing for this market perhaps sells his fruit to a buyer in the orchard, or loaded on the car, or he may ship it to a commission man. In any case, it is very much to his advantage to have a large quantity of fruit of each variety. If he has five hundred barrels of Baldwins, buyers are going to hunt him up and bid for his fruit; whereas, if his five hundred barrels are distributed among the seventeen sorts mentioned above, there would not be enough of any one kind to interest the buyer; and this same general consideration would hold in any type of general market. If he is shipping to a commission man, one hundred barrels each of five sorts will sell for more than five barrels each of one hundred sorts. As a rule, a man chooses this type of market if he is some distance from his market. If he is going to plant an orchard to cater to such a trade, he ought, in my opinion, to select not over five, and preferably about three, varieties. A less number than this does not provide for cross-pollination, and does not allow for the years when certain of his varieties will not bear. I believe that for a steady income from such an orchard a man is better off to have at least three varieties.

The second type of market is the special or personal market. Here the producer comes in direct or nearly direct communication with the consumer, — that is, he either peddles his fruit, or at most sells it to the man who sells it direct to the consumer. The grower perhaps runs a wagon of his own, or, if he does not do this, he sells to a grocery or fruit store which sells to the consumer. In either case he is so near the consumer that he gets the benefit of the good quality of his fruit, or the blame for its bad quality. He gets personal customers, who may say, "Yes, Mr. Jones, those apples we got last week were fine; I want some more like them." Or, to the grocer, "When are you going to have some more of Mr. Jones's apples?" In either case Jones wants to be in a position to supply the demand; in other words, he does not want to work up a market for his Yellow Transparents, and then drop it when Williams Early are in season, and allow his customers to forget all about Jones before his McIntoshes come on. I have known a man, and a good business man, too, who refused 50 cents a barrel more for his Spies than he could sell them for to his regular customers, merely because he did not want to break the connection. For such a grower as we are now considering, I do not believe that ten or a dozen varieties are too many. This may sound like rank heresy, but if the varieties are selected with the proper care and consideration, I am sure that it is right.

But, whichever market one is working for, there are certain characters in fruit and tree which ought to be considered, though their relative importance will vary somewhat. I have a great weakness for score cards, because it seems to me that they will help us to reduce our judgments to a more definite basis, and help one who lacks experience to give more nearly proper weight to each point. I have therefore worked out the following score card, which I have used in my classes with good results, and which I believe will help the intending planter to give the proper rating to each variety: —

Score Card for a Commercial Variety of Apples.

	General Market.		Special Market.	
Tree,	40		35	
1. Heavy bearer,		20		15
2. Early bearer,		10		10
3. Healthy and vigorous,		10		10
		40		35
Fruit,	60		65	
4. Fair size,		10		5
5. Good Color,		20		15
6. Good quality,		12		30
7. Keeps well,		10		10
8. Ships well,		8		5
	100	60	100	65

This is by no means an ideal score card, but it represents fairly accurately my notions as to the comparative value of the different points. To discuss each of these points briefly: —

Tree. (*1*) *Heavy Bearer.* — I have rated this higher for the general market than for the special, because we do grow varieties for the latter which are not especially heavy bearers, because their quality is such that it pays to grow them. In any case it is important that we get the fruit; nothing is more discouraging than an unproductive orchard.

Tree. (*2*) *Early Bearer.* — This needs little discussion. One of the great difficulties in getting men to set apple orchards is the length of time it requires to bring them into bearing. If they came in in two to four years, as peaches do, we should see far more apple trees planted. Those varieties which do come in relatively early are correspondingly welcome. I have rated this the same for both markets, because it seems to me that it is almost equally important. Possibly we could afford to plant for the special market varieties which are a little slower in coming into bearing, if their quality warranted it.

Tree. (*3*) *Healthy and Vigorous.* — This is certainly equally important for both markets, and needs no discussion here. The common ailments which would lower the standing of a variety here would be susceptibility to canker, to apple scab on the twigs, a tendency to winter-kill, etc.

Fruit. (*4*) *Fair Size.* — I have given this double importance for the general market, as we frequently grow special varieties, as the Lady, Fameuse and Pomme Grise, for the special market, if their quality warrants it, when their size would condemn them for the general market; but it is certainly a fact that a fair-sized apple has the advantage, other things being equal.

Fruit. (*5*) *Good Color.* — I suppose this is practically equivalent to saying "red color," but not quite, as some yellow apples are more attractive than others. It seems to me that the craze for red apples is just as insane a notion as that for red Short-Horn cattle, or for Jerseys with a black tongue. But the craze is here, and the red apple sells better, particularly in the general market, than any other color.

Fruit. (*6*) *Good Quality.* — This is a crucial point with the special market, and I believe that it ought to be given more weight than is usual with the general market, particularly here in Massachusetts. We can grow apples of the highest quality; some other sections cannot. If we must compete with those sections (and we certainly must), why should we throw away this advantage by trying to grow Ben Davis? Even in the general market quality is appreciated, as any one will see by watching the market prices and observing the relative difference in price of McIntosh and even as good a variety as the Baldwin.

Fruit. (*7*) *Keeps well.* — There is undoubtedly a market for early apples, and yet, as a rule, the price rises as the season advances. In years when the crop is large and the price is low it is frequently the late winter sorts which bring the balance out on the right side. This is less important now that cold storage has become more perfect, but certainly it is still worth considering.

Fruit. (*8*) *Ships well.* — This is also less important than in former years, for methods of packing and shipping have improved greatly; still, it is even yet important, for if a variety ships well it requires less time and expense in handling, and it is more likely to come on the market in a uniformly good condition.

Let us now turn to a consideration of the individual varieties listed, considering them on the basis of the above score card.

(*1*) *Baldwin.* — The Baldwin is a chance seedling which was found at Wilmington, near Lowell, Mass., and there are few things which Massachusetts has more cause to be proud of than having originated the Baldwin. The tree is a strong grower, long-lived and vigorous, making a round-headed top of excellent shape, and is in most respects an ideal tree. It is hardy except in very severe climates. It does not come into bearing early, ranking about with the Gravenstein in this respect. As a rule, seven or eight years are required, under even good conditions, to bring it into profitable bearing. The tree is somewhat subject to canker, though not very seriously so. It bears very abundantly in alternate years, and little or nothing in the odd years. Whether this tendency can be overcome by thinning, or by some other treatment, remains to be settled. The fruit is finely colored when well grown, of good size, regular in form, and runs as a rule very uniform, with comparatively few culls. It keeps well, the season being from November to March in ordinary storage, and it stands handling very well indeed. The quality is usually ranked from good to above, when well grown, but a poorly grown Baldwin is a poor thing. This point I think needs decided emphasis, as some of our well-grown Baldwins are the equal in color and attractiveness of anything grown in the famous northwest. On the other hand, some of our poorly grown Baldwins are the equal of almost anything disreputable in the apple line. The Baldwin is undoubtedly the most popular and profitable apple in New England and New York. A point worth considering is that it is one of the best export apples, particularly to England, where American-grown Baldwins stand very high. This means that in years when there is a large crop here we would have an outlet to foreign markets. To sum up its good and bad points: —

Baldwin.

Good points: —	Bad points: —
1. Well known.	1. Rather slow in coming into bearing.
2. Long-lived tree.	2. Overbears in alternate years.
3. Good bearer.	3. Not high quality.
4. Uniform grade of fruit.	4. Cankers.
5. Good color.	

(2) *McIntosh.* — Perhaps no other apple is more popular at the present time, or more largely planted, than the McIntosh, and in my opinion it deserves all its popularity. It belongs to the Fameuse group, having originated in Ontario, Canada. The tree is a strong grower, hardy and healthy, one of the finest that I know. The side branches come out at almost right angles, so that the tree will bear an immense load of fruit without breaking down; the branches are well distributed; altogether, it forms a beautiful tree. It comes into bearing relatively early, and bears well, though not overabundantly. It has a strong inclination to be an annual bearer when well cared for, which I consider a decidedly important point. The fruit itself is very attractive in appearance, being a bright, handsome red, with a waxy texture to the

flesh, which is white, tender and very highly perfumed. The aroma of a good McIntosh is something to be remembered. Its season is from the first of September to perhaps the middle of November in ordinary storage, but it will keep in fairly good condition much longer than this. It is particularly good for holding its color and attractive appearance well, which is a very desirable quality. It is not an uncommon thing to find good specimens of McIntosh as late as January or February, which, though they have lost something of their quality, are still very good eating. The fruit ripens unevenly, and has a considerable tendency to drop, so that picking should be done twice and perhaps three times. It is a very desirable variety for local or special trade, but will not stand rough handling. I believe that this last point is being overlooked, and that a good many men are planting the McIntosh who will not give it the type of handling which it demands. At present it is probably the most popular variety in Massachusetts.

McIntosh Red.

Good points: —	Bad points: —
1. Hardy tree, good shape.	1. Tender, requires careful handling.
2. Highest quality.	2. Scabs.
3. Finest color.	3. Ripens unevenly.
4. Uniform grade.	4. Drops.
5. Annual bearer.	

(3) *Rhode Island Greening.* — The Rhode Island Greening is thought to have originated in the State whose name it bears, and probably near Newport, although the records are not very definite. It would certainly stand next to the Baldwin as a commercial apple in New England, though the McIntosh is undoubtedly far ahead of it in the number of trees being planted at the present time. I believe, however, that the Rhode Island Greening deserves more attention than it is receiving at present from those who are planting commercial orchards. The tree is reasonably hardy, winter-killing only in rather severe climates; it is long-lived and generally healthy, though it does not come into bearing early. Probably eight or nine years would be the usual time required to

bring it into bearing. It makes a characteristic tree, being strong and vigorous, and, as already noted, healthy, although the fruit and foliage are both liable to scab, and in some sections the apple canker attacks it. The form of the tree is decidedly drooping, and for this reason it might be headed somewhat higher than the varieties of more upright growth. Its season is a little earlier than that of the Baldwin, and it is a good companion variety to plant with the Baldwin in commercial orchards. The fruit is a bright, handsome green in color in the autumn and early winter, but changes to a yellow color later in the season. It is undoubtedly one of the best cooking apples grown, and a Rhode Island Greening pie is fit for a king. It is by no means to be despised as a dessert apple. It is more nearly an annual bearer than the Baldwin, though not strictly annual, and the fruit hangs very well on the tree. The season is from late October until March, though varying somewhat with the culture and storage conditions; but it ripens very rapidly when subjected to heat, and is very liable to scald in storage, particularly with large, overgrown specimens.

Rhode Island Greening.

Good points: —	Bad points: —
1. Well known.	1. Sometimes scalds in storage.
2. Productive.	2. Color.
3. Good quality.	3. Scabs.
4. Fine cooker.	4. Not as hardy as Baldwin.

(*4*) *Wealthy.* — This variety was originated by Peter Gideon of Minnesota, from seed of the Cherry Crab. The tree is very hardy indeed, and a good, thrifty grower while young; but as the trees get older the rate of growth becomes more moderate, until when they reach middle age the growth is very slow, and careful cultural treatment is often required to keep up its rate of growth. The tree never reaches large size, and, for that reason and others, is very useful as a filler. It comes into bearing very early; frequently fruit will be found on the trees in two or three years, though of course only scattering specimens. The fruit is of good quality and finely colored, being a light straw-yellow, splashed and striped and sometimes almost covered with a handsome crimson. It attains good size on younger trees, but on older trees, where, as noted above, growth has become slow, the fruit is apt to run small. This has to be overcome by severe pruning and high fertilizing. The fruit also needs to be thinned to get the best results. In any case the fruit runs very uniform both in size and shape, and for that reason it makes an excellent variety for boxing. The flesh is tender and juicy, and requires careful handling in order not to injure it. The season is September and October, slightly before the McIntosh; but it can be kept until December in good storage. The fruit drops badly from the tree, and the trees should be picked over two or three times. It is at present being quite largely planted, more so than many other varieties; but, as already noted, its special field is as a filler.

Wealthy.

Good points: —	Bad points: —
1. Bears very early.	1. Drops badly.
2. Hardy tree.	2. Ripens unevenly.
3. Good quality.	
4. Uniform grade.	
5. Good color.	

(5) *Hubbardston.* — This is another variety which originated in Massachusetts, having been found at Hubbardston, Mass., very early in the history of the State. The tree is vigorous, particularly when young, and comes into bearing early, frequently giving a fair scattering of fruit from the orchard at four years. The tree is only moderate in size, but bears heavily, at least biennially and sometimes annually; it is therefore a good variety to be used as a filler. It is apt to overbear in a productive year, and for this reason should receive careful attention, to keep the soil in a good state of fertility and the foliage free from fungous diseases or insects. It will often be necessary, also, to thin the fruit, in order to keep it up to the proper size. The tree is considerably subject to canker where that disease is prevalent, and the fruit to the railroad worm. The fruit is of excellent quality, being firm, fine-grained and rich, and when well grown it is finely colored,

with handsome appearance and attractive texture, which makes it sell well. As a cooking apple it does not rank so high, and ought to be used fairly early, as after it has become more mild it is not nearly as good for this purpose as when it has more acidity. The fruit is uniform and of fair to good size, except when it overbears. Its commercial limit in ordinary storage would be December, and, as with many other varieties, the large-sized, poorly colored specimens do not keep as well as smaller, firmer and better-colored ones. When this variety is well grown it has proved a profitable market sort, standing at present close behind the Greening; and I should have no hesitation in setting it as a market variety, particularly on light soil, where it does especially well.

Hubbardston.

Good points: —	Bad points: —
1. Quality excellent.	1. Overbears and runs small.
2. Early bearer.	2. Railroad worm.
3. Handsome when well grown.	3. Loses quality as cooker.
4. Good bearer.	

(*6*) *Williams Early.* — This is another of our Massachusetts apples, and, like a great many things which Massachusetts has done, this is a good job. It originated in Roxbury, Mass., more than one hundred and fifty years ago, and in my opinion is one of the best and most profitable of the early varieties. The tree is rather a poor grower, and is therefore often best top-worked on some better-growing variety, as Pewaukee or Spy. It is a fairly good cropper, and has a decided tendency to be an annual bearer when it receives the right treatment. The fruit is only medium in size, but a beautiful bright red, with a very fine though mild flavor. Its strong point is for dessert, but, contrary to the opinion of some others, I consider it a very fine cooking apple. The fruit ripens unevenly, so that it needs more than one picking; and, as it is tender both in skin and flesh, it ought to be handled with care and packed in boxes. It is a prime favorite in the Boston market, and I should not hesitate to plant it as a commercial variety.

Williams Early.

Good points: —	Bad points: —
1. Fine color.	1. Ripens unevenly.
2. Fine quality.	2. Tender flesh.
3. Annual bearer.	3. Poor grower.
4. Favorite in Boston markets.	

(7) *Oldenburg.* — This is one of the Russian varieties which has "made good" in America. It is especially valuable where extreme hardiness is required, but I believe it is worthy of a place in our list of commercial varieties for Massachusetts. As suggested, the tree is very hardy, but is of only moderate size. It grows vigorously while young. Its most valuable character, however, is its early bearing. Fruit is frequently borne on trees at three and four years, and fairly good crops are often borne at four and five years. It is also a reliable cropper, often yielding annual crops, and the fruit hangs well to the tree. The foliage is fine and healthy, and altogether it is a fine tree for a filler, where this system of planting is used. The fruit is of good size and very attractive, being a fine light yellow, with stripes and splashes of handsome red. It runs very uniform on the tree, with few culls, and is altogether a very good commercial sort. The flesh is firm but juicy, with a sprightly, sub-acid flavor, and, though not high in quality, is still passable.

Oldenburg.

Good points: —	Bad points: —
1. Hardy tree.	1. Fruit perishable.
2. Very early bearer.	2. Ripens unevenly.
3. Reliable cropper.	3. Only moderate quality.
4. Hangs well to tree.	
5. Handsome color of fruit.	

(8) *Roxbury Russet.* — This is still another of the fine old varieties which have originated in Massachusetts, and goes back to the seventeenth century. From a commercial standpoint it is undoubtedly the best of the russets, and is especially valuable as an export variety, the English market being particularly strong on russets, and especially the Rox-

bury, since it is marketed late in the year. It is perhaps being planted less since cold-storage facilities have improved, but I believe it is still worthy of a place among our list of market varieties. As a cropper it is somewhat variable, but has a strong tendency to annual bearing when well cared for, as it does not tend to overbear. The tree is medium to large in size, and rather a vigorous grower, making usually a flat top. Its principal weakness, so far as the writer knows it, is a tendency to European canker where that disease is common. It makes a characteristic twiggy growth, being full of short fruit spurs, and easily recognized by one familiar with the variety. The fruit is medium to large, being rather variable in both size and shape. It is sometimes oblate, sometimes somewhat conic, and almost always irregular in cross-section. For this reason it is not a good variety for boxing, though these objections apply less to the fruit on well-cared-for trees than on those which receive less care. The flesh is yellowish in color, very firm, but reasonably tender and juicy, with a sprightly sub-acid flavor. In quality it would rank, in the writer's opinion, as good to best. There seems to be considerable objection to it as a commercial variety for our American markets, but I believe that this objection is going to disappear as people become accustomed to attaching less importance to the red skin of an apple.

Roxbury Russet.

Good points: —	Bad points: —
1. Reliable bearer.	1. Canker.
2. Keeps late.	2. Russets not wanted.
3. Good quality.	
4. Well known.	
5. Handsome.	

(9) *Palmer Greening (or Washington Royal).* — This is still another Massachusetts apple, having originated at Sterling, Mass. The tree is only moderately vigorous, even when young, and attains at full age only moderate size, not nearly as large as the Rhode Island Greening. It comes into bearing reasonably early, from six to seven years, bears good crops biennially, but has very little fruit in the off year. The

fruit is greenish in color, or yellowish when fully ripe, and usually has a distinct blush on the sunny side, making it a decidedly attractive apple to any one who is not wedded to a red variety. There is an indication of quality to a good Palmer Greening that is very attractive, particularly to one who has ever eaten it. It is especially valuable as a dessert apple, as its quality ranks from good to best. Professor Dickens of Kansas wrote recently of some Palmer Greenings which had been sent him for his class in pomology: "Two out of eight in my senior class pronounced it the best apple they had ever eaten, and they know Grimes Golden and Jonathan pretty well." It will keep till December, or even till March, in good storage, and its medium size and very uniform shape and size make it an ideal box apple. In my opinion, it ought to be grown more extensively in Massachusetts.

Palmer Greening.

Good points: —	Bad points: —
1. Extra quality.	1. Not well known.
2. Attractive appearance.	2. Biennial bearer.
3. Size and shape.	3. Rather a poor tree.
4. Fairly early bearer.	

(*10*) *Sutton* (*Beauty*). — The Sutton is supposed to be a seedling of the Hubbardston, and originated in Sutton, Mass. The tree is vigorous and healthy, and very upright in growth. One who had become familiar with the Sutton tree would always be able to pick it out. It has a marked tendency to bear biennially, which is an objection. While as yet not at all well known as a market variety, I believe it is one of the coming market varieties. Beach says of it: "In color, texture, quality and season the Sutton is intermediate between the Baldwin and the Hubbardston." It is very uniform in both size and shape, being rather above medium in size, and of a fine conic shape. It is excellent in quality, and of fine red color. It seems specially suited to the fancy box trade, but its flesh is a little too tender for the general market, though it is all right in barrels if handled carefully. I believe it is the type of apple which ought to be grown here in Massachusetts, and am glad to note that Beach reports it as one of the coming commercial apples in New York.

Sutton.

Good points: —	Bad points: —
1. High quality.	1. Scabs some.
2. Good color.	2. Not so well known.
3. Hangs on well.	3. May develop other faults.
4. Productive.	
5. Even in size and shape.	

(*11*) *Gravenstein.* — This is a German variety, introduced into the United States about 1826. Its very attractive appearance and excellent quality make it popular, even in spite of the fact that as a rule it is not very productive. For cooking it is not excelled by any variety of its season, and when fully ripe and not overripe it is an excellent dessert variety. The tree is a very vigorous grower, in fact, too vigorous unless handled carefully, having a tendency to grow too late in the fall and to be damaged by the severe weather which follows. It is liable to sun-scald and to canker. It comes into bearing fairly early, usually from seven to eight years, and is a reliable cropper, though not a heavy one, with a considerable tendency to bear biennially. The fruit ripens quite unevenly, and ought to be picked twice or even three times to secure the best results. The season is from the middle of September until November. It may be kept later than this in good storage, but the color fades badly if it is kept much beyond its season, far more than the McIntosh does. It is apt to grow a good many culls, particularly in the off year, running very variable in both shape and size. Where it succeeds, no other apple of its season can compete with it in the market. In quality it ranks from good to best.

Gravenstein.

Good points: —	Bad points: —
1. Fine quality, cooking and eating.	1. Shy or biennial bearer.
2. Handsome appearance.	2. Winter-kills.
3. Tree needs little pruning.	3. Collar rot, rank grower.
4. Well known.	4. Fades in storage.
	5. Sun-scald and canker.

(12) *Red Astrachan.* — This is another of the Russian apples which has achieved success in the United States, and which I should include as a commercial apple for Massachusetts. It is very early in season, following the Yellow Transparent, and being fit for cooking in July. It is consequently a profitable variety for local markets and for home use, while its attractive color combined with its earliness make it popular. It is, however, very tender in flesh, and will not stand shipping well. It is principally valuable as a cooking apple, though well-grown, fully developed specimens are very good eating. The tree is medium in size, coming into bearing very early, and is reasonably productive, though inclined to bear biennially. Its tendency to be irregular in both size and shape is rather a serious drawback to a commercial variety, making quite a loss from unmarketable fruit. The fruit drops considerably, unless several pickings are made.

Red Astrachan.

Good points: —	Bad points: —
1. Fine color.	1. Irregular in size and shape.
2. Very early.	2. Very tender in fruit.
3. Productive.	
4. Hardy tree.	

(13) *Fall Pippin.* — The origin of this variety is somewhat in doubt, but it is good enough so that its origin does not much matter. It ought to have originated in Massachusetts. The tree is large and rather vigorous, making a roundish, rather dense top. Both leaves and fruit are seriously subject to the apple scab fungus, which is a decided drawback where this disease is troublesome. The fruit ripens very unevenly, which is another objection, as it means repeated pickings, which add somewhat to the expense. The fruit is large, of a fine, clear yellow, and decidedly handsome, having a clean, attractive appearance which makes it sell well. The flesh is fine-grained, tender and juicy, rather aromatic, and ranks as good to best in quality. It is a fine dessert apple, but is especially strong as a culinary variety. In storage it is a variable keeper, but in any case has a long season, owing to its uneven

ripening, beginning in September and lasting well on towards Christmas. I should consider it among the best of the fall varieties for home use, and a good commercial sort.

Fall Pippin.

Good points: —	Bad points: —
1. High quality.	1. Subject to scab.
2. Popular in the market.	2. Ripens unevenly.
3. Attractive yellow color.	

(*14*) *Westfield* (*Seek-no-further*). — The Westfield, or Westfield Seek-no-further, is still another of the Massachusetts contributions to the list of fine varieties of apples. It originated at or near Westfield, in the neighborhood of Springfield, Mass. The tree is very hardy, healthy and long-lived, though inclined to be a biennial bearer. It is nevertheless a very reliable cropper. The fruit is of highest quality, with a nutty, aromatic flavor which one who has once known it cannot forget. It is not particularly attractive in appearance, being a rather dull, brownish-red, but when well grown, and especially when grown on sandy or gravelly soil, where it succeeds best, it often attains a fine, handsome red, which makes it really attractive. It runs very uniform in both size and shape, making it a good box apple, and, as it is principally used as a dessert apple (not being a very good cooker), this is the way it ought to be marketed. Its season is from about October to February, but it will often keep in good storage much later than this. It stands handling and shipping well, and in a limited way I believe it would be profitable as a commercial variety. Certainly it ought to be in every family orchard.

Westfield.

Good points: —	Bad points: —
1. Fine quality.	1. Poor color.
2. Hardy.	2. Not good as a cooker.
3. Productive.	

(*15*) *Northern Spy.* — The Spy is one of the few imported commercial apples which Massachusetts cannot claim, as it originated in New York. It is one of my sincere regrets that the Spy does not succeed better in Massachusetts. There are certain sections where it does admirably, particularly in Franklin County, but as a rule it has the reputation of not being a success with us. Whether it altogether deserves this reputation is a question, but certainly we do not grow good Spies in many sections. The tree is all that could be desired in health and vigor, making a fine-shaped, large tree, and living to a good old age, but it is very slow indeed in coming into bearing, in this respect standing at the foot of the list of reputable varieties. The fruit when well grown is about all that could be desired, being a fine, bright, pinkish-red in color, with a smooth, waxy skin, making an extremely attractive apple. The flesh is firm and crisp, but tender and juicy, and has a flavor that no one will forget, once he has eaten a well-grown, well-colored Spy. Both fruit and foliage are decidedly subject to the attacks of the scab fungus where this disease is prevalent, and its tender skin and flesh make careful handling necessary. But, with all its faults, I should say that in sections where it is known that the Spy succeeds it ought to be put down as one of our leading varieties. In other sections it had probably better be tried only on a small scale; but even here, unless it has been tried under favorable conditions, with modern treatment as to spraying, etc., I believe it is worth experimenting with.

Northern Spy.

Good points: —	Bad points: —
1. High quality.	1. Slow in coming into bearing.
2. Fine appearance.	2. Often does not succeed well.
3. Healthy, hardy tree.	

(*16*) *Yellow Transparent.* — This is the third Russian in the list, and is included principally because of its very early season, ripening in July, when every one is apple-hungry. The tree is very hardy and healthy, and comes into bearing very young indeed. Grafts often bear the second year, and sometimes even the year they are set, the trees usually bearing a reasonable crop the third and fourth years. It is a good, reliable cropper, but ripens so unevenly that it requires two or three pickings to secure the fruit in the best condition. The fruit is a very handsome, clear yellow, but both the flesh and skin are tender, and it therefore bruises easily and shows the marks of careless handling. It is a fine cooking apple, and good specimens are not by any means bad eating. Where early fruit commands a good price, and for near-by markets, it will prove a profitable variety.

Yellow Transparent.

Good points: —	Bad points: —
1. Very hardy tree.	1. Easily bruised.
2. Handsomely colored fruit.	2. Does not stand up well in transit.
3. Early bearer.	

(17) *Blue Pearmain.* — This is a fine old variety, but is not very generally grown, and it is not recommended here except for the family orchard, or in a limited way in commercial plantings. To one who knows and likes the good old-fashioned sorts the Blue Pearmain is always very acceptable. The tree is a good, strong grower, and long-lived. The fruit is mild in flavor, but aromatic and fine, with a rich appearance in well-grown specimens which is attractive. The skin is a little rough and rather thick. The color is deep orange-yellow, splashed and striped and shaded with very dark red, and the heavy white bloom over this gives a bluish appearance. The flesh is firm, yellowish, moderately juicy and aromatic.

Blue Pearmain.

Good points: —	Bad points: —
1. Healthy, vigorous tree.	1. Not generally known.
2. Handsome fruit.	
3. Good quality.	

Mr. Drake. Do I understand that there is some method of making the Baldwin bear every year and of making the King bear more freely?

Professor Sears. No; the trouble with the Baldwin is overbearing one year and not bearing at all the next. The theory is that if you thin and reduce the amount of fruit one year you increase the probability of getting a large crop the next year. The trouble with the King is that it has a tendency to overgrow. I know a few men who grow the King and make it bear very liberally every year, and they are great believers in it; but for the most part they are located on light, sandy soil, where it does not overgrow.

QUESTION. Is there any way to make the Williams fit to eat, and not woody and full of brown chunks? We have tried spraying with different formulas, but it may be that the tree will not bear good fruit.

Professor SEARS. I usually find the trouble is with the man, and not with the tree. Usually, if the tree is properly fertilized and sprayed, say with arsenate of lead and Bordeaux mixture, it will do well. We have given up the Bordeaux mixture at the college, because we found, on such varieties as the Mackintosh Red and the Wealthy, and even the old Ben Davis, that the apples rusted when we used Bordeaux; and we intend to use lime and sulphur, or something of that sort.

The CHAIRMAN. We would like to hear from Professor Rane.

Prof. F. WM. RANE. I have been exceedingly interested in this subject to-night, because it brings me right back where I used to be. This question of varieties is one of the biggest I ever tackled. I have done a great deal of work making out lists for other people, and I do not feel any surer about it to-night than I ever did. There are so many varieties of apples, and they all have their good points. The flavor of the Baldwin never appealed to me, and I have tried to find something to take its place, but the more I looked into it the more I got back to the old Baldwin. The Northern Spy is another that I think a great deal of. People ask what varieties of forest trees to plant. We plant the white pine, because it is easily grown. They ask what is to be the more valuable in the future. We do not know. But the Baldwin is always pretty sure to win. It is the biggest money-producer we have had, with no care whatsoever. Some towns put in 5,000 barrels of Baldwins every other year, that have not been sprayed, fertilized or taken any care of. That shows what they will do without care. We have sometimes found, in spraying as a preventive against the gypsy moth, that one or two trees that were sprayed would produce more fruit than the rest of the orchard. Some good varieties have not been mentioned this evening. There is the Porter, grown on every farm. It has the railroad worm, and so on, but spray it a little, and there is no trouble in selling it. We should get authority from the Legislature to make owners look after their old trees, or cut them down. Take the Baldwin on the old stone wall, fertilize one side, and you will have beautiful Baldwins for a few years, until the grass takes the nourishment from it. I was out west this summer in the apple country, and the conditions they have to contend with and the places they have to live in are terrible. In an automobile you have to keep your hands over your eyes to prevent them being filled with dust. But there is a market for all the apples grown, enough for each of us to get our share. Nearly all the varieties mentioned to-night, together with several others, are certainly, with proper care, very profitable indeed.

The CHAIRMAN. We all know that early apples are usually annual bearers, and I want to ask if this is not because the crop comes off so early that the tree has a chance to recuperate? Also, if by thinning the later varieties so that they would not bear so heavily we could throw them into annual bearers?

Professor SEARS. I do not know about that first theory; I never heard it advanced, but it certainly seems reasonable. As to the second, the tendency in thinning any kind of fruit is to make it bear the next year; if you reduce the crop one year, you increase the crop the next year. Any of our crops that pretend to be annual bearers will run lighter and heavier, like the biennial bearers.

Professor RANE. I tried some experiments in New Hampshire on that line, and they were very unsatisfactory. We took young, fruitful trees, about fifteen years of age, and picked off all the fruit when small one year. The next year they came into active bearing, but the following year we had a frost when the trees were in bloom, and there they were right back in the same year.

The CHAIRMAN. I think if the experiment were tried with trees when they first began to bear, you might have better success.

Prof. Wm. P. Brooks. I know a man who had a large orchard of Baldwins that had been neglected, and none of them bore. He plowed and cultivated half the orchard one year, and the following year it bore heavily. That year he did the same with the other half, and the result was that he had half his orchard bearing one year and half the next. As he had about 40 acres, he regarded this as an advantage, as he could handle half so much easier than the whole. That went on for a few years, but then from some natural cause, either a frost or a very rainy season while the trees were in bloom, he got very few apples, and the next year they were all in bearing together, so it does not seem to be a very easy thing to manage. I want to ask Professor Sears if he thinks that by giving the Baldwin much better care than it ordinarily receives, careful fertilization and tillage, you can make it bear considerably more apples every year?

Professor Sears. The tendency would be that way, and also to get a better apple.

The Chairman. I came across an orchard that had for years been bearing on one side of the trees in one year and on the other side the next. Perhaps some condition destroyed the bloom that way one year; but it seems like a pretty good way to have an orchard bear.

Mr. Drake. I have seen trees where only one limb would bear, but it is a pretty hard matter to explain or secure.

Professor Brooks. Some of us have noticed that Professor Sears did not mention the Sweetheart. Doesn't he think some families would like sweet apples back?

Professor Sears. I shall plant 100 Pearmains next year. I came across an excellent orchard, where they were shipping the Yellow Transparent to England. The apples were shipped in crates, ten of which made a barrel, and brought $12 per barrel in that way. It seems as though we would find a ready market for these early varieties in England, as there are no apples there. It seems to me that there is a tremendous market abroad in the summer for apples grown in the northern United States. I know of no variety better adapted to that than the Williams; it will carry splendidly if picked early, and is a splendid-colored apple when picked in its season.

Secretary Ellsworth. There is one variety Professor Sears recommended very highly, — the Roxbury Russet. I have quite a number of trees, and I think I have got the least out of the Roxbury Russet of any variety I grow, and they are the last variety I should think of setting out. I think that since we have had the improved storage facilities there is less demand for them.

Professor Sears. Of course there is considerable in that. Still, my experience has been that any good apple you have along the last of March and first of April will bring you a good price. There are few apples that rank ahead of the Roxbury Russet for shipping.

Mr. ——. The German people are very fond of Russets. I have handled quite a few, and have no trouble in selling Russets in Philadelphia; can sell a whole carload even early in the season.

The Chairman. The Chicago market will take any number of Bellflowers, and pay a good price for them. I know a man in Maine who grows the Bellflower almost entirely, selling them wholly in Chicago, and last year he realized better than $5 a barrel for them. There are varieties that we have to ship to different places. In western Massachusetts apples seem to grow as naturally as weeds, and the people there, instead of planting orchards and cultivating them, go out into the pasture and graft these natural seedlings, and get splendid apples from them. We would like to have Mr. Gerrett of Greenfield tell us something about that.

Mr. Frank Gerrett. We were pleasantly disappointed in our section this year; we had a much better crop than we expected, and received much higher prices. I hope Professor Sears will have good success with the early varieties he is setting out; but I live in a town of 10,000 people, and early varieties are simply a nuisance with us. We give them away to any one who wants them; the stores will not take them, even hand-picked from the tree, and half of them go to waste. There are years that you cannot sell them in Boston for enough to pay the freight. Perhaps nearer the Boston market the conditions may be different. We have about thirty varieties. The Baldwin was in great demand this year; they took everything we had, and paid us the price. Some years they will not take them at all unless you have remarkably nice Baldwins, or one or two other varieties to go with them. With Baldwins selling at $2 a barrel, they will beat the Russet to death selling at $4 a barrel. My best trees are in my pasture, seedlings that came up themselves. Last spring I staked out about 150 trees that had come up in the pasture, driving a stake and taking a piece of poultry wire and putting it around the trees, to keep the cows away. As soon as they get big enough, we will graft them, and they will yield in a very short time. Mr. John Anderson of Shelburne has an orchard scattered around his farm, and he had three trees this year that yielded him 30 barrels of apples, which he sold for $2.50 a barrel. A vast amount of money came into our little town this year from this source. They took every Baldwin, and they brought from $2.50 to $3.25 per barrel, depending on how they were packed. We had buyers from Illinois, Rhode Island, Philadelphia, New York and many other places.

Our apples were not colored quite as well as usual this year. We began picking on the first of October, and then we had no frost to take off the leaves. If we had known what the conditions were to be, we might have waited two weeks longer, and then the apples probably would have had a better color. We had another condition this year; the apples didn't drop at all, but stayed on the trees. Even cider apples sold for 35 cents a hundred, and you would be surprised to see the amount of money the farmers got for cider apples. If you see an apple tree coming up on your farm, stake it up and graft it; it will be better than any tree you can buy. I suppose there are some conditions under which the Northern Spy can be grown, but not with us. I am grafting all my Spy trees over, as fast as I can. We cannot grow the Bellflower, either.

But the apple business is a good business; at $2.50 a barrel they are a good side issue to ordinary farming. We have a man who takes charge of the packing and assumes all the responsibility, we furnishing all the rest of the help. The buyers all come into our section for the Baldwins. Other kinds grow well, and we like to have them, but it is a question with me whether we can grow anything to beat the Baldwin. Other kinds are desirable for home use and for show purposes, but not to grow extensively for market.

Mr. S. H. Reed. Does it make any difference in the flavor of fruit, what stock it is grafted on?

Professor Sears. We do not know; the whole question is yet to be worked out. There have been cases where it seemed to be pretty definitely shown that there was a decided difference in color. A friend of mine set out a dozen Baldwin trees. The first to come into bearing bore a very handsome red apple, small, but very fine. All the others came into bearing except one, which was the last of all, and that finally bore an apple very large and overgrown, with very little color. He let suckers grow from both those trees, and the first one made a short-jointed, dark growth, with leaves and bark dark, and the leaves fell off long before frost; those of the tree bearing the large apples made a green, rank growth, the leaves being bright green, and hanging on until killed by frost. I remember a row of grafted Gravensteins. One was an old Spitzenberg, a dark-red apple of medium size, but the Gravensteins which grew on it were perfectly red all over, like the Baldwin, — no spotting at all; those that grew on the other trees were normal Gravensteins. Now, in these instances the color was evidently influenced, but I cannot say as to quality.

The Chairman. One point that has not been touched on is the selecting of strains of different varieties. We know perfectly well that in flowers, carnations, for instance, we can improve the variety by selecting the best types. I think the same thing can be done with apples, and in fact I know of such a strain of Baldwin apples. I think a great deal of work can be done by individuals along this line.

Professor Sears. These questions have been handed in on paper: first, "What three peaches are best for a commercial orchard?" Mr. Chairman, will you answer that?

The Chairman. I would choose the Greensboro, the Carmen and the Elberta.

Mr. ——. I would add the Belle of Georgia and the Champion.

Professor SEARS. The next question is: "What is the best cure for the scale?" We have been fighting the scale at the college in various ways, having one orchard we keep for experiment purposes. We have sprayed with lime and sulphur, and have succeeded in keeping the scale down fairly well. This year we started to wipe out the scale in the experiment orchard. Every tree was cleaned and scraped, and then we sprayed with one of the soluble oils, and we are going to spray next spring with lime and sulphur, and I think we shall clean it out. I think that is the treatment, — either the lime and sulphur, or the soluble oils.

The third question is: "In setting out a large block of Baldwins, is it necessary to set others to alternate?" I should answer Yes. Almost any fruit will bear better, and certainly all fruit will be better, if given an opportunity for cross-pollination. In strawberries even the perfect flower will bear a good deal better if you have it crossed, balanced with some other variety; and that certainly holds good with tree fruits.

SECOND DAY.

Secretary ELLSWORTH. It is my pleasure to introduce, as the presiding officer this morning, Mr. John L. Smith of Barre, who represents the Worcester County West Agricultural Society on the Board.

The CHAIRMAN. Ladies and gentlemen, the subject before you this morning is one of great importance to every man, woman and child in Massachusetts. I have the pleasure of introducing to you a speaker who says that he has come to visit with you, not to lecture to you, — Prof. H. E. Cook of Canton, N. Y.

EDUCATION OF THE DAIRYMAN AND THE DAIRY COW.

BY PROF. H. E. COOK, DEAN AND PROFESSOR OF ANIMAL HUSBANDRY OF ST. LAWRENCE UNIVERSITY, CANTON, N. Y.

I had a plan laid out for this address, but I am going to change it. I wished to discuss with you at considerable length the organization side of our dairy business, but Dean Davenport yesterday gave a very important lecture on that line. I never heard a better address on the organization of the farm business. It is my opinion that on this the future success of agriculture depends, the fundamental principles set forth in his address, and I wish that you could have all heard it.

Just a word about dairy organization. I think it is the most poorly organized business that I know anything about in this country, and it is safe to say that most milkmen will agree with me. I speak from the standpoint of the milk producer. When I was eighteen years old I commenced making butter and cheese, and for twelve years I did not go outside a cheese factory or creamery except to take some part in the management of a farm. I have been interested in cows ever since, and I think I know something about the hard side of the dairy business.

Most men will agree that if all the expenses incident to the production of milk were charged against the business, — all expenses of labor, interest on the investment, cows and food, and losses in the dairy, no inconsiderable item, — nine dairies out of ten would be found insolvent. There is a reason for this, which I wish to discuss for a few minutes, and my opinion is the result of a great deal of study and care. The soils of the country, with a few exceptions, have become impoverished by continuous use without fertilization, so that men have gone into the dairy business, as in Wisconsin, for instance, as a means of securing the necessary plant food for their soils. They have followed the dairy business because they needed manure first, and have made that the essential product, with the milk second. Does not that answer the question of why milk will not pay the cost of production? By-products have no relation whatever to the cost of the raw material that goes into them; by-products have no relation in their selling value to the raw material that goes into them. There was a time when wheat bran had no value, and was run into the rivers to get rid of it; and you can all remember when cotton-seed meal had little or no value, and was piled by thousands of tons behind the cotton gins of the south. Now you pay $28 a ton for wheat bran and $35 a ton for cotton-seed meal. More recently distillers' wastes had no value except for feeding immediately around the plant where they were produced; and to-day you pay $32 a ton for dried distillers' grains. The price of wheat and cotton and the price of corn and rye, from which the distillers' grains come, have not changed a great deal since the '60s and '70s. You buy a pound of digestible matter in all these by-products, and you pay the same price for it, whatever it is, — and a high price, because the genius and ability of man have given those by-products a standard and fixed value, where formerly they were waste. I am not going to discuss the feeding of these by-products in dairying; I am simply using this as an illustration of the reason for the comparatively low value of milk, because it has been a by-product, and bears little or no relation to the cost of production.

Have you ever thought it out in that way? I ask you whether this is not the solution of the question why the dairymen all over the land are not getting paid for their labor? The great bulk of the milk produced is produced by the family, — it is a family business, and no account is made of the labor; there are a few exceptions where it is produced entirely by hired labor. Whatever may be your thought as to the economics of milk production, whatever may be your skill and ability to act, if ninety-nine men around you are working on the old basis, with no regard to the cost of production, they will fix the price, and will hold the dairy business where it interferes with the profits of the man who understands and has the finest organization possible for the production of milk.

Perhaps this does not picture the dairy business as radiantly as you would like to have it pictured. As Dean Davenport said yesterday, the business of the Illinois Dairymen's Association has been to get men into the dairy business. That is all right if you want manure, but it is all wrong if you want milk. The result has been that we have cheap cows and cheaper men all over the country producing milk for butter and cheese and for the market; because, when you put a pound of cotton-seed meal through a $30 cow, the manure is worth just as much as when it is dropped by a cow worth $300. The result has been that the whole milk business, from Maine to the Pacific coast and from north to south, has been a cheap, perverted business. There has been too much manure attached to the milk business all the way through, from the economics to the milk pail. In New York men have rebelled almost to the point of the shotgun against taking the manure off the flanks of their cows; and I presume there are just such men in Massachusetts.

The next thing is a panacea for this trouble. It is a slow process to work anything out. First, in my opinion, is the study of the individuality of the cow. A good deal of time has been spent in an effort to control the price of milk shipped into the cities. Most of that time has been wasted. If it has shown any sort of fruition anywhere, it is in the business of shipping milk to Boston. In New York it was an absolute failure. It built milk stations and sent trains into every nook and corner of the State to get milk for New York City. I have taken this ground for a dozen years in my State, and have been mangled and pummeled and punished for it. The organization that tried to control the price of milk shipped into New York is gone, — dead and buried. Peace to its ashes! It was organized on the wrong basis; most of the men who composed it had never been able to organize their own business. The man who cannot manage the business within his grasp will never be able to handle a business 300 miles away, with sharp, shrewd, keen men to deal with on the other side. We may succeed in smashing the milk trusts, if we have them established contrary to law, and in making them change their methods and let us understand something of their work; but so far as organizing the country people to control the price of milk shipped to the cities is concerned, we shall not be able to do it until we get our own business in our own stables under our control. And that takes us right down to the individual cow.

A great many of us do not like to think that we must study the individuality of each cow as thoroughly as the head of a large department store studies the individuality of each department. A friend of mine, who has charge of one of those large department stores, once said to me: "Each department in this business has to stand on its own feet; the grocery department has to pay its own expenses, and the dry goods department the same, and so on." "Well," said I, "you ought to go into the dairy business; we do not have that trouble; we put the brindle cow, the white cow, the black cow, the Jersey, the Holstein, and the Shorthorn, into a stable, and we say, 'Here you are; God bless you, give milk!'" This friend said: "That is so; I do not understand it, but the dairy business will stand what no other business will stand."

We have been able to carry on business in that way because we took no account of our labor. The husband, wife and children all put in their time, and no charge was made for it. In looking for students for our school at Canton I have had young men tell me that they could not afford the necessary $150 or $200 a year for expenses. I have told them that they could earn enough in the same length of time on any farm to pay their expenses at the school, and they have said that they worked for their fathers, and got no money for it. Here was a business organized so that it was dependent on the family working for nothing to support it, for most of these young men were on dairy farms. Any remedy for this condition must come by slow, steady stages.

If we are to study the individuality of the dairy cow, we must have in every stable a weighing sheet, and know just what each cow does. I found that method had more to do with developing good hired men than anything I have ever done. One man in particular made a good deal of fun of weighing every cow's milk; but he had to do it or quit, and he had sense enough to know that he had better stay. That man developed into one of the best men I ever had. He began to study, and see the difference between two cows, one giving a pailful weighing 18 pounds and another 24 or 26 pounds. Then he went further, and saw the difference in cows in regard to their milk, one milking fast and one slow, and he developed into a very fine man. He is now taking charge of one of my farms. Through this weighing we learned of two grade cows of quite ordinary ancestry, one of which made a record in two successive years of over 43,000 pounds of milk, and the other a record for maximum daily yield of 93¼ pounds. The ability of the cows to do this was very largely the result of the training which they had; and their training was very largely due to the fact that the man who had immediate charge of feeding them got his first education in being forced to weigh the milk from individual cows.

To take up another question, another trouble with our dairy business is that we are buying too much. When we began purchasing enormous quantities of foods and grains, they were very cheap. With the high price of labor and our small families, and the difficulty of hiring labor, we began of necessity to buy. Now it is entirely different, — $35 for what you can carry home in your buggy is an awful problem. By buying these foods we are keeping down the crop-producing power of our dairy lands. The cheapest lands in the east, when we consider the lands that have care and attention, are the dairy lands. The trucking lands of the State of New York had an average value in 1899 of over $100; the dairy lands had an average value of $40. I can take you to lands that are renting for more money every year than the average dairy farm will sell for, live stock thrown in, and including the farmer. While the dairy farms have made manure their first and essential value, they have not kept pace in productivity with the trucking farms, where they have to buy all their manure from the cities. The truck farmer had to learn how to till and fertilize, or he could not exist. The dairyman is a poor tiller of the soil. We are spending enormous amounts of money; the farmers of the county of St. Lawrence, where I live, last year spent over $1,000,000 for cattle foods. When I wanted the granges in that section to send $5 apiece as a part of an organization movement to further the business in its every detail in northern New York, they said they were too poor; and yet those men are even shipping alfalfa hay from Colorado. We must stop buying so much.

I think there are two methods of escape, depending upon the individual. One is the production on the farm of everything which the cow eats; that will be the method for one class of men. Another, and the way that works best with me, is the production of some crop of such high value per acre that it will help to purchase some of the better and more valuable concentrates with which to feed, and so increase the production of milk. But what do both methods mean? Better soil care, higher crop production, better tillage.

A few weeks ago I had a tillage plow shipped to me at the college, which proved to me how poor our methods are. It turned up 15 inches of as fine, loose soil as you would wish.

I do not wish to discuss the machine at present, for we have not yet attained results. We harvested 400 bushels of potatoes to the acre this year, but our methods were out of date. We ought to take a lesson from the Germans; they get 500 to 600 bushels of potatoes to the acre, because they till the soil. The dairyman must learn this, and it matters little whether he learns it by growing crops especially adapted for the production of milk, or by growing other crops. Alfalfa is one of the best crops for milk production, and it is not at all a climatic proposition. It can be grown as well in Massachusetts as in the west or south, except that the warmer the season the better the opportunity is for a large crop; but it is a soil question, and you and I must study soil questions.

Just a word of caution: the fruit men and truck farmers are getting more money than the dairymen, and on higher-priced land. The only reason for one class of agricultural industry making more profit than another is that the individuals back of the business are better organized, and do their work better. Go where you will, the people are talking apples, and about the Hood River Valley organization. In my opinion, if the business would put the same organized ability, care and skill into dairying, we should find in a decade or two that it would offer just as great opportunities as the apple business, because it is necessary to have milk, and it is not necessary to have apples. Set apple trees, but set the right sort of cows, also.

Now, to go back to the method of growing oats, and peas, and alfalfa, and other crops of that sort, and taking the cows off the pasture system. I wish that pasturing could be banished from the earth; it just means that we expect to get something, and do not get it. I wish every man who depends on pasturing would next year fence off a square rod in his pasture, where the best feed grows, and then watch to see how much feed grows in that pasture. If it is anything like our pastures, you would wonder what the cow eats to make milk of. The pastures in the east as a whole have gone, in my opinion, never to return. I doubt whether we shall ever be able to establish pastures like those of England, because of our climate. We certainly shall not so long as cows are permitted to graze the pastures until there is nothing left; for that means the production of a plant that will stand that kind of grazing, and the plants that will stand it are the ones that have a very small, meager growth. I tried the experiment of fencing off a plot in the pasture, and it changed my method. I thought there was a good deal growing there, but the cows did not, and they were right.

What shall we do to make our lands better worth while? We are saving our stable manure, and taking care of it quite well. I think the best method is to get it right into the field, for I would rather trust nature than most men. The only way that we can supplement this in the east, as I believe, is by the intelligent use of chemicals. I bought 150 tons of chemicals for the neighbors about our school last year, and only two came back with any complaint. They had been buying mixed goods before, because they were cheaper per ton; but they were so poor in quality and so high priced that they had been fertilizing with money instead of fertilizers.

No man can afford — certainly no dairyman — to buy a single ounce of organic nitrogen, because you all have any amount of it on your farms now. Through poor tillage, you have failed to make it available. The roots of quack grass, or witch grass, make one of the best fertilizers you can have. They contain a large amount of organic matter and nitrogen, and a pound of that nitrogen is worth as much as a pound of cotton-seed or dried blood or bone. You can kill the grass and put the nitrogen into circulation in the soil with one-tenth the money it takes to buy nitrogen. The way to do it is to plow the witch grass in in September, turning up 6 or 7 inches, — not more than that. Take a field on which you wish to plant something about the first of June. Cultivate it immediately after plowing, using a disk harrow, and thoroughly cutting up the grass and roots. If your ordinary harrow will not do it, load it down until it will. Follow it up from time to time through the fall and early spring, often enough so that no green stuff shows above the ground. That treatment will kill any plant. The roots are in a condition of semi-coma; and when a fellow is going down hill, it is easier to kick him a little farther than when he is going up hill. Then plow again in the spring, going a little deeper than before, about 8 or 10 inches. If you have done the work well, you will not have more than 2 or 3 inches of sod left, and by plowing in that way you will turn the sod in between two films of nicely pulverized dirt, and with ordinary cultivation and treatment that will all disappear. Why buy dried blood and cotton-seed meal, when we have so much valuable material right there?

One thing which I wanted to say I have not had an opportunity to say as yet. My subject is "Education of the dairyman and the dairy cow." Up to the present time we have been educating the dairyman, and there is not much use in trying to educate the dairy cow until we have educated the dairyman. Every man's cow, sooner or later, will be just about what his ideal of a cow is. If a man buys cows with a capacity of 500 pounds of butter, and his capacity is 150 pounds of butter, those cows are as sure to land within a short time on a 150-pound basis as the sun is to shine, the grass to grow or the water to run. That is why I spent so much time on the first part of the case.

Now for the latter part. In order to obtain the best results, we should raise our cows. For a certain average production, I believe we can buy cows cheaper than we can raise them. If we wish to get 5,000 or 6,000 pounds of milk, averaging 3½ per cent butter fat, we can buy cows cheaper than we can raise them; but if we wish larger results, the 10,000-pound cows, — and that is what we ought to have, —we must know what their ancestry is, we must breed them and feed them and develop them. One critical time in the development of our dairy cows is the feeding, after they are a year and a half old, until they have passed through one year of milk. It is just the time when we are fixing the habit of the cow. We want this milk machinery developed and enlarged; we want it to be ideal. Develop her digestive ability, see that it is strong, and then develop a milk-producing function in that animal, so that she will take her food and deposit it in the milk pail instead of on the manure pile. You cannot do this in a minute. You cannot take a cow that has been educated for the first three or four years on other lines, and by any means, after that, make her what she would have been if you could have had her at the outset. We all understand that, but not all of us practice it.

If there is a time in the life of the individual mother when she needs the best care and full feed, it is when she calves for the first time. Just what that full feed is to be depends on the individual cow with which you are dealing, and must be worked out individually. Generally in dairy sections the practice is to feed light at that time, because it is thought that if the animal has full feed she will have caked udder and all sorts of trouble. If we feed her properly, she will have nothing of the sort. We should give the heifer at that time just the ration she will need as a milk producer. There are a great many combinations, and we could discuss them for a long time and not get anywhere. Some cows need a wider ration than others; you must adapt the ration to the individual. Why should not the animal have full feed? She is developing her own body — or would, if she had enough to eat — faster than at any time in her life after babyhood. Probably it would be a good thing if she did not come in until two and a half years old, and had a little more time to develop; but when nature steps in to freshen for the first time, and says, "Here is a great task; you must not only go through the ordeal, but you must give milk," the animal is developing faster than at any other time. That is when she needs her food, and just the same food that she would need if she were giving milk, only not quite so much. Balance the ration a little more carefully than you would when she is giving milk. This danger of caked udder is an old tradition. Of course if you feed an unbalanced ration you will be likely to have trouble with the udder when the heifer freshens. That is because the food and care are not such as to produce milk; when she has a quantity of milk she will have no trouble. That is the business of the heifer, of her udder and of every function of her body; it isn't to cake and swell, — that is due to lack of care on the part of her owner.

Ten days or two weeks before the heifer freshens, be careful; do for that heifer mother just what you would do for the human mother; diet at that time; have energy, vitality, and enough fat on the body two weeks before she freshens so that you can diet her for two weeks and she will still have enough vitality to go through that trying ordeal. That is the way to avoid caked udders and retention of the afterbirth, and all those kindred troubles which injure the animal for that year. She cannot get back to where she originally was, if she has any of those troubles at parturition.

Now feed her light for the next four weeks. I do not like the Holstein scheme of testing cows within two weeks after they freshen. That is the time they will make the most milk, but I believe it is fundamentally and constitutionally wrong. We put enough fat onto the animal prior to her calving so that we can let her shrink for a month. The man who has allowed his heifer to calve when she is poor, is forced to feed her to save her life, and trouble frequently follows. She ought not to be returned to her full feed until she has been in milk a month.

I want to give my remedy for almost everything, at parturition or at any other time, — it is hot water. I would rather have a teacupful of hot water than the contents of all the drug stores. I am against all kinds of patent medicines; if you want to take them, it is all right, you will soon pass on; but I beg of you, do not feed those things to your cows. You wouldn't try to clean a clogged sewer with quinine and whiskey; and the inside of a man's body, or a cow's, as I see it, is a sewer. Flush it out with hot water; give the cow all the hot water she wants, and she will drink it, and wash the poisons out of her body.

Also, have a clinical thermometer, and anticipate trouble by determining her temperature. If it goes up to 102° or 103° in the morning, look out, for there is something the matter. Use hot water and blankets. We blanket our horse when there is anything the matter with him, and turn our cow out of doors. The temperature may be as high as that in the afternoon, of course, and not be serious. A woolen blanket and a teakettleful of hot water, repeated if she will take it, constitute all the medicine, outside of being well cared for, that a well-organized dairy institution needs. If the cow is normal — and I am speaking of the period at parturition — she has acquired a thirst, and she will drink the hot water; she would rather have it than four quarts of oats, to start the afterbirth. There is only one animal that can stand really cold water, and that is a man with a strong heart action. He can drink ice water, and seems to live and thrive. With any other animal it reduces the temperature and stops secretion. Any secretion organ is in danger when cold water or cold applications are applied. For a severe case of stoppage, if you have a veterinarian at hand, or the individual skill, I would not stop with the hot water; but with this method of feeding and treatment that danger is reduced to such a small factor that it is not worth reckoning. It is part of our law of breeding to get into trouble, and then find something to get us out quickly. We might well study the Japanese, — they hire doctors to keep them well. A strong, muscular, vigorous cow may be able, just as soon as she is normal, to take cold water, say about 40° or 45°; it ought not to go below that. If a cow of a different make takes it, it might bring on trouble the very first thing. We have not sufficiently studied the individuality of the cow. It enters into her ability to digest and make milk, and into her every movement. These $30 cows do not offer very much for a $200 man to spend his skill on, but I think they are better to experiment on; certainly better than to put a $30 man at work on a $200 cow.

There is not much danger from cold water before parturition, as there is a tendency to fever and a high temperature; I think the danger will be limited to a month before that time. After parturition you have an entirely different condition, with a tendency to a temperature below normal. The cow has spent her strength, and is weak, and suddenly the blood flow is changed from the uterus to the udder; and then some one comes along with a shovelful of feed. They do not want to make blood then; they want to do the things that will not make it.

QUESTION. Would you ever milk before parturition?

Professor COOK. If there is any tendency to inflammation or gargeting, I would milk, but not if the bag is normal. If there is a tendency to deposit poisonous matter in the udder, you must get rid of it as quickly as you can. I think the practice is to be condemned, unless absolutely necessary.

QUESTION. Is it not sometimes possible to have a cow that you cannot dry up?

Professor COOK. Yes. Do not ask that animal to freshen every twelve months. Just carry her period of service over from one to six months, and nature will restore that animal, dry up her milk-giving organs, and she will have a chance to go dry for a month or two. It means the salvation of many a highly organized, highly bred dairy cow. If you want continuity of milk, do not give full feed under a month. A cow should give her full flow for six or eight months. Of course after you have educated your cow to come in in the spring and go out to pasture and give a lot of milk for a month, and then gradually dry off until you can milk six in one pail, simply because they have nothing to eat, they will not do that after a while; but if normal, they should give a full flow for six months.

I want to thank the audience for its very kind attention.

We have all been goodnatured, but I hope not at the expense of some serious consideration of this dairy question. I tried at the outset to deal with some things that I believe are fundamental to our success. We have discussed some of those fundamental questions, and a body like this, strong men, strong in body and strong in mind, ought to give at least some of their energy in the direction of some of these fundamental questions that enter our business.

QUESTION. What kind of feed would you suggest after parturition?

Professor COOK. I dislike to discuss the food question without a good deal of time. If we have clover hay, I would not put a pound of wheat bran into a ration,—it is not needed; the phosphoric material will be good for the cows, if you have not clover hay, though you will pay more for it. A good mixture would be something like this: 200 pounds of gluten or distillers' grains; 200 pounds of corn meal, which is always safe in a ration, as 90 per cent of it is digestible; 50 pounds of cotton-seed; 50 pounds of linseed; and 100 pounds of white wheat middlings.

QUESTION. Is that what is called red dog flour?

Professor COOK. No; that is a good feed, but is usually pretty expensive.

QUESTION. What do you think of molasses?

Professor COOK. Molasses is all right in its place, but molasses feeds should be put in the same list with patent medicines.

QUESTION. If you have no clover hay, would it not be better to buy it, rather than to put in the bran?

Professor COOK. Ordinarily, it would, providing the clover hay had been well cured and was in good condition.

QUESTION. You advise feeding all she will eat of clover hay?

Professor COOK. Yes; if her other feeds have been proportionally related, there will be no danger in giving what she will eat. If they have not been, and the cow attempts to get the amount she ought to have, she will probably have indigestion.

The CHAIRMAN. We have received a very instructive and interesting lecture. The lecturer has not told us all he knows, but he certainly ought to have a little rest. We have with us some large dairymen from whom I know you would like to hear. We would like to hear from Mr. Ellis of Newton.

Mr. George H. Ellis. I am in perfect agreement with nearly all that Professor Cook has said. But there are two or three "don'ts" which I want to interject. In the first place, on the ordinary New England farm don't buy nitrogen by cultivating witch grass; your nitrogen will cost you a great deal more than if you buy it. What crop is the dairyman going to raise with us that he doesn't put in until after the first of June? You must figure in your crops the cost of labor in cleaning out the witch grass, if you have it. Of course if you have it you should get rid of it. But I do not think you get enough out of your witch grass roots to pay you for your time and trouble, although the more cultivation you put in to kill the witch grass, the better the following crop will be.

I am more of a believer in pastures on our New England farms than is the speaker, — perhaps from necessity. Most of us have a good deal of land we cannot cultivate, and it is worth more in pasture than to let it grow up to wood. The test which the speaker offered is not a fair one. You get a great deal more out of the grass to have it fed over several times than when you allow it to make the full growth it will. Change your cattle from pasture to pasture, having three pastures, and allowing each two weeks' rest between grazings, and you will find that the amount of grass you have grown is immeasurably beyond that which the test offered by the speaker would indicate.

With what he has said as to milk being a by-product I have good reason to be in full accord. I started to manufacture milk, not manure, and undertook to retail a high grade of milk at 8 cents a quart. To be sure, a high grade costs more to produce than the ordinary milk; but I found it absolutely necessary to go to 9 cents, 10 cents and 11 cents per quart; and my profit in 1908, on $75,000 of sales, was $36. I shall do somewhat better this year. My home farm is in the center of a city, and my cattle are fed at the barns the year around. My hay is purchased hay, and that makes it cost me very much more than it costs the ordinary farmer. But I believe that the farmer should receive at least 5 cents a quart for milk, if he is to make a living profit. Whenever there is a question of raising the price of milk to the consumers, a howl goes up and monopoly is cried. The raise doesn't amount to anything to the consumers, — 30 to 60 cents a month is not much to them. The Boston Chamber of Commerce is taking an interest in New England as a whole, and one of the next moves of its committee on agriculture will be, I believe, to try to convince the people of Boston, through the newspapers, that they must pay a higher price for milk. The regulations governing the production of milk are not too strict, and should be lived up to; but the consumer, and not the producer, should pay the cost. It is bad for New England to force a part of her people to live under such conditions that they cannot educate their children or live properly themselves. The labor unions claim that the laboring men and their families are entitled to better conditions, and that is absolutely right; but these same people come up and say, "The farmers are robbing us, and it is a sin and a shame."

The Chairman. We should like to hear from Mr. Potter.

Mr. Burton W. Potter. It occurred to me, as Professor Cook was talking, that possibly we could accomplish the same result by weighing our milk three times a month and averaging the results, as suggested by Professor Hills of Vermont. This is an approximation, but accurate enough to accomplish the purpose of showing us whether our cows are profitable or unprofitable; and if we can establish substantially the same thing with nine times less labor, it seems to me it will be worth while to save that labor. In regard to witch grass, I have discovered by accident how to kill witch grass; you know all great discoveries are made by accident. It never occurred to me that witch grass was an asset; if it is, my farm is worth a good deal more than I thought. I planted potatoes on a field where there was a good deal of witch grass. It was soon evident that the potatoes would cost three or four times what they would bring, if we fought that witch grass; so I plowed them under, witch grass and all, and sowed Japanese barnyard millet. The result was that the witch grass disappeared, and I presume it would frequently result in that way.

On the question of pasturage I am with Professor Cook, against Mr. Ellis; but I am not with Professor Cook on the theory that it has disappeared for good. I found out how little actual growth there was in pastures by mowing a pasture on a deserted farm which I secured a few years ago. When Mr. Ellis thinks by taking the top off three or four times he is getting twice as much as if he let it grow, he is much mistaken.

Mr. Ellis. Did you ever try leaving a lawn, that was usually cut twenty different times a season, each time a couple of inches?

Mr. Potter. I do not believe if you tried it and weighed it that you would get any more than if you left it until ripe and then weighed it. We think our cattle are getting a good deal, but it is not there. You cannot get something out of nothing. But I do not believe it is time to give up our pastures. We must fertilize that land. Some of our pastures have not had a particle of new seed or manure for a hundred years, and this is a system of robbery. We must put some of our fertilizer on our pastures. If we plow our pastures where they are smooth enough, and harrow and fertilize, we shall soon have some feed that is worth while, and that will help amazingly in getting milk cheaply.

Mr. Dodge. I am connected with the United States Department of Agriculture, and one of our men has been giving his time for a good many years to the study of grazing property. He has worked in the west and the central States, but is now and will be for some time to come studying the question of grazing in the eastern States. He believes that the most serious difficulty is from overgrazing, both by too heavy a stock per acre and too long a season. He believes that two weeks' delay in turning the cattle out in the spring would make all the difference between good and poor pastures, as it is needed to give the grass a start. He points out that many pastures cannot be plowed. We must find some other way there, — the scratch harrow, or the use of chemicals or addition of seeds. He is trying to get in touch with as many people interested in the question as possible. Those of you who wish will have an opportunity of getting in touch with what experiment work is being carried on.

Professor Cook. The question of pasturing involves a good deal. I believe it is better to grow feeds for the soiling system, and let our cows have the pasture as well. They will clean the pastures, and take all you feed them besides. Probably Mr. Ellis may be right with some grasses. The grass that has a short growth would produce more by frequent grazing than it would to allow it to come to its full maturity; but it is so small in either case that the lesson will remain, and that is the point I wish to make. No man should undertake to change at once from the pasturing system to the soiling system, or he will find himself in trouble. After you get your cow up to the full feeding and full flow of milk under the soiling system, and suddenly turn her away from it, you will have all sorts of trouble. Where she gradually shrinks down in the pasture, the cow takes care of her body, and we don't think anything of it. But begin plowing as fast as you can. Don't try to do it all in one year, but plow up what you can conveniently and apply chemicals and get a good crop, until you have turned all the pasture you can. I want to thank you for criticizing me so little. The question of pastures I did not really discuss at all, but the problems I tried to discuss you did not criticize me on, so I think we must agree.

Afternoon Session.

Secretary Ellsworth. At the request of members of the Board of Agriculture and others, Mr. P. M. Harwood, general agent of the Massachusetts Dairy Bureau, has arranged an exhibit of butter of various grades and its imitations, together with some utensils for making clean milk. He will tell you some of the things the Dairy Bureau is doing for the dairymen of Massachusetts.

General Agent Harwood spoke for about twenty minutes, explaining the work of the Dairy Bureau. Most of the essential points in his address are covered in the annual report of the Dairy Bureau, which is printed elsewhere in this volume. At the close of the meeting the audience had an opportunity to inspect the exhibit mentioned by Secretary Ellsworth. It appeared to interest the audience, and was certainly valuable and instructive.

Secretary Ellsworth. It is now my pleasure to introduce the member of the Board from the Deerfield Valley Agricultural Society, who is also a member of the Legislature, Mr. William B. Avery, who will preside this afternoon.

Mr. Avery. Ladies and gentlemen, on your programme you see the topic for the afternoon, "Crop rotation for the dairy farm." As a rule, we save as good as we have until the last, and I think we have done so to-day. I will introduce Mr. H. O. Daniels of Middletown, Conn.

CROP ROTATION FOR THE DAIRY FARM.

BY H. O. DANIELS, MIDDLETOWN, CONN.

I feel that a great honor has been accorded me, in the opportunity to come to your meeting and talk to you to-day; and I need not say it is also a great pleasure, as you must know it is such, from my accepting the invitation. I believe it is good for men in all kinds of business to meet together at times and to study their needs; and what is true for other lines certainly is true for the agriculturists or farmers, if you please, of our States. While I am accepting your good wishes and the glad hand of fellowship, I in turn wish to extend to you the greetings and best wishes of the hundreds of dairymen and farmers of my own State, Connecticut. I feel a good deal of hesitancy in coming before you, as I realize the fact that many of you are better fitted to talk to this audience, knowing their needs, than I am; but in the hope that what I may say may help some brother over some of the rough places, I am going to tell you some of the experiences I have met and some of the problems I have solved in my work on my own dairy farm.

Mr. James J. Hill, the great railroad promoter and student of our country's needs, contends that the time is at hand when our population will call for all the agricultural products of this country for home consumption, and that in the near future we shall be obliged to import wheat, corn and other staple products, unless we practice more thorough, intensive methods of farming than we use to-day. I think in a measure this is true; and when we look back for a few years, and study our systems of growing crops, we can see where we have been very wasteful of the soil we own, in allowing tremendous losses by leaching and washing. With your permission I will try to outline a plan for conserving the soil fertility, at the same time adding to what we already have, so that when we pass our heritage to our children it will be better and more profitable than when we received it.

My plan for conducting a dairy farm is based on dairying as the principal business, raising only such vegetables, fruits, etc., as are needed for home consumption. The system can be modified to take in a cash field crop as well, if one is so situated as to have a paying market at hand. With us at Millbrook Farm we can keep busy in the production of milk, the raising of stock for our dairy, and the care of a flock of poultry. The latter branch goes well with dairying. For convenience as an illustration, we will suppose that we have a 50-acre farm, all conveniently situated near our farm buildings. In our own case I regret to say that we are not so fortunate, as some of our land is three-fourths of a mile, and some one mile, from the home farm. In nearly all farms certain fields are adapted to growing corn, rye and clover or wheat and clover, and some fields are adapted to growing only hay, on account of the water level in the soil. In this 50-acre farm we will suppose that 30 acres will grow corn, and the other 20 acres will grow only hay. Let us divide this 30 acres into three fields, or, if this not just according to the lay of the land, make four or five fields, but use the 30 acres in a series of three crops.

We will say that we are just beginning, this coming season, our system of crop rotation. If we do not care to plant all this 30 acres in corn, we can gain one year's time and make most excellent silage for the coming summer feeding by sowing a portion, say 10 acres, to oats, about April 10 to 15, sowing only 1½ to 2 bushels of seed to an acre, at the same time sowing 8 quarts of mammoth or medium red clover seed. If your soil needs lime, as most land does, broadcast one-half ton fresh ground lime to an acre, preferably a few days in advance of sowing the seed, and mix thoroughly with the soil. We tried this method on one field the past season, and had most magnificent results, the second crop of clover growing 20 to 24 inches high, and coming into full bloom. Six acres of this second-crop clover furnished sixty head of cattle all the green feed needed for a full month. The first crop of oats and clover we placed in the silo for summer feeding, and it gave excellent results. Next year we are looking for a maximum crop on this field, ready for the silo about June 1 to 10. Starting a field of clover in this way, one can get quick results, thus making the first cycle in our three-year rotation.

After we have harvested our corn by placing it in the silo,— you see I advocate the use of the silo, which we consider very essential to profitable dairying, — we harrow the corn stubble with a cutaway and spring-tooth harrow, apply one-half ton of lime, sow a bushel and a quarter of rye, and harrow it all in as early as possible, which with us is usually about the 1st of October. In the spring, early in April, if the soil is ready, we will take 10 acres of this remaining 20 where we have sown the rye, and harrow over thoroughly with a spike-tooth harrow or heavy weeder, sow 8 quarts of mammoth or medium red clover seed, and roll, after going over once more with the weeder to cover the seed. I think at this time if we use lime instead of ashes in our soil treatment, that we shall need to apply 150 to 200 pounds of muriate of potash to the acre. Clover is a lover of potash, and we must supply it in some form other than in the manure from our stables, if we wish to grow the maximum crops of clover. This treatment with the harrow may at first seem a little harsh for the rye, but it will soon recover and make a splendid growth, and the clover, if the season is right, will be ready to take possession as soon as the rye is removed. A portion of the rye we place in the silo, cut into half-inch lengths and mixed with the clover from a previous year's seeding. We find the best ensilage is made by using one-third rye and two-thirds clover, so that the balance of the rye crop can be cut for hay or left to grow for grain. With this latter practice, however, there is risk of not having a good clover growth if the season is dry, as the rye takes too much water from the soil. There is still another chance for a clover growth on that field this season, if we find the rye has killed out the clover, and that is to plow after the rye is harvested, spread 10 or 12 loads of manure to the acre, and sow 8 quarts of clover and 2 ounces of turnip seed to the acre, at any time from July 20 to August 1. A fine crop of turnips can be harvested, with the possibility of a magnificent crop of clover the next season. I think the practice of some dairymen, of cutting the rye with the reaper when in blossom, before the seed is formed, and selling all to the liveryman as straw, can be commended, as it makes a profitable cash crop, used in this way.

We are experimenting this year with wheat sown on a small portion of our fields, and if we find the spring-sown clover in this crop will come out successfully, after harvesting the wheat for grain, we shall adopt that plan, and depend on clover alone for our summer silage. The price of wheat and the need of it in poultry feeding makes this plan worthy of a trial, and we hope to make a success of it in this connection in our crop system.

We now come to the last year of our rotation system. We have one-third of our tillable area in clover, one-third in rye and clover or wheat and clover, if the latter proves successful, and the balance of our fields we need for corn. In the fall or winter, or as early in the spring as possible, we spread 10 loads of manure per acre on our clover fields, and late in April or early in May we spread 15 loads of manure per acre for the corn crop. After we have once gone over our fields with this three-year rotation, we have a clover sod to plant our corn on, and this makes an ideal soil for our corn crop. We plant about May 15, if the season is right, with Eureka or some other large-growing corn, using 12 to 14 quarts to the acre, planted with a two-row planter. We advise applying at this time 150 to 200 pounds of a high-grade fertilizer, with the planter. This starts the corn along with a rush, and makes easier the work of keeping the weeds down early in the season, before the rush of other work. After the corn is harvested we again sow with rye or wheat, using one-half ton of lime, as previously stated, and make all snug for the winter. This completes our three-year system, and we then go on the following seasons planting corn on the second-year clover sod, and so on each year until we find some better way.

If alfalfa could be grown on these tillable fields, we could extend our rotation system two or three years, and also provide the most valuable of all forage crops for our dairy herds. I think we can apply to our crop system the philosophy of Saint Paul to the Thessalonians, where he said, "Prove all things; hold fast that which is good." Let us study for a moment the possibilities this system of crop rotation offers for the dairy farm. With one-third of our land in clover, one-third in rye and clover or wheat and clover and one-third in corn, we may reasonably expect to harvest 10 tons of clover ensilage, 10 tons of rye and 25 tons of corn ensilage per acre. Basing our estimate on 30 acres of tillable land, we find that we can harvest 200 tons of rye and clover ensilage, 250 tons of corn ensilage and 10 to 20 tons of clover rowen, making 400 to 450 tons of fine ensilage and from 10 to 20 tons of hay, on our 30 acres.

A word in regard to growing our hay on the other 20 acres of hay land. We spread with the manure spreader in the fall or winter, as is most convenient, 10 loads of manure to the acre on these grass fields. Early in April we take our cutaway harrows and go over these grass fields with the harrow set at a good angle, going in half-lap lengthwise of the field, and then diagonally once or twice, until the field shows some little new dirt. Then, if the sod is getting thin, we sow 3 or 4 quarts of alsike clover seed and 1 or 2 quarts of red top, scratch it in with a sulky 10½ foot weeder, and then roll. If you have never tried this treatment for a grass sod, you will be surprised at the wonderful change which takes place. The lifting action of the cutaway harrow opens up the sod, lets the manure down to the roots of the grass, and also lets in sunlight and air and germinates this new seed. Where one or two blades of grass would grow without this treatment, five or six will now spring up; and, with the fine new grass at the bottom, a splendid fine hay is produced, which, supplemented by our ensilage, furnishes a feed through the winter and spring equal to June pasturage, keeping the dairy herd on full feed the year round.

I beg you will not consider this all theory. We are keeping as many as fifty cows through the year, twenty head of young stock during the seven winter months, and six horses all the year, on 50 acres treated in this way. Of course we have to buy grain to balance the ration. For winter feeding we find 100 pounds of wheat bran, 100 pounds of middlings and 100 pounds of cotton-seed meal make a very good, economical mixture, analyzing about 20 per cent digestible protein. By using from 6 to 10 pounds of this grain mixture for cows milking 20 to 40 pounds daily, we can keep up the milk flow economically.

Perhaps this year we shall need to look for some other form of protein, as cotton-seed meal is rather high. If we could get alfalfa to grow in place of our native grasses, we should think we had reached the ideal rotation for a dairy farm.

Let us now look for a moment at the benefits derived from this system:—

First. — After we have the system established, we have to plow but 10 of these 30 acres of tillable land each year, or one-third of our tillable area, as this system is adaptable to a greater or less acreage. We thus reduce the labor required to a minimum.

Second. — We have a good sod to run all our machinery for spreading manure, sowing potash, lime, etc.

Third. — The work is spread over nearly every month in the year, in seasonable time to do it easily.

Fourth. — The tillable fields are covered nearly all the year, thus preventing soil washing and loss of fertility.

Fifth. — The soil is constantly becoming richer in nitrogen, phosphoric acid and potash.

Sixth. — The only outlay for fertilizer is for the half-ton of lime and 150 to 200 pounds of potash used per acre on the rye and clover, costing about $6 per acre, or $60 for the 10 acres; and $3 per acre for the small amount of fertilizer used on the 10 acres in corn; making a total of about $90 per year on the 30 acres of tillable land.

If we find that it pays to use lime on our grass fields, this would cost something more, but not exceeding $10 or $12 more per year, as doubtless one-half ton per acre, used once in four years, would be found sufficient for the ordinary grass plants. In this way we can fertilize and improve our 50 acres at a cost of about $2 per acre, or $100 for the whole farm, as the large herd of cows, young stock and horses will make manure enough to cover all these fields each year.

Seventh. — There is no opportunity for weeds to go to seed and make trouble the following year in the corn field, as the two and sometimes three cuttings of rye and clover prevent that, and finally put the soil in the very best possible condition for plowing for the corn crop. With the treatment I have outlined for the grass field, I believe a good maximum crop of hay can be grown for a good many years without plowing up and reseeding, certainly for ten or more years, as we have a field at home which proves that this can be done.

These grass fields ought, and do, on our farm, to produce at least three tons of hay the first crop, and nearly a ton of rowen the second crop, if the first crop is cut early enough to give a chance for a good second crop. With this system, a 50-acre farm handled as I have outlined would produce from 400 to 450 tons of prime ensilage and 95 to 100 tons of hay each season, and grow better each succeeding year. Of course grain must be bought; but when one considers the manurial value of this purchased feed, as well as the feeding value, and makes the very best use of it by saving all the manure and applying it to the land, I believe the dairy herd, if it is well selected and bred for the purpose for which it is kept, can be made to pay.

In conclusion, allow me to say to those of you who are dairymen that I believe there has never been a time in our history when there has been so much need as at present for us to own and feed only profitable dairy cows. It becomes us to study to be true dairymen, breeding and raising our own cows, and once more covering our hill pastures with a class of cattle that will be a credit to us as breeders, and a heritage to our children worthy of their best thought and endeavor as they go forward in the path we have chosen.

QUESTION. I want to know a little about the lime question. Do you use lime for its fertilizing qualities, or its corrective qualities? Professor Clinton held that it was simply corrective, and that a great deal more importance was placed on lime than it deserved. You have put a great deal of emphasis on treating land with lime, and that is why I want you to explain more fully about it.

Mr. DANIELS. It certainly has corrective qualities, — takes the acid out of the soil, and liberates plant food which is otherwise unavailable. If I had a stomach ache, I should take something to correct it; I have found Jamaica ginger good for that. I have found that the use of lime is a cheap way to correct the ills the soil suffers from, and when it is used, those troubles do not occur. Until I know better, I am going to use lime, and attribute to its use the increased crop growth that follows.

Mr. Wm. H. Bowker. What does the lime cost, delivered at your farm, and where is your farm?

Mr. Daniels. The farm is at Middletown, Conn. Lime costs about $4.25 a ton delivered loose at our railroad station in carload lots, $2.25 per ton at the kiln, and about $2 per ton for freight charges.

Mr. Dodge. What do you consider the most satisfactory stage of development in which to have your corn when it goes into the silo?

Mr. Daniels. With Eureka corn it should make its full growth and begin to ear, and it will ordinarily do that if we plant as early as the 15th of May. Eureka corn will ear very well, but we do not allow our corn to develop the ears too much. We know the protein is a good element in making milk, but with too highly developed ears there will be less foliage. Whatever goes into the ear is taken out of the stalk. If the plant has not tried to reproduce itself by seeding, the nutrients are distributed more through the plant; and on that theory the corn is better for ensilage with small ears than with larger ones. We have it matured enough so that it is sweet, and not rank.

Mr. Williams. On grass land where you use nothing but chemicals, would you cultivate in the way you have recommended? Would it pay to go over grass land with the harrow, where it had not been treated for two or three years, and you secured a ton and a half of hay to the acre, if you had nothing to put on?

Mr. Daniels. It would pay in one way, as it would put new life into the roots; but still you must feed the soil. Mr. George M. Clark, the noted grass grower of our State, had as one of his mottoes that a plant would never die if it had anything to live for; and if we feed that plant, it is going to grow to its fullest development. The harrowing would have some effect, but not as much as if you used manure and chemicals.

One thing which I meant to tell you in regard to rotation is, that it simplifies the amount of actual labor which you have to devote to this branch of farming. You must plow these fields only once in three years. Where you plant corn continuously you must plow every year. Of course in the rotation you must plow for the corn crop, but the rest of the work is done with harrows and cultivators, and it is done at a minimum amount of strain on our farm teams. In plowing for corn, spread the manure on the sod the last of April, and let the clover grow until the first week in May, when it will perhaps be 4 or 5 inches high; then plow and harrow three or four times before you plant the corn.

QUESTION. It is claimed that there is more magnesia in some limes than in others, and that the magnesia is poisonous to plant life. Is that your experience?

Mr. DANIELS. We have recently changed from ashes to lime; but from what I can learn, any fresh-ground lime is very good stuff to buy.

QUESTION. If you could get air-slaked lime, would it be of less value than fresh-ground lime?

Mr. DANIELS. I think so; but they are usually sold out pretty well at the kilns, and do not have much on hand.

QUESTION. Do you use fertilizer on your corn?

Mr. DANIELS. This year we used on one field 200 pounds of high-grade fertilizer; and I think it an advantage, as it starts the corn rapidly, and pushes it up out of the way of the weeds and makes it easier to care for. I think there is sufficient plant food in the soil without purchasing fertilizer. Another advantage of the rotation system is, that you do not have many weeds to contend with; they are entirely destroyed by the clover, so that the land is practically free from them when the corn is planted.

QUESTION. Is not your corn too large to cut with a harvester?

Mr. DANIELS. I have seen a harvester cut corn 16 feet high. We have eliminated the corn harvester, because we believe it is more expensive than cutting by hand.

QUESTION. Have you ever had any experience with sowing soy beans with your corn for ensilage?

Mr. Daniels. We tried it once, but I do not like to grow two crops at the same time. Both growing together, neither develops to the fullest maximum growth, and it is a hard job to cut them by hand. I think a harvester would cut them all right.

Mr. S. H. Reed. Taking into account the difference in season, would you advise Eureka corn for our use for the silo? We cannot plant until May 20.

Mr. Daniels. I do not think your season is very different from ours; we expect frost about the 15th of September.

Mr. Reed. We expect it from the 6th to the 8th, — never later than the 10th.

Mr. Potter. I want to ask the lecturer why he prefers rye to wheat? My experience has been that it does not last very long, gets woody, and does not do as well as wheat.

Mr. Daniels. We are trying to introduce wheat into our system, so as to have it to feed to hens. Wheat is a new thing with us, and rye is one of the things you can almost always bank on as a staple crop. You can sow it in the fall and get good winter covering, and it is sure to do well in the spring. I understand wheat winter-kills on certain soils. If wheat will do as well as rye in the spring, I certainly advise planting it, because it is as good in the green form as rye, and if grown to maturity, so that you can have the grain for poultry and the straw for bedding, it is certainly more valuable.

Question. Do you eliminate the pasture in this system?

Mr. Daniels. Very nearly so. We let our milking herd remain in the home pasture for a month or six weeks, expecting them to get the equivalent of what we feed as hay. About the first of July we feed them hay as well as ensilage, and they remain in the pasture a little longer, going into the stable about the 1st of September and remaining there the rest of the year. The advantage of turning them into the pasture is that it keeps them in good condition. If they are confined all the time, their feet get out of shape. The young stock are turned into another pasture every day through the season.

Mr. Dodge. I think this is the most thorough exposition I have ever heard of the producing of dairy crops on the two different types of land most of us own, — one where we can grow tillage crops, and the other where we are obliged to grow hay alone. I have studied farm conditions a good deal in the last five years, and I believe the average dairy farm in New England is depending too much on the hay crop. I find that the successful dairy farmers are following a rotation plan very much like the one described by Mr. Daniels. One thing is particularly striking, — when the percentage of land kept in hay gets above 50, the number of cows that can be kept is decreased. A great many people are applying manure in too large quantities. They do not get around the farm often enough. I find one result which illustrates what I mean very well. With a rotation once in corn and once in wheat, an application of 12 tons of manure to the acre gave a return of $2.16 per ton, an application of 16 tons to the acre but $1.66 per ton, and an application of 20 tons to the acre but $1.44 per ton. The more they put on the greater was the part wasted, and the less they got back to a ton. By planting to corn and manuring heavily, and then letting the land lie for a long time without attention we have too much land in hay and a great rush of work through haying, which results in some of our hay being cut late. You will find that Mr. Daniels' hay is cut at the right time, and is sweet and full of milk-making qualities. When land is allowed to stay in hay and is not broken up often enough, it suffers unduly from drought. We are stripping the land of hay and putting nothing back.

One thing we have to contend with here is the high price of corn, and many of our farmers are meeting it by raising their own grain. One man whose methods I have investigated is making a profit of about $10 an acre on the peas and oats he grows, and about $15 an acre on his corn. I do not know what his yield of milk is, but I assume that he is making a profit on that, as well as on his grain crops, and as he should if he bought the grain. In that way he is getting two profits, whereas the man who buys his raw material — and a great many are buying too much of it — can make but one profit, no matter how good his cows may be. Professor Sanborn, one of the leading agriculturists of New England, said that it is not so important how much milk or butter we can produce per cow, as how much milk or butter we can produce per acre of New England land.

Question. Would it pay to plow our land once in three or four years, if we had plenty of dressing to apply to it, or would it be better to let it lie, and top-dress it?

Mr. Daniels. I think it would be better to let it lie, and top-dress it. If you can feed the plant so as to continue its life and growth for a number of years, you can do it cheaper than to plow and reseed. Once get your grass land properly seeded, and you can maintain it for ten years, and perhaps fifteen, by cultivating and feeding the plant.

I was glad to hear what Mr. Dodge said about operating a farm. We have just 72 acres of tillable land on our farm. The farm is in three portions, one with the buildings, another half a mile away, and a third a mile and a half away. That third portion is too far away to till, so that we are actually reduced to about 35 acres of tillable land; and we are carrying a herd of about one hundred head of cattle on the farm, and producing all the roughage except what little the cattle get in the pasture. We used to have one field that was in corn continuously for sixteen years. The land got so hard that when it was plowed it would break up in lumps like stone or brick; and the crop would never reach its full growth, because there was not enough humus in the soil to carry it out. Our system of crop rotation has changed all that. We probably get a third better yield per acre of corn than under the old system. We have not the whole farm working yet, but we are working into it. We keep five Italian men, and your humble servant, who is supposed to be a Yankee, is there all the time, and my brother is there a part of the time. He has two boys, ten and twelve years old; and I have one, ten years old. They help a great deal in the summer, as they can mow and rake the hay as well as a man. I should say that we had seven men at work on the farm, and count the boys as good as half a man each. We carry about sixty milking cows and about thirty young stock. We wholesale our milk in the city, four miles away, delivering twice a day in the summer and once a day in winter. Our herd twelve years ago was a purchased herd, and averaged 5,280 pounds of milk per cow. We have since begun to raise our own stock, raising almost all of it in the last four or five years, and the herd has come up to 6,000 pounds per cow. My idea is to get down to fifty cows, and a herd rate per cow that is greater. My ideal is a fifty-cow herd, with an average yield of 8,000 pounds of milk per cow.

QUESTION. Do you raise grains on your farm?

Mr. DANIELS. No; we have no room. When our father left us the farm, twenty years ago, we kept only five cows and a pair of horses. To-day we are carrying, as I have stated, about one hundred head of stock, and all the money we have, we secured in the business.

QUESTION. Are you getting the same returns from the capital invested in your farm as you would expect from a manufacturing business?

Mr. DANIELS. I do not think we are getting as much as some. When we took the farm, we thought that we would like to sell it and buy another, which seemed to us to be better suited to the business. We had the place in a real estate man's hands for a year at $2,800, and could not find a purchaser. A short time ago we thought that we might sell the farm; and, in figuring up to find out what we should ask for it, I found that we would have to get at least $28,000, in order to get back the money we had spent on it; and that money all came out of the farm itself.

Mr. REED. How much protein do you use?

Mr. DANIELS. We use an average of a ton and a quarter protein feeds per cow. I believe in feeding the young stock just as well as the mature cow, and getting them into such shape that when they go into the milking herd they are ready to do business. While we cannot grow our grain, we can buy it and make a profit at present prices, with the class of cows we keep. I believe it is all right to buy our grain if we have learned how to feed what we buy, but not for the $30 cow spoken of.

Mr. REED. From what you have said, we had better put all our corn into the silo. All through the State they are saying we ought to husk our corn and thresh our grain; but the farmer of experience knows it is hard to get rid of the corn stover and the threshed grain.

Mr. DANIELS. Perhaps I could illustrate the system of husking your corn, paying the miller for grinding it, and then feeding it to the cow, by a story told by a friend of mine in advocating the silo. He said it was just like the country boy who went into a restaurant and saw some cheese on the table. He took some bread, spread it with butter, and laid some cheese on it, saying, —

Come together again, you two, —
What poor fool ever separated you?

In the evening a banquet was held at the Hotel Richardson, Lowell, under the auspices of the Lowell Board of Trade. The guests of the evening were Hon. Harold Parker, chairman of the Massachusetts Highway Commission, who spoke on the State highways; and Dr. David Snedden, Commissioner of Education, who spoke on vocational education, and what the State Board of Education has in mind to do in that line in Massachusetts. Other speakers were Charles E. Ward and Secretary Ellsworth, for the State Board of Agriculture; and Hon. Alonzo G. Walsh, for the business men of Lowell. Henry A. Smith, Esq., president of the Board of Trade, presided.

THIRD DAY.

Secretary ELLSWORTH. It gives me pleasure to introduce to you the member from the Middlesex North Agricultural Society, to whom we are so much indebted for the entertainment which we have received, Mr. George W. Trull, who will preside at the morning session.

The CHAIRMAN. I am sure that you will all agree with me when I say that I have enjoyed the lectures very much, each and every one of them, and I am glad to say that that of the next speaker will be no exception. I have the pleasure of introducing Rev. W. H. Davenport of Colrain, Mass., who will talk to you on "Poultry keeping on small farms."

POULTRY KEEPING ON SMALL FARMS.

BY REV. W. H. DAVENPORT, COLRAIN, MASS.

The agriculturist of New England must of necessity exercise his talents on a small parcel of ground, as compared with the farmer of the great west, where machinery plays so important a part in the tilling of the soil. But the area of the plot to be tilled need not in any sense curtail the caliber of its owner, and the occupant of a small farm is under no obligation to be, in mind, in business acùmen or in success, a small farmer. Years of experience in both the east and the west had led us to the conclusion that, while success may smile on one in either locality, still to a certain extent machinery on the large farm is pitted against manhood on the small one, and true success with the latter implies greater manhood. Of the various industries adapted to thrive on a small farm, and to utilize to good account all or any part of the time and talents of any man, no matter how able, who shall wish to undertake it, poultry keeping would appear to be — in a State like Massachusetts, where it is said that last year alone over seventeen million dollars worth of poultry products had to be imported to supply the local demands — a business well adapted to, and within easy reach of, the average man.

In considering the subject at this time, let us take up in turn what I have been pleased to call a mess of "P's," viz., the pleasures, profits, proprietorship, pens, pastures, provender and poultry necessary to successfully conduct a poultry plant on, and as a part of the machinery of, a small farm.

First, the Pleasures. — I have placed pleasure first, because no man can ever do his best in any undertaking without having added to his labors the zest and inspiration which comes from an enjoyment of the work.

No man who does not like a hen, who cannot see beauty or excellence in a hen, and who feels like kicking her or shooing her away whenever she comes near, will ever succeed as a poultry-man. He must learn to feel friendly to her, if he expects her to act as a friend or helper to him. This rule will hold good in every branch of animal husbandry, but in none more truly than in poultrycraft, — possibly from the fact that none of our domestic creatures is more meagerly endowed with intellect than the hen; and for this very reason, one who would best succeed through her existence must have a real interest in her; he must be brains and judgment, as well as master. From the first, then, let us say, if you cannot learn to like and admire her, if you cannot teach her to come at your call, and feel friendly to her when she gives the best her life has to give for your benefit, do not attempt it, — hens will not be a profitable branch on your farm.

Second, the Profits. — We imagine that most men would place this subject first; but our observation has been that it never reaches its highest degree of perfection unless it is first preceded by pleasure. What profits may accrue from a poultry plant depend upon every subject to be dealt with in this address, and, like the links of a chain, one broken means failure of all. The universal verdict has been that $1 per year, per hen, in net profits, is fair. However, not all the real profits are to be counted in cash. The hen we believe to be one of the few creatures, if not the only one, that can be raised profitably on a run-out farm, and, taking nothing from the soil, pay all her expenses, give good profits, and build up the soil at the same time. When we bought our present home, a friend said: "If you are going to farm it, why not buy a place where you can keep a horse without having to buy hay?" To-day we have a horse, two cows and a heifer, and instead of buying are selling a little hay each season. In addition, we have set out apple trees and bought orchard land till we have about eight hundred apple trees, all of which we are fertilizing from the hen house, though we allow the hens no credit in cash for the guano. With us, where everything is sold at wholesale prices, express out, we have never had the net profits sink below the figure $1, and perhaps $1.40 per hen would be a better and fairer average, taking year after year.

The man who is in touch with retail trade may increase his profits much above this figure, though in a sense this increase will be only the legitimate compensation for his increased labor; and if this labor had been expended in caring for an increased number of fowls, the results might be as good or even better. The fact, then, may be taken as granted, — a good hen is worth $1 per year net earnings, if properly cared for; all that is made above or below this sum is due directly or indirectly to the third " P " in our " mess," viz., —

Third, the Personality of the Proprietor. — We have already said that a man who does not, and cannot learn to, like a hen will never succeed as a poultryman. There is something in the fitness of a man for his business that settles the matter of his success or failure often even before he attempts it. We believe there are more farm failures from this than from any other one cause. The average small farm holder is a man of many interests. In some of his branches of husbandry he is an adept, and here he succeeds. In others his labor is fraught with failure because he does not like or understand the work; but it is the custom for the small farmer to have about so many " irons in the fire," and so he continues to be a failure. If, instead, every small land holder would choose just those lines of work he loves, educate himself in them and learn to perfect them under his personal care, then would failure disappear. The proprietor of the poultry plant is the one great factor; he determines whether it is to be a success or a failure. It is not the hen or the breed, but the man, who succeeds or fails.

Given the man who enjoys working for profits on a poultry plant, and we next need, —

Fourth, a Pen or Poultry House. — There are really but three kinds of poultry houses, the long house, the " A " house, and the makeshift. There may be many variations of each; the long house may be cut up into short sections, or prolonged indefinitely; the " A " house may be open or closed, floored and on runners, or floorless on the ground; but really there are but three kinds, after all, and in their treatment the last should be made the first.

The makeshift poultry house is one that should be utilized by poultry-men as far as possible. We believe that on nearly every farm where there is a set of buildings of long standing there are almost invariably one or more places now wholly unused, which may be easily prepared and adapted to the needs of a flock of fowls. A farmer once came to me, saying: "Come up and buy my hens; they will not lay, and I'm going to sell them, and not keep any until I build a good poultry house." I went, and found a flock of splendid pullets, all as fat as could be, with six or seven bushels of unshelled corn under their feet, and as many more of partly shelled corn. No wonder that those pullets did not lay! But what surprised me was that they were living in a big, dry, warm barn basement, wholly unused for other purposes, and of such a nature that the insertion of a few south windows would have made it as good a house for one hundred hens as I ever saw, and this with no other expense. When we bought our place there stood on the lawn a two-story building which was erected fifty years ago for silk culture. Sills decayed, roof leaky, sides and floors bad, — it looked like a case for the bonfire; but with two small boys to help, and no carpenter, we moved, resilled, roofed, floored, shingled the sides, and painted it, until it was something like the "old family vinegar barrel, that had been in the house two hundred years." The owner admitted the new hoops, heads and staves, but declared that it had the "same old bung-hole." So our old building we made into a wagon and tool house, a storage and a rat-proof feed room; but up stairs was an 18 by 30 foot space unused. This we floored double, and, by putting in a stairway and a hall on the first floor, with a front outside door facing south, opening into a half-acre hen pasture, we have made it for five years the home of one hundred hens. So we would say to every farmer, don't build until you use what you have; basement, ground floor or attic, it is all the same to "Biddy," if you give her light, dryness, freedom from drafts and plenty of space.

The second style of house is the "A" house, a very simple structure, with low eaves, high ridge, giving sufficient space for the attendant to stand erect in the center and only enough for the fowls near the eaves, and the gable facing the south. Such a house is seldom used for more than one pen, and its chief advantage is its ease of construction.

Fig. 1 shows an "A" house of the style used by Mr. C. E. L. Hayward of Hancock, N. H. We visited Mr. Hay-

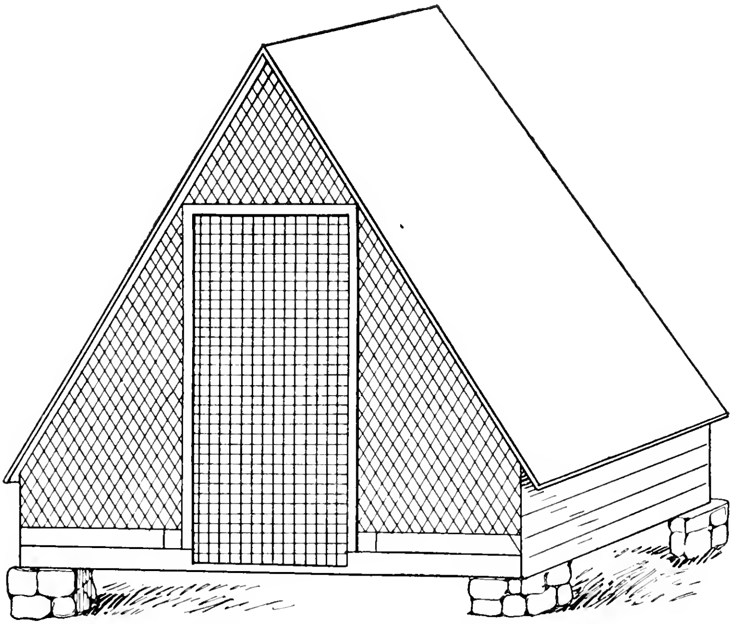


FIG. 1.—An "A" house, of the style used by Mr. C. E. L. Haywood of Hancock, N. H.

ward's farm on one of the coldest days of last January, and counted in one orchard three hundred such houses, all with entirely open fronts, wired in, and containing twelve hens to the house. Other orchards were filled in a similar manner. We have three large houses of this type, built very warm, with double boards and paper between, accommodating fifty hens each. These were built some years ago, and, except that they require less skilled carpentry, we are inclined to consider them without any advantage over the common long house. They are harder to clean, and, being high at the ridge, it is difficult to arrange the roosts in winter so that the fowls can take advantage of their animal heat in warming the sleeping places.

The house which is in most common use we have left until the last, viz., the long house. The long house may be one or more stories high, single or double pitch roof, long or short, high or low, and still be a "long house."

After considerable study, we have originated plans of our own which we believe to be the most economical we have ever seen. These plans for a 10 by 40 foot house for one hundred hens are as follows: first, for sills get five pieces 4 by 6 inch lumber, cut square ends, 9 feet 8 inches long, and eight pieces 2 by 6 inch, each 10 feet long, all of exact lengths. Spike

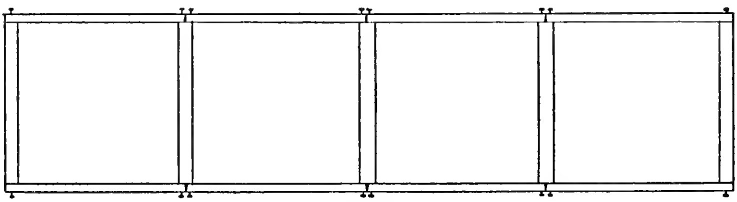


FIG. 2. — Sills of a 10 by 40 foot hen house.

these together as shown in Fig. 2, resting the ends of the cross sills on ten posts or stones, or preferably the whole outside sills on a stone wall, cemented on the inside, and filled with gravel to the bottom of the sills, which should be raised 1 foot above the surrounding ground, to prevent moisture. The sills being completed, we next erect partitions, one on each cross sill, as shown in Fig. 3. These partitions we make of 2 by 4 inch studs, covered, except the doorway on the south side, with cheap, rough, half-inch lumber. The studs, 5½ feet long at the sides and 6½ feet at the center, with those on each side of the center 5¾ feet long, are toe-nailed to the cross sills, the three rafters — there are but three in the building — being nailed to the tops of the center and halfway studs, and the plates and girts spiked to the sides of the side studs, all as shown in Fig. 3. For girts and plates use 2 by 4 inch stuff, 10 feet long. For rafters use 2 by 6 inch lumber of any length, so as to give sufficient to extend three times the length of the building. Square the ends of the rafter lumber and splice into three 40-foot strips, by nailing short boards on

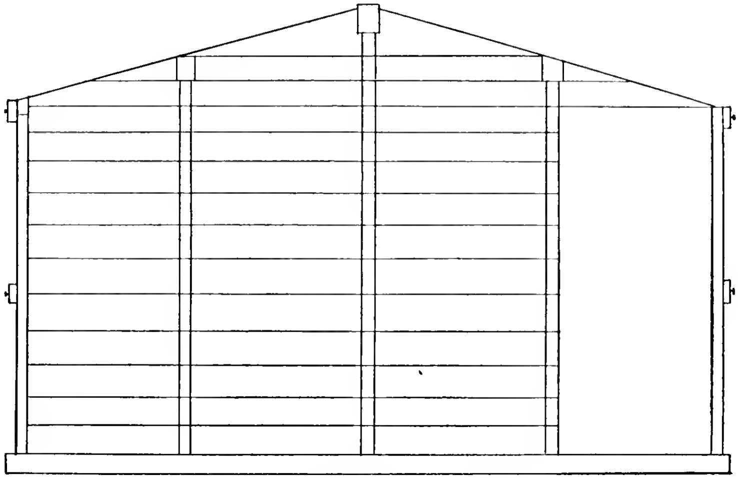


FIG. 3.—Partitions, girts and rafters.

both sides of the joints. Place these rafters lengthwise of the building on top of the three middle studs, and spike the girts and plates to the side studs 3 and 6 feet from the bottom of the sill respectively, this giving both the north and south sides of the frame the same appearance as shown in Fig. 4.

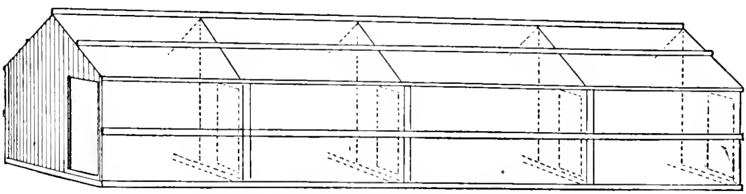


FIG. 4.—Partitions, girts and rafters.

The frame is now complete and ready for covering, which may be done by purchasing 12-foot boards of such quality and finish as suit our taste, and cutting every board exactly in halves. It will now be found that a 6-foot board will exactly reach from the bottom of the sill to the top of the plate, and also from the middle rafter down over the plate, leaving sufficient projection for eaves. Thus two 12-foot lengths will extend entirely over the building, cutting without a particle of waste in the entire structure; or 960 feet of 12-foot boards will cover both sides and roof. Fig. 5 shows the manner of placing the side and roof boards, also the appearance of the building when completed.

This house may be made by a man with little skill as a carpenter, and by covering the roof with some good roofing, like rubberoid or paroid, it will be as warm and as permanent a structure as can be built. On the south side we cut the 6-foot boards in halves, nailing these 3-foot pieces from the sill to the girt for 5 feet of each 10-foot pen, thus leaving space for a window, without the extra expense of purchasing frames. This is also shown in Fig. 5.

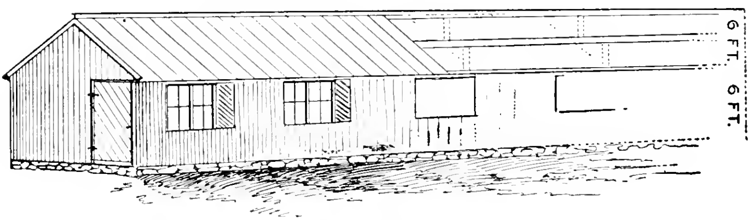


FIG. 5.—Showing how boards, roofing and windows are placed, with ventilating slides beside each window.

Beside each window we place a slide door, to be opened and shut for ventilation; but these doors are never entirely closed. In our houses we use double boarding and paper between on the north side, single boards matched on the south side, and paint the entire building, both for preservation and appearance.

Our house now being completed on the exterior, it consists of four 10 by 10 foot rooms inside, connected by doorways on the south side of each partition, and with windows on the south side of each room. These doorways are never closed in our laying houses, but one hundred hens are kept in one flock, and given the entire use of the house. We find the partitions of such value as a prevention of drafts, and also as giving the fowls opportunity to escape all the effects of nagging and quarreling so common in a large flock kept all together in one or two pens, that, even if not of value in strengthening the building, we would make them for these reasons alone.

Thus our house contains four distinctly separate rooms, all opened together. Each of these rooms is furnished exactly like its fellows. Fig. 6 gives an illustration of one of these rooms, with all its furnishings, which includes the best we

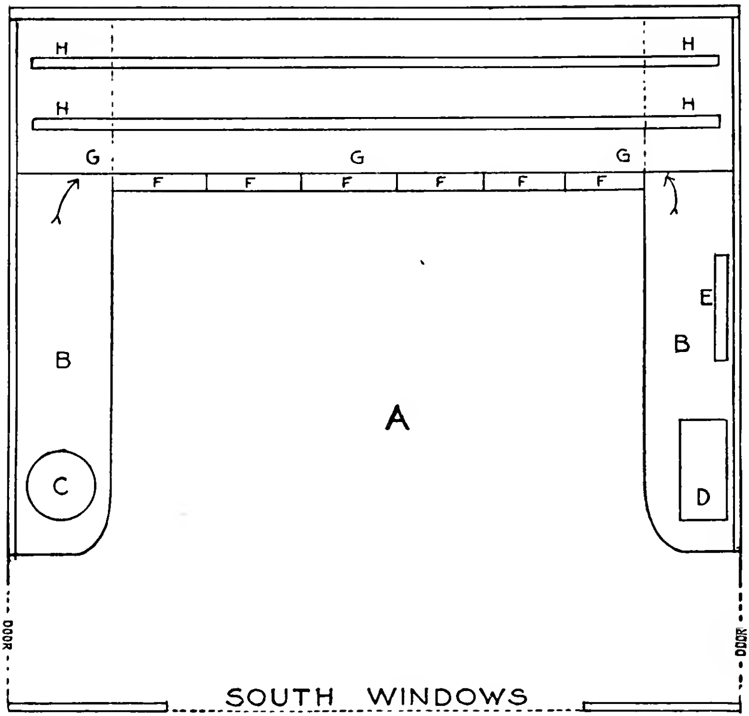


FIG. 6. —Our ideal poultry room: *a*, floor; *b*, side shelves, 2 feet above floor; *c*, water pail; *d*, dry mash box; *e*, shells; *f*, nests, on same level as shelves; *g*, roosting (dropping) boards, 1 foot above shelves and nests; *h*, roosts, 1 foot above roost boards.

have been able to discover in many years of practical experience at utility poultry work. We never allow any feed box, water pail or any other utensil on the floor of a hen house; this space is given wholly to the hens for scratching. The feed and drink are kept on the side shelves, and so free from dirt thrown up by scratching. On the same level as these shelves is a row of nests, which are reached by the fowls by a walk around in the rear and beneath the roosting boards, while the attendant reaches them by a drop door in front and beneath the roosting boards. The nests consist of a wide board, with upright front, back and separating partitions upon it, but no cover; thus making a row of nests which rests at the ends on the two side shelves, and extends upward to within about 1 inch of the dropping boards, but not touching it. By this means there is no runway from the roosts for nits and lice. To cleanse the nests, carry the nest board out of doors, and, emptying the nests where the waste may be safely burned, set the board on the ground and sprinkle — deluge — each nest with whitewash. There being no covers, this is as easily done as to an open box, and makes simple one of the disagreeable tasks of poultry keeping, viz., that of cleansing the house of lice. The dropping board and roosts, as shown in Fig. 6, are easily cleaned and whitewashed. On the shelves, or side boards, we keep our dry mash box or hopper. We have tried nearly every style of hopper, patent or otherwise, with the result that after some years of steady trial we consider a common soap box, such as can be procured at any grocery store, the best apparatus for feeding dry mash, regardless of cost. Get a box with sides 8 inches high (the other dimensions are not important), and fit a frame made of four short pieces of lath nailed two across two, and just large enough to drop freely into the box on top of the mash, to prevent the hens scratching and nesting in it. We have such boxes that have been in use every day for three years, have never been washed or cleaned, and are as clean to-day as any tidy meal bin, feathers being the only filth that ever gathers there, and these are easily thrown out. For water tanks we have also tried many varieties, only to prefer any tub, keg or pail that will hold water, with a sharp, deep V-shaped space cut between each two staves, so that it presents an opening all around for fowls to reach through and drink; but no hen will ever sit on the side and foul the water, or even fly into it but once, if she can help herself. To these two simple utensils should be added on every poultry farm a feed or dry mash mixer, similar to a revolving barrel churn, in which a quantity of each of many kinds of grains or meals may be placed, and by a few revolutions, without the dust or disagreeable labor so common in this work, be quickly mixed into a homogeneous mass.

These simple contrivances are not necessarily a part of any particular house, but the larger the plant and the greater the number of hens, the more do they become a factor in avoiding some of the otherwise difficult duties, which from their disagreeable nature lead many men to slight their work and so lead to failure.

Before leaving the subject of houses, we would mention briefly a house which in one sense may be related to them all, and in another to none, viz., the Maine Experiment Sta-

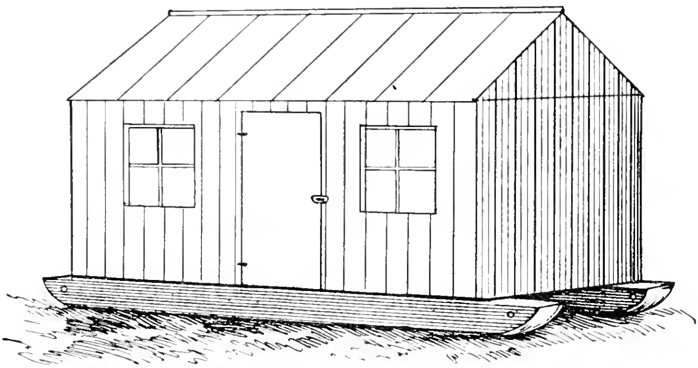


FIG. 7.—The Maine "handy house."

tion's "handy house." Fig. 7 shows one of these houses mounted on runners, ready to hitch to at any time. We have several such houses, and by grouping them in a convenient village in winter and scattering out at will in summer we find them almost indispensable for fancy breeding pens, for hens to sit in at hatching time, for hens with early chicks, for chicks out on the range in summer, for young stock up to laying time, for culls and butcher stock in autumn and winter, — in short, for something all the time; we would not be without them.

Our fifth "P" is the *pasture*. Let the farmer who wishes to succeed with poultry, pasture his hens as much as he would his cows, calves or sheep. There is no stock on the farm that needs good pasture more, or will thrive better in it, than the pig and the hen; and yet these are the first two to be shut up in some dirty place and compelled to feed on filth. It is utterly impossible to get the best results from any flock of fowls shut up in a filthy, grassless confine, or let loose to run at will. No man can get good eggs profitably unless his hens can get grass or some reasonable substitute; and the hen shut up in a grassless pen cannot get it, and the one let loose to run at will gets so crazy after bugs that often she does not know enough to eat what she most needs. I would as soon let a large flock of sheep run loose, and expect success, as a large flock of hens; and even a few are a nuisance on the garden, lawn or piazza. We pasture our hens, giving every laying hen at least one-half square rod of good green grass ground; and whenever the season forbids this, — as in winter, — we feed clover or alfalfa. There is no other stock on the small farm that will pay as much with a little care as one hundred hens in one flock, in one 10 by 40 foot house, with at least 50 square rods of good pasture, and water and good dry mash before them night and day all the time.

The average farmer is stingy of fence, and shuts his flock so close that he has to waste twice the cost of a good fence in his own labor, trying to make them lay, and even then he often fails; or else he lets them loose, and after one or two months of chasing and racing they follow nature and stop laying; so that about July he is ready to market his flock, and lose the best two months in the whole year, August and September. Let him treat them as well as he must his cow; give them good grass, and forage like rape in case of shortage; sow rape in all the rich bare spots in the worn-out yards; in short, let him treat them as the cow compels him to treat her in summer time, if he gets any profitable returns, and for one-half the care a cow will require, one hundred hens, from April until November, will give him double the profits of any cow on his land. Three years ago, on Aug. 1, 1906, we bought one hundred yearling hens for $50, the price of a good cow. Shutting those hens in one flock in one long house, with good pasture for one year, on Aug. 1, 1907, they had paid for all the grain they had eaten and given a net surplus of just $142.40; and from April 1 their care consumed scarcely five minutes of any day. This we attribute very largely to rape and good pasture.

But our fifth "P" is not all the feed a fowl must have. She must also have —

Our sixth "P," viz., *provender;* and with our present prices this is the most difficult "P" in the whole "mess" to get. For years we have made it our rule to try every promising feed of which we could learn, for our hens; and the result has been the choice of a dry mash feed of our own, which has proved the most profitable, from every view-point, of any we have ever used. We feed from April to October daily two quarts of cracked corn to every fifty hens, this to be scattered broadcast over their entire pasture; also, keep the boxes filled with dry mash, and water and oyster shells within reach. This is all the care they get, except cleaning the houses, which our neighbors would be glad to pay for the privilege of doing, for the manure. We also gather the eggs.

Dry mash for summer: one dish good beef scraps; two dishes good corn meal or hominy; four dishes best mixed wheat feed. Mix and keep constantly before hens.

In October we change our mash, and increase the quantity of cracked corn to four quarts to fifty hens, fed before sunset in litter, 3 o'clock P.M., preferably. This, with shells and mash, is their entire winter feed.

Dry mash for winter: one dish good beef scraps; two dishes good alfalfa meal; two dishes good corn meal or hominy.

We now come to the seventh and last "P," the *poultry.* This includes two subjects, *breeds* and *birds.* The breed of poultry a man can most profitably keep depends not on the breed, but on the man himself, and his market and surroundings. As no man on earth has the best wife, except for himself, so there is no best variety of fowls, except as adapted to one man's conditions. Thirty-five years ago we were for the first time given complete charge of a flock of poultry. This flock contained representatives of two up-to-date pure breeds. Since that day we have had charge of birds of nearly every one of our best known utility breeds, and as a result have discovered the one which to us seems most satisfactory to our needs. These we breed constantly. But, while we have been caring for the hundreds of pure-bred fowls, we have also had hundreds of half-breeds, or direct crosses of our pure bred birds. As a result, we have formulated the following table of "ifs," which are wholly borne out by our experience: —

If you want fun, ...	Raise pure breeds.
If you want flesh, ...	Raise pure breeds.
If you want fancy, ...	Raise pure breeds.
If you want ribbons, ...	Raise pure breeds.
If you want big prices, ...	Raise pure breeds.
If you want skill, ...	Raise pure breeds.
If you want fame, ...	Raise pure breeds.
If you want small flocks, ...	Raise pure breeds.
If you want a hobby, ...	Raise pure breeds.
If you want beauty, ...	Raise pure breeds.
If you want eggs, and eggs only, . . .	Raise crosses.

Supplementary to the last "if," we would say that we believe there is no breed of poultry on earth that will lay as many eggs as will the half-breed cross secured by breeding that same variety on some other. This crossing should never be carried to a second cross, as only mongrels will result. No American variety should be crossed with a large breed, and no Mediterranean with a small breed; but by breeding Mediterraneans to American or Asiatics, remarkable results may be obtained. This system is wholly unwise and impracticable except on plants large enough to warrant the keeping of pure strains of parent stock, or so located that one is able to secure eggs for incubation from such plants.

As to the breed we advise a man to keep, we would say, get and keep the variety which you admire the most, and so can learn to like the best. No, it is not the breed, but the individual bird, that tells her story. Given the right man and the right hen, no matter what the style of house, the area of pasture or the nature of the feed, success is almost certainly insured from the first. There are hens that are not hens, and there are hens that are regular egg machines.

A few years ago we were riding through a village when a man stopped us, and said he wanted to sell his hens cheap, for they wouldn't lay. Going to his pens, we found about twenty as beautiful White Leghorn hens as we had ever seen, with great red combs and fine plumage; these we purchased at cheap butcher prices per pound, and drove home, saying to ourselves: "That man does not know how to feed; wait a little, and see if they do not lay." A week passed with no eggs; then egg eaters were discovered, and had to be dealt with. This gave a few eggs; not many. So one after another causes were removed, but that flock never laid well. There was one beautiful hen, — I never saw a finer; people would pick her out, and remark on her beauty. I kept her three months, and never saw her on the nest. At last came the day when we were through setting eggs for hatching, and one night we killed every cock bird on the farm, and hung them down cellar in the cooler. Next morning at 4 o'clock I was awakened from sleep by a clear, shrill "Cock-a-doodle-doo!" I turned over sleepily, and tried to think which cock had escaped me, when it came again, "Cock-a-doodle-doo!" as plainly pronounced as I ever heard it. I went out of doors that morning to see my beautiful White Leghorn hen, which another man and myself together had wintered, and so many had admired for her fine comb, standing on a rock, crying "Cock-a-doodle-doo!" That hen was a hen; I killed her, and found an egg sack and ovaries, but wholly undeveloped; she had never laid an egg. Yes, she was a hen, and still not a hen.

That hen was a fine example of one of the most common causes of failure to make poultry pay. In nearly every flock there are certain individuals which do not pay expenses; they are not hens. A little while after this we found one flock of hens, one hundred and sixty in one pasture, that only averaged about forty eggs per day; feed as we would, we could not increase this average. At last we went to that yard, and for two days marked every hen that went to a nest, and then marketed the other one hundred hens a few days later. That sale did not diminish the average in any noticeable degree; those sixty hens were doing all the work. I kept them two years, and they did nobly; but the one hundred others were eating all the profits, — they were not hens. With our present high prices in grains, this is the first great reformation we must work. The hens that will not lay profitably must be taken from the flock, if we would succeed. To do this by trap nesting in a large flock is an expensive task, to do it by the watchfulness of a practical keeper will add to the efficiency of the whole plant; and it must be done, if we would succeed, — we must dispose of the drones in our flock.

But not every hen is a drone in the hive; some earn gold, if their eggs are not golden. "Old Beauty," one of the homeliest hens on our farm, is such a one. In 1902 she was hatched on my brother's farm in April, and for one year served faithfully in a large flock of pullets. In May, 1903, we purchased her to set, and for two months she gave attention to this work, then began laying. Knowing that an old hen is of little value as a layer, we determined to sell her when she began to moult. August, September and October passed, and she continued to lay. November 10 found the old hen moulting; but before selling her December came, and on the 12th she laid, and continued to lay through the season. Each year she moulted about one month later, and laid in all but one month of the season. When coming three years of age she laid till December, then moulted, and laid in January; when coming four she laid until January, moulted, and again laid in February; and when coming five she had not ceased to lay until February, but had moulted, and again laid in March. In 1908 the old hen began moulting in November, and laid in January. This was the first time she had ever required over one month for her moult, and we feared she had passed her prime; but after a good year's work September found her again moulting, and October 20, the day when the photograph shown in Fig. 8 was taken, she laid, after returning from the photographer's, this being the fifteenth egg she had laid since October 2, or in eighteen days. "Old Beauty" is now in her eighth year, and so far as appearances or action can be relied upon, is just in her prime. She is every whit a hen, — no drone.

Am I giving you the story of an exception to all common rules of poultry craft? We believe not. We have in one pen one hundred old hens, averaging to be now in their fourth and fifth years, and several in their sixth year, which we placed there Oct. 1, 1909, to enter upon a year's experiment as to their profitableness. They are the cream of five years' layers, and we would not exchange their work in 1908 for

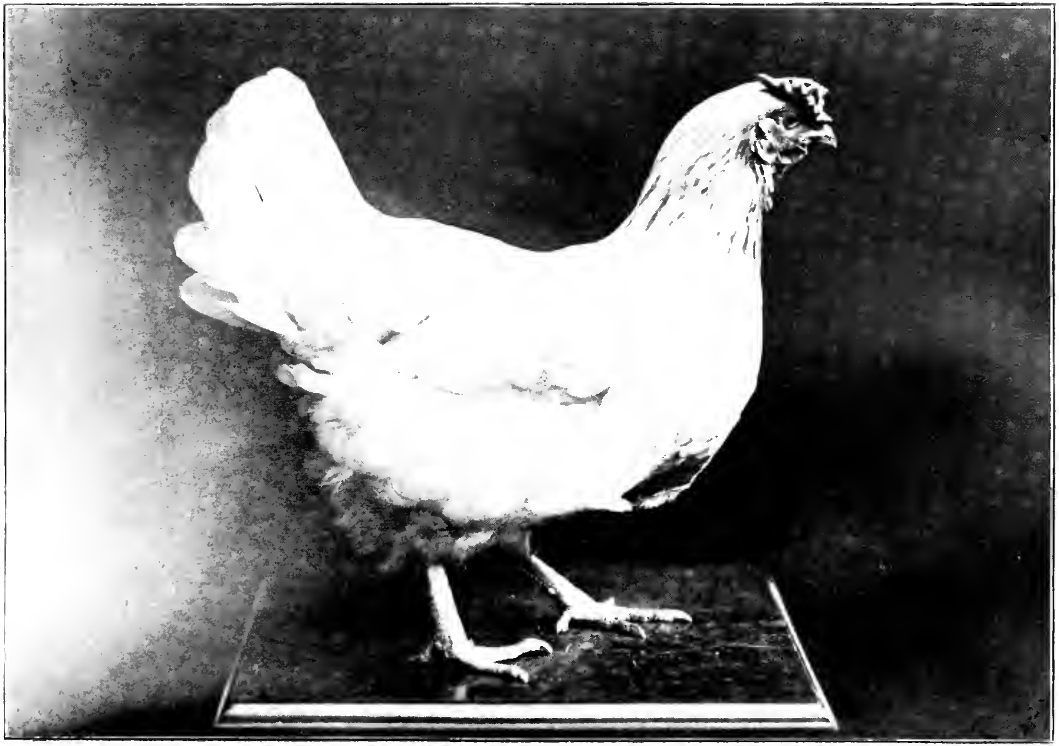


FIG. 8.—From photograph of "Old Beauty," now doing splendid work in her eighth year.

that of any flock of pullets on our place. What they shall accomplish is yet to be seen, but exact accounts are being kept of both eggs and feed. From these experiences we have been led again and again to say, "Never kill a good hen, no matter how old she may be; never keep a poor one, no matter how young."

A careful examination of the photograph of "Old Beauty" (Fig. 8) will show that the form of the ideal laying hen is quite similar to that of the ideal dairy cow; long in the back, deep and full at the breast, and sloping to a great depth behind. This we believe opens a topic too vast for our discussion here, viz., the determining of a good hen by shape and other features. The good hen certainly exists. She should never be killed while good. She is a mint of gold on the small farm or in any other place. May every small farmer in Massachusetts find pleasurable profits in putting his own personality into pens, pastures, provender and poultry, that shall help him to succeed as few other industries in this old Bay State can ever help him to do.

Before leaving the subject, we would say that there are two matters we have purposely left untouched; they are too extensive for complete treatment at this time. They are incubation and location. The matter of incubating and brooding chicks is one depending so largely on the tastes of the poultryman, and successful under such a diversity of conditions, that no one man can do more than tell his own way. We make it a practice to set twenty-five hens and a two-hundred-and-fifty-egg incubator at the same time, and give all the chicks to "Biddy" to brood. By this means, with two incubators set each three times, accompanied by about two hundred hens set in a large sitting room in the loft of our barn, we are easily able to get what chicks we need on a small farm. These we give to "Biddy" in our Maine "handy houses" and portable coops in a large pasture sown with rape, grass and seed corn.

The best location for poultry keeping seems to us to be anywhere where the sun shines and the grass grows. As far as possible, choose pastures with running water in them, and some shade, not too much exposed to the wind. Were we, in closing, to give our best advice to some farmer who wished to keep not over one or two hundred hens, we would say: take the best three or four acre lot on your farm, near the house, but on the best tillage land. Build a good house for the number of hens you wish to keep exactly in the center of the lot. Divide this lot as in Fig. 9, into four parts, surrounding the poultry house, and one corner of each coming to the house. Number these lots 1, 2, 3 and 4, and on the first year fence No. 1 with a good portable poultry fence. The first year turn all the hens into lot No. 1, also put all the droppings from the house on this same lot. The second year change the hens to No. 2, and repeat the process with

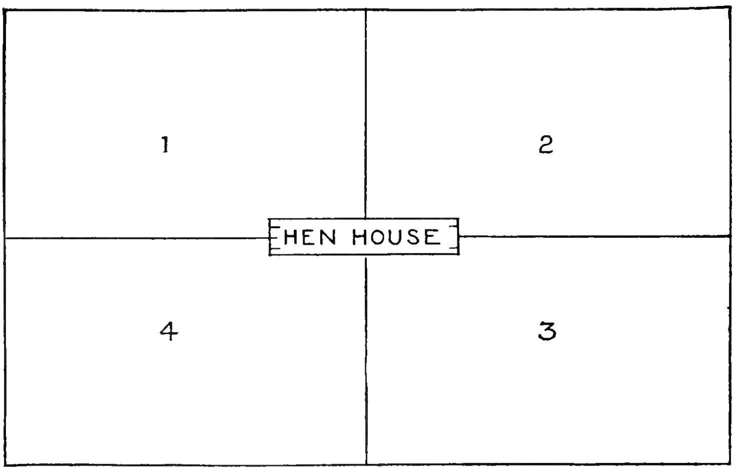


FIG. 9.—An ideal poultry plant for the small farm.

droppings. Also plant and raise, without buying fertilizer, the richest garden you ever saw on lot No. 1. Seed this lot to grass late in the fall. The third year change hens to lot No. 3, and repeat the process as before, raising garden on No. 2, and cutting big hay on No. 1. The fourth year change hens to No. 4, garden on No. 3, and mow Nos. 1 and 2. The fifth year begin again on No. 1, and so continue over the rotation, with always a clean, fresh poultry pasture; always a rich garden and heavy grass to cut; big poultry profits from each of the three crops, unreckoned and unallowed; and an independence such as you had never known before; and if Biddy should give you $1 or more in clear, clean cash for every one of her, you will agree with us that every small farm in Massachusetts might well keep from two to ten hundreds of happy hens.

Question. Have you ever had any trouble with rats?

Mr. Davenport. Not seriously. The worst enemy I ever found was a crow, who disposed of two hundred chickens in two days. For two weeks he troubled us, and no one could get a shot at him. Finally I hung a lot of barrel hoops on a pole, with a crow a neighbor had shot hung by one wing in them, and my enemy never came again.

Question. How are your flock of old hens doing so far?

Mr. Davenport. They averaged seven eggs each for October and November, or, at 3½ cents per egg, about 29 cents per hen. They ate $9.70 worth of feed in October, and $10.02 worth in November. In the summer they will not eat over 7 cents' worth each per month, and they will never go over 11 cents.

Question. How do you prevent a hen moulting in August?

Mr. Davenport. I wouldn't prevent her; I would cut off her head.

Question. When are the hens hatched that moult in February?

Mr. Davenport. I wish I could find out; I am only too glad to get them, but I do not know when they are hatched.

Question. Do you ever have trouble in getting hens at 50 cents apiece?

Mr. Davenport. I have never seen the time until this year when I could not buy all the hens I wanted in Massachusetts at less than 10 cents a pound, and the hens brought in do not average over four pounds apiece. When I have a flock of hens which I am going to send to the market because they are not laying well, and are not worth keeping, for that reason, it has been my custom to shut them up in a yard by themselves and feed them exclusively a corn diet for a week or two, or while they continue to lay, so that they are bound to pay for what they eat.

Question. Do you consider alfalfa an economical feed for hens?

Mr. Davenport. The best quality of alfalfa or the best quality of anything, at a legitimate price, is cheaper than any cheap grain. I buy alfalfa meal, paying whatever we have to, from \$30 to \$34 a ton for it.

Question. Do you not find that the hens waste the dry mash?

Mr. Davenport. I have never had any trouble; but it is all easily avoided by putting in a rack to prevent scratching, such as I described in the lecture.

Question. Do you uniformly keep your pullets over?

Mr. Davenport. The good pullets, those which I think are layers, stay over; the hen that moults in August, and then takes a rest, — you can look at her comb and detect her, — is not a hen which I wish to keep, and she goes to market.

Question. How am I to tell whether I am getting a good meat scrap? I have no objection to paying \$3 a hundred; but I cannot get a scrap that seems to satisfy me.

Mr. Davenport. I solved the scrap problem by leaving it to the hens. I was buying a high-priced scrap, and tried a cheaper one that smelled soapy and did not seem good to me, but which I found analyzed better than the others. The hens seemed to like it just as well, and I felt that if they were satisfied, I was.

Mr. Daniels. My brother has devoted most of his energy to hens, and he has found that ensilage is just as good for hens as for cows, and clover ensilage particularly. Oftentimes when you are cutting clover for the third time it will be six or seven inches high, and a very leafy growth, if the season is right, — not long enough to cut for the stable, but just right for ensilage for hens. I believe it is practicable to have a big hogshead, and pack the ensilage in that, — although we have never tried it; then use the manure spreader, and you can do for the clover top what the clover top would do for you.

Mr. Davenport. I would as soon have that clover to feed to my hens as the alfalfa, for which I pay from \$30 to \$34 a ton.

Mr. JOHN H. ROBINSON. I want to talk to you about the recently organized Massachusetts State Poultry Association, of which I happen to be secretary. The association was organized at a meeting at the office of the State Board of Agriculture last April. We organized the State by districts, because we felt that we could better reach the people in that way, and could equalize the expense, helping the weaker districts by support from the stronger. We divided the State into twelve districts, which to some extent follow the county lines, more so in the western part of the State than in the eastern. The districts that are well organized are the third district, south of Boston, the Boston district, the Fitchburg district, and that about Northampton. We have organizations in some of the others, but not strong ones. We have in all about 170 members at present. We expect, by the time we have been in existence a year, to have about 500 members.

Mr. Davenport made the statement that Massachusetts is importing about $17,000,000 worth of poultry a year. We cannot get the figures exactly, but it is probable that we are importing nearer $25,000,000 worth a year, and Massachusetts is producing less than $6,000,000 worth per year of poultry and eggs. The object of our association is to build up this industry in every way possible, but especially by educational means. We want to see the unproductive land of Massachusetts utilized, and much of it could be used to advantage in poultry raising. First, we want to influence legislation in the interests of poultry. We want a poultry course at the Massachusetts Agricultural College. We are from two to twelve years behind many other States and Canadian provinces in this line of educational work. Some of us tried to get such a course established last year, but there were other things that came first. This year we are going to ask again, and ask for a larger appropriation, with a definite plan, and make a strong effort to put poultry education where it should be in Massachusetts. We want the experiment station to take up some of the problems interesting to poultrymen, and help to solve them. There is a great field for the association to work in, and we would like to have as many as possible of the people interested in poultry join the association and help in the work. A card addressed to me at 232 Summer Street, Boston, will bring you an application blank and copy of the constitution and by-laws of the association.

Mr. Bursley. As we are about closing this session, in behalf of the State Board of Agriculture I will move a formal vote of thanks to the Middlesex North Agricultural Society, the Dracut Grange, the Lowell Grange, and our associate on the Board, Mr. George W. Trull, for what has been done by each and every one of them to make our stay here so pleasant and profitable.

Mr. Isaac Damon. I think perhaps I have attended as many of these meetings as most members of the Board. Some years ago we held a meeting at South Framingham, under the auspices of the Middlesex South Agricultural Society, which I have always thought one of the best meetings we have held; but I think the time has come when we must take off our hats to the Middlesex North Agricultural Society, and that this is perhaps the best meeting I have ever attended. I take great pleasure in seconding that motion.

Mr. Henry S. Turner. I have attended many of these meetings, but I must say that this one has given me the greatest satisfaction of any. We have not only had some really excellent speakers, but also good listeners, and they are needed at all these meetings. I wish also to second the motion that we extend our thanks to the organizations and individuals who have co-operated so well with us.

Carried unanimously. Meeting adjourned.

EIGHTH ANNUAL REPORT

OF THE

STATE NURSERY INSPECTOR

OF THE

MASSACHUSETTS STATE BOARD OF AGRICULTURE.

PRESENTED TO THE BOARD AND ACCEPTED,
JANUARY 11, 1910.

EIGHTH ANNUAL REPORT OF THE STATE NURSERY INSPECTOR.

To the State Board of Agriculture.

I have the honor to submit herewith the eighth annual report of the State Nursery Inspector.

Inspection of nurseries the past season has been of the usual nature. In the course of this work 142 places have been visited, and 112 certificates, covering 119 of these, have been given. At 5 places no stock was found, but, as the owners have not gone out of the business permanently, they will need to be visited next year. Five nurseries have gone out of business, 5 have been refused certificates because of the condition of their stock, and 8 former nurserymen have elected to keep no stock hereafter, but to take out licenses as nursery agents.

The conditions found by the inspectors varied greatly, of course, in different places. As a whole, however, the nurseries were in better condition than at any previous inspection. It is doubtful if the value of all the stock condemned would reach $800, though the work was very carefully done. Where infested stock was found, it was in almost every case directly traceable to infestation near by, but outside the nursery; to stock brought in after the last previous inspection; or to failure, at former inspections, to extend the condemned area far enough around plants found infested.

The situation as regards the gypsy moth is but little changed from that stated in the last report. Infested nurseries receive no certificate until inspection after September 15 fails to show the presence of this insect. This seems to be the most which can be done at present; but the difficulty of finding gypsy moth egg masses on some kinds of stocks, — blue spruces, for example, — when they are present, makes it probable that some day an egg mass will escape discovery, in spite of all the care which it is possible to take.

The new nursery inspection law, prepared by a conference of the nursery inspectors of New England last winter, was offered by them to the legislatures of the six New England States. Massachusetts, however, for various reasons, was the only State in which it was adopted. The writer favored the law mainly in the interests of uniform legislation, and was opposed to certain of its requirements, yielding on these, however, in the interests of harmony, and believing that as a whole, the new law would be better than the old one. He is still of this opinion, though feeling that some parts of the law cause inconvenience and are of little value. If the other New England States should adopt this law, it would seem wise to leave it as it is in Massachusetts; but if they fail to do this, it may prove wise, after a few years, to repeal certain portions of it.

One section of the present law requires every nurseryman residing outside of Massachusetts and desiring to do business in the State to deposit a copy of his inspection certificate, and purchase tags for shipping stock into the State. Each shipment must be accompanied by a tag, whether it consists of a single plant or a carload. It is impossible, therefore, to determine in this way how much nursery stock is sold into the State; but it is at least suggestive that over 9,000 tags were purchased during the fall of 1909.

Another section of the law requires all agents for nursery stock, which they do not grow, to take out licenses. This section will for a time be difficult to enforce, as so few agents know of it, and it is difficult to learn of them. Thus far only 60 licenses have been issued, while it is probable that there are at least five times as many agents who sell nursery stock in the State. It will presumably be several years before this section becomes entirely effective.

Those sections which permit the inspection of other places than nurseries, and their condemnation as dangerous to the interests of neighboring property holders, have been made little use of. The initiative in this must come from those most concerned, as to inspect everywhere would require the entire time of several persons, and the appropriation available is hardly sufficient for the inspection of the nurseries.

FINANCIAL STATEMENT.

Appropriation,		$2,000 00
Compensation of inspectors,	$1,007 50	
Travelling and necessary expenses of inspectors,	834 93	
Supplies (postage, printing, etc.),	44 91	
Unexpended balance,	112 66	
		$2,000 00

I am glad of the opportunity to again express my thanks to the Secretary of the Board of Agriculture for his active interest in, and co-operation with, the work of inspection.

Respectfully submitted,

H. T. FERNALD,
State Nursery Inspector.

AMHERST, Jan. 4, 1910.

Appendix.

Certificates granted to June 30, 1910.

Adams, J. W., & Co., Springfield.
American Forestry Company, South Framingham.
Anderson, Wm. L., Lakeville.
Atkins, P. A., Pleasant Lake.
Barrett, M. W., Hyde Park.
Barrows, H. H., & Son, Whitman.
Barrows, H. E., Brockton and Whitman.
Bay State Nurseries, North Abington and Rockland.
Beals, E. B., Springfield.
Bemis, A. L., Worcester.
Brandley, James, Walpole.
Breed, E. W., Clinton.
Briggs, L. H., Smith's Ferry.
Carr, Chas. E., Dighton.
Casey, C., Melrose.
City of Boston, Boston.
Clapp, E. B., Dorchester.
Continental Nurseries, Franklin.
Cutler, Mary E., Holliston.
Davenport, Alfred M., Watertown.
Davenport, S. Lothrop, North Grafton.
Davis, Peter, & Son, Fairhaven.
Dighton Nursery Company, Dighton.
Draper, James E., Worcester.
Dwyer, E. F., & Son, Lynn.
Eastern Nurseries, Holliston.
Elliott, W. H., Brighton.
Farquhar, R. and J., & Co., Roslindale, Dedham and Sharon Heights.
Field, H. W., Northampton.
Fish, Chas. R., & Co., Worcester.
Ford, J. P., East Weymouth.
Frost, G. H., West Newton.
Gates, W. A., Needham.
Geer, J. T., Three Rivers.
Gilbert, A. L., Springfield.
Gillett, Edw., Southwick.

Gordon, A. B., Randolph.
Gormley, Edw. W., Jamaica Plain.
Guinivan, D. H., Beverly.
Haendler, M. P., South Natick.
Hastings, G. H., Lunenburg.
Heurlein, Julius, South Braintree.
Hitchcock, E. M., Agawam.
Horne, H. J., & Co., Haverhill.
Howard, J. W., Somerville.
Huebner, H., Groton.
Jahn, H. A., New Bedford.
Keen, Cyrus R., Cohasset.
Keizer, H. B., Reading.
Kelsey, Harlan P., Salem.
King, R. B., Nantucket.
Lawrence, H. V., Falmouth.
Lister, James, Stoneham.
Littlefield, Henry F., Worcester.
Littlefield & Wyman, North Abington.
MacGregor, James, Braintree.
MacMannon, J. J., Lowell.
Mann, H. W., Stoughton.
Manning, J. W., Reading and North Wilmington.
Massachusetts Agricultural College, Amherst.
Massachusetts Highway Commission, near Lancaster.
Matthews, Nathan, Hamilton.
McCormack, J. J., Malden.
McMulkin, E., Norfolk Downs.
Mead, H. O., Lunenburg.
Merritt, Charles L., South Weymouth.
Miller, W., & Sons, Lynn.
Moseley, F. S. (O. C. Bailey, superintendent), Newburyport.
Murry, Peter, Fairhaven.
New England Nurseries, Bedford.
Newton Cemetery Corporation, Newton.
Old Colony Nurseries, Plymouth.
Palmer, F. E., Brookline and Newton.
Patterson, Wm., Wollaston.
Payne, Wm. H., Newtonville.
Peirce, C., Dighton.
Phelps, F. H., Lee.
Pierce, Jesse, Beverly Farms.
Pratt, Chas. S., Reading.
Pratt, H. M., Concord.
Quinn, Jas., Brookline.

Rawson, W. W., & Co., Arlington.
Rea, F. J., Norwood.
Rice, C. G. (F. A. Smith, superintendent), Ipswich.
Richards, E. A., Greenfield.
Richards, J. E., Needham.
Riley, Chas. N., New Bedford.
Robinson, D. A., Everett.
Robinson, L. D., Springfield.
Sawyer, F. P., Clinton.
Shirley & Fowle, Danvers.
Shaw, Frank H., Rockland.
Southworth Brothers, Beverly.
Spinney, F. W., Haverhill.
State Forester, Boston.
Story, A. T., & Co., Taunton.
Sullivan & McGrath, Dorchester.
Sylvester, G. F., Hanover.
Sylvia, M. B., New Bedford.
Thurlow, T. C., & Son, West Newbury.
Tuttle, A. M., Melrose Highlands.
Twomey, M. T., Roslindale and Wadsworth.
Voornerveldt, H. H., Nantucket.
Walsh, M. H., Woods Hole.
Walters, C., Roslindale.
Wellesley Nurseries, Wellesley.
Wheeler, Wilfrid, Concord.
Whittet & Co., Lowell.
Whittier, W. B., & Co., South Framingham.
Woodhouse, R. H., New Bedford.
Wright, G. B., Chelmsford.
Yetter, F. J., Greenfield.

SIXTEENTH SEMIANNUAL REPORT

OF THE

CHIEF OF THE CATTLE BUREAU

TO THE

MASSACHUSETTS STATE BOARD OF AGRICULTURE.

For the Year Ending Nov. 30, 1909.

Presented to the Board and Accepted, January 11, 1910.

REPORT.

To the State Board of Agriculture.

The sixteenth semiannual report of the Chief of the Cattle Bureau, as required by section 3 of chapter 116 of the Acts of 1902, is herewith respectfully submitted to your honorable Board.

This report gives in detail an account of the work of the Cattle Bureau for the fiscal year from Dec. 1, 1908, to Dec. 1, 1909. In some respects conditions show an improvement over the previous year. There has been a falling off in the number of cases of glanders and farcy; fewer outbreaks of contagious diseases among swine have been reported than usual; and rabies, which has prevailed so extensively for the past five years, shows a very marked diminution.

During the year the Cattle Bureau has been represented at two meetings of importance: one was the second annual meeting of the Eastern Live Stock Sanitary Association, held at Springfield, Mass., May 21; and the other, the International Veterinary Congress at the Hague the week of September 13.

The second annual meeting of the Eastern Live Stock Sanitary Association was attended by representatives of the cattle commissions of Maine and New Hampshire, the Massachusetts Cattle Bureau, the Connecticut Cattle Commissioner, the New York State Department of Agriculture, the New Jersey Tuberculosis Commission, the Pennsylvania Live Stock Sanitary Board, and a representative of the Bureau of Animal Industry, United States Department of Agriculture. The representatives of the Massachusetts Cattle Bureau were the Chief, Mr. C. A. Dennen and Dr. Benjamin D. Pierce, agents.

The following officers were elected for the ensuing year: president, Dr. Austin Peters of Massachusetts; vice-president, Hon. Raymond A. Pearson of New York; executive committee, Hon. J. M. Deering of Maine, Hon. Franklin Dye of New Jersey, Dr. J. F. DeVine of New York; secretary-treasurer, Dr. Louis A. Klein of Pennsylvania.

It was voted to invite the States of Maryland, Delaware and Ohio to join the association, as they have a community of interests in live stock matters with the States already represented.

The principal subject of interest discussed was bovine tuberculosis, and several resolutions concerning this disease were adopted.

Before adjourning, it was voted to hold the next annual meeting at Atlantic City.

The International Veterinary Congress at the Hague was a very interesting gathering, composed of several hundred veterinarians from all over the civilized globe, including all the European nations, England, the United States, Canada, South America, South Africa and Japan. Many papers on many subjects in various languages were discussed, the official languages of the Congress being German, French and English.

Space does not permit here of an extended description of the Congress or its work; but much benefit must accrue to the world as a result of such meetings, in a discussion of matters for a better protection of the public health, or still further conserving the national live stock interests of the countries represented.

During the absence abroad of the Chief of the Cattle Bureau at this Congress the office was left in charge of Dr. Wm. T. White, to whom much credit is due for the able, conscientious and tactful manner in which he conducted the business of the Cattle Bureau during August and September.

The outbreak of foot-and-mouth disease mentioned in the fourteenth semiannual report as occurring in New York State, Pennsylvania, Michigan and Maryland, was eradicated by the same stamping-out methods adopted in Massachusetts at the time of the outbreak in the winter of 1902–03, by the federal government, with the co-operation of the officials of the States in which it appeared, so that by March 30 the Cattle Bureau orders quarantining Massachusetts against neat cattle, swine, sheep and other ruminants, hay, grain, straw, bags, hides, hoofs, etc., from these States were finally revoked. It was found that the disease was started in Michigan by young cattle that had been used by a large drug-manufacturing establishment for the production of vaccine virus, and that the contaminated virus used there came from another establishment in Philadelphia. It was from this Philadelphia firm that the vaccine virus came that produced the foot-and-mouth disease at Wakefield in the summer of 1903, when Dr. Tyzzer was making his investigations on vaccine. It was from the Philadelphia establishment also that the vaccine virus used as a control seed by the New England Vaccine Company, in Chelsea, was obtained in the summer of 1902; and it was at Owen Clark's place in Chelsea that foot-and-mouth disease seems first to have started in 1902, he being the man who supplied cattle to the New England Vaccine Company, and who took them away again after the company was through with them. The reason why the disease never escaped in the vicinity of Philadelphia seems to be that the calves used there were killed and autopsies made upon them after the vaccine virus was taken from them, instead of being sold to farmers, as is the custom in some establishments. The outbreak of 1908–09 in Michigan, New York and Pennsylvania seems, therefore, to have come from the same source as the Massachusetts outbreak in 1902–03, and to have been carried along in the vaccine virus of the Philadelphia manufacturer for a number of years.

The United States Marine Hospital Service has control of the production of vaccine virus in the United States, and it has now traced out all the contaminated vaccine virus and destroyed it; therefore, there seems to be no further danger of any more outbreaks of foot-and-mouth disease from this source, — outbreaks that have cost the country several millions of dollars.

It is said that none of the contaminated virus from the Detroit establishment was ever put upon the market, as all that was produced from the seed obtained from the Philadelphia firm was set aside, and none of it had ever been sent out at the time it was ascertained that it was contaminated and ought to be destroyed.

Rabies.

The outbreak of rabies which started in the winter and spring of 1905 has almost subsided, and it is hoped that it will soon practically disappear, and become a disease of rare occurrence, until the time arrives when there is another generation of particularly susceptible dogs with a surplus of dog population, when the introduction of some new cases infected with a strong virus will undoubtedly cause another similar outbreak, under our peculiar system of dog management, and history will repeat itself, — at least, there seems to be one of these outbreaks of rabies every fifteen or twenty years.

At the beginning of the year commencing Dec. 1, 1908, Fitchburg was the only place in Massachusetts where an order to restrain dogs was in force, and Fitchburg and Wareham were the only two places where any considerable number of dogs were in quarantine. There has not been a case of rabies in Wareham since September, but in Fitchburg there have been several cases quite recently.

The following table shows the prevalence of rabies during the year ending Nov. 30, 1909: —

	Dogs.	Cattle.	Horses.	Swine.	Goats.
Killed or died with rabies,	126	11	–	2	1
Killed by owners or died in quarantine, not rabid,	164	–	–	–	–
Released from quarantine,	136	5	1	3	–
Animals still in quarantine,	35	–	–	–	–
Totals,	461	16	1	5	1
Grand total,	484	–	–	–	–

One dog released July 12 developed rabies, and was killed September 28.

One human death from rabies has occurred during the past year. A boy died in Lynn, November 6, who was reported to have been bitten by a stray dog several months before. During the year ending November 30, 77 people in Massachusetts took the Pasteur anti-rabic treatment.

The veterinarian of the Boston Board of Health reports 29 cases of rabies in dogs in that city during the year, making a total for the entire State of 154 mad dogs. The total number of dogs having rabies during the year ending Nov. 30, 1908, in Massachusetts, including Boston, was 504; this shows a decrease of 350 cases for 1909. The western part of the State has been entirely free from this disease, as not a case has been reported west of North Brookfield.

During 1909, Dr. Frothingham has examined the brains of 87 animals for rabies, of which 52 have proved positive or probable cases, and 35 have proved to be negative. One dog's head sent to Dr. Frothingham was in such a condition that he could not examine it.

Rabies has not only prevailed extensively in southern New England for the past few years, but is disseminated throughout the eastern three-fourths of the country, as is shown by a recent publication of the Public Health and Marine-Hospital Service of the United States Treasury Department, by Drs. John W. Kerr and Arthur M. Stimson.

The following table may prove of interest in showing the number of cases of rabies and the number of animals dealt with during the outbreak of this disease in Massachusetts, which it is now hoped is nearly over.

Animals which had Rabies, quarantined, etc., during Outbreak commencing early in 1905, continuing to Dec. 1, 1909.

	Dogs.	Cattle.	Horses.	Goats.	Swine.	Cats.
Killed or died with rabies,	1,804	110	12	2	21	5
Killed by owners, or died in quarantine, not rabid,	1,407	10	–	1	21	21
Released from quarantine,	1,770	20	18	2	6	3
Reported as suspected of having rabies but found free from this disease,	170	9	–	–	–	7
Still in quarantine, Dec. 1, 1909,	35	–	–	–	–	–
Total animals dealt with,	5,186	149	30	5	48	36
Grand total,	5,454	–	–	–	–	–
Total animals rabid,	1,954	–	–	–	–	–

Number of human deaths, ... 19

Number of persons who have had to go to the trouble and expense of taking the Pasteur anti-rabic treatment, because of being bitten by rabid dogs, ... 518

The above figures give but an inadequate idea of the amount of property destroyed and the human and animal suffering caused by this malady; yet there are people who do not believe that such a disease as rabies exists, and oppose or ridicule measures taken for its suppression.

Three persons have been prosecuted for not keeping their dogs in quarantine after notice to do so was served upon them by the inspector of animals. One man in Medford was fined $50 in the Malden court; he appealed, but has since died. Two men were prosecuted at Wareham: one was found guilty, and assessed the costs of the prosecution, amounting to $3.65; the other was discharged. The dog owned by the man who was discharged went mad after being quarantined, broke away, and bit a number of other dogs. The owner claimed that he was chained, and that he broke the chain. There was also a question as to whether the notice of quarantine had been properly served on the owner, and he was therefore discharged.

Glanders.

There was a marked diminution in the number of cases of glanders and farcy reported in Massachusetts during the year ending Nov. 30, 1909, from the previous twelve months.

During the year ending Nov. 30, 1908, 941 cases of glanders or farcy were recorded, beside which there were 24 animals under observation at the end of the year. Twenty-one of these were later released, and 3 were killed as having glanders. Adding these 3 to the 941 cases previously decided makes a total of 944 animals killed or which have died that were quarantined prior to Dec. 1, 1908.

During the year ending Nov. 30, 1909, 1,180 horses or mules have been reported, including those dealt with in stable tests. Of these, 684 have been killed as having glanders or farcy, 479 have been released, and 17 were still held for further examination.

This shows a decrease of 260 cases for the entire State, of which 158 are to be credited to Massachusetts outside of Boston, and 102 to Boston, as the veterinarian of the Boston Board of Health reports 287 cases for the year ending Nov. 30, 1909, as compared with 389 cases for the previous year.

Nearly all of the cities in which cases of glanders occur show a marked decrease in the number of cases of this disease except Fall River, where it remains about the same, 22 cases having been killed there in 1908, and 24 in 1909.

In Lowell only 7 cases were found, of which 6 were reported by the agent of the Cattle Bureau detailed to examine the horses sent there to the Thursday auction; of these 6 animals, 5 came from outside of Lowell, 1 each from Maynard, Methuen, Somerville, Lawrence and Nashua, N. H., leaving only 2 horses that were owned in Lowell, as compared with 26 horses the previous year, 19 killed as Lowell horses, and 7 found at the auction stable by the Cattle Bureau agent.

In Worcester, where there were 26 cases in 1908, there were but 14 cases during the year ending Nov. 30, 1909. Several years ago as many as 100 cases of glanders and farcy have been found in Worcester in a single year.

There is practically no glanders in Massachusetts west of Worcester. Occasionally a horse with this disease may be purchased in Boston or in New York by some farmer, taken home by him to a country town, and thus start a small outbreak of this malady; but these outbreaks are as a rule easily handled, and are soon stamped out.

Eighty-four stable tests have been undertaken during the year, 35 cases of glanders having been found in these stables previous to making the tests. Three hundred and eighty-three horses were tested with mallein; of these, 157 were released after the first test, 50 after a second test, 110 on subsequent tests, 49 were killed after the first or subsequent tests, and 17 are held for further tests.

Mallein does not always seem to be infallible, as in one instance a horse that failed to react had a discharge from the nose that infected with glanders guinea pigs which were inoculated with it; and in another instance a horse that had reacted to mallein every year for the last three or four years, in a stable where an outbreak of glanders occasionally occurs, was killed, and was found to show so little indication of disease that the owner will have to be reimbursed by the Commonwealth.

In many instances the inoculation of guinea pigs seems to be of great value in deciding doubtful cases. This work, as in the past, has been done under the supervision of Dr. Langdon Frothingham, at the Harvard Medical School.

The reports of rendering companies, as required by section 111 of chapter 75 of the Revised Laws, as amended by chapter 243 of the Acts of 1907, continue to be of much value in furnishing information of cases of glanders or farcy, which would not otherwise be called to the attention of the Chief of the Cattle Bureau, as the following table illustrates: —

Reports of Rendering Companies.

Rendering Companies.	Number of Reports.	Number of Cases.	Number in Boston.	Number out of Boston.	Number outside of Boston not previously reported.
Butchers' Rendering Company, Fall River.	10	-	-	-	-
Fitchburg Rendering Company,	1	2	-	2	-
William S. Higgins, Saugus, .	4	2	-	2	-
Home Soap Company, Millbury.	10	1	-	1	-
Lowell Rendering Company, .	16	1	-	1	-
Albert G. Markham, Springfield.	3	1	-	1	-
James E. McGovern, Andover,	23	11	-	11	-
Muller Brothers, North Cambridge.	33	89	4	85	10
W. H. Nankervis, Marlborough,	5	1	-	1	-
New Bedford Extractor Company.	6	6	-	6	1
New England Rendering Company, Brighton.	44	98	35	63	24
Peabody Tallow Company, .	5	3	-	3	-
Quincy Tallow Company, .	1	-	-	-	-
N. Roy & Son, South Attleborough.	18	18	-	18	1
A. E. Southwick, Mendon, .	1	-	-	-	-
N. Ward Company, South Boston.	51	255	205	50	9
Whitman & Pratt Rendering Company, North Chelmsford.	16	3	-	3	1
S. Winter, Brockton, . . .	4	2	-	2	-
Worcester Rendering Company.	6	5	-	5	-
Totals, ...	257	498	244	254	46

There do not seem to be any suggestions or recommendations to be made in reference to the management of glanders that have not been made in previous years.

During the year men have been prosecuted for selling glandered horses in Lawrence and Fitchburg.

In Lawrence a man was convicted in the police court of selling a horse with glanders in the previous November, and fined $100; he appealed, and the case is now slumbering peacefully in the office of the clerk of the superior court for Essex County, awaiting the pleasure of the district attorney.

In the Fitchburg police court last March, two men, one from Lunenburg and the other from Shirley, were found guilty of trading around a glandered horse; the former was fined $100, and the latter $50. Each took an appeal, and the cases were settled later in the superior court; the case against the man from Shirley was placed on file, and the man from Lunenburg pleaded guilty through his counsel, and a fine of $100 was paid.

Annual Inspection of Neat Cattle, Farm Animals, and Premises upon which the Former are Kept.

About the middle of September the following circular letter was sent to the inspectors of animals in the cities and towns of the State, together with the necessary books in which to record the results of their work, and blank forms of certificates of health to be given owners in conformance with section 18, chapter 90 of the Revised Laws: —

Commonwealth of Massachusetts,
Cattle Bureau of the State Board of Agriculture,
Room 138, State House, Boston, Sept. 15, 1909.

Directions to Inspectors of Animals.

Inspectors of animals are hereby directed to make a general inspection of the neat stock and incidentally other farm animals in their respective towns, as required by chapter 90 of the Revised Laws, such inspection to commence October 1 and to be completed before the fifteenth day of November.

Wherever inspectors examine animals and find them free from contagious disease, they will give owners certificates of health, as provided for in section 18 of the law, from the book of blanks (Form No. 2) furnished for that purpose. Books will also be provided (Form No. 1) for carrying out the provisions of sections 17 and 24 of chapter 90 of the Revised Laws.

Inspectors will not say on any report, "Same as last year," but will make a full and complete report on every place inspected, including all dimensions and measurements provided for on the blank, and answer in full all questions as to the light, ventilation, sanitary surroundings and water supply, as well as the number of cattle kept in each stable, and give a complete list of other animals in spaces provided in the book.

Inspectors of animals are not to quarantine any cattle as tuberculous unless they show sufficient evidence of disease to make it possible to condemn them on a physical examination, or show evidence of tuberculosis of the udder.

It is also requested that, if cases of tuberculosis in animals are found, inspectors keep a record of them for a few days, and then when animals are quarantined several can be quarantined at once, and duplicates sent here, so that the agent of the Cattle Bureau can see a number at one visit, instead of having to go every two or three days to see one animal at a time, thus avoiding running up expenses as much as possible.

It is also the duty of inspectors of animals to quarantine cattle brought into this State from without the limits of the Commonwealth, if the owner has not had a permit from this Bureau, the same to remain in quarantine until ordered released by the Chief of the Cattle Bureau or his agent.

Inspectors of animals, in case they suspect the presence of any contagious disease among any species of domestic animals, are to quarantine such animals and send duplicates to the Chief of the Cattle Bureau.

Contagious diseases, under the provisions of section 28, chapter 90 of the Revised Laws, 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."

The necessary books for the inspection will be forwarded at once. Please report immediately if not received by October 1. When inspection is completed, return book, Form No. 1, at once by express.

AUSTIN PETERS,
Chief of Cattle Bureau.

The following figures show the net results of the inspection: —

Number herds inspected,	31,986
Number neat cattle inspected,	224,666
Number cows inspected,	169,415
Number herds kept clean and in good condition,	27,420
Number sheep inspected,	23,888
Number swine inspected,	67,307
Number goats inspected,	1,113
Number stables inspected,	33,396
Number stables well located,	29,127
Number stables well lighted,	25,829
Number stables well ventilated,	27,640
Number stables kept clean,	29,096
Number stables with good water supply,	30,956
Number stables improved since last inspection,	1,292

Reports have not been received from Haverhill, Fall River, Sherborn or Ware. The Haverhill inspector resigned in the autumn, because the city would not pay him enough, and the city government has not reported his resignation, increased his salary or chosen his successor.

There seems to be no excuse, so far as is known to the Chief of the Cattle Bureau, for the inspectors of animals in Fall River, Sherborn or Ware not having sent in their reports.

Allowing for no diminution in the number of neat cattle and cows in these four towns from the previous year, and adding them to the totals given above, there seems to be a continued decrease in the number of both neat cattle and cows in the State. The report shows 224,666 neat cattle inspected, of which 169,415 were cows. Adding the number of neat cattle and the number of cows respectively in Fall River, Haverhill, Sherborn and Ware a year ago, and subtracting the total from the number of neat cattle and cows given in last year's report, a falling off is shown of 5,868 neat cattle, of which 4,516 are cows. The report also shows a diminution in the number of sheep, pigs and goats, there being about 2,500 less sheep, over 15,000 fewer swine and 73 less goats than in 1908. If the work of the inspectors is thoroughly done and the figures are reliable, and it is believed they are, this shows a sad state of affairs, and calls for a remedy.

The inspectors of animals are appointed annually in the month of March by the mayors and aldermen in cities and the selectmen in towns, subject to the approval of the Chief of the Cattle Bureau. Of course the Chief of the Cattle Bureau cannot very well refuse to approve any reputable veterinarian appointed by the mayor and aldermen in a city, or any reputable citizen appointed by the selectmen in a town, even though he knows, when a change is made, that the new incumbent is not going to be as efficient as the retiring inspector, or that in some cases a change is made in a border town for the sake of having a man who is blind to the smuggling of untested cattle across the line from neighboring States, in violation of the rules and regulations of the Cattle Bureau. It seems as though in many instances it would be desirable for the Chief of the Cattle Bureau to have still more control and choice in the matter of the appointment of the local inspectors, to the end that the service be improved and rendered more efficient than it is at present.

Tuberculosis.

The work for the eradication and control of bovine tuberculosis can, as usual, be grouped under three heads: first, the examination of animals quarantined by the local inspectors on suspicion of being diseased, and the appraisal and condemnation of those found by the agents to be tuberculous; second, the quarantining and testing of cattle intended for dairy or breeding purposes, brought into Massachusetts from other States to the stock yards at Brighton, Watertown or Somerville, and those brought in on permits to other points; third, testing cattle with tuberculin for owners who are desirous of eradicating the disease from their herds.

The following figures show the number of neat cattle quarantined by local inspectors, the number for which warrants were issued, and the disposition made of the animals: —

Total number of cattle quarantined or reported for examination during the year,			3,332
Massachusetts Cattle.			
Number released,	845		
Number condemned, killed and paid for,	1,040		
Number permit to kill, paid for,	95		
Number permit to kill, to be paid for,	6		
Number permit to kill, no award,	243		
Number died in quarantine, no award,	71		
Number condemned and killed, in process of settlement,	766		
Number in quarantine, unsettled,	2		
Released, died soon after and found tuberculous and paid for,	1		
		3,069	
Cattle from without the State.			
Number released,	13		
Number condemned and killed, no award,	238		
Number condemned, killed, no lesions found, paid for,	8		
Number condemned, killed, no lesions found, to be paid for,	4		
		263	
Total,			3,332

Of the above 263 interstate cattle, 167 were tested and retested at Brighton, 2 of which were released and 165 condemned; no lesions were found in 6, for 4 of which the State has reimbursed the owners, and payment will be made for the remaining 2 upon presentation of claims by owners. Of the remaining 96 cattle (which were tested at other points than Brighton), 6 were found to show no lesions, 4 of which have been paid for, and the remaining 2 will be paid for upon presentation of claims.

In addition to the 3,332 head of cattle disposed of as above, 741 cattle and 1,628 swine have been reported by butchers, renderers and boards of health as having been found tuberculous at time of slaughter. Of this number, 463 cattle and 1,612 swine were slaughtered at the Brighton Abattoir, and 155 cattle and 1,233 swine were but slightly affected and passed by the inspector of the Boston Board of Health or the United States Bureau of Animal Industry inspectors as fit for food. The others were rendered. The cattle and swine reported as tuberculous at the time of slaughter by other boards of health were all cases that showed sufficient evidence of disease to make it necessary to condemn them as unfit for food.

Under the second group, the maintenance of a quarantine against other States to prevent the introduction of tuberculous cattle from outside sources into Massachusetts, the following figures show the number of animals brought in from without the State, and the disposition made of them: —

Receipts of Stock at the Watertown Stock Yards, from Dec. 1, 1908, to Nov. 30, 1909.

New Hampshire cattle,	4,456
Vermont cattle,	6,650
Massachusetts cattle,	1,607
Western cattle,	15,460
Sheep and lambs,	6,473
Swine,	3,468
Calves,	25,728

Receipts of Stock at the New England Dressed Meat and Wool Company's Yards at Somerville, from Dec. 1, 1908, to Nov. 30, 1909.

Maine cattle,	5
New Hampshire cattle,	1,768
Vermont cattle,	5,610
Massachusetts cattle,	51
Western cattle,	57,063
Canada cattle,	23,496
Sheep and lambs,	334,973
Swine,	1,253,855
Calves,	41,251

Receipts of Stock at Brighton, from Dec. 1, 1908, to Nov. 30, 1909.

Maine cattle,	8,900
New Hampshire cattle,	2,453
Vermont cattle,	3,189
Massachusetts cattle,	12,525
New York cattle,	3,734
Western cattle,	54,179
Canada cattle,	1,015
Sheep and lambs,	25,165
Swine,	20,935
Calves,	56,486
Cattle tested,	13,433
Cattle condemned after test,	144
Cattle killed on permit to kill,	28
Cattle released after test,	13,261

The cattle upon which a tuberculin test is required are mostly milch cows to be offered for sale at the Brighton market Wednesdays, beside a few bulls and working oxen. Those animals that come to Watertown or Somerville are taken to Brighton, and all of the testing is done at the stock barn there.

Report of Cattle brought into State during the Year to Points Outside of the Quarantine Stations.

For dairy and breeding purposes, tested before shipment, .	764
For dairy and breeding purposes, tested after arrival, . .	6,750
For dairy and breeding purposes, awaiting test, ...	7
Total, ...	7,521
Neat cattle on which no test was required, exclusive of cattle and calves for immediate slaughter, ...	1,089
Total, ...	8,610

The cattle and calves on which no test was required, exclusive of animals for immediate slaughter, were as follows: —

Returned from out-of-State pastures, ...	795
Calves under six months old, ...	178
Injured and killed, or died before tested, ...	6
Kept in State for brief periods only, ...	110
Total, ...	1,089

The number of cattle and calves brought into the State for immediate slaughter cannot be given exactly, as there were a number of permits issued on which no definite returns were received, there being several large abattoirs in the State where beef cattle are constantly being received in carload lots, and where inspection by United States government officials is in force. In round numbers there were 10,000 cattle and calves brought in on permits, intended for immediate slaughter.

Nearly all of the total number of animals given above were brought into the State on permits issued by the Chief of the Cattle Bureau, only 359 head having been brought in without permits, which were reported to this Bureau by railroad agents, local inspectors or others. Of these, 13 were accompanied by satisfactory certificates of tuberculin test, 17 were calves under six months old, 23 were slaughtered at once for beef or veal, and the remainder, 306 head, were tested by agents of the Cattle Bureau. There were also 4 herds brought into the State without permit for exhibition purposes, which were duly reported to this Bureau.

The following figures show the disposition of animals that were brought into the State on permits, to points outside of the quarantine stations at Brighton, Watertown and Somerville, for which warrants were issued after their having failed to pass a satisfactory tuberculin test: —

Condemned on first test,	5
Condemned on second test,	86
Condemned on third test,	1
Total,	92

Of the above, 4 warrants, with report of killing, have not yet been returned; 5 animals were found on post-mortem examination to be free from disease, and either have been or will be paid for by the State; and 83 were found on post-mortem examination to be affected with tuberculosis.

There were 1,115 permits issued during the year. Of these, 3 were still in force and not reported upon at the close of the year, and 151 were reported as not used.

Thirteen permits were issued allowing cattle to be brought into the State for exhibition at agricultural fairs, to remain for a brief time only; 9 were issued for returning cattle from exhibition in other States; 13 were issued for pasturing herds in the State during the season; 6 allowing cattle to be unloaded in transit or driven through the State; and 3 allowing cattle to cross the line daily to or from pasture.

Sixty-two permits were issued to bring animals to the quarantine stations at Brighton, Watertown or Somerville, or to bring in sheep and swine, during the time that restrictions were in force on account of the existence of foot-and-mouth disease in other States, which otherwise would not have been required.

For several years, at the request of the United States Department of Commerce and Labor, a report of the receipts of all live stock at the port of Boston has been sent to Washington each month. The report is made to show weekly receipts. The following table shows the totals by months for the past year: —

Receipts of Live Stock at Boston for Twelve Months ending Nov. 30, 1909.

For Month ending —	Cattle.	Calves.	Sheep and Lambs.	Swine.	Horses.
Dec. 22,	26,338	9,245	28,311	174,765	2,385
Jan. 26,	24,764	6,244	33,234	140,039	2,485
Feb. 23,	15,484	6,905	19,078	121,984	2,300
March 31,	19,998	12,111	20,111	126,100	3,385
April 27,	13,205	11,417	14,061	77,374	2,395
May 25,	11,230	13,565	11,996	66,535	2,135
June 30,	13,736	14,190	28,310	131,684	2,540
July 31,	10,664	9,494	31,521	102,374	1,995
Aug. 31,	14,062	12,158	45,104	132,264	2,180
Sept. 30,	13,801	8,743	33,259	73,995	1,905
Oct. 31,	17,617	8,976	37,781	56,343	2,117
Nov. 30,	22,210	10,417	51,713	94,914	2,350
Totals,	203,109	123,465	354,479	1,298,371	28,172

The third division of the work consists in testing herds with tuberculin for owners who desire it, and is known as voluntary request work. The following figures show what has been done under this division: —

63 persons, in 30 different cities and towns, made voluntary requests to have their herds tested: —

63 herds were tested, comprising		575 cattle.
Released,	462	
Killed on permit to kill, paid for,	53	
Killed on permit to kill, no award,	60	
		575 cattle.

In 3 of the animals killed no lesions were found on post-mortem examination.

Miscellaneous Diseases.

In addition to rabies, glanders and bovine tuberculosis, the Cattle Bureau is called upon during the year to deal with other diseases of a contagious character, usually classified in these reports as "miscellaneous." While there are fewer cases of these diseases than there are of rabies, glanders and bovine tuberculosis, and while the expense of dealing with them is proportionately less than with tuberculosis, these outbreaks are nevertheless of considerable economic importance, and some of them may be a menace to public health.

Among the miscellaneous diseases are actinomycosis, hog cholera and allied troubles, symptomatic anthrax or blackleg, anthrax, Texas fever, and tuberculosis in other animals than cattle.

There are among animals other communicable diseases over which the Chief of the Cattle Bureau has no jurisdiction, because they are not among those classified in the statutes as contagious, such as mange among horses and cattle.

The law should be amended so as to allow the Chief of the Cattle Bureau to take proper measures for the control and eradication of any disease of a communicable character that appears among our domestic animals. For example, several cases of mange among cattle have been reported during the year; herds in which this disease appears should be quarantined, in order to prevent the trouble from spreading to other farms, and owners directed to take proper steps for treating infected animals and disinfecting their premises. Mange among horses is a similar disease, over which the Chief of the Cattle Bureau should be given some control.

There has been very little disease that can be grouped under the generic term of hog cholera; only 14 outbreaks have occurred, and most of these were early in the year. No new cases of diseases of this kind have been reported during the past autumn or this winter, and the quarantines have been raised from premises where swine were found diseased early last year, as the disease subsided and the premises were disinfected.

Occasionally a case of tuberculosis in a pig is reported before the animal is killed, but most of these cases are found post mortem, when the swine are killed for food.

A case of tuberculosis occurred in a horse which died in Cambridge and was taken to the Brighton Abattoir. It was reported to the Cattle Bureau, and an agent went to see it and took specimens to Dr. Theobald Smith, who decided it was a case. The bacilli resembled the bovine type.

A number of cases of actinomycosis have been reported during the year, 14 or 15 in all, most of them being that form of the disease known as "lumpy jaw." In two or three cases the disease affected the tongue. When this organ is involved, the disease is sometimes known as "wooden tongue." One case reported by the inspector of animals was in a pig killed for food, the lesions being in the abdominal muscles. It was advised to destroy this carcass, as unfit for human food.

Another case of actinomycosis was in the udder of a cow. This animal was ordered killed. Another cow with lumpy jaw was emaciated and unable to eat, and was ordered killed. Where cattle have recent lesions involving the jaw the owner is advised to feed liberally until in good flesh, and then kill for beef under the proper inspection.

In pastures where symptomatic anthrax or "blackleg" has occurred in previous seasons or during the past season, the protective inoculation has been given to the young cattle when the owners requested it. The material used for the protective inoculation the past season has been furnished by the Bureau of Animal Industry, United States Department of Agriculture, and sent to Dr. James B. Paige at the Agricultural College, who has prepared it for use as needed. The treatment has then been administered either by him or his brother, Dr. Henry E. Paige.

One hundred and sixty-six young animals have been vaccinated since April 24, in the towns of Granville, Princeton, Royalston, Ashby, Washington, Greenwich, Prescott, Rowe and Ashburnham. Reports as late as November 20 have been received from all but two owners, who represented only three animals, and all were alive and well except two; one of these died six weeks after inoculation, cause not reported; the other died about ten days after inoculation, with symptoms of blackleg.

A few animals were inoculated earlier in the season with blacklegoids.

A number of animals, both cattle and horses, have died of anthrax during the summer and early autumn, in the vicinity of Great Barrington, most of them in the valley of the Housatonic River, in the town of Sheffield below Great Barrington. At first the animals were supposed to have been poisoned by some poisonous plant growing on low land, which the animals ate because of the shortage of feed caused by the drought; but later, by having specimens of blood from dead animals sent to the Harvard Medical School for examination, the anthrax bacilli were found.

Altogether, 28 cattle are reported to have died of this disease, 11 horses and possibly 2 pigs; 2 men in the town of Sheffield have had malignant pustule on the arms, from skinning cows that died of anthrax. There have not been any cases reported since October, and it is hoped that the outbreak is over, although there is a possibility of its reappearance in the spring.

In addition to investigations of this outbreak made by agents of the Cattle Bureau and its Chief, the Commonwealth is much indebted to the medical officer of health of the district, who has made a very valuable report of what he has been able to ascertain. The origin of the outbreak has not as yet been discovered.

Several sudden deaths occurred in an expressman's stable in Medford early in the summer, in all 3 horses dying. These deaths were very sudden, and occurred in a locality where anthrax was found the previous year, and it was thought at first that death was due to anthrax. Further study showed it to be an acute septic infection; the remaining horses were removed from the stable, and the premises disinfected.

A few cases have been reported of arsenate of lead poisoning in cattle grazing near sprayed trees, as well as the usual cases of infectious pneumonia of cattle, dysentery among cattle, etc., which have been investigated sufficiently to ascertain that they were not contagious diseases recognized by the statutes. A few cases of infectious keratitis (that is, infectious inflammation of the cornea) have been reported during August, but the trouble does not appear to have been serious.

Contagious abortion in cows, as well as barrenness, due to infectious vaginitis, are matters to which the attention of the

Chief of the Cattle Bureau is occasionally called, but not often; yet undoubtedly these troubles frequently occur, and may some day become matters of sufficiently serious importance to require some legislation or action on the part of the State, to advise and assist farmers in checking losses from these causes.

Meat Inspection.

In the tenth semiannual report of the Chief of the Cattle Bureau to your honorable Board, the subject of meat inspection and the laws of this Commonwealth relating to it was dealt with at considerable length. It was again taken up in the twelfth semiannual report, your attention was called to the lax manner in which these laws are enforced by the local authorities, and the baneful influence of local politics upon the inspection of meat was dwelt upon quite fully. At that time the desirability of organizing a State system of slaughterhouse licensing and meat inspection, under the supervision of a competent central authority removed from the influence of local politics, and at the expense of the State, was pointed out.

What was said upon this very important question in the report of January, 1907, and again in January, 1908, seemed to arouse so little comment and awaken so little interest that it was not referred to in the report a year ago. But an agitation over the question of a suitable meat supply the last year seems to have suddenly awakened public interest to demanding that the law be made adequate and operative, and that the inspection in local slaughterhouses and the sanitary surroundings be brought up as nearly as possible to the standard required by the United States government in establishments where animals are slaughtered and meat products prepared for export and interstate commerce. There has been so little change in the laws relating to slaughterhouse licensing and meat inspection during the last three years that the criticisms made upon their shortcomings and failure to protect the public health in the tenth and twelfth semiannual reports of the Chief of the Cattle Bureau to the State Board of Agriculture apply equally as well to conditions to-day as they did at the time they were written. In fact, conditions have been made worse, in an attempt to add too much law to law that was already sufficient.

For instance, when tuberculosis in cattle was first recognized by the Commonwealth as one of the contagious diseases, the law required the condemnation of the carcasses of all cattle infected to any degree with this disease. A committee of the Legislature was appointed in the spring of 1897 to investigate the doings of the Cattle Commissioners, especially the killing of certain cattle from Dracut, which had been tested by private veterinarians employed by the owners. The test was in some ways disappointing to the owners, as many of the best-looking cows and largest milkers reacted, and were condemned by the Cattle Commissioners. These animals were killed at Brighton in the spring of 1897, and a board of experts, consisting of Drs. Theobald Smith, H. C. Ernst, F. S. Billings, Geo. N. Kinnell and Chas. Wood, employed by the State, witnessed the autopsies. The greater proportion of the animals were found to show some slight local lesion that in no way impaired the food value, and only a few were in a condition to make it necessary to destroy the carcasses as unfit for human food. The result was that the Legislature immediately passed an act that no one having cattle tested with tuberculin could receive compensation from the State for reacting animals unless the testing was done by the "Cattle Commissioners or their authorized agents acting as such at the time of the test, and such testing must be subject to the supervision and control of the State Board of Cattle Commissioners." The next year the Legislature passed an act permitting the Cattle Commissioners to make rules and regulations for the inspection of meat to conform to the rules and regulations of the United States Bureau of Animal Industry for the inspection of meat for export and interstate commerce. When the Board of Cattle Commissioners was abolished in the spring of 1902 and replaced by the Cattle Bureau, the law creating the Cattle Bureau provided that the Chief of the Cattle Bureau could issue these rules and regulations provided for in section 7, chapter 90 of the Revised Laws, subject to the approval of the Governor and Executive Council. This was believed to be the policy of the Commonwealth, and it was supposed that Massachusetts had forever abandoned the reckless and extravagant policy of making perfectly wholesome food into fertilizer; yet this condition of affairs was returned to, it appears, by the passage of section 1 of chapter 329 of the Acts of 1908, known as the "bob veal law," which provides as follows: —

SECTION 1. The sale, offer or exposure for sale, or delivery for use as food, of the carcass, or any part or product thereof, of any animal which has come to its death in any manner or by any means otherwise than by slaughter or killing while in a healthy condition, or which at the time of its death is unfit by reason of disease, exhaustion, abuse, neglect or otherwise for use as food, or of any calf weighing less than forty pounds when dressed, with head, feet, hide and entrails removed, is hereby declared to be unlawful and prohibited. Whoever sells or offers or exposes for sale or delivers or causes or authorizes to be sold, offered or exposed for sale or delivered for use as food any such carcass or any part or product thereof, shall be punished by fine of not more than two hundred dollars or by imprisonment for not more than six months.

In the controversy that arose last spring as to the meaning of this section of the law, the Attorney-General's opinion was sought, with the result that he gave the following opinion: —

The laws and statutes of this Commonwealth do not permit meat derived from the carcasses of cattle infected in any degree with tuberculosis or with any other disease to be sold as food within this Commonwealth.

The result of this opinion was to nullify and abrogate the rules and regulations of the Chief of the Cattle Bureau, approved by the Governor and Council, in conformity with the rules and regulations of the United States Bureau of Animal Industry for the inspection of meat for export and interstate commerce. Just how the law was to prevent the sale in Massachusetts of beef or pork from an animal killed in Chicago that was not absolutely technically sound is not exactly clear.

The result of this decision was that the following new section was added to chapter 329, Acts of 1908, as follows: —

SECTION 8. This act shall not affect the provisions of section seven of chapter ninety of the Revised Laws, as affected by section three of chapter one hundred and sixteen of the acts of the year nineteen hundred and two: *provided, however,* that nothing in this act shall be construed to permit the sale, offer for sale, or keeping with intent to sell, for food, of meat infected in any degree with tuberculosis or any other disease.

An intelligent modern system of meat inspection is intended to prevent the sale of meat infected in any degree with tuberculosis or any other disease. At the meeting of the Eastern Live Stock Sanitary Association at Springfield in May the following resolution was passed: —

Whereas, certain States condemn the flesh of animals that are found on post mortem to be affected with slight or localized tuberculosis, thereby causing the loss of many carcasses that would be passed as sound and fit for food by the federal meat inspection service, and that it is admitted by all of the best sanitary authorities to be entirely safe and free from objection: therefore, be it *Resolved,* that measures should be taken to protect the public from foods that contain the germs of bovine tuberculosis; such germs enter the milk from the secretion of cows in certain stages of the disease, and are found in meat only when the disease has progressed beyond a certain stage of development. The extent of the disease in the living animal cannot be determined with accuracy, hence any cow that has reacted to the tuberculin test should not be used for market milk production unless the milk is adequately pasteurized. The extent of the disease in slaughtered animals can be exactly determined on post-mortem examination, and the carcass of an animal infected with tuberculosis should be disposed of in accordance with the condition found; that is, if the location and extent of the lesions are such as to denote the possibility that the edible parts of the carcass may be infected or contaminated, the carcass should be rejected. On the other hand, however, if the disease is of slight or local development, so that all of the possibly contaminated parts or infected organs may be removed, the carcass should not be condemned, but should be passed for use as pure food after the destruction of such parts. To condemn and destroy the entire carcass of slightly or locally infected animals is unjustifiable on any rational sanitary basis, and it is an economic crime. Regulations for inspecting and passing on the carcasses of animals infected with tuberculosis similar to those of the federal meat inspection service are quite sufficient, and are recommended.

The framers of section 1, chapter 329, Acts of 1908, did not intend it to have the effect it did. It was intended, among other things, to prevent cruelty to calves, and was supported by the Society for the Prevention of Cruelty to Animals. It has not, however, fulfilled the intention of its originators in this respect, as this report will presently show.

Section 71 of chapter 56 of the Revised Laws, as amended by chapter 411, Acts of 1908, provides as follows: —

SECTION 71. The board of health, by themselves, their officers or agents, may inspect all veal found, offered or exposed for sale or kept with the intent to sell in its city or town, and if, in its opinion, said veal is that of a calf less than four weeks old when killed, the board shall seize and destroy or dispose of it as provided in the preceding section, subject, however, to the provisions thereof relative to the disposal of money.

Nothing in section 1, chapter 329 of the Acts of 1908, in any way repeals the provisions of section 71, chapter 56, Revised Laws, as amended by chapter 411, Acts of 1908; yet the inspectors and agents of the local boards of health construe the law to allow them to pass the carcass of any little calf three or four days old or less that dresses forty pounds. The usual dressed carcass is supposed to have the legs cut off at the knees and hocks; but as this section specifies how the carcass shall be dressed, the butcher cuts the feet off at the ankles, and thus gains two or three pounds for the weight of the carcass. In some places, if the dressed carcass is small and skinny, a hollow needle, attached to a rubber tube from a compressed air tank, is inserted into the connective tissue among the muscles on the inside of the thighs, and the air turned on, so that each little carcass presents a plump and pleasing appearance to the eye of the uninitiated.

Last spring, when the danger from foot-and-mouth disease commenced to abate, it was decided to allow cattle to come from certain parts of New York State on permits issued by the Chief of the Cattle Bureau. Some of these were issued to butchers in Brighton to ship calves from the dairy districts of New York. It was found that on these permits calves were being shipped to Brighton that were less than four weeks old, most of them being not over three or four days old, and distributed to various slaughtering establishments to be killed for veal, in Brighton, Watertown and Cambridge. As the laws of the State of New York provide that calves under four weeks old can be shipped out of the State only in crates, unless sent in cars with their mothers, and then only with the understanding that they are to be raised, it was necessary to ship them to some fictitious dairy company, in order to mislead the New York State officials, and give them the idea that the calves were to be raised. These little creatures were therefore shipped to the "Cambridge Dairy Company" and other fictitious concerns; and the fact of their arriving in crates ought to be prima facie evidence that they were less than four weeks old, and as a matter of fact nearly all were less than a week old, as the navel strings were still hanging from most of them, fresh and damp. The way they were raised was by the heels when their throats were cut. As these calves were nearly all grade Holsteins, they would when alive weigh eighty pounds or a little over, and would dress forty pounds with their shins on; therefore the agents of the local boards of health stamped them as fit for food, without any regard to section 71, chapter 56 of the Revised Laws, as amended by chapter 411, Acts of 1908 (a later chapter, by the way, than chapter 329, Acts of 1908). Some of the earlier shipments went to a stall at the Brighton Abattoir, where they had the United States inspection. This was too strict for the butchers, who stopped killing the calves there, and took them to a slaughterhouse in Watertown.

Agents of the New York State Department of Agriculture were sent here to investigate the matter, and the Chief of the Cattle Bureau gave them all the assistance he could. These agents said that the law relating to killing "bob veal" in New York State was being very rigidly enforced, and that because of this the calves brought to the railroad stations to be shipped away were sorted. The good calves were shipped to New York City to be killed for veal, and the little bob calves, two or three days old, were packed into crates like chickens and turkeys, and sent to Massachusetts "dairy companies," to be "raised." Some of these poor little creatures, when they arrive at the railroad stations in New York State, are so weak that they are staggering. Such calves are knocked on the head at the point of shipment, and skinned, and those that it is believed can live through the journey of thirty-six to forty-eight hours are shipped to Brighton. A man with a barrel of milk and a calf-feeder accompanies the car as far as Greenfield, and is supposed to feed them on the way.

The Chief of the Cattle Bureau was about to revoke the permits he had issued, but after consulting with the Attorney-General and the lawyer representing the butchers, it was decided that the permits could not be revoked, as they were issued simply because of the restrictions then in force to prevent foot-and-mouth disease being brought into the State; and it was not his province to revoke them to prevent cruelty to animals, or because the inspectors of the local boards of health were passing as fit for food carcasses of calves which the law says are not to be passed as fit for food. The ludicrousness of the situation was added to in one place where the board of health seized several thousand pounds of perfectly good beef and pork, because the animals had some slight tuberculous lesions, and were stamping at the same time the carcasses of bob calves in direct violation of the law. The Society for the Prevention of Cruelty to Animals seems to have been unable to do anything, because of the man with the calf-feeder and barrel of milk, who cared so tenderly for his little charges as far as Greenfield.

At the markets near Boston where live stock comes in by the carload the calves have to be sorted over each week; the good ones are killed under the United States Bureau of Animal Industry inspection, and the little ones are taken to slaughterhouses where they will pass the inspection of the local boards of health, and are then sold on the market in competition with veal which has the United States inspection stamp upon it.

The rules and regulations of the United States Bureau of Animal Industry require that a calf, pig or lamb shall be not less than three weeks old, in order to be looked upon as fit for food, and the Massachusetts law should be changed to conform to this.

It does not seem creditable to the State of Massachusetts that agents of the New York State Department of Agriculture should have to come here to investigate a condition of affairs that this State should have immediately checked, and some legislation should be enacted to remedy this evil.

Farmers are constantly grumbling at the price of milk; yet it seems that when it comes to converting milk into veal, they are unwilling to do that. Possibly if some of the surplus milk were fed to calves, a better price might be obtained for the remainder; and if the calves marketed dressed sixty to seventy-five pounds, fewer calves would furnish just as much veal, and the remaining third might be raised. If keeping cows does not pay, save the bull calves and raise them up as steers, and thus produce some of our own beef nearer home. The Legislature of 1909 remedied a defect in the law for stamping carcasses by providing a penalty for the use of a stamp by an unauthorized person, or for any one having a counterfeit stamp. Now that the Governor has called the attention of the Legislature to existing conditions, no doubt the defects to which your attention was called in the reports of the Chief of the Cattle Bureau, two and three years ago, will be remedied.

Under the present laws the Chief of the Cattle Bureau is authorized to make rules and regulations, subject to the approval of the Governor and Executive Council, for the guidance of local boards of health in the inspection of meat, to conform to those of the United States Bureau of Animal Industry for the inspection of meat for export and for interstate commerce; the Chief of the Cattle Bureau furnishes stamps for marking carcasses that are inspected and passed as fit for food, when boards of health of cities or towns order them; and the licensing authorities of the cities or towns are required to send annually to the Chief of the Cattle Bureau the names of applicants for slaughterhouse licenses, and the action taken on each application; but the Chief of the Cattle Bureau has no authority to see that any of the rules or regulations or laws relating to these matters are complied with. Under the provisions of the law during the past year copies of the rules and regulations for meat inspection have been sent to the board of health in each city and town in the State, also a pamphlet containing a copy of the laws relating to the contagious diseases of animals, and of every section in the law that refers in any way to meat inspection or to the relation and duties of boards of health to the Cattle Bureau. Ninety-seven stamps for branding carcasses of animals killed and inspected for food have been furnished to 77 cities and towns during the year ending Nov. 30, 1909. Eighty-four cities or towns have reported licensing 234 slaughterhouses or establishments where meat products are prepared, and 4 licenses have been reported as revoked in 4 towns.

The law relating to licensing slaughterhouses and reporting them to the Chief of the Cattle Bureau is not well observed, and in addition to the slaughterhouses reported as being licensed there are undoubtedly many unlicensed ones, or, if licensed by the local authority, they are not reported to the Chief of the Cattle Bureau.

One trouble with the present system of requiring local boards of health to furnish the inspection for licensed slaughterhouses is that the expense places on many small towns the burden of providing a system of meat inspection for the larger neighboring cities and towns where the meat is marketed, while the small towns where the slaughterhouses are derive very little or no benefit from it. In the neighborhood of the larger cities abattoirs should be built, with a proper water supply, sewage connections, and an up-to-date rendering plant, where butchers could hire stalls, or where an individual could take an animal, have it killed for a small sum and have the carcass returned to him if it passed the slaughterhouse inspection; then all the dirty little barns and sheds rigged up for slaughterhouses should be abolished. With the building of such establishments it might be possible to secure federal inspection for many of them, and thus relieve the State of a part of the expense of maintaining the inspection; or it might prove desirable to have municipal abattoirs built for the larger cities of the State, owned by the municipalities, where butchers doing a small business could hire stalls at a reasonable rental, thus making it impossible for a single firm or individual to obtain control of the buildings. On the other hand, in remote rural communities the small slaughterhouse is almost a necessity, and ought to be encouraged. With the passing of the ranches of the west, the land is being divided into small holdings, and in time more and more of our beef and mutton must be farm raised. It is desirable to encourage eastern farmers to again raise beef, pork and mutton for home use and the local market, and for this the local slaughter-house is a necessity. With the raising of a greater number of food animals on the eastern farms, the producer and consumer can be once more brought nearer together, increasing the value of his product to the producer, and making the necessities of life more reasonable in price to the consumer, than when the business is in the hands of a few men and combinations of capital. This should be a great food-producing country, but for years the fertility of the land has been poured into the Atlantic Ocean or sent across the sea; and under present conditions it is easy to see that our export trade in cattle, sheep and pork will soon be a thing of the past. Already England is turning to the Argentine Republic for her imported beef supply, and it is safe to predict that the time is not far distant when cattle for slaughter or refrigerated beef will be sent by ship loads to New York City from Buenos Ayres, unless something is done to encourage and develop this declining branch of our agriculture.

Financial Statement.

At the close of the last fiscal year, Nov. 30, 1908, there was on hand, as per the fourteenth semiannual report: —

Balance of appropriation for salaries and expenses for 1908, ...	$94 55	
Balance of appropriation for general work of the Bureau for 1908, . .	6,700 44	
		$6,794 99
Appropriation for salaries and expenses of 1909, chapter 56, Acts of 1909, .	$7,000 00	
Appropriation for general work of the Bureau, chapter 124, Acts of 1909, .	70,000 00	
		77,000 00
Total to be accounted for, ...		$83,794 99

Expended during the year: —		
For 349 head of cattle condemned and killed during the year 1908, paid for in 1909,	$11,211 16	
For 17 head of cattle condemned and killed prior to 1908, paid for in 1909,	327 50	
For 1,151 head of cattle condemned and killed during the year,	25,537 65	
For killing and burial, quarantine claims and arbitration expenses,	211 10	
		$37,287 41
For services of agents (exclusive of glanders work),	$14,454 37	
For expenses of agents (exclusive of glanders work),	5,668 61	
For expenses of quarantine stations,	7,034 24	
For expenses of glanders work, including services and expenses of agents, laboratory work and killing and burial,	9,475 69	
For laboratory expenses (exclusive of glanders work),	1,924 03	
For implements, ear tags, thermometers, etc.,	682 62	
For salary of Chief of Bureau,	1,800 00	
For salary of clerk,	1,190 33	
For salaries of assistant clerks and stenographers,	1,613 82	
For office expenses, printing, postage, stationery, etc.,	1,968 97	
For expenses of Chief of Bureau,	110 59	
		45,923 27
Total expenditures,		$83,210 68
Balance from all accounts, Nov. 30, 1909,		584 31
Total, as above,		$83,794 99

This balance is made up from the following items: —		
Balance of appropriation for salary and expenses, 1908,	$94 55	
Balance of appropriation for salary and expenses, 1909 account,	316 29	
Balance of appropriation for general work of Bureau available for unsettled accounts of 1909,	173 47	
		$584 31

The average price paid for condemned cattle for the year was $22.18.

There has been received during the year, from the sale of hides and carcasses of condemned animals, sale of ear tags, testing cattle for non-resident owners, etc., $4,783.76.

Claims for 772 head of cattle condemned and killed as tuberculous during the year remain unsettled, to be paid for on proof of claims, the appraised value of which amounts to $16,534. The first of December, bills for salaries and expenses of agents and other miscellaneous expenses were received, amounting to $5,673.86. This makes an indebtedness of $22,207.86 to be met with the balance of $173.47.

The amount due at the close of the fiscal year ending Nov. 30, 1908, in excess of the appropriation for that year, was $11,538.66, this amount being chiefly for cattle killed. The Legislature of 1909 did not make any deficiency appropriation for the use of the Cattle Bureau, but worded the appropriation bill so that $70,000 was appropriated for the extermination of contagious diseases among horses, cattle and other animals for "this and previous years." Deducting, therefore, the $11,538.66 which had to be used to pay for cattle claims of 1908 and a few of the previous years, left only $58,461.34 to meet the expenses to be incurred during the fiscal year ending Nov. 30, 1909. As the expenses incurred during 1909 in the work of the Cattle Bureau were nearly as much as for the year previous, there was an indebtedness at the close of the fiscal year of $22,034.39, which will have to be paid from the appropriation for 1910, unless the Legislature makes a deficiency appropriation.

As the annual expenses of the Cattle Bureau in the general work incidental to exterminating contagious diseases among horses, cattle and other animals exceeds $70,000, an estimate sent to the Auditor, under the requirements of section 211 of the Acts of 1905, for the year ending Nov. 30, 1910, gives $100,000 as the amount required for the general work of the Bureau, and $7,000 for the salary of the Chief and his clerk, general clerical assistance, printing, postage and incidental expenses of the office.

As the deficit at the end of the fiscal year of 1908 was nearly $12,000, and as there will probably be a deficit of over $22,000 when all the bills for 1909 have been paid, it can readily be seen that if the expenses continue in the same proportion for another year, after paying out the $22,000 due for back bills there will be barely enough left to go on to the end of the year doing the usual amount of work, if $100,000 is appropriated for this and previous years, provided the present policy of the State in dealing with contagious diseases of animals is to be continued.

Respectfully submitted,

AUSTIN PETERS,
Chief of Cattle Bureau.

NINETEENTH ANNUAL REPORT

OF THE

DAIRY BUREAU

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

REQUIRED UNDER

CHAPTER 89, SECTION 12, REVISED LAWS.

PRESENTED TO THE BOARD AND ACCEPTED,
JANUARY 11, 1910.

Dairy Bureau—1909.

CARLTON D. RICHARDSON, West Brookfield, *Chairman.*
HENRY E. PAIGE, Amherst.
WARREN C. JEWETT, Worcester.

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.

In making this nineteenth annual report it may not be out of place to summarize somewhat the work of the Bureau since its establishment in 1891. Since 1892, when the first real work was done, 57,939 inspections have been made, an average of 3,218 annually, the average for the last two years being 6,981; 2,488 prosecutions have been made, averaging 132 per year; 2,320 convictions have been secured, an average of 128 per year. During the past seven years but 17 cases have been lost, or 2.4 per cent of the entire number prosecuted during that period, and only 20 defendants have been found violating any of the dairy laws a second time. A large majority of these prosecutions have been for violation of the oleomargarine laws. Meanwhile, the wholesale butter trade in Boston, according to Chamber of Commerce reports, has increased since 1900 at the rate of 1,850,154 pounds per year. There have been 545 meetings addressed upon dairy subjects, 280 of which have been since 1903. During these years there have been many demonstrations of the use of the Babcock milk tester, and on the points of the dairy cow; dairy tests have been conducted at fairs; inspections of creameries have been made; considerable dairy literature has been published, including during the past year an article on milk, its value as a food and its care in the home, prepared for translation into the Jewish and Italian languages, to be used among these people in Boston; also rules for the care of milk in the home, for posting. In all this work the welfare of the farmer and honest tradesman, as well as that of the consumer, has been constantly borne in mind.

During the year just closed there have been more total violations of the oleomargarine laws than for some years previous, but they have manifested themselves in different ways. The total number of all violations of laws prosecuted by the Dairy Bureau in 1909 was 206, all of which resulted in convictions. Of these, 5 were for watering milk, 33 for selling renovated butter in unmarked wrappers and 168 for violations of the oleomargarine laws, 121 of the latter being for violation of the oleomargarine restaurant law. This shows an attempt to increase consumption of the goods by taking chances in serving to guests in restaurants, boarding houses and hotels, without proper notice. The law distinctly states that notice shall be given to the guest that the substance so furnished is not butter. In some cases no attempt is made to give notice, and in others an attempt is made not to give notice by putting up a sign where no guest can see it, or by putting up a sign printed in such a way or upon such background that nobody sitting a short distance away can read it. Legally and morally such persons are just as guilty as those who make no attempt to give notice. Neither ignorance of the law nor such attempts at evasion are any defense.

It is true now, as it always has been, that oleomargarine should sail under its own colors, and be sold as and for what it is, entirely upon its own merits. The difference between the value and cost of oleomargarine and butter, and the close resemblance the former bears to the latter, make a temptation to sell and serve oleomargarine for butter so great that many yield to it. Last year we warned against the practice of watering milk. It seems that a warning against the practice of serving oleomargarine for butter in hotels, boarding houses and restaurants, without bona fide notice to guests, is now necessary.

In the educational work of the year we have especially urged that farmers weigh the milk of each cow, keep accurate accounts, raise more grain, buy less, study feeding rations, adopt practical, inexpensive methods of keeping cows clean, use covered milk pails with small openings in the top, and strain milk through sterilized cotton; that they thoroughly mix the milk of the herd before canning or bottling, both for their own protection and for that of the consumer. We have also used our influence towards restoration of confidence in whole raw natural milk; have repeatedly pointed out its superiority as a food over prepared milks, and over many other foods; and have made suggestions as to its care and handling in the hands of the consumer.

We believe that the true condition of the Massachusetts dairyman is not fully appreciated, and that his greatest trouble is that he does not receive enough for his product. When we consider that on May 1, 1890, there were 200,658 cows assessed in Massachusetts, while on May 1, 1909, there were but 168,221, a decline of 32,437 in total, or 1,707 cows per year, and that there were more than 6,000,000 quarts less milk shipped into Boston in 1909 than was the case in 1906, we must conclude that there is something wrong with conditions, and we are of the opinion that a commission should be appointed to investigate and report upon the commercial milk situation. No one looking for truth can reasonably object to such investigation, honestly and impartially made by a competent and reliable Board. We believe this would do much to clear the atmosphere and restore confidence.

We recommend that a law be passed requiring that all milk not the straight, unmanipulated product of the cow be marked and sold for what it is.

We also recommend that a law be enacted making it unlawful to mix, for purposes of sale, any two or more of the following substances: raw whole milk, heated or pasteurized whole milk, skimmed milk, condensed milk, concentrated or evaporated milk, and water, — and making it unlawful for any person or corporation engaged in the sale of milk or cream, other than condensed, concentrated or other evaporated milk, to keep in his place of business condensed, concentrated or evaporated milk, except in an unopened can or receptacle: excepting, however, the preparation and sale of "modified milk," when sold as such, to be used for food for infants or invalids.

We also recommend that a law be enacted requiring that a label, bearing a formula for extending with water, for home use, be securely attached to each container of evaporated, concentrated or condensed milk sold or offered for sale in this Commonwealth, and that the formula thus attached be such that the milk product resulting be not below the Massachusetts standard for whole milk. Such a law should carry with it a suitable penalty in case the milk thus extended fails in any instance to conform to present legal requirements for whole milk.

So long as a milk standard is maintained in this State it is manifestly unfair that these prepared milks from other States should come into our markets without either standard or guarantee as regards their solid food content.

Much has been done for the consumer in the last few years in the way of insuring to him a cleaner product. Is it not high time that he now join in doing something for the Massachusetts milk producer, in order that milk production be made reasonably remunerative, and that a fair share of the milk consumed continue to be produced in this State, under control of our own laws and regulations? Then let consumers and producers join hands, for their interests are mutual.

The personnel of the Bureau and its staff has remained practically unchanged; C. D. Richardson, chairman, H. E. Paige and W. C. Jewett, members, J. Lewis Ellsworth, secretary, P. M. Harwood, general agent, A. W. Lombard, agent, B. F. Davenport, M.D., and H. C. Emerson, M.D., chemists, with five other persons employed from time to time during the year.

The summary of the year's work is as follows: —

Total number of inspections,	[1] 6,872
Number of inspections where no sample was taken,	5,081
Number of samples of butter and oleomargarine, all purchased,	1,779
Number of samples of milk and cream,	90
Cases entered in court,	206
Meetings addressed by chairman of the Bureau,	2
Meetings addressed by Mr. Jewett,	3
Meetings addressed by the general agent,	18

[1] There were 78 extra samples taken during the year, therefore this number is 78 less than the sum of the next three items.

Cases prosecuted during the twelve months ending Nov. 30, 1909, by months and courts, with law violated, and results, are as follows: —

Court.	Month.	Number.	Law violated.	Convicted.	Discharged.
Shelburne Falls,	December,	1	Milk, . . .	1	–
Worcester, .	December,	1	Milk, . . .	1	–
Newton, . .	December,	9	7 oleomargarine, 2 renovated butter.	9	–
Waltham, .	December,	2	Oleomargarine, .	2	–
New Bedford, .	December,	19	Oleomargarine, .	19	–
Franklin, .	January, .	2	Renovated butter, .	2	–
Fall River, .	January, .	3	2 oleomargarine, 1 renovated butter.	3	–
Uxbridge, .	January, .	3	Renovated butter, .	3	–
Lowell, . .	February, .	2	1 oleomargarine, 1 renovated butter.	2	–
North Adams, .	February, .	2	Oleomargarine, .	2	–
Pittsfield, .	February, .	1	Oleomargarine, .	1	–
Northbridge, .	March, .	1	Oleomargarine, .	1	–
Lawrence, .	March, .	7	5 oleomargarine, 2 renovated butter.	7	–
Worcester, .	March, .	21	9 oleomargarine, 12 renovated butter.	21	–
Marlborough, .	March, .	1	Oleomargarine, .	1	–
Malden, . .	March, .	1	Renovated butter, .	1	–
Salem, . .	April, .	3	Oleomargarine, .	3	–
Gloucester, .	April, .	3	Renovated butter, .	3	–
Lynn, . .	April, .	7	Oleomargarine, .	7	–
Lynn, . .	May, .	6	Oleomargarine, .	6	–
Springfield, .	May, .	3	Oleomargarine, .	3	–
Woburn, .	May, .	2	Oleomargarine, .	2	–
Fall River, .	May, .	12	Oleomargarine, .	12	–

Court.	Month.	Number.	Law violated.	Convicted.	Discharged.
Newburyport, .	May, .	1	Oleomargarine, .	1	–
Malden, . .	May, .	2	Oleomargarine, .	2	–
Leominster, .	May, .	12	Oleomargarine, .	12	–
Fitchburg, .	May, .	4	Oleomargarine, .	4	–
Taunton, .	June, .	2	Oleomargarine, .	2	–
Woburn, .	July, .	1	Milk, . . .	1	–
Newburyport, .	July, .	8	Oleomargarine, .	8	–
Worcester, .	July, .	14	Oleomargarine, .	14	–
Quincy, . .	August, .	2	Oleomargarine, .	2	–
Woburn, .	August, .	1	Milk, . . .	1	–
Nahant, . .	August, .	6	Oleomargarine, .	6	–
Hull, . .	August, .	2	Oleomargarine, .	2	–
New Bedford, .	September,	8	Oleomargarine, .	8	–
Springfield, .	September,	1	Milk, . . .	1	–
Clinton, . .	October, .	2	Renovated butter, .	2	–
Woburn, .	November,	2	Oleomargarine, .	2	–
Chelsea, . .	November,	2	Oleomargarine, .	2	–
Fall River, .	November,	11	Oleomargarine, .	11	–
Lowell, . .	November,	11	9 oleomargarine, 2 renovated butter,	11	–
Amesbury, .	November,	2	Renovated butter, .	2	–
Totals, .	. . . .	206	. . . . .	206	–

Note. — The Bureau is especially indebted to the milk inspectors of Boston, Lowell, Revere, Springfield, Taunton, Winchester and Worcester for assistance which has resulted in cases in court. We also record our indebtedness to all others who have aided us in any way.

The charges in the several cases entered in court for the year ending Nov. 30, 1909, have been as follows: —

Selling renovated butter in unmarked packages,	33
Selling oleomargarine without sign on exposed contents,	3
Selling oleomargarine when butter was asked for,	29
Selling oleomargarine without being registered,	7
Selling oleomargarine without sign in store,	2
Selling oleomargarine in unmarked packages,	4
Furnishing oleomargarine in restaurants, etc., without notice to guests,	121
Selling oleomargarine containing foreign coloration,	2
Selling milk containing added water,	5
	206

The following is a list of inspections without samples and the number of samples taken in the years 1903–09, inclusive: —

YEAR.	Inspections without Samples.	Samples taken.
1903,	4,135	1,395
1904,	4,456	1,157
1905,	4,887	971
1906,	4,985	576
1907,	4,538	1,374
1908,	5,516	1,575
1909,	5,003	1,869
Totals,	33,520	8,917
Averages,	4,788	1,273

Oleomargarine.

No licenses for the sale of colored oleomargarine were issued in this State, but two sales of such goods have been discovered by the Bureau during the year, and the parties promptly prosecuted.

The following figures show the oleomargarine output for the United States since 1902: —

Under Old Law.

	Pounds.
1902,	126,316,472

Under New Law.

1904,	48,071,480
1905,	49,880,982
1906,	53,146,657
1907,	68,988,850
1908,	79,107,273
1909,	90,621,844

It will be seen by the foregoing figures that the first effect of the present national oleomargarine law, which really forces the sale of oleomargarine upon its own merits, was to greatly reduce the output. In 1904 it reached its lowest point; since then there has been a gradual increase in the output, averaging about 8,000,000 pounds per year.

The number of United States oleomargarine retail licenses issued in this State is more than double that of one year ago, and this increase has occurred since Sept. 1, 1909.

The number of wholesale licenses remain the same as last year. The figures are as follows: —

Wholesale licenses in Boston,	13
Wholesale licenses in other cities,	8
Total,	21
Retail licenses in Boston,	46
Retail licenses in other places,	465
Total,	511

With over 500 different concerns selling oleomargarine in Massachusetts, a condition exists unlike anything in the past.

Renovated Butter.

The violations of the renovated butter law in this State have continued to decline, there having been but 33 such violations during the year. The high price of butter has caused more of the goods to be used than was the case in 1908, but it has been sold more carefully. There is one licensed concern in this State manufacturing renovated butter. A majority of the goods sold is in print form.

Butter.

The Chamber of Commerce figures show a decrease in consumption of butter for the first time since 1900, — the inevitable result of the high cost of living, including the high price of butter. Consumers are obliged to economize; therefore less butter is used, and to some extent at least this is being made up by the use of oleomargarine, exact figures for the local sale of which are unobtainable. The wholesale price of butter has ruled 2 cents per pound higher than in 1908, and nearly 9 cents higher than in 1904. The creamery at Shelburne Falls has passed into the hands of H. P. Hood & Sons, and the Williamsburg and a few other creameries have gone out of business.

The amount of consumption of butter for 1908 was 66,869,455 pounds; that of 1909, 65,939,692 pounds, — a decrease of 929,763 pounds. In 1900 the consumption was but 49,288,306 pounds. Therefore the average increase of consumption has been 1,850,154 pounds per year for the last nine years, — a grand record.

The following table shows the average quotation for the best fresh creamery butter, in a strictly wholesale way, in the Boston market for the last nine years, as compiled by the Boston Chamber of Commerce: —

MONTH.	1909. Cents.	1908. Cents.	1907. Cents.	1906. Cents.	1905. Cents.	1904. Cents.	1903. Cents.	1902. Cents.	1901. Cents.
January,	30.9	29.7	30.4	25.2	28.0	22.7	28.0	25.0	25.0
February,	30.0	32.1	31.7	25.2	31.6	24.6	27.0	28.5	25.0
March,	29.1	30.2	30.2	25.5	28.0	24.1	27.0	29.0	23.0
April,	27.9	28.4	32.2	22.2	29.1	21.6	27.5	32.0	22.0
May,	26.6	21.1	31.4	19.9	23.9	19.9	22.5	25.0	19.5
June,	26.4	21.5	21.3	20.2	20.7	18.4	22.75	23.5	20.0
July,	27.2	23.6	25.9	21.0	20.6	18.3	20.5	22.5	20.0
August,	28.2	21.5	26.0	23.8	21.6	19.1	20.0	21.5	21.0
September,	31.3	25.3	29.2	25.6	21.2	20.8	22.0	23.5	22.0
October,	31.7	27.5	29.9	26.9	22.1	21.5	22.5	24.5	21.5
November,	31.4	29.5	27.1	27.6	23.0	24.1	23.5	27.0	24.0
December,	32.9	31.0	27.5	30.7	23.9	25.7	21.5	28.5	24.5
Averages,	29.5	27.5	28.48	24.48	24.47	21.73	26.23	25.0	22.3

The Chamber of Commerce figures regarding the butter business in Boston for 1908 and 1909 are as follows: —

	1909. Pounds.	1908. Pounds.
Carried over,	8,960,328	6,854,760
Receipts for January,	3,918,459	2,875,253
Receipts for February,	2,258,710	2,529,472
Receipts for March,	2,762,898	3,182,045
Receipts for April,	3,089,741	3,570,013
Receipts for May,	4,810,649	6,123,261
Receipts for June,	11,309,791	11,675,687
Receipts for July,	11,357,950	11,534,423
Receipts for August,	8,648,239	8,800,812
Receipts for September,	7,406,108	8,990,275
Receipts for October,	5,140,375	4,707,422
Receipts for November,	2,813,501	2,268,606
Receipts for December,	2,257,397	3.585,918
Total supply,	74,014,482	76,697,947
Exports for year, deduct,	44,050	868,164
Net supply,	73,970,432	75,829,783
Storage stock December 31, deduct,	8,030,740	8,960,328
Consumption for year,	65,939,692	66,869,455

Milk.

We are glad to note some apparent increase in the consumption of raw whole milk in Boston. During the years 1907 and 1908 there was a decided falling off. In carred milk alone this amounted to 10,402,697½ quarts; but a turn has been made, and 1,351,657½ quarts more were shipped in during 1909 than was the case in 1908, but it is still 6,151,040 quarts behind where it was three years ago, and this in the face of a constantly increasing population.

We are also glad to note a slight increase in the price paid the farmers by the Boston contractors, brought about by extending the winter price over eight months instead of six, as formerly. The average price now paid in the 9-cent zone is still below 4 cents a quart. Milk production cannot be placed on a satisfactory footing in Massachusetts until at least 5 cents per quart is the average price paid the farmer throughout the year. A creditable move has been made by some of the contractors in offering an increased price for milk made under specially sanitary conditions. This is manifestly a help to those consumers who can afford to pay for such milk, as well as to the farmers, who care to take the necessary pains to produce it.

The amount of certified milk sold in the State is very limited indeed, owing to its high cost to the consumer and to the extreme requirements in its production.

It is reported that the sales of cream are falling off as the result of the high cost of living; this is natural, as cream is something of a luxury compared with whole milk. We regret that there are no figures available giving the exact amount of this decrease.

Appended Tables.

Tables I. and II. show instances where prosecutions might have been made under the milk standard law had not the samples of milk of known purity indicated that the original samples were of pure milk. Notified of this fact the owners of the herds withdrew their milk from market.

Table III. shows a case where the producer was liable to criminal prosecution under the milk standard law, but the health authorities forbade further sale of this milk on account of the poor condition of the cows.

Tables IV., V. and VI. show analyses where parties were prosecuted under the milk adulteration law, without resort to the milk-of-known-purity method for comparison.

Tables VII. and VIII. show cases where the samples of milk of known purity for comparison helped in prosecutions and convictions under the milk adulteration law.

Table IX. shows analyses upon which prosecutions of 1909 were based.

Table X. shows the number of cows assessed in Massachusetts in 1890, 1906 and 1909, with decrease and averages.

Table XI. shows the amount of milk brought into Boston by railroad in the fiscal years of 1906, 1907, 1908 and 1909.

TABLE I. — *Analysis of Milk taken from Possession of a Farmer in Worcester County, ready for Delivery to a Worcester Peddler.*

SAMPLE NO.	Mark on Can.	Fat.	Solids not Fat.	Total Solids.	Refraction.
1,	K [1]	3.20	8.50	11.70	-
2,	K [1]	3.30	8.52	11.82	40.7
3,	K [1]	2.90	7.78	10.68	38.8
4,	K	2.80	7.70	10.50	39.2
5,	K	3.50	8.78	12.28	-
6,	K	2.90	8.24	11.14	40.6
7,	K	3.30	8.38	11.68	-
8,	K [1]	3.00	8.70	11.70	41.4

[1] Night's milk.

NOTE. — This milk being manifestly pure milk, samples of known purity were subsequently taken from the herd.

Analysis of Samples of Night's Milk of Known Purity taken from the Herd producing the Milk, Analysis of which is given in Above Table.

Cow No.	Breed.	Fat.	Other Milk Solids.	Total Solids.	Refraction.
1	Holstein, ...	3.00	7.24	10.24	38.6
2	Holstein, ...	3.40	7.70	11.10	38.1
3	Holstein, ...	2.70	7.58	10.28	39.2
4	Holstein, ...	3.20	8.40	11.60	-
5	Holstein, ...	3.10	8.20	11.30	40.5
6	Holstein, ...	3.50	8.20	11.70	-
7	Holstein, ...	2.60	8.06	10.66	39.5
8	Holstein, ...	3.40	8.42	11.82	-

This producer withdrew his milk from the market.

TABLE II. — *Analyses of Samples of Milk taken in Revere, April 26, from Five Cans of Milk ready for Delivery to Lynn Peddler.*

Sample No.	Fat.	Solids not Fat.	Total Milk Solids.	Refraction.
1, ...	4.0	7.96	11.96	40.5
2, ...	3.0	7.44	10.44	39.1
3, ...	3.6	8.56	12.16	42.2
4, ...	3.2	8.58	11.78	42.6
5, ...	3.3	8.64	11.94	42.6

Analyses of Samples of Night's Milk of Known Purity taken from Herd producing Above-mentioned Milk.

Cow No.	Breed.	Estimated Amount Milk (Quarts).	Fat.	Solids not Fat.	Total Milk Solids.	Refraction.
1	Grade, Holstein, black and white.	3	3.4	8.48	11.88	42.2
2	Grade, Holstein, black and white.	5	3.0	8.10	11.10	41.4
3	Grade, Holstein, black and white.	4	3.5	7.94	11.44	40.5
4	Grade, Holstein, black,	5	3.3	8.20	11.50	41.6
5	Grade, Holstein, black and white.	5	2.9	7.74	10.64	40.4

NOTE. — Advice was given as to how to bring the milk of this herd up to standard, but the owner withdrew the milk from the market and sold the herd.

TABLE III. — *Analysis of Milk taken from Possession of Producer in Marblehead, ready for Delivery to a Salem Peddler, April, 1909.*

Sample No.	Fat.	Solids not Fat.	Total Milk Solids.	Refraction.
1, ...	4.55	8.41	12.96	39.5
2, ...	2.75	8.25	11.00	40.0

NOTE. — Sample No. 1 was taken from a full 8-quart can and Sample No. 2 from an 8-quart can containing about 4 quarts of milk. It is evident that in the attempt to mix the milk the top of can No. 2 was turned into can No. 1, thus making the contents of No. 1 above and of No. 2 below the average quality of the herd's milk.

Analysis of Milk of Known Purity taken from Herd of Above-mentioned Producer, April, 1909 (Night's Milk).

Cow No.	Breed.	Estimated Amount Milk (Quarts).	Fat.	Solids not Fat.	Total Milk Solids.	Refraction.
10	Grade, Ayrshire, . .	2	3.20	7.70	10.90	39.0
11	Grade, Ayrshire, . .	1	3.30	8.84	12.14	42.3
12	Grade, Holstein, . .	2	3.30	8.78	11.08	41.0
13	Grade, Ayrshire-Holstein,	1	3.40	8.06	11.46	40.5

NOTE. — The above-mentioned animals were in extremely poor condition, and the milk was thereafter excluded from the Salem market.

TABLE IV. — *Analyses of Two Samples of Milk taken in Colrain, November, 1908, as it was about to be sent to a Creamery.*

Sample No.	Fat.	Other Milk Solids.	Total Milk Solids.	Refraction.
1, ...	2.80	6.80	9.60	34.5
2, ...	3.60	8.46	12.06	41.0

NOTE. — There being no question but that Sample No. 1 contained added water, the defendant was summoned into court, pleaded guilty, and was fined $50, which he paid.

TABLE V. — *Analyses of Samples of Milk taken at a Dairy in East Longmeadow just before Delivery to a Springfield Peddler, August, 1909.*

Sample No.	Fat.	Solids not Fat.	Total Milk Solids.	Refraction.
1, ...	2.70	4.97	7.67	30.30
2, ...	1.30	2.98	4.28	24.45
3, ...	2.55	4.87	7.42	29.80

NOTE. — This milk was manifestly watered, and the party was summoned into court without further ado. The circumstances were out of the ordinary. The milk was being furnished to a hospital in Springfield, where the discovery was made that something was wrong. Investigation showed that the milk had been adulterated before it left the farm, by a boy who, having been scolded for allowing the cows to shrink in their milk flow, had watered the milk for the sole purpose of making good with his parents. He evidently little thought of the far-reaching consequences of his act. He knows better now.

TABLE VI. — *Analyses of Seven Samples of Milk taken in Wilmington just before being delivered to a Woburn Peddler.*

Sample No.	Fat.	Solids not Fat.	Total Milk Solids.	Refraction.
1, ...	3.2	7.66	10.86	38.9
2, ...	3.6	7.50	11.10	37.9
3, ...	3.6	7.50	11.10	38.7
4, ...	2.5	7.22	9.72	38.4
5, ...	2.9	6.70	9.60	36.4
6, ...	3.4	7.12	10.52	37.4
7, ...	3.7	7.22	10.92	37.4

NOTE. — The above shows that water was put into all the cans. The milk was not mixed before canning. The party when summoned into court pleaded nolo, was found guilty, and fined $50, which he paid.

Table VII. — *Analyses of Two Samples of Night's Milk taken from the Possession of a Woburn Producer, on Aug. 3, 1909, as it was ready for Delivery to a Winchester Peddler.*

Sample No.	Fat.	Solids not Fat.	Total Milk Solids.	Refraction.
1,	3.00	7.30	10.30	38.50
2,	3.10	7.60	10.70	38.00

Analyses of Samples of Night's Milk of Known Purity taken from the Herd producing the Above-mentioned Milk.

Cow No.	Breed.	Estimated Amount Milk (Quarts).	Fat.	Solids not Fat.	Total Solids.	Refraction.
1	Brindle,	4½	4.1	9.7	13.8	41.2
2	Roan,	7¼	3.4	8.7	12.1	40.7

Note. — The result of this investigation was to assure the prosecuting officer of his ground, and a complaint was made against this farmer for having in his possession, with intent to sell, milk to which water had been added. He was tried, found guilty, and fined $50, which he paid.

Table VIII. — *Analysis of Milk obtained from a Worcester County Producer, ready for Delivery to a Worcester Peddler, November, 1908.*

Sample No.	Mark on can.	Fat.	Solids not Fat.	Total Solids.	Refraction.
1,	7 [1]	3.8	7.72	11.52	38.3
2,	7 [1]	4.0	7.80	11.80	38.9
3,	7 [1]	4.0	8.26	12.26	39.6
4,	No mark	4.2	7.96	12.16	38.6
5,	No mark	4.2	7.98	12.18	38.9

[1] Night's milk.

Note. — After taking the above samples, milk from this herd dropped from 5 cans per day to 4 cans. This milk was said by the owner to have been mixed, therefore the analysis indicates that varying amounts of water were added to the milk in the different cans. He afterwards pleaded guilty to having in his possession milk to which water had been added, and paid a fine of $50.

Analyses of Samples of Night's Milk of Known Purity from the Herd of the Same Producer.

Cow No.	Breed.	Estimated Amount Milk (Quarts).	Fat.	Solids not Fat.	Total Solids.	Refraction.
1, . .	Holstein and Jersey, .	2	3.80	9.16	12.96	–
2, . .	Holstein and Jersey, .	2	4.50	9.20	13.70	–
3, . .	Grade Ayrshire, . .	5	3.40	8.20	11.60	41.1
4, . .	Holstein, ...	3	4.20	8.50	12.70	40.9
5, . .	Holstein and Jersey, .	2	4.70	8.40	13.10	40.7
7, . .	Holstein and Jersey, .	2	4.40	9.34	13.74	–
8, . .	Holstein and Jersey, .	2	6.20	9.70	15.90	–
11, . .	Holstein and Galway, .	2	3.60	8.54	12.14	–
Mixed milk,	. . . .	–	4.20	8.80	13.00	41.2

TABLE IX. — *Milk Analyses upon which were based the Prosecutions of 1909.*

Case No.	Fat.	Other Milk Solids.	Total Solids.	Refraction.	Remarks.
1, ...	2.80	6.80	9.60	34.59	Contained added water.
2, ...	4.20	7.96	12.16	38.65	Contained added water.
3, ...	2.90	6.70	9.60	36.40	Contained added water.
4, ...	3.00	7.30	10.30	38.50	Contained added water.
5, ...	1.30	2.98	4.28	24.45	Contained added water.

TABLE X. — *Number of Cows assessed in Massachusetts, 1890, 1906 and 1909.*

Number of cows assessed May 1, 1890, ...	200,658
Number of cows assessed May 1, 1909, ...	168,221
Decrease (nineteen years), ...	32,437
Average annual decrease, ...	1,707
Number of cows assessed May 1, 1906, ...	181,816
Number of cows assessed May 1, 1909, ...	168,221
Decrease (three years), ...	13,595
Average annual decrease, ...	4,531

TABLE XI. — *Showing Milk brought into Boston by Railroad, 1905–09.*

	Quarts.	Quarts.
December, 1905, to December, 1906,	114,233,976	–
December, 1906, to December, 1907,	109,882,190½	4,351,785½ [1]
December, 1907, to December, 1908,	103,381,278½	6,050,912 [1]
Total decrease, two years,		10,402,697½ [1]
December, 1908, to December, 1909,	108,082,936	4,251,657½ [2]
Net decrease since 1906,		6,151,040 [1]

CREAMERIES, MILK DEPOTS, ETC.

Appended we give a revised list of the principal creameries, milk depots, etc., owned and operated by Massachusetts individuals and corporations.

Co-operative Creameries.

Location.	Name.	Superintendent or Manager.
1. Ashfield,	Ashfield Creamery,	William Hunter, manager.
2. Belchertown,	Belchertown Creamery,	M. G. Ward, president.
3. Cheshire (P. O. Adams).	Greylock Creamery,	C. J. Fales, president.
4. Cummington,	Cummington Creamery,	W. E. Patridge, superintendent.
5. Easthampton,	Hampton Creamery,	W. H. Wright, treasurer.
6. Egremont (P. O. Great Barrington).	Egremont Creamery,	E. A. Tyrrell, manager.
7. Monterey,	Berkshire Hills Creamery,	F. A. Campbell, manager.
8. New Boston,	Berkshire Creamery,	F. M. Rugg, president.
9. New Salem (P. O. Millington).	New Salem Creamery,	W. A. Moore, treasurer.
10. Northfield,	Northfield Creamery,	Chas. C. Stearns, superintendent.
11. Shelburn,	Shelburne Creamery,	Ira Barnard, manager.
12. Westfield (P. O. Wyben).	Wyben Springs Creamery,	C. H. Kelso, manager.
13. West Newbury,	West Newbury Creamery,	R. S. Brown, treasurer.

[1] Decrease. [2] Increase.

Proprietary Creameries.

Location.	Name.	Owner or Manager.
1. Amherst,	Amherst Creamery,	W. A. Pease.
2. Amherst,	Fort River Creamery,	E. A. King.
3. Brimfield,	Crystal Brook Creamery,	F. N. Lawrence.
4. Everett,	Hampden Creamery Company.	Hampden Creamery Company.
5. Fitchburg, 26 Cushing Street.	Fitchburg Creamery,	G. S. Learned.
6. Gardner,	Boston Dairy Company,	Boston Dairy Company.
7. Groton,	Lawrence Creamery,	Myron P. Swallow.
8. Heath,	Cold Spring Creamery,	I. W. Stetson & Son.
9. Hinsdale,	Hinsdale Creamery,	Ashley B. Clark, treasurer.
10. Marlborough,	Este's Creamery,	F. F. Este.
11. North Brookfield,	North Brookfield Creamery,	H. A. Richardson.
12. Shelburne Falls,	Shelburne Falls Creamery,	H. P. Hood & Sons.

Educational.

Amherst,	Dairy Industry Course, Massachusetts Agricultural College.	W. P. B. Lockwood, professor in charge.

Milk-distributing Depots.

Name.	Location.	Manager.
Alden Bros.,	Boston, office 1171 Tremont Street, depot 28 Duncan Street.	Charles L. Alden.
Boston Dairy Company,	Boston, 484 Rutherford Avenue,	W. A. Grostein.
Elm Farm Milk Company,	Boston, Wales Place,	James H. Knapp.
H. P. Hood & Sons,	Boston, 494 Rutherford Avenue, Branch, 24 Anson Street, Forest Hills.	Charles H. Hood.
	Lynn, 193 Alley Street.	
	Malden, 425 Main Street.	
	Salem, 252 Bridge Street.	
	Watertown, 289 Pleasant Street.	
	Lawrence, 629 Common Street.	
D. Whiting & Sons,	Boston, 570 Rutherford Avenue,	George Whiting.
C. Brigham Company,	Cambridge, 158 Massachusetts Avenue.	John K. Whiting.
Deerfoot Farms,	Southborough,	S. H. Howes.
Springfield Co-operative Milk Association.	Springfield,	F. B. Allen.
Tait Bros.,	Springfield,	Tait Bros.
Wachusett Creamery,	Worcester,	E. H. Thayer & Co.
C. Brigham Company,	Worcester, 9 Howard Street,	C. Brigham Company.

Milk Laboratory.

Name.	Location.	Manager.
Walker-Gordon Laboratory.	Boston, 793 Boylston Street.	George W. Franklin.

Receiving Depots for Milk for Shipments to New York City.

F. D. Shove Milk Factory,	West Stockbridge, ...	C. M. Riggs.
Willow Brook Dairy Company.	Sheffield, ...	George Patterson.

Expenses.

The following is a classified statement of the expenses for the year ending Nov. 30, 1909: —

Bureau: compensation and traveling expenses, . . .	$322 43
Agents: compensation, ...	2,506 90
Agents: traveling expenses and samples purchased, .	2,748 97
General agent: traveling and necessary expenses, . .	436 80
Chemists: analyses, tests, court attendance, . . .	1,659 00
Printing and supplies, ...	192 31
Educational, ...	133 59
Total, ...	$8,000 00

P. M. HARWOOD,
General Agent.

Accepted and adopted as the report of the Dairy Bureau.

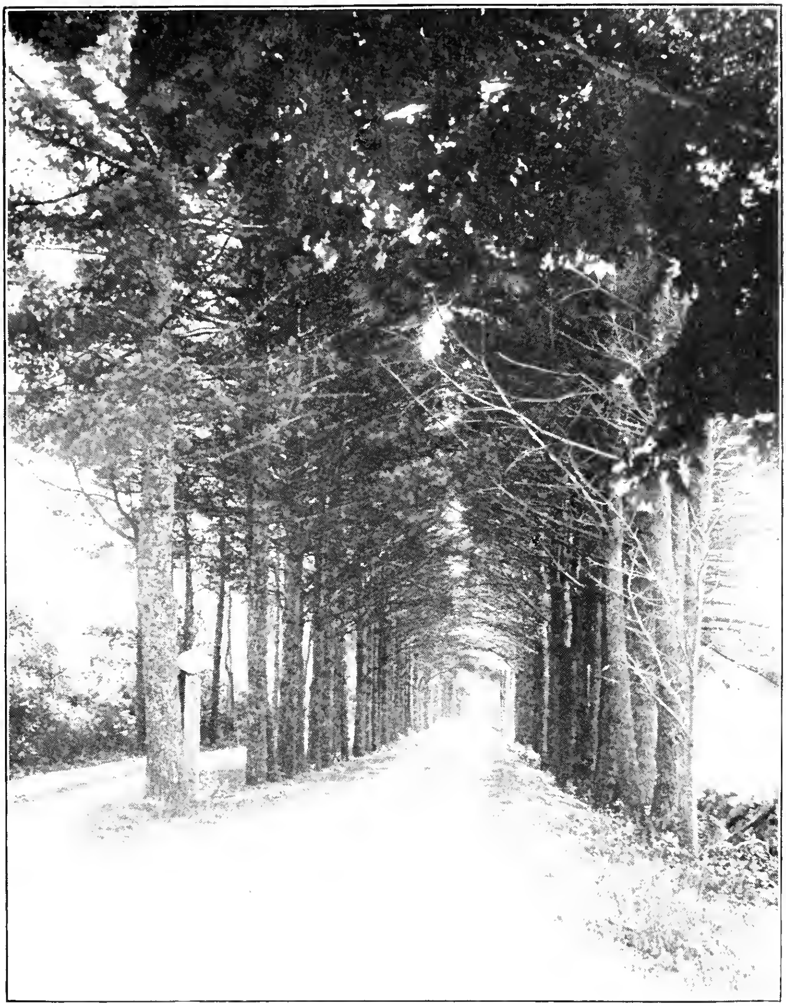
CARLTON D. RICHARDSON.
HENRY E. PAIGE.
W. C. JEWETT.

SIXTH ANNUAL REPORT

OF THE

STATE FORESTER.

SYNOPSIS PRESENTED TO THE BOARD AND ACCEPTED, JANUARY 11, 1910.



Savory Ways, in the Town of Carver.—The planter of these trees by the roadside was a public benefactor. If white pines will grow as well as this along a dry and compact roadside in forty years, imagine what better forestry could accomplish throughout our State.

SIXTH ANNUAL REPORT OF THE STATE FORESTER.

Introduction.

Never has there been a time in the history of the State when forestry matters more need the wholesome consideration of your honorable body than the present. Forestry and forest products have been our birthright, and we do well to reflect upon their importance to the present in the building of our ship of State, and not lose sight of the necessity of conserving them for our future needs. The histories of older nations are an open book to us, and tell only too well their pathetic tale.

The year has been one of great activity, and forestry interests have been given more recognition than ever before. The forestry legislation has been well received by our people. It may not be in good taste to boast of our new laws, but we do wish it known that the American Forestry Association has recommended several of our enactments for general adoption.

During the present year the results from organization and a more definite policy have been very evident. The forest warden system, which was fully explained in last year's report, has been very effective, and we have but just begun to see its usefulness. It takes time to create a proper forestry sentiment, let alone appreciation. Not only have a larger per cent. of the forest wardens and their deputies shown increased interest this year, but many, — a great many, — of our most public-spirited and influential people from every section of the State have co-operated in the forward movement of forestry endeavors.

The services of the State Forester have been in constant demand, not only in making examinations and giving advice on forestry matters, but for lectures, demonstrations and forestry literature. More fire warning notices and forest law posters have been distributed and actually found posted in the towns of the Commonwealth than ever before.

The permit act for setting fires out of doors was very generally adopted last spring by the towns and cities throughout the State, and it is the opinion of the wardens generally that this legislation alone will be a great saving to the State from forest fires.

For the first time the forest wardens have been gathered together at conferences, which will be explained in detail elsewhere in this report. In thus acquainting these officers with their duties, we shall secure an efficiency not possible heretofore.

By an act of the last General Court the work of suppressing the gypsy and brown-tail moths was placed under the State Forester. This bill was signed by Governor Draper on March 14. Since that time, of course, the State Forester's duties have been greatly enlarged. It was found advisable to unite the offices, and, as there was not sufficient room to accommodate both departments in the State House, the office of the State Forester was transferred to No. 6 Beacon Street, tenth floor. In the readjustment of these two departments under one head, the aim has been to retain and adopt all the better features of each organization. The experience of the first half-year has resulted in a more effective organization than has seemed possible.

Ever since coming to Massachusetts in the capacity of State Forester, my work has certainly been met with public-spirited encouragement; and now, under my enlarged duties, I simply ask that you give me the same cordial and co-operative support as in the past. Any State department, having the spending of money for the public good, appreciates and covets assistance from the people generally. We propose to have a "live wire" organization in all our undertakings in the State Forester's work; and I believe I am not overstating it when I say that the citizens of Massachusetts generally are in accord in requesting you, the General Court, to enact laws sufficient for our present and future forestry interests.

Organization.

The placing of the moth work under the State Forester by the Legislature and through the recommendation of Governor Draper necessitated a reorganization of the work, to meet the new requirements of the office.

It is to be expected that in the union of forces it will take time to adjust the machinery to the new conditions; but I am frank to say that all members of the organization have adapted themselves most happily to the new system, and, although nine months only have passed, the work is running on smoothly. What is true in this respect in the office force is equally true in the field work. The moth men are not only showing renewed interest in their work, but are assisting in perfecting better forestry conditions, assuming responsibility, and showing interest in preventing and extinguishing forest fires. The forestry assistants are helping in such work as marking the trees and superintending the thinning work so necessary in combating gypsy moths, and at the same time benefiting the growth from a modern forestry standpoint.

After going over the organization carefully and discussing the matter fully with men experienced in the work, under the sanction of the Governor, the 6 divisions into which the moth-infested district was formerly divided were reorganized, and increased to 15. With 6 divisions each agent in charge had an average of 35 towns to look after, and he was allowed a number of inspectors to accomplish the necessary field work. In all, 53 men were employed in the old organization. In the new organization of 15 divisions the 6 agents were given the more difficult ones, and the remaining 9 were filled by experienced inspectors. Four other inspectors were retained for special duties, subject to the direction of the main office. From 53 men, therefore, the force has been cut down to 19, and by furnishing the present division superintendents with motor cycles, with only 12 to 15 towns to cover, they can readily keep in close touch with local conditions. Not only do I believe that our efficiency is greater, but in a year's time it is believed the saving to the Commonwealth, even after deducting the expense of motor cycles, will be $8,000 to $10,000.

The next step needed is in raising the standard of the local town superintendents. The moth work has now progressed far enough so that competent men are available, and it is poor business policy to be compelled to have the work in some towns and cities in the hands of men utterly unable to get the best possible results.

The present organization of the State Forester's staff is as follows: —

Staff.

Mr. F. W. Rane, B.Agr., M.S.,	State Forester.
Mr. L. H. Worthley,	Assistant Forester, in charge of moth work.
Mr. H. O. Cook, M.F.,	Assistant Forester, in charge of forestry management.
Mr. R. S. Langdell,	Assistant Forester, in charge of nursery work.
Mr. Gould, M.F.,	Assistant Forester.
Mr. Chas. O. Bailey,	Secretary.
Miss Elizabeth Hubbard,	Clerk, in charge of accounts.
Mr. F. P. Woodbury, A.B.,	Clerk, in charge of forest fire records.
Miss Charlotte Jacobs,	Clerk, in charge of mail and office.
Mr. George A. Smith,	Agent, Division 1, as follows: Chelsea, Danvers, Everett, Hamilton, Ipswich, Lynn, Lynnfield, Marblehead, Middleton, Nahant, Peabody, Revere, Salem, Swampscott, Wenham and Winthrop.
Mr. John W. Enwright,	Agent, Division 2, as follows: Arlington, Bedford, Billerica, Burlington, Lexington, Malden, Medford, Melrose, Reading, Saugus, Stoneham, Wakefield, Wilmington, Winchester and Woburn.
Mr. Chas. W. Minott,	Agent, Division 3, as follows: Belmont, Brookline, Cambridge, Concord, Lincoln, Natick, Needham, Newton, Somerville, Sudbury, Waltham, Watertown, Wayland, Wellesley and Weston.
Mr. Frank A. Bates,	Agent, Division 4, as follows: Abington, Avon, Braintree, Cohasset, Hanover, Hingham, Holbrook, Hull, Milton, Norwell, Quincy, Randolph, Rockland, Scituate and Weymouth.
Mr. Francis C. Worthen,	Division Superintendent, Division 5, as follows: Amesbury, Boxford, Georgetown, Groveland, Merrimac, Newbury, Newburyport, Rowley, Salisbury, Topsfield and West Newbury.
Mr. Henry F. Armstrong,	Division Superintendent, Division 6, as follows: Andover, Chelmsford, Dracut, Haverhill, Lawrence, Lowell, Methuen, North Andover, North Reading and Tewksbury.
Mr. Thomas W. Emerson,	Division Superintendent, Division 7, as follows: Acton, Ayer, Boxborough, Carlisle, Dunstable, Groton, Littleton, Pepperell, Townsend, Tyngsborough and Westford.

Mr. Clarence W. Parkhurst, .	Division Superintendent, Division 8, as follows: Ashland, Bellingham, Dover, Framingham, Franklin, Holliston, Medfield, Medway, Millis, Norfolk and Sherborn.
Mr. Wm. A. Hatch, . . .	Division Superintendent, Division 9, as follows: Canton, Dedham, Foxborough, Hyde Park, Norwood, Plainville, Sharon, Stoughton, Walpole, Westwood and Wrentham.
Mr. George A. Sands, . .	Division Superintendent, Division 10, as follows: Blackstone, Grafton, Hopedale, Hopkinton, Hudson, Marlborough, Maynard, Mendon, Milford, Northborough, Northbridge, Southborough, Stow, Upton, Uxbridge and Westborough.
Mr. Harry B. Ramsey, . .	Agent Division 11, as follows: Ashby, Auburn, Berlin, Bolton, Clinton, Fitchburg, Gardner, Greenfield, Harvard, Holden, Lancaster, Leicester, Leominster, Lunenburg, Millbury, Oxford, Palmer, Princeton, Shirley, Shrewsbury, Springfield, Sutton, Templeton, Warren, Westminster and Worcester.
Mr John A. Farley, . .	Agent, Division 12, as follows: Carver, Duxbury, Halifax, Hanson, Kingston, Marshfield, Pembroke, Plymouth, Plympton and Whitman.
Mr. Lewis W. Hodgkins, . .	Agent, Division 13, as follows: Attleborough, Bridgewater, Brockton, East Bridgewater, Easton, Lakeville, Mansfield, Middleborough, North Attleborough, Raynham, Taunton and West Bridgewater.
Mr. John F. Carleton, . .	Division Superintendent, Division 14, as follows: Barnstable, Bourne, Brewster, Dennis, Falmouth, Marion, Mashpee, Orleans, Rochester, Sandwich, Truro, Wareham, Wellfleet and Yarmouth.
Mr. Saul Phillips, . . .	Division Superintendent, Division 15, as follows: Beverly, Essex, Gloucester, Manchester, North Shore Woodlands and Rockport.

Co-operative Scientific Staff.

L. O. Howard, Ph.D., . .	Chief United States Bureau of Entomology, Washington, D. C., *Parasites and Predaceous Insects.*
Theobald Smith, Ph.B., M.D., .	Professor of Comparative Pathology, Harvard University, *Diseases of Insects.*
Roland Thaxter, Ph.D., . .	Professor of Cryptogamic Botany, Harvard University, *Fungous Diseases affecting Insects.*
E. L. Mark, Ph.D., LL.D., .	Director of the Zoölogical Laboratory, Harvard University, *Protozoa and Insect Life.*
W. M. Wheeler, Ph.D., . .	Professor of Entomology, Harvard University, *Experimental Entomologist.*
C. H. Fernald, Ph.D., . .	Professor of Entomology, Massachusetts Agricultural College, *Consulting Entomologist.*
M. L. Guptil, ...	Expert experimentalist.
Frank H. Moshier, . . .	Entomologist in charge of laboratory.

List of Forest Wardens and Local Moth Superintendents.

[Alphabetically by towns.]

Town or City.	Badge No.	Forest Warden.	Local Moth Superintendent.
Abington, . .	287	B.Ernest Wilkes, chief fire department,	C. Frederick Shaw.
Acton, . .	181	William H. Kingsley, ...	James O'Neil.
Acushnet, . .	275	Eben F. Leonard, ...	– –
Adams, . .	7	John Clancy, ...	– –
Agawam, . .	93	Edward M. Hitchcock, ...	– –
Alford, . .	24	John H. Wilcox, ...	– –
Amesbury, .	228	James E. Feltham, chief fire department.	A. L. Stover.
Amherst, . .	67	G. E. Stone, tree warden, . .	– –
Andover, . .	212	J. H. Playdon, tree warden, . .	J. H. Playdon.
Arlington, . .	193	Walter H. Pierce, chief fire department,	William H. Bradley.
Ashburnham, .	104	William D. Miller, ...	– –
Ashby, . .	158	Wm. S. Green, ...	H. A. Lawrence.
Ashfield, . .	50	Chas. A. Hall, ...	– –
Ashland, . .	200	H. H. Piper, ...	H. G. Spring.
Athol, . .	105	Frank P. Hall, chief fire department, .	– –
Attleborough, .	265	Hiram Packard, 3 Hope Street, chief fire department.	Wm. E. S. Smith.
Auburn, . .	123	J. Fred Searle, ...	– –
Avon, . .	259	E. Walter Packard, constable, . .	Willard W. Beals.
Ayer, . .	169	Charles E. Perrin, ...	Loring A. Carman.
Barnstable, .	315	Henry C. Bacon, P. O. Hyannis, .	Harry W. Bodfish.
Barre, . .	142	D. H. Rice, ...	– –
Becket, . .	23	Elmer D. Ballou, ...	– –
Bedford, . .	179	Chas. E. Williams, ...	W. A. Cutler.
Belchertown, .	73	James A. Peeso, constable, . .	– –
Bellingham, .	326	L. F. Thayer, town treasurer, . .	Henry A. Whitney.
Belmont, . .	194	John F. Leonard, chief fire department,	Chas. F. Houlahan.
Berkley, . .	271	Gideon H. Babbitt, ...	– –
Berlin, . .	139	Walter Cole, constable, . . .	Willis Rice.
Bernardston, .	39	E. E. Benjamen, ...	– –
Beverly, . .	220	Robert H. Grant, chief fire department,	Josiah B. Brown.
Billerica, . .	173	Geo. C. Crosby, chief engineer fire department.	Francis J. Dolan.
Blackstone, .	111	Thomas Reilly, ...	– –
Blandford, .	81	H. K. Herrick, ...	– –
Bolton, . .	146	Frank A. Powers, tree warden, . .	Chas. E Mace.
Boston,[1] . .	–	– – –	D. Henry Sullivan.

[1] No forest area.

List of Forest Wardens and Local Moth Superintendents — Con.

Town or City.	Badge No.	Forest Warden.	Local Moth Superintendent.
Bourne, . .	311	Emory A. Ellis, P. O. Bournedale, .	Stillman B. Wright.
Boxborough, .	182	M. L. Wetherbee, selectman, . .	John J. Sherry.
Boxford, . .	218	Harry L. Cole, selectman, . .	Chas. Perley.
Boylston, . .	138	Chas. S. Knight, metropolitan watchman.	– –
Braintree, . .	244	James M. Cutting, special police, P. O. South Braintree.	E. E. Abercrombie.
Brewster, . .	318	T. B. Tubman, highway surveyor, P. O. North Brewster.	David A. Newcomb.
Bridgewater, .	293	Edwin S. Rhoades, ...	Robert J. McNeeland.
Brimfield, . .	99	Edward J. Prindle, ...	– –
Brockton, . .	286	Harry C. Marston, chief fire department.	Edward Moltan.
Brookfield, .	120	David N. Hunter, ...	– –
Brookline, . .	237	Geo. H. Johnson, chief fire department,	Ernest B. Dane.
Buckland, . .	49	William Sauer, P. O. Shelburne Falls,	– –
Burlington, .	178	Walter L. Skelton, tree warden, .	Walter W. Skelton.
Cambridge,[1] .	–	– – –	J. F. Donnelly.
Canton, . .	249	Laurence Horton, fire engineer, P. O. Ponkapoag.	Augustus Hemenway.
Carlisle, . .	171	Herbert P. Dutton, selectman, . .	G. G. Wilkins.
Carver . .	304	Eugene E. Shaw, ...	Herbert F. Atwood.
Charlemont, .	42	Fred D. Legate, ...	– –
Charlton, . .	115	Carlos Bond, ...	– –
Chatham, . .	320	Geo. H. Eldredge, ...	– –
Chelmsford, .	172	Arthur E. Barton, ...	M. A. Bean.
Chelsea,[1] . .	–	– – –	J. A. O'Brien.
Cheshire, . .	11	Chas. D. Cummings, ...	– –
Chester, . .	80	William H. Babb, ...	– –
Chesterfield, .	63	Chas. A Bisbee, P. O. Bisbee, . .	– –
Chicopee, . .	87	John H. Pomphret, chief fire department.	– –
Chilmark, . .	308	Ernest C. Mayhew	– –
Clarksburg, .	3	Robert Lanfair, R. F. D. No. 1, P. O. North Adams.	– –
Clinton, . .	145	Daniel W. Goss, 40 East Street, .	Wm. McGown.
Cohasset, . .	246	Wm. J. Brennock, captain fire department.	Joseph E. Grassie.
Colrain, . .	37	Wm. H. Davenport, ...	– –
Concord, . .	180	G. E. Morrell, chief fire department, .	H. P. Richardson.
Conway, . .	51	Chas. Parsons, tree warden, . .	– –
Cummington, .	60	W. S. Gabb, P. O. Swift River, .	– –
Dalton, . .	14	William M. Colton, forester, Flint Stone Farm.	– –
Dana, . .	147	Elmer A. Collier, chief fire department, P. O. North Dana.	– –

[1] No forest area.

List of Forest Wardens and Local Moth Superintendents — Con.

Town or City.	Badge No.	Forest Warden.	Local Moth Superintendent.
Danvers,	210	Thos. E. Tinsley, tree warden,	Thos. E. Tinsley.
Dartmouth,	278	John W. Howland, P. O. North Dartmouth.	– –
Dedham,	241	George A. Phillips,	George A. Phillips.
Deerfield,	52	Wm. L. Harris, selectman,	– –
Dennis,	317	Alpheus P. Baker, constable, P. O. South Dennis.	H. H. Sears.
Dighton,	272	Ralph Earle,	– –
Douglas,	112	W. L. Church, county commissioner,	– –
Dover,	240	John Breagy,	Arthur Hagerty.
Dracut,	163	Daniel D. Fox,	Herbert C. Jones.
Dudley,	110	F. A. Putnam,	– –
Dunstable,	161	Dexter Butterfield,	James A. Davis.
Duxbury,	303	Fred B. Knapp, master Powder Point School.	Henry A. Fish.
E. Bridgewater,	298	Loren A. Flagg, chief fire department, P. O. Elmwood.	Wm. T. Greene.
E. Longmeadow,	95	Asher Markham,	– –
Eastham,	322	W. Horton Nickerson, road surveyor,	– –
Easthampton,	77	Frank P. Newkirk, tree warden,	– –
Easton,	264	John Baldwin, chief fire department, P. O. North Easton.	R. W. Melendy.
Edgartown,	309	George N. Cleveland,	– –
Egremont,	29	Frank W. Bradford, Great Barrington, R. F. D. No. 3.	– –
Enfield,	74	Chas. W. Felton,	– –
Erving,	46	Ch. H. Holmes, selectman, P. O. Farley,	– –
Essex,	233	Otis O. Story, tree warden,	Otis O. Story.
Everett,[1]	–	– – –	James Davidson.
Fairhaven,	276	Albert C. Aiken,	– –
Fall River,	280	William Mulligan, tree warden,	– –
Falmouth,	312	J. M. Watson,	W. B. Bosworth.
Fitchburg,	157	Geo. H Hastings, superintendent,	Geo. H. Hastings.
Florida,	5	Fred R. Whitcomb, P. O. Hoosac Tunnel.	– –
Foxborough,	261	Ernest A. White, chief fire department and constable.	Frank C. Carpenter.
Framingham,	197	James Stalker, P. O. South Framingham, assistant tree warden.	N. I. Bowditch.
Franklin,	255	Edward S. Cook, dealer in wood and lumber.	M. J. Van Leeuwen.
Freetown,	274	Andrew M. Hathaway, P. O. Assonet,	– –
Gardner,	153	Theodore W. Danforth,	T. W. Danforth.
Gay Head,	343	Leander B. Smally, Menemsha, Mass.,	– –
Georgetown,	224	Clinton J. Eaton,	Edward J. Watson.
Gill,	45	Lewis C. Munn,	– –

[1] No forest area.

List of Forest Wardens and Local Moth Superintendents — Con.

Town or City.	Badge No.	Forest Warden.	Local Moth Superintendent.
Gloucester, .	234	– – –	Herbert J. Worth.
Goshen, . .	61	Sidney F. Packard, P. O. R. F. D. No. 2, Williamsburg.	– –
Gosnold, . .	344	Harold S. Veeder, P. O. Cuttyhunk, .	– –
Grafton, . .	125	Sumner F. Leonard, overseer of the poor.	Chas. K. Despeau.
Granby, . .	79	C. N. Rust, ...	– –
Granville, . .	91	Laurence F. Henry, selectman, . .	– –
Gt. Barrington, .	25	Daniel W. Flynn, 54 Russell Street, .	– –
Greenfield, .	44	William A. Ames, tree warden, . .	Wm. A. Ames.
Greenwich, .	327	William H. Walker, P. O. Greenwich Village.	– –
Groton, . .	167	James B. Harrington, chief fire department.	William A. Woods.
Groveland, .	225	Sidney E. Johnson, 311 Center Street,	Raymond B Larive.
Hadley, . .	66	Edward P. West, tree warden, . .	– –
Halifax, . .	299	Edwin H. Vaughan, assessor, . .	Frank D. Lyon.
Hamilton, . .	222	Fred Berry, P. O. Essex, R. F. D., .	Fred A. Nason.
Hampden, . .	97	John S. Swenson, ...	– –
Hancock, . .	9	Chas. F. Tucker, ...	– –
Hanover, . .	295	Chas. E. Damon, P. O. Box 113, North Hanover.	Lyman Russell.
Hanson, . .	296	Albert L. Dame, tree warden, P. O. South Hanson.	A. L. Dame.
Hardwick, . .	141	Myron N. Ayres, constable, . .	– –
Harvard, . .	152	Benjamin J. Priest, ...	Geo. C. Maynard.
Harwich, . .	319	John Condon, ...	– –
Hatfield, . .	65	John M. Strong, P. O. West Hatfield,	– –
Haverhill, . .	216	John B. Gordon, chief fire department,	Geo. F. Moore.
Hawley, . .	48	Ernest R. Seare, tree warden, P. O. Charlemont.	– –
Heath, . .	36	S. G Benson, ...	– –
Hingham, . .	289	Geo. Cushing, chief fire department, .	Arthur W Young.
Hinsdale, . .	15	Lewis B. Brague, tree warden, . .	– –
Holbrook, . .	247	E. W. Austin, ...	William Hayden.
Holden, . .	136	Henry E. Holt, ...	H. E. Holt.
Holland, . .	101	O. F. Howlett, P. O. Southbridge, R. F. D. No. 2.	– –
Holliston, . .	202	Waldo E. Collins, ...	Geo. H. Moody.
Holyoke, . .	85	Chas. C. Hastings, ...	– –
Hopedale, . .	328	Walter F. Durgin, constable, superintendent of parks.	Walter F. Durgin.
Hopkinton, .	201	R. I. Frail, ...	John T. Riley.
Hubbardston, .	149	Ernest A. Young, tree warden, . .	– –
Hudson, . .	199	Fred W. Trowbridge, chief fire department.	R. H. Hapgood.
Hull, . .	329	Smith F. Sturges, tree warden, P. O. Allerton.	John Knowles.

List of Forest Wardens and Local Moth Superintendents — Con.

Town or City.	Badge No.	Forest Warden.	Local Moth Superintendent.
Huntington, .	70	Daniel B. Mack, constable, . .	– –
Hyde Park, .	330	Harry G. Higbee, ...	Harry G. Higbee.
Ipswich, . .	223	Augustus J. Barton, ...	James A. Morey.
Kingston, . .	301	Thos. W. Bailey, selectman, . .	Carl C. Faunce.
Lakeville, . .	283	Nathan F. Washburn, P. O. Middleborough.	S. T. Nelson.
Lancaster, . .	151	Everett M. Hawkins, chief fire department.	Geo. F. Morse, Jr.
Lanesborough, .	10	King D. Keeler, constable, . .	– –
Lawrence, . .	214	Chas. G. Rutter, chief fire department,	Isaac Kelley.
Lee, . . .	22	James W. Bossidy, ...	– –
Leicester, . .	122	Walter E. Sprague, ...	J. H. Woodhead.
Lenox, . .	18	Geo. W. Fitch, ...	– –
Leominster, .	155	William K. Morse, chief fire department, P. O. North Leominster.	S. R. Walker.
Leverett, . .	57	Orman C. Marvel, assessor, . .	– –
Lexington, .	188	Azor P. Howe, ...	E. P. Merriam.
Leyden, . .	38	Herman W. Severance, Bernardston, .	– –
Lincoln, . .	187	Edward R. Farrer, tree warden, .	Edward R. Farrar.
Littleton, . .	170	Chas. F. Johnson, town clerk, . .	Alfred Hopkins.
Longmeadow, .	94	Oscar C. Pomeroy, ...	– –
Lowell, . .	165	Edward S. Hosmer, chief fire department.	Charles A. Whittet.
Ludlow, . .	88	Edward E. Chapman, constable, .	– –
Lunenburg, .	156	Clayton E. Stone, ...	Stephen Farnsworth.
Lynn, . .	331	Nathan M. Hawkes, park commissioner,	Albert C. Doal.
Lynnfield, . .	209	Thos. E. Cox, P. O. Wakefield R. F. D.,	Alfred W. Copeland.
Malden, . .	191	Frank Turner, ...	Geo. W. Stiles.
Manchester, .	236	Frederick Burnham, ...	John D. Morrison.
Mansfield, . .	263	Herbert E. King, ...	W. O. Sweet.
Marblehead, .	332	William H. Stevens, ...	William H. Stevens, 2d.
Marion, . .	306	Isaac E. Hiller, ...	James H. Morss.
Marlborough, .	198	Chas. H. Andrews, chief fire department.	M. E. Lyons.
Marshfield, .	292	Edward E. Ames, ...	P. R. Livermore.
Mashpee, . .	313	Joseph A. Peters, ...	Watson F. Hammond.
Mattapoisett, .	281	Everet C. Stetson, ...	– –
Maynard, . .	184	Arthur J. Coughlan, room 17, Maynard's block.	Albert C. Coughlin.
Medfield, . .	252	Waldo E. Kingsley, chief fire department.	Geo. L. L. Allen.
Medford, . .	192	Chas. Bacon, chief fire department, .	Wm. J. Gannon.
Medway, . .	254	Clyde C. Hunt, captain fire department.	Frank Hager.
Melrose, . .	–	– – –	John J. McCullough.

List of Forest Wardens and Local Moth Superintendents — Con.

Town or City.	Badge No.	Forest Warden.	Local Moth Superintendent.
Mendon,	119	Geo. B. Cromb,	Frank M. Aldrich.
Merrimac,	227	Edgar P. Sargent,	Frank E. Bartlett.
Methuen,	213	Herbert B. Nichols,	Alfred H. Wayland.
Middleborough,	284	C. W. Weston,	John C. Chase.
Middlefield,	342	Thos. H. Fleming, P. O. Bancroft,	– –
Middleton,	211	Oscar H. Sheldon,	Benj. T. McGlauflin.
Milford,	127	Elbert M. Crockett, chief fire department.	Patrick F. Fitzgerald.
Millbury,	124	William E. Horn,	Edward F. Roach.
Millis,	253	Chas. La Croix,	Fred Holland.
Milton,	242	Nathaniel T. Kidder, park commissioner.	Nathaniel T. Kidder.
Monroe,	31	S. R. Tower,	– –
Monson,	98	Omer E. Broadway,	– –
Montague,	53	Fred W. Lyman, lumber dealer,	– –
Monterey,	28	Andrew J. Hall,	– –
Montgomery,	82	Frank C. Preston, P. O. Huntington,	– –
Mt. Washington,	30	Fred Porter,	– –
Nantucket,	333	Albert R. Coffin,	– –
Nahant,[1]	–	– – –	Thos. Roland.
Natick,	204	William E. Daniels,	H. H. Hunnewell.
Needham,	238	Howard H. Upham, captain fire department.	Ernest E. Riley.
New Ashford,	6	Wm. E. Baker,	– –
New Bedford,	277	Edward F. Dahill, chief fire department.	– –
New Braintree,	131	E. L. Haven,	– –
New Marlborough,	32	Dennis Hayes, P. O. Mill River,	– –
New Salem,	55	Rawson King, P. O. Cooleyville,	– –
Newbury,	231	William P. Bailey,	O. B. Tarbox.
Newburyport,	230	David Kent, 26 Arlington Street,	Charles P. Kelley.
Newton,	205	Walter B. Randlett, chief fire department, P. O. West Newton.	Chas. J. Bucknam.
Norfolk,	256	C. Albert Murphy,	C. Albert Murphy.
North Adams,	4	H. J. Montgomery, chief fire department.	– –
North Andover,	215	Geo. A. Rea,	Peter Holt.
N. Attleborough,	262	Harvey W. Tufts, chief fire department,	F. P. Toner.
N. Brookfield,	129	H. S. Lytle, chief fire department,	– –
N. Reading,	175	Irving F. Batchelder,	Geo. E. Eaton.
Northampton,	72	Frederick E. Chase,	– –
Northborough,	140	T. P. Haskell,	T. P. Haskell.

[1] No forest area.

List of Forest Wardens and Local Moth Superintendents — Con.

Town or City.	Badge No.	Forest Warden.	Local Moth Superintendent.
Northbridge, .	117	W. E. Beemap, P. O. Whitinsville, .	Arthur F. Whitin.
Northfield, .	40	Fred W. Doane, ...	– –
Norton, . .	266	Alden G. Walker, ...	– –
Norwell, . .	290	John Wahlen, ...	John H. Sparrell.
Norwood, . .	250	J. Fred Boyden, chief fire department,	H. Frank Winslow.
Oak Bluffs, .	334	Samuel N. Kidder, ...	– –
Oakham, . .	135	Chas. H. Trowbridge, ...	– –
Orange, . .	47	Chas. E. Lane, ...	– –
Orleans, . .	321	Chas. F. Poor, ...	Albert A. Smith.
Otis, . . .	27	Wilbur L. Strickland, ...	– –
Oxford, . .	335	A. W. Stafford, North Oxford, . .	Chas. G. Larned.
Palmer, . .	89	James Summers, chief fire department, P. O. Box 333.	C. H. Keith.
Paxton, . .	130	Geo. W. Van Wyke, ...	– –
Peabody, . .	219	Michael V. McCarthy, Forest Street, .	James F. Callahan.
Pelham, . .	68	E. P. Bartlett, P. O. Amherst, . .	– –
Pembroke, .	294	Jos. J. Shepherd, ...	Calvin S. West.
Pepperell, . .	160	Geo. G. Tarbell, P. O. East Pepperell, Room 17, Aldine block.	John Tune.
Peru, . . .	16	Clarence W. Hathaway, ...	– –
Petersham, .	148	George P. Marsh, ...	– –
Phillipston, .	106	William Cowbleck, Athol, R. F. D. No. 3.	– –
Pittsfield, . .	13	Lucien D. Hazard, ...	– –
Plainville, . .	59	J. F. Thompson, ...	E. C. Blackwell.
Plainfield, . .	309	Lestan E. Parker, ...	– –
Plymouth, . .	302	Herbert Morissey, ...	Geo. R. Briggs.
Plympton, . .	300	Thomas W. Blanchard, ...	Zina E. Sherman.
Prescott, . .	69	Waldo H. Pierce, P. O. Greenwich Village.	– –
Princeton, . .	150	J. Heyden Stimpson, ...	J. Harry Allen.
Provincetown, .	325	James H. Barnett, ...	– –
Quincy, . .	243	Peter J. Williams, chief fire department.	Randolph C. Bainbridge.
Randolph, . .	248	Chas. A. Wales, chief fire department,	James E. Blanche.
Raynham, . .	270	John V. Festing, ...	Geo. M. Leach.
Reading, . .	176	Herbert E. McIntire, ...	Guy A. Hubbard.
Rehoboth, . .	268	Silas A Pierce, ...	– –
Revere,[1] . .	–	– – –	George Babson.
Richmond, .	17	T. B. Salmon, ...	– –
Rochester, . .	282	William N. Smellie, ...	– –

[1] No forest area.

List of Forest Wardens and Local Moth Superintendents — Con.

Town or City.	Badge No.	Forest Warden.	Local Moth Superintendent.
Rockland, . .	288	John H. Burke, water commissioner, .	Frank H. Shaw.
Rockport, . .	235	A. J. McFarland, P. O. Box 91, .	Eli Gott.
Rowe, . .	35	Merritt A. Peek, ...	- -
Rowley, . .	232	Daniel O'Brien, agent Gypsy Moth Commission.	Daniel O'Brien.
Royalston, .	102	Willard W. White, P. O. South Royalston.	- -
Russell, . .	83	Sidney F. Shurtleff, highway surveyor,	- -
Rutland, . .	143	Henry Converse, chief fire department,	- -
Salem,[1] . .	-	- - -	Amos Stillman.
Salisbury, . .	229	Wm. H. Evans, ...	Chas. M. Pike.
Sandisfield, .	33	Lyman H. Clark, P. O. New Boston, .	- -
Sandwich, . .	314	John F. Carlton, P. O. Spring Hill, .	B. F. Denison.
Saugus, . .	207	Ole C. Christiansen, ...	Thos. E. Berrett.
Savoy,[1] . .	8	Herbert H. Fitzroy, P. O. Savoy Center.	- -
Scituate, . .	291	John F. Turner, tree warden, . .	Percival S. Brown.
Seekonk, . .	267	John L. Barker, P O. Attleborough, R. F. D. No. 4.	- -
Sharon, . .	251	John G. Phillips, ...	T J. Leary.
Sheffield, . .	31	Geo. G. Peek, ...	- -
Shelburne, . .	43	H. O. Fisk, P. O. Shelburne Falls, .	- -
Sherborn, . .	203	Milo F. Campbell, constable, South Sherborn.	J. P. Dowse.
Shirley, . .	168	Melvin W. Longley, assessor, . .	A A. Adams.
Shrewsbury, .	132	Wm. E. Rice, ...	Frank L. Ott.
Shutesbury, .	58	Emmons J. Spear, ...	- -
Somerset, . .	336	James Wilson, fish and game warden,	- -
Somerville,[1] .	-	- - -	Asa B. Pritchard.
South Hadley, .	78	Joseph Beach, P. O. South Hadley Falls.	- -
Southampton, .	76	Geo. W. Tyler, ...	- -
Southborough, .	337	Harry Burnett, tree warden, . .	Harry Burnett.
Southbridge, .	109	Aimee Langevin, Olney Avenue, .	- -
Southwick, .	92	Edward Gillett, tree warden, . .	- -
Spencer, . .	121	A. F. Howlett, ...	- -
Springfield, .	86	Burton Steere, assistant fire chief, .	Wm. F. Gale.
Sterling, . .	144	G. F. Herbert, assessor, . . .	- -
Stockbridge, .	21	Geo. Schneyer, selectman, P. O. Glendale.	- -
Stoneham, . .	190	Geo. E. Sturtevant, chief fire department.	Geo. M. Jefts.
Stoughton, .	258	Jesse E. Smith, ...	Wm. P. Kennedy.
Stow, . .	183	William H. Parker, P. O. Gleasondale,	J. Frank Robbins.

[1] No forest area.

List of Forest Wardens and Local Moth Superintendents — Con.

Town or City.	Badge No.	Forest Warden.	Local Moth Superintendent.
Sturbridge, .	108	Chas. M. Clark, P. O. Fiskdale, .	– –
Sudbury, . .	185	F. E. Bent, ...	Wm. E. Baldwin.
Sunderland, .	338	A. C. Warner, ...	– –
Sutton, . .	116	Ransom W. Richardson, . . .	John E. Gifford.
Swampscott, .	339	Geo. P. Cahoon, chief fire department,	Geo. Newhall.
Swansea, . .	273	Thos. L. Mason, constable, P. O. R. F. D. No. 2.	– –
Taunton, . .	269	Fred A. Leonard, chief fire department, School Street.	Alvaro Harnden.
Templeton, .	107	Henry H. Seaver, P. O. Baldwinville,	John B. Wheeler.
Tewksbury, .	164	Herbert W. Pillsbury, . . .	Harry M. Briggs.
Tisbury, . .	310	Albert Rotch, P. O. Vineyard Haven,	– –
Tolland, . .	90	Eugene M. Moore, ...	– –
Topsfield, . .	218	Isaac B. Young, selectman, . .	C. W. Floyd.
Townsend, .	159	F. J. Piper, chief fire department, .	Geo. E. King.
Truro, . .	324	Naylor Hatch, ...	Joseph H. Atwood.
Tyngsborough, .	162	Otis L. Wright, ...	Howard E. Noble.
Tyringham, .	26	Geo. F. Knapp, ...	– –
Upton, . .	126	Geo. Z. Williams, chief fire department,	Geo. H. Evans.
Uxbridge, . .	113	Arnold S. Allen, constable and chief fire department.	– –
Wakefield, . .	208	Samuel T. Parker, ...	W W. Whittredge.
Wales, . .	100	W. W. Eager, ...	– –
Walpole, . .	340	N. Emmons Winslow, chief fire department.	Philip R. Allen.
Waltham, . .	195	Geo. L. Johnson, chief fire department,	Jesse M. French.
Ware, . .	75	L. S. Charbonneau, P. O. Box No. 25,	– –
Wareham, . .	305	Arthur B. Savary, ...	J. J. Walsh.
Warren, . .	119	Joseph St. George, constable, . .	Alfred A. Warriner.
Warwick, . .	41	Chas. H. Williams, ...	– –
Washington, .	19	Geo. Messenger, R. F. D., Becket, .	– –
Watertown, .	206	John C. Ford, tree warden, . .	John C. Ford.
Wayland, . .	196	Clarence S. Williams, Cochituate, .	Daniel Graham.
Webster, . .	111	Arthur B. Patterson, . . .	– –
Wellesley, . .	239	Fletcher M. Abbott, tree warden, .	Fletcher M. Abbott.
Wellfleet, . .	323	Edwin P. Cook, ...	Everett S. Jacobs.
Wendell, . .	54	Geo. A. Lewis, ...	– –
Wenham, . .	221	Jacob D. Barnes, tree warden, . .	Jacob D. Barnes.
West Boylston, .	137	Frank H. Baldwin, agent Metropolitan Water Board.	– –
West Bridgewater,	285	Octave Belmore, tree warden, . .	Octave Belmore.
West Brookfield,	128	Robert M. Carter, P. O. Box 135. .	– –

List of Forest Wardens and Local Moth Superintendents — Con.

Town or City.	Badge No.	Forest Warden.	Local Moth Superintendent.
Westborough, .	133	James H. McDonald, chief fire department.	Walter Sullivan.
West Newbury, .	226	Silas M. Titcomb, P. O. Byfield, .	Robert J. Forsyth.
West Springfield,	341	A. A. Sibley, ...	– –
West Stockbridge,	20	Bernard Manning, ...	– –
West Tisbury, .	307	William J. Rotch, ...	– –
Westfield, . .	84	Geo. H. Byers, chief fire department, P. O. address, Arnold Street.	– –
Westford, . .	166	John A. Healey, P. O. Graniteville, .	Harry L. Nesmith.
Westhampton, .	71	Levi Burt, ...	– –
Westminster, .	154	John C. Goodridge, chief fire department.	Stillman Whitney.
Weston, . .	186	Edward P. Ripley, ...	Edward P. Ripley.
Westport, . .	279	Frank Whalon, North Westport, .	– –
Westwood, .	251	E. E. Smith, P. O. Islington, . .	C. H. Southerland.
Weymouth, .	245	J. Rupert Walsh, P. O. East Weymouth.	Dummer Sewall.
Whately, . .	56	James A. Wood, ...	– –
Whitman, . .	297	Clarence A. Randall, tree warden, .	Clarence A. Randall.
Wilbraham, .	96	Henry I. Edson, P. O. North Wilbraham.	– –
Williamsburg, .	61	Howard C. Pomeroy, ...	– –
Williamstown, .	2	Daniel Hogan, ...	– –
Wilmington, .	174	Jos. M. Hill, chief fire department, P. O. North Wilmington, P. O. Box 24.	Oliver A. McGrane.
Winchendon, .	103	Arthur L. Brown, chief fire department	– –
Winchester, .	189	Irving L. Symmes, chief fire department.	Samuel S. Symmes.
Windsor, . .	12	H. Ward Ford, tax collector, . .	– –
Winthrop,[1] .	–	– – –	Frank W. Tucker.
Woburn, . .	177	Frank E. Tracy, chief fire department,	John H. McGann.
Worcester, .	131	H. Ward Moore, Winnefred Avenue, .	J. H. Hemingway.
Worthington, .	62	Chas. E. Clark, ...	– –
Wrentham, .	260	Chas. E. Brown, chief fire department,	Wm. M. Gilmore.
Yarmouth, .	316	Seth Taylor, constable, . . .	Chas. R. Bassett.

New Legislation.

The new legislation enacted by the last General Court on forestry matters was as follows: —

1. An act relative to the liability of railroads for the extinguishment of forest fires.

2. An act empowering the Governor of the Commonwealth

[1] No forest area.

to issue a proclamation for a closed season for game during times of drouth.

3. Amended law, extending the area in one tract from 40 to 80 acres in lands purchased by the State for reforestation.

4. An act placing the work of suppressing the gypsy and brown-tail moths under the State Forester.

5. Appropriation for gypsy and brown-tail moth work.

6. An act to encourage the growth of white pine timber.

1. An Act relative to the Liability of Railroads for the Extinguishment of Forest Fires.

The enactment of this bill makes the railroads liable not only for the damage resulting from a fire caused by them, but for the expense of extinguishment of the fire. This act at first might seem to work hardship on railroads, as it was shown last year that 43 per cent. of the fires set in the State were railroad fires. With our new forest warden law, however, it is believed by both the State Forester and the railroad officials that with a perfected system of fire fighting the railroads themselves will gladly reimburse the towns and cities for the expense of extinguishing fires set by them, believing that by so doing the real damage to property will be thus lessened, and in the outcome not only will the railroads themselves be the gainers financially, but the towns and cities, in that less acreage is likely to be burned.

The act is as follows: —

Acts of 1909, Chapter 394.

An Act relative to the Liability for the Extinguishment of Forest Fires.

Be it enacted, etc., as follows:

Section 1. Any railroad corporation which, by its servants or agents, negligently, or in violation of law, sets fire to grass lands or forest lands shall be liable to any city or town in which such fire occurs, for the reasonable and lawful expense incurred by such city or town in the extinguishment of the fire.

Section 2. Cities and towns may recover sums to which they are entitled under the provisions of this act by an action of contract in the superior court. [*Approved May 14, 1909.*

2. *An Act empowering the Governor of the Commonwealth to issue a Proclamation for a Closed Season for Game in Times of Drouth.*

This is a precautionary measure that will result in calling the attention of the public to the importance of being careful about fires at a time when attention is most needed.

The act is as follows: —

ACTS OF 1909, CHAPTER 422.

AN ACT TO AUTHORIZE THE GOVERNOR TO PROCLAIM A CLOSE SEASON FOR GAME IN TIMES OF DROUTH.

Be it enacted, etc., as follows:

SECTION 1. Whenever, during an open season for the hunting of any kind of game in this state, it shall appear to the governor that by reason of extreme drouth the use of firearms in the forest is liable to cause forest fires, he may, by proclamation, suspend the open season and make it a close season for the shooting of birds and wild animals of every kind for such time as he may designate, and may prohibit the discharge of firearms in or near forest land during the said time.

SECTION 2. During the time designated as above by the governor, all provisions of law relating to the close season shall be in force, and whoever violates any such provision shall be subject to the penalties prescribed therefor. In case any person shall, during a close season proclaimed as aforesaid, discharge a firearm in or near forest land, or shoot any wild animal or bird, as to which there is no close season otherwise provided by law, he shall be subject to a fine of not more than one hundred dollars.

SECTION 3. A proclamation issued under authority hereof shall be published in such newspapers of the state and posted in such places and in such manner as the governor may direct, under the charge and direction of the state forester and the commissioners on fisheries and game. [*Approved May 21, 1909.*

3. *Revised Law extending the Area in One Tract from 40 to 80 Acres in Lands purchased by the State for Reforestation.*

The restriction to 40 acres was found to necessitate the expense of an extra survey where the lots ran slightly over the limited number, and by placing the area at 80 acres this objection is eliminated.

The act is as follows: —

ACTS OF 1909, CHAPTER 214.

AN ACT RELATIVE TO THE PURCHASE BY THE STATE FORESTER OF LAND ADAPTED TO FOREST PRODUCTION.

Be it enacted, etc., as follows:

SECTION 1. Section one of chapter four hundred and seventy-eight of the acts of the year nineteen hundred and eight is hereby amended by striking out the words "forty acres", in the tenth line, and inserting in place thereof the words: — eighty acres, — so as to read as follows: — *Section 1.* For the purpose of experiment and illustration in forest management and for the purposes specified in section seven of this act the sum of five thousand dollars may be expended in the year nineteen hundred and eight, and the sum of ten thousand dollars annually thereafter, by the state forester, with the advice and consent of the governor and council, in purchasing lands situated within the commonwealth and adapted to forest production. The price of such land shall not exceed in any instance five dollars per acre, nor shall more than eighty acres be acquired in any one tract in any one year, except that a greater area may so be acquired if the land purchased directly affects a source or tributary of water supply in any city or town of the commonwealth. All lands acquired under the provisions of this act shall be conveyed to the commonwealth, and no lands shall be paid for nor shall any moneys be expended in improvements thereon until all instruments of conveyance and the title to be transferred thereby have been approved by the attorney-general and until such instruments have been executed and recorded.

SECTION 2. This act shall take effect upon its passage. [*Approved March 25, 1909.*

4. An Act placing the Work of suppressing the Gypsy and Brown-tail Moths under the State Forester.

The enactment of this law was the result of its recommendation by Governor Draper in his inaugural address.

The act is as follows: —

ACTS OF 1909, CHAPTER 263.

AN ACT TO PROVIDE FOR CONSOLIDATING THE OFFICE OF SUPERINTENDENT FOR SUPPRESSING THE GYPSY AND BROWN TAIL MOTHS AND THE DEPARTMENT OF THE STATE FORESTER.

Be it enacted, etc., as follows:

SECTION 1. Section one of chapter four hundred and nine of the acts of the year nineteen hundred and four, as amended by section one of chapter four hundred and seventy-three of the acts of the year nineteen hundred and seven, is hereby further amended by striking out the said section and inserting in place thereof the following: — *Section 1.* The governor, with the consent of the council, shall appoint an officer to be known as the state forester, and shall determine his salary. He shall be a trained forester who has had a technical education. He shall be ex officio a member of the state board of agriculture. He shall act for the commonwealth in suppressing the gypsy and brown tail moths as public nuisances. The governor may, with the consent of the council, remove the state forester at any time for such cause as he shall deem sufficient. In case of the death, removal or resignation of the state forester the governor shall forthwith appoint a successor.

SECTION 2. The office of superintendent for suppressing the gypsy and brown tail moths is hereby abolished. All the powers, rights, duties and liabilities of the said superintendent are hereby transferred to the state forester. No existing contracts, proceedings or liabilities shall be affected hereby, but the state forester shall in all respects and for all purposes be the lawful successor of the superintendent for suppressing the gypsy and brown tail moths.

SECTION 3. This act shall take effect upon its passage. [*Approved April 7, 1909.*

5. *An Act to provide Funds for carrying on the Moth Work during a Definite Period of the Year, so that the Effect of the Work will not be handicapped.*

The act is as follows: —

ACTS OF 1909, CHAPTER 452.

AN ACT TO PROVIDE FOR THE SUPPRESSION OF THE GYPSY AND BROWN TAIL MOTHS.

Be it enacted, etc., as follows:

SECTION 1. The state forester is hereby authorized to expend for the suppression of the gypsy and brown tail moths, and for expenses incidental thereto, the sum of one hundred and fifty thousand dollars annually for three years, beginning with the year nineteen hundred and ten; and if any part of the said one hundred and fifty thousand dollars remains unexpended at the close of any year the balance may be expended in the following year.

SECTION 2. This act shall take effect upon its passage. [*Approved May 26, 1909.*

6. *An Act to encourage the Growth of White Pine Timber.*

This bill was enacted in order to encourage land owners to leave seed trees and encourage natural methods of reforestation.

It offers as a premium exemption from taxation for a certain period of all lands that are properly restocked to white pine.

ACTS OF 1909, CHAPTER 187.

AN ACT TO ENCOURAGE THE GROWTH OF WHITE PINE TIMBER.

Be it enacted, etc., as follows:

SECTION 1. Land which does not exceed in value ten dollars an acre, if well stocked with thrifty white pine seedlings that have attained an average height of not less than fifteen inches, upon satisfactory proof of its condition by the owner to the assessors, shall be exempt from taxation for a period of ten years thereafter: *provided,* that if any trees of commercial value, except such as are reasonably removed for the improvement of the white pine growth, are cut or removed from the said land, the exemption herein provided for shall cease.

SECTION 2. All acts and parts of acts inconsistent herewith are hereby repealed.

SECTION 3. This act shall take effect upon its passage. [*Approved March 18, 1909.*

ACKNOWLEDGMENTS.

It is with pleasure that the State Forester acknowledges the valuable services and loyal support which he has received through his corps of assistants, not only in the office but in the field, throughout the year.

Mr. L. Howard Worthley has been untiring in his efforts to leave nothing undone in his assistance in perfecting the organization of the moth work and in getting the best possible results.

Mr. H. O. Cook, M.F., has kept up the high standard in technological lines, and, as the reports show, has increased the efficiency of the work in forestry management beyond that of any previous year.

Mr. R. S. Langdell, who has charge of the nursery work, has not only demonstrated that this work is a commercial success, but has penetrated every section of the State, and is largely responsible for the splendid beginning already made in reforestation.

Mr. Chas. O. Bailey has loyally stood at his post of duty as secretary, and kept the machinery well oiled and properly running.

The State Forester is under obligation, for courteous treatment and kindly consideration, to all citizens, boards and officials with whom he has come in contact, and especially to Dean W. C. Sabine of Harvard University, Dr. L. O. Howard of the United States Bureau of Entomology, and his predecessor, A. H. Kirkland, for kindly assistance, suggestions and advice. He wishes also to acknowledge the great assistance rendered by the men of the co-operative scientific staff.

GENERAL FORESTRY.

Examination of Woodlands and Practical Assistance given Owners.

This department of our forestry work is the largest establishment of all our lines, yet it is not as familiar to the people of the State as it should be. If it were, we believe that there would be many more calls for advice than we receive at present. By examinations we refer briefly to this, that owners of woodland in the State may, by applying to this office on a special blank, have a trained forester come and look over their woodland, and he will point out to them how it can be improved, and furnish any other information which it is in his power to give. Where it is a case of thinning, he may, if he sees fit, mark a portion of the trees to be cut. The only expense to the owner for this advice is the travelling expenses of the visiting forester. This offer applies equally to land owners who want advice on the planting of barren land. Counsel given on the ground, where all the conditions can be seen and met, is far superior to any given by correspondence or to the general advice contained in pamphlets.

The following table shows the number of examinations made in this and past years, together with the combined area of the various wood lots. It will be noticed that there is a slight falling off since last year; but this fact does not discourage us, because in 1908 we made a special effort to advertise this part of our work, first by sending out a large number of examination application blanks to those on our mailing list, and second, by sending a special circular letter to all the water boards in the State. The result was, of course, that quite a number of requests for assistance were received which otherwise would not have been made, including some of our largest. Holding that the figures of last year were abnormal, we consider those of this year to be distinctly encouraging; yet, as we have said before, we think that there should be more use made of this offer on the part of the State of free forestry advice.

	1904. (6 mos.)	1905.	1906.	1907.	1908.	1909.
Number,	14	36	47	37	65	60
Total area,	2,000	6,545	9,357	8,713	15,842	15,862

As was done last year, a circular letter with an accompanying set of questions was sent to those who received advice during 1908, the object of which was to ascertain how far the recommendations made by the visiting forester had been carried out. A larger percentage of replies was received than last year, there being 46 who sent in reports, to 12 who did not. Eight were not given blanks, as enough was known of their work, through other channels, to make further information unnecessary. The following table gives a summary of these reports: —

Reports received from Examiners of 1908.

Recommended to thin: —	
All the work done,	8
Partly done,	13
Nothing done,	10
Recommended to plant: —	
All the work done,	2
Partly done,	13
Nothing done,	15
Recommended to do nothing,	4
Clean cutting recommended,	2

Results of Examinations of 1907.

Recommended to thin: —	
All the work done,	3
Partly done,	6
Nothing done, or not reporting,	8
Recommended to plant: —	
All the work done,	2
Partly done,	10
Nothing done, or not reporting,	8
Recommended to do nothing,	4

Contrary to results in 1907, thinning work in 1908 seemed to be more popular than planting. This may be due in part to the fact that we have endeavored to mark a portion of the trees to be cut.

For a record of the work done, see list under forestry expenditures and receipts.

Reforestation Work.

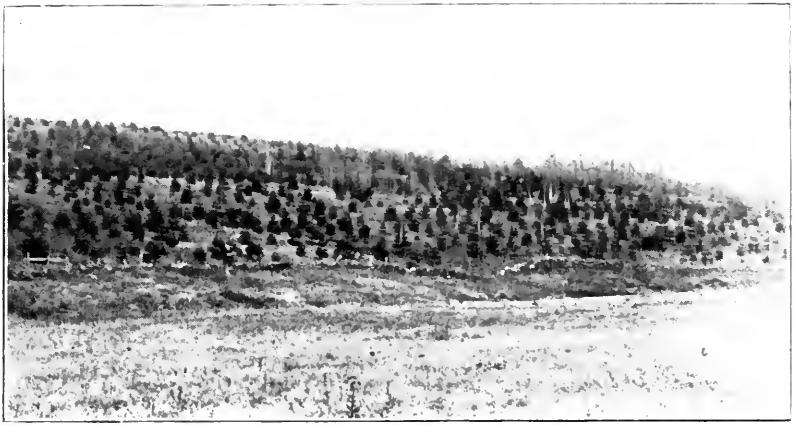
Great interest has been shown in regard to reforesting the waste and denuded lands of the Commonwealth. The reforestation law of 1908 fills to a large extent a long-felt want in this line of work, and, although the State planting is necessarily limited by the appropriation, it is desired as far as possible to plant one or more lots in each town in the State. This will place before the people an example which private owners can follow out in their own work, and in time bring much of the lands generally considered worthless and an eyesore to the community back into a profitable forest growth.

Land referred to as fit only for reforesting purposes can be classed under the following types: cut-over land, burnt-over land, and run-out pasture land (growing up to gray birch, etc.). The land taken over under this act generally comes under one of the foregoing types.

The first of the year a notice and copy of the acts were sent to the selectmen, forest warden and the leading newspapers in each town. From applications desiring to take advantage of the act, deeds for 929 acres of land have been recorded and the tracts planted last spring. For this purpose 500,000 three-year-old white pine transplants were obtained from German nurseries, and as many more seedlings from this country, a portion of the latter being sent out from the State nursery at Amherst.

The different lots were planted by local workmen in the towns, under the supervision of experienced foresters from this office. The average cost of planting this year ranges from $6 to $10 per acre; but by raising our own trees in a nursery established for the purpose the cost could be greatly reduced.

In a few instances it was deemed advisable to cut a fire belt on the exposed side of the plantation, to act as a protection from



A white pine plantation on the watershed of the Wachusett reservoir, near Clinton.

A mixed white pine and hard-wood plantation, five years after setting. The hard woods are not a success.

forest fires, which are the chief danger and drawback to setting out trees to be grown for a term of years.

The coming year land in other sections will be planted, and it is hoped plantations will become quite generally distributed throughout the State.

The following plantations were made in the towns named during the past year: —

STATE PLANTATIONS.

Town.	Acres.	Type of Land.	Variety planted.
Andover,	40	Cut and burnt land,	White pine.
Ashburnham,	66	Run-out pasture,	White pine.
Ashburnham,	10	Run-out fields,	White pine.
Ashburnham,	5	Old orchard,	White pine.
Carver,	5	Burnt-over land,	White pine.
Gardner,	93	Burnt-over land,	White pine.
Hubbardston,	54	Sandy plain land,	White pine.
Hubbardston,	40	Plains land,	White pine.
Hubbardston	40	Cut and burnt land,	White pine.
Hubbardston,	14	Cut-over land,	White pine.
Hubbardston,	10	Cut-over land,	White pine.
Kingston,	10	Burnt-over land,	White pine.
Montague,	26 [1]	Plains land,	White pine.
Paxton,	55	Cut-over land,	White pine.
Pelham,	16	Cut-over hillside,	White pine.
Pelham,	6	Cut-over land,	White pine.
Rowley,	10	Cut-over land,	White pine.
Sandwich,	14	Cut-over land,	Scotch and Austrian pine.
Spencer,	35	Cut and burnt land,	White pine.
Spencer,	23	Run-out pasture,	White pine.
Spencer,	6	Cut-over land,	White pine.
Templeton,	107 [1]	Cut-over land,	White pine.
Templeton,	60 [1]	Cut-over land,	White pine.
Westminster,	40	Cut-over land,	White pine.
Westminster,	40	Cut-over land,	White pine.
Westminster,	39	Burnt-over land,	White pine.
Westminster,	36	Cut-over land,	White pine.
Westminster,	29	Cut-over land,	White pine.
Total area,	927		

[1] Lots protected by fire belt.

Planting done under Advice of State Forester.

Name.	Town.	Variety.	No. of Trees.
Amherst Water Company,	Amherst,	White pine,	10,000
Holyoke Water Company,	Holyoke,	White pine,	10,000
Leominster Water Company,	Leominster,	White pine,	7,000
Westfield Water Company,	Westfield,	White pine,	7,000
Harlow Brook Cranberry Company,	Wareham,	White pine,	5,000
Fred Barclay,	Spencer,	White pine,	12,000
Lewis I. Wright,	Gardner,	White pine,	2,000
E. E. Rice,	Boston,	White pine,	1,000
D. H. Rice,	Barre,	White pine,	2,000
N. D. Bill,	Springfield,	Chestnut,	500
E. P. Dunbar,	West Bridgewater,	White pine,	4,000
A. H. Hall,	Leominster,	White pine,	1,000
Brown Bros. and John Folsom,	Winchendon,	White pine,	50,000

Evergreen Seedlings now imported Free of Duty.

It may be of interest to know that the last session of Congress removed the duty on evergreen seedlings. This places the reforestation work with evergreens on a practical basis. Our people will ultimately grow their own stock, and the foreign importation will keep prices within bounds until that time. The tariff heretofore was $1 per 1,000, and 15 per cent. ad valorem.

Forest Nursery.

The State forest nursery at Amherst on the farm of the Agricultural College was again enlarged last spring, and we have prospects of being able to use at least 1,200,000 white pine two-year-old trees of our own growing in the reforestation work throughout the State next spring. Besides white pine we also have many other species in lesser lots, but all of value in the State work. The detail table which follows may be of interest. The State forest nursery work speaks for itself, when we show that the total expense of carrying it on has been for three years $5,749.69, and were we to sell the stock now on hand at current prices it would be worth $7,500.

Meanwhile, we have been using seedlings and transplants every year which are not included here. Last spring alone we dug from the nursery at least 150,000 trees, and at present we have fully 2,000,000 one-year-old white pine seedlings, besides 100,000 of other species. The following table shows the estimated amount of nursery stock on hand: —

Variety.	Age (Years).	No. of Trees.
White pine seedlings,	2	1,200,000
White pine seedlings,	1	2,000,000
Pitch pine seedlings,	2	40,000
Pitch pine seedlings,	1	50,000
Norway pine seedlings,	1	5,000
Austrian pine seedlings,	1	2,000
Norway spruce seedlings,	1	25,000
Balsam fir seedlings,	1	5,000
Hemlock seedlings,	1	5,000
Red spruce seedlings,	1	2,000
Black locust seedlings,	1	5,000
Total,	. . .	3,339,000
White pine transplants,	4	25,000
White pine transplants,	3	25,000
White ash transplants,	2	20,000
Norway spruce transplants,	3	3,000
Black locust transplants,	2	2,000
Catalpa speciosa transplants,	2	300
Honey locust transplants,	2	6,000
Total,	. . .	81,300

It has been the aim of the State Forester not only to demonstrate in the nursery what can be done, but to assist those interested in growing their own trees by sending literature describing how to collect the seed, and even furnishing an assistant to demonstrate how to make the seed beds and plant the seeds. During the planting season at the nursery we are glad to welcome any one desiring experience in nursery work. This offers an opportunity not only to see how the work is performed, but to get some actual experience. Last spring several persons availed themselves of this offer.

A few persons have started seed beds of their own. One man will have 150,000 two-year-old seedlings to use from his own growing next spring, while another estimates he will have from 250,000 to 350,000. Many more will have smaller lots.

Larger State Nursery needed.

The time has come when the State should have a more definite forest nursery policy. It is deemed practically necessary that the State operate a nursery of sufficient size to raise its own trees for reforestation purposes under the reforestation act. It is believed the State Forester will be unable to secure sufficient suitable land in large enough area on the farm of the Agricultural College to carry on the work necessary. The college already feels cramped for land, and the small tract used for the present nursery, which is altogether inadequate for the needs of the coming year, is allowed us only temporarily. If the college trustees feel unable to allow the State Forester double the area where the present nursery is located, it will necessitate making plans elsewhere. A water supply should be put in, more screens made and a better work shed built. The nursery should also be fenced off, as damage has repeatedly resulted from animals getting loose and trampling the beds. These improvements will be necessary, whether we remain at the college or move the nursery elsewhere.

The State Forester should be given sufficient funds for establishing a nursery commensurate with the carrying out of the reforestation act, for, as already demonstrated, it amounts only to lending the money to carry on work that will be returned to the State treasury later in the sale of forest products.

New York State last year published a bulletin offering forest tree seedlings and transplants from the State forest nursery to any one who would guarantee to plant them in that State, at the following prices: —

White pine transplants,	$4.25 per 1,000, f.o.b.
White pine seedlings (2 years old),	2.25 per 1,000, f.o.b.
Scotch pine transplants,	3.75 per 1,000, f.o.b.
Scotch pine seedlings,	2.25 per 1,000, f.o.b.

While the State of New York was encouraging its people in reforestation by the above generous offer, Massachusetts was unable to purchase similar white pine seedlings for less than $4 per 1,000 in this country, and even at that price we were compelled to take them in 100,000 lots; for 1,000 lots the price was $5 per 1,000 for the best and $4 for second quality. Transplants of white pine were quoted at from $10 to $20 per 1,000.

If New York can do this, and make the work self-supporting, I feel sure that under similar conditions Massachusetts can do as well.

As was stated last year, it is not the intention of the State to go into the nursery business, other than to meet requirements in carrying out a practical economic reforestation policy. If we can grow seedlings and pay all expenses for $2.25 per 1,000, why should we be compelled to pay $5? Using, as we will the coming spring in the State reforestation work, 2,000,000, the cost if grown by ourselves would not exceed $4,500, while in the American markets they would cost us $8,000 if purchased in large lots, or $10,000 if purchased in smaller quantities.

While the difference in white pine seedlings seems large, transplants are comparatively more expensive, the one being $4.25 per 1,000 as compared to $12.

Norway Spruce as a Forest Tree.

This tree is used quite commonly as an ornamental tree in this State, and common observation shows that it succeeds remarkably well. As a possible forest tree it has not been considered very seriously until this year. It is believed that the Norway spruce will succeed where our native spruces are found growing naturally, and perhaps elsewhere. The following experience of Mr. George Aiken, manager of the Billings Farm at Woodstock, Vt., in growing Norway spruce on his farm, is herewith offered, with his permission.

One acre was planted with three-year-old trees, 8 feet apart each way, requiring 680 trees to the acre. The land was a poor, sandy hillside, unfit for cultivation. In 1908, when the trees were thirty-two years of age, or thirty-five years from seed, 4 average-sized trees were cut. Their measurements were as follows: —

No. 1,	72 feet high,	11-inch butt cut,	46½	feet of logs 6 inches at top.
No. 2,	57 feet high,	15-inch butt cut,	47½	feet of logs 6 inches at top.
No. 3,	63 feet high,	14-inch butt cut,	42	feet of logs 6 inches at top.
No. 4,	67 feet high,	16-inch butt cut,	40	feet of logs 6 inches at top.

These 4 trees produced 1 cord of pulp wood. Reckoning from this yield as applied to an acre, the yield would be 172½ cords, which at the current price of $6.50 per cord, would give the income from this acre $1,120 in thirty-two years.

Computing the land at $5 per acre, cost of trees and planting at $5, and to this adding compound interest for the thirty-two years, the total would amount to $65.50; adding to this taxes for thirty-two years, or $7.50, makes the total investment $73, and hence leaves a net income of $1,046.86, or a yearly average of $36.72 per acre. Mr. Aiken claims that this land is not worth over 50 cents per acre per annum for grazing.

The pulp wood cut here was sold to the International Paper Company, who made it into paper at the Bellows Falls mill. Mr. Edward Barrett, superintendent of this mill, reports as follows: —

The Norway Spruce Test. — One cord of rough wood, 71 sticks 4 feet long, after preparing for grinding room, gave us 98 cubic feet; this made 1,228 pounds of dry wood pulp. The spruce worked nicely on the paper machine, and, under the same conditions as our regular spruce, gave us a higher test for strength and a brighter shade with the same amount of color.

For the first time the State Forester expects to set out quite a large number of Norway spruce in Massachusetts the coming spring. The beauty of the spruce for pulp wood is that practically the whole tree is utilized.

Forest Fires of 1909.

Forest fires have been altogether too numerous throughout the State during the past season. We are convinced that the permit act which went into effect last spring gave splendid results, and that forest wardens generally were more active than ever; but with all this we are not accomplishing the results we should and must.

A large tract of land in Hubbardston, which was reforested by the department last spring.

A portion of one of the lots turned over to the State. The cord wood taken out pays the expense, and the remaining stand is in a much-improved condition.

The total number of forest and grass fires reported to the State Forester during the year was, 1,531; the number of acres burned over, 42,808; loss to the State, $236,478.

From the table it is shown that the chief cause of forest fires is from railroad locomotives, which set 497, or 34 per cent. of the total of the year, compared with 490 last year. Next in point of number are fires from unknown causes, 360. The third largest cause is due to burning brush, 108, or 7½ per cent. of the total. The fourth in number is that caused by smokers, 90. It is believed, however, that in the latter should be included the great number of those listed under the unknown, and even some of those attributed to other causes. The fifth cause was directly traceable to our juvenile population, as 83 were known to be set by boys.

It is hoped that our railroads will exert themselves to lessen these fires in the coming year. We certainly should ascertain the causes unknown at present, and, with our permit law in force, the burning brush cases should be very much reduced; while the number of fires caused by smokers and boys will be overcome only by a determination to place the responsibility where it belongs by our forest wardens, deputies and people generally interested in preserving our forests.

Fires from Smoking.

That the careless smoker, who persists in the habit when in woodlands or traversing the country during a dry time, whether at work or play, is the greatest menace to future forestry, it is believed there is little question. The railroad fires are confined to certain areas, but the smoker is everywhere. If forest wardens or their deputies were to bring more circumstantial evidence to bear against smokers from known locations where hunters, fishermen, campers, woodsmen, etc., have traversed, it is believed the effect of the law which makes such persons liable for damages would prove helpful to future forestry.

Causes of Forest Fires in Massachusetts, 1909.

Causes.	No.	Per Cent.
Berry pickers,	25	1.72
Blasting fuse,	1	-
Boys set fire,	83	5.72
Burning brush,	108	7.51
Campers,	9	-
Carelessness,	2	-
Charcoal,	1	-
Children playing,	9	-
Coals dumped,	5	-
Cranberry bogs,	1	-
Electric wires,	2	-
Fire balloons,	1	-
Fireworks and fire crackers,	4	-
Fishermen,	2	-
Grass fires,	30	2.06
Gypsy moth,	6	-
Hunters,	8	-
Incendiary,	36	2.48
Lightning,	1	-
Locomotive sparks,	497	34.26
Mayflower parties,	2	-
Picnic parties,	2	-
Rubbish fires,	31	2.13
Smokers,	90	6.20
Steam saw mills,	5	-
Spark from burning building,	6	-
Spark from forest fire,	11	0.76
Steam roller,	3	-
Scattering,	106	7.33
Unknown,	360	24.89
Wood choppers,	3	-
Reported too late for tabulating,	63	-
Total,	1,513	-

Arrests and Convictions.

Forest wardens have been extremely lenient as regards arrests for violations of the State forest fire laws, — altogether too much so, it is believed. The idea has been to caution people and educate them in realizing the danger of forest fires before arresting them. It is believed, however, that we have been generous in this respect, and henceforth if we are to stop fires we must be reasonable, but assert a little more backbone in controlling them.

The following arrests and convictions were made during the year 1909: —

Edgartown, July 12. Conviction of man taken while burning without a permit; case placed on file.

Falmouth, June 1. Young man convicted of setting woods fire, and sent to reformatory.

Holbrook, December. Conviction of man burning without a permit; paid fine and costs.

Lancaster, April 2. Man taken while burning without a permit; paid costs and damages.

Mansfield, March 30. Tramp convicted of setting fire to farmer's wood lot; sent to jail.

Plymouth, August 8. Man convicted of burning without a permit; fined $10.

Reading, October 13. Two men burning without permit; fined $25 each.

Spencer, April 10. Man burning without permit; fined $10.

Stoughton, April 7. Man burning without permit; fined.

Tewksbury, July. Boys placed on probation.

Upton. Two men arrested; placed on probation.

Wrentham. Cases on file.

TABLE OF ACRES, COST AND DAMAGE, BY MONTHS.

MONTHS.	Acres.	Cost.	Damage.	Damage per Acre.
January,	13	-	$20	-
February,	12	-	-	-
March,	1,577	$684	4,763	$3.02
April,	12,515	2,866	72,195	5.76
May,	4,322	1,588	38,080	8.81
June,	405	242	11,870	29.30
July,	11,992	2,715	26,396	2.20
August,	1,940	2,745	10,833	5.57
September,	1,092	562	21,413	19.51
October,	384	180	1,805	5.17
November,	585	356	612	0.61

Table of Forest Fire Totals.

	No. of Fires.	Acres burned.	Cost to put out.	Damage.
Reports received too late for tabulation, .	63	246	$110	$1,515
Totals of reports tabulated for 1909, . .	1,450	42,562	15,433	219,425
Forest fire totals for 1909, . . .	1,513	42,808	$15,543	$220,930

Railroad Co-operation in Forest Fire Fighting.

During the last year, as heretofore, the officials of the railroads have for the most part shown a very helpful and co-operative spirit in regard to forest fires. More attention has been given to keeping the spark-arresters on engines in order, while our forest wardens and the section men are working together for the prevention of fires. The new legislation of last year, whereby the railroads are to reimburse the towns for the cost of fighting fires known to be set by them, was enacted without any protest, and, in fact, with their consent. Hereby an organization for forest fire fighting is resulting which will prevent fires that otherwise would be of great expense to railroads. The damages for one fire are likely to cost a railroad more than the total expense of reimbursing all of its towns in fighting fires set by them.

President Tuttle of the Boston & Maine Railroad complimented us by having a representative at both the Northampton and Boston conferences of forest wardens, who discussed "What the railroads are doing to prevent fires," and pointed out wherein they were glad to co-operate with the towns in stopping forest and grass fires. The New York, New Haven & Hartford Railroad also sent a representative to the Middleborough meeting in a like capacity. Mr. Louville Curtis, the representative of the Boston & Maine Railroad, has already adopted the use of hand fire extinguishers on the western division of their road, and is delighted with the results. He believes that their use will become very common by railroads for extinguishing forest or grass fires in the future. They could be kept at points along the line easy of access, and quickly shipped by the first train or sent by a special if occasion demanded. Much clearing up and widening of the right of way have been done by the New York, New Haven & Hartford Railroad throughout the year, particularly in the Cape section.

Forest Fire Deputies needed.

The forest warden law has undoubtedly been tested far enough to be pronounced a success as another step in perfecting our organized efforts against forest fires. I now propose the idea of empowering the State Forester to appoint deputies at large to assist him. Many of our forest wardens need instruction and co-operation in getting their work well in hand. The best way to teach these men just how to accomplish results in fighting forest fires is to confer with them right on the ground, and demonstrate what can be accomplished and how it can be done. There are experienced men whom the State Forester could in times of emergency delegate to assist, and, if need be, with authority to take charge.

In the case of the gypsy and brown-tail moth agents, these men are at present mounted on motor cycles and hence are familiar with the country. They are already State employees, and men interested in the preservation of the forests. They will gladly acquaint themselves with modern methods of fighting forest fires, and, were they appointed deputies authorized to assume responsibility, the State would have their services at no extra compensation. Of course this would apply only throughout the moth-infested territory, but other plans could be worked out for the remainder of the State at a minimum cost.

State Subsidy to Towns for Better Forest Fire Protection.

The time has come when we can ill afford to allow forest fires to run rampant over the State, destroying each year thousands of dollars worth of property.

In many cases the reason for present conditions is that a great many of our rural towns have nothing in the way of equipment with which to fight forest fires when they occur. With a simple equipment, consisting of a few hand chemical fire extinguishers provided with extra charges and loaded into a light one-horse spring wagon, together with some shovels and hoes, many of the fires could be easily handled before they could do much damage.

Believing, therefore, that the State can afford to encourage the towns to make a definite beginning in stopping forest fires, I recommend the following for your consideration: that the State offer through the State Forester to reimburse towns 50 per cent. of their expenditures for forest fire fighting equipment, or in making forest fire protective belts, to an amount not to exceed $250 for each town thus accepting such aid.

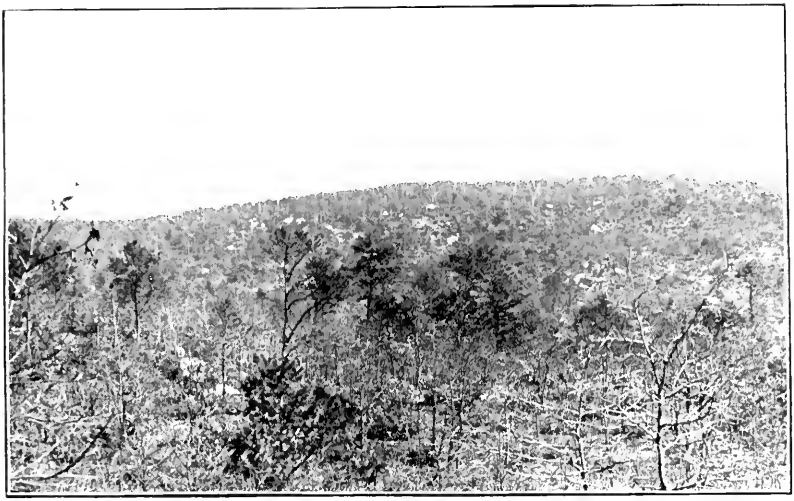
This idea is practically that now in operation by the State in the construction of our State highways, which has proved a great success. The incentive for towns that would otherwise move slowly is apparent.

The total expense, were every town to accept, would amount to about $80,250, — not one-third of the annual loss from forest fires, and with every possibility of the expenditure meaning a saving of ultimate millions in future values to the State.

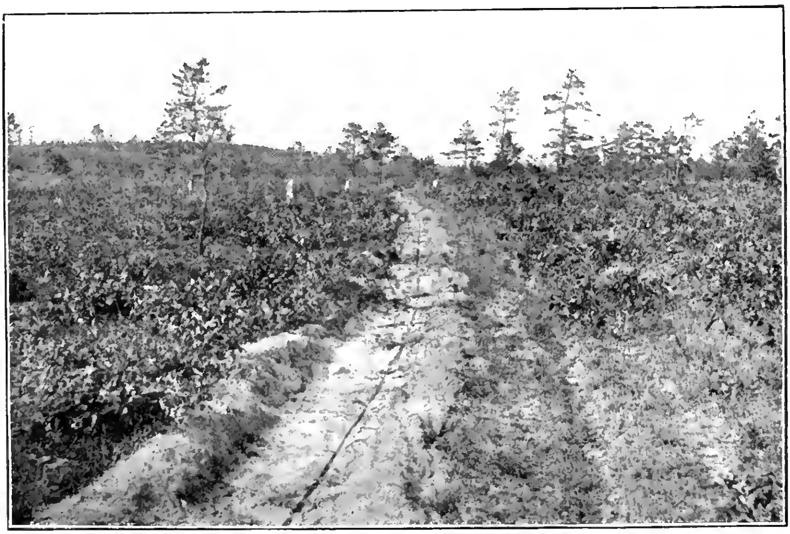
Plan for establishing Forest Fire Lookouts.

This plan provides for the erection of lookout towers on various high points throughout the State, with the object of detecting and locating forest fires while yet in an incipient stage. The plan is by no means a new one, even in this State, as is evidenced by the towers already in use in Plymouth and Duxbury, and described in the recent fire bulletin issued by this office; while it is generally conceded that the system of towers used by the large timber operators in Maine is one of their most valued assets, since it affords means of preventing fires which would otherwise destroy millions of feet of valuable timber.

But, while the principle and the results are thus similar, the method of application in Massachusetts must necessarily differ greatly from that in Maine. This is because of the different physical conditions of the two States, as we may say; for, while the forest regions of Maine are practically in the central and northern part of the State, and often lie for miles in unbroken tracts, in Massachusetts there are no real forests, properly so-called, and the tracts of woodland that do exist are scattered



A photograph, taken after the fire, of a portion of the ten thousand acres burned at Bourne and Falmouth.



The plowed fire line along an old road, which enabled Sandwich to protect the town from the Bourne fire. Bourne on the left, Sandwich on the right.

over all parts of the Commonwealth, from Cape Cod to the Berkshires, and occur under widely different topographical conditions. And, furthermore, such systems of lookouts as we have mentioned are managed over comparatively localized areas, usually vast wilderness, by the owners themselves for their own benefit, while the difference in Massachusetts is obvious.

The problem is not to immediately establish a complete fire protection system all over the State, but to endeavor, by placing lookouts at certain important points, to co-operate as far as possible with the local wardens in the quick detection of fires. It is easily seen that such a system becomes useful largely in proportion to the distance covered from a given point, so that a tower erected on flat country may prove of great service. Take, for example, the Plymouth tower. This tower was built by the town of Plymouth, and is of skeleton steel construction somewhat like a windmill tower, with a small sheet-iron cabin at the top. The structure itself is 85 feet high, and the watchman is elevated 250 feet above sea level, — an elevation which enables him to see many miles over the surrounding flat country. A man is kept on watch in this tower in dry seasons from March 15 to October 1, from 8 in the morning till 6 at night. This watchman is connected by telephone with the forest warden, and the plan has proved to be a most excellent one.

The Cape has by far the most destructive fires of any region in the State, and it is therefore thought advisable to lay the strongest emphasis on that section at present, at the same time choosing suitable locations in other sections. At least two towers are urged for the Cape section.

One of the necessary equipments of such stations is the telephone, and the cost of installation would depend, first on whether such hills were already equipped (as is Mt. Greylock); and, second, on the distance to the nearest line and likelihood of future development in the vicinity, which would affect the cost of putting in such a line. In the more remote localities a larger proportion of the expense would have to be borne by the State.

Other equipment consists of good field glasses, range finder and accurate maps of the region. The cost of the structure itself depends, of course, on the locality and the amount of construction necessary. Of 22 stations in Maine, the cost runs anywhere from $350 to $1,000, depending largely on the length of telephone connection. Telephone lines have cost there from $30 to $40 a mile.

One of the large lumber companies owning timber lands in Maine recommends a number of extinguishers on hand at the watch tower for use in case of emergency, and also the maintenance of a patrol during especially dry times.

As regards the expense of maintenance, it seems only fair that it should be borne in part at least by the towns to which protection is given.

Assistant needed in Forest Fire Work.

The time has come when the State Forester should have the assistance of a man who can spend his whole time on forest fire work. For the next few years each town should be visited, and the whole matter of forest fire prevention gone over carefully with the local wardens. Your State Forester cannot get over each of our 321 towns and give them the attention they should have regarding forest fires, and at the same time keep the reforestation, moth work, lectures, correspondence, etc., going. With a competent assistant, however, he can direct the work, and save great values that each year at present are a total loss. Such an assistant could be provided with a motor cycle, by means of which even the most inaccessible country sections could be easily reached. The idea would be to keep this man in the field, particularly during the forest fire season. The expenses of such a man would be his salary and travelling expenses.

Power Sprayers as Forest Fire Equipment.

With the high-power engines and improved pumps on the modern power sprayers, we have an outfit not only adapted to spraying our tallest trees in moth-suppression work, but when properly handled they can be used very effectively for fighting forest fires. While these outfits are rather heavy when loaded, and need a strong team to handle them on the ordinary roads, they may need four horses when operating in woodlands. The advantages of these machines are that they contain a large tank for water, and also that their power is sufficient so that hose one thousand feet or more in length can be used. In cases where the machines can be placed at the water supply, they can pump directly to the fire.

The following quotation is taken from a letter written to H. L. Frost & Co. by Mr. J. D. Barnes, local superintendent and forest warden, Wenham, Mass.: —

> I also put the machine to a good fire test. Of course we did not purchase this outfit for a fire fighter, but we happened to have a large fire here, where nine ice houses were burning at once. Now, there was a forest across the road from these buildings, also a group of four cottages. I started to save the forest land, not thinking I could do anything about the cottages, but to my surprise we stopped the forest fires and saved the cottages. I started the machine at 4 P.M. and played until 3 A.M., and then started at 7 A.M. and played all day except the noon hour, using two streams of 500 feet of 1-inch hose each, drafting and playing direct. I had to remove the plug in the bottom of the tank to get rid of surplus water, which gained about 400 gallons every forty minutes, which the nozzles could not take care of.

Automobiles and Motor Cycles in Forestry Work.

Upon assuming the duties of the moth work, it was found that the expenditure of a large amount of money in automobile hire would be necessary, as this is the only expedient way of getting into the infested districts and keeping in touch with the field work. It was found that this expense during the previous year had been over $2,000. The matter was taken up with Governor Draper, and he authorized the purchase of an automobile, which has been in constant use. When controversies have arisen in towns or cities over the conditions of the work, we have been able to take the board of selectmen, mayors and others interested directly into the field. It has not been uncommon for the automobile to cover from 10 to 20 towns in a single day, and to do business with as many local superintendents.

The motor cycles were purchased by the department for the division superintendents, and were first used in September. From this short experience we are convinced that the efficiency of each man is greatly multiplied. With a motor cycle he can if need be get into every town under his supervision in one day.

Two motor cycles have also been purchased for the use of the forestry assistants.

I predict even farther that it is only a matter of a short time before our towns will be able to combat forest fires through the assistance of automobiles. Already some of our public-spirited forest wardens have automobiles of their own, and they do not hesitate to use them as occasion demands. They reach the fire quickly, and thus accomplish results when other means of conveyance would be too late.

Fire Balloons.

A few complaints have reached the State Forester claiming that the so-called toy paper or hot-air balloons have been responsible for starting forest fires, and their use should be regulated. It can be readily seen that where the conditions are just right the damage from this source might be very serious. It is recommended, therefore, that in order to fly these balloons the participant be required to secure a permit from a forest warden, and that the liability for damages should they occur be the same as for other fires set out of doors.

Price to pay for fighting Forest Fires in Towns.

There seems to be no uniformity in towns regarding the price per hour paid for fighting forest fires. One town may pay 15 cents an hour and another 50 cents, while others range between these two extremes. At the various conferences of forest wardens held the past fall this question was brought up, and it was the consensus of opinion that a uniform rate should be adopted for the entire State. This question, however, is a local one; and, while 15 cents may not be enough, 50 cents seems high, and it is believed that the town forest warden should have the matter adjusted at the town meeting to meet his needs. One forest warden has an arrangement with his town chief of the fire department, whereby he can have experienced firemen at the rate of 50 cents for the first hour and 25 cents for each succeeding hour. A few live men who are willing and interested in the town's future welfare, with some up-to-date equipment, are worth much more than a large number of unorganized men, as frequently found at forest fires.

Slashings or Brush should be burned.

The common custom of allowing the slashings to remain upon the ground after lumbering operations leaves a veritable tinder box for forest fires. A fire once started here is soon beyond control, and the damage is not confined even to the area covered with slashings, but in most cases adjoining properties are endangered and fequently large areas are devastated. With forest products at present prices and the facts well understood that fires are the great menace to future forestry, it is time that we should enact laws regulating the handling of slashings.

The United States Forest Service requires that the brush resulting from lumbering operations upon the forest reserves be piled and burned as a part of any contract they let. Wisconsin has a special commission appointed by the Legislature to report recommendations toward regulating this matter.

There are few States that need to give attention to this subject more than Massachusetts. We are thickly populated, and the damages from fires are relatively great. Our markets are of the best, and as a matter of business we can ill afford to practice a slack policy.

If when operating our forest or wood lots the brush is made at the time into small piles, they can be burned at a time when there is no danger from spreading. It is advisable to burn the slashings when operating, if conditions are favorable, as they are then green; and, as the work is usually done during the winter season, there is snow on the ground, or sufficient moisture is present to prevent any spreading of the fire.

With the slashings and general débris out of the way, the fire danger is reduced to a minimum; and, whether the land is reforested by setting out seedlings or a copse growth established, the conditions for future success will be of the best.

Fire Lines and Protective Moth Belts.

It is a common practice in the gypsy moth work to surround badly infested colonies that otherwise would spread by making protective belts of 50 to 100 feet wide, and by thinning out the stand and opening up an avenue whereby the insects cannot pass without being destroyed. This protective moth belt is usually kept sprayed, and thus the insects are poisoned before they get across it.

This same belt can also be utilized as a forest fire line, as it serves to make a stand against a fire, if it is so desired. Old wood roads can be made to answer nicely for these belts. In the first place, the road is needed for getting spraying pumps through for moth suppression, and forest fire wagons need similar conditions; and, if roadsides are widened on either side, giving the width mentioned, both purposes are accomplished. Forest wardens and moth superintendents should take advantage of these conditions, and work together in getting more of these protective belts in the town.

Cape Forest Fires.

Each year great waste and destruction from forest fires seem to visit some section of the Cape country. This condition has continued so long and become so common that not only are many thousands of acres reduced to acorn brush deserts, but, from their being burned over every few years as soon as they accumulate enough vegetation to feed the flames, there is little likelihood of conditions improving until something is done.

Where fires have been kept out and even nature had a chance to assist, we find sufficient forest growth to really amount to considerable commercial value. Even on rough, rocky and ledgy lands, as well as those of pure sand, if we will keep out fires so that a forest floor can accumulate, the mulch or humus, which is composed of decaying leaves, twigs, etc., will form and here magnificent forests can be grown. The early history of this country tells us that the Cape was completely forested, and if it was once, it can be again reforested under modern methods. First of all we must stop the forest fires.

The pitch pine revels in the Cape conditions more than most other species, because it has a thick bark and can withstand fires better than most other trees; and then, again, it propagates easily from seed, even small specimens yielding more or less cones. If this tree will grow under such adverse conditions, were we to assist it in its struggle and even collect and plant or

A fifty-foot fire lane to protect the plantation on the left. In the center of the picture and at the inner edge of the fire lane is a six-foot trench, made with mattocks and shovels by taking off the turf which surrounds the planting. Burning brush in separate piles, when the snow is on the ground, to avoid forest fires. Work of the State Forester, carried on under the reforestation act.

sow the seed, start nurseries and transplant the seedlings, we soon could bring about great results on the Cape. Nor are we confined to the pitch pine. Many more species of trees will grow here when once they are given a little consideration as regards shelter, soils and freedom from fires.

Last summer a forest fire of approximately 10,000 acres burned over a territory in the towns of Bourne and Falmouth. Upon making a thorough examination of this fire, as to its causes, methods of handling, etc., it is evident that this forest fire which laid waste this vast territory could have been handled easily and controlled with comparatively no damage had there been any organized effort or suitable equipment.

From data secured through competent men, whose reports are now on file in the State Forester's office, together with photographs showing conditions where fires crossed roads, maps of the territory burned each day, it is evident that if we Massachusetts people are willing to allow such conditions to continue to exist, we certainly are neglecting our birthright.

If towns are not willing or able to protect themselves, the State should step in and regulate or assist. Since this large fire the towns adjacent have been aroused to activity in future protection, and it is hoped this interest may not die out until something results.

It is generally acknowledged that these fires originate from Mayflower gatherers and blueberry pickers. It is evident that this being the case, some regulations must be made for fixing the responsibility and punishing the offenders.

It is understood that the association composed of the boards of selectmen of various towns expects to ask some legislation on this subject this year.

Authority to accept Donations.

If the State Forester were given authority to accept lands or funds on behalf of the Commonwealth which are to be used for State reserves and managed by the State Forester, with the understanding that all net sales from the management of such lands shall be used by him for improving State forestry conditions, subject to the approval of the Governor and Council, it is believed the State would derive a great deal of benefit. This suggestion has come to the office a few times from such sources as we have reason to believe would be interested in aiding the future forestry work in Massachusetts.

Public Lectures and Addresses.

As heretofore, the State Forester has endeavored to do as much of this kind of work as he could consistently, and keep up the regular routine work of the department. More engagements have been filled than ever before. The policy of accepting invitations preferably when a large and representative audience is assured (not less than 100), and the meeting an open one, has been adhered to this year, as last. The requests for lectures have been greater than ever.

Besides the 51 lectures by the State Forester, occasional engagements have been filled by assistants. The usual course of lectures was given at the Massachusetts Agricultural College during January.

Meeting with the State Firemen's Association.

The State Forester was requested to again address the State Firemen's Association on the occasion of their annual meeting, held at Plymouth, September 15. Chiefs of the fire departments have expressed a willingness to co-operate with forest wardens in suppressing forest fires, and have offered in many instances to instruct the wardens in the use and care of extinguishers. The State Firemen's Association also sent representatives to address the conference meetings of forest wardens at Northampton and Boston, the subject being, in each instance, "The Co-operative Relations between the Firemen's Association and the Forest Wardens."

The Society for the Promotion of Agricultural Science.

This organization, which is the oldest and most influential society of the kind in this country, held its meeting at Portland, Ore., on August 17, and the State Forester, who is secretary-treasurer, attended this meeting. The special program for this occasion was "Forestry," and various phases of the subject were discussed by leading scientists from different sections of the United States. This meeting was held directly after the National Irrigation and Forestry Congress, and just before the Association of American Agricultural Colleges Experiment Stations.

I also visited Seattle, where the Alaska-Yukon Exposition was held. Besides the excellent forestry exhibit, occasion was offered here to spend some time with the fire warden of the State of Washington and various lumber companies, in getting a better idea of the forestry methods used.

The following statement was given to the press upon my return: —

On a recent trip through the northwest, I have had splendid opportunities to examine the magnificent forests of that section. This was not my first trip, and hence, from a forester's standpoint, it has proven even more interesting. One is first impressed with the great amount of forest products and particularly by the cheapness thereof; but upon further reflection and study of the area and prices, it grows upon one that after all we Massachusetts people get very little benefit from them. While prices are relatively low, that country is so far away that other than for our best grades it is prohibitive for our use. Fine, square-edged lumber is looking for a market in Washington to-day, and it is offered for much less per 1,000 feet than we get for our round-edged box boards. There are hundreds of miles of treeless areas between here and there, and a country that will demand in a few decades even more forest products than the famous forests will be able to supply. We Massachusetts people must depend for our future lumber supply, I am convinced, upon our own well-directed efforts.

Our people may think their State Forester is overzealous in regard to forestry matters, but he is more willing than ever to go on record in stating that there are few subjects of more importance at the present hour that really need the attention of our Massachusetts people than that of reforestation, and even more mandatory laws governing forestry management. Every dollar rightly spent in the old Bay State now is bound to return us 100 per cent. in future benefits.

Conferences of Forest Wardens.

During the latter part of October and fore part of November the State Forester held a series of five forest warden conferences, which were distributed evenly throughout the State. All the forest wardens of the State were invited to attend, with their travelling expenses paid, as per chapter 475, section 8, Acts of 1907. The first conference was held at Pittsfield, on October 14, and included all of the towns in Berkshire County; the second, at Northampton, on October 29, included Hampshire, Hampden and Franklin counties; the third, held at Boston, State House, on November 4, included all the towns in Essex and Suffolk counties; the fourth convened at Worcester, on November 11, and included the towns of Worcester County; while the fifth, held at Middleborough, on November 18, consisted of all the counties of the Cape, Plymouth, Barnstable and Dukes.

These meetings were the first attempts to get the forest wardens together. The conferences were in each case held throughout one day, beginning at 10 o'clock and continuing until 4 P.M., taking out only forty-five minutes for lunch. The program consisted in a general outlining of the State's policy by the State Forester, which was followed by a discussion for the remainder of the forenoon, in which the wardens took an active interest. Other subjects discussed by competent speakers were: reforestation; forestry management; forest insects and their control; co-operation of railroads; co-operation of chiefs of fire departments with forest wardens; forest fire equipment; co-operation between towns, etc.

As was expected, there was not sufficient time to go into the subjects in detail, but one of the great benefits was in getting the wardens together, and setting them to thinking in lines of accomplishing results in their towns.

Splendid interest and a very co-operative feeling were manifest at each meeting, and it is the opinion of your State Forester that the expenses for these meetings will be as productive of future results as any money investment this year. The total expenses of the five meetings did not exceed $500. The benefits of these conferences are already shown in the increased interest of the forest wardens in sending in reports of fires and in asking for assistance in their work. This conference in the future will resolve itself into a gathering whereby we may keep posted on modern methods of fire fighting and other forestry operations.

One of the roads that the Bourne fire crossed. Had this roadway been widened, it would be a natural fire lane. Had there been a well-organized force, the fire should have been stopped here. By making a study of our town and wood roads throughout wooded sections, and widening them for fire belts, much of our present fire losses could be curtailed.

Municipal Forests.

This type of forestry work has again received more or less of our attention this year. The forest working plan for land belonging to the city of Fall River in the North Watuppa watershed, which is the water supply for that city, was completed and published in a bulletin from this office. This bulletin has not only proved of interest to other cities and towns as well throughout the State, but has been called for by many cities from outside the State. When the advantages to be derived from such undertakings become more fully understood, there is little doubt but that the recommendations outlined in the bulletin mentioned will be generally carried out and put into practice. This bulletin was not generally distributed, but can be had by any one interested in such work.

Bulletin on Forest Fires.

A bulletin entitled "We must stop Forest Fires in Massachusetts," was published during the year. It contained 44 pages, and was published that our people may realize more fully the exact condition of forest fires in the State, and especially to bring together data for the benefit of our forest wardens and their deputies, that they may know what the better towns of the State are doing, thereby gaining new ideas and being enabled more intelligently to accomplish good results in their own communities. The bulletin contains several illustrations of forest fire wagons and equipment, together with estimate costs; and gives a list of all the forest wardens, with their addresses, from each town and city in the State.

Bulletin on Thinning.

The first bulletin on "Forest Thinning" has been exhausted for some time, and we have a new bulletin now in press on this subject, which contains some definite experimental data of Massachusetts conditions and treats the subject in an up-to-date manner. This bulletin will be of interest, we believe, to the whole State, and particularly throughout the gypsy-moth-infested territory; for, by thinning our woodlands properly, the conditions are not only better for forestry proper, but for the suppression of insect pests.

Permit Act, Result of Vote.

The results of the vote by our Massachusetts towns on the permit act were very satisfactory, and for the most part the act was adopted. The failure of a few towns to accept the provisions was found to be due to a misunderstanding of the objects sought, and they will probably adopt the law at their coming annual town meetings. Forest wardens generally are convinced of the value of the permit act in lessening forest fires, while this office can point to far more efficient service throughout the State.

Massachusetts Fire Permit Law. — Towns accepting Chapter 209, Section 5.

Towns voting to accept the law,	248
Towns voting to reject the law,	15
Towns failing to report on vote (probably favorable),	47
Towns postponing action on the law,	7
Chapter 209, section 5, does not include the cities whose ordinances should cover same,	27

Co-operation with the United States Forest Service.

The State Forester has been favored with hearty co-operation from the United States Forest Service throughout the year. The work on "Massachusetts Wood-using Industries," which was begun last year, has been completed and is now in press. Mr. H. S. Hackett, in charge of wood utilization, and Mr. Hu Maxwell, expert, both of the United States Forest Service, have rendered us splendid service in this work.

Recently arrangements have been made with another department of the United States Forest Service, under the supervision of Mr. J. G. Peters, to carry on some co-operative work in forest survey work.

The State Forester wishes to acknowledge many other courtesies extended to him by Mr. Gifford Pinchot and the United States Forest Service.

Pine Tree Blight.

The alarm in regard to the disease called the pine tree blight, which was so prevalent two years ago, has very much subsided of late. Occasional trees have died from this cause during the year, but nothing equal to the number of last year, which in turn was less than that of the year before. Our people generally have become familiar with it, and are following the practice of cutting out and utilizing all pine trees of commercial size that are badly affected. It is quite generally believed that we have little to fear from this malady in the future in growing white pine.

The Chestnut Bark Disease.

This disease of the chestnut has been extremely disastrous along the southern Hudson River district and in certain sections of Connecticut. By reading about it and its results in the above-named territory, many of the people owning chestnut forests have become alarmed and written to our office. We have not as yet had any large area reported which was thought to be infested with this chestnut disease. Experts on the subject seem to differ as to the cause of the depredation. The United States Department of Agriculture claims the disease is *Diaporthe parasitica*, and that it is contagious; while equally skilled botanists, like Dr. G. P. Clinton of Connecticut and Dr. G. E. Stone of Amherst, claim that it is due to unfavorable climatic conditions.

It is believed to be unnecessary for us to worry at present over the chestnut bark disease in Massachusetts. If chestnut trees here and there become unhealthy, it is a safe rule to remove them, and thus minimize possible trouble. This method we are practising with the white pine blight. It is certainly to be hoped that this trouble may not come our way, for our chestnut growths are valuable properties.

Forestry Exhibits.

During the year various forestry exhibits, mainly showing moth work and seedlings, have been made, the principal ones being before the following organizations: the New England apple show, Boston, October 18–23; the Boston "1915 Exhibition," Boston, during November and part of December; and at the meeting of the American Association of Economic Entomologists, Boston, December 27–29. The other displays were largely made before agricultural fair associations in the newly infested sections.

Massachusetts Forestry Work recognized in Other States.

During the past year we have had cause to feel complimented upon our work, as the State of New York, in a bulletin entitled "Instructions for Reforesting Lands," published, with due credit, many tables found in our handbook on "Forest Mensuration of the White Pine." Also, this pamphlet of ours has been sought by many forest schools. Another of our publications, "Forest Trees of Massachusetts, how you may know them," a pocket manual, was practically copied in full by the Maine Forestry Commission. Other States have in part adopted the Massachusetts forestry legislation.

Expenditures and Receipts.

In accordance with section 6 of chapter 409 of the Acts of 1904, as amended by the Acts of 1907, chapter 473, section 2, the following statement is given of the forestry expenditures for the year ending Nov. 30, 1909: —

Forestry Expenditures.

Salaries of assistants,	$3,875 70
Travelling expenses,	1,083 24
Stationery, postage and other office supplies,	1,048 35
Printing,	1,018 85
Instruments,	80 17
Forest warden account,	290 44
Nursery,	2,305 94
Co-operative work with the United States Department of Agriculture,	215 00
Miscellaneous,	81 95
	$9,999 64
Balance,	36
Total appropriation,	$10,000 00

REFORESTATION ACCOUNT.

Seedlings,	$771 01
Land,	1,792 50
Labor,	5,769 47
Equipment,	663 58
Travelling,	846 31
	$9,842 87
Balance,	157 13
Total appropriation,	$10,000 00

There was realized from the sale of publications $73.62, which amount has been turned over to the Treasurer and Receiver-General. If to this amount are added the amounts unexpended, $157.49, we have $231.11 as a credit for the year.

In accordance with section 5 of the above-named chapter, the following statement is given of the receipts for travelling and subsistence: —

LECTURES.

Auburndale Improvement Association,	$0 50
Attleborough Women's Club,	1 50
West Manchester Women's Club,	–
Montague Agricultural School,	50
Cornell Club,	2 00
Leominster Board of Trade,	1 74
Quincy Unitarian Club,	46
Amesbury Women's Club,	1 70
Cambridge Entomological Club,	–
Maugus Club, Wellesley Hills,	50
Fall River Natural Science Association,	5 00
Chicopee Falls Women's Club,	5 50
Milton Women's Club,	35
Agriculture Board of Trade,	2 50
Farmers' Institute, East Charlemont,	6 24
New England Rural Conference,	–
Concord Women's Club,	85
Men's Club, Melrose,	1 00
Fitchburg Grange,	3 00
Farmers' Institute, Brimfield,	4 55
Boston Merchants' Club,	2 00
High School Masters' Club,	75

North Reading Grange,	$1 29
Farmers' Institute, West Brookfield,	4 15
Plymouth Board of Trade,	3 50
Middlesex Women's Club, Lowell,	2 50
Lexington Grange,	1 25
Lee Grange,	8 10
Swift River Valley Pomona Grange, Greenfield,	6 67
State Board of Agriculture, Cummington,	10 14
New Hampshire Board of Trade, Manchester,	4 00
State Firemen's Association, Plymouth,	3 50
Board of Agriculture, Barre, Fair,	3 10
Pittsfield Wardens' Conference,	–
Northampton Wardens' Conference,	–
Boston Wardens' Conference,	–
Worcester Wardens' Conference,	–
Middleborough Wardens' Conference,	–
Gardner Women's Club,	3 31
Channing Club of Boston,	1 00
Hyde Park Current Events Club,	50
The Atalanta Club, Lynn,	1 10
Palmer Men's Club,	3 40
Cantabrigia Club, Cambridge,	1 00
Boston Society of Civil Engineers,	1 22
Economic Club, Boston,	22
Boston Market Gardeners' Association,	2 00
Massachusetts Reform Club, Boston,	22
Massachusetts Forestry Association,	–
Conservation Club, Kingston,	1 50
American Forestry Association,	25 00
Friday Club, Everett,	25
Webster Grange, Marshfield,	1 50
Becket Camp, Becket,	4 00
Harmony Grange, Easton,	1 00
Holden Farmers' Club,	1 00
Cape Ann Literary Association, Gloucester,	1 25
American Association of Economic Entomologists,	–

A list of the visits made, the area of woodland involved and the receipts for expenses, are as follows: —

EXAMINATIONS OF WOODLANDS.

Name of Owner.	Town.	Area (Acres).	Expense.
Adams, Sarah E.,	Pembroke,	7	$2 00
Barryune, F. J.,	Lynnfield,	22	1 00
Barnes, H. K.,	Shirley,	43	1 40
Burbank Hospital,	Fitchburg,	400	12 40
Burgess, J. K.,	Dedham,	50	50
Carpenter, S. L.,	Sharon,	15	80
Clapp, W. A.,	Ashland,	90	1 00
Cook, Robert,	Brockton,	50	1 00
Cunningham, Paul,	Bolton,	125	1 45
Crane, A. S.,	Weston,	5	–[1]
Dole, W. A.,	Townsend,	28	1 60
Emery, Miss M. E.,	Newburyport,	55	1 50
Foxborough State Hospital,	Foxborough,	110	1 25
Fillebrown, Mrs. W.,	Plympton,	50	1 25
Gaskill, D. W.,	Blackstone,	75	1 50
Gilbert, E. H.,	Ware,	170	3 50
Greenwood, Levi,	Gardner,	275	4 80
State Board of Insanity,	Lexington,	20	2 80
Hubbard, Eliot,	Millis,	40	90
Humphrey, L. C.,	Rochester,	200	2 10
Hyde, H. S.,	West Springfield,	60	4 30
Jones, C. H.,	Weston,	200	–[1]
Joslin, E. P.,	Oxford,	100	2 40
Harlow Brook Cranberry Company,	Wareham,	1,000	2 00
Libby, F. M.,	Wakefield,	10	–[1]
Manning, Warren,	Billerica,	78	–[1]
Milford Water Company,	Milford,	175	1 50
McCarthy, N. F.,	Lynnfield,	50	.[2]
Matthews, W. L.,	Conway,	50	4 60
Morse, Prof. A. D.,	Pelham,	300	3 80
Needham Park Board,	Needham,	60	35
Newton City Forester,	Newton,	10	–[2]
Paine, Chas ,	Sturbridge,	125	3 00
Parker, F. H.,	Westborough,	175	1 00
Parker, Chas. S.,	Westford,	23	70
Prescott, C. W ,	Concord,	60	–[1]
Simmons, H. F.,	Hanover,	10	1 25

[1] Train fares paid by owner. [2] No expense.

Examinations of Woodlands — *Concluded.*

Name of Owner.	Town.	Area (Acres).	Expense.
Swett, Frank,	Westminster,	103	$2 50
Symington, R. B.,	Plymouth,	2	3 95
Thorndike, R. K.,	Millis,	20	90
Tolland Fish and Game Association,	-	500	8 50
Walker, Mrs. J. G.,	Hamilton,	6	1 00
Warren, Fiske,	Harvard,	285	1 85
Whitney, Fred,	Leominster,	12	1 75
Williams, G. F.,	Needham,	200	-[1]
-	Canton,	8	-[2]
Y. M. C. A. Camp,	Becket,	200	5 40
Massachusetts Fish and Game Association,	Carver and Plymouth,	6,000	3 40
Barclay, Fred,	Spencer,	200	-[2]
Freeman, Lucy,	Wrentham,	30	1 30
Hillside Industrial School,	Greenwich,	300	4 00
Gloucester Common,	Gloucester,	1,500	2 05
Conservation Association,	Kingston,	1,000	1 50
Bill, Nathan D.,	Worthington,	600	4 80
Adams, Chas. F.,	Lincoln,	500	70
Newton, Mr.,	Royalston,	23	3 00
Dexter, Prof F. B.,	Fairhaven,	8	2 70
Symington, R. B.,	Plymouth,	4	2 00
Thompson, M. S.,	Newbury,	40	1 50
Lane, Emory,	Waltham,	5	-[2]
Total,		10,860	-

[1] Train fares paid by owner. [2] No expense.

SECOND ANNUAL REPORT

OF THE

STATE ORNITHOLOGIST.

SYNOPSIS PRESENTED TO THE BOARD AND ACCEPTED, JAN. 11, 1910.

PLATE I.

A device to attract swallows. Photograph of swallow on her nest, on projecting end of board nailed to a floor beam. (Photograph from nature by Edward Howe Forbush. See page 262.)

ANNUAL REPORT OF THE STATE ORNITHOLOGIST FOR THE YEAR 1909.

Work of the Year.

A great demand has arisen for lectures by the State Ornithologist; therefore lecturing has been the chief educational work undertaken during the year 1909. Thirty free lectures on the utility of birds and their protection have been given during the year. The stereopticon has been used chiefly for illustrating evening talks, and colored plates and charts have been utilized mainly for the afternoon meetings. The audiences have consisted largely of farmers and their families, the members of agricultural organizations, teachers and pupils in the schools and sportsmen.

Laws for the better protection of birds were advocated by the State Ornithologist before the legislative committee on fisheries and game. Among others the following important bills were passed: —

A bill for the protection of wild fowl protects swans at all times and wild ducks, geese and brant annually between the thirty-first day of December and the fifteenth day of September (Acts of 1909, chapter 421).

A bill for the protection of shore, marsh and beach birds establishes a perpetual close season for the kildeer plover and piping plover, and an annual close season for all other shore birds, excepting upland plover, between the thirty-first day of December and the first day of August (Acts of 1909, chapter 508). The upland plover is protected by law at all times under a previous enactment.

These two bills were designed to confine all shooting of migratory game birds to the fall months and the month of December, but strong opposition developed, and at a conference between committees of the House and Senate a compromise was made permitting the shooting of shore birds during the month of August.

A bill was passed making all public lands bird and game refuges or sanctuaries (Acts of 1909, chapter 362).

Recommendations for Legislation for 1910.

The larger shore birds, such as the curlews, godwits and willets, are now, with a single exception, in danger of extermination, but there seems to be little hope of securing uniform legislation adequate for their protection throughout the country, unless the power of making regulations for their conservation can be placed in the hands of the federal authorities in the manner proposed by the House bill introduced into Congress by the Hon. J. W. Weeks. In the mean time Massachusetts should extend protection at all times to the smaller sandpipers and plovers, ordinarily called peeps, ring-necks and beach birds. These birds are so small that they are of no more food value than a sparrow. As game they are beneath the notice of the real sportsman. Some of them are valuable as insect destroyers, and they are all beautiful, confiding, innocent creatures. They should be left with other little birds to roam our shores, marshes and fields unmolested. As the larger species become rarer the gunner will turn his attention to these. Already their numbers have been greatly reduced, and, if they are to be saved from extermination. protection must be extended to them.

The close season on the upland plover expires in 1910. The bird is now so rare that this close season should be continued, protecting this bird at all times.

More reservations for the protection of birds and game are needed. If certain ponds, swamps and marshes in the interior and certain waste lands along the seacoast were set aside as refuges, upon which hunting, shooting and trapping of all useful birds and animals were prohibited for all time, we might at least preserve some useful species of migratory game birds from extinction. Massachusetts ought not be behind other States in this movement, for there is no State in the Union the population of which has been more destructive to game and birds.

The investigation into the history and present status of the game birds, shore birds and wild fowl of the Commonwealth, which was begun in 1908, has been continued throughout the year 1909. A large correspondence has been kept up with sportsmen, naturalists and others familiar with past and present conditions, not only in Massachusetts but in the other States of the Atlantic seaboard and the Provinces of Canada, through which the migratory species range. Many narratives of early explorers have been examined for references to the important species. The causes of the extinction of some birds and the extirpation of others, as well as those for the decline of many, have been sought, and the remedies for the present game depletion have been found. This material, when condensed, will form an illustrated report of not over four hundred pages, describing the species of game birds now existing in this Commonwealth and exhibiting the causes of the extirpation and extinction of those that have disappeared. Before the report can be published an appropriation will be required for printing.

One important part of the work of the year was a survey to determine whether the birds that had been greatly reduced in numbers by inclement or unseasonable weather or violent action of the elements in recent years were recovering.

The Recovery of those Species of Birds decimated by the Elements in 1903 and 1904.

Causes of Destruction.

In the spring and early summer of 1903 an extreme drought, accompanied by forest fires, was followed by a series of long, cold storms and floods, and the ensuing winter was exceptionally severe. The destruction of birds by the elements during these abnormal seasons was very marked. Rails disappeared from the flooded meadows, and the eggs and young of most of the smaller birds, excepting some that nested under good shelter, were destroyed. The eggs and young of game birds suffered excessively.[1] Both young and adults

[1] Forbush, Edward Howe, "Destruction of Birds by the Elements in 1903–1904," annual report of the Massachusetts State Board of Agriculture, 1903, pp. 455 to 503.

of some purely insectivorous species perished from lack of food and from exposure.

The ensuing years have been marked by some bad storms and late frosts; but most of the decimated species soon recovered their numbers, except the ruffed grouse (*Bonasa umbellus*), bobwhite (*Colinus virginianus*), rails (*Porzana carolina* and *Rallus virginianus*), marsh wrens (*Telmatodytes palustris*), swallows (*Iridoprocne bicolor* and *Hirundo erythrogaster*), chimney swifts (*Chætura pelagica*) and martins (*Progne subis*).

The purple martins of Massachusetts were the greatest sufferers from the storms of 1903, which almost exterminated them, and the bobwhite suffered most from the severity of the succeeding winter. Probably more than 90 per cent. of these birds in the State were destroyed during that season. The increase of Virginia rails and sora rails has been very slow, and even now they and the marsh wrens are not much in evidence in some of the meadows where they were common in the spring of 1903.

Partial Recovery of the Game Birds.

The ruffed grouse increased somewhat in numbers during the seasons of 1904, 1905 and 1906, but during the winter of 1906–07 large numbers of goshawks appeared and killed many grouse. The breeding season of 1907 was cold and wet; the eggs did not hatch well; disease appeared among the young broods in some localities, and in some cases among the adults. In some places wood ticks were prevalent, and in the fall of that year grouse were unusually scarce in New England, the other northeastern States and the eastern Provinces of Canada. The seasons of 1908 and 1909 have been more favorable, however, and grouse have increased in some sections. Two winters since that of 1903–04 have been unfavorable for the bobwhite, and the species has increased very slowly, except in the southeastern portions of the State, where the winters are not usually so severe as elsewhere. There are now large areas in the Commonwealth from which the bobwhite has been extirpated. It is very difficult to secure this bird from other States for stocking purposes, and it should be protected by law at all times in all the territory where it is now rare.

Recovery of the Swifts, Swallows and Martins.

Notwithstanding the fact that thousands of chimney swifts, swallows and martins, both adult and young, were destroyed in the June storm of 1903, the diminution in the number of these birds, if we except the martins, is not very noticeable to-day. Nevertheless, the swallows and swifts are not nearly so numerous in many localities as they were before the catastrophe of 1903. I have found no previous records of any such widespread destruction of birds by the elements in this Commonwealth, except in the case of the martins.

Nuttall, writing in 1832, states that a few years previously, after a rainy midsummer, many martins in the maritime parts of Massachusetts were found dead in their boxes.[1]

Sir Charles Lyell records that in the spring of 1836 thousands of these birds, with their young, died in their nests during a storm of cold rain which lasted two weeks, and destroyed the insects throughout the States of New York and New England.[2] Either this storm or the one spoken of by Nuttall probably was referred to by Dr. Brewer in a notice quoted by Audubon in 1838, in which he mentions the then recent destruction of martins in Massachusetts by a storm.[3]

Prof. John L. Russell of Salem stated in 1864 that purple martins were then very rare in that vicinity, because of a long-continued cold rain and the consequent want of suitable food, which killed them by scores, so that few had been seen since.[4] Probably he refers not to the great storm mentioned by Sir Charles Lyell, but to a later and more local catastrophe. It is evident that the martins recovered from the former decimation, for they were locally abundant in Massachusetts in after years, and so late as the time when the house sparrow was introduced from Europe. Since then the

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1 Nuttall, Thomas, "Manual of the Ornithology of the United States and Canada. The Land Birds," 1832, p. 599.

2 Lyell, Sir Charles, "A Second Visit to the United States of North America," 1849, Vol. I., p. 36.

3 Audubon, John James, "Ornithological Biography," Vol. V., 1849, p. 408.

4 Russell, John L., "The Natural Phenomena of the Seasons," annual report of the Commissioner of Agriculture for 1864, p. 354, published in 18 5.

sparrow has driven out many martins and occupied most of the martin boxes. For this reason the martins were much reduced in numbers, even before the great storm of 1903.

Efforts were made in 1909 to ascertain, by means of notices in the daily and weekly press and by hundreds of letters to correspondents, whether the martins were again obtaining a foothold here. Most of the correspondents replied that they had seen none. Some stated that they had heard of some, but upon investigation found them to be not martins but tree swallows, and a few answered that they had seen martins only in migration. A few reports of breeding martins have been obtained from several of the eastern counties of the State, and two come from the central region. While the State Ornithologist has not been able to investigate the accuracy of all these reports personally, he has no doubt that most of them, if not all, are authentic.

Abstracts of Reports regarding the Breeding of Martins in Massachusetts in 1909.

Bristol County.

Dartmouth. — A pair nested at South Dartmouth, the only ones I have seen for years. — H. P. Burt, New Bedford, June 15, 1909.

Essex County.

Ipswich. — Saw probably six or eight pairs nesting in Ipswich. One man told me he knew the same pair had returned for several years. — Mrs. Frances L. Pettingill, Salisbury, June 10, 1909.

On December 27 Mrs. Pettingill wrote that when she was at Ipswich later in the season she did not see any martins, and does not know whether she was mistaken, but she says that all she saw when there in September were tree swallows.

Marblehead. — A pair nested in a small keg in Lower Marblehead. Several pairs were reported about the premises, but only one pair built. — Robert F. Homan, June 10, 1909.

Left when the young were able to fly. — Robert F. Homan, July 21, 1909.

Merrimac. — There has always been a strong colony in Merrimac until the storm of 1903; since then a few struggling pairs have come back, but they do not increase very fast, because of the English sparrows, which have taken possession of the house. — Frank E. Watson, Haverhill, July 23, 1909.

Salisbury. — I am told that a pair nested in Salisbury last year, but the sparrows succeeded in driving them away this year; they did not return. — Mrs. FRANCES L. PETTINGILL, July 21, 1909.

Saugus. — Martins have been seen several times since May in this village. During a hard storm late in May three took possession of a bird house in our yard. They seemed to be storm beaten, and one fell from the house and died. The others evidently left. — LOUISA W. CASWELL, Cliftondale, July 3, 1909.

Wenham. — Last year I saw only one pair; this year in a search over town I found only one pair nesting. — S. E. KNOWLTON, June 29, 1909.

HAMPDEN COUNTY.

Springfield. — For more than forty years these birds have come to my home; last year only two pairs came, and they did not stay. I concluded they did not come this year because the house was so filled with grass by the English sparrows. — W. A. CONE, June 26, 1909.

MIDDLESEX COUNTY.

Concord. — There are three houses now well filled with martins. — R. H. HOWE, Jr., June, 1909.

Similar reports were received later from Messrs. Samuel Hoar and A. B. C. Dakin.

Dunstable. — The martins took a box on the elm quite near our house in Dunstable; some red squirrels came and the martins disappeared. The squirrels were seen coming out of the box. — Mrs. MORRIS WILDE, Tyngsborough.

Newton. — A pair came to my place last spring, which I saw, and no mistake. Later in the season, I should say in August, a boy from Newton Highlands, about one mile from my place, told me that a pair of martins had nested and raised young in a bird box at his home. I questioned him considerably about them and found that he knew what he was talking about, so I have not the least doubt that his statement is correct, and the fact that the birds were looking for nest boxes at my place would show that they would be likely to locate somewhere near. — JOSEPH MASON, Dec. 23, 1909.

Townsend. — A small colony of martins is at Townsend Harbor. — A. C. HILL, Belmont, June 26, 1909.

I saw a man from Townsend Harbor yesterday; he says there are martins there this year. The house blew down in the winter and they were late in getting it up, but the birds were there. — J. T. MELLUS, Wellesley, May 30, 1909.

Mr. John Hardy of Belmont also reports this colony.

NORFOLK COUNTY.

Dedham. — The purple martins that were nesting in Dedham in May, 1909, disappeared before the nests were completed. The English sparrow, I suppose, was to blame. — J. S. SEABURY, Oct. 1, 1909.

Hyde Park. — Robert L. Frampton of Hyde Park has a small colony of purple martins and has had them for quite a number of years. — CHARLES F. JENNEY, June 14, 1909.

I have a four-apartment house occupied now by four pairs of martins. — R. L. FRAMPTON, June 12, 1909.

PLYMOUTH COUNTY.

Wareham. — I saw some purple martins in East Wareham a few days ago. — THOMAS ALLEN, Marion, May 23, 1909.

These birds probably failed to breed as no one else reports them.

WORCESTER COUNTY.

Gardner. — There is a colony of martins in a bird house near our factory; it is the first family I have seen for several years. I do not know how many there are, but quite a number. — J. S. AMES, Gardner, June 26, 1909.

Millbury. — Mr. C. E. Hoyle reports that there was still a colony of martins in Millbury in 1908. (No later report.)

Leominster. — There was one colony of the martins in our town last year, we think five or six pairs, which was an increase over the previous year. — WILLIAM HOLDEN, Leominster, Dec. 23, 1909.

These reports show that the martins are barely obtaining a foothold in the Commonwealth, and that they are increasing very slowly, if at all, except at Concord. It is probable that there are other small colonies that have been overlooked in this inquiry. Nevertheless, it has been searching and widespread enough to reveal the fact that the martins are not recovering as they have in the past from similar calamities.

If we are to believe Sir Charles Lyell, the destruction of these birds by the great storm of 1836 was far greater than that effected by the storm of 1903, for he says that they were destroyed throughout the States of New England and New York. Whereas, although the storm of 1903 was very destructive to the birds of Massachusetts, the eastern part of New York and portions of New Hampshire and Vermont, it was much less so in other parts of New York, in Maine, part of New Hampshire and in Connecticut and Rhode Island. During Lyell's second visit to the United States, undertaken in 1845, only nine years after the great destruction of martins, he says: —

> The larger kind of house martin is encouraged everywhere; small wooden boxes being made for them on roofs or on top of poles, resembling pigeon houses, which may often be seen on the top of a sign-post before a New England inn. They are useful in chasing away birds of prey from the poultry yard, and I once saw a few of them attacking a large hawk. But I suspect they are chiefly favored for mere amusement's sake, and welcomed like our swallows as the messengers of spring on their annual return from the south. It is pleasing to hear them chattering with each other, and to mark their elegant forms and bluish black plumage, or to watch them on the wing, floating gently in the air or darting rapidly after insects.[1]

At the time this was written Lyell was traveling in Massachusetts. This indicates that in nine years after the great catastrophe of 1836 the birds had become common again, while in the present instance six years have gone by and the martins are still very rare or entirely absent throughout most of the State.

Martins in considerable numbers doubtless migrate through the State in spring and in late summer or early fall on their way to and from Maine, new Hampshire and the maritime Provinces. It is a well-known fact that during the summer martins often visit boxes at considerable distances from their own. It is now believed that young birds, in their first season, travel considerable distances in all directions from the homes of their nativity. When the martins return in the spring the adult birds that occupied the boxes the year before are believed to be the first to arrive. They are followed later by the young of the previous year, and when the boxes are filled the surplus young birds are driven out and have to search for homes elsewhere. Doubtless many young martins wander into the State from Connecticut and Rhode Island in the summer, during their first long flights

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[1] Lyell, Sir Charles, "A Second Visit to the United States of North America," 1849, Vol. I., p. 35.

from their native nesting boxes in other States. The ensuing spring these and others that have been crowded out of their natal boxes are on the watch for breeding places in this State. Why, then, do not martins increase faster in Massachusetts? The only good reasons that can be assigned for the failure of the young birds, reared in the States about us or within our territory, to repopulate the State with martins are (1) we do not put up enough suitable houses properly located; (2) those put up are mainly occupied by English sparrows or other birds.

The purple martin is one of the most graceful, beautiful, companionable and useful of insectivorous birds. Its food is believed to consist entirely of insects. In the compartments of a martin box were found enormous numbers of the wing cases of the striped cucumber beetle. A correspondent from Ohio remarks that he believes that a large colony of martins on his grounds destroys a cartload of insects every summer. The martin is a valuable ally to the farmer, because of its habit of driving hawks and crows away from the farmyard, thus becoming a protector of the young poultry. We need more martins in Massachusetts.

We must bring back the Martins.

After what has been said above, the question "how shall we bring back the martins" answers itself. We must do as our forefathers did — furnish them nesting boxes; and then do what our forefathers were not obliged to do, — keep out sparrows as well as other enemies. Certain conditions must be observed in locating and building the boxes or we cannot expect that they will be occupied by martins.

The purple martin is not a bird of the Canadian fauna and cannot be expected to breed on our mountain tops. In this latitude it will thrive best in the low altitudes and on fertile lands. Broad river valleys, with fresh-water meadows, moist fields and gardens are its favorite resorts, for in such localities an abundance of vegetation insures a sufficiency of insect food, as well as sheltered nooks where insects may be found, even on the cold mornings of late April and early May. Concord, which now probably harbors more martins than any other Massachusetts town, is very favorably situated at the junction of the Musketaquid and the Assabet rivers, with meadows, fertile fields, orchards, pastures and market gardens all about, encompassed by sheltering hills. Probably martins were never numerous in the Berkshire Hills, but they might be attracted again to some of the river valleys, and they were formerly abundant on the Connecticut. They may yet become common again along the Connecticut, the Merrimac, the Blackstone, the Charles, the Mystic and other rivers, as well as about the larger lakes, ponds and marshes, if we help them in re-establishing themselves.

Houses for martins should have the rooms at least 6 inches square and 7 inches high. If the first box is a small one of two to four apartments it will require little care. When a colony has been established a larger box may be built. A barrel makes a good martin house. One head is removed, entrances are cut, small boxes are fastened inside for the rooms, a long box is placed in the center to receive the pole, the head is put in and the whole roofed with zinc or tin, as in the cut.

Martin boxes should be tight enough to keep out draughts and rain. They may be made to accommodate a single pair or a hundred pairs, according to the fancy of the owner and the length of his purse.

The entrance for the birds should be at least $2\frac{1}{4}$ inches in diameter and 1 inch to 2 inches above the floor. This will give room to clean out the apartments whenever it becomes necessary.

The box should be placed either on a roof of a building where it will be inaccessible to cats or on a pole 13 feet or more in height. There is little danger of getting the box too high. Martins are likely to be frightened away from boxes placed only 10 to 12 feet from the ground, particularly if there are children about.

The English sparrow must be kept out, for the sparrows, if allowed to enter the box before the martins come in the spring, will fill it with rubbish, and will then usually hold it against the martins. Sometimes both sparrows and martins will occupy the same box, but when this happens the martins eventually will be driven out if the sparrows are allowed to retain their foothold in the box. Sparrows will destroy the eggs of the martins, as well as their young. To prevent occupation by the sparrows the houses may be put up when the martins first come in the spring and taken down when they leave, or the openings may be kept closed until the first part of May or even later, when most of the sparrows will have already built nests elsewhere. After a box has been occupied by martins one season some of them may return to it very early the next year. Sometimes they make their appearance soon after the middle of April. A watch should be kept for them the second year, and the box should be opened when they arrive, as they will need it for shelter should cold

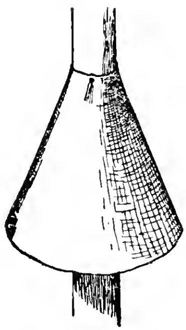


FIG. 1.

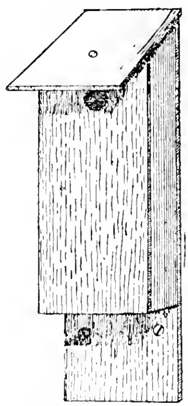


FIG. 2.

weather ensue. If the entrances are closed again in the fall as soon as the martins have gone, the sparrows will have little opportunity to occupy the houses. Even in this case, however, it may be necessary sometimes to shoot sparrows in order to keep them away from the martin boxes. A 22-caliber rifle and long shells loaded with smokeless powder and dust shot will be sufficient to kill some of the most troublesome sparrows at a range of ten yards or more when quick action becomes necessary. If the sparrows are so numerous that they drive out the martins it may be necessary to kill them by wholesale in the manner described by Dr. C. F. Hodge in his book "Nature Study and Life." [1]

Bluebirds and squirrels are sometimes troublesome, but

[1] Hodge, C. F., "Nature Study and Life," p 315.

squirrels and cats may be kept from ascending the pole of a martin box by the use of a flaring tin or zinc collar (see Fig. 1); and if a long box 16 to 18 inches high (see Fig. 2), with a hole 1½ inches in diameter, is put up at a distance of 200 feet or more from the martin box and within 10 feet of the ground it will generally prove more attractive to the bluebirds than will an ordinary martin box.

Tree swallows also take boxes vacated by the martins. In this connection the "notice" published by Audubon in 1838 from the pen of T. M. Brewer, and referred to above, may be quoted: —

> A trivial fact will, I think, show how exceedingly attached these birds are to certain districts. Not many years ago an unusually cold season destroyed all the birds of this species in the immediate neighborhood of Boston; and, although those met within twenty miles of the sea shore escaped with comparatively little loss, yet the place of the dead martins has never to this day been made good, excepting by the intrusion of another species. Perhaps this fact proved nothing; it, however, appears to me to show that these birds return in spring to the places where they are reared; or why, if the young of the last year ramble in search of convenient boxes, should none have come here, although they are around us? It cannot be that they are not a match for the White-bellied swallows (*Hirundo bicolor*) which have taken their places.[1]

While the martins are usually more than a match for the tree swallows, the latter as well as the bluebirds and sparrows have a decided advantage, as they are usually on the ground earlier than the martins, and if they once get possession of the boxes they will fight with great fury in the defense of their homes, and when once they have nested in a box or apartment they are likely to hold it. Hence the value of the policy of keeping the martin box closed against all comers until the looked-for tenants arrive. In the mean time, other boxes should be provided, at some distance, for other species. Some who have experimented in this way have observed that tree swallows and bluebirds, while selecting a domicile and building the nest, often play the part of the dog in the manger by driving other birds away, not only from their own nesting boxes but also from any empty boxes near by. If, however, the swallows or bluebirds have chosen their nests and begun

[1] Audubon, John J., "Ornithological Biography," Vol. V., p. 408, 1849.

housekeeping before the martins arrive, they are not so jealous of their neighbors.

Mr. Chester S. Day writes that he has in his back yard at West Roxbury a pole on which is a house for swallows. He put up a new house only 40 feet away, and about midway between them is a telephone post, on which he placed a number of boxes in which the bluebirds nested earlier in the season. After pair No. 1 of the swallows had laid their eggs they made no objection to the nesting of pair No. 2 in the new box, although prior to that time there had been constant fighting. When pair No. 2 had laid their eggs they did not oppose the nesting of another pair still in one of the boxes on the telephone pole.

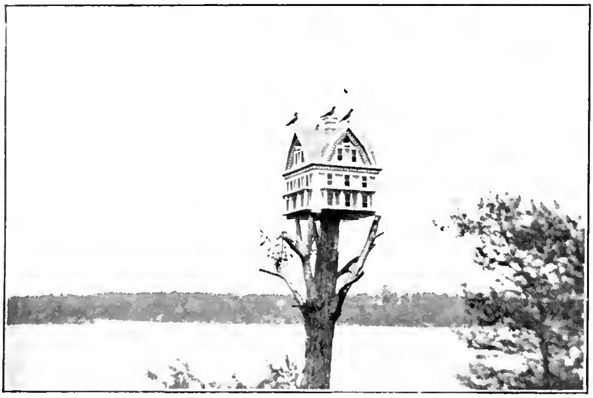
Successful Efforts to establish Martin Colonies.

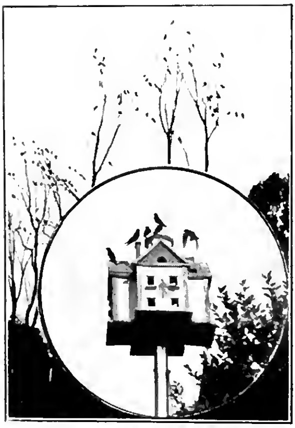
Early in June, 1907, I spoke in a church at Hadlyme, Conn., to an audience of the villagers. The talk was illustrated with lantern slides, showing, among other things, how readily birds may be attracted by cheap, easily constructed nesting boxes. At that time there were no martins nesting in that neighborhood and people said that none had been seen there for years. On June 8, three days later, one of the villagers who had attended the lecture saw martins on the roof of the dwelling house of Mr. Lee L. Brockway. The next day Mr. Arthur W. Brockway saw two pairs there, and at once put up a small bird house on a tall cedar pole. The martins immediately occupied it, and each pair reared two broods that summer.

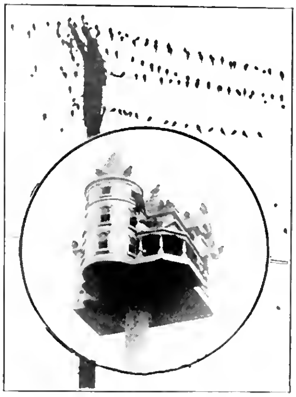
Two years later, when I visited Hadlyme again, there were three houses in that yard, all built by Mr. A. W. Brockway, all well filled with martins, and their musical chattering enlivened the village street. Fourteen pairs were nesting there, and I am informed by Mr. Brockway that they raised two broods each this year. Mr. Brockway has built bird houses for others also, and thus increased the bird population. His boxes are small and inexpensive, but the martins find them satisfactory.

Mr. J. Warren Jacobs of Waynesburg, Pa., has done excellent work by publishing directions for building martin houses and caring for the birds, as well as by building bird

PLATE II.







Martin Colonies attracted by Bird Houses.

Upper Figure. — Martin colony in three martin boxes made by Arthur W. Brockway at Hadlyme, Conn.

Lower Figures. — Martin colonies established in houses made by J. Warren Jacobs of Waynesburg, Pa.

houses for others and sending them far and wide. Every one who is interested in the subject should read his Gleanings No. 2, entitled "The Story of a Martin Colony," and also Gleanings No. 5, "The Purple Martin and Houses for its Summer Home." He distributed martin houses in 1909 to persons living in twelve different States and in the District of Columbia. He states that about 70 per cent of the houses sent out were occupied during the first year, and many of them were put up in localities where previously the martins had been seen only in migration.

The unsuccessful attempts to attract martins given below may serve as a warning to those who wish to try similar methods. A wise man will profit by the experience of others.

Unsuccessful Attempts to reintroduce Martins.

Among the ingenious methods taken to introduce martins from other States, that of placing their eggs in the nests of tree swallows and barn swallows has thus far failed. Mr. Owen Durfee of Fall River secured four eggs from Windsor Locks, Conn., in 1909, which he put into a tree swallow's nest; the eggs hatched and the young birds lived eight days, when they all died. They were all about the same size and appeared to have been well nourished. Two trees in the same yard were sprayed on the day the birds died; but Mr. Durfee thinks that the birds succumbed to the excessive heat.

Mr. Chester S. Day secured four eggs from Mr. J. Warren Jacobs and put them under tree swallows at his home in West Roxbury, but the eggs did not hatch.

Mr. Jacobs records, in Gleanings No. 5, several experiments made by placing the eggs of martins in the nests of barn swallows and tree swallows. It was found necessary to remove all the swallow eggs, else the swallows would not care for the young martins after the young swallows, which developed first, had left the nest. In some cases the martin eggs failed to hatch, and where they hatched the young died from some cause before they were fully fledged.

Tree swallows are so much smaller than martins that possibly they do not bring food enough to the nest after the young martins have grown larger than their foster parents. A pair of swallows might succeed better with two martin eggs than with four. In the case of the cowbird, which is usually reared in the nest of a much smaller bird, nature provides that only one young cowbird is ordinarily left to the care of its little foster parents. Perhaps only one martin's egg should be placed in a swallow's nest and the young swallows should be all removed soon after they are hatched.

The experiment of closing up the martin box in the night and removing it, with the old and young enclosed, to another locality has been tried at least twice, but in both cases the old birds deserted the young. In one case most of the young were successfully reared by hand, and the colony was maintained for two years, after which the birds disappeared. In the other case they all contracted disease and died.

Adult birds caught and sent to other localities have disappeared at once. Young birds partly grown have been sent to new localities and reared by hand. This is a hopeful method for those who know how to rear the birds, and are willing to take the necessary trouble, but I know of no permanent colony having been established in this way.

We can do something to attract the chimney swifts and to increase their numbers by keeping open chimneys without fires during the months from April to October. The tree swallows may be attracted and increased by building small boxes for them, and all that is necessary to increase the barn swallows is to leave openings in the farm buildings for the birds to get in, and if the rafters are smooth it is well to nail up a block, cleat or any piece of wood along the rafters. The illustration of the barn swallow on the nest shows how a pair of these birds located their home in a barn within a few feet of the back of a cow, for the reason that here they found a projecting end of a board on which the nest could be safely placed. (See Plate I.)

Investigations of the Destruction of Birds by Spraying.

Investigations of the possible poisoning of birds by spraying trees with arsenical insecticides were continued through the summer of 1909. The result was inconclusive, but from what we now know it seems probable that the fatal effects of such spraying have been exaggerated both by the people and the press. We cannot say that no birds die from eating live, poisoned insects, from eating poisoned foliage or from drinking poisoned water, but after several years' study of the subject it seems safe to assume that although probably some birds are fatally poisoned, they are the exception and not the rule. Probably there is far more destruction of birds where unsprayed trees are stripped of their foliage by the gypsy moth and the brown-tail moth than where spraying is done and the foliage is saved. The defoliation of the trees by these insects, which exposes the nests of the birds to the sun and rain, and to their natural enemies, results in the death of nearly all young birds in a region so defoliated, while the spraying probably kills at most comparatively few. The dearth of birds in parts of the region infested by the gypsy moth and the brown-tail moth is no doubt due largely to defoliation, as well as to the filling of holes in trees where birds formerly nested, and the cutting down of trees as well as the cutting and burning of underbrush. These operations, which are necessarily a part of the work of the moth suppression, are not destructive to birds if not carried on in the nesting season, but they drive them away. The effect of the spraying operations upon birds may be illustrated by the case of the rose-breasted grosbeak. This bird is very fond of the Colorado potato beetle. Potatoes have been sprayed with Paris green and other arsenical insecticides ever since this beetle first appeared in New England, and there is much circumstantial evidence which seems to point to the death of rose-breasted grosbeaks which have fed among the poisoned potatoes. Nevertheless, the Colorado beetle has furnished a new food supply for the grosbeaks, and the birds appear to be more numerous in Massachusetts than they were forty-five years ago, before the beetle was introduced.

The results of the investigation of the year follow. Letters were sent early in May to many correspondents, and notices were published widely in the press requesting all persons finding dead birds near sprayed trees to send them to the State Ornithologist for examination. Much correspondence resulted and many dead birds were received at this office. Some correspondents were positive that large numbers of birds had been killed by the spraying in their neighborhoods, but most of them failed to produce any dead birds. Many correspondents in Massachusetts and other States, tree wardens, nurserymen, orchardists and others who made a business of spraying trees, and who claimed to have kept a careful watch for dead birds, reported that they had failed to find any. People on whose estates spraying had been done wrote that they had instructed their men to keep a close lookout for dead birds, but that none had been found. Mr. F. H. Carpenter of Seekonk wrote on July 24 that he had found five dead birds after the spraying and had tested them for arsenic. He asserted that he had found very slight traces of the poison in a chipping sparrow, a black and white warbler and a red-eyed vireo, but no traces were found in the others. Each bird sent to the State Ornithologist, and received by him in good condition, was first examined externally to see if any evident cause of death appeared. If no injury was noted the bird was carefully skinned and again examined. If then no sign of external injury was found the skinned bird was preserved in a weak solution of formaldehyde or alcohol and sent to a chemist for examination. The first two birds were examined by Dr. B. F. Davenport, and showed no traces of arsenic. Subsequent examinations were made at the laboratory at Harvard University, for the reason that Dr. Sanger, the director of the laboratory, has recently perfected a new and very delicate method of analysis which is well adapted to this work. Samples of the formaldehyde solution and of the paraffin paper in which the birds were wrapped for transportation were first analyzed, to eliminate any possibility of error. They were found to contain no arsenic. Such of the birds as were received during the absence of the State Ornithologist from the office, and others in which decomposition had begun, were placed in the formaldehyde undissected and unskinned. This may have had a tendency to vitiate the result of the analysis in these cases, as there might have been an opportunity for the feathers to accumulate arsenic while the birds were feeding on sprayed trees.

Record of Birds examined in 1909.

Date.	Name of Sender.	Description of Bird.	Remarks.
June 1	Dr. C. W. Pease, Needham, Mass.	Scarlet tanager found under sprayed trees. Body contused on right side; blood coagulated there and in brain; may have been killed by a large stone or by flying against tree.	Not analyzed.
June 1	T. W. Saunders, Wellesley Hills, Mass.	House wren. No sign of external injury; abdomen much swollen; evidently a female; probably some trouble with ovary as there was an egg unexpelled.	Not analyzed.
June 15	W. W. Symmes, Winchester, Mass.	Kingbird. Maxillary bone broken at juncture of skull; brain much congested with coagulated blood; evidently had flown head first against a building.	Not analyzed.
June 18	W. W. Blair, Newtonville, Mass.	Young English sparrow. Death caused by blow on nape; coagulated blood there; skin not broken.	Not analyzed.
June 18	Dr. F. W. Saunders, Westfield, Mass.	Young English sparrow. Contusions and bruises both sides of body; death caused by blow or bite; probably caught by cat.	Not analyzed.
June 18	Miss Carolyn Arnold, Newtonville, Mass.	Young English sparrow. Badly bruised both sides of body, but skin unhurt; death caused by shock or blow, by cat possibly.	Not analyzed.

DATE.	Name of Sender.	Description of Bird.	Weight (Grams).	Arsenic found (As_2O_3) (Milligrams).	Parts examined.	Weight of Parts used (Grams).	Remarks.
June 19	Not known,	Young English sparrow. Plump and fat like others, but no sign of bodily injury; skinned.	16.5	.004	All but skin,	–	
June 21	Theron A. Appolonio, Boston, Mass.	Female flicker. Bird emaciated; plumage worn; no sign of external injury.	72.2	.008	All but skin,	–	
June 22	R. L. Agassiz, Boston, Mass.,	Young chickadee,	3.9	.086	Entire bird,	–	
June 24	W. W. Blair, Newtonville, Mass.	Rose-breasted grosbeak from Lexington,	34.8	.032	Entire bird,	–	
June 25	Rev. Burt L. York, West Medford, Mass.	Chimney swift. Skinned; apparently uninjured; no trace of arsenic.	–[1]	–[1]	–[1]	–[1]	
July 2	E. F. Holden, Melrose, Mass.,	Young grackle. Decomposition begun; not skinned.	21.2	.003 .093	Viscera. Rest, except head and claws.	4.1 8.5	Total. .096.
July 5	Misses Curtis, Crow Island, Manchester-by-the-Sea, Mass.	Red-eyed vireo. Skinned; no apparent injury and no trace of arsenic.	–[1]	–[1]	–[1]	–[1]	
July 8	Seth A. Borden, Fall River, Mass.	Female Baltimore oriole. Not skinned,	31.8	.001	Viscera,	4.7	
July 9	James A. Lowell, Boston, Mass.	Female rose-breasted grosbeak. Found dead at Chestnut Hill; not skinned.	55.6	.004	Viscera,	9.8	
July 9	Col. Wm. D. Sohier, Boston, Mass.	Black-throated green warbler. Not skinned,	12.7	.002	Viscera,	2.4	
July 12	Miss Allen, State House, Boston, Mass.	Young robin, fledged. Skinned and examined; in good condition; no signs of injury.	45.5	.001	Viscera,	16.3	1 claw absent.

July 12	R. L. Agassiz, Boston, Mass.,	Woodcock. Badly bruised from blow; intestines filled with clotted blood; peritoneum broken, but no visible break in skin; death from shock; may have flown against something.	[2]	—[2]	—[2]	—[2]	
July 13	Misses Curtis, Crow Island, Manchester-by-the-Sea, Mass.	Young downy woodpecker. Place sprayed June 30; bird dried and full of maggots; skinned.	18 2	.076	All except head, wings and tail.	5 1	Maggoty.
July 23	G. C. Stearns, Boston, Mass.,	Young English sparrow. Apparently injured in some way; skinned.	23 5	.002 .001	Viscera, . Rest, except head and claws.	6 5 12 5	1 claw absent. Total .003.
July 26	Mrs. Frances A. Wait, Medford, Mass.	Young robin. Not dissected or skinned, .	98 3	.002	Viscera, .	13 1	
Aug. 2	Miss J. M. Schaefer, Boston, Mass.	Blue Jay. Adult female; not dissected or skinned,	107 2	.002	Viscera,	16 9	
Aug. 2	Dr. J. W. Baker, Newton, Mass.	Young robin. Not dissected or skinned, .	105 2	.003	Viscera,	14 7	
Aug. 7	Huntington Smith, Dedham, Mass.	Young robin, nestling. Examined; decomposition set in; no sign of severe injury; bowels discolored, but this may have been result of decomposition; skinned.	38 1	.001	Viscera, .	9 9	
-	Rufus King, Plainville, Mass.,	Brown creeper. Not dissected or skinned, . .	9 5	.001	All, . . .	9 5	

[1] Analyzed by Dr. Davenport, no arsenic.

[2] Not analyzed.

In addition to the above a cedar waxwing was received early in July from Miss Aurelia L. Dupee of Foxborough, which was in such a condition of decomposition that it was disposed of by the clerk who received the body, and never reached the State Ornithologist; and two other birds went astray in some manner and never reached the office.

A cuckoo was received from Mr. James A. Lowell, preserved in alcohol by a taxidermist. This the chemist did not analyze because the alcohol in which it was preserved had not been first analyzed, which would invalidate the result.

Regarding sixteen of the analyses recorded above which were made at the chemical laboratory of Harvard College, the director, Prof. Charles R. Sanger, makes the following remarks: —

The results of the above analyses show in all but Nos. 19 and 15 negligible traces of arsenic. The amounts of arsenic in Nos. 19 and 15, .096 and .076 milligrams, respectively, are also very small in themselves, though relatively larger than the results from the other ten.

You will notice that No. 2, which was *plucked*, contained no more arsenic in the rest of the body than in the viscera. We examined only the viscera in the majority of cases, as it was reasonably certain that the arsenic, if present, would be localized in the viscera. But No. 19, *unplucked*, gave little or no arsenic in the viscera, but nearly all in the rest of the body, which included feathers. In No. 15, again, the unplucked body was used. This makes it possible to explain the larger amounts of arsenic in Nos. 19 and 15 by contamination of body surface, not necessarily ingestion. If due to ingestion, however, the weight of arsenic found is so small compared to the weight of the birds (not over 1 part in 200,000) that one cannot say that death was due to poisoning by arsenic.

Referring again to my letter to you of July 14, 1909, in which I reported .086 milligrams of arsenic in a bird weighing 3.9 grams, we have here 1 part in 45,000. There were also traces of lead in that bird, and, since we have no data concerning the resistance of birds to arsenic, one cannot say that the death of that bird (No. 4*a*) was not due to poisoning by arsenate of lead. Tests for lead in Nos. 19 and 15 have, however, resulted negatively.

In conclusion, it seems to me that these sixteen analyses are inconclusive as to the effect of spraying with arsenate of lead upon birds, and also that any series of analyses are likely to be inconclusive until we have some definite data as to the lethal dose of arsenic for birds, the localization of arsenic in and the excretion from the bird system.

The investigations of the last few years have shown only two birds that were possibly killed by arsenate of lead. When we consider the effective advertising that this investigation has had, the number of people who have been on the lookout for dead birds where spraying has been done, the few birds that have been received and the very small percentage (two birds) in the case of which the fatal poisoning by arsenate of lead seems even possible, it seems hardly worth while to continue the investigation.

Some Changes in Bird Life in Massachusetts.

It has been my melancholy duty to record the decrease or disappearance of many species of Massachusetts birds. It now gives me some gratification to record an apparent increase of a few species in Massachusetts within comparatively recent years. The species under consideration are the mallard (*Anas boschas*), the canvasback duck (*Aythya vallisneria*), the evening grosbeak (*Coccothraustes vespertinus*), the prairie horned lark (*Otocorys alpestris praticola*) and the Carolina wren (*Thryothorus ludovicianus*).

The mallard, formerly rare in Massachusetts, has been increasing in numbers during the last decade, particularly in the southeastern part of the State. The canvasback, formerly a rather rare straggler, has increased somewhat of late, and in the fall of 1908 was seen in numbers, particularly in the ponds of Martha's Vineyard.

The evening grosbeak was first noted here in the early part of the year 1890. It has been seen again in smaller numbers during the winter of 1898-99 and again in December, 1899.

The Carolina wren evidently is moving northward. It has begun breeding within the State and winters here.

The prairie horned lark appears to have extended its breeding range eastward. It now breeds not uncommonly in parts of Maine, New Hampshire and Connecticut and also breeds in this State.

BULLETINS

MASSACHUSETTS BOARD OF AGRICULTURE,

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THE FARMER'S INTEREST IN GAME PROTECTION.

BY EDWARD HOWE FORBUSH, STATE ORNITHOLOGIST OF MASSACHUSETTS.

Introduction.

It is unfortunate that so many farmers evince little or no interest in game protection. Some regard game laws as of no advantage to the farmer, but rather as class legislation for the benefit of the sportsman. Nevertheless, the protection of game affects the agriculturists more vitally than any other element of our population. The farmers own the greater part of the land, and the game is more accessible to them than to any other class, for they live upon the land where the game is. Game conservation is advocated under our present system not solely to furnish sport for a limited number of individuals, but to protect the useful species of birds and mammals for the benefit of the whole people. Rational game protection should so work out as to restrict injurious species to some extent, to protect the land owner against law-breaking, trespassing hunters, and to create a community of interest between the farmer and the sportsman. The principle that the game is the property of the State is now well established in this country, and has been sustained by the higher courts; but by means of laws against trespass, which have been enacted simultaneously with the game laws, the farmer has been given practical control of the game so long as it remains on his land, and the exclusive privilege of hunting it there during the open season. In Massachusetts he is even allowed by law at any time to kill deer that are injuring his crops, and also to collect damages from the State for such injury. Game laws tend to limit the number of hunters and to shorten the season during which hunting is legal. They also protect most insect-eating birds at all times, and abolish the trapping and netting of game. Were it not for these laws, the farmer would be continually annoyed by the tramping of hunters through his fields at all seasons, the tearing down of his pasture walls and fences and the shooting of birds in the nesting season.

Some game birds are very valuable to the farmer as insect and weed destroyers; some game mammals, on the contrary, are sometimes destructive to his crops or trees; but the farmer who takes advantage of the laws enacted for the prevention of trespass, the protection of crops and the conservation of game and birds, may thereby add to his prosperity as well as to his pleasure in life, and by fostering the increase of fish, game and birds he may make life more attractive to his boys, and thus help to keep them on the farm. This paper will be devoted mainly to the material advantages that the farmer may derive from the protection of wild game, and particularly game birds.

Economic Value of Game Birds.

High among the valuable destroyers of insects and weeds we must rank the bob-white, commonly known in New England as the quail. This bird has not only an esthetic value, by reason of its bright, lively presence and its cheery call, but it is also one of the chief feathered helpers in field and garden.

Dr. Judd of the Bureau of Biological Survey gives some interesting records obtained by a study of its food.[1]

The contents of the stomachs of 801 bob-whites were examined by the experts of the survey; over 50 per cent of the food consisted of seeds, the bulk of this being weed seeds. One bird had in its stomach 1,000 seeds of rag weed; another had eaten no less than 5,000 seeds of the troublesome pigeon grass. As each bird eats two or more meals a day of this character during the season when weed seeds may be found, a few flocks of such birds might do much to limit the production of weeds on any farm. Dr. Judd estimates that the bob-whites of Virginia consume 573 tons of weed seeds between September 1 and April 30. Examining the insect food of this bird, he finds that many of the most important insect pests of the United States are eaten in quantities. Cucumber beetles, bean leaf beetles, May beetles, click beetles and their progeny the wireworms, weevils, among them the notorious Mexican cotton boll weevil, potato beetles, spinach flea beetles, grape vine beetles, corn bill bugs, chinch bugs, cut-worms, cotton worms, boll worms, southern tobacco worms, army worms, garden caterpillars, grasshoppers, locusts and ants are found in its bill of fare. It is one of the few birds that are very destructive to the Colorado potato beetle and the chinch bug. Without question the bob-white or quail is one of the birds that the farmer should strive to protect. The ruffed grouse, the heath hen, the wild turkey, the introduced pheasants, the woodcock and the snipe, — all have a greater or less value as insect destroyers, and most of these birds feed upon the seeds of weeds.

Wild ducks may be of great service during any outbreak of insect pests in the fields. They are destructive to grasshoppers, locusts and army worms. Most of the non-game birds of the farm are particularly beneficial. In a report of the Secretary of Agriculture on the work of the Biological Survey, transmitted to Congress with a special message by President Roosevelt on Dec. 21, 1907, it is estimated that the

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[1] Judd, Sylvester D. The Economic Value of the Bob-white. Year Book, United States Department of Agriculture, 1903, pp. 193–204.

sparrows of the United States saved the farmers of the country in 1906 $35,000,000 by the destruction of weeds; and that a single species of hawk saves the farmers of the western States $175,500 a year by the destruction of grasshoppers and field mice. It will pay the farmer, therefore, to promote the protection of nearly all the birds of the farm, and to lend his influence to the enforcement of the game laws, for the birds that are distinctly injurious are not protected.

The Economic Value of Game Mammals.

The native game mammals of Massachusetts consist of squirrels, hares, commonly called rabbits, and deer. The woodchuck, raccoon, fox and other mammals, although hunted, are usually classed as vermin. Squirrels are of some service as tree planters, for they distribute the seeds of nut-bearing and cone-bearing trees far and wide; also they destroy insects, for a time, in the summer. Under protection, however, they are likely to so increase in numbers as to become destructive to birds, nuts, fruit and grain.[1] Rabbits, when numerous, destroy young trees; and deer, under the same conditions, attack young fruit trees and vegetables. Therefore the farmer has not the same economic incentive for conserving mammals that he has for protecting birds. Nevertheless, all these animals add to the attractiveness of country life. And if the laws are so framed as to give to the owner of the land an opportunity to protect his property from their inroads, and to take a reasonable number for food, the game mammals may be considered as of considerable value to the farmer.

Financial Benefits derived from Game.

Under the present laws the game on the farm may be so conserved and handled as to bring in an annual cash revenue to the farmer. Owing to the laws which prohibit the sale of grouse and woodcock, these birds cannot be marketed; but quail, wild fowl, shore birds and hares or rabbits may still be sold in our markets. Ordinarily, however, the farmer will find it more profitable to lease his land for shooting purposes than to sell the game in the market. Associations of farmers and sportsmen have been formed, in which the farmers grant shooting rights on their property to a limited number of sportsmen, and the sportsmen agree to protect the farm property from poachers. In other cases the protection of the farm property is left to the farmer. In Rockford township, Illinois, a farmers' association was organized in 1901, each member of which had the right to grant to any one the privilege of hunting on his farm in his company. All undertook to promote the strict enforcement of the game laws. Seventy-five members were enrolled, representing 12,000 to 15,000 acres of land. The system under which this association worked was

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[1] Gray squirrels are now (1909) protected at all times; but undoubtedly this law will be amended or repealed if squirrels become too numerous.

so complete that poaching and trespassing were nearly eliminated. Notwithstanding the shooting done, prairie chickens and quail increased in numbers, while insect-eating birds became abundant.[1]

A somewhat similar system is in operation in North Carolina. Exclusive shooting privileges over farm lands are secured by the sportsman either by paying the owner a certain sum per acre, or by paying all taxes on his real and personal property. The sportsman or the sportsmen's club may thus lease several farms. The lease does not interfere in any way with the rights of the owner to cultivate the land, or with his residence thereon. Planting is encouraged. Many of the lessees furnish the farmers with cow peas or grain for planting, that the quail may have better food and cover, and this planting is often carried out on a large scale. Some of these lessees employ game keepers to destroy the natural enemies of the game and to keep watch for law breakers. Thus the farmer is relieved from some of the trouble and annoyance of guarding his property and prosecuting poachers. This system has become very popular among the southern farmers, and the game is regarded as one of the assets of the farm. In Guilford County more than 150,000 acres have been leased out in this manner, and there are in the State some large preserves, varying in size from 9,000 to more than 18,000 acres. This system, as applied in the south, has a tendency to better the condition of the agricultural population, and to give the children of the farmers better educational facilities. Under the laws of North Carolina special taxes are imposed for the support of the school system, and the farmers, realizing that their taxes are paid by the sportsmen, are more likely to vote additional funds for school purposes. Thus the game helps to educate the children.[2] This system has brought additional prosperity to the region, and has increased the numbers of game and birds. It gives the farmer opportunities to furnish boats and teams to the hunters, and he and his boys receive some employment as guides and helpers.

This system has not made much headway in Massachusetts, but farmers who have given it a trial are well satisfied with the result. A number of farmers in southeastern Massachusetts, who have learned the value of the bob-white, find that they can maintain a good stock of these birds by combining, and leasing the shooting rights. Their lands are not much wooded, and are more easily guarded against poachers and trespassers than the wooded lands in some other parts of the State. This may account, in a measure, for their success.

The principal difficulty in finding lessees for shooting rights lies in the scarcity of the game, but this drawback can be remedied. Wherever the game is protected against excessive shooting, and where such

[1] Palmer, Theodore S. Some Benefits the Farmer may derive from Game Protection. Year Book, United States Department of Agriculture, 1904, p. 518.

[2] Some of the South Carolina lands are poor and rather barren, and where the rights are taken by the acre the annual rental averages only about 6 cents per acre, — a sum which would look small to Massachusetts farmers.

natural enemies of the game as lynxes, cats, foxes, raccoons, minks, weasels, rats, crows and bird hawks are held in check by the gamekeeper, the game soon becomes abundant. In some cases it increases so fast that considerable shooting becomes necessary to prevent excessive increase and the consequent spread of infectious diseases, which are very fatal on an overcrowded game preserve. In this latitude the bob-white is sometimes nearly exterminated by severe winters; but much of this excessive mortality might be avoided by giving the birds a little care, protection and food. The woodcock needs only suitable cover and protection. The ruffed grouse or partridge is hardy, and may be made numerous on any preserve which contains good cover and an abundant supply of food. The wooded hillsides of Massachusetts, interspersed with swampy hollows, are the natural paradise for this king of game birds; and there is much rocky and swampy land that is of little value for anything but the production of timber and game. The pinnated grouse or heath hen ought to thrive under protection on much of the sparsely wooded land in southeastern Massachusetts. The increase in the numbers of these birds on Martha's Vineyard since they have been made the wards of the Fish and Game Commissioners gives hope that they may recover their lost ground. Snipe and certain shore birds will gather on any suitable marshes where they are not continually molested, while ducks may be attracted to ponds, streams or fens by a few call or decoy ducks, or by wild rice or a supply of grain for food.

The principal objection urged by the opponents of the system of leasing shooting rights and the establishment of game preserves is that the policy is un-American, and that it gives over the shooting privileges into the hands of the wealthy few, thus depriving the many of the right to take game that belongs to the whole people. It may be admitted that the system is un-American, for the American policy of destruction which has been so successful in the past allows unlimited freedom to all to take or destroy every living wild thing upon the face of the earth. Such license was necessarily permitted during the time of settlement; but unless the people are restrained in their rapacious tendencies, as population increases the extinction of all wild game will result. Already the day of open and free shooting in the east has passed. The occupation of the market hunter has become intermittent and precarious, and necessary laws have been enacted, — too late, indeed, to save some species of our game, but in time to prevent the destruction of others. As population increases, the number of shooters will increase; and the present system of game protection must and undoubtedly will be changed to follow that of other countries, which, although more thickly settled than our own, have nevertheless an abundance of game in fields and coverts as well as in their markets. In the mean time, under inadequate protection our own supply has been continually decreasing.

If we are to have game in the future, we must strictly regulate hunting, and adopt some system of game preserving, coupled with artificial propagation of game. The policy of licensing hunters, which is just coming into effect in New England, will largely restrict the number of hunters, particularly the alien hunters; and this is a long step in the right direction. Ignorant foreigners, who come here without knowledge of our laws and with the idea implanted in their minds that liberty in the new country means license to do as they please, should not be allowed to shoot at all or to range the country at large, unless some means can be provided by which they may be controlled and identified. Many of these people shoot all kinds of mammals and birds for food, and the license fee of $15 exacted of them (for hunting) stops most of the hunting by this class; while those who continue to hunt must carry an identifying license, and have it ready for the inspection of the citizen or game warden. But even with the alien eliminated from the field there will still remain an army of hunters so vast that, with free shooting allowed, the game will have little chance except in remote regions.

Under our present system, the only salvation of the game is to prohibit its sale and thus remove the incentive for market shooting. But with the advent of artificial propagation and scientific game preserving the sale of such species as can be reared in captivity or produced in large numbers on game preserves may be permitted, and may even become necessary as a means of encouraging propagation. Unless some such plan is adopted, we shall soon have no game in our markets except such as is imported from foreign countries. The demand for game will continue, and it remains for our people to decide whether they will produce it here or send thousands of dollars abroad for it. Our country is so large that it is not probable that the greater part of it ever will be occupied by game preserves, as is the case in some European regions; therefore, the overflow from these preserves will still afford shooting for the people in the country surrounding them. It is undoubtedly true that the rich have advantages over the poor under this system, as in many other respects, and they always will have certain advantages under any system; but it is also true that the farmer is in a position to derive some benefits from the expenditure of the rich man's money in support of a system of game preserving which, while it interferes to a certain extent with free shooting, provides an abundance of game in regions where without it and under the old system there would be no game at all.

The above is not written for the purpose of advocating any change in our system of game laws, to approve the European system of game preserving, or to recommend laws permitting the sale of game; but merely to point out the logical tendency of a movement which already has gained a strong foothold in this country, and to show the farmers the benefits that they may derive from the inevitable extension of this system.

The Artificial Propagation of Game.

The rearing of native upland game birds in confinement is still a subject of experiment, and never has been made a financial success; but enough has been accomplished to prove that it is possible to rear the ruffed grouse, the pinnated grouse and the bob-white in domestication. Mallard ducks, black ducks, wood ducks, teal, Canada geese and a few other species have been reared successfully. When such birds as wood ducks and Canada geese find a ready market alive at from $5 to $15 a pair, or more, those who understand the business of rearing them ought to make a profit. Pheasants may be sold at similar prices, and at present they will bring about $3 per pair, food value, in some of our markets. The writer introduced in the Massachusetts Legislature of 1908 a bill framed to permit the sale of pheasants in the markets. This bill, although altered somewhat from the original draft, passed to be enacted in such form as to allow the shooting and sale of these birds if taken by the owner on his own land under permit from the Massachusetts Commissioners on Fisheries and Game. Any successful pheasant raiser in Massachusetts ought now to be able to dispose of all the birds that he can rear. If the people take advantage of this law, enough of these birds should be raised by farmers and sportsmen to make them plentiful in our markets. The ring-necked pheasant, which is the species most commonly reared, is not a conspicuous success as a wild game bird in Massachusetts; but it has succeeded better, under the adverse conditions surrounding game birds here, than has any other introduced species. It thrives best, however, if given some care and protection, and it needs to be fed in winter. As a half-domesticated game bird, artificially propagated, protected and fed by man, it is unexcelled. Its general distribution throughout the State under protection is not desirable, for it carries diseases that are fatal to native game birds; and where it becomes numerous it is destructive to certain crops, and consumes the food of quail in winter. But if reared in inclosures while young, and allowed to run half wild on the grounds of the owner, it makes a very desirable addition to the supply of game for the table, and therefore will probably take the place in our markets of some of the native game birds now illegally sold.

A general open shooting season for pheasants would prevent them from becoming over numerous, and thus constituting a menace to our native game birds. In the mean time, those who wish to propagate or protect pheasants have now their opportunity.

Deer may be reared in pastures and sold alive at a profit. The rearing of game in inclosures or on preserves must be depended on to help in solving the problem of the game supply of the future.

ECONOMY OF LABOR IN POULTRY KEEPING ON FARMS.

BY JOHN H. ROBINSON, EDITOR "FARM POULTRY."

The most important problem in poultry keeping is the labor problem. This is as true where the poultry keeper does his own work as where he hires all or a part of it. There is no advantage in getting large egg yields and growing large numbers of poultry when the margin of profit is below what might be obtained on a smaller production.

Keepers of poultry acquired several generations ago the habit of not reckoning their labor, or the labor they hired, when estimating or computing their profits on poultry. Such an error may be excused when the time given to poultry would otherwise be idle time, but even then it is better to give labor due consideration, for failure to do so has brought thousands of ambitious poultry keepers to grief. The common fundamental error in the reasoning of the person who thinks that because he has done well with a small flock he can do correspondingly well when he devotes all or a large part of his time to poultry is failure to see that the methods of managing the small flock will not, when applied to large numbers, enable the attendant to handle enough fowls to give him a living wage for the time devoted to the flock.

The labor problem, while most troublesome when poultry is kept on a large scale, demands careful attention wherever poultry is kept for profit. Even in the many cases where the poultry keeper is not dependent upon the income from poultry it should have consideration, for if it is of interest to one to make a little profit from work taken up in spare time or for recreation, it should be worth while to try to make as much profit as possible without making the work burdensome. One of the best ways to accomplish this is by saving labor, — using every possible contrivance of method or appliances to that end. Considered in a broad way, the saving of labor includes also the utilization of inexpensive labor, and of persons who would, perhaps, otherwise be unproductive. Let us discuss the question first from this point of view.

Poultry keeping was for thousands of years universally left to women, children and infirm men. It was not until the industry began to be boomed for the wonderful possibilities of profit in keeping fowls in flocks too large to be easily managed by this class of labor that able-bodied men began to regard the care of poultry as worth their while. Then the common idea was to make money by conducting operations on a large scale, or by securing large per capita returns. In either case the methods used were devised and applied with little regard to the cost of labor. There has been a very general opinion, not yet dissipated, that it was a good thing for the poultry industry and a mark of progress when it became a man's occupation, and that when men took it up they would work out more systematic methods, better adapted to the handling of poultry on a large scale. In some cases and to some extent they have done this. It has been a good thing, too, that men have learned a better appreciation of the value of poultry; but in many places it was clearly a mistake for men, especially on farms, to take on themselves the care of poultry. This many men are beginning to find out.

The work of a farm which has a properly diversified culture affords opportunities for profitable outdoor employment for every pair of hands on the farm. A proper division of the variety of tasks which make up the routine of the day, the season or the year requires that those capable of doing any of the work shall devote their time and skill to doing the things that others cannot do. It is not good management on a farm, or anywhere else, if skillful hands and strong hands are engaged in doing work not especially requiring either skill or strength, while those who could do these tasks are idle and adding nothing to the family income. It is a doubtful kindness to the feminine members of the farmer's family that relieves them wholly of outdoor duties. There has been as much masculine selfishness as consideration for the gentler sex on many farms where men have taken over the care of poultry. Even if it be granted that the head of the family and proprietor of the farm takes the care of the poultry because he likes it, that does not acquit him of the charge of selfishness, if by taking this work himself he prevents other members of the family from becoming interested in it. I have known men — altogether a good many of them — who persisted in looking after the poultry themselves, though not notably successful with it, when their wives, daughters or sons would have done it much better had they left it to them, — and let them alone. I have known a good many men who, though failures as poultry keepers, declared they would stick to it until they succeeded, — and succeeded according to their original plans, — and kept on losing money and neglecting work for which they were better fitted, when had they turned the poultry over to other members of the family to do with according to opportunities, and given their own time to work at which they could make a living, all would have been better off.

These, of course, are the extreme cases. In the average instance the wise course is for the farmer to keep his interest in poultry, exercising a measure of supervision over it or assisting with it when necessary, but in this and every other part of farm work planning to let other members of his household do such work as they are able to do and interested in doing, allowing them to get such pleasure as they may from it and giving them a fair proportion of the proceeds, whether a fair proportion means a little or all.

I was on a farm in Rhode Island a few years ago where a couple of thousand chickens were grown annually. The family consisted of the father, mother and two daughters about sixteen and eighteen years of age. The daughters were unusually attractive girls, refined and lady-like in demeanor, as self-possessed and as able to look after themselves as any girl in country or city ought to be. The family were just beginning to establish themselves on this farm. Money was none too plenty with them. The father was trying to carry on the farm work and handle the hens without hiring help. These girls, in addition to what they were doing in the house, took all the care of the chickens until they were old enough to be colonized in fields distant from the house.

On a Massachusetts farm where several thousand chicks are grown annually, and hatched and reared with hens, the farmer's wife, a physically strong woman who cannot stand constant indoor life, takes a large part of the care and practically all responsibility of the setting-hens and young chickens, while a daughter does most of the housework and takes her "outings" driving to the village, sometimes several times daily, and looking after the flowers about the house. Both women are better for this sort of occupation, and their work, of direct assistance to the men, is more than equal to the services of a good man.

On many farms where less stock is kept one or more boys, under paternal supervision, take care of quite a flock of poultry, earn something for themselves and at the same time add to the family income. One house I happen to know of has an arrangement of this kind. The boy owns and takes care of the poultry. His father furnishes everything, house, fence, feed. When the boy is at school or has other engagement his mother (usually) looks after the poultry for him. He has to supply the house a certain number of dozens of eggs per week. Anything over this the house has to buy as any other customer would. Poultry consumed in the family is not counted. On poultry and eggs sold the boy divides the receipts with his mother.

The few instances described illustrate the point of utilization of "all hands" in poultry work. Such arrangements are not always practicable, but they might be made to the advantage of all concerned very much oftener than they are.

Taking up now the other phase of the subject, let us consider some of the ways of saving labor in handling poultry on the farm that apply, no matter who does the work.

First, and on general principles, make the poultry of all kinds do as much as possible for itself. Why cut cabbage or roots in little pieces for birds which can pick it to pieces themselves? This applies, too, in the feeding of little chickens. The usual directions for feeding little chickens make the preparation of "first foods" for chicks as much work as the preparation of an elaborate dish for the table. For nearly twenty years the writer has fed little chickens from the start the same mash he gave to hens (and, when he had them, to ducks and geese), and has fed them from the start whole wheat and cracked corn. Chickens on this diet will not grow as fast at the start as those that get more concentrated foods and more variety, but losses will be light, and they will develop rugged little bodies that later will stand heavy feeding and make better and more rapid growth.

For exercise for adult fowls on the farm leaves on the floors of the houses save labor for the poultryman and utilize in the best way a waste product. Straw in Massachusetts is worth more for other purposes than it is for scratching litter. A good many poultrymen buy it and use it, but at prevailing prices it is questionable whether they can afford to do so. Almost every farmer can get leaves enough either from trees on the farm or from woods near by to provide scratching litter for his hens, and use the leaves liberally. The advantage of leaves over straw is that by frequently adding a few fresh leaves, which are immediately scattered quite evenly over the floor, grain thrown in the litter is at once concealed, and does not have to be covered with a fork or raked in. The cleanings of the house when leaves are used as litter are also in much more satisfactory shape to apply to land for fertilizing purposes.

With regard to cleanliness in poultry houses. The labor of cleaning the houses daily or frequently is a heavy item in the course of a year and if the house is constructed right, ventilated properly, and the fowls are normal, is quite unnecessary. This doctrine, I know, seems almost repulsive to those to whom the idea of dirt of any kind accumulating seems intolerable and the practice inexcusable. But with due regard for the conditions mentioned there is really no valid objection to the time-honored practice of cleaning the poultry house only once or twice a year.

Most of the sites on which poultry houses are placed in Massachusetts are well drained. The soil is light and sandy, and makes the best kind of floor for poultry. The moisture in the droppings is absorbed or evaporates (or is absorbed and evaporates). The dry droppings mixed with the earth of the floor and with finely broken litter, and covered over with a layer of coarser litter, give off no odor, nor does the presence of such material in the floor where the hens are fed have injurious effects on grain with which it comes in contact unless grain accumulates and lies there too long, and with litter becomes damp and heats. Ordinary good judgment in feeding and ventilation is all that is necessary to avoid trouble in this connection. It should be noted that the conditions described are quite different from those that obtain where droppings accumulate without mixture with earth or litter, or without opportunity to dry as they accumulate.

If a poultry house is in a permanent location it ought to be sufficient to clean out all droppings and litter every spring, and in the fall take out the soil as deep as it is mixed with droppings and refill with fresh earth. The expense of doing this is much less than the cost of frequent cleanings. Whenever it can be done it is better to use colony houses, with or without yards, and move them every year or two. On many farms in England it is customary to use smaller colony houses than are commonly found in this country, — houses about 6 feet square, — keeping a dozen to fifteen hens in each and moving a short distance at frequent intervals. By this plan poultry run on grass benefits the grass without destroying it. It does not at present seem likely that this plan will be extensively adopted in this country. Land is cheaper and labor dearer here than there. The tendency is to larger flocks, and even when provision is made for moving houses they are rarely shifted as often as it was planned to move them. The colony house moved as often as necessary to keep the land from becoming foul seems the best plan for New England farms. One of the drawbacks to poultry keeping here in recent years is the condition of land, so much of which has had poultry on it constantly for a long term of years. It is often hard to get people to believe that the fault is in the land conditions. I have seen good poultrymen in constant trouble for several years on land they could not be convinced was injurious to their poultry, speculating, studying and trying all kinds of experiments to find out what was wrong with the birds or the feed. Then when at last they did move the poultry to another part of the farm their troubles seemed to vanish. Growing poultry constantly on the same land is like growing any other crop, with the difference that while the ordinary vegetable crop takes away from the soil, poultry are adding to the soil matter which is poisonous to them when soil over which they run is heavily charged with it, but which is of great value to vegetation. If the farmers of Massachusetts would plan to rotate poultry with vegetable crops, or keep poultry on the same ground with vegetable crops they would soon find that the poultry-carrying capacity of their land was greater than they had supposed, that many of the ills poultry on contaminated land are heir to they do not suffer when on new land, that it is much easier to handle poultry on new land, and that every part of the land to which the poultry has access is benefited.

Many cultivated crops are better for having poultry in them at least a part of the season. After corn is about a foot high a few fowls or chickens can keep quite a plot of corn free from weeds and injurious insects. Even when the corn plot is quite heavily stocked with poultry they are not likely to do serious injury until the corn is ripening and bent ears and parted husks tempt them to help themselves. It might be debatable then whether there was any real loss in letting the birds help themselves to what corn they wanted. The answer depends on what point of view is taken. It must be remembered that the poultry have done a good deal for the corn, and that if they did not eat it other grain must be given them. Asparagus is a crop in which chickens can run from the time cutting ceases until winter. They will keep the asparagus clean and give it a liberal fertilizing. Raspberries and blackberries poultry may be kept in except when the fruit is ripening. If not too many are put in they will do no more harm in the spring than to break down a part of the growing plants. As there is usually a superabundance of these, what destruction they cause in this way is often beneficial.

On grass land where but one crop of hay is cut each year poultry may be kept on the land from the time the hay is taken off. Some of the best mowings I have seen in this State are those that are cut but once a year and poultry kept on them with the second growth so strong it really seemed a waste not to cut it. Of course too much poultry on grass land will ruin it. There is a medium where the land and poultry alike profit. An orchard furnishes an ideal place for poultry. It gives shade as well as a grass run, and the birds destroy many insects. Whether in field, orchard or garden the fowl that has an opportunity to do something for itself is saving labor for its owner, saving on the feed bill, and under proper restrictions is actually doing work which otherwise he would have to hire done. It is also keeping in good physical condition, and thus saving anxiety and extra care that go with unthrifty stock, to say nothing of the losses steadily occurring among such stock.

In the feeding of poultry on the farm many economies are possible. There is usually more or less vegetable matter that unless fed to hogs or hens goes to waste. When apples are falling from the trees the unmarketable stuff may be fed very freely to poultry. They will eat large quantities of apples, and seem to thrive better on them than on any other fruit or vegetable. Nothing else seems to go as far in saving on grain feed.

Fowls may be fed all the overripe tomatoes and cucumbers they will eat. The lettuce that runs to seed and the split heads of cabbage ought to be given them more regularly than is usually the case. Too often these things go to waste while poultry goes hungry for green food, because it is nobody's business in particular to give it to them.

Hopper feeding, of which so much is said now-a-days, is an advantage or not according to circumstances. Where fowls have opportunity to exercise and get considerable variety of other food feeding grain in hoppers in which a supply for several days or a week is put saves a great deal of labor. Under opposite conditions the apparent saving in work of giving feed may be more than offset by the work and worry brought about by hopper feeding under wrong conditions. It is not possible to make the same plan or method work equally well for all persons under all circumstances; nor is it possible for any one else to decide for a poultry keeper what is best policy for him. All points involving a weighing of results of different courses each poultry keeper has to work out for himself. In fact, the most essential thing for the poultry keeper who would economize labor is to use his own head; to think about and study out his problems. No one else can do it for him, because no one else can see or know the situation as he sees and knows it. One of the best poultrymen in this section used to say that there was no need of a man getting up early in the morning if he would lie awake awhile every night planning how to avoid it.

LIVE STOCK IN MASSACHUSETTS.

BY J. A. FOORD, PROFESSOR OF FARM ADMINISTRATION, MASSACHUSETTS AGRICULTURAL COLLEGE.

The history of agriculture in our own and other countries shows quite clearly that live-stock farming, carefully conducted, in connection with rotation of crops, is the simplest and easiest method of maintaining and increasing the fertility of the land, and thus insuring a gradually increasing production. The live-stock industry in Massachusetts is less important than it was ten years ago, and it may not be out of place to inquire whether or not this downward movement is a healthy and profitable one for the farmer, and, as well, how it may be checked.

Dairy Cattle.

Reliable statistics give the number of cattle in Massachusetts from 1890 to 1908 as follows: —

Year.	Cows.	Neat Cattle Other than Cows.	Total.
1890,	200,658	62,549	263,207
1900,	180,245	56,715	236,960
1901,	178,291	55,291	233,582
1902,	179,593	49,351	228,944
1903,	179,033	46,586	225,619
1904,	180,372	46,641	227,013
1905,	181,920	44,368	226,288
1906,	181,816	42,536	224,352
1907,	179,075	39,414	218,489
1908,	171,458	38,743	210,201

Not only is the total number of cattle slowly decreasing, but the proportion of "neat cattle other than cows," which was 23.7 per cent of the total number in 1890, dropped gradually until in 1907 it was only 18 per cent; it was 18.4 per cent in 1908. This is only another way of saying that Massachusetts farmers are raising fewer and fewer of their own cows; attention has already been called to this tendency in the report of the Secretary of the State Board of Agriculture for 1908.

Many dairy farmers in Massachusetts are neglecting one of the most important branches of the business, that is, the breeding and improvement of dairy cattle. The milk producers, especially in the eastern and central parts of the State, often buy their cows, and raise neither grain nor young stock, most of the cows going to the butcher as soon as they fail to give a profitable flow. The phrase "it is cheaper to buy than to raise" has often been used by farmers in the past without careful calculation, and undoubtedly to the benefit of the seller instead of the buyer. There are exceptions to all rules, but at the present prices of grain and cows, a question worthy of the most careful consideration is whether the Massachusetts dairy farm cannot with profit be made more self-sustaining.

The farmer who, instead of buying, raises a good deal of his own grain and most of his young stock, may not handle quite as much money and labor during the year, but will often show just as good *net* returns at the end of it. The net returns for a series of years will also be more likely to be in his favor. The plan of continually changing cows prevents taking advantage of the application of the rule that "like produces like," and the "grading up" of the herd becomes impossible except by chance purchases. Not only is the price of cows increasing, but good cows are difficult to obtain. The continual discarding of the offspring of the best producers for veal, or even at younger age, must have a depressing influence upon the quality and productiveness of our cattle as a whole, and is a doubtful business practice. Even the regions from which the milk producers obtain their milking stock must either send to market only their lower grade cows, or else by sending their best animals deprive themselves of the possibility of a gradual improvement in each succeeding generation.

Disease, also, is very likely to be introduced where cows are purchased frequently and from many sources. Tuberculosis and contagious abortion are, perhaps, the troubles most likely to occur in a herd that is kept up by the constant purchasing of new animals. Each of these diseases is causing the dairymen of the State enormous losses every year, and will undoubtedly continue to do so until every one co-operates to stamp them out. Tuberculosis is a so-called "germ" disease, and the policy of "say nothing about it," and the practice of keeping slightly infected tuberculous animals in the herd, are both foolish and short-sighted A herd with a clean bill of health will be more profitable to its owner in the long run than a diseased one, and the sooner the cattle owners of the State decide to keep only healthy herds, and adopt a policy of co-operation with each other and the State for the suppression of tuberculosis, the better it will be for the financial success of the dairy business as a whole.

Bovine tuberculosis may be diagnosed or detected, even in its early stages, by means of the tuberculin test in the hands of a careful and competent man. Provided slightly infected animals are found, and their ability as producers makes it desirable, they may be separated from the main herd and kept for breeding purposes. They must be absolutely separated, both in the stable and out of it, from the main herd, the milk produced by these animals must be pasteurized by heat before being fed to calves, pigs or other animals, and care must be taken that calves do not suckle their dams at any time. The process of breeding a healthy herd from an infected one involves a good deal of care and detail, but it can be accomplished in a shorter time and at less expense than is usually supposed. The result is worth the effort. Mention should here be made of the fact that unscrupulous dealers have learned how to prevent the usual reaction of tuberculin, thus again placing the dairyman who buys his cows at a disadvantage. To the man who breeds his own stock, however, the test is just as valuable as ever, because he has them under his own control.

In the improvement or grading up of a herd of milch cows one of the first steps is to weigh and record the amount of milk produced each day. While this seems like quite an undertaking, when proper arrangements are provided the amount of time required is very small, and the returns from such work are such that the writer has yet to hear of a progressive dairyman who has discontinued the work after beginning it with proper utensils and arrangements. The influence upon the milkers, and the ease with which the owner or herdsman can detect a lessened flow as soon as it occurs, are worth the cost. Hanging spring balances, with adjustable hand that can be set back for the weight of the pail, may be obtained at any good hardware store. It is only necessary then to make the pails used by the different milkers weigh the same by the addition of a little solder on the bottom of the outside of the pail; the weight of milk can then be read directly from the scales.

The data thus obtained of the work actually done by the cows will contain some surprises but are the best criterion in judging of their value. Too much stress should not be put upon one year's work, but after the dairyman has weighed the milk from his herd for two or three years, a fairly correct estimate of the producing ability of the individual cows of the herd may be obtained.

To make the record complete, and especially if cream, or milk with a high per cent of fat, is desired, samples of the milk of each cow should be tested by the Babcock test. These samples may be obtained in several different ways: (1) by taking a small amount of milk from both a night and morning milking, and testing such a sample once or twice a month, or, better, once a week; (2) by taking a small amount (less than one-half ounce) of milk from each milking for a week. These samples may be kept from souring by the use of corrosive sublimate. This preservative may be obtained in small tablets ready for use from most dairy supply houses. As corrosive sublimate is a poison the tablets contain some coloring matter, to guard against the accidental use of the milk. Samples should be kept out of reach of children and small animals, and if the composite samples are used they should be covered with a tight stopper, to prevent evaporation. Evaporation, by decreasing the amount of water, will slightly increase the per cent of fat. Eight-ounce round glass bottles, with ground-glass stoppers are excellent for keeping composite test samples; they are inexpensive and may be obtained from chemical supply houses. Lightning fruit jars are sometimes used for the same purpose. It is desirable to test at least one week in each month, and if a continual weekly composite test is made, it will, of course, be more accurate. Fairly good results can be obtained, however, if a carefully taken sample is tested once or twice a month. A hand machine and glassware for making the Babcock test may be obtained for less than $10, and its operation is not difficult, although care in the manipulation of the test is demanded if accurate results are desired.

The scales and the Babcock test are the factors that should carry the most weight in judging our dairy herds. Function, not form, is or should be the chief consideration. What can the animal do? is much more important to the practical dairyman than whether the form, the color or the tilt of the horns conform to the requirements of a breed score card. These requirements are often desirable and add to the value of an animal, but it should always be kept in mind that performance is the main thing. Prof. Eugene Davenport, whose opinion and advice on the subject of animal breeding deserves the most careful consideration, writes as follows in Vol. III. of the "Cyclopedia of American Agriculture," recently published: —

> Form is striking because it appeals directly to the eye, but it has been greatly overemphasized, not only as the direct object of breeding but also as an index of quality, for all studies yet made indicate that the correlation between form and function is in most cases far less than was hitherto supposed. The individual as a whole has occupied too much attention in the mind of the breeder. The single character is the real object of thought and selection in all successful breeding operations; it is the real unit of study in all problems of heredity, and the actual basis of operation in all cases of variability. The individual is but a single instance of the many patterns that may be cast out of the various characters that belong to the race, and he is not to be taken too seriously. The dominant characters of the race and their correlations, — this is the great question in all the problems of the breeder and in all efforts at further improvement.

Another early step in the improvement of any herd or flock, and a step that should be taken at once by many New England breeders, is the purchase of a pure-bred sire from record-making ancestry. It is an old saying that the sire is half the herd. Few dairymen can afford all pure-bred females, at least in starting a herd, but none should be without a pure-bred bull, whose near ancestors show marked excellence along the lines it is desired to breed for. The use of such an animal with those females that show the best results when judged by the scales and the Babcock test, as just described, and the raising of the heifer calves, will lay the foundations of a herd that, while capable of continual improvement, the owner need not be ashamed of. Such a course of action will, it is believed, in many cases prove safer and more profitable in the long run than purchasing cows and keeping them only one or two milking periods before sending them to the butcher.

Beef Cattle.

The lack of suitable abattoirs in the small towns of New England is a drawback to the raising of beef in this section, but those farmers who are located at some distance from the railroad and on cheap land might well consider the advisability of keeping a beef or dual-purpose breed. The dairymen of England, farming on high-priced land, keep many Shorthorn cattle, and although the milking habit of the Shorthorn as a breed in America has been allowed to degenerate, some milking strains remain, and could undoubtedly be improved and kept with profit on some farms.

The increase in the number of working oxen in several New England towns during the last two or three years is worthy of notice. Oxen can never take the place of horses as in the early days, but the farmer who has more work than one team can do, and not enough for two teams, will find a yoke of oxen an inexpensive help. They are less costly than horses, and in case of accident, lack of work or a rising market can be sold for beef. The difficulty in obtaining men who understand driving and handling them is perhaps the chief objection to their use.

Horses.

There is a good demand in the cities of the State for heavy draft horses, and those weighing 1,400 pounds or over nearly always command a good price. The horses to supply this demand come from Ohio and the States to the west of it. There is no good reason why these horses should not be raised in Massachusetts. Our soil and climate are well adapted to raising horses of good quality and strong bone, and a heavier horse could be used with advantage on New England farms. It is time that we recognized in New England more fully than we do the advent of modern farm machinery, and the need of preparing for it and making plans for its profitable use by clearing out stone walls, underdraining wet places and doing away with fences wherever possible. When this is done we shall see that a man can just as easily direct a team weighing 3,000 pounds as one weighing 2,000, and that the former will be the more economical per unit of work done. The labor problem, as all farmers know, is still awaiting solution, and this is but a suggestion. The following quotation is from an article by M. W. Harper, in a recent number of the "Cornell Countryman," and is worthy of repetition: —

> The heavy horse can be produced with less effort and less risk to mare and foal. The brood mare should be worked up to the time of foaling; it is better for her. The heavy mare is more phlegmatic, not so apt to injure herself or the colt while in foal, as is the lighter and higher strung mare. Again, when the colts are young, they are not so active, not so apt to hurt themselves, as are the lighter and higher strung animals. And even if they should blemish

themselves, while very objectionable, yet it is not so much so as it would be with the lighter horses. Draft colts can be made to earn their own keep from the time they are two years old, when they can be put to light work. They are not so hard to train as the lighter ones, as they are more phlegmatic and take to their work better. If one is raising coach or saddle horses it may cost more to properly educate them than the entire cost of the draft colt.

The heavier horses are always in good demand on the market. They are least affected by business depressions, by fads and fancies. If one is breeding coach or saddle horses, they are usually considered pleasure animals, and the first to be affected by business depressions. Again, the draft horse will be the least affected by the motor car. Whatever else may be said, the motor car has come to stay, and as there are about seventy thousand automobile licenses in New York State alone, we can hardly gainsay that it has affected the number of pleasure horses to some extent.

If it is true, as seems to be the case, that the larger the horse the larger the farm machinery, then it is true that more work will be accomplished per man, and hence less human effort will be expended per acre. This will decrease the cost of production and increase the net returns per acre, therefore the value of the land is increased. Furthermore, if it is true that the draft horse is the more economically raised, the least affected by business depressions, and worth the most when ready for market, it would seem well worth while to give him greater recognition in the east than has hitherto been accorded him.

The Percheron horse is probably the best of the heavy breeds for New England markets and conditions. The Percherons have strong, fine bone, good spirit and action, and the weight that is necessary to haul heavy loads on smooth city streets. Although originally gray in color they have been bred and selected for a darker type, until black is as often found as gray.

If those interested in draft horses in any neighborhood would combine their forces for the purchase of a Percheron or other good draft stallion, the improvement in the stock would soon be noted, and before long money that is now sent out of the State for horses might be paid to Massachusetts farmers.

Sheep.

There are thousands of acres in Massachusetts that are well adapted to the raising of sheep. It might almost be said, better adapted to sheep than any other stock or crop. There is a home market for mutton and winter lambs, and they can be raised at a profit. It would, however, be foolish at the present time to advocate sheep husbandry in Massachusetts, to give a description of the most desirable breed or suggestions as to their care. The dog to-day is a privileged character, and not until he is put under the same conditions of restraint as the other domestic animals can sheep farming be safely carried on with profit. Dogs should be confined to the land or property of their owners, and either held in restraint or muzzled when they leave it. We require this for all other animals, why not for the dog? Not even our children are allowed as much liberty as the worthless curs that make sheep farming in Massachusetts impossible. The remedy is not a difficult one or hard to find, and with a little co-operation the time should not be far distant when the law will make impossible the half-starved, half-cared-for, half-wild mongrels that threaten our inhabitants and the other domestic animals with the possibility of hydrophobia, and prevent the pursuit of a profitable industry by many of our citizens. Kindness itself would put such dogs under the turf.

WESTERN METHODS IN NEW ENGLAND ORCHARDING.

BY F. C. SEARS, PROFESSOR OF POMOLOGY, MASSACHUSETTS AGRICULTURAL COLLEGE.

Even the most casual observer, if he gives the subject any consideration whatever, must be impressed with the fact that eastern fruit has been almost entirely crowded out of the better class of our eastern markets. It still commands a part of the second and third and fourth class markets, where worm-holes and bruises and apple scab are not considered insurmountable objections to an apple; but who ever sees a sign displayed these days in any high-class fruit store, "Choice Massachusetts Apples" (or Connecticut or Vermont or Maine apples)? There are honorable exceptions, of course, to this exclusion of our eastern fruit, men who care for their orchards and who pack their fruit carefully and skillfully, and whose fruit commands the highest market price. But these men have personally overcome the prejudice which exists in the minds of most consumers against our eastern apples. The vast majority of New England orchardists, however, send their fruit to the general market and take what is left after the several "middlemen" have received their share, and little enough it is, as a rule.

All this is discouraging to any one who is interested in eastern orcharding, and who would like to see the industry take its place where it belongs, as one of the leading branches of farming in New England, and as the equal, if not the superior, of orcharding anywhere in the country.

The situation would be far *more* discouraging were it not for the few cases alluded to above, where men are already making the orchard business a splendid success here in New England; and were there not certain factors which warrant one in believing that we have only to take hold of the industry in a business-like way to make it the equal of orcharding in any other section.

Let us briefly review the situation in the western apple section, and see what factors have contributed to their success. To begin with, their orchards are most of them young, many of them right in their prime and others just coming into bearing, so that the fruit which they are producing there at present is the very best that many of these orchards will ever produce. I do not believe that the importance of this factor is half appreciated by our New England orchardists, who are trying to compete against this class of fruit with fruit from or-

FIG. 1. — Boxes of western apples. Two-two diagonal pack on Spitzenbergs and three-three off-set pack on Grimes Goldens. This is the kind of packing we must do to compete with the west.

FIG. 2. — Good New England apple country. There are thousands of acres like this to be had at from $10 to $50 per acre.

FIG. 3. Clean culture in the orchard. Notice the tug-less harness, which prevents injury to the trees; also, that the soil is kept like a garden.

chards long past their prime. Until we get orchards on a par with the west as to age, we shall not be competing with them on anything like an equal footing.

In the second place, the orchard business is a great industry with them. Whole districts do little else than grow apples, and with this immense capital at stake, and with every man in the section talking and thinking and even dreaming of nothing but apples, the industry is bound to forge ahead. This is a well-recognized principle in *any* industry, yet one which we have systematically neglected here in New England. If Denmark had had only a handful of men scattered over the country who were engaged in dairying, it would never have become the leading dairy country of the world. And if we are to put the orchard industry of New England on a satisfactory footing, one of the first steps that must be taken is to get more people engaged in it. I have repeatedly urged the importance of this, for I believe that too much stress cannot be laid on it.

The third factor which has certainly contributed to the success of the western fruit is the fertility question. Their lands are new, virgin soils, full of all the elements of plant food, and the fruit grown on them has all the raw materials at its disposal which it can possibly use at any stage of its development. We here in New England are growing the fruit which we expect to compete with it on lands which are many of them already worn out with constant cropping, and which are in addition too often forced to grow two crops every year, — a crop of fruit and a crop of hay.

The fourth factor in their success is spraying. It is a business proposition with them, and they never neglect it. One hears of orchards which are sprayed five, six, seven or even more times in a season; and experimental spraying at the Oregon Agricultural College has shown that 99 per cent of their apples can be kept free from worms or fungous diseases, and many of their orchardists are approaching very close to this in actual practice by proper spraying. With us in New England the orchard which is sprayed at all is the exception; and usually one, or at most two, sprayings are all that even these orchards receive.

A fifth element of their success is certainly cultivation. It is thorough and continuous, so that all the power of the soil goes to making fine foliage and fine fruit, instead of being divided up among weeds, grass and fruit trees, as is too often the case with us.

The sixth factor in the conquest of our markets by western fruit, and the one which more than all others has given them the inside track, is, in the writer's opinion, their method of handling and grading and packing their fruit after it is grown. Even with our faulty methods of growing fruit, we produce a lot of fine apples, but nine-tenths of them are not marketed so as to command the highest price which their quality would warrant; while with the western grower the grading and packing is such as to insure the apples reaching the consumer in perfect condition. Not only is every apple perfect, or practically so, — the few blemished ones which they produce being discarded, — but they are graded so that all the apples in each box are exactly alike. Fig. 1 shows two boxes of western apples, — a box of Spitzenbergs, from A. I. Mason, Hood River, Ore.; and a box of Grimes' Golden, packed by Stirling & Pitcairn, Kelowna, B. C., which the writer had shipped to Amherst for use in his classes in pomology. And though these boxes came clear across the continent alone, by express, thus receiving much rougher handling than they would if shipped in car lots, as is usual, yet so perfect was the packing and so careful had been the previous handling of the apples that they arrived with practically every apple in perfect condition; and the apples in the middle of the boxes and in the bottom were just as good as those on the top. This is certainly the key to western success in getting gilt-edged prices for their fruit. "A dozen Oregon Spitzenbergs," or "a box of Colorado Winesaps," has a definite meaning, just as much so as "a dozen California navel oranges," and customers are willing to pay for this certainty of getting something which is good.

The seventh and last factor in the success which I shall mention — though there are doubtless a few other minor ones which might be included — is their climate. I believe that the dry, sunny weather, which most of their famous apple sections have, puts a color and a "finish" on their fruit which it is difficult to get here in the east. Mind, I don't say that it *can't* be done here, but certainly it *is n't* very often, even in the few well-cared-for orchards which we can boast. That, it seems to me, is the only factor in the situation which need disturb the man who wants to go into orcharding here in New England; and, as I shall try to show, this is more than offset by advantages which we have.

Let us turn now to the situation here in New England, and see what factors there may be to encourage the prospective orchardist to select New England as his field of operations. In the first place, land values are very much in favor of New England. Men have been "going west to grow up with the country" for so long that prices for land in any of the good fruit sections are abnormally high, while they are correspondingly low here in the east. One hears constantly of the wonderful prices which are paid out there for raw lands, or for land just set to orchard, while $1,000, $2,000 and even $5,000 per acre have been refused for bearing orchards. Here in New England, on the contrary, splendid orchard land can be bought for $5, $10 to $50 per acre. No country in the world abounds more in ideal orchard sites than New England. Fig. 2 is typical of hundreds of sections here, where high, rolling lands, with splendid orchard soils, can be had at prices which will give the man starting an orchard on them a tremendous advantage over the man who starts on the high-priced lands of the west. If one can buy land ready to set out in trees at $25 per acre, — and this can be done in many parts of New England, — he has just one-quarter of the capital to pay interest on which the man has who uses $100 land,

and his chances of paying dividends are that much better. The skeptical may ask, "If this is so, why have our New England lands so long gone begging?" and the writer frankly admits that he would like to ask that question himself, though he certainly does not want to be classed among the skeptical as to New England's possibilities in orcharding. As nearly as it has been possible for the writer to figure out a reply to this question, — which is certainly a legitimate one and an important one, if we are to convince those intending to go into orcharding that New England has distinct advantages to offer them, — the reasons are about as follows: —

1. There is the almost universal feeling that an orchard is a long-time investment; that it is going to take years before any returns will be received from it; that, while it might be all right as an investment for one's children, the one who planted it could not expect to get much out of it; and this feeling has been heightened and strengthened here in the east by the records of small family orchards, set years before the orchard was thought of as a serious business proposition, and which without any care whatever *have* taken a long time to come into bearing.

2. We are so largely a suburban community here in New England that truck crops and dairying have been profitable; and once these branches were started, they naturally kept in the lead, as farmers are proverbially conservative and slow to change into new lines.

3. There has too long been a feeling here in the east that we could not compete with the west in *any* line of agriculture. When grain crops were the main feature of farm operations, and when the grain States of the middle west were first opened up, it *was* a one-sided fight; and our eastern farmers came to feel that anything which the western farmer *could* produce he was bound to win on, and they have therefore the more assiduously stuck to truck and dairying, where they were safe from that competition. But just as at the "National Corn Show" last year it was a young man from Connecticut who took the prize for the highest yield of corn per acre in the United States, and who is now giving pointers and selling seed corn to his western competitors, so I believe that if the eastern orchardists will only try it, they can as fully and easily upset the notion that the west has an absolute and iron-clad lead in the production of apples.

Next to the question of land, and more important in some ways, I should place the matter of the quality of New England-grown fruit. I believe that there is no other section where the flavor and aroma and juiciness and sweetness, and, in fact, all those factors on which we base our estimate of the quality of an apple, are more highly developed than right here. This is not my own judgment alone, though I have had many opportunities of comparing the fruit from this region with that from other sections, and particularly with the far western apples so generally found in full possession of our best fruit stores. And almost without exception, when our eastern apples were as well grown and had been as carefully handled, — which I am sorry to be obliged to admit was not always the case, — almost without exception I have had no hesitation in saying that the advantage in quality lay strongly on the side of our home apples. Prof. John Craig of Cornell, one of the highest authorities on such matters, one of the judges at Oregon's "National Apple Show" last year, and a man who has had frequent opportunities of testing this matter, has repeatedly expressed the opinion, both publicly and privately, that for *quality* eastern apples were in the lead. The late Charles Downing held the same view. He received apples from all over this continent where they were grown in his day, and expressed the opinion that the mountain regions of Virginia and North Carolina and the orchard sections of higher latitude — Nova Scotia, New England, etc. — produced apples of the highest excellence of any that he received. And the same opinion has been expressed to the writer on many occasions by those who have taken the pains to test the comparative merits of our New England apples and those of Oregon, Colorado and other western sections. Now, if this is so, the importance of this one fact more than outweighs all other possible advantages that the west can have over us. "Quality" ought to be our motto, to be kept constantly before the attention of our growers, from the time they select their varieties till the ripe fruit is put in the hands of the consumer in absolutely perfect condition as to growing and handling. It ought to be dinged into the ears of the customer and in every way possible brought to the attention of the other senses, — particularly his sense of taste, — until to call for New England apples would be not the *last* but the *first* thing that he would think of doing.

A third factor which certainly *ought* to stand in favor of the New England orchardist is the matter of markets. If he is competing on anything like equal terms with his western competitors in other respects, it would certainly seem that the fact that he is right in the midst of the best markets in the world, while his competitors are three thousand miles *away* from them, ought to give him the difference in the cost of freight and express rates as a margin of profit, or a handicap on his competitors. The thing to do then is to *make* the terms equal, to so adopt up-to-date methods, — whether they be western, northern, southern or eastern, — that this market factor *shall* stand to our credit. Unfortunately, this nearness to markets has in the past worked as much, if not more, against as for New England fruit; for, while the grower of good fruit finds it easier to get his product in the hands of the consumer, so does the man with wormy or windfall apples for sale, and as at present the old, worn-out orchards of New England are producing an unfortunately large amount of this class of fruit, the customer is led to believe that this is about all we grow here. While our western friends are so far from market that no one is rash enough to ship windfalls or other refuse on here, so they are spared the reflected odium of this trash in the markets, and their fruit ranks correspondingly high with consumers and with everybody who loves a fine thing. Only a few days ago the writer was provided by the secretary of the State Board of Agriculture with a box of apples for demonstration purposes which cost $5 in hard cash. That was the market rate for these apples, held over in cold storage. They are less at the beginning of the season, of course, but such is their reputation that they are always high.

The foregoing discussion presents the main facts of the orchard situation, both east and west, as the writer sees them. It only remains to "sum up the case," and to make some specific suggestions as to putting our orchard industry on its feet in accordance with the general principles already given; as to adopting some western methods. The writer suggests, to those who may be thinking of planting an orchard, the following points: —

First, if possible, put out as much as 10 acres of orchard. The equipment for running the orchard costs as much for an acre as for 10, and the cost of setting it is very little indeed, comparatively. An orchard in which the writer is interested cost less than 6 cents per tree to fit the land and set the trees. The trees themselves for 10 acres ought not to cost over 15 cents each. Furthermore, with an orchard of this size one can afford to do many things, and will be enthused to do many more, in caring for it which one would not with a smaller orchard. By all means make the orchard large enough.

Second, use the greatest care in choosing varieties. Get prolific ones, for there is no profit in growing an orchard which doesn't bear. You must get the bushels if you are going to get the dollars. If possible, get varieties which have been grown in that particular locality. By all means choose high-quality ones. In the writer's opinion, the Ben Davis ought never to be planted, — in Massachusetts, at all events. Possibly it may be allowable in parts of Maine, where better sorts will not grow; but an eastern Ben Davis is such a poor thing, as compared with those of the middle west, and the variety is such a poor thing anyhow, that we certainly cannot afford to grow it in the Bay State. Select popular varieties, if you can. People don't know the Rome Beauty nor the Wismer's Dessert as they do the Baldwin, the Rhode Island Greening and the Hubbardston.

Third, plan to practise clean cultivation in the orchard from the beginning, if possible. It means better care in so many other ways. It means better acquaintance with every tree in the orchard, and consequently better attention to its needs. In particular, it means less borers, and in localities where they are troublesome this is a very important point. If absolutely impossible to cultivate, on account of the steepness of the land, — and there undoubtedly are thousands of acres of splendid orchard land on the hillsides of New England, — then practise the so-called "sod-culture" method; that is, mow the grass and weeds which grow on the land, and leave them for a mulch about the trees.

Fourth, begin to fertilize the orchard as soon as it is set, and keep it up every year. In the writer's orchard each tree is given 1 ounce of nitrate of soda and 1 pound of a mixture made at the rate of 5 pounds of basic slag or of acid phosphate, to furnish the phosphoric acid, and 3 pounds of high-grade sulphate of potash. This is scattered about the tree — not close enough to injure the trunk — as early as the land is in good condition in the spring. For bearing orchards we use 500 pounds of slag or acid phosphate and 300 pounds of high-grade sulphate of potash per acre. Mr. J. H. Hale uses 1,000 pounds of bone meal and 400 pounds of muriate of potash. Either of these formulas is high feeding, but high feeding pays with trees as truly as with steers; and particularly if one is starting an orchard on old pasture land, or lands which have been otherwise depleted of their plant food, — and these sorts of lands often offer ideal orchard sites, — it is imperative to get back the plant food into them, and in liberal quantities, too.

Fifth, spray the orchard. It isn't always necessary to spray it during the first few years; but, on the other hand, it is sometimes absolutely necessary if the trees are to be saved. Rose chafers will sometimes drop down on them, or crawl up, in a night, and prompt measures and strong poisons are necessary to prevent great damage. A good spray pump ought to be bought when the orchard is set, and kept in readiness. Keep an eye out for the San José scale, and for anything else which may attack the trees, and keep ahead of them. When the trees come into bearing, spraying becomes still more imperative. The codling moth is always rampant in our orchards, and wormy apples are tolerated in a way which is ruinous to our reputation. Fig. 4 shows some Baldwins which were on sale at a fruit store in the town of Amherst, and practically every one had a worm in it. One of the most prominent orchardists of Massachusetts stated to the writer last year that in his opinion the Canadian law, which allows 10 per cent of wormy or otherwise defective specimens in No. 1 apples, was far too strict, and that his own No. 1's that year would average nearly 50 per cent wormy. Until we get a different view from this of what is allowable in No. 1 fruit, the west will continue to take charge of our best markets.

Sixth, practise thinning when trees set heavily. This gets rid of the defective specimens of fruit before the tree has had the drain of bringing them to full maturity, and the result is better fruit for that year, and more likelihood of a crop the following year. Some varieties need thinning far more than others, but any variety of any fruit which

FIG. 4. — Local Baldwins. A worm hole furnished with every one, and still they sell at 2 cents each.

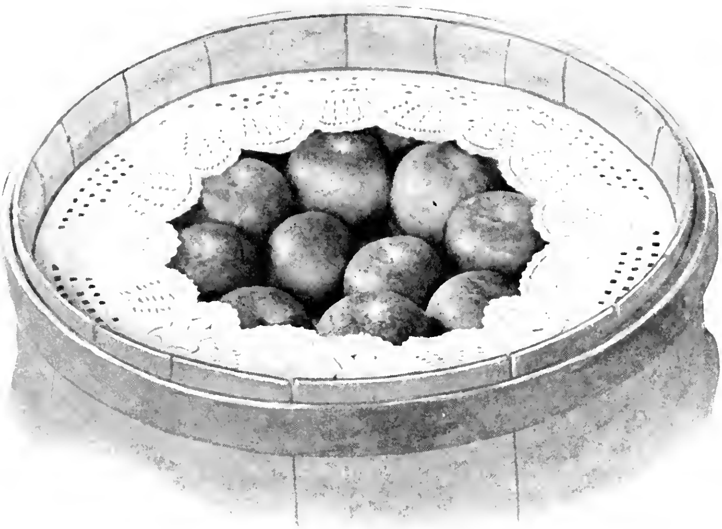

FIG. 5. — A well-packed barrel of apples. The "lace circle" adds to its attractiveness, and with good apples it is good business to use it.

tends to overbear will be benefited by it; and it is by no means as expensive an operation as many people think.

Seventh, and last, handle the fruit with the greatest care, grade it with the greatest accuracy, and pack it with the greatest skill and honesty. In picking and sorting, the fruit ought never to be tossed about or let fall. No apple should be let go of until it is in contact with those already in the basket. Pad baskets and tables, to avoid bruising. For packages use the regular bushel box for all the best grades of apples; either 10 by 12 by 20 inches inside measure, or $10\frac{1}{2}$ by $11\frac{1}{2}$ by 18 inches. The old, flat bushel box used for vegetables ought to be abandoned. The box ends should be of three-fourths-inch stock, the sides of three-eighths-inch, and the top and bottom of one-fourth-inch. For the top, bottom and sides good clean spruce, straight-grained and free of knots, is best. It must be good stock, to provide strength and springiness with lightness. Where barrels are used, — and they will undoubtedly long continue to be our main package, — get new ones, if possible; second-hand ones are never entirely satisfactory. And grade and pack with the greatest care. Carry out J. H. Hale's famous motto, found on his labels, "U C Top U C All." Use the lace circles shown in Fig. 5, and do everything possible to make the package and its contents attractive.

And, above and beyond all, *have faith in the industry.* Talk New England fruit to your friends and neighbors and customers. Tell them we can grow the finest apples in the world, and that we ought to take hold and recover our lost markets. And then *practise what you preach.*

THE CULTURE OF THE PEAR.

BY GEORGE T. POWELL, GHENT, N. Y.

The pear is one of the very desirable fruits, and one that is not produced in sufficient quantities to supply the demand for it. It is somewhat more difficult to grow than the apple, suffers under neglect, and hence it is not found on many farms, even in garden culture, in many instances. It will, however, well repay those who will select a suitable piece of land and plant pear trees, bringing to them the care they require. The tree is not as much subject to insect attack as the apple tree; but the pear blight is at times very hard to control, and causes heavy inroads upon orchards. It is only necessary to know the right conditions and to follow right methods, that this most excellent fruit, now mainly a luxury, may be grown with profit over a much wider territory.

The Soil.

The ideal soil for the pear is a clay loam. The temperature of such soil is somewhat lower than that of a more open or sandy character. The clay soil is more retentive of moisture, which is essential to the best development of the tree and fruit. If for want of sufficient moisture the pear receives a check in its growth, particularly in its early stages, it will not be so fine in quality; there will be more or less discolored specimens and unevenness in form, with roughness of skin, which is undesirable, and which lessens the value of the fruit for the best trade.

Pears will grow on a variety of soils, but they are not adapted to many of them, hence pear orchards are not successful in many places. While the soil needs to be well supplied with plant food, it should not contain too much nitrogen, as an over-luxurious growth of wood is subject to blight. If bearing trees, in addition to producing a full crop of fruit, make an annual growth of from 6 to 10 inches, they are in the best possible condition.

Many orchards are planted on sandy soil, and while under the best culture they often produce excellent fruit, the trees are shorter lived and are more subject to blight, because of higher temperature of the soil and from lack of moisture. The quality and character of the soil affect the quality of the fruit, which is indicated by the skin of the fruit. Where the skin is of a smooth, glossy character, with uniformity in the shape of the fruit, the highest quality is obtained.

The pear cannot thrive in a soil too retentive of water, and under-draining is one of the first operations to be performed with a clayey or heavy soil. According to the amount of water to be carried off, the drains should be laid from 30 to 60 feet apart, using tiles 4 inches in diameter, with collars, and laying them 3 feet deep. Drains are valuable not only for carrying off surplus water, but they aerate the soil by the air drawn into them. They also convey the humidity or moisture of the atmosphere to the soil in times of prolonged drouth, thereby aiding the growth of trees and other vegetation; hence they become equally valuable in wet and in dry weather.

Preparation of the Land for an Orchard.

The soil should be plowed as deep as may be done to make a loose condition for the roots of the trees when they are planted. A crop of corn or potatoes grown the first year will put the soil in the best condition for the trees, as the tillage required for these crops makes a most excellent preparation. If corn is grown, the sowing of 18 pounds of crimson and red clover seed per acre in equal parts on the last cultivation will make an excellent cover crop, to be plowed in the following spring. This will give good physical condition to the soil, and aid in conserving moisture for the trees the first year after planting.

Planting the Trees.

Trees two years of age should be selected from the nursery, either in dwarfs or standards. At this age the trees have a good supply of roots, which are not so much reduced in digging as in older trees, and they will come into bearing as soon and sometimes sooner than older trees, which, from the loss of roots, require one or two years to become well started and established. The smaller trees cost less and may be planted in much less time than the larger size. For orchard planting, if of standard trees, 25 feet space should be allowed in each direction. Plant the trees 3 to 4 inches deeper than they stood in the nursery. Care should be taken to spread the roots well and have the earth well packed over them. The stem should be cut back one-third, leaving four branches well separated to form the tops of the trees. Where the winters are mild autumn planting may be done. Where the winter temperature reaches 20° below zero it is better to plant in the spring.

Varieties of Standard Trees.

There are many varieties of pears, and it is difficult to recommend for different sections, because of the wide variations in soil and climate. The pear is not adapted to general cultivation, and one may travel over a large territory and not see orchards of this fruit. For those who contemplate or desire to plant pear trees, it is well to look over the locality and note whether there are any old trees there, and, if so, to ascertain the varieties that have done well, and then plant those varieties.

For market, plant but few varieties; a large quantity of one variety is much more valuable than a small quantity of several kinds. Very early pears are not profitable; few varieties earlier than the Bartlett make much profit.

Clapp's Favorite may be planted to a limited extent as a summer pear. It is a little larger than the Bartlett, is handsome in color, with a blush over a yellow skin. The fruit must be picked promptly and shipped as soon as it gets good size and color, as it decays at the core, which makes it a difficult pear to handle in any large quantity. Dealers do not like to handle this variety to any large extent, on account of the uncertainty of its soundness. The tree is vigorous in growth, while the fruit is good in quality, but not equal to the Bartlett. It should be picked eight or ten days before it ripens.

The Bartlett is the best pear, most universally grown and in greatest demand. It is medium to large in size, yellow in color when ripe, and is often covered with a handsome shade of delicate red on one side. It is exceedingly juicy and of fine flavor; very desirable for canning. The tree is a good grower. The Bartlett leads all varieties in demand.

The Seckel represents the highest excellence in quality. It is a russet and yellow, more or less covered with red when ripe. It is very fine and delicate in its flesh, and exceedingly sweet and juicy. The fruit is usually small in size. It always commands the highest price.

The Bosc is a variety of high quality; the fruit is large in size, russet in color, juicy and sweet, and finer than the Bartlett. The tree is a poor grower, both in the nursery and in the orchard. It will make a better tree by being top-worked on a stronger variety, like the Anjou or Keiffer. This is done by setting buds of the Bosc upon the stronger variety in August or September, or by grafting in the spring.

The Anjou is one of the most reliable market pears. The fruit is large in size, greenish yellow in color when ripe, and is of fine flavor. It may be kept in cold storage until after the holidays. The tree is strong in growth and is large in size. On account of the large size to which the Anjou tree grows, it is well to give it 20 feet space in one direction and 30 in the other. The tree is slow in coming into bearing, but when it does begin to produce, it is a regular annual bearer.

The Winter Nelis is a late variety of high quality. The fruit is green with a yellow tinge when ripe, and it is very juicy and sweet. The tree is a slow grower and needs good soil.

In a collection for home use the following would be desirable: for summer, — Osband's Summer, Gifford, Margaret, Tyson, Wilder's Early; for autumn — Flemish Beauty (this should be thoroughly sprayed with Bordeaux mixture, as it is subject to the pear scale; it is excellent), Hardy; for winter — Sheldon, Worden, Seckel, Vermont Beauty, Laurence, Winter Nelis. These are all of excellent quality.

Excepting the Bartlett, the Keiffer is planted more than any other variety. The tree is hardy and vigorous in growth. The fruit is always hard, and ships well. Its color is attractive when fully matured, being yellow, covered mostly with red. As a dessert pear it is absolutely worthless. It is sold from the fruit stands in large quantities late in the autumn and winter, when other varieties are mostly gone; but it is most disappointing to purchasers, who are deceived by its very attractive appearance. Its chief value is for canning, for which it is used to an enormous extent. It is excellent in flavor when canned, its only defect being in a coarse, gritty core. Although the Keiffer sells for a less price than most other varieties, it has proved profitable to commercial planters.

Dwarf Trees.

The cultivation of dwarf trees has not been very extensive in our country. There are but few commercial orchards of dwarf trees that have been a success. But few varieties seem to make a good union upon the Angers quince, which is used for dwarfing the pear. The Angouleme seems to be the best of the leading varieties for this purpose. The Angers quince is used for dwarfing pears because it is of slow-growing habit, and when the pear is budded upon its roots it also is slower of growth and becomes dwarfed in size. Quince cuttings about 7 inches long are planted in the soil, which root readily. In the summer these are budded with the pear buds, which grow and make the dwarf trees.

One of the reasons why dwarf pear culture has not been more generally adopted is because some of the best commercial varieties do not grow well on the quince root, but are more profitable when grown on standard trees. The standards require less pruning than dwarfs, and will do well with less cultivation; hence the dwarfs have been confined more largely to gardens where a few trees only are planted. Where the soil is rightly adapted and the higher care and culture required by dwarf trees is given, they are profitable, as has been demonstrated in some instances.

The Angouleme is especially well adapted to dwarfing. It is a large pear, yellow in color, somewhat coarse in its flesh, but of excellent flavor. The tree makes strong growth, and is the best of all varieties for dwarf culture. It is much better as a dwarf than a standard.

The Anjou makes a good dwarf tree, but the fruit, growing to large size, drops heavily before the time for picking, and for this reason it is not profitable for commercial growing as a dwarf. The dropping of the fruit is a defect of the Anjou in either the standard or the dwarf trees.

The Seckel makes a good tree as a dwarf, and it is well to have it in a garden collection. It is better to be double-worked, budding it upon another variety. This is done by putting buds of the Seckel upon Angouleme or Anjou trees, which makes a better tree than when budded directly upon the quince.

The Louise Bon de Jusey is excellent as a dwarf. The tree grows to good size, while the fruit is large and of the best quality. The fruit is yellow and green when ripe, and often with a handsome blush. It is very juicy and has a slight astringency, which makes it particularly good for canning. This variety is not grown much in late years, but for dwarf culture it is one of the kinds that will return profits.

The Josephine is a pear of high quality, ripening in the autumn and early winter, grows well as a dwarf, and is a pear to be included in planting for market or for the home garden.

Winter Nelis is one of the finest early winter pears, but should be top or double-worked if grown as a dwarf.

Distance to plant Dwarf Trees.

They should be planted 16 feet in both directions. Dwarf trees must have high culture; sufficient space should be given to allow a pair of horses to work between them at all times, and 16 feet is none too much. As the trees must be kept regularly pruned, this width between the trees will be sufficient to allow for cultivation, spraying and gathering the fruit. Planted at this distance, 172 trees may be set upon an acre.

In planting dwarf trees, the point of union between the pear and quince should be set 4 inches under the ground. If the union is above the ground, as is often the case, the trees will break at that point and they will be short lived. The deep planting will insure the trees from breaking when loaded with fruit, and they will live to be a century old. The bark of the pear stock may at any time in the spring be split in one or two places with a knife, and changed into a standard tree if desired. By this process roots will be formed on the pear stock which will change its character to that of a standard. To hasten the process, after splitting the bark, making the cuts well down on the pear stock about 1 inch long in the form of a cross, turn up the corner of the bark and place a small wooden plug under it. Roots will be formed in a short time, that will extend out into the soil. At these points there will be a check in the movement of the sap that will result in the formation of roots. As the trees are set at distances for dwarfs, this operation would not be desirable unless a portion of the trees were taken out.

Cultivation.

The cultivation of the soil is of the highest importance after the trees have been set, and this should begin with the planting and be regularly continued. When the trees begin to bear fruit freely, they do not make so vigorous growth; and when growth ceases, the tree will soon begin to decline, hence some fertilizer should be applied. In addition to bearing fruit, the trees should make an annual growth of from 6 to 10 inches; and to obtain this, annual tilling of the soil is necessary. Sod-bound trees will make little or no growth, and will produce but little and inferior fruit.

After the trees are planted, the soil should be harrowed and no crops grown. This will keep down weeds, and make the soil loose and in condition to retain sufficient moisture for the needs of the trees. The harrowing should be continued until the middle or last of July, by which time, after the trees begin to bear, the fruit will be well developed and will fill out to full size.

The soil should then have a cover crop to carry it over the winter without loss from the thorough tillage given. For this purpose clover is excellent, as it restores the nitrogen that is taken up by the trees and the fruit, while its roots and top hold and cover the soil during the winter, and prevent the washing away of fine soil, as also the nitrates that have been set free from the frequent summer tillage. A mixture of crimson and the common red clover seed, in equal parts, 18 pounds to the acre, is desirable to sow, as the former makes a quick autumn growth, while the latter will generally remain in the soil through the winter and spring. Both kinds add nitrogen to the soil while growing, and their roots aid in holding moisture after being plowed in the following spring.

As the pear tree needs constant tillage of the soil and does not withstand too much nitrogen, it is well to omit the clover cover crop for one or two years at a time, and substitute rye instead, which does not add nitrogen, as it has not the power or function of the clover plant to utilize the free nitrogen of the air. The rye when it is used should be sown at the rate of 1½ bushels to the acre, and sown by the middle or the last of August. All cover crops should be plowed in early in the spring, or as soon as the soil is dry enough. If allowed to grow in the spring, cover crops take up the water from the soil very rapidly, and for this reason soil that has upon it cover crops may be plowed a week earlier than that which is naked.

The cost of the clover seed mixture would, one year with another, be about $1.90 and the rye $1.20 per acre. In some places, where August 1 would be too late to sow clover, winter vetch may be used.

The cultivation for standard and dwarf trees should be the same. While it is quite generally considered that dwarf trees require higher culture than standards, the standards will give much more return for the higher culture when they receive it.

The growing of crops between the rows for three or four years, such as corn, potatoes, vegetables or strawberries, may be carried on, provided each crop is grown with fertilizers liberally used at the rate of 10 two-horse loads of rotted stable manure or 600 to 800 pounds of chemical fertilizer per acre. While this will produce some income during the time the trees are growing to the bearing period, it is not quite so good for the soil as the clover and rye system; but when the income is needed, the cropping with liberal fertilizing is admissible.

Pruning.

This is an important part of the work of developing a pear orchard, and to do it properly requires a knowledge of the objects of pruning. These are: to give the trees right form; to stimulate growth, also to check it; to expose the foliage and fruit as much as possible to the sun, yet to so protect the body of the trees that they are not injured by the sun's rays; to check strong trees and to strengthen weak-growing varieties, — so that pruning means much more than cutting off a few branches at one time. It is applied to different parts of a tree, at different seasons and for different purposes.

But little pruning is required for standard trees after their form is once well established. They should be branched low, the lower limbs to be not over 2 feet from the ground. The tree should be trained in a somewhat pyramidal form, though after it reaches 12 feet in height the leader should be kept cut out, and the top spread, rather than have the trees grow high. If the tops are not pruned the trees will grow from 50 to over 60 feet high, which makes spraying and picking of the fruit difficult. Excepting pruning the tops of the trees after the side branches are well developed and balanced, but little annual pruning will be required, and this makes the standard trees more acceptable to most planters.

Dwarf trees require much more, and annual, pruning. They should be given a pyramidal form with a broad base, made by extending the lower branches and shortening in those above them. To develop fruit spurs close to the body of the tree, the annual growth should be pruned back about one-half. This should be done in July, when the growth is nearly made, which will check the flow of sap and distribute it more generally through the lower portions of the tree. Dwarf trees, from lack of judicious and timely pruning, are often allowed to grow too high. Occasionally a branch or two and sometimes a leader needs to be cut out of the tops to give the trees sufficient open form to allow the sun to reach all parts of the trees.

The form of the trees may be easily controlled by the manner of making the cuts upon the branches. If an upward growth is desired, the cut should be on the under side of a bud on the annual growth; if a more spreading form is desired, the cut should be made on the upper side of a bud, — that is, on the under side of the branch. By following this method, either form of the tree desired may be produced.

Summer pruning needs to be done with judgment. Its effect is to produce fruitfulness, but it is by a checking process to the growth of a tree. As the trees begin to bear fruit freely there will not be so much growth of wood, when the pruning should be done more largely in the latter part of winter or early spring, when the trees are dormant. It is important to obtain some annual growth of wood upon trees that are bearing, as this indicates a thrifty and vigorous condition, one always desirable to maintain; and, in addition to cultivation and fertilizing, pruning becomes an important factor.

Pear Blight.

This is the most serious disease to which the trees are subject. It is caused by a microbe, which attacks the young growth and often the blossoms. The only remedy is to cut off all affected wood as soon as the disease shows, cutting several inches below the discolored parts. The spread of the disease is often from the old wood. The large branches will be affected, and it is shown in patches of dead bark. The most effective time to prune for blight is in the winter. All of the large branches that show the blight should be thoroughly treated; the bark should be shaved so far as these patches show, cutting out all affected parts, and disinfecting with sulphate of copper or diluted carbolic acid.

Blight has swept down the pear orchards so largely in all sections of the country, and particularly on the Pacific coast, that the supply of the fruit is now short, and prices are ruling high for it. Eternal vigilance, however, in cutting close and disinfecting, and particularly the winter pruning, will control the disease and save the trees to a large degree. Thorough spraying with the lime and sulphur or with some of the sulphur preparations will aid in keeping the trees and fruit free from fungous injuries.

Insects.

The pear is quite free from the many insects that prey upon other fruits. The codling moth has to be dealt with, and arsenate of lead, $1\frac{3}{4}$ pounds to 50 gallons of water, very thoroughly applied, will save over 90 per cent of the fruit. This should be applied as soon as the blossoms have fallen, and one very thorough spraying is sufficient.

The pear psylla is one of the most persistent enemies of the pear. It is periodical in its visitations, but often remains in orchards for ten to fifteen years, by which time the trees are useless. Many die from the injury done in six or seven years.

By the use of the present power sprayers, and using one of the best of the soluble oils, — and there is nothing superior to Scalecide, — this pest may be entirely controlled. The oil will spread and work down in the axils of the leaves and on the stems of the fruit, where the young psylla work, and will destroy them. We had 2,000 trees ruined after fourteen years of contest with this insect, working with a hand pump. Had a power sprayer been brought out at that time, the orchard could have been cleared of the insect in two years.

The San José scale flourishes on the pear, but it may be readily kept in check by the sulphur or oil spray, applied when the trees are dormant.

Marketing.

The demand for pears is so great that there is little trouble to dispose of them in any market. A large foreign demand has grown up, and large quantities of Bartletts and Keiffers are exported annually.

Where pears are of fine or fancy quality, they should be wrapped in paper and shipped in bushel boxes. The boxes will cost 18 cents, but fruit well packed in boxes commands a much higher price than when shipped in barrels, provided the fruit is fine. In packing in boxes, the grading should be well done, so that an even number of pears may be packed, and the number stenciled on the box. This is of value to the buyer, who may know just what he will have to sell. Where there is uncertainty in regard to the number of pears in a box, the buyer will bid the lowest price.

To export pears, the boxes should have cushions made of paper and excelsior placed on the bottom and top of each box, as the fruit will keep tight and ship better. It is important that the pears reach the market in good condition, as when they become slack, bruised and wet they have to be sold at a much lower price.

Bartletts and later pears — the Bosc, Anjou, Seckel and Winter Nelis — may be held in cold storage for several weeks. For storing, the fruit should be shipped as soon as possible after it is picked and packed. Every day of delay in getting the fruit to the cold storage will shorten its keeping quality. For the most successful results in storage the fruit should be picked when fully matured, but not at all approaching ripeness. The right time for picking is when the pear will cleave from the fruit spur readily and without breaking the stem; at this time the finest quality will develop. The pear differs from most fruits, in that it is much better ripened off the tree; and if left on the trees to get too near the ripening point neither the quality of the pears nor their keeping in storage will be so good.

There is a large and growing demand for pears for canning, both in home and foreign markets, which gives a large outlet for the crop when grown on a large scale.

Eastern Massachusetts Superior for Pears.

There are few sections of our country where better pears are grown than in the territory for 40 miles about Boston. The soil and climatic conditions are most excellent, the trees thrive, and the fruit is of the best in every point of fine quality. Other sections of the State have good conditions for this fruit, and a pear industry may be built up that will have large financial value.

FINANCIAL RETURNS

AND

ANALYSIS OF PREMIUMS AND GRATUITIES

OF THE

INCORPORATED SOCIETIES,

WITH

MEMBERSHIP AND INSTITUTES,

FOR THE YEAR 1909

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 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	[1] $8,197 94	$8,121 97	$8,197 94
2	Barnstable County,	1844	1,740 00	[2] 9,910 00	9,910 00	10,080 39
3	Blackstone Valley,	1884	3,000 00	[3] 5,000 00	5,000 00	5,085 67
4	Deerfield Valley,	1871	4,094 01	[3] 9,200 00	9,450 00	9,450 00
5	Eastern Hampden,	1856	3,000 00	[3] 7,000 00	7,000 00	7,055 58
6	Essex,	1818	4,527 20	[4] 16,618 85	16,618 85	16,618 85
7	Franklin County,	1850	3,768 00	[5] 11,049 54	11,049 54	11,049 54
8	Hampshire,	1850	3,255 26	[1] 5,052 42	5,052 42	5,052 42
9	Hampshire, Franklin and Hampden,	1818	8,141 29	[6] 18,198 38	18,198 38	18,198 38
10	Highland,	1859	3,262 00	[5] 3,123 32	3,120 00	3,123 32
11	Hillside,	1883	3,113 32	[6] 6,237 44	6,237 44	6,240 79
12	Hingham (Agricultural and Horticultural),	1867	17,406 15	[7] 4,875 60	4,875 60	4,875 60
13	Hoosac Valley,	1860	2,006 00	[3] 15,000 00	15,000 00	15,369 20
14	Housatonic,[8]	1848	6,335 33	[5] 25,935 02	25,935 02	25,935 02
15	Marshfield (Agricultural and Horticultural),	1867	3,755 33	[3] 13,000 00	13,000 00	13,573 28
16	Martha's Vineyard,	1859	4,552 17	[9] 4,762 09	4,762 09	5,054 12
17	Massachusetts Horticultural,	1829	525 00	[10] 564,524 70	825,472 96	837,366 03
18	Massachusetts Society for Promoting Agriculture,[11]	1792	–	–	–	–
19	Middlesex North,	1855	3,000 00	[12] 7,242 78	7,179 45	7,242 78
20	Middlesex South,	1854	3,000 00	[3] 12,000 00	12,000 00	12,057 58
21	Nantucket,	1856	3,500 00	[3] 3,200 00	3,200 00	3,375 91
22	Oxford,	1888	4,400 00	[6] 11,545 70	11,515 70	11,545 70
23	Plymouth County,	1819	9,550 00	[13] 1,890 27	1,890 27	1,890 27
24	Spencer (Farmers' and Mechanics' Association),	1888	4,034 00	[14] 10,350 00	10,350 00	10,572 89
25	Union (Agricultural and Horticultural),	1867	4,447 23	[14] 9,000 00	9,000 00	9,272 55
26	Weymouth (Agricultural and Industrial),	1891	10,270 00	[14] 11,270 00	11,270 00	11,299 04
27	Worcester,	1818	7,730 00	[6] 91,457 25	91,457 25	91,457 25
28	Worcester East,	1890	2,296 23	[1] 11,213 01	11,213 01	11,213 01
29	Worcester Northwest (Agricultural and Mechanical),	1867	3,400 00	[6] 14,106 89	14,106 89	14,106 89
30	Worcester South,	1855	3,127 40	[14] 11,400 00	11,400 00	11,839 95
31	Worcester County West,	1851	3 175 00	[14] 14,000 00	14,000 00	14,013 39
			$150,413 24	$936,361 20	$1,197,416 20	$1,212,213 34

[1] Invested in real estate, cash, crockery, tables, etc.
[2] Invested in real estate and bank funds.
[3] Invested in real estate.
[4] Invested in real estate, stocks and bonds and cash.
[5] Invested in real estate, stocks and bonds, cash, crockery, tables, etc.
[6] Invested in real estate, bank funds, crockery, tables, etc.
[7] Invested in real estate, bank funds, cash, crockery, tables, etc.

Societies for the Year ending Dec. 31, 1909.

Real Estate.	Notes.	Stocks and Bonds.	Bank Funds.	Bills due and unpaid.	Crockery, Tables, etc.	Cash on Hand.	Total Liabilities.	
$7,716 69	-	-	-	-	$405 28	$75 97	$1,500 00	1
8,000 00	-	-	$1,910 00	-	-	170 39	153 25	2
5,000 00	-	-	-	-	-	85 67	1,579 21	3
9,200 00	-	-	-	-	250 00	-	108 39	4
7,000 00	-	-	-	-	-	55 58	6,852 15	5
15,300 00	-	$720 00	-	-	200 00	398 85	9,000 00	6
10,000 00	-	1,000 00	-	-	-	49 54	3,731 60	7
5,000 00	-	-	-	-	50 00	2 42	-	8
16,204 92	-	-	1,293 46	-	700 00	-	2,643 75	9
3,000 00	-	-	-	-	120 00	3 32	-	10
5,000 00	-	-	887 44	-	350 00	3 35	-	11
2,500 00	-	-	1,226 79	-	900 00	248 81	30 00	12
15,000 00	-	-	-	-	-	369 20	9,000 00	13
24,849 37	-	500 00	-	-	425 00	160 65	2,050 00	14
12,500 00	-	-	-	-	500 00	573 28	1,608 54	15
2,750 00	$100 00	-	1,712 09	$21 00	200 00	271 03	6 00	16
518,564 63	-	251,000 00	-	-	55,907 43	11,893 97	5,750 00	17
-	-	-	-	-	-	-	-	18
-	4,908 00	-	2,271 45	-	-	63 33	-	19
12,000 00	-	-	-	49 00	-	8 58	8,036 05	20
3,200 00	-	-	-	-	-	175 91	-	21
11,000 00	-	-	45 70	-	500 00	-	1,357 00	22
-	-	-	1,808 29	41 80	39 00	1 18	-	23
9,400 00	-	-	-	143 00	950 00	79 89	2,293 00	24
8,000 00	-	-	-	80 00	1,000 00	192 55	1,500 00	25
11,000 00	-	-	-	-	270 00	29 04	3,969 00	26
72,752 70	-	-	16,766 18	-	1,938 36	-	-	27
10,784 00	-	-	-	-	400 00	29 01	-	28
13,000 00	-	-	806 89	-	300 00	-	3,050 00	29
11,000 00	-	-	-	-	400 00	439 95	520 50	30
13,000 00	-	-	-	-	1,000 00	13 39	875 76	31
$842,722 31	$5,008 00	$262,220 00	$28,728 29	$334 80	$66,805 07	$15,394 86	$65,614 20	

8 No report.

9 Invested in real estate, notes, bank funds, crockery, tables, etc.

10 Invested in real estate, library, furniture, bonds and other securities.

11 Represented on the Board by special enactment and makes no returns.

12 Invested in notes, bank funds and cash.

13 Invested in bank funds, cash, crockery, tables, etc.

14 Invested in real estate, crockery, tables, etc.

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),	-	-	$1,500 00	$2,387 72	$597 00	-
2	Barnstable County,	$153 25	-	-	8,162 41	600 00	$25 60
3	Blackstone Valley,	-	$39 21	1,540 00	3,783 12	600 00	-
4	Deerfield Valley,	-	108 39	-	2,503 34	600 00	-
5	Eastern Hampden,	-	324 13	6,528 02	6,451 17	600 00	-
6	Essex,	-	-	9,000 00	5,571 72	600 00	2 27
7	Franklin County,	-	31 50	3,700 00	6,860 47	600 00	-
8	Hampshire,	-	-	-	2,026 11	600 00	-
9	Hampshire, Franklin and Hampden,	-	150 00	2,493 75	12,136 57	600 00	9 78
10	Highland,	-	-	-	1,808 28	600 00	-
11	Hillside,	-	-	-	1,413 94	600 00	16 07
12	Hingham (Agricultural and Horticultural),	30 00	-	-	1,052 46	581 80	108 64
13	Hoosac Valley,	-	-	9,000 00	5,491 51	600 00	-
14	Housatonic,[1]	-	50 00	2,000 00	12,019 54	600 00	2 02
15	Marshfield (Agricultural and Horticultural),	2 45	-	1,606 09	6,193 66	600 00	-
16	Martha's Vineyard,	-	6 00	-	1,368 84	600 00	72 98
17	Massachusetts Horticultural,	[2]5,750 00	-	-	23,366 35	600 00	-
18	Massachusetts Society for Promoting Agriculture,[4]	-	-	-	-	-	-
19	Middlesex North,	-	-	-	934 69	600 00	334 69
20	Middlesex South,	122 55	65 50	7,848 00	2,689 13	600 00	-
21	Nantucket,	-	-	-	1,322 56	600 00	-
22	Oxford,	-	-	1,357 00	5,878 83	600 00	-
23	Plymouth County,	-	-	-	606 11	323 35	68 00
24	Spencer (Farmers' and Mechanics' Association),	-	143 00	2,150 00	2,696 53	600 00	-
25	Union (Agricultural and Horticultural),	200 00	-	1,300 00	2,339 83	600 00	-
26	Weymouth (Agricultural and Industrial),	-	469 00	3,500 00	3,970 12	600 00	814 06
27	Worcester,	-	-	-	31,426 35	600 00	-
	Worcester East,	-	-	-	9,369 90	600 00	-
28 29	Worcester Northwest (Agricultural and Mechanical),	-	-	3,050 00	7,418 45	600 00	-
30	Worcester South,	58 50	62 00	400 00	6,648 35	600 00	-
31	Worcester County West,	-	150 76	725 00	3,686 52	600 00	-
		$566 75	$1,599 59	$57,697 86	$181,584 58	$17,102 15	$1,454 11

[1] No report. [2] Awarded in 1909; paid in 1910. [3] Awarded in 1908; paid in 1909.

FOR THE YEAR ENDING DEC. 31, 1909 — *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.	
-	$3 00	-	$1,787 72	$2,311 75	$779 75	$1,532 00	-	-	1
-	75 00	$116 40	7,345 41	7,992 02	996 15	4,905 02	$38 90	$2,051 95	2
-	40 97	763 35	2,378 80	3,697 45	618 60	821 36	65 00	2,192 49	3
-	35 00	18 67	1,849 67	2,503 34	1,418 30	776 64	8 40	300 00	4
-	23 00	-	5,828 17	6,395 59	912 12	3,375 76	259 80	1,847 91	5
$1,248 00	6 00	-	3,715 45	5,718 04	818 50	2,916 00	456 58	1,526 96	6
40 00	1 00	-	6,219 47	6,860 47	2,602 30	4,078 31	179 86	-	7
-	55 00	100 00	1,271 11	2,023 69	660 76	632 18	130 75	600 00	8
-	135 00	-	11,391 75	10,424 63	1,401 25	2,155 00	253 53	6,614 85	9
-	37 00	3 50	1,167 78	1,801 64	621 20	1,176 74	3 70	-	10
-	35 00	17 00	745 87	1,321 35	702 55	618 80	-	-	11
-	151 00	11 70	199 32	909 92	602 20	307 72	-	-	12
-	88 00	-	4,803 51	5,112 31	1,835 75	1,564 74	450 00	1,271 82	13
25 00	314 00	-	1,178 52	11,994 99	5,689 50	4,974 63	128 65	1,202 21	14
-	55 00	90 00	5,448 66	5,620 38	2,128 10	3,386 45	105 83	-	15
-	28 00	2 00	665 86	1,124 96	605 67	330 19	-	189 10	16
11,351 10	910 00	128 00	10,377 25	17,688 49	[3] 4,745 00	-	-	12,943 49	17
-	-	-	-	-	-	-	-	-	18
-	-	-	-	869 65	514 65	125 00	-	230 00	19
-	31 45	244 94	1,812 74	2,680 55	1,260 24	942 31	48 00	430 00	20
-	16 00	47 24	659 32	1,146 65	627 50	519 15	-	-	21
-	62 00	61 11	5,155 72	5,878 83	752 19	2,826 57	-	2,300 07	22
-	5 00	29 30	180 46	492 93	354 80	109 33	-	28 80	23
-	5 00	23 00	2,068 53	2,616 64	1,366 17	1,213 42	37 05	-	24
-	35 00	-	1,704 83	2,147 28	920 63	960 23	-	266 42	25
-	70 00	5 00	3,295 12	3,941 08	728 85	110 00	131 25	2,971 58	26
-	165 00	290 00	29,557 29	28,732 03	7,226 40	7,136 31	-	14,369 32	27
-	341 00	1,450 00	6,978 90	8,637 42	2,076 00	6,561 42	-	-	28
-	10 00	-	6,808 45	6,829 85	1,510 75	2,673 60	230 50	2,415 00	29
-	124 00	-	5,924 35	6,488 54	1,156 93	4,933 45	20 00	378 16	30
-	15 00	12 00	3,059 52	3,933 83	1,958 30	1,130 28	35 50	809 75	31
$12,664 10	$2,871 42	$3,413 21	$133,579 55	$167,896 30	$47,690 88	$62,792 51	$2,583 30	$54,739 88	

[4] Represented on the board by special enactment and makes no returns.

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),	$1,500 00	$779 85	$779 85	–	–	–	[1] –
2	Barnstable County,	2,452 00	1,149 40	996 15	$128 00	–	–	$1,152 00
3	Blackstone Valley,	1,181 15	700 45	618 60	145 00	$63 00	$63 00	703 50
4	Deerfield Valley,	1,705 70	1,418 30	1,418 30	–	–	–	864 00
5	Eastern Hampden,	1,071 00	912 12	912 12	–	–	–	[1] –
6	Essex,	2,100 00	1,010 25	818 50	–	–	–	1,244 00
7	Franklin County,	[2] 3,300 00	[2] 2,602 30	[2] 2,602 30	–	–	–	2,500 00
8	Hampshire,	1,546 25	660 76	660 76	–	–	–	960 00
9	Hampshire, Franklin and Hampden,	1,850 00	1,428 00	1,401 25	50 00	–	–	1,370 75
10	Highland,	689 50	621 20	621 20	–	–	–	415 50
11	Hillside,	900 00	702 55	702 55	5 00	2 00	2 00	625 00
12	Hingham (Agricultural and Horticultural),	1,363 70	632 20	602 20	71 75	–	–	–
13	Hoosac Valley,	1,835 75	[2] 1,835 75	1,835 75	–	–	–	[1] –
14	Housatonic,	[2] 7,100 00	[2] 5,689 50	[2] 5,689 50	–	–	–	2,058 00
15	Marshfield (Agricultural and Horticultural),	2,612 40	2,130 55	2,128 10	100 00	8 00	8 00	446 00
16	Martha's Vineyard,	665 50	623 03	605 67	9 00	4 00	4 00	444 00
17	Massachusetts Horticultural,	5,750 00	5,055 50	[3] 4,745 00	303 00	97 00	[3] 97 00	–
18	Massachusetts Society for Promoting Agriculture,[4]	–	–	–	–	–	–	–
19	Middlesex North,	600 00	659 55	514 65	–	–	–	229 25
20	Middlesex South,	1,800 00	1,389 79	1,260 24	45 00	10 00	10 00	[1] –
21	Nantucket,	1,200 00	627 50	627 50	60 00	60 00	60 00	604 00
22	Oxford,	1,289 25	894 50	752 19	78 00	46 00	44 00	891 00
23	Plymouth County,	343 75	354 80	354 80	60 00	50 00	50 00	88 50
24	Spencer (Farmers' and Mechanics' Association),	[2] 1,900 00	[2] 1,566 17	[2] 1,366 97	–	–	–	1,015 00
25	Union (Agricultural and Horticultural),	1,685 45	1,120 63	920 63	–	–	–	816 50
26	Weymouth (Agricultural and Industrial),	1,105 00	749 60	728 25	–	–	–	679 00
27	Worcester,	[2] 8,990 50	[2] 7,226 40	[2] 7,226 40	–	–	–	4,282 75
28	Worcester East,	2,500 00	2,100 00	2,076 00	32 00	26 00	26 00	1,940 25
29	Worcester Northwest (Agricultural and Mechanical),	1,663 00	1,535 50	1,510 25	–	–	–	[1] –
30	Worcester South,	2,700 00	1,185 18	1,156 93	130 00	36 00	36 00	1,111 00
31	Worcester County West,	2,218 75	1,958 30	1,958 30	57 00	27 00	27 00	978 50
		$65,618 65	$49,318 88	$47,591 01	$1,273 75	$429 00	$427 00	$25,418 50

[1] Not reported. [2] Including trotting.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1909.

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.	
$369 50	$369 50	–	–	–	[1] –	$248 75	$248 75	[1] –	$2 50	1
454 75	378 50	–	–	–	$575 00	285 00	219 05	$11 00	5 00	2
470 50	432 50	–	–	–	115 40	83 40	69 45	10 00	5 00	3
619 12	619 12	–	–	–	78 50	65 45	65 45	12 00	6 00	4
801 00	801 00	–	–	–	[1] –	179 25	179 25	32 00	24 00	5
389 50	389 50	$196 00	–	–	500 00	385 25	315 25	14 00	–	6
1,098 50	1,098 50	–	–	–	500 00	232 50	232 50	21 00	13 00	7
394 00	394 00	–	–	–	183 75	115 76	115 76	6 00	1 00	8
1,061 00	1,050 75	101 00	–	–	224 25	220 50	214 25	36 00	20 00	9
385 15	385 15	18 00	$10 25	$10 25	70 00	57 50	57 50	5 00	5 00	10
460 75	460 75	50 00	44 25	44 25	100 00	81 15	81 15	4 00	75	11
–	–	166 00	36 00	36 00	779 70	413 70	383 70	3 50	4 00	12
428 75	428 75	–	–	–	[1] –	72 25	72 25	–	–	13
1,201 75	1,201 75	273 00	265 00	265 00	323 00	278 25	278 25	38 00	38 00	14
404 70	403 25	77 50	–	–	212 00	180 25	179 50	17 50	14 00	15
218 00	200 00	–	–	–	[1] –	90 40	90 40	10 00	4 00	16
–	–	–	–	–	5,128 00	4,958 50	[3] 4,958 50	–	–	17
–	–	–	–	–	–	–	–	–	–	18
205 50	193 25	–	–	–	295 45	259 05	253 65	–	–	19
371 60	371 60	–	–	–	172 30	170 55	170 55	–	–	20
285 25	285 25	134 00	54 00	54 00	134 00	70 25	70 25	16 00	–	21
628 00	566 70	65 50	51 30	49 68	179 50	101 03	98 25	9 00	5 00	22
70 00	70 00	–	–	–	104 75	104 00	104 00	–	–	23
536 00	428 80	30 00	22 50	18 00	90 00	112 50	90 00	10 00	10 00	24
488 83	488 93	–	–	–	69 10	48 70	48 70	13 25	5 75	25
464 10	464 10	46 00	6 00	6 00	210 00	135 30	125 28	5 50	50	26
2,789 75	2,789 75	–	–	–	474 00	447 50	417 50	22 00	18 00	27
1,483 50	1,479 50	–	–	–	291 50	298 00	292 50	15 00	10 00	28
1,112 50	1,100 75	–	–	–	[1] –	331 50	322 75	30 00	3 00	29
763 00	739 00	–	–	–	194 50	143 10	138 25	18 00	11 00	30
726 25	726 25	–	–	–	151 65	152 15	152 15	15 00	8 00	31
$18,681 33	$18,131 98	$1,157 00	$489 30	$483 18	$10,376 65	$10,294 49	$10,075 36	$372 75	$213 50	

[3] Awarded in 1908; paid in 1909. [4] Held no fair and made no returns.

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),	$2 50	[1] –	$98 85	$98 85	$44 00	$44 00
2	Barnstable County,	5 00	$309 00	307 10	299 55	97 55	94 05
3	Blackstone Valley,	5 00	107 25	44 50	28 60	32 50	21 50
4	Deerfield Valley,	6 00	99 20	100 90	100 90	51 75	51 75
5	Eastern Hampden,	24 00	60 00	58 85	58 85	59 00	59 00
6	Essex,	–	254 00	153 75	147 50	87 75	76 25
7	Franklin County,	13 00	200 00	82 55	82 55	4 75	4 75
8	Hampshire,	1 00	59 56	32 00	32 00	–	–
9	Hampshire, Franklin and Hampden,	20 00	68 00	61 00	55 50	65 50	60 75
10	Highland,	5 00	76 80	68 20	68 20	25 10	25 10
11	Hillside,	75	105 00	84 15	84 15	45 45	45 45
12	Hingham (Agricultural and Horticultural),	4 00	161 75	115 35	115 35	63 15	63 15
13	Hoosac Valley,	–	[1] –	144 85	144 85	29 10	29 10
14	Housatonic,	38 00	598 75	458 00	458 00	79 50	79 50
15	Marshfield (Agricultural and Horticultural),	14 00	177 50	160 00	160 00	53 00	52 00
16	Martha's Vineyard,	4 00	[1] –	139 88	139 88	199 40	190 40
17	Massachusetts Horticultural,	–	–	–	–	–	–
18	Massachusetts Society for Promoting Agriculture,[3]	–	–	–	–	–	–
19	Middlesex North,	–	47 40	34 75	32 50	35 25	35 25
20	Middlesex South,	–	97 80	56 00	56 00	33 35	33 35
21	Nantucket,	–	60 00	38 00	38 00	85 00	85 00
22	Oxford,	5 00	82 50	85 00	74 43	–	–
23	Plymouth County,	–	39 50	60 05	60 05	70 75	70 75
24	Spencer (Farmers' and Mechanics' Association),	8 00	50 00	47 25	37 80	20 05	16 40
25	Union (Agricultural and Horticultural),	5 75	140 25	102 35	102 35	57 00	56 90
26	Weymouth (Agricultural and Industrial),	50	109 65	16 85	16 85	35 50	33 25
27	Worcester,	18 00	110 75	92 00	92 00	102 00	102 00
28	Worcester East,	10 00	208 35	162 45	150 00	98 75	97 25
29	Worcester Northwest (Agricultural and Mechanical),	3 00	[1] –	61 50	60 50	24 00	23 25
30	Worcester South,	11 00	79 25	68 85	68 85	63 75	63 75
31	Worcester County West,	8 00	101 58	82 00	82 00	10 00	10 00
		$211 50	$3,403 78	$3,006 98	$2,946 06	$1,572 90	$1,523 90

[1] Not reported. [2] And gratuities. [3] Held no fair and made no returns.

INSTITUTES, FOR THE YEAR ENDING DEC. 31, 1909 — *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 Institute Sessions held.	Average Number attending Institutes.	
–	[2] 282	–	14	$117 00	202	39	241	6	55	1
$1,170 00	186	206	14	–	219	195	414	3	72	2
–	101	14	11	–	293	305	598	3	229	3
575 00	[2] 250	–	22	151 50	940	258	1,198	8	118	4
1,450 00	180	–	41	28 00	256	174	430	6	78	5
–	313	[1] –	23	–	895	21	916	9	100	6
990 00	[1] –	[1] –	26	–	1,400	100	1,500	5	180	7
–	[1] –	–	13	–	[1] –	[1] –	600	4	121	8
808 50	[2] 291	–	29	–	643	257	900	6	150	9
70 00	132	4	20	–	245	118	363	6	70	10
50 00	[2] 300	–	20	–	770	46	816	5	8	11
–	64	159	6	–	342	141	483	3	35	12
1,499 00	115	–	10	88 33	399	5	404	2	35	13
3,382 50	468	–	13	–	1,816	65	1,881	3	55	14
1,290 00	82	240	26	1 60	304	524	828	8	102	15
85 00	[1] –	[1] –	6	–	80	93	173	3	70	16
-	188	83	103	273 00	703	124	827	9	156	17
–	–	–	–	–	–	–	–	–	–	18
–	133	41	13	–	[4] 700	[4] 300	1,000	11	286	19
–	96	29	15	–	302	198	500	3	150	20
130 00	[1] –	–	1	–	215	388	603	3	16	21
930 00	115	4	14	4 50	350	284	634	3	400	22
–	[2] 108	–	12	–	[5] 610	[5] 512	[5] 1,122	6	40	23
762 50	110	5	19	–	474	412	886	2	25	24
218 00	169	72	23	2 00	660	844	1,504	3	320	25
850 00	[1] –	[1] –	14	34 40	497	14	511	3	100	26
3,890 00	334	8	73	1,714 25	1,485	219	1,701	5	137	27
–	284	47	41	168 00	121	110	231	6	118	28
1,500 00	247	4	31	42 25	423	241	664	5	105	29
1,035 00	138	43	25	10 00	566	590	1,156	6	74	30
476 50	208	89	25	–	425	82	507	6	81	31
$21,162 00	4,894	1,048	703	$2,634 93	16,335	6,659	23,591	151	[6] 137	

[4] Estimated. [5] Reported in 1907. [6] General average of attendance.

DIRECTORY

OF THE

AGRICULTURAL AND SIMILAR ORGANIZATIONS OF MASSACHUSETTS.

June, 1910.

State Board of Agriculture, 1910.

Members ex Officio.

His Excellency EBEN S. DRAPER.
His Honor LOUIS A. FROTHINGHAM.
Hon. WM. M. OLIN, *Secretary of the Commonwealth.*
KENYON L. BUTTERFIELD, 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.*
F. WM. RANE, B. Agr., M.S., *State Forester.*
J. LEWIS ELLSWORTH, *Secretary of the Board.*

Members appointed by the Governor and Council.

	Term expires
CHARLES E. WARD of Buckland,	1911
HENRY M. HOWARD of West Newton,	1912
CHARLES M. GARDNER of Westfield,	1913

Members chosen by the Incorporated Societies.

Amesbury and Salisbury (Agricultural and Horticultural),	J. J. MASON of Amesbury,	1912
Barnstable County,	JOHN BURSLEY of West Barnstable,	1913
Blackstone Valley,	JACOB A. WILLIAMS of Northbridge,	1912
Deerfield Valley,	WM. B. AVERY of Charlemont (P. O. East Charlemont),	1911
Eastern Hampden,	O. E. BRADWAY of Monson,	1912
Essex,	FREDERICK A. RUSSELL of Methuen,	1911
Franklin County,	CHARLES P. ALDRICH of Greenfield,	1913
Hampshire,	HOWARD A. PARSONS of Amherst (P. O. North Amherst),	1913
Hampshire, Franklin and Hampden,	FRANK P. NEWKIRK of Easthampton,	1912
Highland,	HENRY S. PEASE of Middlefield (P. O. Chester, R. F. D.),	1911
Hillside,	W. A. HARLOW of Cummington,	1911
Hingham (Agricultural and Hort'l),	HENRY A. TURNER of Norwell,	1912
Hoosac Valley,	L. J. NORTHUP of Cheshire,	1912
Housatonic,	N. B. TURNER of Great Barrington (P. O. Housatonic),	1912
Marshfield (Agricultural and Hort'l),	WALTER H. FAUNCE of Kingston,	1912
Martha's Vineyard,	JAMES F. ADAMS of West Tisbury,	1913
Massachusetts Horticultural,	WILFRID WHEELER of Concord,	1912
Massachusetts Society for Promoting Agriculture,	N. I. BOWDITCH of Framingham,	1912
Middlesex North,	GEO. W. TRULL of Tewksbury (P. O. Lowell, R. F. D.),	1911
Middlesex South,	ISAAC DAMON of Wayland (P.O. Cochituate),	1911
Nantucket,	JOHN S. APPLETON of Nantucket,	1912
Oxford,	WALTER A. LOVETT of Oxford,	1913
Plymouth County,	AUGUSTUS PRATT of Middleborough (P. O. North Middleborough),	1911
Spencer (Farmers' and Mech.'s Ass'n),	WALTER C. BEMIS of Spencer,	1913
Union (Agricultural and Hort'l),	SYLVESTER H. PEEBLES of Blandford,	1913
Weymouth (Agricultural and Ind'l),	THERON L. TIRRELL of Weymouth (P. O. South Weymouth),	1912
Worcester,	B. W. POTTER of Worcester,	1911
Worcester East,	GEO. F. MORSE of Lancaster,	1912
Worcester Northwest (Agricultural and Mechanical),	ALBERT ELLSWORTH of Athol,	1913
Worcester South,	WILLIAM E. PATRICK of Warren,	1913
Worcester County West,	JOHN L. SMITH of Barre,	1911

ORGANIZATION OF THE BOARD.

OFFICERS.

President,	His Excellency EBEN S. DRAPER, *ex officio.*
1st Vice-President,	JOHN BURSLEY of West Barnstable.
2d Vice-President,	WM. B. AVERY of East Charlemont.
Secretary,	J. LEWIS ELLSWORTH of Worcester.

Office, Room 136, State House, Boston.

COMMITTEES.

Executive Committee.

Messrs. John Bursley of West Barnstable.
Augustus Pratt of North Middleborough.
O. E. Bradway of Monson.
Henry S. Pease of Middlefield.
John J. Mason of Amesbury.
Charles E. Ward of Buckland.
Walter A. Lovett of Oxford.
Charles M. Gardner of Westfield.

Committee on Agricultural Societies.

Messrs. O. E. Bradway of Monson.
Albert Ellsworth of Athol.
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The secretary is a member, *ex officio*, of each of the above committees.

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General Agent, ... P. M. Harwood of Barre.

Office, Room 136, State House.

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Henry T. Fernald, Ph.D., of Amherst.

STATE ORNITHOLOGIST.

Edward Howe Forbush of Westborough.

STATE INSPECTOR OF APIARIES.

Burton N. Gates, Ph.D., of Amherst.

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Entomologist,	Prof. C. H. Fernald,	Amherst.
Botanist,	Dr. Geo. E. Stone,	Amherst.
Pomologist,	Prof. F. C. Sears,	Amherst.
Veterinarian,	Prof. James B. Paige,	Amherst.
Engineer,	Wm. Wheeler,	Concord.

MASSACHUSETTS AGRICULTURAL COLLEGE.

Location, Amherst, Hampshire County.

Board of Trustees.

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Deerfield Valley,	D. T. Barnard, Shelburne.	S. W. Hawkes, Charlemont.	Chas. M. Haskins, Charlemont.
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Hillside,	H. S. Packard, Plainfield.	C. F. Burr, Ringville.	Rob't L. Streeter, Cummington.
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Marshfield,[1]	Thomas Lawson, Boston.	I. H. Hatch, North Marshfield.	M. H. Kent, Marshfield.
Martha's Vineyard,	B. T. Hillman, Edgartown.	F. A. Look, West Tisbury.	Geo. H. Luce, West Tisbury.
Massachusetts Horticultural,	Gen. S. M. Weld, Dedham.	Wm. P. Rich, Boston.	Walter Hunnewell, Wellesley.
Massachusetts Society for Promoting Agriculture,	C. S. Sargent, Brookline.	Francis H. Appleton, Peabody.	R. M. Saltonstall, Newton.
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Middlesex South,	John J. Erwin, Wayland.	John L. Card, Wellesley.	George E. Fay, Framingham.
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[1] And horticultural.

AGRICULTURAL SOCIETIES, ETC. — *Concluded.*

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Union,[1]	H. K. Herrick, Blandford.	E. W. Boise, Blandford.	Geo. O. Millard, Blandford.
Weymouth (Agricultural and Industrial),	Josiah B. Reed, South Weymouth.	A. F. Barnes, South Weymouth.	E. J. Pitcher, South Weymouth.
Worcester,	Walter D. Ross, Worcester.	E. S. Knowles, Worcester.	L. F. Herrick, Worcester.
Worcester East,	John E. Thayer, Lancaster.	Warren Goodale, Clinton.	John W. Forrester, Clinton.
Worcester Northwest (Ag'l and Mechanical),	Joseph Wilcox, Athol.	Albert Ellsworth, Athol.	E. L. Worrick, Athol.
Worcester South,	Herman S. Cheney, Southbridge.	C. V. Corey, Sturbridge.	C. V. Corey, Sturbridge.
Worcester County West,	James A. Rice, Barre.	Edward A. Brodeur, Barre.	Hervey L. Pierce, Barre.

[1] And horticultural.

Horticultural Societies.

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Houghton,	Lynn,	Frank L. Whipple, Lynn.	Mrs. Nellie L. Day, Lynn.
Lenox,	Lenox,	Allan Jenkins, Lenox.	Geo. H. Instone, Lenox.
Massachusetts,	The State,	Stephen M. Weld, Boston.	Wm. P. Rich, Boston.
North Shore,	Manchester,	Wm. Till, Magnolia.	James Salter, Manchester.
Springfield Amateur,	Springfield,	A. J. Griffin, Springfield.	J. Alden Davis, Springfield.
Worcester County,	Worcester,	Geo. C. Rice, Worcester.	Adin A. Hixon, Worcester.

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NAME.	LOCATION.	PRESIDENT.	SECRETARY.
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Needham,	Needham,	John F. Mills, Needham.	Wm. A. Parker, Needham Heights.
Oakham,	Oakham,	Wayland Angier, Oakham.	W. W. Russell, Oakham.
Princeton,	Princeton,	J. C. F. Mirick, Princeton.	J. E. Merriam, Princeton.
Westminster,	Westminster,	Arno E. Hurd, Westminster.	Arthur W. Nye, Westminster.

Farmers' and Mechanics' Clubs.

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Groton,	Groton,	Wm. A. Lawrence, Groton.	L. H. Sheedy, Groton.
Holden,	Holden,	E. W. Merrick, Jefferson.	M. Addie Holden, Holden.
Pepperell,	Pepperell,	H. W. Hutchinson, Pepperell.	Chas. F. Spaulding, Pepperell.
Shirley,	Shirley,	H. S. Hazeu, Shirley Centre.	M. W. Longley, Shirley Centre.
Shrewsbury,	Shrewsbury,	E. A. Bartlett, Shrewsbury.	F. J. Stone, Shrewsbury.

Farmers' Clubs.

NAME.	LOCATION.	PRESIDENT.	SECRETARY.
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Buckland,	Buckland,	F. L. Warfield, Buckland.	Miss Lura T. Hite, Shelburne Falls.
East Charlemont,	East Charlemont,	W. W. Smith, East Charlemont.	Geo. H. Wheeler, East Charlemont.
Easthampton,	Easthampton,	W. E. Bartlett, Easthampton.	Wm. A. Underwood, Easthampton.
Franklin,	Franklin,	E. S. Cook, Franklin.	L. W. Daniels, Franklin.
Halifax,	Halifax,	Jas. T. Thomas, Halifax.	Mrs. Geo. W. Hayward, Halifax.
Lancaster,	Lancaster,	George F. Morse, South Lancaster.	F. A. Hanaford, South Lancaster.
New Braintree,	New Braintree,	Jas. E. Barr, New Braintree.	Chas. S. Lane, New Braintree.
Rehoboth,	Rehoboth,	Dr. C. N. Raymond, Rehoboth.	Wm. H. Gladding, Rehoboth.
Rowley,	Rowley,	J. D. Dodge, Rowley.	T. P. Hale, Rowley.
South Bristol,	New Bedford,	Herbert Wing, South Dartmouth.	Allen Russell, Jr., Acushnet.
Tatnuck,	Worcester,	Herbert R. Kinney, Worcester.	H. Ward Moore, Worcester.
Upton,	Upton,	Appleton P. Williams, Upton.	Edward B. Newton, Upton.
West Brookfield,	West Brookfield,	S. Newell Cutler, Warren.	Sumner H. Reed, West Brookfield.
Wilbraham,	Wilbraham,	B. F. Green, North Wilbraham.	H. M. Bliss, R. F. D. 2, Ludlow.

POULTRY ASSOCIATIONS.

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,	Daniel P. Foster, North Beverly.	Walter R. Bell, Manchester.
Falmouth Poultry Association,	Falmouth,	E. P. Davis, Falmouth.	R. E. Small, Falmouth.
Greenfield Score Card Poultry Club,	Greenfield,	W. E. Weatherwax, Greenfield.	S. H. Stone, Greenfield.
Lawrence Poultry and Pet Stock Association,	Lawrence,	B. D. Todd, Lawrence.	Asa L. Harris, Lawrence.
Milford Poultry Association,	Milford,	Geo. P. Sheldon, Hopedale.	W. H. Pyne, Milford.
North Abington Poultry Association,	North Abington,	Chas. W. Pratt, North Abington.	Jas. H. Dwyer, North Abington.
Northern Berkshire Poultry Association,	North Adams,	W. G. Carter, North Adams.	C. A. Larabee, North Adams.
Plymouth Poultry Association,	Plymouth,	T. Allen Bagnell, Plymouth.	F. C. Chandler, Kingston.
Springfield Poultry and Pet Stock Association,	Springfield,	E. C. Powell, Longmeadow.	E. S. Evans, Springfield.
West Brookfield Poultry Association,	West Brookfield,	R. H. Buffington, West Brookfield.	E. L. Richardson, West Brookfield.
Worcester Poultry Association,	Worcester,	Walter D. Ross, Worcester.	W. H. Fitton, Worcester.

MISCELLANEOUS.

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Connecticut Valley Breeders' Association,	Western New England,	George E. Taylor, Jr., Shelburne.	O. C. Burt, Easthampton.
Cranberry Growers' Association,	Cape Cod District,	George R. Briggs, Bournedale.	Wm. M. Marsh, Wareham.
Franklin Harvest Club,	Connecticut Valley,	H. O. Strong, Southampton.	C. B. Lyman, Southampton.
Hampden Harvest Club,	Connecticut Valley,	The members alternately.	Edwin C. Powell, Longmeadow.
Haverhill Agricultural Society,	Haverhill,	Edward H. George, Groveland.	Leslie K. Morse, Haverhill.
Massachusetts Cattle Owners' Association,	The State,	B. W. Potter, Worcester.	J. L. Harrington, Lunenburg.
Massachusetts Creamery Association,	The State,	W. H. Wright, Easthampton.	A. M. Lyman, Montague.
Massachusetts Forestry Association,	The State,	Nathaniel T. Kidder, Milton.	Irving T. Guild, Boston.
Massachusetts Fruit Growers' Association,	The State,	S. T. Maynard, Northborough.	N. Howard Brown, Marlborough.
Massachusetts Nurserymen's Association,	The State,	Windsor H. Wyman, North Abington.	A. E. Robinson, Bedford.
Massachusetts Society of Bee-keepers,	The State,	E. C. Britton, Canton.	T. J. Hawkins, Everett.
Massachusetts State Poultry Association,	The State,	Henry D. Smith, Rockland.	J. H. Robinson, Boston.
Stockbridge Club,	Amherst,	N. Herbert Hill, Amherst.	Raymond C. Barrows, Amherst.
Ware Agricultural Society,	Ware,	F. F. Gilmore, Ware.	E. P. Lovett, Ware.
Worcester County Harvest Club,	Worcester,	F. P. Knowles, Auburn.	Mrs. D. A. Howe, Worcester.
Worcester County Bee-keepers' Association,	Worcester,	Jas. P. Porter, Worcester.	C. H. Goodell., Worcester.
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Overseer,	E. E. Chapman of Ludlow.
Lecturer,	E. F. Richardson of Millis.
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Assistant Steward,	E. H. Gilbert of Stoughton.
Chaplain,	Rev. A. H. Wheelock of Marlborough.
Treasurer,	Hon. F. A. Harrington of Worcester.
Secretary,	Wm. N. Howard of South Easton (P. O. North Easton).
Gate Keeper,	F. L. Warfield of Buckland.
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George S. Ladd,	Sturbridge.
C. A. Dennen,	Pepperell.

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Elmer D. Howe,	Marlborough.
Warren C. Jewett,	Worcester.
George S. Ladd,	Sturbridge.
C. D. Richardson,	West Brookfield.

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Moses U. Gaskill,	Mendon.
E. B. Hale,	Bernardston.
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John Bursley,	West Barnstable.
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H. W. Carter,	Millbury.
Chester B. Williams,	Cochituate.

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Horace E. Wallis,	Waltham.
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Dr. M. H. Williams,	Sunderland.
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J. P. Ranger,	North Brookfield.
M. A. Morse,	Belchertown.
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Borough, No. 11,	F. Howard Brown, Hosmer St., Marlborough.	Mrs. S. Mabel Thompson, Westborough, R. F. D., No. 2.	Mrs. Maria A. Gilmore, Westborough, R. F. D. No. 2.
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Western Hampden, No. 18,	E. F. Goodwin, Huntington.	Rev. M. J. Allen, Southwick.	Miss Annette Sackett, Westfield.
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Hillside, No. 20,	Edward J. Clark, Cummington, R. F. D.	Mrs. E. S. Gloyd, Plainfield.	Mrs. Belle D. Miner, East Windsor.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

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Mayflower, No. 22,	Clarence W. Fearing, South Weymouth.	Dr. Flavel F. Thomas, South Hanson.	Winthrop Fillebrown, Bryantville, R. F. D.
Middlesex Central, No. 23,	Clarence H. Cutler, Lexington, R. F. D.	S. P. Robertson, Band Building, Lexington.	Frank T. Marston, 20 Fairmount St., Melrose.
Cape Cod, No. 24,	S. Fremont Crocker, East Sandwich.	Rev. E. A. Chase, Brewster.	Henry C. Davis, Cummaquid.
Subordinate Granges.			
"Guiding Star" of Greenfield, No. 1.	Haven A. Mowry, Leyden Road, Greenfield.	Mrs. Flora C. Bragge, Leyden Road, Greenfield.	Mrs. Grace M. Hinckley, 63 Wells St., Greenfield.
Deerfield, No. 2,	John F. Childs, Deerfield.	Harry Brown, Deerfield,	P. G. Davis, Deerfield.
Northfield, No. 3,	T. R. Callender, Northfield.	Mrs. L. O. Clapp, Northfield.	Mrs. T. R. Callender, Northfield.
Groton, No. 7,	Mrs. L. E. Starr, Pepperell.	Mrs. Blanche M. Brown, Groton.	Mrs. Mary D. Boynton, Box 47, Groton.
Conway, No. 8,	Wm. D. Allis, Conway, R. F. D.	Mrs. Wm. D. Allis, Conway, R. F. D.	L. T. Hopkins, Conway, R. F. D.
Barre, No. 9,	George F. Smith, Barre.	Mrs. M. F. Bathrick, Barre.	James M. Washburn, Barre.
Pittsfield, No. 14,	John H. Noble, 309 Holmes Road, Pittsfield.	Mrs. John H. Noble, Holmes Road, Pittsfield.	Miss Bessie F. Parker, 965 Holmes Road, Pittsfield.
"Hope" of Hadley, No. 15,	R. Lyman Cook, Hadley.	Mrs. A. E. Cook, Hadley.	Leslie R. Smith, Hadley.
Amherst, No. 16,	E. F. Gaskill, Amherst.	Prof. Sydney B. Haskell, Amherst.	Mary H. Scott, Amherst.
Cheshire, No. 17,	Warren B. Cole, Adams, R. F. D.	Mrs. J. G. Bennett, Cheshire.	Mrs. Maude L. Purdy, Cheshire.
Hinsdale, No. 19,	A. N. Warren, Hinsdale.	Miss Harriet E. Tracy, Hinsdale, R. F. D.	T. Augustus Frissell, Hinsdale.
Westfield, No. 20,	E. D. Herrick, 13 Jefferson St., Westfield.	Miss Dorethea P. Bein, 21 Harrison Ave., Westfield.	Miss H. L. Thomas, 8 Kellogg St., Westfield.
Lanesborough, No. 21,	W. E. Foster, Lanesborough.	Miss E. J. Tillottson, Lanesborough.	Mrs. Ella L. Foster, Lanesborough.
Worcester, No. 22,	Scott T. Pierce, Holden St., Worcester.	Mrs. S. T. Pierce, Holden St., Worcester.	Mrs. Nancy E. Moore, 92 Summer St., Worcester.
Dalton, No. 23,	Frank N. Groesbeck, Dalton.	James E. Barden, Dalton.	Loretta Barton, Dalton.
Blandford, No. 24,	Phillip H. Robinson, Blandford.	Cordelia F. King, Blandford.	Percy A. Wyman, Blandford.
New Lenox, No. 26,	Horatio H. Sears, New Lenox.	Miss Elsie A. Dunbar, West St., Lenox.	Mrs. H. H. Dewey, New Lenox.

Easthampton, No. 27,	Fred L. Frost, Glendale St., Easthampton.	Chella Underwood, Chapman Ave., Easthampton.	Lillian A. Russell, 15 Prospect St., Easthampton.
Richmond, No. 32,	Mrs. Ida B. Coleman, Pittsfield, R. F. D.	Jesse H. Fairfield, Jr., Richmond.	Ida H. Barnes, Richmond.
Adams, No. 34,	Daniel Upton, Adams, R. F. D.	Miss Lizzie Todt, Columbia St., Adams.	Mrs. Chas. Daniels, Orchard St., Adams.
Russell, No. 36,	Alfred B. Copeland, Russell.	Miss Edith H. Gushie, Woronoco.	Mrs. Joab M. Dewey, Russell.
"Thrifty" of Leverett, No. 37,	C. H. Beeman, Leverett.	Miss Stella Ingram, Hillsborough.	F. N. Bourne, Moores Corner.
Granville, No. 40,	Harry S. Hartley, Granville.	Mrs. Harry S. Hartley, Granville.	Mrs. L. G. Noble, Granville.
Montgomery, No. 45,	Walter D. Allyn, Montgomery.	Miss Helen Kelso, Montgomery.	Miss Florence Moore, Montgomery.
Southwick, No. 46,	W. S. Barnes, Southwick, R. F. D.	Rev. M. J. Allen, Southwick.	Arthur Gillett, Southwick, R. F. D.
Becket, No. 47,	Mrs. C. E. Lyman, Becket.	Mrs. Marie Fairfield, Becket, R. F. D. No. 1.	Arthur H. Capen, Becket, R. F. D. No. 1.
"Highland" of Huntington, No. 48,	William E. Wright, Norwich.	Mrs. S. C. Wilbur, Huntington.	E. F. Goodwin, Huntington.
"Granite" of South Worthington, No. 29.	Rufus H. Adams, Ringville.	Mrs. Lora P. Adams, Ringville.	Mrs. Helen L. Drake, Huntington.
"Golden Rule" of Prescott, No. 52,	Chas. W. Berry, Greenwich Village, R. F. D.	Mrs. Edith M. Petrie, Greenwich Village, R. F. D.	Mrs. Fanny G. Thayer, Greenwich Village, R. F. D.
Sterling, No. 53,	Frank W. Drew, Sterling.	Mrs. Caswell A. Wood, Sterling.	Frank P. Elliott, Sterling.
Springfield, No. 54,	W. O. Parmenter, 180 White St., Springfield.	Mrs. Eliza C. Hotchkiss, 243 Central St., Springfield.	Mrs. Lillian A. Cornell, 307 Main St., Springfield.
Cummington, No. 56,	W. E. Ford, Cummington.	Mrs. Aletha Morey, Cummington.	Rollin E. Bates, Cummington.
Auburn, No. 60,	Wm. E. Barrows, Box 806, Worcester.	Mrs. Alice E. Keep, Auburn, R. F. D. No. 1.	Mrs. Eleanor W. Barrows, Box 806, Worcester.
Egremont, No. 63,	Ray W. Spurr, Great Barrington, R. F. D.	Wm. P. Claney, South Egremont.	Chester G. Dalzell, South Egremont.
"Union" of Belchertown, No. 64,	Myron G. Ward, Belchertown.	Mrs. M. G. Ward, Belchertown.	Mrs. Lillian Kelley, Belchertown.
Brimfield, No. 65,	F. N. Lawrence, Brimfield.	Mrs. B. A. Garms, Brimfield.	Mrs. Mary K. Hitchcock, Brimfield.
Charlemont, No. 66,	Clinton A. Hawkes, Charlemont.	Herbert E. Warfield, Charlemont.	Mrs. Belle E. Mayhew, Charlemont.
Hardwick, No. 67,	Nelson L. Smith, Hardwick.	Sumner R. Parker, Hardwick.	Ethel L. Kennedy, Ware, R. F. D. No. 2.
Shelburne, No. 68,	Wm. J. Purrington, Shelburne.	D. P. Bardwell, Bardwell's Ferry.	Earl A. Newhall, Shelburne.
Ashfield, No. 69,	Clinton Wing, Ashfield, R. F. D.	Mrs. Chester Guilford, Ashfield.	Mrs. Joseph Tatro, Shelburne Falls, R. F. D.
Phillipston, No. 70,	F. A. Lincoln, Phillipston.	Mrs. Ella R. White, Athol, R. F. D. No. 3.	Mrs. Cora A. Dunton, Phillipston.
Leyden, No. 71,	W. A. Campbell, Greenfield, care Leyden stage.	Rev. E. G. Hooper, Leyden.	Mrs. E. H. Black, Bernardston, R. F. D. No. 2.
"Prescott" of Pepperell, No. 73,	Walter L. Shattuck, East Pepperell.	Miss Sarah B. Tucker, Pepperell.	Miss S. Luella Parker, East Pepperell.
Princeton, No. 74,	A. E. Hutchinson, Jefferson, R. F. D.	Chester Hall, Princeton.	Stella Richardson, Brooks Station.
Colrain, No. 76,	Earl M. Nicholls, Lyonsville.	Mrs. Mary Stacy, Shelburne Falls.	Anna May Gilchrest, Colrain.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Windsor, No. 77,	F. Y. Tournier, East Windsor.	Mrs. Lila J. Tournier, East Windsor.	Mrs. Belle Miner, East Windsor.
Holden, No. 78,	Frank C. Hubbard, Jefferson, R. F. D.	William H. Hayden, Holden.	Mrs. Ina Stanhope, Holden, R. F. D.
Spencer, No. 79,	Arthur Monroe, Spencer.	J. R. Kane, Spencer.	John W. Bigelow, Spencer.
Bernardston, No. 81,	R. H. Cushman, Bernardston.	Mrs. Mary Corbett, Bernardston.	Mrs. Nellie Hale, Bernardston.
"Manhan" of Southampton, No. 82.	Chas. S. Hooker, Southampton.	Mrs. C. S. Hooker, Southampton.	Mrs. C. P. Gridley, Southampton.
Chesterfield, No. 83,	William Hayden, Chesterfield.	Mrs. Howard Rhoades, Chesterfield.	Katherine Quinn, Chesterfield.
Warwick, No. 85,	G. A. Witherell, Warwick.	Etta M. T. Bass, Warwick.	Jessie M. Rouviere, Warwick.
North Orange, No. 86,	W. E. Blackmer, North Orange.	Hattie M. Baker, North Orange.	G. A. Miller, North Orange.
Buckland, No. 87,	Eugene D. Griswold, Buckland.	Warren D. Forbes, Shelburne Falls.	Vera Elmer, Buckland.
Lee, No. 88,	Charles R. Bradley, Lee, R. F. D.	Mrs. W. A. Dikeman, Lee.	Mrs. H. J. Voight, Lee.
Worthington, No. 90,	Alden N. Curtis, Worthington.	Elmer N. Curtis, Worthington.	Miss Nellie C. Shipman, Cummington, R. F. D.
Charlton, No. 92,	Loren Stevens, Dodge, R. F. D.	None elected.	Rose E. Bowers, Charlton Depot.
Grafton, No. 93,	J. Frank Johnson, North Grafton.	Mrs. Mary J. Robinson, Grafton.	Mrs. Eva M. Sibley, Grafton.
Petersham, No. 95,	George K. Wilder, Petersham.	Miss M. E. Williams, Petersham.	Mrs. Ruby J. Stone, Petersham.
Savoy, No. 99,	W. S. Hathaway, Savoy.	Margaret McCulloch, Savoy.	Mrs. C. A. Maranville, Savoy.
Shrewsbury, No. 101,	Walter E. Brigham, Shrewsbury.	Mrs. Lewis E. Gates, Shrewsbury.	Mrs. Emily A. Carey, Shrewsbury.
Stow, No. 103,	Shervington Vance, Stow.	Mrs. Susie E. Scott, Stow.	Mrs. Fannie A. Stevens, West Acton, R. F. D.
"Garfield" of North Dana, No. 104,	Lyman Randall, North Dana.	Mrs. Nellie M. Brown, North Dana.	Mrs. Effie L. Thayer, North Dana.
Marlborough, No. 105,	F. Howard Brown, Hosmer St., Marlborough.	Mrs. O. A. Morton, 184 Pleasant St., Marlborough.	Mrs. Elmer D. Howe, Fair View Farm, Marlborough.
West Boylston, No. 106,	Wm. C. Pierce, West Boylston.	Mrs. J. Frank Record, West Boylston.	Mrs. M. A. Cook, West Boylston.
Millbury, No. 107,	Mrs. M. F. Stockwell, West Millbury.	Miss Florence I. Bently, West Millbury.	E. P. Davidson, West Millbury.
Hudson, No. 108,	Alfred F. Ordway, Hudson, R. F. D.	Mary L. Eddy, Hudson.	Mrs. Mary E. Lawrence, 55 Lincoln St., Hudson.

Sutton, No. 109,	Wallace F. King, R. F. D. No. 1, Sutton.	Miss E. S. Woodbury, Sutton, R. F. D. No. 1.	Rev. Oscar V. Stetson, Sutton, R. F. D. No. 1.
Sherborn, No. 110,	John N. Reid, Sherborn.	F. T. Daniels, Sherborn.	A. H. Daniels, Sherborn.
Boylston, No. 111,	C. S. Knight, Boylston Center.	Abbie D. Flagg, Boylston, R. F. D.	Edna B. Garfield, Boylston, R. F. D.
"East Medway" of Millis, No. 112,	Harry E. King, Millis.	Clarence E. Simpson, Millis.	Fred H. Holland, Jr., Millis.
Framingham, No. 113,	M. R. Parsons, South Framingham, R. F. D. 2.	Mrs. Agnes Lummus, High St., Framingham.	George E. Fay, 35 Winter St., Framingham.
Medfield, No. 114,	Mrs. Sadie Dewar, Medfield.	Mrs. Cora Kennett, Medfield.	Mrs. W. W. Preston, Medfield.
Holliston, No. 115,	Lovell E. Littlefield, Holliston.	Mrs. Sarah E. Watts, Holliston.	Mrs. Nellie V. Pope, Holliston.
Westborough, No. 116,	Mason Taft, Westborough, R. F. D. No. 1.	Gertrude Herrick, Parkman St., Westborough.	Julia H. Rogers, Westborough, R. F. D. No. 2, Box 5.
Dover, No. 117,	Lewis B. Paine, Dover.	Granville Perkins, Needham, R. F. D.	Mrs. Miriam B. Chickering, Dover.
Southborough, No. 118,	E. F. Collins, Southborough.	Mrs. Wm. Duncan, Southborough.	Mrs. Fred Wells, Fayville.
Northborough, No. 119,	Willis E. Wheeler, Northborough.	Mrs. Blanche E. Kimball, Northborough.	Miss E. M. Cutler, Northborough.
Lancaster, No. 120,	Charles L. Wilder, Lancaster.	J. Fred Brown, South Lancaster.	Mrs. F. J. Sawyer, Lancaster.
Sudbury, No. 121,	Thomas F. O'Neil, Maynard, R. F. D.	Mrs. S. Josie White, Sudbury.	Mrs. Ida J. Rice, Maynard, R. F. D.
Templeton, No. 122,	H. H. Seaver, Templeton.	Mrs. Hattie Kendall, Baldwinville.	Mrs. R. S. Titterton, Templeton.
Oxford, No. 123,	James H. Carling, Oxford.	Bertha G. Chaffee, Oxford.	Mabel R. Taft, Oxford.
Ashland, No. 124,	Herbert Wenzel, Ashland.	Hiram Hotchkiss, Ashland.	Mrs. L. F. Bennett, Ashland.
Upton, No. 125,	Whitman H. Holbrook, West Upton.	Miss Myrtice S. King, Upton.	Mrs. L. Jennie Chapman, West Upton.
Hubbardston, No. 126,	Geo. E. Holt, Hubbardston.	Mrs. Mary McWilliams, Hubbardston.	Mrs. H. F. Collins, Hubbardston.
Amesbury, No. 127,	C. M. Currier, 137 Elm St., Amesbury.	Mrs. Annie S. Gale, 72 Monroe St., Amesbury.	Charles F. Tillett, 220 Main St., Amesbury.
North Andover, No. 128,	Leon H. Bassett, North Andover.	Charles S. Moxley, North Andover.	Walter H. Hayes, North Andover.
Lincoln, No. 129,	Edward F. Flint, Lincoln.	Edward W. Herman, South Lincoln.	Harold S. Cousins, South Lincoln.
Gardner, No. 130,	Ernest L. Sawin, 3 Rich St., Gardner.	Mabel M. Groves, 82 School St., Gardner.	Mabel C. Bolster, 66 Glenwood St., Station A, Gardner.
Boxborough, No. 131,	Charles E. Bradford, West Acton.	Mrs. A. F. Cunningham, West Acton, R. F. D.	Ralph C. Whitcomb, West Acton, R. F. D.
North Brookfield, No. 132,	C. D. Richardson, West Brookfield.	Mrs. Minnie H. Crooks, North Brookfield.	Miss Jennie E. Doane, North Brookfield.
Berlin, No. 134,	I. E. Coulson, Berlin.	Mrs. Edith S. Sawyer, Berlin.	Mrs. Bertha M. Cole, Berlin, R. F. D.
Norfolk, No. 135,	Henry G. Holbrook, Norfolk.	Edwin W. Holbrook, Norfolk.	Emma F. Holbrook, Norfolk.
Ipswich, No. 136,	Fred A. Smith, Ipswich.	E. S. D. Seymour, Ipswich.	Mrs. Helen Moulton, Ipswich.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
East Blackstone, No. 137,	Addie M. Stearns, Blackstone, R. F. D.	Mrs. Sabra Bennett, Blackstone, R. F. D.	Mrs. N. Greenhalgh, Blackstone, R. F. D.
Northampton, No. 138,	Josiah W. Parsons, 128 Bridge St., Northampton.	A. J. Morse, 8 Third Ave., Northampton.	Mrs. Ida A. Fuller, 3 Edwards Sq., Northampton.
East Sandwich, No. 139,	Mrs. F. A. Bursley, West Barnstable.	John F. Carleton, Spring Hill.	Rosa S. Armstrong, East Sandwich.
West Boxford, No. 140,	Frank N. Chadwick, West Boxford.	Hattie F. Chadwick, West Boxford.	Miss Matilda B. Lund, Ward Hill, R. F. D. No. 1.
Montague, No. 141,	Chas. M. Hemenway, North Leverett.	Mrs. Kate Hayden, Montague.	Mrs. Eva G. Farnsworth, Montague.
Bolton, No. 142,	Arthur L. Burnam, Bolton, R. F. D.	Mrs. M. H. Mentzer, Bolton, R. F. D.	Mrs. Geo. L. Taylor, Bolton, Hudson Star Route.
Mendon, No. 143,	Edward F. Blood, Mendon.	Mrs. Mabel A. Holbrook, Mendon.	B. W. Sanderson, Mendon.
Franklin, No. 144,	John L. Mackintosh, Franklin.	Lucy E. Tower, Franklin.	Jennie P. Fisher, Franklin.
Douglas, No. 145,	Edwin T. Rawson, East Douglas.	Mrs. Minnie E. Park, Douglas.	Mrs. Arvilla L. Leonard, Manchaug.
West Newbury, No. 146,	S. Bixby Sargent, Merrimac.	Mrs. Ruth A. Ruddock, Groveland.	Mrs. Agnes C. Smith, West Newbury.
West Springfield, No. 147,	Homer B. Miller, West Springfield, R.F.D. No. 1.	Mrs. Cornelia Fisher, West Springfield, R. F. D. No. 1.	Lillian M. Capron, 15 Elm St., West Springfield.
Harvard, No. 149,	Clarence Beard, Littleton.	Mrs. Carrie E. Harlow, Harvard.	Henry A. Knight, Harvard.
Concord, No. 150,	Edgar F. Clark, Concord.	Mrs. S. Addie Garfield, Concord.	Mrs. Mattie Jones, Concord.
East Longmeadow, No. 152,	H. J. Moody, East Longmeadow.	Carrie Goss, East Longmeadow.	Flora D. Burton, East Longmeadow.
Wilbraham, No. 153,	Arthur F. Smith, North Wilbraham.	Mrs. E. C. Clark, Ludlow, R. F. D.	Mrs. C. E. Pease, Ludlow, R. F. D.
Haverhill, No. 154,	Joel W. Goodell, 66 Essex St., Haverhill.	Miss Annie Adams, Broadway, Haverhill.	Mrs. Grace A. Merrill, 1231 Broadway, Haverhill.
Methuen, No. 155,	Sydney V. Coburn, Methuen.	Elsie R. Houston, 216 Broadway, Lawrence.	Frank A. Gordon, 96 Arnold St., Methuen.
West Bridgewater, No. 156,	Walter S. Flanders, Oak St., Montello.	Effie M. Flanders, Oak St., Montello.	Rhoda F. Wilbur, West Bridgewater.
Granby, No. 157,	W. F. Forward, Granby.	Miss Myra E. Chapin, Granby, R. F. D.	Miss Gladys M. Rust, Granby.
"Nemasket" of Middleborough, No. 158.	Leroy C. Decker, North Middleborough.	Mrs. Hannah Perry, Middleborough.	Mrs. Annie D. Deane, Middleborough.
"Green River" of Williamstown, No. 159.	Frank P. Stevens, Blackinton.	Helen M. Fowler, Williamstown, R. F. D.	Harriet M. Knell, Williamstown, R. F. D.

South Hadley, No. 160,	L. J. Alvord, South Hadley.	Mrs. Robert Wilson, South Hadley.	E. M. Burnette, South Hadley.
"Laurel" of West Newbury, No. 161.	Eben S. Poore, West Newbury.	Mrs. Belle E. Kennett, West Newbury.	Chas. F. Brown, West Newbury.
Dartmouth, No. 162,	George F. Macomber, Dartmouth.	Herbert C. Canney, Dartmouth,	Hannah A. Briggs, Dartmouth.
Dudley, No. 163,	George B. Truell, Dudley, R. F. D.	Mrs. S. C. Walker, Dudley, R. F. D. No. 1.	W. H. Paine, Dudley.
Warren, No. 164,	Justin D. Nichols, North St., Ware.	Mrs. Lizzie Tolman, 10 Bank St., Ware.	Mrs. E. J. Howard, Ware, R. F. D. No. 1.
Wellesley, No. 166,	Henry M. Howard, West Newton.	Henry S. Adams, Needham.	Abbie H. Goulding, Natick.
Rowe, No. 167,	Henry D. Wright, Rowe.	Rev. Maynard B. Barnard, Rowe.	Mrs. Anna L. Henry, Rowe.
Somerset, No. 168,	Frank E. Hathaway, Pottersville.	Mrs. Mary D. Eddy, Somerset, R. F. D.	Miss Lois A. Davis, Somerset, R. F. D.
Lunenburg, No. 169,	M. Warland Sterlin, Lunenburg.	Mrs. Alice W. Sterlin, Lunenburg.	Thomas Aker, Lunenburg.
New Braintree, No. 170,	Chas. H. Barr, New Braintree.	Mrs. Julia A. Ross, New Braintree.	Mrs. Kitty C. Pollard, New Braintree.
Merrimac, No. 171,	Albert P. Wadleigh, Merrimac.	Edson C. Walker, Merrimac, R. F. D.	Mrs. Cora L. Wadleigh, P. O. Box 149, Merrimac.
Ashby, No. 172,	Mrs. Minnie L. Green, Ashby.	Mrs. Henrietta Willard, Fitchburg.	Mrs. Flora E. Ingerson, Ashby.
Hopkinton, No. 173,	Mrs. Emily Eames, Hopkinton.	Mrs. Emily Eames, Hopkinton.	Minnie Kilburn, Hopkinton.
Brookfield, No. 174,	H. E. Cottle, Brookfield.	Mrs. Annie E. Hyde, West Brookfield.	Mrs. Lottie F. Clarke, Brookfield.
Athol, No. 175,	Clifford H. Smith, 55 Grove St., Athol.	Mrs. Hattie Page, 279 Kennebunk St., Athol.	Miss Lucy E. Swan, 45 Pleasant St., Athol.
"Millers River" of Orange, No. 176,	Fred E. Carey, Orange.	Nellie H. Drake, Orange.	Josephine Clapp, Orange.
Sturbridge, No. 177,	Mrs. C. L. Edgerly, Sturbridge.	Mrs. Elizabeth Barnes, Sturbridge.	Rev. J. C. Hall, Sturbridge.
Ludlow, No. 179,	George E. Davis, Ludlow Center.	Wm. Ashwell, Ludlow, R. F. D. No. 1.	Mrs. Chas. Chapman, Ludlow, R. F. D. No. 1.
West Brookfield, No. 180,	Arthur H. Warfield, West Brookfield.	Mrs. Carrie E. Webb, West Brookfield.	Mrs. Annie W. Hunt, West Brookfield.
Westport, No. 181,	Samuel T. Brightman, Westport.	Arthur H. Gifford, South Westport.	Arthur T. Potter, Westport.
Southbridge, No. 182,	James T. Smith, 35 Chestnut St., Southbridge.	Mrs. E. T. Torrey, Southbridge, R. F. D.	Tattersall Wallwork, 33 Chestnut St., Southbridge.
Andover, No. 183,	Ralph A. Bailey, Andover.	Miss Madeleine Hewes, Andover.	Edward W. Burtt, Andover, R. F. D.
Topsfield, No. 184,	J. Albert Blaisdell, Topsfield.	Miss A. G. Bradstreet, Topsfield.	Miss Elizabeth D. Peabody, Box 21, Topsfield.
"Milton" of North Attleborough, No. 185.	D. B. Hunt, North Attleborough, R. F. D.	Mrs. Thos. F. Deane, South Attleborough.	Miss Ruth E. Hunt, North Attleborough, R. F. D.
Fitchburg, No. 186,	Miss Amy L. Andrews, Fitchburg, R. F. D. No. 1.	Miss Edan L. Wilder, Hastings Hall, Fitchburg.	Mrs. Alice H. Arnold, 191 Elm St., Fitchburg.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Littleton, No. 188,	Wm. L. Pickard, Littleton.	Mrs. J. A. Wright, Littleton.	Miss Augusta W. Smith, Littleton Common.
Warren, No. 189,	Chas. E. Wilson, Warren.	Mrs. Grace L. Patrick, Warren.	Mrs. Alice M. Bliss, Warren.
Bellingham, No. 190,	Charles S. Carter, Caryville.	Chas. H. Dolloff, 17 Green St., Milford.	Ada H. Greenwood, Box 95, Milford.
Winchendon, No. 192,	Lester P. Gates, Winchendon.	Mrs. E. M. Bartlett, Winchendon.	Charles W. Brooks, Winchendon.
Foxborough, No. 193,	Wm. E. Perkins, Foxborough.	A. J. Nichols, Foxborough, R. F. D.	Nellie F. Capen, Foxborough.
Townsend, No. 194,	Wilbur H. Scales, Townsend.	Margaret B. Higgins, Townsend.	Flora I. Atwood, Townsend.
Royalston, No. 195,	Eri Stewart, Athol, R. F. D.	C. A. Stimson, Athol, R. F. D.	Ellen M. Stockwell, Box 6, Royalston.
Easton, No. 196,	Walter A. Baldwin, North Easton.	Mrs. Emma L. Keith, North Easton, R. F. D.	Mrs. Emily M. Drew, 11 Grafton St., Brockton.
"Brookville" of Holbrook, No. 197,	William B. Emery, Brookville.	Mrs. Cora Shaw, 433 Howard St., Brockton.	L. A. Leonard, Brookville.
Leominster, No. 198,	James A. Davis, Pleasant St., Leominster.	Mrs. Lilla King, Wallace Park, Whalom.	Miss Bertha E. Hudson, 625 Main St., North Leominster.
Stoughton, No. 199,	Paul S. Jones, Stoughton.	Miss Abby Pickering, Stoughton.	Mrs. J. M. Spaulding, West Stoughton.
Uxbridge, No. 200,	Dr. M. R. Sharpe, Uxbridge.	Mrs. Edwina Robbins, Uxbridge.	Miss Helen J. Hollis, Uxbridge.
Ashburnham, No. 202,	Elmer G. Fosgate, Ashburnham.	Miss Abbie A. Whitney, Ashburnham.	Mrs. Sadie M. Fosgate, Ashburnham.
Westminster, No. 203,	Frank W. Derby, Westminster Center.	Mildred L. Nye, Westminster Center.	Lizzie E. Baker, Westminster, R. F. D. No. 1.
Rowley, No. 204,	H. S. Morong, Box 163, Rowley.	J. Harris Todd, Box 102, Rowley.	John A. Marshall, Rowley.
"Webster" of Marshfield, No. 205,	Walter I. Seaverns, Marshfield.	Mrs. Lizzie C. Flavell, Marshfield.	Frank T. Harlow, Marshfield.
Tewksbury, No. 207,	Miss Edith Haines, North Billerica, R. F. D.	E. P. Streckwald, Tewksbury Center.	Geo. E. Crosby, Lowell, R. F. D. No. 1.
Westford, No. 208,	Frank C. Wright, Westford, R. F. D. No. 1.	Miss Martha Grant, Westford, R. F. D. No. 1.	Mrs. F. C. Wright, Westford, R. F. D. No. 1.
Hanson, No. 209,	Dr. F. S. Thomas, South Hanson.	Mrs. W. H. Hayes, South Hanson.	Mrs. Leon F. Estes, South Hanson.
Chicopee, No. 211,	Edwin L. Shaw, 150 Chicopee St., Chicopee.	Miss Bertha Morehouse, Willimansett.	Mrs. Edna S. Herriek, 254 Chicopee St., Chicopee.
"Oak Hill" of Attleborough, No. 212.	E. D. Gilmore, South Main St., Attleborough.	Mrs. E. V. Carpenter, Oak Hill Ave., R. F. D. No. 4.	Mrs. M. P. Smith, Locust St., R. F. D. No. 4.

"Massapoag" of Sharon, No. 213,	C. Elbert Howard, East Foxborough.	Raymond B. Earle, Sharon.	Mrs. Mary E. Ferrin, Sharon.
Walpole, No. 214,	Geo. W. Laurie, Main St., Walpole.	T. W. Proctor, M.D., Common St., Walpole.	Carrie C. Snyder, Box 372, Walpole.
Mattapoisett, No. 215,	Geo. A. Austin, Mattapoisett.	Mrs. Etta Hiller, East Mattapoisett.	Walter E. Blaine, Mattapoisett.
Dracut, No. 216,	Frank A. Huntley, Dracut Center.	John A. Weinbeck, Wentworth Ave., Lowell.	S. Howard Chace, 97 18th St., Lowell.
Norton, No. 218,	Henry J. Danforth, East Norton.	Harry E. Gardner, Norton.	Miss Nellie H. Lincoln, East Norton.
East Princeton, No. 219,	Perley Aldrich, East Princeton.	Calvin A. Drury, East Princeton.	Alwilda Drury, Princeton.
Sunderland, No. 220,	Frank O. Williams, Sunderland.	George P. Smith, Sunderland, R. F. D.	Miss A. M. Clark, Sunderland.
"Anawan" of Rehoboth, No. 221,	C. C. Viall, Rehoboth, R. F. D. No. 2.	Joseph A. Carpenter, Rehoboth, R. F. D. No. 2.	Elmie G. Fuller, Attleborough, R. F. D. No. 1.
Tyngsborough, No. 222,	Warren A. Sherburne, Tyngsborough, R. F. D. No. 1.	Francena L. Sherburne, Tyngsborough, R. F. D.	Norman R. Sherburne, Tyngsborough, R. F. D.
Billerica, No. 223,	Mrs. Lulu M. Hutchinson, Billerica.	Mrs. Margaret M. Wright, Billerica.	Mrs. Lillian F. Dutton, Bedford, R. F. D.
Sheffield, No. 224,	Edwin H. Cande, Sheffield.	Mrs. A. V. Palmer, Sheffield, R. F. D. No. 1.	George A. Scott, Sheffield.
Williamsburg, No. 225,	Raymond Warner, Williamsburg.	Mrs. Charles Hyde, Williamsburg.	Mrs. A. J. Polmatier, Williamsburg.
West Medway, No. 226,	Ralph W. Hunter, West Medway.	Miss Eva Jackson, Caryville.	Mrs. Hattie A. Moon, West Medway.
Heath, No. 227,	S. G. Benson, Heath.	Mrs. B. C. Carraher, Heath.	E. P. Dickinson, Heath.
Salisbury, No. 228,	George E. Dow, Salisbury.	John C. Currier, Salisbury.	Frances Bragg, Salisbury.
Cochituate, No. 229,	Sydney Loker, Cochituate.	Warren Valentine, Cochituate.	Mrs. Gertrude D. Bishop, Cochituate.
Taunton, No. 230,	Mason E. Marvel, 72 Worcester St., Taunton.	Lincoln Lewis, 15 Fisher St., Taunton.	Geo. A. Hart, 206 County St., Taunton.
"Ponkapoag" of Canton, No. 231,	Joseph W. Farwell, Canton, R. F. D.	Mrs. Lois Dean, Mechanic St., Canton.	Julia A. Crowley, Ponkapoag.
Plainfield, No. 232,	Chas. A. Williams, Plainfield.	Mrs. C. F. Dunham, Plainfield.	Mrs. N. K. Lincoln, Plainfield.
Lexington, No. 233,	L. C. Sturtevant, Hancock Ave., Lexington.	Sylvester P. Robertson, Waltham St., Lexington.	Mrs. Edith M. Hutchinson, Blossom St., Lexington.
Newbury, No. 234,	Fred W. Chase, 24 Summit Pl., Newburyport.	Mabel H. Poore, 235 Merrimac St., Newburyport.	Marcia E. Little, 4 Green St., Newburyport.
Oakham, No. 235,	John W. Dwelly, Oakham.	Walter M. Robinson, Oakham.	Lilla B. Robinson, Oakham.
"Quascacunquen" of Byfield, No. 236.	Herbert Patch, Rowley, R. F. D. No. 1.	Mrs. Ellen Sandford, South Byfield.	Miss Jessie N. Towne, Rowley, R. F. D. No. 1.
Groveland, No. 237,	J. E. Carter, Jr., Georgetown, R. F. D. No. 1.	Mrs. Nellie M. Carter, Georgetown, R. F. D. No. 1.	M. Lottie Tuttle, 149 Main St., Groveland.

Massachusetts Patrons of Husbandry — *Continued.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Bradford, No. 238,	Chas. W. Horne, 600 Salem St., South Groveland.	Mrs. Grace F. Pierce, 4 New St., Bradford.	Edward M. Nason, 237 Neck Road, Ward Hill.
North Reading, No. 239,	L. R. Hayward, South Middleton.	Mrs. Lucie M. Hayward, South Middleton.	Mrs. Blanche W. Burditt, North Reading.
Palmer, No. 241,	Francis L. Jones, Palmer.	Ruth Burgess, Palmer.	Anna M. Wells, Palmer.
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Chelmsford, No. 244,	Arnold C. Perham, Chelmsford.	Bessie K. Emerson, South Chelmsford.	Harlan E. Knowlton, Chelmsford.
Greenwich, No. 245,	Colman P. Tyler, Ware, R. F. D. No. 2.	Mabel Gelling, Greenwich.	Mrs. J. E. Lincoln, Greenwich Village.
West Stockbridge and Alford, No. 246.	John P. Smith, State Line, R. F. D. No. 1.	Mrs. A. G. Bristol, West Stockbridge.	Albert R. Hensel, State Line, R. F. D. No. 1.
"Harmony" of Easton, No. 247,	Wyman H. Boyce, South Easton.	Mabelle R. Daniels, Easton, R. F. D.	Jennie M. Goss, South Easton, R. F. D.
Wendell, No. 248,	C. M. Ballou, Wendell.	Mrs. Bessie Stafford, Wendell.	Mrs. Grace Oliver, Wendell.
Baldwinsville, No. 249,	Geo. H. Lawrence, East Templeton.	Mrs. Geo. H. Lawrence, East Templeton.	Mrs. Ernestine Smith, Otter River.
Everett, No. 250,	Frank T. Marston, 20 Fairmount St., Melrose.	Mrs. Mattie L. Grimes, 6 School Street Pl., Everett.	C. E. Dinslow, 116 High St., Everett.
West Tisbury, No. 251,	Dr. C. D. Fairchild, West Tisbury.	Mrs. Hepsie A. Look, West Tisbury.	U. E. Mayhew, West Tisbury.
"Wachusett" of Leominster, No. 252.	E. N. Saunders, Leominster.	Jennie E. Vinton, Leominster.	Emma L. Hatstat, Leominster.
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Chilmark, No. 255,	Henry H. Allen, Chilmark.	Mrs. Florence B. Mayhew, Chilmark.	Miss Leona B. Mitchell, Chilmark.
New Salem, No. 256,	Frank D. Cogswell, New Salem.	Fred F. Ballard, Box 53, Millington.	Mrs. Geneva S. Ballard, Box 53, Millington.
Rochester, No. 257,	George T. Parker, Acushnet.	Clara F. Bennett, Marion, R. F. D.	A. G. Ashley, Marion, R. F. D.
Carlisle, No. 258,	James H. Wilkins, Billerica, R. F. D.	Mrs. Lucy R. Davis, Carlisle.	Miss G. Chamberlin, Carlisle.
Acton, No. 259,	Arthur E. Payson, Acton.	Mrs. Nelson H. Tenny, South Acton.	Miss Ella L. Miller, North Acton.
Dennis, No. 260,	Frank B. Howes, Dennis.	Frank E. Howes, Dennis.	Nathan Crowell, East Dennis.
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"Hill Top" of Windsor, No. 267,	Alden C. Cady, Windsor.	Luke O. Bickuell, Dalton.	H. J. Whitmarsh, Windsor.
Wilmington, No. 268,	Charles B. Osborn, Wilmington.	Helen W. Carter, Wilmington.	Falerie M. Perry, Wilmington.
"Mill River" of New Marlborough, No. 269.	H. P. Comstock, New Marlborough.	Fannie Kasson, Southfield.	Wm. S. Bradley, Southfield.
South Weymouth, No. 270,	John E. Inkley, South Weymouth.	A. M. Richardson, South Weymouth.	Clarence W. Fearing, South Weymouth.
Milford, No. 271,	Geo. L. Macuen, Milford.	Miss Kate Chapin, Milford.	Minnie B. Wilcox, South Milford.
Brewster, No. 272,	Dr. L. A. Crocker, Brewster.	Rev. E. A. Chase, Brewster.	Mrs. Lilly M. Tubman, North Brewster.
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Westhampton, No. 275,	Levi Burt, Westhampton.	Mrs. Levi Burt, Westhampton.	George E. Clapp, Westhampton, R. F. D. No. 2.
"Ware Valley" of Ware, No. 276,	Edgar D. Winslow, Ware.	Ella M. Winslow, Ware.	Armand A. Grise, Box 76, Ware.
Plympton, No. 277,	F. H. True, Plympton.	Mrs. Alice H. Torrey, Plympton.	R. W. Seymour, Plympton.
Gill, No. 278,	Frank D. Jones, Turners Falls.	Mrs. Clayton H. Purple, Gill.	F. P. Grout, Gill.
Newburyport, No. 279,	Arthur J. Brooks, 8 North Atkinson St., Newburyport.	Jeanette Noyes, 44 Milk St., Newburyport.	Joshua L. Chase, 25 Forester St., Newburyport.
Pocasset, No. 280,	Bion A. Landers, Cataumet.	Mrs. Lena F. Fuller, Cataumet.	Miss Mira Chadwick, Cataumet.
Vineyard Haven, No. 281,	Wm. A. Robinson, Vineyard Haven.	Bertha West, Vineyard Haven.	Edna W. Claghorn, Vineyard Haven.
Waltham, No. 282,	Horace E. Wallis, 719 Main St., Waltham.	Frank L. Barnes, 842 Main St., Waltham.	Jennie W. Graham, 61 Adams St., Waltham.
Bedford, No. 283,	Luther A. Ford, Bedford.	Geo. H. Sweetnam, Bedford.	Mrs. Luella F. Sweetnam, Bedford.
East Bridgewater, No. 284,	H. C. Bacon, Whitman, R. F. D.	Ray T. Hayward, East Bridgewater.	Caroline Bacon, Whitman, R. F. D.
Acushnet, No. 285,	A. Frank Lawrence, Acushnet.	Mrs. Cora B. Fuller, Acushnet.	Jennie A. Washburn, Acushnet.
West Gloucester, No. 286,	George W. Lane, West Gloucester.	Mrs. Sydney Haskell, West Gloucester.	Mrs. E. H. Currier, 236 Concord St., West Gloucester.

MASSACHUSETTS PATRONS OF HUSBANDRY — *Concluded.*

NAME.	MASTER.	LECTURER.	SECRETARY.
Woburn, No. 287,	George A. Dudley, Woburn.	Selwyn Graham, Burlington.	Mary C. Breslin, Woburn.
Duxbury, No. 288,	Leroy M. Peterson, Millbrook.	Henry P. Moulton, Duxbury.	Sidney C. Soule, Millbrook.
Yarmouth, No. 289,	Joshua E. Howes, Yarmouthport.	Thomas T. Crowell, Yarmouthport.	Christopher H. Howes, Yarmouth.
Norwood, No. 290,	C. O. Littlefield, Norwood.	E. H. Dunbar, Norwood.	Warner H. Holbrook, Norwood.
Juvenile Granges.			
Russell, No. 1,	Annie Hawkins, Woronoco.	Donald Lincoln, Russell.	Viola Martin, Russell.

INDEX.

INDEX.

Public Document No. 31

TWENTY-SECOND ANNUAL REPORT

OF THE

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

PART I.,

BEING PART III. OF THE FORTY-SEVENTH ANNUAL REPORT OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

JANUARY, 1910.

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TWENTY-SECOND ANNUAL REPORT

OF THE

MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

PART I.

DETAILED REPORT OF THE EXPERIMENT STATION.

INTRODUCTION.

In accordance with the provisions of the amended act relative to the publication of the reports of the Massachusetts Agricultural College, passed by the Legislature of 1909, the report of the experiment station, which is a department of the college, is presented in two parts. Part I. will contain the formal reports of the director, treasurer and heads of the departments, and papers of a technical character giving the results of investigations carried on in the station. This will be sent to agricultural colleges and experiment stations and to workers in these institutions, as well as to libraries. Part I. will be published also in connection with the report of the Secretary of the State Board of Agriculture, and will reach the general public through that channel. Part II. will contain papers of a popular character, and will be sent to persons on our general mailing list.

WM. P. BROOKS,

Director.

CONTENTS.

PART I.

MASSACHUSETTS
AGRICULTURAL EXPERIMENT STATION
OF THE
MASSACHUSETTS AGRICULTURAL COLLEGE,
AMHERST, MASS.

TWENTY-SECOND ANNUAL REPORT.
Part I.

ORGANIZATION.
Committee on Experiment Department.

Charles H. Preston, *Chairman.*
J. Lewis Ellsworth.
Arthur H. Pollard.
Charles E. Ward.
Harold L. Frost.
The President of the College, *ex officio.*
The Director of the Station, *ex officio.*

Station Staff.

Charles A. Goessmann, Ph.D., LL.D., Honorary Director and Expert Consulting Chemist, 40 North Pleasant Street.
William P. Brooks, Ph.D., Director and Agriculturist, Massachusetts Agricultural College.
Joseph B. Lindsey, Ph.D., Vice-Director and Chemist, 47 Lincoln Avenue.
George E. Stone, Ph.D., Botanist and Vegetable Pathologist, Mt. Pleasant.
Charles H. Fernald, Ph.D., Entomologist, 3 Hallock Street.
James B. Paige, D.V.Sc., Veterinarian, 42 Lincoln Avenue.
Frank A. Waugh, M.Sc., Horticulturist, Massachusetts Agricultural College.
John E. Ostrander, C.E., Meteorologist, 33 North Prospect Street.
Henry T. Fernald, Ph.D., Associate Entomologist, 44 Amity Street.
Edward B. Holland, M.Sc., Associate Chemist, 28 North Prospect Street.
Henri D. Haskins, B.Sc., Chemist (Fertilizer Control), 89 Pleasant Street.
Philip H. Smith, B.Sc., Chemist (Food and Dairy Control), 102 Main Street.
Fred C. Sears, M.Sc., Pomologist, Mt. Pleasant.
Henry J. Franklin, Ph.D., Assistant Entomologist (Cranberry Investigations), 56 Pleasant Street.
Erwin S. Fulton, B.Sc., Assistant Agriculturist, North Amherst.
Edwin F. Gaskill, B.Sc., Second Assistant Agriculturist, R. J. Goldberg's, North Pleasant Street.
George H. Chapman, B.Sc., Assistant Botanist, Fearing Street.
Jas. C. Reed, B.Sc., Assistant Chemist.
Jacob K. Shaw, M.S., Assistant Horticulturist.

JOSEPH F. MERRILL, B.Sc., Assistant Chemist, 32 North Prospect Street.
CARL D. KENNEDY, B.Sc., Assistant Chemist, 88 Pleasant Street.
JOHN N. SUMMERS, Assistant Entomologist, 66 Pleasant Street.
FRED C. KENNEY, Treasurer, Mount Pleasant.
CHARLES R. GREEN, B.Agr., Librarian, Mount Pleasant.
ROSE J. BROWN, Secretary to the Director, Draper Hall, Massachusetts Agricultural College.
JAMES T. HOWARD, Inspector, Feed and Dairy Division, North Amherst.
ROY F. GASKILL, Assistant in Animal Nutrition, Massachusetts Agricultural College.
C. M. DAMON, Observer, 20 South College, Massachusetts Agricultural College.
JESSIE V. CROCKER, Stenographer, Department of Botany and Vegetable Pathology, Sunderland.
HARRIET COBB, Stenographer, Department of Plant and Animal Chemistry, 35 East Pleasant Street.
BRIDIE E. O'DONNELL, Stenographer, Department of Entomology, Hadley.

REPORT OF THE DIRECTOR.

The work of the station during the past year has followed the usual lines. There has been some increase in the amount of research work. This has been made possible by the increase in the amount received from the Adams fund for the current year. Especial attention is called to the fact that immediate results cannot in most cases be expected from such fundamental scientific investigations as are allowed under the Adams fund. A number of important problems are receiving most careful investigation and study. Among them, the more important are the following: —

Studies in milk secretion.
Molasses and digestion depression.
Why arsenicals burn foliage.
Plant breeding, and subsidiary thereto, variation in garden peas and apples.
Determination of physiological constants.
Investigation to determine the economic importance of digger wasps in relation to agriculture.
Studies of pyrallidæ and tortricidæ.
Experiments to determine the plant food requirements of asparagus.
Cranberry investigations to determine plant food requirements.
Relations of climate to plants in health and disease.
Cranberry insect work.

In some of the investigations, results, from which practical lessons which seem to be of importance even now, have been obtained; but no one of them has yet been carried to completion, and most of them are of such a nature that long and patient research will undoubtedly be essential before the fundamental laws which determine the results can be determined.

Particular attention is called to the fact that the passage of the Adams act has not in the slightest degree increased the amount of station funds available for more popular and directly practical station work. Indeed, in one direction the passage of the Adams act has imposed an additional tax upon other station funds, for the act provides that the expense of publication of the results of Adams fund research work cannot be paid from that fund. Such expense must be borne by other station funds. There has been no change in the amount of such funds available to this station, with the exception of an addition of $500 made about seven years ago, during the past twenty-one years. Meanwhile, there have been constantly increasing demands upon the station for work of various kinds, while there has inevitably been a tendency to broaden the scope of such experiments as are already carried on under these funds. The fertilizer control work, moreover, now encroaches upon ordinary station funds. The costs of the collection of samples, analytical work and the publication of the bulletin now considerably exceed the amount of license fees received. This topic will be more fully discussed later in the report, but is mentioned here simply to emphasize the fact that available station resources are not sufficient to cover the costs of such additions to our work as are called for. Poultry men, tobacco growers and cranberry growers, particularly, are urging the experiment station to undertake experiments for the promotion of these industries. Every possible economy has been used in the expenditure of station funds. A small amount has been made available for co-operative experiments with tobacco, and some work with cranberries will be undertaken during the coming year. The possibilities, however, of carrying on such work as the men engaged in these industries would like to see undertaken are comparatively small. The demands upon the station during the past twenty-one years have greatly increased, and they have never increased at a more rapid rate than within the past year. It would seem to be quite time, therefore, to ask for increased funds to provide for the growth in station work which the times demand.

Changes in Staff.

There has been no change in the heads of departments in the station staff during the past year. This fact has been favorable to station efficiency, although in this connection it may not be out of place to point out the fact that the rapid growth of the college has imposed much additional work upon the educational side upon most heads of departments in the station. This fact has necessarily reduced the time and energy available for station work, and the further growth of the college will force upon those responsible for station management a careful consideration of the question whether there should not be connected with the station a larger number of men who have had such training and experience, and who possess such natural ability, that they are competent, without immediate supervision, to originate and carry on investigations of the highest order.

The chemical research work of the station suffered a serious break in the resignation of Dr. R. D. MacLaurin. The place left vacant by his resignation has not been filled, but an additional assistant in chemistry is now employed, thus making it possible to push chemical research investigations which are in progress under Mr. Holland more rapidly than it has been possible to do heretofore.

The connection of Mr. F. A. Johnson with the experiments pertaining to cranberry insects has ceased during the past year. The station, however, has been fortunate in once more obtaining the services of Henry J. Franklin, Ph.D., for entomological work. Dr. Franklin will devote a large share of his time to cranberry insects, but will be placed in local charge of other experimental work with cranberries in the cranberry district. He will be available also for other entomological investigations as time permits.

Mr. P. V. Goldsmith has resigned during the past year to accept a more lucrative position as a sugar chemist. The two new assistants in chemistry are J. F. Merrill, B.Sc., and Carl D. Kennedy, B.Sc.

Buildings.

No important new buildings have been erected during the past year. We have, however, put up, by use of ordinary station funds, three portable brooder houses. These houses are of the Cornell University pattern. They are heated by gasoline and each will accommodate 200 chickens.

Extensive improvements have been made in the old station barn and stables. A large part of the old floor in the main barn has been torn out and a concrete floor put in its place. A cellar 25 by 56 feet in size has been made under the stables. This will provide greatly needed additional room for winter storage of fruits and vegetables. The old stable partitions and fittings have been removed, and a solid concrete floor has been laid over the old plank floor, while new stall partitions and fittings will take the place of the old. These improvements have been carried out with funds appropriated by the last Legislature.

Particular attention is called to the fact that additional room must be provided in our chemical laboratory. The provision of such room is made imperative by the demands made upon us for research work, the rooms upon one side of the laboratory being used in the fertilizer control and those on the other side in the feed and dairy control work. These rooms are fairly sufficient for the control work; but they do not provide either the space or the conditions essential for chemical research work. In spite of all possible efforts to prevent such results it is inevitable that the analytical work connected with the examination of fertilizers and feeds will sometimes load the air with fumes which might vitiate absolutely the research work going on, and this might mean a tremendous loss of time and the sacrifice of the results of much skilled work. To undertake to carry on research work under such risks must, of course, be extremely unsatisfactory; but even could such risks be avoided, the working conditions in a laboratory where control work is being prosecuted are not favorable to research work. Research work requires undisturbed quiet. In the presence of numerous men engaged in ordinary routine chemical work there must necessarily be a certain amount of movement and confusion. Research work side by side with routine control work cannot therefore be made to give the best results.

Plans for the provision of accommodations needed for research work have received the careful attention of the members of the station staff most concerned. It will be necessary, in order to carry out plans which will be at all adequate to our needs, to secure a special appropriation from the Legislature.

Station Activities.

Station activities have embraced work along all the different lines mentioned in our last annual report. These lines are experiment, research, dissemination of information and control work. As already pointed out, there has been little change in the amount of practical experimental work during the year. Research work has been somewhat increased, as has also been pointed out. In the lines of work which come under the head of dissemination of information there has been comparatively little change during the year, although some heads of departments have called attention to the fact that, since the organization of an extension department in the college, there is a slight decrease in the number of calls for information coming to the station. This has been noticeable chiefly in the number of letters of inquiry. It must be regarded as desirable, from the standpoint of station efficiency, that the members of the station staff should be relieved as far as may seem possible of the necessity of doing routine extension work. Such relief will mean more time and energy for investigational work, which must be regarded as the most important function of the experiment station.

The amount of control work during the past year has been greater than in any previous year. The increase has been due chiefly to the fact that a greater number of samples of fertilizers have been collected and a greater number of analyses of fertilizers carried out.

Attention is called to the fact that three of our neighboring New England States have seed laws. These laws must tend to prevent to some extent the sale of inferior seed in these States, and it would seem probable that since there must always be a certain amount of such seed, there will be increased probability that it will seek a market in those States not having seed laws. This, it seems likely, will mean an increase in the amount of inferior seed brought into Massachusetts for sale. The laws in our neighboring States have not yet been long in effect, and the tendency to which I have referred has not yet shown itself. Should it seem, however, that Massachusetts is becoming a dumping ground for inferior seed, it will clearly be the part of wisdom to endeavor to secure the enactment of a law for the protection of honest dealers (who, it is believed, are in a large majority in the State) and of the buyers and users of farm and garden seeds.

The investigation carried on by Dr. Burton N. Gates and the correspondence of the experiment station have made it perfectly apparent that both European and American foul brood are common among bees in various parts of the State. The existence of this disease threatens an industry which is already of considerable importance, and which might, with great advantage to our citizens, receive much greater attention. The passage of an act providing for an inspector of apiaries would be most desirable. The work of this inspector would be largely and no doubt chiefly educational. These diseases can be eradicated or controlled. Many beekeepers would no doubt undertake to rid their apiaries of disease could they be shown how to do the work. Under existing conditions, however, a beekeeper unfortunate enough to have either of the varieties of foul brood would have little encouragement to rid his apiary of the disease for the reason that he must anticipate re-infection from the apiaries of beekeepers who should neglect to carry out remedial treatment with the thoroughness essential to success. The inspector of apiaries, therefore, must be given authority to compel remedial treatment, or, if other measures fail, to destroy infected colonies. New York and Connecticut now have laws providing for such work as has been indicated, and it is quite time that Massachusetts also should enact such a law.

It seems probable that a national law covering the manufacture and sale of insecticides and fungicides will be enacted by the Congress now in session. Such a law has been under joint consideration by the Bureau of Entomology of the Department of Agriculture, a committee of Economic Entomologists and prominent manufacturers. A law was introduced into the last Congress, and has now been brought into such form that it seems to be fairly satisfactory to all interests involved. This law, of course, can be effective in the States only in governing interstate transactions, but since practically all manufacturers of insecticides and fungicides do an interstate business, the passage of the national law will probably prove effective in controlling the manufacture and trade in these materials.

Publications during 1909.

The new plan for the publication of the annual report of the station referred to in my last report became effective for the first time during the past year. Under this plan a larger proportion of the material published by the station will appear in the annual report than has been customary heretofore. Thus, for example, the two parts of the annual report for 1909 make a total of 300 pages, whereas the annual report for 1908 included 172 pages only. The amount of matter to be published in bulletin form is reduced by the change just referred to, and the number of such publications during the past year has been considerably less than in 1908. The total number of printed pages, including both bulletins and reports is, however, the same for the two years.

The amount of circular matter sent out is also practically the same, namely, 30 pages in 1909 and 32 pages in 1908. A full list of the publications for the year follows: —

Publications during 1909.

Annual report: —

Parts I. and II. 300 pages.

Bulletins: —

No. 128. Inspection of Commercial Feed Stuffs, P. H. Smith and P. V. Goldsmith. 56 pages.

No. 129. Beekeeping in Massachusetts, Burton N. Gates. 32 pages.

No. 130. A Summary of Meteorological Observations, J. E. Ostrander. 28 pages.

Circulars: —

No. 20. The Use of Lime in Massachusetts Agriculture, Wm. P. Brooks. 6 pages.

No. 21. The Control of Onion Smut, G. E. Stone. 2 pages.
No. 22. Poultry Manures, their Treatment and Use, Wm. P. Brooks. 4 pages.
No. 23. A Parasite of the Asparagus Beetle, H. T. Fernald. 4 pages.
No. 24. An Act to provide for the Protection of Dairymen. The Babcock Test, J. B. Lindsey. 8 pages.
No. 25. Cottonseed Meal, J. B. Lindsey. 8 pages.

Publications Available for Free Distribution.

Bulletins: —

No. 33. Glossary of Fodder Terms.
No. 41. Use of Tuberculin.
No. 68. Fertilizer Analyses.
No. 76. The Imported Elm-leaf Beetle.
No. 83. Fertilizer Analyses.
No. 84. Fertilizer Analyses.
No. 89. Fertilizer Analyses.
No. 90. Fertilizer Analyses.
No. 103. Fertilizer Analyses.
No. 113. Fertilizer Analyses.
No. 115. Cranberry Insects.
No. 117. Trade Values, and Fertilizer and Soil Analyses.
No. 121. Seed Separation and Germination.
No. 123. Fungicides, Insecticides and Spraying Directions.
No. 124. Bee Diseases in Massachusetts.
No. 125. Shade Trees.
No. 126. Insects Injurious to Cranberries, and how to fight them.
No. 127. Inspection of Commercial Fertilizers.
No. 129. Beekeeping in Massachusetts.
No. 130. Meteorological Summary — Twenty Years.
Technical Bulletin No. 2. The Graft Union.
Technical Bulletin No. 3. The Blossom End Rot of Tomatoes.
Index to bulletins and annual reports of the Hatch Experiment Station previous to June, 1895.
Index to reports and bulletins, 1888–1907.

Annual reports: —

Annual reports of the station for the following years are available: 10th (1898), 11th (1899), 12th (1900), 13th (1901), 14th (1902), 15th (1903), 16th (1904), 17th (1905), 20th (1908), and 21st, Parts I. and II. (1909).

Of some few other bulletins and reports we have a very limited supply. These will be furnished only in order to complete sets for libraries.

Examination of the above list makes it apparent that relatively few of our earlier bulletins can now be furnished. The publications printed by the station during the early years of its existence were naturally issued in comparatively small editions. The demand was limited. The growth of interest in improved methods in agriculture was not fully anticipated. It is now apparent that it would have been well had many of our bulletins and reports, which are of a character to make their contents of some permanent value, — even if only for purposes of library reference, — been issued in larger numbers. Many institutions, especially those devoted to agricultural education, and hundreds of individuals, are now vainly seeking to complete files of station publications. We cannot recall the past. Its mistakes are irremediable; but we should heed its lessons. The growth of interest in such matters as station reports and bulletins treat will continue, and the rate of such growth will be more rapid in the future than in the past. It would clearly seem unwise to figure our editions too close to present demand, and yet to this course we seem to be compelled on account of the pressure upon station funds, made greater by the last grant from the federal government, — the Adams fund, — since this fund provides means for increased research, while the act granting it expressly stipulates that no part of the fund shall be used in meeting the costs of publication of results. These costs are, therefore, an increased burden on funds already fully utilized in meeting the expenses of other lines of work.

It may be urged that under the conditions above outlined the amount of work in other lines should be decreased, but this is an alternative which the demands of the times render most difficult, and which I believe would be decidedly unwise. We are under constant pressure to undertake more experimental work and in new lines. The various special agricultural interests urge us to more fully recognize them. Poultrymen, asparagus growers, cranberry growers, tobacco growers, hothouse men and many others have their special problems, which they look to us, and rightly, to help them solve. We need more funds then, rather than less, for our experimental work, and hence the necessity of a more generous provision for publication. The size of our editions should be increased, but under existing appropriations this is impossible.

A committee of the American Association of Agricultural Colleges and Experiment Stations, after a most careful study of the whole subject of station publications, has recently made a report strongly urging, among other things, that, with a view to making provision for future demands, station publications should be electrotyped when issued. The adoption of this course now does not seem to me to be our most pressing necessity, but some such provision in the near future will no doubt be desirable.

The demand for general bulletins of information, referred to at some length in my last report, shows no sign of abatement. On the contrary, it is ever increasing. The information which may be furnished by such bulletins is greatly needed. Could it be placed in the hands of persons calling for it, marked improvement in agricultural methods might be confidently anticipated. I believe, however, that this demand should be chiefly met by private enterprise. Certainly it cannot be met by the station without special provision to cover its costs. Meeting it, however, would seem to be in the nature of extension rather than experimental work, and therefore, under the modern conception of respective functions, perhaps belongs rather to the college than to the station.

Letters of Inquiry.

The number of letters of inquiry annually received in the different departments of the experiment station continues to increase. During the past year the total number of such letters received and answered was 6,500. Attention to these letters consumes a very considerable proportion of the time and energy of members of the station staff, thus materially curtailing the amount of attention which can be given to investigation. The numerous letters of acknowledgment received from correspondents receiving suggestions and advice make it apparent that the assistance which the station is able to render by answering these letters is appreciated. The amount of work of this character which the public will call upon the Massachusetts Agricultural Experiment Station to do is sure to increase. This line of work is highly important and useful, and it would seem to be the part of wisdom to make special provision for it in order that station workers may be more free to devote themselves to investigation.

Lectures and Demonstrations.

Members of the station staff have been frequently called upon during the past year to deliver public lectures and to conduct demonstrations. The number of lectures and demonstrations given during the year was 56, while a large number of invitations to accept such engagements were, of necessity, declined. Work of this character makes heavy inroads upon the time of station workers, for it involves in the long run the use of much time in travel and in preparation. In so far, however, as station men have special knowledge of certain subjects, it seems desirable that they should address a reasonable number of important meetings, since in this way the results of the work of the station are carried to the public, while the lecturer on his part is brought into closer and wholesome touch with the public which he aims to serve.

Miscellaneous Analyses.

The chemist reports the usual large number of miscellaneous analyses. Work of this character done during the year may be summarized as follows: —

Water,	99
Milk,	389
Cream,	2,933
Feed stuffs,	98
Fertilizers and fertilizer materials,	234
Soils,	42
Miscellaneous substances,	45

This summary includes simply the analytical work carried out for individuals. The results of these analyses are of interest in most cases only to the persons sending in the material. It is recognized that this work has its value; but investigational work is of wider interest and of greater value. It has been our policy, therefore, and must continue to be our policy, to confine work of this kind to relatively narrow limits. Should we comply with all requests for work of this character, it is probable that the time of all the chemists at present employed would be very largely occupied in this work.

The most marked increase in demands for private analytical work is for soil analyses. There appears to be a widespread misconception as to the probable value to the individual of a chemical analysis of his soils. This subject was rather fully discussed in my last annual report; but it seems wise once more to repeat that the results of such analysis do not constitute a satisfactory basis for determining either the crop adaptation or the manurial requirements in the great majority of cases. No accurate count has been made, but it is believed that the number of requests for such analyses made during the past year has been at least 300. To have made this number of complete analyses would have required the continuous services of two chemists for a year; while to have determined simply the leading fertilizer elements must have required the full time of one chemist.

The leading soil types found in the State have already been analyzed repeatedly in most cases. Fertilizer requirements appear to be determined in the majority of instances more largely by the crop than by peculiarities in the chemical composition of the soil. It is particularly pointed out, therefore, that correspondents need only to state the type of soil, the character of the subsoil, the recent manurial treatment and the crop in order to give us a basis for suggestions in relation to the selection of fertilizers. Samples of soil, if sent, will not usually be analyzed, unless the type of soil or the conditions which have affected it appear to be of unusual character.

Control Work.

The amount of work connected with the execution of the fertilizer and feed laws increases from year to year. During the past year 1,042 samples of fertilizers have been examined in accordance with the requirements of the fertilizer law, and 946 samples of cattle feeds have been analyzed. Conditions as affecting the trade in feed stuffs have been on the whole satisfactory. The fertilizer inspection has, however, resulted in the discovery of a larger number of fertilizers not equal to guarantee than has been found in any previous year. It has not been thought best to make any prosecutions during the past year; but the particular attention of dealers is called to the fact that such conditions as existed this year must not continue, and that prosecutions will undoubtedly be necessary should serious shortages again occur. Details of the inspection work will be found in the report of the chemist.

Testing Pure-bred Cows.

Attention was called in the last report to the fact that a small increase in the scale of charges for testing pure-bred cows had been found necessary. There was at first some criticism of the station for making such an increase, but it is believed that the necessity for it was made clear to parties interested in the work. The new scale of charges now excites no opposition, while the amount of such work steadily increases. The fact that its results are profitable to the parties concerned is made sufficiently apparent by the fact that the number of cows offered for test continues to increase. The present scale of charges is believed to be sufficient to fairly cover the cost, and it must, therefore, be regarded as satisfactory both to the interested public and to the station.

Mailing Lists.

During the past year we have undertaken, by correspondence with postmasters throughout the State, to revise our general mailing list. The last revision was made two years ago; but as the result of the revision now in progress we have cancelled 1,441 addresses because of death or removal as reported by the postmasters. Postmasters have also reported over 2,000 changes in address. Before these changes are made, we shall address the individuals concerned, and shall re-enter them under new addresses only in those cases in which they reply to the postal card inquiry. It seems probable that the total number of addresses dropped from our list as the result of the revision will be at least 2,500. The facts stated make it apparent that postmasters do not as a rule comply with the postal regulations affecting station publications, and return them in the event of non-delivery. These facts make it very apparent also that frequent revision of mailing lists is a necessity if wasteful distribution of reports and bulletins is to be avoided. There is little doubt that our lists for other States and for foreign countries also need revision, and this work will be undertaken as soon as conditions make it possible.

The extent to which our general publications circulate is made apparent by the following statement of the numbers in our lists: —

Residents of Massachusetts,	13,098
Residents of other States,	2,102
Residents of foreign countries,	196
Newspapers,	512
Libraries,	288
Exchanges,	112

The number of additions to our general mailing lists on direct application of the parties concerned during the past year has been 1,500.

In addition to the above lists, our publications are sent to those on the general Washington list, which includes members of the faculties and station staffs in agricultural colleges and experiment stations. The total number of addresses on this list is 2,350.

We use also the following special mailing lists: —

Cranberry growers,	1,424
Beekeepers,	2,475
Meteorological,	373

Asparagus Substation, Concord.

The work at this substation has made very satisfactory progress. All details connected with the local execution of plans for planting, fertilization and culture have been, as heretofore, faithfully and skillfully looked after by Mr. Charles W. Prescott, from whom the land in use has been leased, and to whom the work has from the first been indebted for many valuable suggestions and services characterized by most unusual enthusiasm and devotion.

No new lines of work have been undertaken. Our principal investigations, it will be remembered, are of two general classes, — breeding experiments and fertilizer experiments.

Breeding Experiments. — During the past year good progress has been made in these experiments, which have for their object the production of more rust-resistant types of asparagus, which shall at the same time possess desirable market characteristics. The number of varieties in the experimental plots at the present time is 65. Mr. J. B. Norton, who began observations in Concord last year, has devoted practically all of his time during the past season to the asparagus breeding experiments. It will be remembered that in this work we enjoy the co-operation of the United States Department of Agriculture, and Dr. B. T. Galloway, Chief of the Bureau of Plant Industry, under whose direct charge work of this description comes, has definitely assigned Mr. Norton to take local charge of the work in Concord. Mr. Norton succeeded during the past season in making numerous promising selections and a large number of artificial fertilizations. Some of the seed resulting from this work will be planted in Washington, and a close preliminary study of the plants produced will be made there during the coming winter. It is hoped to shorten the time needed for testing the value of different types by following this course. Those which seem promising will be taken to Concord for further testing and observation. It is a pleasure to testify to the enthusiasm and faithful industry of Mr. Norton, who, besides devoting himself to the breeding experiments, has proved very helpful in taking observations and making records on the fertilizer experiments as well. An exhaustive chemical study of the roots as affected by the varying fertilizer treatment is now in progress and appears to promise results of importance and great value.

Fertilizer Experiments. — The conditions in the fertilizer plots continue to be highly satisfactory. There was, it is true, considerable rust, as was the case almost everywhere in Concord last fall; but it did not begin as early in the fertilizer plots as in many beds in the district, and it is believed that the injury was not serious. No differences in the extent of rust injury which could be attributed to variations in fertilizer treatment could be detected. Cutting continued longer this year than last. The first cutting was on May 7, and the last on June 6. The quality of the product was especially good, as was perhaps only natural on a vigorous new bed. There were considerable differences in yield on the different plots; but the product will not be reported at this time, as it is not clear that the differences recorded were connected with varying fertilizer treatment. The preparation of the entire area, as was pointed out last year, was so thorough that the growth even on the plots receiving least fertilizer is still unusually vigorous.

Tent Experiments. — The fact was reported last year that it is the plan to conduct experiments for the purpose of determining the influence of tent shade as affecting (1) yield; (2) quality of product; (3) extent of injury from rust. It was, however, found that conditions in the different plots of the old asparagus bed, in which this work was begun, were not sufficiently uniform to warrant the continuance of the work on that bed. During the past season, however, a new bed has been set for the purpose of continuing these experiments.

Cranberry Substations.

It will be remembered that our cranberry work follows two principal lines of inquiry relating (1) to the fertilizer requirements of the crop; (2) to the insect enemies of cranberries.

The only work done in connection with insects during the past year has been of a preliminary nature, as during the early part of the season we did not enjoy the services of an entomologist who could be assigned to this work. The station, however, has been fortunate in concluding an engagement with Dr. Franklin, who conducted insect work which gave such valuable results two or three years ago. Dr. Franklin returns to this experiment station as an assistant in entomology; but it is our expectation that he will be put in local charge of all our experimental work with cranberries, although he will, as heretofore when connected with the station, devote his time principally to a study of insects in their relations to the crop. Dr. Franklin was unable to take up this work earlier than October 1, but he spent several weeks in the cranberry sections of the State laying plans and making preparations for the work of another year.

The past year has been characterized by a significant development in the relations of cranberry growers to our work. As a result of extended correspondence and conference, a committee representing the Cape Cod Cranberry Growers' Association came to the decision to solicit contributions towards the financial support of experimental work with cranberries. The committee prepared a circular letter asking for *pro rata* contributions, and this letter, in printed form, was sent to all known cranberry growers in the State. This letter follows: —

To the Cranberry Growers of Massachusetts.

A legislative committee appointed by the Cape Cod Cranberry Growers' Association has conferred with Messrs. Brooks, Preston and Damon of the State Experimental Station, and finds them heartily in sympathy with a plan for a substation to be located in the cranberry-growing district. They are willing to help us in every way if we will help ourselves by bearing a reasonable proportion of the expense. As cranberry growing is limited to certain areas, they do not feel justified in asking the State to bear the whole burden.

Such a station would investigate cranberry insects and their parasites, giving particular attention to the ravages of the fruit worm. It would also consider the various diseases of the cranberry, and would determine the best methods of spraying and flooding. Systematic experiments with fertilizers would be carried on with relation to their effect on the color, quantity, size and keeping qualities of the fruit, and to determine their retentive values in the soil. The propagation of new varieties, the destruction of weeds and mosses and the study of climatic conditions, with the probable assistance of the United States Weather Bureau, would all be included in this work. The station would, in short, be here to serve us.

We have every reason to believe that, by acting *promptly*, we can secure the services of Mr. Henry J. Franklin for this undertaking. Most of the growers are familiar with the earnest, conscientious investigations which he made during his connection with the Amherst station. His bulletin, "How to fight cranberry insects," and the mounted specimens which he prepared for us, prove his ability.

If every grower will contribute one cent for each barrel of berries that he shipped last year, we believe that, with the co-operation of the station, the necessary funds can be raised. If you are willing to contribute that amount, will you please fill in the enclosed postal card. We do not want the money now, and shall not ask for it unless a sufficient amount is pledged to insure the success of the plan. A prompt answer will be greatly appreciated.

A large number of growers responded favorably, and the total amount of money pledged toward the support of experimental work as a result of this movement was about $1,000.

It is with especial satisfaction that this action on the part of cranberry growers and its results are reported, for it is believed that this policy of self-help on the part of special interests has much to commend it. These interests may fairly be asked to contribute to the support of work especially designed to benefit them; but this is by no means the only reason for the approval of this policy. It means a greater interest on the part of the growers in the work which is going on, for human nature is so constituted that what costs something is valued more highly than that which is a free gift. This policy means, moreover, closer co-operation, wholesome supervision and helpful criticism. It is to be hoped that the results of this initial movement in the direction of private support of experimental work on the part of special interests will so commend themselves to cranberry growers that not alone will they be inclined to continue a measure of support, but that other special interests, recognizing the advantages of the system, may be led to adopt a similar plan of co-operation.

It must be at once recognized that, in order that the experiments contemplated in the interests of cranberry producers may be carried on under satisfactory conditions, it will be necessary to control a moderate area of cranberry land and the buildings necessary for handling the crop, and to provide moderate laboratory accommodations. Unless the work can be located in permanent quarters, fully under the control of the experiment station, it cannot possibly be prosecuted in a satisfactory manner. Two methods of acquiring control of such property as is needed are to be considered: (1) the needed land and buildings might be leased for a number of years; (2) the needed property might be acquired by purchase. The second of the two plans would seem to possess considerable advantages as compared with the first. Cranberry land ordinarily returns so large an income that the rental which would undoubtedly be expected by an owner would be large. Moreover, questions of possible damage to the property as a result of experimental work might arise, which would be difficult to settle in a satisfactory manner. Should the second plan be adopted there is little doubt that the net income derived from the crops produced would be sufficient to constitute a material contribution to the funds available to pay the costs of experimental work. If, therefore, the needed property can be purchased at a satisfactory price, the methods of support of experimental work would be largely settled. It would seem, therefore, to be extremely desirable either that growers unite in the purchase of the property to be placed at the disposal of the station, or that the State be asked to appropriate money for the purpose. It is quite impossible that the cost either of leasing the needed property or of purchasing it should be met by the use of ordinary station funds. Such funds are quite inadequate in amount to meet so large an added expenditure.

The co-operation of the United States government in certain lines of investigation has been asked for, and we are already assured of material assistance in the study of plant diseases and the climatic conditions which affect the crop.

Fertilizer Experiments. — The fertilizer experiments at Red Brook Bog, lying at Waquoit, have been continued. This includes 33 plots of one-twentieth of an acre which are subjected to varying fertilizer treatment. The use of fertilizers has been so planned that the results must ultimately afford a valuable basis for determining what should be the composition of cranberry fertilizers. It is recognized, of course, that conditions vary in different bogs, and that no one formula can possibly be the best under all conditions. Our object is to learn if possible the specific effects of different fertilizer elements. When these are understood, it will be possible to adapt the fertilizer to meet varying conditions in different bogs.

Most of the plots in our experiment gave a fairly good crop in 1909, but, owing to a misunderstanding on the part of men employed in harvesting the fruit upon portions of the bog outside the fertilizer plots, the product from a few of the plots was mixed, and a complete record of results would be impossible. There were, moreover, a few plots in which considerable damage was done by insects. The results, therefore, are not to be reported in detail at this time, but the following conclusions seem to be fully warranted as the result of observations and records so far made.

1. The use of some fertilizer will clearly prove profitable on many bogs. The average product on the no-fertilizer plots (7 in number) in our experiments this year was 7.5 bushels per plot, or at the rate of 150 bushels per acre. The average product on the fertilizer plots (19 in number) was 13.4 bushels per plot, or at the rate of 268 bushels per acre. The average product on the 10 plots to which a complete fertilizer was applied was at the rate of 306.5 bushels per acre. A complete fertilizer was made up by the mixture of nitrate of soda, acid phosphate and a potash salt.

2. The use of nitrate of soda greatly promotes the growth of vines, and seems also to be favorable to fruitfulness. Even with the smallest quantity of nitrate used in our experiments (at the rate of 200 pounds per acre) the growth of the vines has been very luxuriant, — so luxuriant that the fruit, although abundant, was poorly colored and probably inferior in keeping qualities. The vine growth was so rank that another year the rate at which nitrate is used will be greatly reduced. *It is believed that nitrate in excess of 100 pounds per acre will seldom be necessary.*

3. The influence of high-grade sulfate of potash appears to be decidedly favorable. It promotes fruitfulness, good color and high quality. The highest yield obtained on any of the plots (22½ bushels, which is at the rate of 450 bushels per acre) was produced where the maximum quantity of sulfate of potash was used in connection with a moderate amount of nitrate of soda and acid phosphate. The total fertilizer application to this plot was at the rates per acre: —

	Pounds.
Nitrate of soda,	200
Acid phosphate,	400
High-grade sulfate of potash,	400

4. Phosphoric acid appears in these experiments to have less effect than either of the other fertilizers employed, though it appears probable that when applied in soluble form, such as acid phosphate, it will be likely to promote early ripening, and will be favorable to fruit of relatively high color.

WM. P. BROOKS,
Director.

REPORT OF THE TREASURER.

ANNUAL REPORT

Of Fred C. Kenney, Treasurer of the Massachusetts Agricultural Experiment Station of the Massachusetts Agricultural College,

For the Year ending June 30, 1909.

The United States Appropriations, 1908–09.

	Hatch Fund.	Adams Fund.
Dr.		
To receipts from the Treasurer of the United States, as per appropriations for fiscal year ended June 30, 1909, under acts of Congress approved March 2, 1887 (Hatch Fund), and March 16, 1906 (Adams fund),	$15,000 00	$11,000 00
Cr.		
By salaries,	$12,734 18	$8,163 08
labor,	479 84	1,004 41
publications,	6 50	–
postage and stationery,	103 23	46 75
freight and express,	21 48	32 20
heat, light, water and power,	103 88	230 76
chemical supplies,	91 64	338 80
seeds, plants and sundry supplies,	362 92	302 75
fertilizers,	254 53	260 48
feeding stuffs,	241 28	–
library,	143 04	24 85
tools, implements and machinery,	–	–
furniture and fixtures,	244 00	50 00
scientific apparatus,	113 03	513 04
live stock,	10 25	–
traveling expenses,	20	31 26
contingent expenses,	15 00	–
buildings and land,	75 00	1 62
	$15,000 00	$11,000 00

State Appropriation, 1908–09.

To balance on hand,	$7,529 52	
Cash received from State Treasurer,	13,500 00	
from fertilizer fees,	5,210 00	
from farm products,	2,387 57	
from miscellaneous sources,	4,825 17	
		$33,452 26
Cash paid for salaries,	$8,616 19	
for labor,	8,155 03	
for publications,	1,837 45	
for postage and stationery,	992 11	
for freight and express,	853 48	
for heat, light, water and power,	423 66	
for chemical supplies,	336 41	
for seeds, plants and sundry supplies,	1,670 95	
for fertilizers,	586 10	
for feeding stuffs,	1,115 02	
for library,	318 71	
for tools, implements and machinery,	10 07	
for furniture and fixtures,	337 47	
for scientific apparatus,	566 61	
for live stock,	12 00	
for traveling expenses,	1,882 73	
for contingent expenses,	95 00	
for buildings and land,	604 77	
Balance,	5,538 50	
		$33,452 26

REPORT OF THE AGRICULTURIST.

DEPARTMENT OF AGRICULTURE.

WM. P. BROOKS, AGRICULTURIST; E. S. FULTON, E. F. GASKILL, ASSISTANTS.

The work in the department of agriculture in the experiment station has followed the usual lines during the past year. The most important investigations in progress have reference to what in general may be denominated fertility problems. They are designed to throw light upon various questions connected with the selection, use and methods of application of manures and commercial fertilizers. A considerable number of the experiments in progress has already continued for a number of years, and the results are becoming increasingly valuable, as they afford, with the passage of the years, surer indications as to the ultimate effects to be expected. The number of field plots on the station grounds used in the experiments the past year was 351.

Pot experiments have been continued and have been designed chiefly to throw light upon the relative values of different materials which may be used, respectively, as sources of nitrogen, phosphoric acid and potash. Tests of this character afford the surest indications as to the relative availability of different materials. The principal crops used in this work are Japanese barnyard millet, soy beans and dwarf Essex rape. We have used 346 pots during the past year. In some phases of our work, mainly as a check upon field results, we use closed plots, and the number of these in use the past season was 167.

The experiments in progress will not be taken up in detail in this report; but attention is called to some of the more striking results.

I. The experiments on Field A, which have for their object the determination of the relative value, as sources of nitrogen, of some of the leading materials which may be used to furnish that element, have been continued. These experiments were begun in 1890. The crops grown in order of their succession have been: oats, rye, soy beans, oats, soy beans, oats, soy beans, oats, oats, clover, potatoes, soy beans, potatoes, soy beans, potatoes, oats and peas, corn and clover for the last two years. These two crops have been considerably mixed with grass. The best crop of the year was produced where dried blood was used as a source of nitrogen, but the crop produced upon nitrate of soda was practically the same. On the basis of 100 for nitrate of soda, the relative standing of the different nitrogen fertilizers and the no-nitrogen plots (total yield) was as follows: —

	Per Cent.
Nitrate of soda,	100.00
Dried blood,	100.50
Sulfate of ammonia,	87.14
Barnyard manure,	83.00
No nitrogen,	72.34

The relative standing of the different materials for the twenty years during which the experiments have continued is as follows: —

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	94.05
Dried blood,	92.34
Sulfate of ammonia,	86.47
No nitrogen,	70.99

On the basis of increase in crop as compared with the no-nitrogen plots the average of the twenty years shows the following relative standing: —

	Per Cent.
Nitrate of soda,	100.00
Barnyard manure,	79.51
Dried blood,	73.62
Sulfate of ammonia,	53.36

It will be seen that the nitrate of soda has given a much larger average increase in crop than any of the other materials.

There would seem to be little doubt, therefore, that this material must be regarded as one of the most satisfactory of the nitrogen fertilizers, and since it can usually be purchased at a lower average cost per unit of nitrogen than other fertilizers containing that element, it would seem to be the part of wisdom to use it as largely as soil and crop conditions will permit.

II. The experiments on Field B, for determining the relative value for different crops of the muriate and high-grade sulfate of potash when used in equal amounts, have been continued. These experiments began in 1892. Five pairs of plots are under comparison. Up to 1899 the potash salts were used in quantities (varying in different years, but always in equal amounts on the two members of pairs of plots) ranging from 350 to 400 pounds per acre. Since 1900 the quantity used has been uniform on all the plots, and at the rate of 250 pounds per acre annually. In connection with the potash we have used the same amount of fine ground bone annually for each plot throughout the entire period of the experiment. The rate of application of the bone is 600 pounds per acre. The season of 1909 is the eighteenth year of these experiments. The crops during that year were corn on two pairs of plots, asparagus and rhubarb occupying each a portion of one pair of plots, raspberries and blackberries each occupying a portion of one pair, carrots on one pair of plots and cabbages on the other. The yield of berries was very small, on account of serious winterkilling. This was less on the sulfate of potash than on the muriate. On both pairs of plots occupied by corn the sulfate gave a heavier yield of grain, while the muriate gave a larger yield of stover. The difference in favor of the grain amounted to about 5 bushels. The difference in stover in favor of the muriate was at the rate of about 600 pounds per acre. The asparagus gave much the heavier crop on the muriate, at the rate of 6,002 pounds per acre on that salt against 3,257 pounds on the sulfate. The rhubarb gave a crop at the rate of 22,786 pounds per acre of stalks on the muriate and 28,349 pounds on the sulfate. The carrots gave a better yield on the sulfate, at the rate of 822.4 bushels per acre against 799.1 bushels on the muriate. The cabbages gave much the larger yield of hard heads on the sulfate, the figures being at the following rates per acre: —

	Pounds.
Muriate of potash: —	
Hard heads,	17,466
Soft heads,	6,878
High-grade sulfate of potash: —	
Hard heads,	21,966
Soft heads,	2,434

III. In Field C we have under comparison for use in connection with manure three different materials used as a source of nitrogen, — sulfate of ammonia, nitrate of soda and dried blood, — and the two potash salts, muriate and high-grade sulfate, each salt being used with each of the three nitrogen fertilizers and in connection with a liberal application of dissolved bone black, the same on all plots. The comparison of these different fertilizers in this field was begun in 1891, but up to the year 1898 they were used without manure. Since that time all plots receive annually a dressing of stable manure, at the rate of 30 tons per acre. A large variety of crops has been grown in this field. The crops the past year were asparagus, rhubarb, cauliflower and onions. Rhubarb and cauliflowers have given the heavier yields on sulfate of ammonia as a source of nitrogen; but both asparagus and onions have given smaller yields on this material than on either of the other nitrogen fertilizers. Nitrate of soda gave a yield of asparagus about 25 per cent. greater than sulfate of ammonia, while for onions the difference in favor of the nitrate of soda was in much greater proportion. With muriate as the source of potash, the yield of No. 1 onions on the different nitrogen fertilizers was at the following rates per acre: —

	Bushels.
Sulfate of ammonia,	359.2
Nitrate of soda,	565.1
Dried blood,	515.9

With sulfate of potash as the source of potash the rate of yield of No. 1 onions per acre for the different nitrogen fertilizers was as follows: —

	Bushels.
Sulfate of ammonia,	412.0
Nitrate of soda,	703.6
Dried blood,	557.5

The average yields on the different potash salts were at the following rates per acre: —

	Bushels.
Muriate of potash: —	
No. 1 onions,	480.10
Pickling onions,	77.80
Sulfate of potash: —	
No. 1 onions,	557.70
Pickling onions,	57.97

For rhubarb the muriate of potash gave the larger crop, at the rate per acre of 77,400 pounds, against 64,828.7 pounds on the sulfate.

The cauliflowers gave the better crop on the sulfate, the rates per acre being as follows: —

	Pounds.
Muriate of potash,	24,695
Sulfate of potash,	30,691

The asparagus gave the better yield on the sulfate, but the difference was small. The rates per acre were as follows: —

	Pounds.
Muriate of potash,	4,951.0
Sulfate of potash,	5,176.7

The results with onions and with cauliflowers are the most striking, and are in close agreement with results previously obtained. The cauliflower, like the cabbage, seems to be more certain to give a satisfactory crop on the sulfate than on the muriate on soils fairly retentive of moisture.

The crops on the plot in this field, where manure is used without fertilizers, are in most cases still nearly as good as on the plots where fertilizers are used in addition to the manure; but we would again point out that the history of this plot and its manurial treatment previous to its inclusion in this field were different from those of the other plots. Nevertheless, the fact that the crops on this plot still compare so favorably with those on the plots where fertilizer also is used raises the question whether the latter is a benefit.

IV. In the experiments comparing the different potash salts, which were begun in 1898, and in which these salts are used in quantities to furnish equal actual potash per acre annually, the crop the past year was hay, mixed timothy, red top and clovers. The average yield of the no-potash plots was at the following rates per acre: —

	Pounds.
Hay,	5,744
Rowen,	680

The average yield of all the potash plots, 35 in number, was at the following rates per acre: —

	Pounds.
Hay,	6,412.6
Rowen,	1,555.4

It will be noticed that the increase in the yield of hay was not very large, and that the yield without the potash was for both crops slightly in excess of 3 tons per acre. The rowen crop on the potash plots is much greater than on the no-potash plots because of the larger proportion of clover. The most striking result of the experiments, indeed, is the comparative failure of clover on the plots to which no potash was applied, and its great inferiority on the five plots to which kainit is annually applied. On these plots, and especially on the plots to which the kainit is applied, the yield of timothy was remarkably heavy, the proportion of this grass being much greater than on plots to which the other potash salts are applied.

V. In the field where ten of the leading materials which may be used as sources of phosphoric acid have been under comparison since 1897, the crop during the past year was soy beans. The phosphates used in this experiment are applied in connection with equal and liberal quantities of nitrogen and potash in available forms, at such rates as will furnish equal actual phosphoric acid per acre. The average yield of the three no-phosphate plots was at the rate of 6,668 pounds, or 27.8 bushels per acre. The average yield on the ten phosphatic fertilizers was at the rate of 1,835.2 pounds, or 30.6 bushels. The average increase on the phosphate plots as compared with the no-phosphate was at the rate of 167.2 pounds per acre. The highest increase, at the rate of 296 pounds per acre, was produced on the steamed bone meal. This increase is at the rate of 17.7 per cent. There was not a very wide difference between the crops produced on the different phosphates, and the most striking result of the experiment is the fact that the crop where no phosphate has been applied during the past thirteen years is nearly equal to the crops produced on the best of the phosphate plots. On the same plots last year, cabbage being the crop, the increase on the best phosphatic material of the year, bone meal, was 667 per cent. of the average crop produced on the no-phosphate plots. These facts serve to emphasize the point which I have previously many times referred to, that in considering the plant-food requirements of soils it is of the first importance that the crop be taken into consideration. For the successful cultivation of the cabbage on this soil a rapidly available form of phosphoric acid is essential; but for the soy bean, the application of phosphoric acid seems to have been relatively unimportant.

VI. The crop on the south corn acre, where manure at the rate of 6 cords to the acre annually has been under comparison since 1890 with an application per acre at the rate of 4 cords of manure and 160 pounds of high-grade sulfate of potash, during the past year was hay, mixed timothy, red top and clovers. The plots to which the large applications of manure alone have been made were materially larger than on the combination of a lesser amount of manure and potash. The following are the average rates per acre: —

	Pounds.
Manure alone: —	
Hay,	4,930
Rowen,	530
Manure and potash: —	
Hay,	3,670
Rowen,	490

The rowen crops of the past season were exceptionally small, on account of a very marked deficiency in rainfall. It is apparent, however, that although the combination of the lesser amount of manure and potash substantially equals the larger amount of manure for corn, which is grown in alternate two-year rotations with hay, it is not equal for the production of hay.

VII. On the north corn acre, where the combination of fertilizer materials rich in potash is under comparison with a combination of similar materials in different proportions, and furnishing less potash and much more phosphoric acid, the crop the past year was hay, mixed timothy, red top and clovers. This experiment was begun in 1891, and for the past fourteen years corn and hay, two years each, have regularly alternated. Owing to the very dry summer the field was cut but once. The average yields were at the following rates per acre: —

	Pounds.
On the fertilizer combination rich in phosphoric acid and relatively poor in potash,	5,094
On the fertilizer combination richer in potash and poorer in phosphoric acid,	5,320

The proportion of clover in the plots receiving the combination richer in potash is noticeably greater than on the other plots. The combination richer in potash in these experiments has shown itself substantially equal to the other combination for the production of corn, and superior for the production of hay.

VIII. The experiments for the production of hay, by using in rotation as top-dressing barnyard manure, wood ashes and a mixture of bone meal and potash, have been continued during the past year in the nine-acre field where these experiments have been under progress since 1893. The average yield on the entire area during the past year was at the rate of 5,036 pounds of hay. The yields on the different materials used in top-dressing were at the following rates per acre: —

	Pounds.
Barnyard manure,	5,394
Wood ashes,	4,708
Fine ground bone and potash,	5,160

The average yields to date under the different systems of top-dressing have been at the following rates per acre: —

	Pounds.
Barnyard manure,	6,373
Wood ashes,	5,805
Fine ground bone and potash,	6,164

The average yield of the nine acres, from 1893 to 1909 inclusive, has been at the rate of 6,150 pounds per acre. The average of the past year, it will be seen, is materially below the long-time average, a fact undoubtedly due to the deficiency of summer rainfall, previously referred to.

IX. In the experiments comparing winter application of manure with spring application of an equal quantity, put into large heaps in the field in the winter and spread in the spring, the crop this year has been hay, mixed timothy, red top and clovers. The two systems of applying manure are under comparison on five pairs of plots, and the experiment has been in progress since 1899. The average crops of the past season were at the following rates per acre: —

	Pounds.
Winter application of manure: —	
Hay,	7,045.0
Rowen,	460.6
Spring application of manure: —	
Hay,	6,482.0
Rowen,	659.2

It will be noted that the winter application has given a larger crop of hay, but that the manure applied in the spring has given a heavier yield of rowen. If we combine the hay and rowen crops, the average yields have been at the following rates per acre: —

	Pounds.
Winter application of manure,	7,505.6
Spring application of manure,	7,141.2

The field in which these experiments are located slopes considerably in a direction running lengthwise with the plots. The superiority of the results obtained where the manure is applied in winter becomes more strikingly evident when it is remembered that by following this system the labor cost is materially less than under the other, since when the manure is applied in the spring it must be handled twice.

X. The leading feature of the poultry experiments during the past year has been the continuation of the experiments comparing the dry with the moist-mash system of feeding. We have carried through six experiments, three during the winter and three during the summer, using in these experiments six different flocks of fowls. The results have been similar to those obtained last year. In the majority of the experiments the fowls receiving the moist mash have produced a greater number of eggs. The moist-mash feed has seemed to be superior to the dry feed in four out of the six experiments, and the number of eggs in most of these experiments has been materially greater than the number produced under the dry system of feeding. In the two experiments in which the dry system gave the greater number of eggs, the differences were relatively small. Averaging the six experiments, the results are as follows: —

Number of Eggs daily per 100 Hens.

Moist mash,	36.3
Dry feeds,	34.5

REPORT OF THE CHEMIST.

JOSEPH B. LINDSEY.

DEPARTMENT OF PLANT AND ANIMAL CHEMISTRY.

Research section: Edward B. Holland, Robert D. MacLaurin.[1]
Fertilizer section: Henri D. Haskins in charge.
Feed and dairy section: Philip H. Smith in charge.
Assistant chemists: Lewell S. Walker, James C. Reed, Philip V. Goldsmith,[2] C. D. Kennedy.[3]
Assistant in animal nutrition: Roy F. Gaskill.
Inspector: James T. Howard.[4]
Clerks and stenographers: Harriet M. Cobb, Alice M. Howard.

In the following pages is given a brief outline of the work carried on by the department for the year ending Dec. 1, 1909.

1. Correspondence.

The number of letters sent out during the year ending December 1, on the basis of stamps used, has been 5,641, some 841 more than in the preceding year. Comparatively few stamps are used for packages. The correspondence divides itself principally into (*a*) answering letters of inquiry, (*b*) the execution of the fertilizer and feed laws, (*c*) testing of cows, and (*d*) in the ordering of supplies.

[1] Resigned Sept. 1, 1909.
[2] Resigned Dec. 1, 1909.
[3] From October, 1909.
[4] From April 1, 1909.

2. Numerical Summary of Work in the Chemical Laboratory.

From Dec. 1, 1908, to Dec. 1, 1909, there have been received and examined 99 samples of water, 389 of milk, 2,933 of cream, 98 of feed stuffs, 234 of fertilizers and fertilizer materials, 42 of soils and 45 miscellaneous. In connection with experiments made by this and other departments of the station, there have been examined 191 samples of milk, 157 of cattle feeds, 58 of fertilizers, 26 of soils and 534 of agricultural plants. There have also been collected and examined 1,042 samples of fertilizer in accordance with the requirements of the fertilizer law, and 946 samples of cattle feeds in accordance with the requirements of the feed law. The total for the year has been 6,794. This summary does not include work done by the research division.

In addition to the above, 25 candidates have been examined and given certificates to operate Babcock machines, and 4,071 pieces of Babcock glassware have been tested for accuracy of graduation, of which 43, or 1.06 per cent., were inaccurate.

3. Résumé of Work of the Research Section.

The research work was carried on jointly by Mr. E. B. Holland and Dr. R. D. MacLaurin. Mr. Holland has given attention particularly to a study of methods for the determination of insoluble acids in butter fats, and has co-operated with the entomological department relative to the burning of foliage by insecticides. Quite satisfactory progress has been made in both of these lines of work, but they are not sufficiently advanced to warrant any detailed publication. A paper on the stability of butter fat, prepared by Mr. Holland, appears elsewhere in this report.

Work on the constitution of fats and the chemistry of fat formation has been suspended by the resignation of Dr. MacLaurin. Dr. MacLaurin devoted substantially a year to the study of this subject, and has signified to the writer his intention of preparing his work for publication.

4. Work in Animal Nutrition.

Work to note the effect of molasses on the digestibility of the ration with which it is fed has been sufficiently advanced to warrant a paper on the subject, which appears elsewhere in this report.

Experiments on the most suitable varieties of corn for the silo have been in progress for a number of years. The results show that such varieties as the Leaming, Pride of the North, Rustler White Dent, Longfellow and Sanford White are more suitable for this latitude than Early Mastodon, Improved White Cap, Brewer's Dent, Wing's White Cap and Eureka. We have noted the degree of maturity by September 15, the yield of dry matter, the proportion of dry matter in stocks, ears, husks and leaves, as well as the degree of digestibility of most of the several varieties. The excess in yield of green material from the latter varieties consists largely of water. In case the coarse dents are field cured, the stalks will not cure out well, and as late as the middle of November contain a much larger amount of water than the smaller varieties. The detailed report of this experiment will probably be ready for publication in another year.

Digestion tests with alfalfa and red clover at the same stages of growth have been completed, but a large amount of laboratory work in connection with the samples still remains to be done before the final results can be obtained.

5. Résumé of Work of the Fertilizer Section.

Mr. H. D. Haskins, in charge, presents the following report: —

The activities of the fertilizer division have been confined chiefly to the fertilizer control work and the examination of fertilizers, soils, refuse by-products, etc., forwarded by farmers and others interested in agriculture. The results of the year's work would indicate that a larger number of private formulas and home-mixed fertilizers had been used by the Massachusetts farmers than ever before. The work of the collection and inspection of licensed fertilizers has also increased during the year. A larger number of fertilizers was licensed this year than during the past season, and the collection and analysis of samples reach the highest number ever attained during the history of fertilizer inspection work in Massachusetts.

(*a*) *Fertilizers licensed.*

During the year 431 distinct brands of fertilizers and agricultural chemicals have been licensed in Massachusetts. Licenses have been secured during the year by 78 manufacturers, importers and dealers, counting each branch of the American Agricultural Chemical Company as a separate company. Two more licenses were issued and 22 more brands were licensed than for 1908. The brands licensed this year may be classed as follows: —

Complete fertilizers,	306
Fertilizers furnishing potash and phosphoric acid,	9
Ground bone, tankage and dry ground fish,	51
Agricultural chemicals and organic compounds furnishing nitrogen,	65
Total,	431

(*b*) *Fertilizers collected.*

An effort was made during the season to cover a larger territory than heretofore, and to procure, so far as possible, representatives of every brand of goods sold in the State. As a general rule, fertilizers cannot be found plentifully in the open markets in Massachusetts until after April 1. Some of the fertilizer is used on early crops by the 15th or 20th of April, and by May 1 considerable of the fertilizer is in the ground. Our collecting season being relatively short, an extra man was delegated to gather samples during that portion of the season when the fertilizer was found most plentiful. The samples were in all cases taken by an authorized agent from the experiment station. Mr. James T. Howard, the assistant usually delegated to this work, assisted by Mr. C. W. Gaskill, covered the eastern portion of the State, while Mr. E. C. Hall looked after the collection in the Connecticut Valley and the central portion of the State. Samples were taken from over 280 different agents, and over 110 different towns were visited.

The total number of samples collected was 1,042, representing 458 distinct brands, — being 418 more samples than during the preceding year. Wherever possible an analysis has been made of a composite made up of equal weights of the same brand collected in various parts of the State. Samples have been taken with the usual care and discrimination, the collecting agents being instructed to sample at least 10 per cent. of the number of packages of each brand, and never less than five bags, without making a special note of the fact on the guarantee slip which is sent to the laboratory with each sample taken.

(c) *Fertilizers analyzed.*

The following analyses have been made in connection with the inspection of licensed fertilizers: —

Complete fertilizers,	384
Ground bone, tankage and fish,	61
Materials furnishing phosphoric acid, potash and lime, such as ashes,	16
Nitrogen compounds, such as nitrate of soda, sulfate of ammonia, blood, castor pomace, cottonseed meal and linseed meal,	68
Potash compounds,	34
Phosphoric acid compounds,	17

In addition to the above, 33 samples of fertilizer have been analyzed that were not licensed but which were goods manufactured for private use. These goods were sampled officially by our collecting agents from stock in the possession of the consumer. This makes a total of 613 analyses which have been made during the season of 1909.

In some instances, where the results of analysis of a composite sample showed a brand to be seriously deficient in plant food, a new sample has been prepared for analysis from each original sample taken, and separate analyses have been made. This was done to ascertain if the shortage was general, or confined to one or more lots of the same brand. Thirty-five such complete analyses were made during the season from 13 composite samples; 172 more analyses have been made than during the previous year.

(d) *Trade Values of Fertilizing Ingredients.*

	Cents per Pound.	
	1909.	1908.
Nitrogen: —		
In ammonia salts,	17	17½
In nitrates,	16½	18½
Organic nitrogen in dry and fine ground fish, meat, blood and in high-grade mixed fertilizers,	19	20½
Organic nitrogen in fine bone and tankage,[1]	19	20½
Organic nitrogen in coarse bone and tankage,[1]	14	15
Phosphoric acid: —		
Soluble in water,	4	5
Soluble in ammonium citrate (reverted phosphoric acid),	3½	4½
In fine ground bone and tankage,[1]	3½	4
In coarse bone and tankage,[1]	3	3
In cottonseed meal, linseed meal, castor pomace and ashes,	3	4
Insoluble (in neutral citrate of ammonia solution) in mixed fertilizers,	2	2
Potash: —		
As sulphate free from chlorides,	5	5
As carbonate,	8	8
As muriate (chloride),	4¼	4¼

The above schedule of trade values was adopted at a meeting of the station directors and chemists from the New England and New Jersey experiment stations, which was held in March, 1909. They represent the average cash pound cost, at retail, of the three essential elements of plant food in their various forms, as furnished by chemicals and unmixed raw materials, in the large markets during the six months preceding March 1, 1909. The trade values for nitrogen and phosphoric acid are somewhat lower than for the previous year.

The following table shows the average comparative commercial values, the retail cash prices and the percentages of difference of the licensed complete fertilizers analyzed in Massachusetts during the season of 1908 and 1909: —

Year.	Commercial Values.	Retail Cash Prices.	Difference.	Percentages of Difference.
1908,	$25 81	$36 20	$10 39	40 25
1909,	22 19	34 62	12 43	56 01

It must be remembered that the "commercial values" represent the retail price of the raw or unmixed materials, and that

[1] Fine and medium bone are separated by a sieve having circular openings one-fiftieth of an inch in diameter, the valuation of the bone being based upon the degree of fineness.

the manufacturer cannot sell mixed fertilizers at these figures. He must obtain an advance sufficient to cover costs of manufacture, bagging, agencies, credits, etc. The above differences do not represent his profits. These are much smaller, and are probably not excessive in the case of reliable firms. It is probable, however, that the cash buyer of high-grade unmixed goods can secure needed plant food in that form at a cost considerably lower than in licensed complete fertilizers, and that by intelligent selection he can procure materials from which can be made home mixtures at least equally effective with such fertilizers.

(e) *Summary of Analyses and Guarantees.*

MANUFACTURER.	Number of Brands Analyzed.	Number with All Three Elements equal to Guarantee.	Number equal to Guarantee in Commercial Value.	Number with One Element below Guarantee.	Number with Two Elements below Guarantee.	Number with Three Elements below Guarantee.
W. H. Abbott,	3	1	2	1	2	–
American Agricultural Chemical Company,	69	37	65	23	9	–
Armour Fertilizer Works,	10	4	6	4	2	–
Baltimore Pulverizing Company,	2	–	2	2	–	–
Beach Soap Company,	4	3	4	1	–	–
Berkshire Fertilizer Company,	6	4	6	2	–	–
Bowker Fertilizer Company,	31	19	32	15	–	–
Joseph Breek & Son,	3	1	3	2	–	–
Buffalo Fertilizer Company,	9	4	7	4	1	–
Coe-Mortimer Company,	9	3	6	4	2	–
Eastern Chemical Company,	1	–	1	1	–	–
Essex Fertilizer Company,	11	8	10	3	–	–
R. & J. Farquhar & Co.,	5	2	5	3	–	–
Hubbard Fertilizer Company,	3	2	3	1	–	–
Jordan Marsh Company,	1	–	–	–	1	–
Listers Agricultural Chemical Works,	7	7	7	–	–	–
James E. McGovern,	1	–	–	–	1	–
Mapes Formula and Peruvian Guano Company,	17	11	17	5	1	–
National Fertilizer Company,	12	6	12	6	–	–
Natural Guano Company,	1	–	1	–	1	–
New England Fertilizer Company,	6	3	5	2	1	–
Olds & Whipple,	6	5	6	1	–	–
Parmenter & Polsey,	6	3	6	3	–	–
R. T. Prentiss,	3	–	–	1	1	1
Pulverized Manure Company,	3	–	–	–	2	1
W. W. Rawson & Co.,	2	1	1	–	1	–
Rogers Manufacturing Company,	9	8	9	1	–	–
Rogers & Hubbard Company,	8	5	8	3	–	–
Ross Brothers Company,	3	1	2	1	1	–
N. Roy & Son,	1	–	1	1	–	–
Sanderson Fertilizer and Chemical Company,	7	1	5	6	–	–
M. L. Shoemaker & Co., Ltd.,	2	1	2	1	–	–
Swift's Lowell Fertilizer Company,	18	10	15	5	3	–
Whitman & Pratt Rendering Company,	5	3	5	2	–	–
Wilcox Fertilizer Works,	6	6	6	–	–	–
A. H. Wood & Co.,	3	–	–	2	1	–

The above table shows: —

1. That 296 distinct brands of complete licensed fertilizers were collected and analyzed.

2. That 138 brands (46.6 per cent. of the whole number analyzed) fell below the manufacturer's guarantee in one or more elements.

3. That 106 brands were deficient in one element.

4. That 30 brands were deficient in two elements.

5. That 2 brands were deficient in all three elements. In this connection it might be added that 80 brands were found deficient in nitrogen, 63 in potash and 28 in phosphoric acid.

6. That 45 out of the 296 brands analyzed (over 15 per cent. of the total number) showed a commercial shortage. The term "commercial shortage" means that the brands in question did not show the quantity and value of plant food guaranteed, although the excess of any element of plant food was figured in full value to offset the deficiencies.

7. That certain manufacturers are either extremely careless in mixing or else they do not allow a sufficient margin for variation in the composition of crude stock. In other words, they try to have their goods run too close to the minimum guarantee.

(*f*) *Commercial Shortages.*

The following table has been prepared to show the commercial shortages in the mixed fertilizers for the season of 1909, also to furnish a comparison with the previous year: —

Commercial Shortages.

COST.	NUMBER OF BRANDS.	
	1909.	1908.
Over $4 per ton,	4	–
Between $3 and $4 per ton,	2	3
Between $2 and $3 per ton,	5	1
Between $1 and $2 per ton,	14	7
Under $1, not less than 25 cents,	35	Not given.

The season of 1909 shows the largest number of deficiencies and commercial shortages which has probably ever occurred in this State. The largest number occurring are below $1 per ton, and yet many of the deficiencies are very serious, running 1 per cent. or over below the minimum guarantee. In the table of shortages, in all cases where an excess of plant food has occurred the commercial value of the excess has been used to offset the commercial shortage resulting from a deficiency in some of the other elements. This practice is certainly extremely fair to the manufacturer. We should not lose sight of the fact, however, that serious deficiencies or excesses change the essential character of a fertilizer. A prosecution in every case this year must, from necessity, have contained a certain element of unfairness, as some of the cases of the most serious deficiencies occurred where the licensee was not the manufacturer, and was, therefore, not directly responsible for the composition of the goods, which were manufactured by parties outside of the State. Therefore no prosecutions have been made for shortages. It seemed wise, after a careful review of the situation, to take up the matter with each manufacturer separately, and endeavor to secure an adjustment that would be as favorable as possible to the consumer. It is obviously not possible, however, to follow such a method year after year. *All manufacturers whose goods have fallen seriously below their guarantees have been advised, and all others are hereby informed, that such conditions cannot continue to exist, and that another season it will be necessary to prosecute violators of the statute.*

(*g*) *Grades of Fertilizer.*

The 323 brands of complete fertilizers may be divided into three groups: —

Low-grade fertilizers, having a commercial value of $18 or less per ton,	83
Medium-grade fertilizers, having a commercial value of between $18 and $24 per ton,	122
High-grade fertilizers, having a commercial value of over $24 per ton,	118

The following table has been compiled for the purpose of making a study of the three grades of goods: —

Grade of Fertilizer.	Number of Brands.	Per Cent. of Whole.	Average Composition. Per Cent. Nitrogen.	Per Cent. Available Phosphoric Acid.	Per Cent. Potash.	Pounds Available Plant Food in 100 pounds of Fertilizer.	Average Valuation.	Average Cost.	Excess of Selling Price over Valuation.	Percentage Difference.
High, ...	118	36.53	3.94	7.62	8.00	19.56	$27 63	$39 05	$11 42	41.33
Medium, ...	122	37.77	2.61	8.10	5.34	16.05	20 69	33 85	13 16	63.61
Low, ...	83	25.70	1.80	7.35	3.06	12.21	15 32	29 51	14 19	92.62

The above table shows: —

1. That the per cent. of nitrogen and potash is much higher in the high-grade goods than in the medium or low grade.

2. That with about a 32 per cent. advance in price over the low-grade fertilizers, the high-grade furnished more than 60 per cent. increase in available plant food.

3. With about 32 per cent. advance in price over the low-grade goods, the high-grade furnished over 80 per cent. increase in commercial value.

4. A ton of the average high-grade fertilizer furnishes about 43 pounds more of nitrogen, 5½ pounds more of available phosphoric acid and 99 pounds more of actual potash than does a ton of the low-grade goods.

5. The average high-grade fertilizer costs 15½ per cent. more than the medium-grade article; it furnishes about 22 per cent. more plant food and has about 35.5 per cent. greater commercial value.

6. The medium-grade fertilizers cost about 15 per cent. more than the low-grade and furnish over 35 per cent. greater commercial value.

7. The percentage of difference between cost and valuation in low-grade goods is more than double that for high-grade fertilizers.

Table showing the Pound Cost of Nitrogen, Potash and the Various Forms of Phosphoric Acid in the Three Grades of Fertilizer.

	Low-grade Fertilizer (Cents).	Medium-grade Fertilizer (Cents).	High-grade Fertilizer (Cents).
Nitrogen,	36.60	31.08	26.85
Potash (as muriate),	9.63	8.18	7.07
Soluble phosphoric acid,	7.71	6.54	5.65
Reverted phosphoric acid,	6.74	5.73	4.95
Insoluble phosphoric acid,	3.85	3.27	2.83

The above table shows: —

1. That nitrogen has cost 9.75 cents more per pound, available phosphoric acid about 2 cents more per pound and potash 2.56 cents more per pound in the average low-grade fertilizer than in the average high-grade goods.

2. That nitrogen has cost 4.23 cents, the available phosphoric acid over 3/4 of a cent and the potash 1.11 cents more per pound in the average medium-grade fertilizer than in the average high-grade goods.

3. That every conclusion which can be drawn from the above table emphasizes the fact that the farmer cannot afford to purchase low-grade fertilizers.

(*h*) *Unmixed Fertilizers.*

Ground Bones. — Twenty-nine samples of ground bone have been analyzed during the inspection of 1909. Eleven of the brands have been found deficient in phosphoric acid and 8 in nitrogen; 8 brands had a commercial shortage ranging from a few cents to \$2.95 per ton. The average retail cash price for bone has been \$30.39 per ton, the average valuation \$26.09 and the percentage difference 16.57.

Tankage. — Nine samples of tankage have been analyzed and show the usual variations in composition; only 1, however, has shown a serious shortage in nitrogen, and 4 tested low in phosphoric acid. There were no commercial shortages. The average retail cash price was \$30.18, the average valuation \$29.86 and the percentage difference 1.07. The average cost of nitrogen per pound in this material has been 17.1 cents in fine tankage and 13 cents in coarse tankage.

Dissolved Bone. — Three samples of dissolved bone have been analyzed, only 1 of which was found deficient in plant food. No commercial shortages were found. The average retail cash price was $26.67, the average valuation $20.69 and the percentage difference 28.90.

Dry Ground Fish. — Twenty samples of dry ground fish have been examined, of which 9 were found deficient in nitrogen and only 1 in phosphoric acid. Six brands showed a commercial shortage ranging from a few cents to $1.89 per ton. The average retail cash price was $38.96, the average valuation $36.13 and the percentage difference 7.83. Nitrogen from dry fish has cost, on the average, 23.88 cents per pound.

Wood Ashes. — Thirteen samples of ashes have been analyzed, of which 3 were found deficient in phosphoric acid and 6 in potash. Six of these samples showed a commercial shortage ranging from 32 cents to $1.10 per ton.

(1) *Nitrogen Compounds.*

Sulfate of Ammonia. — Three samples have been analyzed and found well up to the guarantee. The average cost of nitrogen per pound in this form has been 17.53 cents.

Nitrate of Soda. — Thirteen samples have been analyzed, only 2 being found deficient in nitrogen. The average cost of nitrogen per pound in form of nitrate of soda has been 17.11 cents.

Dried Blood. — Two samples of this material were examined and found deficient in nitrogen; each contained sufficient phosphoric acid, however, so that there was no commercial shortage. The average cost of nitrogen from blood has been 25.57 cents per pound.

Castor Pomace. — Four samples of castor pomace have been analyzed, 1 sample only being found deficient in nitrogen, and this equivalent to $2.36 per ton. The average cost of nitrogen in this form has been 23.67 cents per pound.

Linseed Meal. — Three samples of flax meal have been tested and the nitrogen guarantee has been maintained in each instance. The nitrogen from this source has cost, on the average, 26.47 cents per pound.

Cottonseed Meal. — Forty-three samples of cottonseed meal have been examined. This has been the product from six companies which have licensed this material to be sold as a fertilizer in Massachusetts during the past year. This material, like the castor pomace and linseed meal, is bought largely as a nitrogen source for tobacco. Seventeen out of the 43 samples analyzed show a nitrogen shortage ranging from a few cents to $2.39 per ton. Nitrogen from cottonseed meal has cost, on the average, 23.61 cents per pound.

(2) *Potash Compounds.*

Carbonate of Potash. — Three samples have been analyzed and all of them were found to be of good quality. Potash in this form has cost, on the average, 7.68 cents per pound.

High-grade Sulfate of Potash. — Nine samples have been analyzed and the potash guarantee was maintained in all but 3 of them. The pound of potash has cost in this form, on the average, 5.03 cents.

Potash-magnesia Sulfate. — Six samples have been analyzed and in every case the potash guarantee has been maintained. The pound of actual potash has cost in this form 5.41 cents.

Muriate of Potash. — Thirteen samples have been examined and only 2 samples have shown a potash shortage, amounting to a few cents per ton in value. The pound of actual potash in form of muriate has cost, on the average, 4.18 cents.

Kainit. — Three samples have been analyzed, all testing over the minimum guarantee in potash. The average pound cost of potash from kainit has been 6.13 cents.

(3) *Phosphoric Acid Compounds.*

Dissolved Bone Black. — Three samples have been examined and all were found of good quality. The pound of available phosphoric acid from this source has cost, on the average, 7.41 cents.

Acid Phosphate. — Seven samples have been analyzed and the available phosphoric acid guarantee was maintained in all but 1 instance. The pound of available phosphoric acid from this source has cost, on the average, 5.69 cents.

Basic Slag Phosphate. — Six samples have been examined and the available phosphoric acid in all but 1 sample has run somewhat under the amount guaranteed. There has been a commercial shortage in only one instance, however, as the deficiency was made up by an excess of insoluble phosphoric acid. The pound of available phosphoric acid (by Wagner's method) from slag has cost, on the average, 5.79 cents.

(i) *Miscellaneous Fertilizers, Soils and By-products for Free Analysis.*

As in the past, free analyses have been made for farmers and others interested in agriculture so far as our time and facilities would warrant. Work of this nature, however, has been done when it would not conflict with the official inspection of commercial fertilizers. Including the materials which have been tested for the various departments of the experiment station, 385 analyses have been made. They may be grouped as follows: 292 fertilizers and by-products used as fertilizers, 68 soils and 25 samples of miscellaneous materials. Information has been furnished each applicant at the time the results of analyses were reported as to the best method of using fertilizer materials, also as to their average commercial value. Information has also been furnished with soil analyses as to the best method of treating the soil, also as regards the fertilization of the same. Both the fertilizer materials and soil samples have been taken according to instructions furnished from this office, and are therefore in all cases representative samples. These analyses do not appear in our fertilizer bulletin.

The fertilizer section has, as in past years, been active in co-operative work with the Association of Official Agricultural Chemists, and also with the fertilizer branch of the American Chemical Society.

6. Résumé of Work of the Feed and Dairy Section.

Mr. P. H. Smith, in charge, submits the following report: —

(a) *The Feed Law.*

During the past year 946 samples of feed stuffs offered for sale in the Massachusetts markets were collected by the official inspector. These have been examined, and the results are being brought together for publication in bulletin form.

Practically no misrepresentation was detected, although in a number of instances feed stuffs lacked the guarantee and other information required by the statute. Wherever dealers appeared to be particularly careless in this respect the matter was put into the hands of an attorney for settlement, but thus far in every case a satisfactory agreement has been made without resorting to the courts. In the future it is the intention to prosecute where dealers cannot be brought by less drastic means to comply with the law. The requirements of the Massachusetts law are simple and explicit, and afford protection to the reputable dealer as well as to the consumer, therefore the continued evasion of the law by a few dealers is inexcusable and should not be tolerated.

The extent to which the national pure food law aids in preventing adulteration and misrepresentation where feeds enter into interstate commerce is perhaps not known and appreciated as it should be. State officials and others in close touch with the work can see that its effects are far reaching and of great assistance to those engaged in local control work.

Cottonseed meal, usually one of the cheapest sources of protein for the Massachusetts dairyman, has for the past season been quite satisfactory in quality. The results thus far obtained for new meal indicate that, on account of the short cotton crop of the present season, conditions will be much the same as for the season of 1906–07. In spite of the excessively high price many dealers have sold short, and considerable slightly inferior meal is being offered. This may be accounted for in part by the poor quality of the seed, but it is felt, in some instances at least, that hulls and linters are intentionally added.

(1) *Low-grade By-products should be sold under their True Names.*

On account of our increasing population and prevailing high prices, it is becoming more and more necessary to utilize all by-products having any substantial food value in the feeding of our domestic animals. While screenings, weed seeds, oat hulls, corn cobs, cottonseed hulls and other low-grade material may contain some nutriment, the foregoing statement should not be taken to indicate that a compounded feed containing one or more of these materials, together with some high-grade concentrate, is just as valuable as the high-grade concentrate itself. Where such a mixture is offered at its face value, and no misrepresentation attempted, it is certainly a legitimate article of trade, and should be so recognized. The writer firmly believes, however, that, in order that the consumer may purchase intelligently, the ingredients going to make up a compounded feed should be stated on each package, but no legislation absolutely prohibiting the sale of low-grade material should be enacted unless it can be shown that certain kinds of material are poisonous or injurious to the animal.

The molasses feeds, of which there is an increasing number, form an excellent outlet for certain kinds of low-grade material, — especially screenings, — the molasses rendering them more palatable. Most of the manufacturers now grind the grain screenings before using them as a constituent of these feeds.

There are various feeds now offered which contain more or less ground alfalfa. It is believed that feeders cannot afford to pay grain prices for alfalfa hay, even when fine ground; it is decidedly more economical to purchase the high-grade concentrates unmixed, and to depend upon home-grown English hay, alfalfa, clover hay and corn silage as sources of roughage.

(2) *Protein v. Carbohydrates.*

Many manufacturers claim that the experiment stations place too much emphasis upon the value of protein and too little emphasis upon the value of carbohydrates. This station has never questioned the value and necessity of liberal amounts of carbohydrates in the ration. The question is rather an economic one, especially for the New England feeder, who, under our climatic conditions, can easily raise a sufficient quantity of carbohydrates and must depend largely upon *purchased protein* to balance or round out the ration, particularly in the feeding of dairy animals.

(3) *Weight of Feed Stuffs.*

Up to this time we have paid but little attention to the weight of feed stuffs. Data recently brought together show that while the feed law states *explicitly* that the *net weight* of each package should be stated, the practice has been, except in a few instances, to state gross weight as net. When feed stuffs sold for $15 a ton and less, the difference in value between net and gross weight of sacked feeds amounted to comparatively little, but at the present time the "value difference" is much greater. In a few instances what appear to be a deliberate attempt to give short weight was noted, and consumers should be on their guard against such deception.

(4) *Uniform Feed Law.*

It was the writer's pleasure to attend, during September, a conference between a committee of the American Feed Manufacturers' Association and State control officials, held at Washington, in the interests of a uniform feed stuffs law. The decision of the conference was that such a law should be as simple as possible, and that a buyer of any feed stuffs should be informed of the following points: —

1. The number of net pounds in the package.
2. Name, brand or trademark.
3. Name and principal address of the manufacturer or jobber responsible for placing the commodity on the market.
4. Its chemical analysis expressed in the following terms: (*a*) minimum percentage of crude protein, (*b*) minimum percentage of crude fat, and (*c*) maximum percentage of crude fiber.
5. If a compound or mixed feed, the specific name of each ingredient therein.

The Massachusetts law does not require a guarantee of fiber or a statement of ingredients in a compounded feed, and it is felt that if the present law could be amended to contain these statements it would be materially strengthened.

(b) *The Dairy Law.*

The work required by this act is divided into three natural subdivisions: (1) the examination of candidates, (2) the testing of glassware, and (3) the inspection of machines.

(1) *Examination of Candidates.*

During the past year 25 candidates have been examined for proficiency in Babcock testing. Of these, 14 were students at the ten weeks' winter course and 3 were students in the regular college course; the other 8 held positions in different parts of the State. All candidates were at least fairly proficient and capable of doing good work. At the last session of the Legislature, section 4 of the dairy law (chapter 202 of the Acts of 1901) was so amended as to give the director of the experiment station power to revoke the certificate of an operator providing it is found that he is not doing satisfactory work. Following is the section as amended: —

SECTION 4.[1] No person shall, either by himself or in the employ of any other person, firm or corporation, manipulate the Babcock test or any other test, whether mechanical or chemical, for the purpose of measuring the butter fat contained in milk or cream as a basis for determining the value of such milk or cream, or of butter or cheese made from the same, without first obtaining a certificate from the director of the Massachusetts[2] agricultural experiment station that he or she is competent to perform such work. Rules governing applications for such certificates and the granting of the same shall be established by the said director. The fee for issuing the said certificate shall in no case exceed two dollars, shall be paid by the applicant to the said director, and shall be used in meeting the expenses incurred under this act. If the duly authorized inspector finds an operator who, after receiving his certificate of competency, is not, in the judgment of the inspector, correctly manipulating the Babcock or other test used as a basis for determining the value of milk and cream, or who is using dirty, untested or otherwise unsatisfactory glassware, he shall immediately report the case in writing to the director of the station. The director shall at once notify said operator in writing and give him

1 See chapter 425, Acts of 1909.
2 Massachusetts substituted for Hatch. See chapter 66, Acts of 1907.

not less than thirty days to make the necessary improvements. At the expiration of that time the director may order a second inspection, the cost of which shall be borne by the operator or by the person, firm or corporation employing him, and if the required improvement has not been made, the director is empowered to notify in writing said operator, or the person, firm or corporation employing him, that his certificate of competency is revoked. In case of any subsequent violation the said director may revoke the certificate of competency without giving the notice aforesaid.

(2) *Testing Glassware.*

During the past year 4,071 pieces of glassware were examined, of which 43 pieces, or 1.06 per cent., were inaccurate. Following is a summary of the work for the nine years that the law has been in force: —

Year.	Number of Pieces tested.	Number of Pieces Condemned.	Percentage Condemned.
1901,	5,041	291	5.77
1902,	2,344	56	2.40
1903,	2,240	57	2.54
1904,	2,026	200	9.87
1905,	1,665	197	11.83
1906,	2,457	763	31.05
1907,	3,082	204	6.62
1908,	2,713	33	1.22
1909,	4,071	43	1.06
Totals,	25,639	1,844	7.19[1]

The passage of this law has prevented 1,844 pieces of inaccurately graduated glassware, representing 7.19 per cent., of the entire number tested, from coming into use.

(3) *Inspection of Babcock Machines.*

In 1901, at the time of the first annual inspection, there were in Massachusetts 40 creameries and milk depots using the Babcock test as a basis for fixing the value of milk and cream. Owing to the increasing demand for milk, many creameries have either suspended operations or have been bought up by

[1] Average.

the large Boston milk companies, so that at the present inspection (November, 1909) but 29 places were visited, of which 16 were creameries, 11 milk depots, 1 city milk inspector and 1 chemical laboratory. Ten of the creameries were co-operative and 6 proprietary. The 11 milk depots were in every case proprietary. Twenty-nine machines were inspected, of which 2 were condemned, but on second inspection a few weeks later they were found to have been put in good condition. Those in use are 11 Facile, 8 Agos, 6 Electrical, 3 Wizard and 1 Twentieth Century. The glassware, as a whole, was clean, and so far as noted was Massachusetts tested. It is believed, on account of worn bearings and carelessness in keeping them clean and well oiled, that an excess of steam is necessary in many cases to give the required speed. Care should be taken to see that steam machines do not overheat the tests, which should be read between 120° and 140° F.

The creameries and milk depots which pay by the test are as follows: —

Creameries.

Location.	Name.	President or Manager.
1. Amherst,	Amherst,	W. A. Pease, manager.
2. Ashfield,	Ashfield Co-operative,	Wm. Hunter, manager.
3. Belchertown,	Belchertown Co-operative,	G. B. Jackson, manager.
4. Brimfield,	Crystal Brook,	F. N. Lawrence, proprietor.
5. Cheshire,	Greylock Co-operative,	Carl Williams, manager.
6. Cummington,	Cummington Co-operative,	W. E. Partridge, manager.
7. Egremont,	Egremont Co-operative,	E. A. Tyrrell, manager.
8. Easthampton,	Hampton Co-operative,	W. S. Wilcox, manager.
9. Heath,	Cold Spring,	F. E. Stetson, manager.
10. Hinsdale,	Hinsdale Creamery Company.	W. O. Solomon, proprietor.
11. Monterey,	Berkshire Co-operative,	F. A. Campbell, manager.
12. New Salem,	New Salem Co-operative,	W. A. Moore, president.
13. North Brookfield,	North Brookfield,	H. A. Richardson, proprietor.
14. Northfield,	Northfield Co-operative,	C. C. Stearns, manager.
15. Shelburne,	Shelburne Co-operative,	Ira Barnard, manager.
16. Wyben Springs,	Wyben Springs Co-operative.	C. H. Kelso, manager.

Milk Depots.

Location.	Name.	President or Manager.
1. Boston,	D. W. Whiting & Sons,	Geo. Whiting, manager.
2. Boston,	H. P. Hood & Sons,	W. N. Brown, manager.
3. Boston,	Boston Dairy Company,	W. A. Graustein, president.
4. Boston,	Walker-Gordon Laboratory,	M. B. Small, manager.
5. Boston,	Oak Grove Farm,	Alden Brothers, proprietors.
6. Cambridge,	C. Brigham Company,	J. R. Blair, manager.
7. Cheshire,	Ormsby Farms,	W. E. Penniman, manager.
8. Dorchester,	Elm Farm Milk Company,	J. H. Knapp, manager.
9. Sheffield,	Willow Brook Dairy,	G. W. Patterson, manager.
10. Southboro,	Deerfoot Farm Dairy,	S. H. Howes, manager.
11. Springfield,	Tait Brothers,	Tait Brothers, proprietors.
12. Springfield,	Emerson Laboratory,	H. C. Emerson, proprietor.
13. Springfield,	Milk inspector,	Stephen C. Downs.

Attention is called to the article on the "Babcock Test," published in Circular No. 24 of this station, and to the article on "Reading the Babcock Test," printed elsewhere in this report.

(*c*) *Milk, Cream and Feeds sent for Free Examination.*

The experiment station will analyze samples of milk, cream and feeds sent for examination in so far as the time and resources at its command permit, and in addition will furnish such information as is likely to prove of value in interpreting the results of such analysis. Under the dairy law the station has the right to charge the cost of the analyses of milk and cream; charges, however, are not made unless the number of analyses required is considerable. Only in exceptional cases should material intended for free chemical examination be sent except by previous arrangement. Upon application full instructions for sampling and directions for shipping will be furnished, which will often obviate the necessity of sending another sample in place of the one improperly taken.

(d) *Analysis of Drinking Water.*

Since the establishment of the station in 1882, sanitary analyses of drinking water have been carried out for parties within the State. Beginning Jan. 1, 1903, free analyses were discontinued, and a charge of $3 a sample made. The reason for this change was the fact that many parties abused the privilege, and also because work of this character interfered with legitimate experiment station work. The above charge must be paid when the sample of water is sent. During the year 91 samples have been tested and the results promptly reported.

In order to secure an analysis application must first be made, whereupon a suitably encased glass jar, together with full instructions for collecting and forwarding the sample, will be forwarded by express. An analysis of water sent in shippers' jars will not be undertaken, neither will bacteriological nor mineral analyses be made. The object in offering to make an examination of water is to enable the citizens of the State, depending upon wells and springs, to ascertain at a minimum expense whether their supply is free from such objectionable matter as is likely to gain entrance from sink, barn or privy. Such an examination is referred to as a sanitary analysis.

Lead pipe should never be employed for carrying drinking water; in case it is in use it should be removed at once, and galvanized iron or iron coated with asphaltum substituted. *Lead is a poison* and after it has entered the system it is eliminated only with the greatest difficulty.

(e) *Miscellaneous.*

In addition to the work already described, this division has conducted investigations and made other analyses as follows: —

1. It has co-operated with the Official Dairy Instructors and Investigators Association in a study of the Babcock test, the results of which are published elsewhere in this report.

2. It has made an investigation on the use of the Zeiss immersion refractometer in the detection of watered milk, the results of which are likewise published in the present report.

3. It has co-operated with the Association of Official Agri-

cultural Chemists in a study of methods for the determination of the various ingredients in condensed milk.

4. It has co-operated with the Association of Official Agricultural Chemists in a study of methods for the determination of total nitrogen.

5. In connection with the experimental work of this and other departments of the experiment station, this division has made partial analyses of 191 samples of milk, 157 samples of cattle feeds and 520 samples of agricultural plants.

(*f*) *Testing of Pure-bred Cows.*

The work of testing cows for the various cattle associations has increased considerably during the past year. At the present time two men are kept on the road a greater part of the time on work in connection with the Jersey, Guernsey and Ayrshire tests. The rules of the above associations require the presence of a supervisor once each month at the farms where animals are on test. The milk yields noted by the supervisors at their monthly visits are used in checking up the records reported by the owners to the several cattle clubs. The Babcock tests obtained at that time are likewise reported and used as a basis for computing the butter-fat yield for that month.

The Holstein-Friesian tests are of much shorter duration, usually seven or thirty days, and require the presence of a supervisor during the entire test. These tests give rather irregular employment to a number of men during the winter months. On account of the uncertainty of the work such men are difficult to obtain, but thus far it has not been necessary for the experiment station to refuse an application.

During the past year 1 seven-day and 33 yearly Guernsey, 5 seven-day and 66 yearly Jersey, and 8 yearly Ayrshire tests have been completed. For the Holstein-Friesian association 77 seven-day, 3 fourteen-day, 8 thirty-day and 1 sixty-day tests have been completed. There are now on test for yearly records 80 Jerseys, 29 Guernseys, 9 Ayrshires and 1 Holstein.

REPORT OF THE BOTANISTS.

G. E. STONE; G. H. CHAPMAN, ASSISTANT.

The routine work of the botanist for the past year has been similar to that of other years. Correspondence relating to various diseases and special problems has occupied much time, and investigations of various problems have been taken up.

In carrying out the details connected with the routine work and investigations we have had the assistance of Mr. G. H. Chapman, and in the keeping of records, seed testing and correspondence, Miss J. V. Crocker has been of much assistance. Mr. R. D. Whitmarsh, who is pursuing graduate studies at the college, has aided materially in the diagnosis of diseases and in other ways about the laboratory.

Diseases More or Less Common to Crops during the Year.

The season of 1909 was exceptionally dry, like that of 1908, and vegetation suffered materially. Some rain fell in the early spring months, but the average precipitation was below the normal. The summer was remarkably free from thunderstorms. The growing season opened later than usual and vegetation was a week or two behind throughout the whole season, some crops not maturing as well as in other seasons.

Little or no winter injury was observed to vegetation, but late frosts in the spring affected asparagus in some localities. The injury was in some respects similar to a trouble which has been previously reported on as being associated with a fungus (*Fusarium*).

Some cases were noted of defoliation of apple trees by frost blisters, caused by the effects of late spring frosts.

Besides the usual number of fungous diseases commonly met with, the following may be mentioned as being more or less abundant, and worthy of note for other reasons.

The past season has been a favorable one for rusts in general. Apple rust (*Puccinia*), which is seldom present, was more or less abundant, as in the season of 1908, and affected both foliage and fruit. Certain varieties seemed to be more susceptible than others. Some bad cases of bean rust (*Uromyces*) were noted here and there. This rust, like the one on the apple, is seldom troublesome with us. Hawthorns were affected more severely than usual with rust, resulting in some damage to nursery stock. The wild species of hawthorn is seldom immune to rust, but there is usually no complaint of nursery stock rusting. Quince rust (*Gymnosporangium*), which is always to be found, was more abundant than usual. Some severe cases of rust (*Phragmidium*) were also noted on the rose, and powdery mildew (*Sphærotheca*) was quite prevalent.

Peach leaf curl (*Exoascus*) was occasionally observed, but was not troublesome.

A bacterial wilt of the eggplant, which is more common in the south, was reported once or twice.

One severe case of beet scab (*Oöspora*) was also observed. In this particular case the soil had been limed, which substantiates the fact that liming the soil increases scab materially. While with us the beet is not so susceptible to scab as the potato, care should be taken not to plant beets where scab is abundant, and special precautions should be taken in applying lime to the soil.

Potatoes were generally free from troubles, but some cases of *Rhizoctonia* were observed; also a bacterial rot of the tuber.

Dropsical swelling of pear twigs, a more or less unusual trouble, was reported at different times, and the Baldwin fruit spot, which appears to be more common in dry than wet seasons, has been quite prevalent.

The leaf spot of apple (*Phyllosticta*) was very abundant early in the season and caused considerable defoliation.

More or less severe injury has resulted to peach and plum trees the last year or two from what is known as "gummosis." This disease is apparently caused, at least in many cases, by leaving the old "mummied" fruit affected with Monilia on the trees over winter. These "mummied" plums, contaminated with fungi, come in contact with the branches and cause "gummosis." This trouble is now being studied in the laboratory and field.

The blossom-end rot of tomatoes, a dry-season disease, was quite common, causing considerable injury. A liberal supply of soil moisture during the period of setting fruit is the best remedy for this trouble.

The downy mildew of the cucumber and melon (*Plasmopara*) occurred as usual during August and September, affecting both out-of-door crops and those under glass, while *Anthracnose* (*Colletotrichum*) was not so destructive as in some seasons.

The leaf spot caused by *Alternaria* was quite general on the foliage and fruit of the muskmelon and watermelon, but a large field of rust-resistant melons was found on September 7 to be absolutely free from any blight. Since spraying melons for blight has proved to be of little value, it is desirable to use types which are immune to the blight. The best method of growing melons in this climate consists in selecting an early, sandy soil, with warm exposure. The soil should be thoroughly tilled, and the plants set out early, blight-resisting varieties being used. A location as free as possible from frequent dews should be selected, and manure in the hills is superior to fertilizers, since it gives the plant better soil conditions. It is best to start the plants early in pots or strawberry boxes under glass, and transplant to the open field. Native muskmelons are far superior to the half-matured imported product, and a ready market awaits the successful grower.

Shade-tree Troubles.

The rainfall during the early spring months revived vegetation in general from the effects of the severe drought of the preceding season. This stimulated trees and shrubs to assume a healthy appearance and produce a good crop of foliage. The succeeding months, however, were very dry, and considerable defoliation of shade and fruit trees occurred in June and July. The long period of drought resulted in a premature coloration of the foliage, and consequent early defoliation.

Occasional high winds, with lack of soil moisture, caused sun scorch, particularly to maples. Some of the defoliation, particularly that of the elm, was caused by squirrels, and some was due to a natural shedding of the twigs. *Dothidella ulmi*, a leaf-spot fungus occasionally found on elms, was unusually abundant rather early in the season, and this was also responsible for much loss of foliage.

The Italian poplar was more severely affected with the rust (*Melampsora*) than usual, and the twigs and leaves of the ash suffered from a similar fungus to an unusual extent. Horse-chestnut foliage was badly affected with a leaf spot (*Phyllosticta*), and a black spot (*Rhytisma*) more or less common every year on the white maple was unusually abundant. It was more common on the white maple than usual, and the leaves of the red maple were literally covered with it.

Ivy (*Ampelopsis*) was affected with a leaf spot. In some localities quite a few maple trees were killed by sun scald, while others were scalded only on their southern exposure. Following this outbreak of sun scald, *Nectria*, a fungus of saprophytic habit, developed freely.

REPORT OF THE ENTOMOLOGISTS.

C. H. FERNALD; H. T. FERNALD; J. N. SUMMERS.

The work of the department of entomology during the year 1909 has differed little from that of preceding years. Correspondence, as usual, has required much time, and many inquiries involve considerable investigation where some of the less familiar insects are concerned. This has been particularly true during the past season, the number of insects concerned having been larger than usual, though serious injury from their attacks has been rather conspicuously absent.

Experimental work in some subjects has been continued from previous years, while in others it has been temporarily suspended. The construction of the new entomological building has necessitated giving up the use of the present greenhouse, as this was liable to removal to its new site at any time, and when this should occur any experiments under glass would necessarily come to an end. For this reason further tests of the resistance of muskmelons to fumigation have been discontinued for the present, but it should be possible to resume them another year. Studies on the number and relative importance of the different broods of the codling moth have been continued, but the orchard in which these have been made thus far has now been taken for other uses, and has been so treated that it is no longer available for this purpose. Unless another orchard, under conditions suitable for the work, can be obtained, this line of investigation will, therefore, have to be dropped, although in order to reach satisfactory results it should be continued for at least four or five years more.

Experiments on methods for the control of the cabbage maggot have been repeated again, but without satisfactory results, the maggots, though more abundant than during the two years preceding, being still too scarce to give results which could be considered entirely trustworthy.

Observation of the dates of appearance of the young of our common scales have been continued, adding the records of another year to those already in hand. This work will also need to be continued for a number of years in order to provide data of sufficient value for general use.

The experiments for the control of the onion thrips have proceeded far enough to show that spraying the onions after this insect has appeared on them is, at best, only a partial remedy. One of the results of the work of this pest is to curl the leaves of the onion, and the insects at once gather on the inner side of the curled surface, so that many of them cannot be reached by the spray, though those which are reached in this way are destroyed. A study of the life history of these insects shows that they pass the winter at the top of the ground in protected places, such as are furnished by dead grass around the onion fields, in rubbish heaps and similar places; and a few attempts to destroy them by burning over the grass and rubbish around the fields have been followed by a reduction in the abundance of the insect the next spring. This method of control has not as yet been tested long enough to prove that the result was actually due to the treatment rather than to merely natural causes, but, in any case, it seems to be the most promising way we have yet found to check this insect, and it should be repeated until its value has been fully determined.

Perhaps the most important entomological event of the year at the station was the discovery of an egg parasite of the common asparagus beetle, which was found actively at work about the first of June. Observations on this insect, its habits and life history, have been published as Circular No. 23 of the station, and also in the "Journal of Economic Entomology."

The control of wire worms, attacking seed corn in the ground soon after it has been planted, is important, as these pests, when abundant, often necessitate the replanting of many acres. Experiments to prevent the attacks of this insect have been carried on by Mr. Ralph H. Whitcomb of Amherst, and his ingenuity has discovered that when the corn, when planted, has been covered with tar as a repellant for crows, as is quite generally done in this locality, and then treated with a mixture of Paris green and dust until a greenish color is perceptible, it will not be eaten by wire worms. These experiments will be repeated the coming year.

Within the last twenty years Massachusetts has been invaded by several injurious insects which naturally belong farther south. Among these may be mentioned the elm-leaf beetle, San José scale, common asparagus beetle and the twelve-spotted asparagus beetle. How far north these pests can spread and be injurious is as yet unknown, but it is certain that there are limits to this spread, and for at least some of those named it seems quite certain that these limits may probably be found within this State. It is not a particular degree of latitude which marks the barrier to their further spread northward, but rather climatic conditions, and these are modified by elevation. In other words, the limiting lines of distribution appear to be isothermal in their nature, though their exact character is as yet unsettled. It may be the average winter temperature, the minimum winter temperature or some other factor which settles whether an insect shall be a pest at any given place near its northern limit. In any case, the determination of this cause, and the resulting conclusion that an insect will or will not become injurious at a given place, will be of much importance. As an example of this it may be stated that such evidence as is now available, though as yet too little to be conclusive, suggests the belief that in Massachusetts the elm-leaf beetle will not be likely to be of much importance in those parts of the State which are more than a thousand feet above sea level, except, perhaps, near the southern edge of the State, where the altitude is to some extent offset by the more southern latitude. To work out problems of this nature fuller meteorological data are needed, as well as more observations of the distribution of the insects themselves, and studies of this kind have been in progress for several years, and will be continued.

Parasitism as one of nature's methods for the control of injurious forms has long been recognized. It has been utilized in numerous cases by man, who has conveyed parasites from one country to another to attack their hosts, which have already been by accident thus transferred. Perhaps the most gigantic experiment of this kind is that now being conducted by the Bureau of Entomology of the United States Department of Agriculture and those in charge of the gypsy moth work in Massachusetts, in importing from the old world the parasitic and other enemies of the gypsy and brown-tail moths, in the hope that they may become established in this country and bring these pests under control.

No one seems to know, however, how effective parasites really are; conceding their importance, we have only the most general statements on the subject, and almost the only paper giving more than these is a short one by Dr. L. O. Howard, entitled "A Study of Insect Parasitism."

It would seem most desirable to substitute statistics for guess-work on a subject so important as this, and therefore the scope of parasitism by the insects of a restricted group, the conditions favoring and checking it, and all the factors entering into the problem have been taken up for prolonged study, and it is hoped that tangible results may in time replace the vague generalizations on this subject which, thus far, are all that have been available.

Investigations on spraying have been continued since the last report, but with disappointing results. As was stated last year, the first step was to obtain pure spraying materials, and it was supposed that these were available, as reliable manufacturers offered them as such. To be certain, however, these were analyzed, and the results showed that the materials were not as pure as was necessary for the purpose, making it necessary to make these materials at the station. This has held up the work to some extent, for while considerable time was spent in applying the materials to various plants, and watching the results, the later discovery of the unreliability of the materials used has made valueless the experimental work done with them. New spraying materials made here must, therefore, be obtained to use in these experiments, in order to obtain the results needed as a basis for the study of the commercial materials which is to follow, and at present the work is at a standstill till these materials can be prepared. It is expected, however, that they will be available for use during the coming summer.

THOMAS SLAG. A SHORT HISTORICAL REVIEW.

BY J. B. LINDSEY.

Thomas slag, or basic phosphatic slag, is a by-product in the modern method of steel manufacture from ores containing noticeable quantities of phosphorus. The process of removing the phosphorus from the ore was discovered by the English engineers Gilchrist and Thomas, and, briefly stated, consists in adding to the so-called converter containing the molten ore a definite quantity of freshly burnt lime, which, after a powerful reaction, is found to be united with the phosphorus, and swims upon the surface of the molten steel in the form of a slag.

Composition of the Slag.

The composition of the Thomas or Belgian slag varies according to the character of the ore and the success of the process for removing the impurities. The following figures show such variations:[1] —

	Per Cent.
Phosphoric acid,	11–23
Silicic acid,	3–13
Calcium oxide (lime),	38–59
Ferrous and ferric oxides,	6–25
Protoxide of manganese,	1–6
Alumina,	.2–3.7
Magnesia,	2–8
Sulphur,	.2–1.4

More or less metallic iron is enclosed in the coarse slag which is generally thoroughly removed from the ground material by the magnet.

[1] Agricultur Chemie von Adolf Mayer, II Band, 2te Abtl., 6 Auflage pp. 138, 139.

Manurial Value of Slag recognized.

The manurial value of the slag was not recognized for a long time; finally experiments revealed that a considerable portion of its phosphoric acid was soluble in dilute citric and carbonic acids, which led to successful field experiments. The only preparation of the slag for fertilizing purposes, when its value was first recognized, consisted in having it finely ground in especially prepared mills, so that 75 per cent. would pass through a sieve with perforations of .17 millimeter diameter. This requirement was suggested by M. Fleischer, who used the slag with much success in improving the condition of marsh and meadow lands.

Methods for determining Availability and Adulteration.

Previous to 1890, by means of pot experiments as well as by laboratory investigations, Wagner demonstrated that the phosphoric acid in different slags of the same degree of fineness varied in its availability from 30 to 90 or more per cent., and, further, that many brands were adulterated with Belgian or other insoluble mineral phosphates.

The previous method, therefore, of determining the value of a slag by the percentage of total phosphoric acid present and the degree of fineness, was of secondary importance.

In order to detect adulteration with mineral phosphates, Wagner originally used a dilute solution of citrate of ammonia and free citric acids.[1] The phosphoric acid in all of the mineral phosphates was sparingly soluble in such a reagent, while an unadulterated high-grade slag gave up 80 to 90 parts of its phosphoric acid. Further investigations on various soils with many brands of slag made it clear that the results obtained from pot experiments corresponded quite well with those secured by means of the citric acid solution. This may be illustrated as follows:—

[1] Chemiker Zeitung No. 63, 1895; also Düngungsfragen Heft I., p. 16, von P. Wagner, 1896.

Brand of Slag.	Phosphoric Acid available in Citric Acid Solution.	Phosphoric Acid available in Pot Experiments.
1,	100	100
2,	85	80
3,	81	72
4,	72	72
5,	73	66
6,	76	63
7,	39	40
8,	48	38
9,	42	38
10,	45	31
11,	38	30

Results similar to the above were secured by Maercker,[1] who stated that "the results removed all doubt that the citrate solubility and plant experiments were so nearly proportioned that one had the same right to value the slag according to its content of phosphoric acid soluble in citrate solution as to value a superphosphate by its content of water soluble phosphoric acid."

As a result of these investigations, the union of German experiment stations, at its meeting at Kiel in September, 1896, adopted the method of determining the relative value of the slag according[2] to its phosphoric acid solubility in a 2 per cent. citric acid solution, and did away with the previous standard of total phosphoric acid and fineness.

Wagner as well as Maercker repeatedly called attention to the fact that experiments both in the laboratory and with plants gave positive evidence that those slags of *like phosphoric acid content* which were *richest in silicic acid* gave the best results. G. Hoyermann, working independently, came to similar conclusions. At the present time, according to Wagner, practically all of the iron works treat the molten slag as it flows from the converter with hot quartz sand, with the result that the avail-

[1] Landw. Presse 1895, No. 82.

[2] Method slightly modified from the original. Present method described in Konig's Untersuchung landwirtschaftlich und gewerblich wichtiger Stoffe. Dritte Auflage, pp. 173, 174.

ability of the phosphoric acid is improved from 10 to 30 per cent.[1]

Chemical Combination of Phosphoric Acid in Slag.

The form in which the phosphoric acid exists in the slag has never been fully explained. It was formerly supposed that it was combined with lime as a tetra-calcium phosphate, and that this latter compound, being less stable than tri-calcium phosphate, under the influence of dilute acids became easily available to the plants by being decomposed into the calcium salt of the dissolving acid and bi-calcium phosphate. The tetra-lime phosphate, however, has never been made artificially,[2] although it has been recognized by the aid of the microscope in the slag, and exists as a mineral under the name of isoklas.

More recent investigations having shown, as already indicated, that those slags richest in silicic acid of like phosphoric acid content gave the best results, the conclusion followed that a part of the lime must be in the form of lime silicate. It is now generally held, especially by Wagner,[3] that the phosphoric acid is combined in the slag as a double salt of tri-calcium phosphate and calcium silicate, and that in this form the roots are able to utilize it. It is also believed probable that some of the phosphoric acid is more or less united with iron as a basic iron phosphate.

The Use of Phosphatic Slag.

Basic slag has been shown to work especially well upon sour marsh and meadow lands, upon porous, well-aired soils rich in humus, as well as upon sandy soils deficient in lime.

When a rapid development of the crop is not desired, the slag may be used exclusively in place of acid phosphate. On the other hand, in cases when it is feared that the crop will not mature early enough, upon heavy, cold land and in high altitudes, where the season is short, acid phosphate should be given the preference.

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[1] Already cited, p. 28; also, Anwendung Künstlicher Düngemittel, vierte Auflage von Wagner, pp. 74, 75.

[2] Hilgenstock: Jahresber. Chem. Technologie, 1887, p. 282, after Adolf Mayer, already cited.

[3] Wagner, already cited.

The phosphoric acid in slag is comparable in its quickness of action to nitrogen in barnyard manure, tankage and green crops; and the phosphoric acid in acid phosphate to the action of nitrogen in nitrate of soda. A combination of slag and sulfate of potash (500 pounds slag and 150 pounds potash) has been found to work especially well upon grass land, and to be very favorable to the development of clover.

Quantity of Slag per Acre.

If the soil is particularly deficient in phosphoric acid, one can use as high as from 800 to 900 pounds of slag to the acre, plowed in and supplemented with 200 pounds of acid phosphate in the hill or drill.

If, on the contrary, the soil is naturally rich in phosphoric acid, or has been made so by large additions of slag for a series of years (1,000 or more pounds yearly), then it is necessary only to replace from year to year the amount removed by the crop. In such cases Maercker states that one part of phosphoric acid in basic slag is as valuable as an equal amount in acid phosphate.

EFFECT OF PORTO RICO MOLASSES ON DIGESTIBILITY OF HAY AND OF HAY AND CONCENTRATES.

BY J. B. LINDSEY AND P. H. SMITH.

I. INTRODUCTION.

In New England, cane molasses brought in tank steamers from Porto Rico has been freely offered for a number of years at from 12 to 15 cents a gallon of 12 pounds in barrel lots. The material is dark in color but quite satisfactory in quality. It has been found to contain from 20 to 28 per cent. of water (average 24 per cent.), about 3 per cent. of protein (largely as amids), 6 to 7 per cent. of ash, and the balance of sugars and allied substances. The following analyses made at this station represent the composition of three different samples of Porto Rico molasses: —

		1904. Sample.		1905. Sample.		1906. Sample.	
Water,			24.40		28.50		24.98
Ash,			7.13		6.04		5.57
Crude Protein,	Albuminoids,	1.24	3.17	.96	2.82	–	2.19
	Amids,	1.93		1.86		–	
Extract Matter,	Cane sugar,	29.72	65.30	36.26	62.64	37.86	67.26
	Invert sugar,	25.03		19.38		20.48	
	Undetermined,	10.55		7.00		8.92	
			100.00		100.00		100.00

It may be remarked that two analyses of the ash have shown traces of phosphoric acid and 3.66 and 4.84 per cent. of potash, the latter being by far the most predominant ash constituent. Beet molasses has been shown to contain rather more ash than cane molasses.

It can be assumed with safety that molasses, being soluble in water, is easily digested and assimilated when fed in reasonable amounts. If fed in excess it is likely to affect adversely the heart and kidneys, and to appear undigested in the urine.[1] It is a well-known fact that the addition of starch, sugar and similar substances causes a distinct depression in the digestibility of the material with which they are fed.[2] Various reasons have been advanced to account for this depression, which has as yet not been definitely proved. In case of beet molasses, Kellner [3] has shown an average digestion depression of 9 per cent., and he states that the value of beet molasses for cattle and sheep consists in its 55 per cent. of digestible carbohydrates (1,100 pounds to the ton).

Lehmann,[4] as a result of three digestion experiments (nine single trials) with sheep, obtained an average digestion depression of 11 per cent., which he deducts from the 71 per cent. of total organic matter in beet molasses, thus securing 60 per cent., or 1,200 pounds, of digestible organic matter to the ton.

Grandeau and Aleken have shown that molasses when fed to horses also causes a noticeable digestion depression. Alquier and Drouineau, in reviewing the work of both French and German investigators, state that in case of horses the addition of 3 pounds of molasses per 1,000 pounds live weight caused a depression of 4.5 per cent., while with ruminants the feeding of 4 pounds of molasses per 1,000 pounds live weight produced an average depression of only 3 per cent. in the digestibility of the foods with which it was fed.[5]

Patterson [6] reported, in case of two steers, when molasses constituted some 12 per cent. of the total dry matter of the ration, an improvement of 24 per cent. in the digestibility of the hay. Molasses fed to four steers in combination with hay and grain, and comprising 14 per cent. of the total dry matter of the ration, improved the condition of the hay and grain ration 14.5 per cent. (coefficients of digestibility of the dry matter of the hay

[1] Kellner, Arbeiten der D. Landw. Ges. 152 Heft., 1909, p. 16.

[2] Kellner, Die Ernahrung Landw. Nutzthiere, fünfte Auflage 1909, pp. 50, 51. Numerous references are cited by Kellner.

[3] Landw. Verssuchs. 53 Bd., pp. 220 and 233, 234, 304 and 342, 343; 55 Bd., p. 384.

[4] Landw. Jahrbücher, Vol. XXV., Ergänzungsband II., 1896.

[5] Ann. Sci. Agron., 2 série, 1904, Tome I, pp. 249-254.

[6] Molasses Feeds, Bulletin 117, Maryland Experiment Station.

and grain without molasses, 55.1 per cent.; with molasses, 63.1 per cent.). Patterson's results are quite the opposite of all previous work along this line.

II. EXPERIMENTS AT THE MASSACHUSETTS EXPERIMENT STATION.

Experiments relative to the effect of Porto Rico molasses on digestibility have been in progress at intervals at this station since 1905. Different amounts of molasses have been added to a basal ration of hay, of hay and corn meal, and particularly of hay and gluten feed. The experiments made during the winter of 1905 and 1906 have been published in detail.[1] The numerous other experiments are here reported for the first time.

Sheep were employed in all cases; in Series XI. and XII. grade Southdown wethers were used, and in Series XIII. and XIV. one and two year old Shropshires were employed.

The hay was cut in 2-inch lengths before being fed, and was largely Kentucky blue grass, with an admixture of some clover and sweet vernal grass. The gluten feed represented the dried residue of Indian corn (*Zea mais*) in the manufacture of corn-starch, and consisted of the hulls and glutinous part of the corn, together with that portion of the starch and broken germs which could be removed by mechanical means. It was free from any indication of decomposition. The corn meal consisted of the ground corn kernels.

The sheep were fed twice daily, — about 7 o'clock in the morning and 5 in the afternoon. The molasses was mixed with about its weight of water and sprinkled over the hay, or was mixed with the grain and eaten without the addition of water. The food was given in galvanized-iron pans which fitted closely into the wooden stalls in which the sheep were confined.[2] Particles of cut hay that were thrown out of the box were carefully brushed up and returned. Any waste remaining at the end of the period was preserved and analyzed. Water in galvanized-iron boxes was always before the sheep. The fæces were collected twice daily, preserved in wide-mouth glass-

[1] Nineteenth report of the Hatch Experiment Station, pp. 126-149.

[2] Illustrated in eleventh report of the Massachusetts State Experiment Station, 1893, p. 148.

stoppered bottles and taken to the laboratory every twenty-four hours. The daily sample was poured upon a newspaper, well mixed and an aliquot part (usually 1/10) weighed into a crystallization dish and dried at 60° C. After this drying was completed the samples were allowed to stand at ordinary temperature for a number of days, and were reweighed, mixed, ground, placed in glass-stoppered bottles and eventually analyzed. Nitrogen was determined in the dry sample but not in the fresh fæces, as is frequently done at the present time. The entire period lasted fourteen days, seven of which were preliminary, the fæces being collected during the last seven. The sheep were kept in roomy stalls during the first three days, and then harnessed and placed in the digestion stalls for the last eleven days of the trial.

The results of the different experiments are first presented, together with a discussion of the same. The full data follows the discussion.

A. Hay and Molasses.

Summary of Results.

Series XII., Period III.

[800 grams hay, 100 grams molasses and 10 grams of salt.]

(*a*) *Coefficients for Molasses.*

	Dry Matter.	Ash.	Crude Protein.	Extract Matter.
Old Sheep II., ...	69.05	-	-	87.26
Old Sheep III., ...	100.99	41.31	80.29	101.58

From the above coefficients it would appear that Sheep II. digested only 69 per cent. of the total dry matter of the molasses, while Sheep III. digested the entire amount fed. It can, however, be safely assumed that molasses, being quite soluble in water, is easily digested and entirely resorbed in the digestion tract. Only minute traces of reducing substances have been recognized in the fæces.

(b) *Depression noted (Grams).*

Old Sheep II.

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of 800 grams hay when fed alone,	476.72	23.31	53.52	179.27	208.31	10.67
Digested of 800 grams hay plus 100 grams molasses, ...	527.44	23.17	51.88	177.82	265.30	9.27
Minus 100 grams molasses fed, assumed to be all digested, ...	73.45	5.35	2.79	-	65.31	-
Remains for 800 grams hay digested when fed with molasses, ...	453.99	17.82	49.09	177.82	199.99	9.27
Difference or depression, ...	—22.73	—5.49	—4.43	—1.45	—8.32	—1.40

Old Sheep III.

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of 800 grams hay when fed alone,	476.72	23.31	53.52	179.27	208.31	10.67
Digested of 800 grams hay plus 100 grams molasses, ...	550.90	25.52	55.76	184.40	274.65	10.56
Minus 100 grams molasses fed, assumed to be all digested, ...	73.45	5.35	2.79	-	65.31	-
Remains for 800 grams hay digested when fed with molasses, ...	477.45	20.17	52.97	184.40	209.34	10.56
Difference or depression, ...	+.73	—2.14	—.55	+5.13	+1.03	—.11

When the hay was fed by itself the nutritive ratio of the digestible ingredients was 1 : 7.7, and when fed with molasses, 1 : 9; molasses constituted 9.5 per cent. of the dry matter of the hay-molasses ration. In case of Sheep II. the 100 grams of molasses created a very marked depression in the digestibility of the several ingredients of the hay, namely, 21.09 (22.73) grams of dry matter, equal to 4.7 per cent. In case of Sheep III. there appears to have been a very slight gain in the digestibility of the hay.

Series XIII., Period I.

[600 grams hay, 100 grams Porto Rico molasses, 10 grams salt.]

(a) *Coefficients for Molasses.*

	Dry Matter.	Ash.	Crude Protein.	Extract Matter.
Sheep I, ...	99.77	48.08	52.40	102.01
Sheep II, ...	96.34	47.36	23.65	100.66
Average, ...	98.06	47.70	38.03	101.34

(b) Depression noted (Grams).

Sheep I.

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of 600 grams hay when fed alone,	354.34	18.07	40.41	110.27	178.99	6.54
Digested of 600 grams hay plus 100 grams molasses,	427.10	20.89	42.16	113.00	243.99	7.05
Minus 100 grams molasses, all digested,	72.93	5.87	3.34	-	63.72	-
Remains for 600 grams hay digested when fed with molasses,	354.17	15.02	38.82	113.00	180.27	7.05
Difference,	—.17	—3.05	—1.59	+2.73	+1.28	+.51

Sheep II.

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of 600 grams hay when fed alone,	354.54	18.07	40.41	110.27	178.99	6.54
Digested of 600 grams hay plus 100 grams molasses,	424.60	20.85	41.20	112.62	243.13	6.79
Minus 100 grams molasses, all digested,	72.93	5.87	3.34	-	63.72	-
Remains for 600 grams hay digested when fed with molasses,	351.76	14.98	37.86	112.62	179.41	6.79
Difference,	—2.67	—3.09	—2.55	+2.35	+.42	+.25

The nutritive ratio of the hay when fed by itself was 1 : 7.5, and of the molasses-hay ration, 1 : 8.6; the dry matter of the molasses constituted some 12 per cent. of the dry matter of the hay-molasses ration. A slight depression only is noted, being rather more pronounced in case of Sheep II. The depression falls upon the ash and protein. An apparent slight improvement in digestibility is noted in case of the fiber and extract matter. Sheep I. gained 3 pounds in live weight, and Sheep II. maintained equilibrium.

SERIES XI., PERIOD III.[1]

[800 grams hay, 150 grams molasses and 10 grams salt.]

(a) Coefficients for Molasses.

	Dry Matter.	Ash.	Crude Protein.	Extract Matter.
Paige Sheep IV.,	107.09	92.16	40.43	102.76
Paige Sheep V.,	90.93	80.02	10.17	95.80

[1] Already published in nineteenth report of this station, p. 145.

The coefficients indicate that in one case the molasses depressed the digestibility of the hay and in one case it actually improved it.

(*b*) *Depression noted* (*Grams*).

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Paige Sheep IV., ...	+7.60	—.71	—2.52	+8.03	+2.60	+.42
Paige Sheep V., ...	—9.73	—1.81	—3.80	—.04	—3.95	+.19

The nutritive ratio of the hay ration was as 1 : 9.9, and of the hay-molasses ration, 1 : 10.7 ; molasses constituted 13.2 per cent. of the dry matter of the total ration. In this case the results are contradictory, in one case increasing and in the other depressing the digestibility of the hay. Each sheep lost 2 pounds in weight during the seven days.

Series XIII., Period III.

[600 grams hay, 200 grams molasses, 10 grams salt.]

(*a*) *Coefficients for Molasses.*

	Dry Matter.	Ash.	Crude Protein.	Extract Matter.
Sheep I, ...	88.96	59.34	21.57	94.76
Sheep II, ...	74.67	52.41	-	89.72

(*b*) *Depression noted* (*Grams*).

Sheep I.

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of 600 grams hay when fed alone,	357.06	18.22	40.72	111.13	180.37	6.60
Digested of 600 grams hay plus 200 grams molasses, ...	486.81	25.24	42.20	111.76	300.89	6.75
Minus 200 grams molasses, assumed to be all digested, ...	145.86	11.83	6.86	-	127.18	-
Remains for 600 grams hay digested when fed with molasses, ...	340.95	13.41	35.34	111.76	173.71	6.75
Difference or depression, ...	—16.11	—4.81	—5.38	+.63	—6.66	+.15

Sheep II.

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of 600 grams hay when fed alone,	357.06	18.22	40.72	111.13	180.37	6.60
Digested of 600 grams hay plus 200 grams molasses, ...	465.99	24.42	40.71	100.14	294.48	6.25
Minus 200 grams molasses, assumed to be all digested, ...	145.86	11.83	6.86	-	127.18	-
Remains for 600 grams hay digested when fed with molasses, ...	320.13	12.59	33.85	100.14	167.30	.25
Difference or depression, ...	36.96	—5.63	—6.87	—10.99	—13.07	—.35

The nutritive ratio of the hay when fed alone was 1:7.5, and of the hay-molasses ration, 1: 10.1; molasses constituted 21.4 per cent. of the dry matter of the hay ration. The digestion depression is very noticeable, especially with Sheep II. The average depression for both sheep was 13.56 grams of dry matter and 10.63 grams of organic matter per 100 grams of molasses. The total average depression was equivalent to 18.2 per cent. of the dry matter of the molasses consumed. The feeding of 200 grams of molasses caused an average loss of 7.4 per cent. in the digestibility of the hay. No particular change was noted in the live weight of either animal.

SERIES XI., PERIOD IV.[1]

[800 grams hay, 250 grams molasses, 10 grams salt.]

(a) Coefficients for Molasses.

	Dry Matter.	Ash.	Crude Protein.	Extract Matter.
Paige Sheep IV., ...	91.89	47.38	-	95.35
Paige Sheep V., ...	88.21	57.54	-	95.30

(b) Depression noted (Grams).

Average, Sheep, IV. and V.

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of 800 grams hay when fed alone,	404.56	23.19	32.51	132.44	208.07	8.03
Digested of 800 grams hay plus 250 grams molasses, ...	566.92	31.20	32.04	136.99	358.65	8.06
Minus 250 grams molasses, all digested, .	180.30	15.24	7.10	-	157.96	-
Remains for 800 grams hay digested when fed with molasses, ...	386.62	15.96	24.94	136.99	200.69	8.06
Difference or depression, ...	−17.94	−7.23	−7.57	+4.55	−7.38	+.03

The nutritive ratio of the hay-molasses ration was 1: 11.2, and molasses constituted 20.6 per cent. of the dry matter of the total ration. The results show that 17.94 (17.60) grams less hay were digested when 250 grams of molasses were fed than when the hay was fed by itself; or 100 grams of molasses caused

[1] Already reported, *loco citato*, pp. 146, 147.

a depression in the hay of 7.2 (7.02) grams of dry matter and 4.1 grams of organic matter. The depression was equivalent to 9.9 per cent. of the dry matter of the molasses fed. The total molasses likewise caused a loss of 4.4 per cent. in the digestibility of the dry matter of the hay.

General Summary.

In the table below the results of the several experiments with hay and molasses are brought together for comparison. The results of one experiment by Kellner are also stated.

RATION.	Nutritive Ratio.	Per Cent. Molasses in Dry Matter of Ration.	Depression per 100 Grams Fresh Molasses fed.		Depression equals Per Cent. of Molasses fed (Dry Matter).	Percentage Loss in Digestibility of Hay.	Gain or Loss in Live Weight (Pounds).
			Dry Matter (Grams).	Organic Matter (Grams).			
800 grams hay, . .	-	-	—21.09	—15.60	-	-	—1.0
100 grams molasses, .	1:9.0	9.50	+3.36	+5.50	-	-	±
600 grams hay, . .	-	-	—0.12	+2.93	-	-	+3.0
100 grams molasses, .	1:8.6	12.0	—2.62	+0.47	-	-	±
600 grams hay, . .	-	-	+5.21	+6.90	-	-	—2.0
150 grams molasses, .	1:10.7	13.2	—6.27	—5.07	-	-	—2.0
600 grams hay, . .	-	-	—8.04	—5.63	-	-	—.75
200 grams molasses, .	1:10.1	21.4	—18.45	—15.64	8.2	7.4	+1.25
800 grams hay, . .	-	-	-	-	-	-	+4.50
250 grams molasses, .	1:11.2	20.6	—7.10	—4.10[1]	9.9	4.4	+3.00
800 grams hay,[2] . .	-	-	-	-	-	-	-
100 grams molasses, .	1:9.3	9.2	-	—14.4	22.4[3]	3.4	-

The nutritive ratio of the different lots of hay varied from 1 : 7.5 to 1 : 9.9; the addition of different amounts of molasses naturally widened the ratio, variations being noted of from 1 : 8.6 to 1 : 11.2. So far as one is able to judge, the different ratios were without effect on depression. Our own experiments indicate that when cane molasses constituted from 10 to 13 per cent. of the dry matter of the total ration it was without pronounced effect on the digestibility of the hay. In case of one trial with one sheep the depression was very marked, but in the other five single trials with different sheep the influence was slight, or one trial was contradictory of the other. The same

[1] Average, two sheep.

[2] Kellner's results in Landw. Vers., 55 Bd. S. 384.

[3] Organic matter of molasses fed.

results hardly hold true in case of Kellner's trial with two sheep, in which beet molasses composed 9.2 per cent of the dry matter of the ration. Here one notes a depression of 14.4 grams of organic matter per 100 grams of molasses. The two sheep gave closely agreeing results.

In our own case, when molasses composed some 20 per cent. of a hay-molasses ration the depression was quite noticeable, averaging in case of four single trials with four different sheep 10.14 grams of digestible dry matter and 7.37 grams of digestible organic matter for each 100 grams of molasses fed. These latter trials show a loss or depression equivalent to from 9.9 to 18.2 per cent. of the dry matter of the molasses fed; or, otherwise expressed, the molasses caused a loss of from 4.4 to 7.4 per cent. in the digestibility of the hay. The feeding of 20 per cent. of cane molasses did not cause as great a depression as did the feeding of 9.2 per cent. of beet molasses (Kellner's results). It is doubtful, however, if these varying results are due to the different kinds of molasses.

In experiments of this sort one is obliged to take into account individuality, the effect of food upon different individuals, as well as the condition of the animal at the time of the trial. Positive conclusions cannot be drawn unless the evidence is very pronounced. Why it is that two animals, both apparently in good condition, should give contrary results it is difficult to explain. Thus, in the above table note that molasses appeared to have caused a depression of 21.09 grams dry matter with one sheep and an increase of 3.36 grams with another; also, in another case 100 grams of molasses caused an increase of 5.21 grams and in another case a decrease of 6.27 grams in the digestibility of the hay.

B. Hay, Corn Meal and Molasses.

Two experiments were conducted in each case with two sheep, using 100 and 200 grams of molasses. Unfortunately, in each experiment one of the sheep suffered from indigestion and did not complete the trial.

Summary of Results.

SERIES XIII., PERIOD VI.

[500 grams hay, 150 grams corn meal, 100 grams molasses, 10 grams salt.]

(*a*) *Coefficients for Molasses.*

	Dry Matter.	Ash.	Protein.	Extract Matter.
Sheep III., ...	85.20	78.60	19.24	91.29

(*b*) *Depression noted (Grams).*

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of hay and corn meal when fed without molasses, ...	407.18	15.67	42.30	89.07	249.23	10.94
Digested of hay and corn meal plus 100 grams molasses, ...	469.12	20.37	42.96	87.99	307.01	10.74
Minus 100 grams molasses, all digested, .	72.70	5.98	3.43	-	63.69	-
Remains for hay and corn meal digested when fed with molasses, ...	396.42	14.39	39.53	87.99	243.72	10.79
Difference or depression, ...	—10.76	—1.28	—2.77	—1.08	—5.51	—.15

The nutritive ratio of the hay and corn-meal ration was 1 : 8.6, and of the hay-corn-meal-molasses ration, 1 : 9.7 ; molasses constituted 11 per cent. of the dry matter of the total ration. The depression observed is 10.79 (10.76) grams of dry matter and 9.51 grams of organic matter per 100 grams of molasses.

SERIES XIII., PERIOD VIII.

[500 grams hay, 150 grams corn meal, 200 grams molasses, 10 grams salt.]

(*a*) *Coefficients for Molasses.*

	Dry Matter.	Ash.	Crude Protein.	Extract Matter.
Sheep II., ...	75.26	23.11	60.44	84.90

(*b*) *Depression noted (Grams).*

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of hay and corn meal when fed without molasses,	414.44	12.97	21.90	110.60	258.01	10.94
Digested of hay and corn meal plus 200 grams molasses,	423.99	22.83	26.04	98.41	365.67	11.02
Minus 200 grams molasses, all digested,	145.56	11.89	6.85	-	126.21	-
Remains for hay and corn meal digested when fed with molasses,	378.43	10.94	19.19	98.41	238.86	11.02
Difference or depression,	—36.01	—2.03	—2.71	—12.19	—19.15	+.08

Molasses constituted 20 per cent. of the dry matter of the total ration; the nutritive ratio of the hay-corn-meal ration was 1 : 17.9, and of the hay-corn-meal-molasses ration 1 : 18.4.[1] The depression was very noticeable, being 18 grams of dry matter and 17 grams of organic matter per 100 grams of molasses.

C. Hay, Gluten Feed and Molasses.

Numerous experiments were carried out to note the effect of different amounts of molasses upon a combination of hay and gluten feed, the latter being a rich protein concentrate. Hay, gluten feed and molasses is a much more suitable ration than is one composed only of hay and molasses, or of hay, corn meal and molasses.

In calculating the depression caused by the molasses, the digestibility of the hay-gluten-feed ration was first determined. The amount of molasses fed was assumed to be all digested and was deducted from the total amount digested of the hay-gluten-feed-molasses ration, the remainder being the hay and gluten feed digested when fed with the molasses. The difference between the hay-gluten-feed digested when fed without the molasses

[1] A new lot of hay was used in this experiment; it contained only 7.19 per cent. of protein, as against 12.24 per cent. in the hay used to secure the coefficients for the digestibility of the hay and corn meal, and which were applied to the hay-corn meal and 100 grams molasses ration. The low protein content of the hay accounts for the very wide nutritive ratio of the present hay-corn-meal-molasses ration. The coefficients of the hay-corn-meal ration, applied in case of the present experiment, were those obtained with the hay having the high protein content. Had an experiment been made with the low protein hay-corn-meal ration it is possible the coefficients might have been lower than the ones actually used, in which case a less depression would have been obtained than the one actually found.

and when fed with the molasses shows the depression exerted by the latter. The coefficients of digestibility for the hay and for the hay-gluten-feed rations will be found in a table with the other data.

Summary of Results.

SERIES XIV., PERIOD VI.

[500 grams hay, 150 grams gluten feed, 50 grams molasses, 10 grams salt.]

(*a*) *Coefficients for Molasses.*

	Dry Matter.	Ash.	Crude Protein.	Extract Matter.
Sheep III.,	38.19	-	-	66.08
Sheep IV.,	9.73	-	-	38.47

(*b*) *Depression noted (Grams).*

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Sheep III.,	—23.13	—4.10	—4.26	—4.83	—10.90	—.33
Sheep IV.,	—33.78	—3.44	—5.48	—7.26	—19.77	—.26

(*c*) *Average, Sheep III. and IV. (Grams).*

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of 500 grams English hay and 150 grams gluten feed when fed without molasses,	409.17	16.27	48.74	103.26	232.16	10.16
Digested of hay and gluten feed plus 50 grams molasses,	418.14	15.56	46.55	97.21	248.96	9.87
Minus 50 grams molasses, all digested,	37.42	3.06	2.23	-	32.13	-
Remains for hay and gluten feed digested when fed with molasses,	380.71	12.50	44.32	97.21	216.83	9.87
Difference or depression,	—28.46	—4.32	—4.42	—6.05	—18.49	—.30

The nutritive ratio of the hay-gluten-feed ration was 1 : 7.3, of the hay-gluten-feed-molasses ration, 1 : 8. The rather wide ratio of the hay-gluten-feed ration was due to the low protein content of the hay. Molasses constituted only 6 per cent. of the dry matter of the total ration. The average depression was 59.72 (56.92) grams of dry matter and 52.18 (49.32) grams of organic matter per 100 grams of fresh molasses fed, and equaled about 76 per cent. of the dry matter of the molasses fed. The feeding of 50 grams of molasses caused an apparent depression, or loss of 6.9 per cent. in the digestibility of the hay-gluten-feed-ration. The cause of this excessive depression for so small an amount of molasses is not clear. The sheep substantially maintained their weight during the experiment.

Series XIV., Period VII.

[500 grams hay, 150 grams gluten feed, 100 grams molasses, 10 grams salt.]

(a) Coefficients for Molasses.

	Dry Matter.	Ash.	Crude Protein.	Extract Matter.
Sheep III.,	66.37	19.61	-	86.02
Sheep IV.,	42.92	34.36	-	65.48

(b) Depression noted (Grams).

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Sheep III.,	—25.32	—4.96	—6.08	—6.73	—9.03	+.18
Sheep IV.,	—42.96	—4.01	—5.83	—11.97	—22.29	—.40

(c) Average, Sheep III. and IV. (Grams).

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of 500 hay and 150 grams gluten feed when fed without molasses,	411.92	16.36	49.29	103.69	233.77	10.25
Digested of hay and gluten feed plus 100 grams molasses,	453.04	18.04	47.85	94.34	282.69	10.14
Minus 100 grams molasses, assumed to be all digested,	75.26	6.17	4.51	-	64.58	-
Remains for hay and gluten feed digested when fed with molasses,	377.78	11.87	43.34	94.34	218.11	10.14
Difference or depression,	—34.14	—4.49	—5.95	—9.35	—15.66	—.11

The nutritive ratio of the hay-gluten-feed ration was 1 : 7.3, and of the hay-gluten-feed-molasses ration, 1 : 8.6; molasses constituted 11.3 per cent. of the dry matter of the total ration. The average depression found was 35.56 (34.14) grams of dry matter and 31.07 grams of organic matter per 100 grams of molasses, and is equivalent to 47 per cent. of the molasses fed. The feeding of 100 grams of molasses caused a loss of 8.3 per cent. in the digestibility of the hay-gluten-feed ration. Sheep IV. showed considerably more depression than Sheep III.; the former sheep lost ½ pound and the latter gained 2 pounds in weight during the seven days of the trial.

Series XII., Period V.

[600 grams hay, 200 grams gluten feed, 100 grams molasses, 10 grams salt.]

(a) Coefficients for Molasses.

	Dry Matter.	Ash.	Crude Protein.	Extract Matter.
Paige Sheep IV.,	52.27	51.30	-	70.31
Paige Sheep V.,	48.88	77.53	-	69.70
Average,	50.58	64.42	-	70.01

(b) Depression noted (Grams).

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Paige Sheep IV.,	—37.14	—2.35	—6.91	—7.75	—19.83	—.35
Paige Sheep V.,	—35.39	—1.41	—7.06	—8.16	—19.53	+.76

(c) Average, Sheep IV. and V. (Grams).

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of 600 grams hay and 200 grams gluten feed when fed without molasses,	515.72	15.39	82.23	145.12	262.16	10.87
Digested of hay and gluten feed plus 100 grams molasses,	552.83	18.83	78.03	137.16	307.72	11.08
Minus 100 grams molasses, all digested,	73.37	5.34	2.79	-	65.24	-
Remains for hay and gluten feed digested when fed with molasses,	479.46	13.49	75.24	137.16	242.48	11.08
Difference or depression,	—36.26	—1.90	—6.99	—7.96	—19.68	+.21

The nutritive ratio of the hay-gluten-feed ration was 1 : 5.2, and of the hay-gluten-feed-molasses ration, 1 : 6; molasses represented 9.4 per cent. of the dry matter of the total ration.

The average depression was 36.32 grams of dry matter and 34.42 grams of organic matter per 100 grams of molasses fed, and equaled 50 per cent. of the dry matter of the molasses fed. The feeding of 100 grams of molasses caused a depression, or loss of 7 per cent. in the digestibility of the hay-gluten-feed ration.

Both sheep were in good condition during the experiment; Sheep IV. showed an apparent gain of 4 pounds and Sheep V. a loss of 3.5 pounds. Such variations would hardly be expected.

Series XIV., Period IX.

[500 grams hay, 150 grams gluten feed, 150 grams molasses, 10 grams salt.]

(*a*) *Coefficients for Molasses.*

	Dry Matter.	Ash.	Crude Protein.	Extract Matter.
Sheep IV.,	56.63	30.24	-	76.86

(*b*) *Depression noted (Grams).*

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of 500 grams hay and 150 grams gluten feed when fed without molasses,	423.47	16.91	49.53	107.16	241.60	9.90
Digested of hay and gluten feed plus 150 grams molasses,	487.01	19.75	44.90	97.32	315.49	9.55
Minus 150 grams molasses, all digested,	112.20	9.39	6.68	-	96.13	-
Remains for hay and gluten feed digested when fed with molasses,	374.81	10.36	38.22	97.32	219.36	9.55
Difference or depression,	—48.66	—6.55	—11.31	—9.84	—22.24	—.35

The nutritive ratio of the hay-gluten-feed ration was as 1 : 7.5, and of the hay-gluten-feed-molasses ration, 1 : 9.7; molasses composed 16 per cent. of the dry matter of the ration. The depression noted was 33.52 grams of dry matter and 29.16 grams of organic matter per 100 grams of molasses fed, and is likewise equivalent to practically 45 per cent. of the dry matter of the molasses consumed. The feeding of 150 grams of molasses caused a loss of 11.9 per cent. in the digestibility of the hay-gluten-feed ration. This sheep made a gain of 5 pounds in one week according to our weights.

Series XIV., Period IV.

[500 grams hay, 150 grams gluten feed, 200 grams molasses, 10 grams salt.]

(a) Coefficients for Molasses.

	Dry Matter.	Ash.	Crude Protein.	Extract Matter.
Sheep III.,	77.58	47.22	24.19	88.30
Sheep IV.,	74.18	48.27	1.05	85.21

(b) Depression noted (Grams).

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Sheep III.,	—33.41	—6.55	—6.52	—6.46	—14.98	—.18
Sheep IV.,	—38.47	—6.42	—8.51	—6.00	—18.93	—.04

(c) Average, Sheep III. and IV. (Grams).

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of 500 grams hay and 150 grams gluten feed when fed without molasses,	408.00	16.23	48.55	103.02	231.48	10.13
Digested of hay and gluten feed plus 200 grams molasses,	521.08	22.16	49.64	96.79	342.53	9.97
Minus 200 grams molasses, all digested,	149.02	12.41	8.60	-	128.01	-
Remains for hay and gluten feed digested when fed with molasses,	372.06	9.75	41.04	96.72	214.52	9.97
Difference or depression,	—35.94	—6.48	—7.51	—6.23	—16.96	—.16

The ratio of the hay-gluten-feed-molasses ration was as 1 : 9.3, against 1 : 7.4 in case of the hay-gluten-feed ration, and 20.4 per cent. of the dry matter of the entire ration consisted of molasses. The depression was 18.67 (17.97) grams of dry matter and 15.43 (14.73) grams of organic matter per 100 grams of molasses, which was equal to 25 per cent. of the dry matter of the molasses fed. The feeding of 200 grams of molasses caused a loss or depression of 7.60 per cent. in the digestibility of the 650 grams of hay-gluten-feed ration. Sheep III. lost 2 pounds and Sheep IV. 3.5 pounds in live weight during the trial.

SERIES XII., PERIOD VII.

[600 grams English hay, 200 grams gluten feed, 200 grams molasses, 10 grams salt.]

(a) Coefficients for Molasses.

	Dry Matter.	Ash.	Crude Protein.	Extract Matter.
Paige Sheep IV.,	76.78	76.59	-	85.72
Paige Sheep V.,	73.71	81.06	-	84.21

(b) Depression noted (Grams).

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Sheep IV.,	—34.18	—2.51	—7.66	—6.19	—18.70	+.94
Sheep V.,	—38.70	—2.03	—6.70	—10.55	—20.67	+1.30

(c) Average, Sheep IV. and V. (Grams).

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of 600 grams hay and 200 grams gluten feed when fed without molasses,	517.35	15.43	82.53	145.51	262.94	10.91
Digested of hay and gluten feed plus 200 grams molasses,	628.13	23.88	80.94	137.14	374.17	12.03
Minus 200 grams molasses, all digested,	147.22	10.72	5.59	-	130.91	-
Remains for hay and gluten feed when fed with molasses,	480.91	13.16	75.35	137.14	243.26	12.03
Difference or depression,	—36.44	—2.27	—7.18	—8.37	—19.68	+1.12

The nutritive ratio of the hay and gluten-feed ration was 1 : 5.2, and with the addition of 200 grams molasses, 1 : 6.7 ; molasses composed 17.2 per cent. of the dry matter of the total ration. The depression observed was 18.2 grams of dry matter and 17.05 grams of organic matter per 100 grams of molasses fed, and is equivalent to 25 per cent. of the dry matter of the molasses fed. The feeding of 200 grams of molasses caused a loss of 7 per cent. in the digestibility of the hay-gluten-feed ration. Both sheep lost in weight during the experiment, Sheep IV. losing 4 pounds and Sheep V. 5 pounds. This is not what would be expected from animals receiving more than a maintenance ration. Sheep IV. passed through the experiment in good condition. Sheep V. began to show signs of indigestion shortly after the beginning of the period proper, and the disturbance became so pronounced that the experiment was discontinued at the end of the sixth day. The results show that he digested a little less than Sheep IV.

This and the trial immediately preceding show similar results; namely, an equal depression and a loss in weight, in spite of the fact that the several animals were receiving more than a maintenance ration.

Series XI., Period VIII.

[600 grams hay, 200 grams gluten feed, 250 grams molasses, 10 grams salt.]

(*a*) *Coefficients for Molasses.*

	Dry Matter.	Ash.	Extract Matter.
Paige Sheep IV.,	76.50	64.12	86.93
Paige Sheep V.,	72.53	65.25	84.80
Average,	74.52	64.59	85.87

(*b*) *Depression noted (Grams).*

	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Digested of hay and gluten feed when fed without molasses,	524.97	18.75	81.88	148.40	264.22	11.74
Digested of hay and gluten feed plus molasses,	660.31	29.58	79.47	139.96	399.66	11.61
Minus 250 grams molasses fed, assumed to be all digested,	181.68	16.75	7.16	-	157.77	-
Hay and gluten feed digested when fed with molasses,	478.63	12.83	72.31	139.96	241.89	11.61
Difference or depression,	—46.34	—5.92	—9.57	—8.41	—22.33	—.13

The nutritive ratio of the hay-gluten-feed ration was 1 : 5.3, and of the hay-gluten-feed-molasses ration, 1 : 7.1; molasses constituted 20.2 per cent. of the dry matter of the total ration. The average depression for both sheep was 18.5 grams of dry matter and 16.1 grams of organic matter per 100 grams of molasses, and equals 25.5 per cent. of the dry matter of the molasses fed.

The feeding of 250 grams of molasses caused a loss of 8.8 per cent. in the digestibility of the hay-gluten-feed ration. Each sheep lost 3 pounds in live weight during the seven days.

Series XII., Period XI.

[600 grams English hay, 200 grams gluten feed, 250 grams molasses, 10 grams salt.]

(*a*) *Coefficients for Molasses.*

	Dry Matter.	Ash.	Crude Protein.	Extract Matter.
Young Sheep II., ...	70.10	39.63	-	82.92

(*b*) *Depression noted (Grams).*

	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
Digested of 600 grams English hay and 200 grams gluten feed when fed without molasses, ...	498.12	15.47	74.29	139.31	256.86	11.84
Digested of hay and gluten feed plus 250 grams molasses, ...	628.12	20.82	71.91	131.24	393.59	10.56
Minus 250 grams molasses, all digested, .	185.45	13.50	7.05	-	164.90	-
Remains for hay and gluten feed digested when fed with molasses, ...	442.67	7.32	64.86	131.24	228.69	10.56
Difference or depression, ...	—55.45	—8.15	—9.43	—8.07	—28.17	—1.28

The ratio of the hay-gluten-feed-molasses ration was as 1 : 7.6, and of the hay-gluten-feed ration 1 : 5.7; molasses constituted 20.4 per cent. of the dry matter of the total ration. The depression observed was 22 (22.2) grams of dry matter and 18.8 (19) grams of organic matter for each 100 grams of molasses fed, and was equivalent to about 30 per cent. of the dry matter of the molasses. The feeding of 250 grams of molasses caused a loss of 11.1 per cent. in the digestibility of the hay and gluten feed. The sheep passed through the trial in good condition, and neither gained nor lost in live weight.

Series XII., Period X.

[600 grams English hay, 200 grams gluten feed, 300 grams molasses, 10 grams salt.]

(*a*) *Coefficients for Molasses.*

	Dry Matter.	Ash.	Crude Protein.	Extract Matter.
Paige Sheep IV., ...	87.09	74.25	-	92.60

(b) Depression noted (Grams).

	Dry Matter.	Ash.	Crude Protein.	Fiber.	Extract Matter.	Fat.
Digested of 600 grams English hay and 200 grams gluten feed when fed without molasses,	523.59	15.63	83.44	147.41	266.00	11.04
Digested of hay and gluten feed plus 300 grams molasses,	715.92	27.57	82.21	146.52	447.82	11.80
Minus 300 grams molasses, all digested,	220.83	16.08	8.39	-	196.36	-
Remains for hay and gluten feed digested when fed with molasses,	495.09	11.49	73.82	146.52	251.46	11.80
Difference or depression,	—28.50	—4.14	—9.62	—.89	—14.54	+.76

The nutritive ratio of the hay-gluten-feed ration was as 1 : 5.2, and of the hay-gluten-feed-molasses ration, 1 : 7.6 ; molasses constituted some 23.5 per cent. of the dry matter of the total ration. The depression was 9.48 grams of dry matter and 8.1 grams of organic matter for each 100 grams of molasses fed, and was equivalent to 13 per cent. of the dry matter of the molasses. The feeding of 300 grams of molasses caused a loss of 5.4 per cent. in the digestibility of the hay-gluten-feed ration. The sheep kept in good condition during the experiment, but showed an apparent loss in live weight of 8 pounds. This is believed to be an error, although in a general way it confirms the results of previous trials, which indicate that when molasses constitutes more than 15 per cent. of the dry matter of the total ration a loss of live weight results, although more than a maintenance ration is being fed.

General Summary.

Effect of Molasses upon Digestibility of Hay and Gluten Feed.

In the following table an attempt has been made to summarize the principal results of feeding different amounts of molasses upon the digestibility of a ration composed of hay and gluten feed. The results obtained by Lehmann[1] and by Garland[2] are also appended.

[1] *Loco citato.*

[2] Berichte des landw. Institutes der Univ. Halle, XV. Heft, pp. 23-25.

Our Own Results.

RATION.	Nutritive Ratio.	Per Cent. Molasses in Dry Matter of Ration.	Depression per 100 Grams Molasses fed. Dry Matter (Grams).	Depression per 100 Grams Molasses fed. Organic Matter (Grams).	Depression equals Per Cent. of Molasses fed (Dry Matter).	Percentage Loss in Digestibility of Hay and Gluten Feed.	Gain or Loss in Live Weight. (Pounds.)
500 grams hay, 150 grams gluten, 50 grams molasses	1:8.0	6.0	59.72	52.18	76.0	6.9	—1.00 —.50
500 grams hay, 150 grams gluten, 100 grams molasses	1:8.6	11.3	35.56	31.07	47.0	8.3	—.50 +2.00
600 grams hay, 200 grams gluten, 100 grams molasses	1:6.0	9.4	36.32	34.42	50.0	7.0	+4.00 —3.50
500 grams hay, 150 grams gluten, 150 grams molasses	1:9.7	16.0	33.50	29.16	45.0	11.9	+5.00
500 grams hay, 150 grams gluten, 200 grams molasses	1:9.3	20.4	18.67	15.43	25.0	7.6	—2.00 —3.50
600 grams hay, 200 grams gluten, 200 grams molasses	1:6.7	17.2	18.20	17.05	25.0	7.0	—4.00 —5.00
600 grams hay, 200 grams gluten, 250 grams molasses	1:7.1	20.2	18.56	16.1	25.5	8.8	—3.00 —3.00
600 grams hay, 200 grams gluten, 250 grams molasses	1:7.6	20.4	22.0	18.8	30.0	11.1	-
600 grams hay, 200 grams gluten, 300 grams molasses	1:7.6	23.5	9.5	8.1	13.0	5.4	—8.00

Lehmann's Results.

RATION.	Nutritive Ratio.	Per Cent. Molasses in Dry Matter of Ration.	Dry Matter (Grams).	Organic Matter (Grams).	Depression equals Per Cent. of Molasses fed (Dry Matter).	Percentage Loss in Digestibility of Hay and Gluten Feed.	Gain or Loss in Live Weight. (Pounds.)
500 grams hay, 300 grams cottonseed meal, 200 grams molasses	1:3.3	18.0[1]	19.75	22.2	28.5[1]	8.2	-
500 grams hay, 300 grams palm-nut cake, 300 grams molasses	1:9.5	24.0[1]	8.8	11.6	15.0[1]	6.1	-
500 grams hay, 300 grams cottonseed meal, 400 grams molasses	1:4.4	32.0[1]	7.0	7.4	9.5[1]	6.0	-

Garland's Results.

RATION.	Nutritive Ratio.	Per Cent. Molasses in Dry Matter of Ration.	Dry Matter (Grams).	Organic Matter (Grams).	Depression equals Per Cent. of Molasses fed (Dry Matter).	Percentage Loss in Digestibility of Hay and Gluten Feed.	Gain or Loss in Live Weight. (Pounds.)
476 grams hay and grain, 68 grams molasses	1:5.7	11.0	-	13.8	16.7	3.8	-

[1] Estimated, assuming that the molasses contained 78 per cent. of dry matter, the hay 88 per cent. and the concentrates 92 per cent.

The nutritive ratio of the two hay and gluten-feed rations with which the molasses was fed varied from 1 : 5.5 to 1 : 7.5, hence the nutrients may be considered satisfactorily proportioned. After the addition of the molasses the rations were widened from 1 : 6 to 1 : 9.7 ; most of them could not be considered unduly wide. In two of the three experiments reported by Lehmann the rations were quite narrow, due to the presence of so much cottonseed meal. So far as one is able to judge, the width of the ration did not bear any direct relation to the depression observed. In all of the experiments reported molasses constituted from 6 per cent. to approximately 32 per cent. of the dry matter of the total ration.

It is noted that when molasses made up from 9 to 16 per cent. of the dry matter of the ration, the depression averaged 32.1 grams of organic matter per 100 grams of fresh molasses; when molasses composed about 20 per cent. of the dry matter of the ration, in case of eight single trials, it averaged approximately 15.5 grams of organic matter per 100 grams of molasses. The average of all of our experiments, excepting the first, show a depression of 21.8 grams of organic matter per 100 grams of fresh molasses. Lehmann's experiments show that when beet molasses composed 18 per cent. of the dry matter of the ration, the depression was 22.2 grams of organic matter per 100 grams of molasses. This depression decreased to 7.4 grams of organic matter per 100 grams of molasses when molasses composed some 30 per cent. of the dry matter of the ration.

Results of a similar character are secured when one calculates the depression on the basis of the percentage of the dry matter of the molasses fed. When it composed 9 to 16 per cent. of the dry matter of the total ration, the depression or loss was equivalent to nearly 50 per cent. of the amount fed. When, however, 20 per cent. of the dry matter of the total ration consisted of molasses, the depression equaled only 24 per cent. In case of Lehmann's results, the depression decreased from 28.5 to 9.5 per cent.

The percentage loss in digestibility of the feeds with which the molasses was fed proved to be reasonably constant. The average percentage loss in case of twelve experiments, including nine of our own and three of Lehmann's, was 7.86. In most cases the variations do not depart widely from this average. The smaller amounts of molasses in most cases caused practically as much absolute depression as the larger amounts.

The amount of hay and gluten-feed fed to the different sheep was probably a little less than a maintenance ration; this was intended in order that, when from 100 to 300 grams of molasses were added, the total amount would not be more than the animal could consume.

With molasses composing 6 to 11.3 per cent. of the dry matter of the ration, one notes, on the whole, comparatively little change in the live weight, but when this was increased to some 20 per cent., the live weight of each sheep shows a pronounced decrease in almost every case, although the total ration was certainly in excess of maintenance requirements. The reason for this loss in weight cannot be explained. Occasional qualitative tests for sugar in the fæces were made with negative results. The urine was not collected, but it is believed that sugar would not have thus escaped unassimilated. The loss of digestible material through depression hardly seems sufficient to account for it. A possible explanation lies in the fact that each sheep was given 2,500 grams of water daily, usually considered a liberal allowance. In most of the cases showing a loss in weight the sheep drank the entire amount, but the attendant, contrary to instructions, failed to supply more. It may be that the molasses induced an increased thirst, and required more water for its complete metabolism than was supplied, and the intake of water being relatively less than the outgo caused a temporary loss of weight. In one case, however, where the 2,500 grams of water were entirely consumed, the sheep neither gained nor lost in weight. It is to be regretted, however, that this oversight occurred.

General Conclusions.

(a) *Hay and Molasses.*

1. Our own experiments indicate that molasses had relatively little effect in depressing the digestibility of the hay when the amount fed did not exceed 10 to 13 per cent. of the dry matter of the total ration.

2. When molasses composed 20 per cent. of the dry matter of the total ration, the depression averaged 7.37 grams of organic matter per 100 grams of fresh molasses, and the molasses caused substantially a loss of 6 per cent. in the digestibility of the hay.

(b) *Hay, Corn Meal and Molasses.*

3. In case of two single trials the depression was from 9.5 to 17 grams of organic matter per 100 grams of molasses.

(c) *Hay, Gluten Feed and Molasses.*

4. When relatively small amounts of molasses were fed the depression was higher *per 100 grams of molasses* than when relatively large amounts were fed.

5. When relatively small amounts of molasses were fed the loss expressed in dry matter *as percentage of molasses fed* was higher than when relatively large amounts of molasses were consumed.

6. The feeding of small amounts of molasses have in most cases caused as much depression of the feeds with which they were fed as large amounts, the loss averaging substantially 8 per cent.

Why molasses seemed to exert less depression on the hay than on a ration composed of hay and a concentrate is difficult of explanation.

D. *The Cause of the Depression produced by Molasses.*

Our own numerous experiments, as well as those of other investigators, have shown that molasses exerts a distinct depression upon those feed stuffs with which it is fed. This depression appears to vary, depending upon the character of the feed, the amount of molasses fed and the individuality and condition of the animal. The addition of considerable amounts of sugar and starch have been shown to produce similar results.[1]

The cause or causes of this depression have never been fully demonstrated. Kellner [2] offers a partial explanation substantially as follows: —

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[1] See the numerous experiments of Henneberg and Stohmann, Kühn and Fleischer, E. Wolff, etc., in the Journal für Landw. and in the Landw. Versuchssta.

[2] *Loco citato*, fünfte Auflage, pp. 50, 51.

(*a*) The cause or partial cause of the depression of the proteid matter is due to the increased excretion of metabolic by-products in the fæces. It has been definitely proved that for every 100 grams of digested dry matter there is excreted .4 to .5 of a gram of nitrogen, or 2.5 to 3.1 grams of protein, hence the additional carbohydrates increase the digestible dry matter and cause the excess excretion of metabolic nitrogen, which is calculated as undigested nitrogen.

(*b*) According to Hirschler [1] an increase of the carbohydrates or of lactic acid in the ration checks the action of putrefactive bacteria, *i.e.*, those acting upon the proteid matter, and G. Gothwald [2] has confirmed this for herbivorous animals.

(*c*) It being known that the easily soluble and digestible carbohydrates are large yielders of lactic and butyric acids in the processes of digestion, it seems at least possible that it is these acids, when present in sufficient quantities, which check the further action of the micro-organisms, and prevents their attacking the more difficult digestible carbohydrates, such as the fiber, pentosans, gums, etc.

Alquier and Drouineau [3] state that in case of ruminants the depression is caused because the food remains for a long time in the digestive tract, and is subjected to the action of various micro-organisms. These organisms follow the line of the least resistance, and attack the sugars and other soluble carbohydrates, leaving the cellulose, ligno-cellulose and pentosans, which they would attack and dissolve more freely were the soluble carbohydrates not present in excess; hence the depression falls largely upon these latter compounds.

It is further explained that in case of the horse the action of molasses in causing the depression is not due primarily to the action of micro-organisms for the reason that the food remains so short a time in the intestines, but to the alkaline salts, — potash and soda, — which cause an increased action of the intestines (peristalsis). Grandeau's work is cited, in which, in an average of four trials with four different horses the first fæces appeared sixteen hours after the feeding of molasses, while

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[1] Zeitschrift für physiol. Chem. 10 Bd. 1886, p. 306; also 39 Bd. p. 99; Abs. from Kellner.

[2] Journal fur Landw. 39 Jahrgang, 1888, p. 325.

[3] Ann. de Sci. Agron. 2 Serie, 1904. Tome I., pp. 252–258.

twenty-seven hours elapsed before the first fæces from a normal ration were excreted.

Observations at this Station.

In order to note the effect of molasses in increasing peristalsis, thereby causing a less complete digestion of the food, a number of observations were made using lampblack as an indicator.

October 21, at 4 P.M., Sheep III., receiving hay, gluten feed, salt and *200 grams of molasses*, was fed in addition 10 grams of lampblack. The first indication in the fæces appeared at 1 P.M. on the following day, — twenty-one hours after feeding. The lampblack could be observed in the fæces until 4 P.M. of October 25, — some four days thereafter.

October 27, at 4 P.M., and October 28, at 7 A.M., Sheep II., receiving a ration of hay, gluten feed and salt, was given in addition a total of 10 grams of lampblack. Indications of the lampblack first appeared at 2 P.M. on the following day, October 28, — twenty hours after the first feeding. At the same time Sheep IV., receiving hay, gluten feed, salt and *200 grams of molasses*, was given in addition 15 grams of lampblack, which first appeared in the fæces at 4 P.M. of the following day, — twenty-two hours later.

November 6, at 5 P.M., and November 7, at 7 A.M., Sheep I., receiving a ration of hay, gluten feed and salt, was fed in addition with 10 grams of lampblack, which first appeared in the fæces at noon on November 7, — nineteen hours later. This lampblack was noticed in the fæces until noon of November 12, nearly six days (one hundred and thirty-nine hours) after the first was given.

November 6, at 5 P.M., and November 7, at 7 A.M., Sheep IV., receiving a ration of hay, gluten feed, salt and *200 grams of molasses*, was given in addition a total of 15 grams of lampblack. It first appeared at 7 A.M., November 7, — fourteen hours later, — and disappeared at 7 A.M., November 12, — one hundred and thirty-four hours later.

November 7, at 4 P.M., and November 8, at 7 A.M., Sheep II., receiving a ration of hay, gluten feed and salt, was given in addition 10 grams of lampblack. The first indication of lampblack was at 7.30 A.M., November 8, — fifteen and a half hours later, — and it had entirely disappeared from the faeces on November 13, at 4 P.M., — six days later.

November 7, at 4 P.M., and November 8, at 7 A.M., Sheep III., receiving hay, gluten feed, salt and *200 grams of molasses*, received in addition a total of 15 grams of lampblack. The first colored faeces were noted November 8, at 2 P.M., — twenty-two hours later, — and the color disappeared November 13, at 4 P.M., — after a lapse of six days.

The above data placed in tabular form are as follows: —

Sheep Number.	Normal Ration. Lampblack appeared (Hours).	Molasses Ration. Lampblack appeared (Hours).	Normal Ration. Lampblack disappeared (Hours).	Molasses Ration. Lampblack disappeared (Hours).
II.,	20.0	-	-	-
I.,	19.0	-	139.0	-
II.,	15.5	-	144.0	-
IV.,	-	22.0	-	-
III.,	-	21.0	-	96
IV.,	-	14.0	-	134
III.,	-	22.0	-	144
Average,	18.2	19.7	141.5	139

It is evident that these results do not show sufficient variation to warrant a conclusion that the molasses exerted any peristaltic action. It is to be admitted that the lampblack did not prove as sharp an indicator as was desired. It is intended to make additional observations of a similar character, using another indicator, and also to continue our inquiry relative to the cause of the depression.

Data of the Experiments.

Composition of Feed Stuffs (Per Cent.).

[Dry Matter.]

Series.	Periods.	Feeds.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
XI.	III., IV.,	English hay,	8.20	8.69	32.14	48.56	2.41
XI.	V., VII., VIII.,	English hay,	6.75	12.23	33.45	44.67	2.90
XI.	VII.,	Gluten feed,	1.67	24.98	7.22	63.34	2.79
XI.	III., IV.,	Porto Rico molasses,	8.45	3.94	–	87.61	–
XI.	VIII.,	Porto Rico molasses,	9.22	3.94	–	86.84	–
XII.	III., IV., V., VII., X., XI., XIV.,	English hay,	6.75	12.23	33.45	44.67	2.90
XII.	IV., V., VII., X., XI., XIV.,	Gluten feed,	1.53	26.22	6.30	63.35	2.60
XII.	III., V., VII., X., XI.,	Porto Rico molasses,	7.28	3.80	–	88.92	–
XIII.	I., II., III., IV., V., VI.,	English hay,	6.46	12.24	29.24	49.49	2.57
XIII.	VII., VIII.,	English hay,	6.43	7.19	34.08	49.82	2.48
XIII.	II., IV., VI., VII., VIII.,	Corn meal,	1.58	10.45	2.10	81.22	4.65
XIII.	I.,	Porto Rico molasses,	8.05	4.58	–	87.37	–
XIII.	III.,	Porto Rico molasses,	8.11	4.70	–	87.19	–
XIII.	VI.,	Porto Rico molasses,	8.23	4.72	–	87.05	–
XIII.	VIII.,	Porto Rico molasses,	8.17	4.71	–	87.12	–
XIV.	XI.,	English hay,	7.13	7.75	32.64	50.01	2.49
XIV.	III., IV., V., VI., VII., IX.,	English hay,	6.82	7.67	30.35	52.79	2.37
XIV.	III., IV., V., VI., VII.,	Gluten feed,	4.12	27.22	7.81	56.54	4.31
XIV.	IV.,	Porto Rico molasses,	8.33	5.77	–	85.90	–
XIV.	VI.,	Porto Rico molasses,	8.18	5.95	–	85.87	–
XIV.	VII.,	Porto Rico molasses,	8.20	5.99	–	85.81	–
XIV.	IX.,	Porto Rico molasses,	8.37	5.95	–	85.68	–

Composition of Fæces (Per Cent.).

[Dry Matter.]

Series.	Periods.	Sheep Number.	Feed or Ration.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
X.	VI.	IV.	English hay,	11.61	9.90	30.66	44.91	2.92
X.	IX.	V.	English hay,	11.23	9.24	31.93	44.49	3.11
XI.	V.	IV.	English hay,	11.18	14.10	24.20	46.24	4.28
XI.	V.	V.	English hay,	10.49	13.17	26.51	45.74	4.09
XI.	VI.	II.	English hay,	10.80	14.70	23.99	46.27	4.24
XI.	VI.	III.	English hay,	10.57	14.03	25.31	45.74	4.35
XI.	VII.	IV.	Hay and gluten feed,	10.55	15.33	22.35	47.20	4.57
XI.	VII.	V.	Hay and gluten feed,	10.63	15.05	22.84	46.84	4.64
XI.	III.	IV.	Hay and molasses,	12.16	10.72	29.32	44.87	2.93
XI.	III.	V.	Hay and molasses,	11.83	10.53	30.33	44.47	2.84
XI.	IV.	IV.	Hay and molasses,	13.66	11.47	27.13	44.86	2.83
XI.	IV.	V.	Hay and molasses,	12.87	11.49	28.95	43.94	2.75
XI.	VIII.	IV.	Hay, gluten feed and molasses,	11.15	16.36	21.26	47.44	3.79
XI.	VIII.	V.	Hay, gluten feed and molasses,	10.82	16.21	22.09	47.15	3.73
XII.	IV.	IV.	Hay and gluten feed,	12.27	15.50	21.65	45.97	4.61
XII.	IV.	V.	Hay and gluten feed,	11.75	15.22	22.83	45.30	4.90
XII.	XIV.	II.Y.	Hay and gluten feed,	9.98	18.48	22.31	45.44	3.79
XII.	III.	II.	Hay and molasses,	11.91	14.82	23.00	45.80	4.47
XII.	III.	III.	Hay and molasses,	12.11	14.64	22.47	46.42	4.36
XII.	V.	IV.	Hay, gluten feed and molasses,	11.31	16.00	21.55	47.13	4.01
XII.	V.	V.	Hay, gluten feed and molasses,	10.57	15.94	22.89	46.79	3.81
XII.	VII.	IV.	Hay, gluten feed and molasses,	11.31	16.42	21.64	47.01	3.62
XII.	VII.	V.	Hay, gluten feed and molasses,	10.88	15.68	23.11	46.94	3.39
XII.	X.	IV.	Hay, gluten feed and molasses,	12.35	17.70	19.83	46.31	3.81
XII.	XI.	II.Y.	Hay, gluten feed and molasses,	11.44	17.38	22.04	45.62	3.52

Composition of Fæces (Per Cent.).

[Dry Matter.]

Series.	Periods.	Sheep Number.	Feed or Ration.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
XIII.	V.	I.	English hay,	9.32	14.24	24.35	48.01	4.08
XIII.	V.	II.	English hay,	9.03	13.59	26.55	46.88	3.95
XIII.	IV.	III.	English hay and corn meal,	8.71	15.09	25.44	46.89	3.87
XIII.	VII.	II.	English hay and corn meal,	10.71	14.60	26.46	44.38	3.85
XIII.	I.	I.	English hay and molasses,	10.88	14.79	23.92	46.68	3.73
XIII.	I.	II.	English hay and molasses,	10.75	15.12	23.80	46.51	3.82
XIII.	III.	I.	English hay and molasses,	10.88	15.52	23.05	46.94	3.61
XIII.	III.	II.	English hay and molasses,	10.21	14.71	26.21	45.38	3.49
XIII.	VI.	III.	Hay, corn meal and molasses,	8.87	15.69	24.52	47.18	3.74
XIII.	VIII.	II.	Hay, corn meal and molasses,	9.81	13.34	27.78	45.95	3.12
XIV.	XI.	I.	English hay,	11.16	10.65	27.78	46.91	3.50
XIV.	XI.	II.	English hay,	10.45	10.17	29.55	46.65	3.18
XIV.	III.	I.	English hay and gluten feed,	11.51	13.51	23.65	47.92	3.41
XIV.	III.	II.	English hay and gluten feed,	11.46	12.89	25.07	47.15	3.43
XIV.	V.	III.	English hay and gluten feed,	10.89	13.12	25.28	47.19	3.52
XIV.	V.	IV.	English hay and gluten feed,	11.85	13.31	24.34	46.68	3.82
XIV.	IV.	III.	Hay, gluten feed and molasses,	12.16	14.01	24.20	46.63	3.00
XIV.	IV.	IV.	Hay, gluten feed and molasses,	12.84	14.84	22.54	46.61	3.17
XIV.	VI.	III.	Hay, gluten feed and molasses,	11.58	13.62	24.60	46.98	3.22
XIV.	VI.	IV.	Hay, gluten feed and molasses,	11.63	13.21	23.70	48.15	3.31
XIV.	VII.	III.	Hay, gluten feed and molasses,	11.85	14.38	25.18	45.63	2.96
XIV.	VII.	IV.	Hay, gluten feed and molasses,	11.38	13.27	24.88	47.23	3.24
XIV.	IX.	IV.	Hay, gluten feed and molasses,	12.37	15.25	23.19	46.18	3.01

Dry Matter Determinations made at Time of weighing out the Different Foods, and Dry Matter in Air-dry Fæces (Per Cent.).

Series.	Period.	Sheep Number.	English Hay.	Gluten Feed.	Molasses.	Fæces.
X.,	VI.	IV.	88.35	-	-	93.35
X.,	IX.	V.	89.77	-	-	95.08
XI.,	V.	IV.	88.65	-	-	92.22
XI.,	V.	V.	88.65	-	-	92.14
XI.,	VI.	II.[1]	88.97	-	-	93.54
XI.,	VI.	III.[1]	88.97	-	-	93.52
XI.,	VII.	IV.	88.55	90.03	-	93.47
XI.,	VII.	V.	88.55	90.03	-	93.61
XI.,	III.	IV.	88.15	-	71.49	92.84
XI.,	III.	V.	88.15	-	71.49	93.14
XI.,	IV.	IV.	87.22	-	72.12	92.33
XI.,	IV.	V.	87.22	-	72.12	92.16
XI.,	VIII.	IV.	88.92	92.02	72.67	92.50
XI.,	VIII.	V.	88.92	92.02	72.67	92.36
XII.,	IV.	IV.	87.50	-	89.88	92.49
XII.,	IV.	V.	87.50	-	89.88	92.23
XII.,	XIV.	II.Y.	90.65	91.13	-	94.37
XII.,	III.	II.[1]	87.80	-	73.45	92.05
XII.,	III.	III.[1]	87.80	-	73.45	92.16
XII.,	V.	IV.	87.85	89.68	73.37	91.41
XII.,	V.	V.	87.85	89.68	73.37	91.42
XII.,	VII.	IV.	88.07	90.14	73.61	92.95
XII.,	VII.	V.	88.07	90.14	73.61	92.70
XII.,	X.	IV.	89.25	90.87	73.61	93.51
XII.,	XI.	II.Y.	90.57	89.98	74.18	93.87

Dry Matter Determinations made at Time of weighing out the Different Foods, and Dry Matter in Air-dry Fæces (Per Cent.).

Series.	Period.	Sheep Number.	English Hay.	Gluten Feed.	Corn Meal.	Molasses.	Fæces.
XIII.,	V.	I.	90.07	-	-	-	93.65
XIII.,	V.	II.	90.07	-	-	-	93.65
XIII.,	IV.	III.	89.65	-	89.32	-	94.14
XIII.,	VII.	II.	89.12	-	90.36	-	94.31
XIII.,	I.	I.	88.62	-	-	72.93	93.35
XIII.,	I.	II.	88.62	-	-	72.93	93.58
XIII.,	III.	I.	89.30	-	-	72.93	93.74
XIII.,	III.	II.	89.30	-	-	72.93	93.67
XIII.,	VI.	III.	90.10	-	90.64	72.70	93.34
XIII.,	VIII.	II.	89.05	-	90.24	72.78	93.65
XIV.,	XI.	I.	90.05	-	-	-	93.41
XIV.,	XI.	II.	90.05	-	-	-	93.49
XIV.,	III.	I.	88.42	90.75	-	-	93.13
XIV.,	III.	II.	88.42	90.75	-	-	93.11
XIV.,	V.	III.	89.45	91.15	-	-	94.16
XIV.,	V.	IV.	89.45	91.15	-	-	91.26
XIV.,	IV.	III.	89.27	91.00	-	74.51	92.38
XIV.,	IV.	IV.	89.27	91.00	-	74.51	92.48
XIV.,	VI.	III.	89.47	91.52	-	74.84	93.99
XIV.,	VI.	IV.	89.47	91.52	-	74.84	94.01
XIV.,	VII.	III.	89.72	93.24	-	75.26	93.74
XIV.,	VII.	IV.	89.72	93.24	-	75.26	93.79
XIV.,	IX.	IV.	90.25	91.27	-	74.80	93.36

[1] Old sheep.

Average Daily Amount of Manure excreted and Water drunk (Grams).

SERIES.	Periods.	Sheep Number.	Feed or Ration.	Manure, excreted daily.	One-tenth Manure Air Dry.	Water drunk daily.
X.	VI.	IV.	English hay,	678	32.15	1,138
X.	IX.	V.	English hay,	699	31.41	1,924
XI.	V.	IV.	English hay,	610	26.11	1,781
XI.	V.	V.	English hay,	623	27.02	1,642
XI.	VI.	II.	English hay,	613	26.21	1,694
XI.	VI.	III.	English hay,	608	28.80	1,544
XI.	VII.	IV.	English hay,	460	20.82	1,498
XI.	VII.	V.	English hay,	459	20.01	1,318
XI.	III.	IV.	Hay and molasses,	674	31.10	1,725
XI.	III.	V.	Hay and molasses,	745	32.86	1,995
XI.	IV.	IV.	Hay and molasses,	738	33.34	2,114
XI.	IV.	V.	Hay and molasses,	855	34.12	2,014
XI.	VIII.	IV.	Hay, gluten feed and molasses,	635	25.84	1,843
XI.	VIII.	V.	Hay, gluten feed and molasses,	655	25.86	1,953
XII.	IV.	IV.	Hay and gluten feed,	455	40.70[1]	1,382
XII.	IV.	V.	Hay and gluten feed,	639	41.72[1]	1,351
XII.	XIV.	II.Y.	Hay and gluten feed,	1,020	23.86	2,436
XII.	III.	II.	Hay and molasses,	628	26.99	1,836
XII.	III.	III.	Hay and molasses,	581	24.41	1,927
XII.	V.	IV.	Hay, gluten feed and molasses,	593	24.70	2,071
XII.	V.	V.	Hay, gluten feed and molasses,	688	24.97	1,786
XII.	VII.	IV.	Hay, gluten feed and molasses,	683	24.26	1,770
XII.	VII.	V.	Hay, gluten feed and molasses,	862	24.82	2,167
XII.	X.	IV.	Hay, gluten feed and molasses,	743	23.76	2,429
XII.	XI.	II.Y.	Hay, gluten feed and molasses,	945	29.90	2,500
XIII.	V.	I.	English hay,	508	21.91	2,214
XIII.	V.	II.	English hay,	531	23.02	2,193
XIII.	IV.	III.	Hay and corn meal,	516	18.91	2,500
XIII.	VII.	II.	Hay and corn meal,	442	17.64	2,369
XIII.	I.	I.	Hay and molasses,	468	19.02	1,631
XIII.	I.	II.	Hay and molasses,	450	19.29	1,619
XIII.	III.	I.	Hay and molasses,	528	20.79	1,414
XIII.	III.	II.	Hay and molasses,	620	23.02	1,536
XIII.	VI.	III.	Hay, corn meal and molasses,	588	20.36	2,150
XIII.	VIII.	II.	Hay, corn meal and molasses,	526	21.59	2,159
XIV.	XI.	I.	English hay,	633	24.55	2,292
XIV.	XI.	II.	English hay,	722	26.62	2,251
XIV.	III.	I.	Hay and gluten feed,	389	17.21	2,246
XIV.	III.	II.	Hay and gluten feed,	451	19.84	2,407
XIV.	V.	III.	Hay and gluten feed,	469	19.64	2,385
XIV.	V.	IV.	Hay and gluten feed,	378	17.90	1,639
XIV.	IV.	III.	Hay, gluten feed and molasses,	560	23.81	2,470
XIV.	IV.	IV.	Hay, gluten feed and molasses,	508	21.81	2,450
XIV.	VI.	III.	Hay, gluten feed and molasses,	591	22.36	2,212
XIV.	VI.	IV.	Hay, gluten feed and molasses,	455	21.00	1,269
XIV.	VII.	III.	Hay, gluten feed and molasses,	744	22.79	2,461
XIV.	VII.	IV.	Hay, gluten feed and molasses,	513	22.15	2,338
XIV.	IX.	IV.	Hay, gluten feed and molasses,	827	22.85	2,089

[1] One-fifth of sample.

Weight of Animals at Beginning and End of Period (Pounds).

Series.	Period.	Sheep Number.	Feed or Ration.	Beginning.	End.	Gain or Loss.
X.	VI.	IV.	English hay, ...	156.00	155.50	—.50
X.	IX.	V.	English hay, ...	133.25	137.75	+4.50
XI.	V.	IV.	English hay, ...	142.00	144.00	+2.00
XI.	V.	V.	English hay, ...	122.00	121.50	—.50
XI.	VI.	II.	English hay, ...	154.00	150.00	—4.00
XI.	VI.	III.	English hay, ...	146.50	145.00	—1.50
XI.	VII.	IV.	Hay and gluten feed, . .	141.50	141.00	—.50
XI.	VII.	V.	Hay and gluten feed, . .	118.50	120.00	+1.50
XI.	III.	IV.	Hay and molasses, ...	144.00	142.00	—2.00
XI.	III.	V.	Hay and molasses, ...	124.00	122.00	—2.00
XI.	IV.	IV.	Hay and molasses, ...	145.50	150.00	+4.50
XI.	IV.	V.	Hay and molasses, ...	122.50	125.50	+3.00
XI.	VIII.	IV.	Hay, gluten feed and molasses,	145.00	142.00	—3.00
XI.	VIII.	V.	Hay, gluten feed and molasses,	125.50	122.50	—3.00
XII.	IV.	IV.	Hay and gluten feed, . .	121.50	119.00	—2.50
XII.	IV.	V.	Hay and gluten feed, . .	110.50	108.50	—2.00
XII.	XIV.	II.Y.	Hay and gluten feed, . .	94.50	91.50	—3.00
XII.	III.	II.	Hay and molasses, ...	108.00	107.00	—1.00
XII.	III.	III.	Hay and molasses, ...	125.00	125.00	-
XII.	V.	IV.	Hay, gluten feed and molasses,	121.00	125.50	+4.50
XII.	V.	V.	Hay, gluten feed and molasses,	115.50	112.00	—3.50
XII.	VII.	IV.	Hay, gluten feed and molasses,	127.00	123.00	—4.00
XII.	VII.	V.	Hay, gluten feed and molasses,	115.00	110.00	—5.00
XII.	X.	IV.	Hay, gluten feed and molasses,	128.00	120.00	—8.00
XII.	XI.	II.Y.	Hay, gluten feed and molasses,	95.50	95.50	-
XIII.	V.	I.	English hay, ...	81.25	85.00	+3.75
XIII.	V.	II.	English hay, ...	78.50	78.50	-
XIII.	IV.	III.	Hay and corn meal, ...	83.00	83.50	+.50
XIII.	VII.	II.	Hay and corn meal, ...	80.00	80.00	-
XIII.	I.	I.	Hay and molasses, ...	76.50	79.50	+3.00
XIII.	I.	II.	Hay and molasses, ...	72.50	72.50	-
XIII.	III.	I.	Hay and molasses, ...	83.25	82.50	—.75
XIII.	III.	II.	Hay and molasses, ...	79.50	80.75	+1.25
XIII.	VI.	III.	Hay, corn meal and molasses, .	79.75	84.50	+4.75
XIII.	VIII.	II.	Hay, corn meal and molasses, .	79.00	77.00	+2.00
XIV.	XI.	I.	English hay, ...	90.00	88.50	—1.50
XIV.	XI.	II.	English hay, ...	90.50	88.50	—2.00
XIV.	III.	I.	Hay and gluten feed, . .	91.25	91.00	—.25
XIV.	III.	II.	Hay and gluten feed, . .	87.25	86.25	—1.00
XIV.	V.	III.	Hay and gluten feed, . .	92.25	88.00	—4.25
XIV.	V.	IV.	Hay and gluten feed, . .	95.00	93.00	—2.00
XIV.	IV.	III.	Hay, gluten feed and molasses,	93.50	91.50	—2.00
XIV.	IV.	IV.	Hay, gluten feed and molasses,	101.00	97.50	—3.50
XIV.	VI.	III.	Hay, gluten feed and molasses,	88.50	87.50	—1.00
XIV.	VI.	IV.	Hay, gluten feed and molasses,	96.50	96.00	—.50
XIV.	VII.	III.	Hay, gluten feed and molasses,	85.50	87.50	+2.00
XIV.	VII.	IV.	Hay, gluten feed and molasses,	101.00	101.50	+.50
XIV.	IX.	IV.	Hay, gluten feed and molasses,	95.50	100.25	—4.75

Coefficients employed for the Hay, Hay and Corn Meal and Hay and Gluten Feed, which were applied to the Preceding Feeds and Feed Combinations when fed together with Molasses in Order to show the Depression exerted by the Latter.

Series.	Period.	Sheep Number.	Ration.	Dry Matter.	Ash.	Protein.	Fiber.	Extract Matter.	Fat.
XI.	III.	IV., V.	Hay and molasses,	57.98	40.52	53.61	59.06	61.41	47.76
XI.	IV.	IV., V.	Hay and molasses,	57.98	40.52	53.61	59.06	61.41	47.76
XI.	VIII.	IV.	Hay, gluten feed and molasses,	72.64	47.18	72.87	77.20	73.86	56.49
XI.	VIII.	V.	Hay, gluten feed and molasses,	73.67	48.78	74.36	77.57	75.03	57.46
XII.	III.	II., III.	Hay and molasses,	67.87	49.17	62.31	76.30	66.39	52.37
XII.	V.	IV., V.	Hay, gluten feed and molasses,	73.00	40.16	73.75	77.35	75.07	54.50
XII.	VII.	IV., V.	Hay, gluten feed and molasses,	73.00	40.16	73.75	77.35	75.07	54.50
XII.	X.	IV.	Hay, gluten feed and molasses,	73.00	40.16	73.75	77.35	75.07	54.50
XII.	XI.	II.Y.	Hay, gluten feed and molasses,	68.86	39.23	65.37	72.14	72.00	57.95
XIII.	I.	I., II.	Hay and molasses,	66.64	52.63	62.09	70.93	68.02	47.87
XIII.	III.	I., II.	Hay and molasses,	66.64	52.63	62.09	70.93	68.02	47.87
XIII.	VI.	III.	Hay, corn meal and molasses,	69.43	50.13	61.00	66.18	74.76	61.12
XIII.	VIII.	II.	Hay, corn meal and molasses,	71.38	42.16	47.45	71.55	77.77	63.11
XIV.	IV.	III.	Hay, gluten feed and molasses,	68.00	44.00	66.00	68.00	72.00	61.00
XIV.	IV.	IV.	Hay, gluten feed and molasses,	72.00	46.00	70.00	73.00	76.00	62.00
XIV.	VI.	III.	Hay, gluten feed and molasses,	68.00	44.00	66.00	68.00	72.00	61.00
XIV.	VI.	IV.	Hay, gluten feed and molasses,	72.00	46.00	70.00	73.00	76.00	62.00
XIV.	VII.	III.	Hay, gluten feed and molasses,	68.00	44.00	66.00	68.00	72.00	61.00
XIV.	VII.	IV.	Hay, gluten feed and molasses,	72.00	46.00	70.00	73.00	76.00	62.00
XIV.	IX.	IV.	Hay, gluten feed and molasses,	72.00	46.00	70.00	73.00	76.00	62.00

Calculation of Coefficients.

Series X., Period VI., Sheep IV.

English Hay.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
800 grams English hay fed,	706.80	55.27	60.50	228.65	344.57	17.81
321.50 grams manure excreted,	300.12	34.84	29.71	92.02	134.78	8.76
Grams digested,	406.68	20.43	30.79	136.63	209.79	9.05
Per cent. digested,	57.54	36.96	50.89	59.76	60.88	50.81

Nutritive ratio of ration, 1: 11.9.

Series X., Period IX., Sheep V.

English Hay.

800 grams English hay fed,	718.16	59.97	63.20	229.02	349.17	16.80
314.13 grams manure excreted,	298.67	33.54	27.60	95.37	132.88	9.29
Grams digested,	419.49	26.43	35.60	133.65	216.29	7.51
Per cent. digested,	58.41	44.07	56.33	58.36	61.94	44.70
Average per cent. for both sheep,	57.98	40.52	53.61	59.06	61.41	47.76

Series XI., Period V., Sheep IV.

English Hay.

800 grams English hay fed,	709.20	47.87	86.74	237.23	316.80	20.57
261.10 grams manure excreted,	240.79	26.92	33.95	58.27	111.34	10.31
Grams digested,	468.41	20.95	52.79	178.96	205.46	10.26
Per cent. digested,	66.05	43.76	60.86	75.44	64.85	49.88

Series XI., Period V., Sheep V.

English Hay.

800 grams English hay fed,	709.20	47.87	86.74	237.23	316.80	20.57
270.20 grams manure excreted,	248.96	26.12	32.79	66.00	113.87	10.18
Grams digested,	460.24	21.75	53.95	171.23	202.93	10.39
Per cent. digested,	64.90	45.44	62.20	72.18	64.06	50.51
Average per cent. for both sheep,	65.48	44.60	61.53	73.81	64.46	50.20

Average nutritive ratio of rations for two sheep, 1: 7.5.

Series XI., Period VI., Sheep II.

English Hay.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
900 grams English hay fed,	800.73	54.05	97.93	267.84	357.69	23.22
262.10 grams manure excreted,	245.17	26.48	36.04	58.82	113.44	10.40
Grams digested,	555.56	27.57	61.89	209.02	244.25	12.82
Per cent. digested,	69.38	51.01	63.20	78.04	68.29	55.21

Series XI., Period VI., Sheep III.

English Hay.

900 grams English hay fed,	800.73	54.05	97.93	267.84	357.69	23.22
288 grams manure excreted,	269.34	28.47	37.79	68.17	123.20	11.72
Grams digested,	531.39	25.58	60.14	199.67	234.49	11.50
Per cent. digested,	66.36	47.33	61.41	74.55	65.56	49.53
Average per cent. for both sheep,	67.87	49.17	62.31	76.30	66.39	52.37

Average nutritive ratio of rations for two sheep, 1: 7.7.

Series XI., Period VII., Sheep IV.

Hay and Gluten Feed.

600 grams English hay fed,	531.30	35.86	64.98	177.72	237.33	15.41
200 grams gluten feed fed,	180.06	3.01	44.98	13.00	114.05	5.02
Amount consumed,	711.36	38.87	109.96	190.72	351.38	20.43
208.20 grams manure excreted,	194.60	20.53	29.83	43.49	91.85	8.89
Grams digested,	516.76	18.34	80.13	147.23	259.53	11.54
Per cent. hay and gluten feed digested.	72.64	47.19	72.87	77.19	73.86	56.40

Series XI., Period VII., Sheep V.

Hay and Gluten Feed.

Amount consumed as above,	711.36	38.87	109.96	190.72	351.38	20.43
200.10 grams manure excreted,	187.31	19.91	28.19	42.78	87.74	8.69
Grams digested,	524.05	18.96	81.77	147.94	263.64	11.74
Per cent. hay and gluten feed digested.	73.67	48.78	74.36	77.57	75.03	57.46

Average nutritive ratio of rations for two sheep, 1: 5.4.

Series XI., Period III., Sheep IV.

Porto Rico Molasses.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
800 grams English hay fed,	705.20	57.83	61.28	226.65	342.45	17.00
150 grams molasses fed,	107.24	9.06	4.23	-	93.95	-
Amount consumed,	812.44	66.89	65.51	226.65	436.40	17.00
311 grams manure excreted,	288.73	35.11	30.95	84.66	129.55	8.46
Grams digested,	523.71	31.78	34.56	141.89	306.85	8.54
Minus hay digested,	408.87	23.43	32.85	133.86	210.30	8.12
Molasses digested (grams),	114.84	8.35	1.71	8.03	96.55	.42
Per cent. digested,	107.09	92.16	40.43	-	102.76	-

Series XI., Period III., Sheep V.

Porto Rico Molasses.

Amount consumed as above,	812.44	66.89	65.51	226.65	436.40	17.00
328.60 grams manure excreted,	306.06	36.21	32.23	92.83	136.10	8.69
Grams digested,	506.38	30.68	33.28	133.82	300.30	8.31
Minus hay digested,	408.87	23.43	32.85	133.86	210.30	8.12
Molasses digested (grams),	97.51	7.25	.43	-	90.00	.19
Per cent. digested,	90.93	80.02	10.17	-	95.80	-
Average per cent. for both sheep,	99.01	86.09	25.30	-	99.28	-

Average nutritive ratio of rations for two sheep, 1: 13.6.

Series XI., Period IV., Sheep IV.

Porto Rico Molasses.

800 grams English hay fed,	697.76	57.22	60.64	224.26	338.82	16.82
250 grams molasses fed,	180.30	15.24	7.10	-	157.96	-
Amount consumed,	878.06	72.46	67.74	224.26	496.78	16.82
333.40 grams manure excreted,	307.83	42.05	35.31	83.51	138.09	8.87
Grams digested,	570.23	30.41	32.43	140.75	358.69	7.95
Minus hay digested,	404.56	23.19	32.51	132.44	208.07	8.03
Molasses digested (grams),	165.67	7.22	—.08	8.31	150.62	-
Per cent. digested,	91.89	47.38	-	-	95.35	-

Series XI., Period IV., Sheep V.

Porto Rico Molasses.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
Amount consumed as above, . .	878.06	72.46	67.74	224.26	496.78	16.82
341.2 grams manure excreted, . .	314.45	40.47	36 13	91 03	138 17	8.65
Grams digested, ...	563.61	31.99	31.61	133.23	358.61	8.17
Minus hay digested, ...	404 56	23.19	32 51	132 44	208.07	8 03
Molasses digested (grams), . .	159.05	8.80	.10	.79	150.54	.14
Per cent. digested, ...	88.21	57.74	-	-	95.30	-
Average per cent. for both sheep, .	90.05	52.56	-	-	95.33	-

Average nutritive ratio of rations for two sheep, 1: 16.

Series XI., Period VIII., Sheep IV.

Porto Rico Molasses.

600 grams English hay fed, . .	533.52	36.01	65.25	178.46	238.32	15.47
200 grams gluten feed fed, . .	184.04	3.07	45.97	13.29	116 57	5.13
250 grams molasses fed, . . .	181 68	16.75	7 16	-	157.77	-
Amount consumed, ...	899.24	55.83	118.38	191.75	512.66	20.60
258.40 grams manure excreted, .	239.02	26.65	39 10	50 82	113 39	9.06
Grams digested, ...	660.22	29.18	79.28	140.93	399 27	11.54
Minus hay and gluten feed digested,	521.24	18 44	81.05	-	262 12	-
Molasses digested (grams), . .	138.98	10.74	-	-	137.15	-
Per cent. digested, ...	76.50	64 12	-	-	86 93	-

Series XI., Period VIII., Sheep V.

Porto Rico Molasses.

Amount consumed as above, . .	899.24	55 83	118 38	191.75	512.66	20.60
258.60 grams manure excreted, .	238 84	25 84	38 72	52 76	112 61	8.91
Grams digested, ...	660.40	29 99	79 66	138 99	400.05	11.69
Minus hay and gluten feed digested,	528 63	19 06	82 70	-	266.27	-
Molasses digested (grams), . .	131.77	10 93	-	-	133.78	-
Per cent. digested, ...	72.53	65.25	-	-	84.80	-
Average per cent. for both sheep, .	74 52	64 69	-	-	85.87	-

Average nutritive ratio of rations for two sheep, 1: 7.1.

Series XII., Period IV., Sheep IV.

Gluten Feed and Hay.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
600 grams English hay,	525.00	35.44	64.21	175.61	234.52	15.23
200 grams gluten feed,	179.76	2.75	47.13	11.32	113.88	4.67
Amount consumed,	704.76	38.19	111.34	186.93	348.40	19.90
Minus 203.52 grams manure excreted,	188.24	23.10	29.18	40.75	86.53	8.68
Grams digested,	516.52	15.09	82.16	146.18	261.87	11.22
Per cent. gluten feed and hay digested.	73.29	39.51	73.79	78.20	75.16	56.38

Series XII., Period IV., Sheep V.

Gluten Feed and Hay.

Amount consumed as above,	704.76	38.19	111.34	186.93	348.40	19.90
Minus 208.62 grams manure excreted,	192.41	22.61	29.28	43.93	87.16	9.43
Grams digested,	512.35	15.58	82.06	143.00	261.24	10.47
Per cent. gluten feed and hay digested.	72.70	40.80	73.70	76.50	74.98	52.61
Average per cent. for both sheep,	73.00	40.16	73.75	77.35	75.07	54.50

Series XII., Period XIV., Sheep II. (Young.)

Gluten Feed and Hay.

550 grams English hay,	498.58	33.65	60.98	166.78	222.72	14.46
250 grams gluten feed,	227.83	3.49	59.74	14.35	144.33	5.92
Amount consumed,	726.41	37.14	120.72	181.13	367.05	20.38
238.64 grams manure excreted,	226.20	22.57	41.80	50.47	102.79	8.57
Grams digested,	500.21	14.57	78.92	130.66	264.26	11.81
Minus hay digested,	328.66	17.48	37.80	121.53	144.01	7.84
Gluten feed digested (grams),	171.55	-	41.12	9.13	120.25	3.97
Per cent. hay and gluten feed digested.	68.86	39.23	65.37	72.14	72.00	57.95

Series XII., Period III., Sheep II. (Old).

Porto Rico Molasses.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
800 grams English hay, ...	702.40	47.41	85.90	234.95	313.76	20.37
100 grams Porto Rico molasses, .	73.45	5.35	2.79	–	65.31	–
Amount consumed, ...	775.85	52.76	88.69	234.95	379.07	20.37
Minus 269.86 grams manure excreted,	248.41	29.59	36.81	57.13	113.77	11.10
Grams digested, ...	527.44	23.17	51.88	177.82	265.30	9.27
Minus hay digested, ...	476.72	23.31	53.52	179.27	208.31	10.67
Molasses digested (grams), . .	50.72	—.17	—1.64	—1.45	56.99	—1.40
Per cent. digested.	69.05	–	–	–	87.26	–

Series XII., Period III., Sheep III.

Porto Rico Molasses.

Amount consumed as above, . .	775.85	52.76	88.69	234.95	379.07	20.37
Minus 244.09 grams manure excreted,	224.95	27.24	32.93	50.55	104.42	9.81
Grams digested, ...	550.90	25.52	55.76	184.40	274.65	10.56
Minus hay digested, ...	476.72	23.31	53.52	179.27	208.31	10.67
Molasses digested (grams), . .	74.18	2.21	2.24	5.13	66.34	—.11
Per cent. digested, ...	100.99	41.31	80.29	–	101.58	–

Series XII., Period V., Sheep IV. (Paige).

Porto Rico Molasses.

600 grams English hay, ...	527.10	35.58	64.46	176.31	235.46	15.29
200 grams gluten feed, ...	179.36	2.74	47.03	11.30	113.62	4.66
100 grams Porto Rico molasses, .	73.37	5.34	2.79	–	65.24	–
Amount consumed, ...	779.83	43.66	114.28	187.61	414.32	19.95
246.97 grams manure excreted, .	225.76	25.53	36.12	48.65	106.40	9.05
Grams digested, ...	554.07	18.13	78.16	138.96	307.92	10.90
Minus hay and gluten feed digested,	515.72	15.39	82.22	145.12	262.05	10.87
Molasses digested (grams), . .	38.35	2.74	—4.06	—6.16	45.87	.03
Per cent. digested, ...	52.27	51.31	–	–	70.31	–

Series XII., Period V., Sheep V.

Porto Rico Molasses.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
Amount consumed as above,	779.83	43.66	114.28	187.61	414.32	19.95
249.67 grams manure excreted,	228.25	24.13	36.38	52.25	106.80	8.70
Grams digested,	551.58	19.53	77.90	135.36	307.52	11.25
Minus hay and gluten feed digested,	515.72	15.39	82.22	145.12	262.05	10.87
Molasses digested (grams),	35.86	4.14	—4.32	—9.76	45.47	.38
Per cent. digested,	48.88	77.53	-	-	69.70	-
Average per cent. for two sheep,	50.58	64.42	-	-	70.01	-

Series XII., Period VII., Sheep IV. (Paige).

Porto Rico Molasses.

600 grams English hay,	528.42	35.67	64.63	176.76	236.05	15.32
200 grams gluten feed,	180.28	2.76	47.27	11.36	114.21	4.69
200 grams Porto Rico molasses,	147.22	10.72	5.59	-	130.91	-
Amount consumed,	855.92	49.15	117.49	188.12	481.17	20.01
242.64 grams manure excreted,	225.53	25.51	37.03	48.80	106.02	8.16
Grams digested,	630.39	23.64	80.46	139.32	375.15	11.85
Minus hay and gluten feed digested,	517.35	15.43	82.53	145.51	262.94	10.91
Molasses digested (grams),	113.04	8.21	—2.07	—6.19	112.21	.94
Per cent. digested,	76.78	76.59	-	-	85.72	-

Series XII., Period VII., Sheep V.

Porto Rico Molasses.

Amount consumed as above,	855.92	49.15	117.49	188.12	481.17	20.01
248.17 grams manure excreted,	230.05	25.03	36.07	53.16	107.99	7.80
Grams digested,	625.87	24.12	81.42	134.96	373.18	12.21
Minus hay and gluten feed digested,	517.35	15.43	82.53	145.51	262.94	10.91
Molasses digested (grams),	108.52	8.69	—1.11	—10.55	110.24	1.30
Per cent. digested,	73.71	81.06	-	-	84.21	-
Average per cent. for two sheep,	75.25	78.83	-	-	84.97	-

Series XII., Period X., Sheep IV. (Paige).

Porto Rico Molasses.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
600 grams English hay,	535.50	36.15	65.49	179.12	239.21	15.53
200 grams gluten feed,	181.74	2.78	47.65	11.45	115.13	4.73
300 grams Porto Rico molasses,	220.83	16.08	8.39	-	196.36	-
Amount consumed,	938.07	55.01	121.53	190.57	550.70	20.26
237.57 grams manure excreted,	222.15	27.44	39.32	44.05	102.88	8.46
Grams digested,	715.92	27.57	82.21	146.52	447.82	11.80
Minus hay and gluten feed digested,	523.59	15.63	83.44	147.41	266.00	11.04
Molasses digested (grams),	192.33	11.94	—1.23	—.89	181.82	.76
Per cent. digested,	87.09	74.25	-	-	92.60	-

Series XII., Period XI., Sheep II. (Young).

Porto Rico Molasses.

600 grams English hay,	543.42	36.68	66.46	181.77	242.75	15.76
200 grams gluten feed,	179.96	2.75	47.19	11.34	114.00	4.68
250 grams Porto Rico molasses,	185.45	13.50	7.05	-	164.90	-
Amount consumed,	908.83	52.93	120.70	193.11	521.65	20.44
299.04 grams manure excreted,	280.71	32.11	48.79	61.87	128.06	9.88
Grams digested,	628.12	20.82	71.91	131.24	393.59	10.56
Minus hay and gluten feed digested,	498.12	15.47	74.29	139.31	256.86	11.84
Molasses digested (grams),	130.00	5.35	—3.38	—8.07	136.73	—.28
Per cent. digested,	70.10	39.63	-	-	82.92	-

Series XIII., Period V., Sheep I.

English Hay.

700 grams English hay,	630.49	40.73	77.17	184.36	312.03	16.20
Minus 219.10 grams manure excreted,	205.19	19.12	29.22	49.96	98.51	8.37
Grams digested,	425.30	21.61	47.95	134.40	213.52	7.83
Per cent. digested,	67.46	53.06	62.14	72.90	68.43	48.33

Series XIII., Period V., Sheep II.

English Hay.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
700 grams English hay,	630.49	40 73	77.17	184.36	312.03	16.20
Minus 230.19 grams manure excreted,	215 57	19 47	29.30	57 23	101.06	8 52
Grams digested,	414.92	21.26	47.87	127.13	210.97	7 68
Per cent. digested,	65 81	52.20	62.03	68.96	67 61	47.41
Average per cent. for two sheep,	66 64	52.63	62.09	70.93	68.02	47.87

Series XIII., Period IV., Sheep III.

English Hay, Corn Meal.

500 grams English hay,	448.25	28.96	54.87	131.07	221.84	11.52
150 grams corn meal,	133.98	2 12	14.00	2.81	108.82	6.23
Amount consumed,	582.23	31.08	68.87	133.88	330.66	17.75
189 06 grams manure excreted,	177.98	15.50	26 86	45.28	83.45	6.89
Grams digested,	404 25	15.58	42.01	88.60	247.21	10.86
Per cent. digested,	69.43	50 13	61.00	66.18	74.76	61.12

Series XIII., Period VII., Sheep II.

English Hay, Corn Meal.

500 grams English hay,	445 60	28 65	32 04	151.86	222.00	11 05
150 grams corn meal,	135 54	2 14	14.16	2.85	110.09	6 30
Amount consumed,	581 14	30.79	46.20	154.71	332.09	17.35
176.37 grams manure excreted,	166 33	17 81	24.28	44 01	73 82	6 40
Grams digested,	414.81	12.98	21.92	110.70	258.27	10.95
Per cent. digested,	71.38	42 16	47.45	71.55	77.77	63.11

Series XIII., Period I., Sheep I.

Porto Rico Molasses.

600 grams English hay,	531.72	34.34	65.08	155.47	263.15	13.67
100 grams Porto Rico molasses,	72.93	5.87	3.34	-	63 72	-
Amount consumed,	604.65	40.21	68.42	155.47	326 87	13.67
Minus 190 20 grams manure excreted,	177.55	19 32	26 26	42.47	82 88	6 62
Grams digested,	427.10	20 89	42.16	113.00	243.99	7.05
Minus hay digested,	354 34	18 07	40.41	110 27	178.99	6.54
Molasses digested (grams),	72.76	2.82	1 75	2.73	65 00	.51
Per cent. digested,	99.77	48 04	52.40	-	102.01	-

Series XIII., Period I., Sheep II.

Porto Rico Molasses.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
Amount consumed as above,	604.65	40.21	68.42	155.47	326.87	13.67
Minus 192.90 grams manure excreted,	180 05	19 36	27.22	42.85	83.74	6.88
Grams digested,	424.60	20.85	41.20	112.62	243 13	6.79
Minus hay digested,	354.34	18.07	40.41	110 27	178 99	6.54
Molasses digested (grams),	70.26	2.78	.79	2.35	64.14	.25
Per cent. digested,	96 34	47.36	23.65	–	100.66	–
Average per cent. for two sheep,	98.06	47.70	38.03	–	101.34	–

Series XIII., Period III., Sheep I.

Porto Rico Molasses.

600 grams English hay,	535.80	34.61	65.58	156.67	265.17	13.78
200 grams Porto Rico molasses,	145.86	11.83	6 86	–	127 18	–
Amount consumed,	681.66	46.44	72.44	156.67	392.35	13.78
Minus 207.86 grams manure excreted,	194.85	21.20	30 24	44 91	91 46	7.03
Grams digested,	486.81	25.24	42 20	111.76	300.89	6.75
Minus hay digested,	357.06	18 22	40 72	111.13	180.37	6.60
Molasses digested (grams),	129 75	7.02	1.48	.63	120.52	.15
Per cent. digested,	88 96	59 34	21.57	–	94.76	–

Series XIII., Period III., Sheep II.

Porto Rico Molasses.

Amount consumed as above,	681.66	46 44	72 44	156 67	392.35	13.78
Minus 230.24 grams manure excreted,	215 67	22 02	31 73	56 53	97 87	7 53
Grams digested,	465 99	24 42	40 71	100.14	294.48	6.25
Minus hay digested,	357 06	18.22	40 72	111 13	180 37	6 60
Molasses digested (grams),	108 93	6 20	.01	10.99	114.11	.35
Per cent. digested,	74 67	52 41	–	–	89 72	–
Average per cent. for two sheep,	81 82	55 88	21 57[1]	–	92.24	–

[1] One sheep.

Series XIII., Period VI., Sheep III.

Porto Rico Molasses.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
500 grams English hay,	450.50	29.10	55.14	131.73	222.95	11.58
150 grams corn meal,	135.96	2.15	14.21	2.86	110.43	6.32
100 grams Porto Rico molasses,	72.70	5.98	3.43	–	63.29	–
Amount consumed,	659.16	37.23	72.78	134.59	396.67	17.90
203.60 grams manure excreted,	190.04	16.86	29.82	46.60	89.66	7.11
Grams digested,	469.12	20.37	42.96	87.99	307.01	10.79
Minus hay and corn meal digested,	407.18	15.67	42.30	89.07	249.23	10.94
Molasses digested (grams),	61.94	4.70	.66	–	57.78	–
Per cent. digested,	85.20	78.60	19.24	–	91.29	–

Series XIII., Period VIII., Sheep II.

Porto Rico Molasses.

500 grams English hay,	445.25	28.63	32.01	151.74	221.82	11.04
150 grams corn meal,	135.36	2.14	14.15	2.84	109.91	6.29
200 grams Porto Rico molasses,	145.56	11.89	6.85	–	126.81	–
Amount consumed,	726.17	42.66	53.01	154.58	458.57	17.33
Minus 215.89 grams manure excreted,	202.18	19.83	26.97	56.17	92.90	6.31
Grams digested,	523.99	22.83	26.04	98.41	365.67	11.02
Minus hay and corn meal digested,	414.44	12.97	21.90	110.60	258.01	10.94
Molasses digested (grams),	109.55	9.86	4.14	–	107.66	–
Per cent. digested,	75.26	23.11	60.44	–	84.90	–

Series XIV., Period XI., Sheep I.

English Hay.

700 grams English hay,	630.35	44.82	48.85	205.74	315.24	15.70
245.46 grams manure excreted,	229.28	25.59	24.42	63.69	107.56	8.02
Grams digested,	401.07	19.23	24.43	142.05	207.68	7.68
Per cent. digested,	63.63	42.91	50.01	69.04	65.88	48.92

Series XIV., Period XI., Sheep II.

English Hay.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
700 grams English hay,	630.35	44.82	48.85	205.74	315.24	15.70
266.16 grams manure excreted,	248 83	26.00	25 31	73 53	116.08	7.91
Grams digested,	381.52	18.82	23.54	132.21	199.16	7.79
Per cent. digested,	60.53	41.99	48.19	64.27	63.18	49.62
Average per cent. for both sheep,	62.08	42.45	49 10	66.66	64.53	49.27

Series XIV., Period III., Sheep I.

Gluten Feed and Hay.

500 grams English hay,	442.10	30.15	33.91	134.21	233.35	10.48
150 grams gluten feed,	136 13	5 61	37 05	10 63	76 97	5 87
Amount consumed,	578.23	35.76	70.96	144.84	310.32	16.35
Minus 172.09 grams manure excreted,	160 27	18 45	21 65	37 90	76.80	5 47
Grams hay and gluten feed digested,	417.96	17.31	49.31	106.94	233.52	10.88
Per cent. hay and gluten feed digested.	72.28	48.41	69.49	73.83	75.25	66.54

Series XIV., Period III., Sheep II.

Gluten Feed and Hay.

Amount consumed as above,	578 23	35 76	70.96	144.84	310 32	16.35
Minus 198.37 grams manure excreted,	184 70	21 17	23 81	46 30	87 08	6 34
Grams hay and gluten feed digested,	393.53	14 59	47.15	98.54	223.24	10.01
Per cent. hay and gluten feed digested.	68.06	40.80	66.45	61 13	71.94	61 22
Average per cent. for both sheep,	70.17	44 61	67.97	67.48	73 60	63.88

Series XIV., Period V., Sheep III.

Gluten Feed and Hay.

500 grams English hay,	447 25	30.50	34 30	135.74	236 11	10.60
150 grams gluten feed,	136 73	5 63	37 22	10 68	77 31	5.89
Amount consumed,	583.98	36.13	71 52	146.42	313.42	16.49
Minus 196.35 grams manure excreted,	184 88	20 13	24 25	46 74	87 25	6 51
Grams hay and gluten feed digested,	399.10	16 00	47.27	99.68	226.17	9.98
Per cent. hay and gluten feed digested.	68 34	44 20	66 09	68.08	72 16	60.52

Series XIV., Period V., Sheep IV.

Gluten Feed and Hay.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
Amount consumed as above, . .	583 98	36 13	71.52	146.42	313.42	16.49
Minus 179.00 grams manure excreted,	163 36	19 36	21.74	39 76	76 27	6 23
Grams hay and gluten feed digested,	420.62	16.77	49.78	106.66	237.15	10.26
Per cent. hay and gluten feed digested.	72.03	46.42	69 60	72.85	75.67	62.22
Average per cent. for both sheep, .	70.19	45.31	67 85	70.47	73.92	61.37

Series XIV., Period IV., Sheep III.

Porto Rico Molasses.

500 grams English hay, ...	446.35	30.44	34.24	135.47	235.62	10.58
150 grams gluten feed, ...	136.50	5.62	37.16	10.66	77.18	5.88
200 grams molasses, ...	149.02	12 41	8 60	-	128.01	-
Amount consumed, ...	731.87	48.47	80.00	146.13	440.81	16.46
238.06 grams manure excreted, .	219 92	26 74	30 80	53.22	102 56	6.60
Grams digested, ...	511.95	21.73	49.20	92.91	338.25	9.86
Minus hay and gluten feed digested,	396.34	15 87	47 12	99 37	225 22	10.04
Molasses digested (grams), . .	115.61	5.86	2.08	—6.46	113.03	—.18
Per cent. digested, ...	77.58	47.22	24.19	-	88.30	-

Series XIV., Period IV., Sheep IV.

Porto Rico Molasses.

Amount consumed as above, . .	731.87	48.47	80.00	146.13	440.81	16.46
218.07 grams manure excreted, .	201.67	25 89	29 93	45 46	94 00	6 39
Grams digested, ...	530.20	22.58	50.07	100.67	346.81	10.07
Minus hay and gluten feed digested,	419 65	16.59	49 98	106 67	237 73	10 21
Molasses digested (grams), . .	110.55	5.99	.09	—6.00	109.08	—.14
Per cent. digested, ...	74 18	48 27	1.05	-	85 21	-
Average per cent. for both sheep, .	75.88	47.75	12 62	-	86.76	-

Series XIV., Period VI., Sheep III.

Porto Rico Molasses.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
500 grams English hay, . . .	447.25	30.50	34.30	135.74	236.11	10.60
150 grams gluten feed, ...	137.28	5.65	37.37	10.72	77.62	5.92
50 grams molasses, ...	37.42	3.06	2.23	–	32.13	–
Amount consumed, ...	621.95	39.21	73.90	146.46	345.86	16.52
223.6 grams manure excreted, . .	210.18	24.34	28.63	51.70	98.74	6.77
Grams digested, ...	411.77	14.87	45.27	94.76	247.12	9.75
Minus hay and gluten feed digested,	397.48	15.91	47.30	99.59	225.89	10.08
Molasses digested (grams), . .	14.29	—1.04	—2.03	—4.83	21.23	—.30
Per cent. digested, ...	38.19	–	–	–	66.08	–

Series XIV., Period VI., Sheep IV.

Porto Rico Molasses.

Amount consumed as above, . .	621.95	39.21	73.90	146.46	345.86	16.52
210.03 grams manure excreted, .	197.45	22.96	26.08	46.80	95.07	6.54
Grams digested, ...	424.50	16.25	47.82	99.66	250.79	9.98
Minus hay and gluten feed digested,	420.86	16.63	50.17	106.92	238.43	10.24
Molasses digested (grams), . .	3.64	—.38	—2.35	—7.26	12.36	—.26
Per cent. digested, ...	9.73	–	–	–	38.47	–
Average per cent. for both sheep, .	23.96	–	–	–	52.28	–

Series XIV., Period VII., Sheep III.

Porto Rico Molasses.

500 grams English hay, . . .	448.60	30.59	34.41	136.15	236.82	10.63
150 grams gluten feed, ...	139.86	5.76	38.07	10.92	79.08	6.03
100 grams molasses, ...	75.26	6.17	4.51	–	64.58	–
Amount consumed, ...	663.72	42.52	76.99	147.07	380.48	16.66
227.90 grams manure excreted, .	213.63	25.32	30.72	53.79	97.48	6.32
Grams digested, ...	450.09	17.20	46.27	93.28	283.00	10.34
Minus hay and gluten feed digested,	400.15	15.99	47.84	100.01	227.45	10.16
Molasses digested (grams), . .	49.94	1.21	—.57	—6.73	55.55	.18
Per cent. digested, ...	66.37	19.61	–	–	86.02	–

Series XIV., Period VII., Sheep IV.

Porto Rico Molasses.

Daily Record.	Dry Matter.	Ash.	Protein.	Fiber.	Nitrogen-free Extract Matter.	Fat.
Amount consumed as above,	663.72	42.52	76.99	147.07	380.48	16.66
221.48 grams manure excreted,	207.73	23.64	27.57	51.68	98.11	6.73
Grams digested,	455.99	18.88	49.42	95.39	282.37	9.93
Minus hay and gluten feed digested,	423.69	16.72	50.74	107.36	240.08	10.33
Molasses digested (grams),	32.30	2.12	—1.32	—11.97	42.29	—.40
Per cent. digested,	42.92	34.36	-	-	65.48	-
Average per cent. for both sheep,	54.65	26.99	-	-	75.75	-

Series XIV., Period IX., Sheep IV.

Porto Rico Molasses.

500 grams English hay,	451.25	30.77	34.61	136.95	238.23	10.69
150 grams gluten feed,	136.90	5.98	36.14	9.84	79.66	5.28
150 grams molasses,	112.20	9.39	6.68	-	96.13	-
Amount consumed,	700.35	46.14	77.43	146.79	414.02	15.97
228.51 grams manure excreted,	213.34	26.39	32.53	49.47	98.53	6.42
Grams digested,	487.01	19.75	44.90	97.32	315.49	9.55
Minus hay and gluten feed digested,	423.47	16.91	49.53	107.16	241.60	9.90
Molasses digested (grams),	63.54	2.84	—4.63	—9.84	73.89	—.35
Per cent. digested,	56.63	30.24	-	-	76.86	-

STABILITY OF BUTTER-FAT SAMPLES.[1]

BY E. B. HOLLAND, M.SC.

In the examination of butter fat, the question of stability is one of prime importance. Should appreciable changes take place in the samples, results would be vitiated and deductions as to the effect of feed would be of questionable value. That oils and fats are readily acted upon by a number of agents has been long recognized, but whether butter-fat samples as ordinarily treated would be sufficiently changed as to affect analytical results is uncertain, though quite probable from the nature of the substance. To secure definite information on the subject it was necessary to carry out several experiments, of which a description with data follows.

The object of the first experiment was to determine the action of air, light and moisture, respectively, at the same temperature, upon butter fat. Heat as an independent factor could not be studied at that time as it would have increased the work to a point beyond which it could have been handled, but the action of heat was noted more particularly in another experiment. About ten pounds of butter fat were prepared by melting fresh butter and filtering the supernatant fat through paper in a jacketed funnel. Two-ounce bottles, 73 in number, were filled with the melted fat and placed in the north window of the station creamery building in March, 1908. These bottles were divided into seven sets, four of which were closed with a glass stopper and sealed with ceresin to practically eliminate the oxidizing action of the air, and the remainder simply protected by a single thickness of unbleached cotton cloth tied over the top, which readily permitted circulation of the air. One set of

[1] This work was undertaken jointly with Dr. R. D. MacLaurin, but owing to the resignation of Dr. MacLaurin it has been completed and prepared for publication by Mr. Holland.

the sealed bottles was guarded from light [1] and from moisture, and served as a check. Two sets of both closed and open bottles had 1 cubic centimeter of water added, one set of each being exposed to north and east light (not sun) and one set protected from light.[1] Another set of both closed and open bottles was exposed to the light. From these various combinations it was thought deductions might be drawn as to the relative action of air, light and moisture upon butter fat.

The fat was of fair average composition, as shown by the analytical results: —

Saponification number,	232.47
Acid number,	1.48
Reichert-Meissl number,	29.84
Mean molecular weight of volatile acids,	96.90
Insoluble acids (per cent.),	88.21
Mean molecular weight of insoluble acids,	253.08
Iodine number,	28.40
Melting point (Wiley method),	32.95° C.
Refractive index, 40° C.,	1.4525
Valenta test,	28.50° C.

One or two samples were drawn from every series in June and December, 1908, and March and October, 1909, melted, filtered and analyzed. The testing in June, 1908, was more or less unsatisfactory, especially the iodine number, because of the high temperature prevailing, and what deductions may be offered will be based largely upon the remaining data, which represents periods of six, twelve and eighteen months.

Physical Changes.

The original fat, when melted, gave a transparent oil of a pronounced yellow color and a slight but characteristic odor. On standing, the color gradually faded. This, however, was far from uniform, even with members of the same series. The checks were very irregular, varying at the end of the test from yellow to almost white; with moisture the color was less intense, with light similar, and with moisture and light rather better

[1] In providing for the circulation of air, a little diffused light reached the samples.

than the checks. Light, in the absence of air, did not accelerate loss of color.

Air induced the most uniform destruction of color. As the air always carried more or less moisture, it was impossible to differentiate as to the effect of light and added moisture. The most notable change was obtained from the combined action of all three factors.

The sealed samples were porous, and developed a slight odor, unlike that of the original fat. The open samples were more like tallow, both in appearance and odor. Old samples containing added water were turbid on melting, and required considerable time to settle clear.

Chemical Changes.

As decomposition of fats and oil seems to progress along two fairly well-defined lines, that of hydrolysis and that of oxidation, only such determinations were planned as would readily serve to measure these changes; acid and saponification numbers for the former, and iodine number for the latter. Too much must not be expected of these determinations for so complex a reaction, but they are at least indicative. If the decomposition became extensive, other tests would be warranted.

As shown by Table 1, added moisture, in the absence of air, had no appreciable hydrolytic action in excess of the check. Light alone, and with moisture present, preserved the original fat practically unchanged for eighteen months while the check manifested a noticeable breaking down. Moist air increased hydrolysis, both light and added water intensified the reaction. Lewkowitsch states that dry air without light has no action on oils and fats, and his explanation will be presented later.

Aldehydes were produced in both open and closed samples, as shown by the brown color of the saponification test (October, 1909), except in the sealed samples exposed to light.

TABLE 1. — *Saponification Number.*

	March, 1908.	June, 1908.		September, 1908.		March, 1909.		October, 1909	
	Test.	Test.	Difference.	Test.	Difference.	Test.	Difference.	Test.	Difference.
Check,	232.47	233.32	+.75	232.93	+.46	232.81	+.34	234.28	+1.81
Moisture,	-	233.25	+.78	232.60	+.13	232.66	+.19	234.26	+1.79
Light,	-	233.20	+.73	232.33	—.14	232.33	—.14	231.99	—.48
Light and moisture,	-	232.80	+.33	232.53	+.06	232.75	+.28	232.36	—.11
Air and moisture,	-	233.63	+1.16	232.97	+.50	235.19	+2.72	235.63	+3.16
Air and light,	-	234.24	+1.77	233.72	+1.25	235.98	+3.51	237.32	+4.85
Air, light and moisture,	-	234.51	+2.04	234.74	+2.27	238.21	+5.74	239.28	+6.81

Acid Number.

Check,	1.46	1.40	—.06	1.51	+.05	1.42	—.04	2.75	+1.29
Moisture,	-	1.44	—.02	1.51	+.05	1.59	+.13	2.80	+1.34
Light,	-	1.40	—.05	1.40	—.06	1.39	—.07	1.60	+.14
Light and moisture,	-	1.41	—.05	1.44	—.02	1.59	+.13	1.93	+.47
Air and moisture,	-	1.43	—.03	1.54	+.08	2.12	+.66	3.39	+1.93
Air and light,	-	1.48	+.02	1.57	+.11	2.29	+.83	4.03	+2.57
Air, light and moisture,	-	1.58	+.12	1.88	+.42	3.29	+1.83	5.90	+4.44

Ether Number.

Check,	231.01	231.82	+.81	231.42	+.41	231.39	+.38	231.53	+.52
Moisture,	-	231.81	+.80	231.09	+.08	231.07	+.06	231.46	+.45
Light,	-	231.80	+.79	230.93	—.08	230.94	—.07	230.39	—.62
Light and moisture,	-	231.39	+.38	231.09	+.08	231.16	+.15	230.43	—.58
Air and moisture,	-	232.20	+1.19	231.43	+.42	233.07	+2.06	232.24	+1.23
Air and light,	-	232.76	+1.75	232.15	+1.14	233.69	+2.68	233.29	+2.28
Air, light and moisture,	-	232.93	+1.92	232.86	+1.85	234.92	+3.91	233.38	+2.37

TABLE 2. — *Iodine Number.*

	March, 1908.	June, 1908.		September, 1908.		March, 1909.		October, 1909.	
	Test.	Test.	Difference.	Test.	Difference.	Test.	Difference.	Test.	Difference.
Check,	28.40	29.13	+.73	26.70	—1.70	27.88	—.52	25.88	—2.52
Moisture,	-	28.74	+.34	28.29	—.11	28.13	—.27	25.93	—2.47
Light,	-	28.26	—.14	28.08	—.32	27.38	—1.02	27.43	—.97
Light and moisture,	-	26.86	—1.54	27.83	—.57	27.98	—.42	28.31	—.09
Air and moisture,	-	28.69	+.29	28.02	—.38	26.23	—2.17	25.42	—2.98
Air and light,	-	28.04	—.36	27.79	—.61	25.81	—2.59	24.66	—3.74
Air, light and moisture,	-	27.59	—.81	26.88	—1.52	24.43	—3.97	24.29	—4.11

In the absence of air, added moisture appeared to have no effect as compared with the check on the unsaturated compounds, while light both with and without moisture prevented oxidation to some extent as measured by the iodine number (Table 2). The experiments of Ritsert [1] proved that light, in the absolute exclusion of air, could not produce rancidity, but the preserving action here noted is a peculiar feature worthy of further study.

Moist air increased the oxidation of the fat, with light and added moisture contributing factors. Light in the presence of moist air was destructive, a marked contrast to its action when air was excluded.

The hypothesis of Lewkowitsch,[2] supported by the investigations of Geitel [3] and Duclaux,[4] offers an explanation of the probable changes that take place in the development of rancidity in oils and fats. The initial change he ascribes to the action of moisture in the presence of fat-splitting enzymes. The free fatty acids resulting from the hydrolysis are oxidized by the air in the presence of light. Ritsert [1] asserts that oxygen and light must act simultaneously, neither of the agents alone being able to produce rancidity.

On the basis of the above assumption the hydrolysis of the check samples must have been due to traces of moisture in the fat and in the air between fat and stopper, and the oxidation to the air and a very limited amount of diffused light. This may be possible, as the changes were not, in themselves, excessive, though rather out of proportion to the conditions prevailing. It fails, however, to explain why similar samples in the light gave less rather than equal or greater changes under conditions which naturally should have been more favorable. The changes in the open samples were not wholly in accord with the theory. Light was a factor in oxidation, as was to be expected, but also in hydrolysis, which is difficult to explain. With many points indecisive and others unconsidered, the prime object of the experiment has been attained in showing that filtered butter-fat samples of normal acidity can be satisfactorily preserved in well-stoppered bottles. The action of high temperatures and sunlight

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[1] Untersuchungen über d. Ranzigwerden der Fette. Inaug. Dissert. Berlin, 1890.
[2] Chemical Technology and Analysis of Oils, Fats and Waxes, 3d Edition, Vol. I., pp. 23, 24.
[3] Journ. f. prakt. Chemie, 1897 (55), 448.
[4] Annales de l'Institut Pasteur, 1887; Compt. rend. 102, 1077.

should, of course, be avoided. As to the specific action of air, light and moisture, the experiment should be considered only preliminary, pointing the way for further work under "control" conditions.

Action of Heat.

The object of the second experiment was to ascertain what changes might take place upon heating butter fat several days at 50° C. Fresh samples were prepared. After heating a sample twenty-four hours in a water bath, varying amounts were weighed for saponification, acid and iodine numbers; similar portions were withdrawn at the end of forty-eight hours, and again after seventy-two hours' heating.

The analysis of the check sample and of the heated fat are presented in the following table: —

	Saponification Number.	Acid Number.	Ether Number.	Iodine. Number.
Check,	233.07	.84	232.23	28.18
Heated twenty-four hours,	233.99	.74	233.25	28.10
Heated forty-eight hours,	233.30	.81	232.49	28.17
Heated seventy-two hours,	233.62	.83	232.79	28.16

The results indicate a slight difference between the two samples in spite of careful mixing, as shown by the saponification and acid numbers. Heating gave a very slight increase in acid number, otherwise no change is noticeable. It seems evident, therefore, that any reasonable heating of butter fat at a temperature not exceeding 50° C. would have little appreciable effect upon analytical results.

ADDITIONAL NOTES FOR METHODS IN FAT ANALYSIS.[1]

BY E. B. HOLLAND, M.SC.

In the titration of saponification and acid numbers of the fat, and neutralization number of the insoluble acids, 1 cubic centimeter of indicator should be used. This has been our practice for some years, though not so stated in the methods, and gives a more definite end point, especially in the case of acid number. The writer has also noted the rather ambiguous statements relative to desired temperature for the above titrations. A temperature of 40° to 45° C. has proved very satisfactory. It is sufficiently high to maintain the soaps and fatty acids in solution and yet not destroy the sensitiveness of the indicator. Slight saponification may take place in the determination of acid number, but the error is less than the opposite fault of too great chilling.

Sulfuric acid is preferable to hydrochloric for the decomposition of the soap in the determination of insoluble acids; 150 cubic centimeters of water together with 5 cubic centimeters of sulfuric acid (1–4) clears the solution rapidly with little apparent action on the fatty acids.

The variable results in iodine number at a high temperature are evidently due to volatilization of iodine and not to a secondary reaction. Moistening of the cork stopper with potassium iodide solution will reduce the loss, but not prevent it, if the temperature exceeds 10° to 15° C.

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[1] Massachusetts Agricultural Experiment Station, twenty-first report (1909), pp. 120–138.

VOLUMETRIC DETERMINATION OF COPPER.[1]

BY E. B. HOLLAND, M.SC.

The co-operation of the laboratory in the experiments conducted by other departments of the station has often rendered necessary quantitative determinations of reducing sugar, sucrose, lactose and starch in a variety of products. The final step in every case is the determination of the cuprous oxide precipitated from Allihn's solution by the reducing action of the sugar. After a considerable study of different methods of filtration, and various ways of determining the amount of precipitate as copper, cuprous and cupric oxides, the following method was adopted, having proved highly satisfactory if reasonable attention is paid to details. It might be said, further, that as such work often has to be done at odd times, it is desirable to maintain a supply of sugar tubes,[2] and only to titrate when there are a number of tests on hand. By exercising a little care the same tubes can be used repeatedly without change of felt.

The process consists of heating an aliquot part of the sugar solution with the mixed Allihn's solution (30 cubic centimeters of "white," 30 cubic centimeters of "blue" and 60 cubic centimeters of water) and filtering by aid of suction through a sugar tube with an asbestos felt supported by glass wool. The cuprous precipitate is transferred to the tube, washed with hot water until free from alkali and then with alcohol. The copper is dissolved in 5 cubic centimeters of concentrated nitric acid, thoroughly washed with hot water, and the filtrate run into an Erlenmeyer flask by means of suction. The solution is evaporated to small volume to expel excess of acid, and afterwards diluted with 60 cubic centimeters of water. Too great concentration should be avoided, as it often results in the precipi-

[1] An adaptation of the Low zinc-acetate method.
[2] Eimer and Amend, No. 3263.

tation of a very insoluble form of copper and the loss of the determination. Twenty-five cubic centimeters of a saturated solution of zinc acetate and 20 cubic centimeters of potassium iodide (165 grams to 1,000 cubic centimeters) are added, and the free iodine titrated with N/10 sodium thiosulfate solution (24.83 grams per liter). The thiosulfate is run in gradually, with constant shaking, until the brownish yellow color (iodine) has been largely destroyed; then 2 cubic centimeters of starch paste (1 gram to 200 cubic centimeters) are added and the titration continued until the blue particles have entirely disappeared. Towards the end of the reaction the flask should be stoppered and shaken thoroughly.

The copper equivalent of the thiosulfate is determined by diluting 25 cubic centimeters of a standard copper solution with water, evaporating and titrating exactly as in the test. The standard solution is prepared by dissolving 10 grams of pure dry metallic copper in 200 cubic centimeters of concentrated nitric acid, and making up to a liter with water at 20° C. The solution should be analyzed gravimetrically, and will keep almost indefinitely. From this data the reducing action of the sugar solution can be readily calculated in terms of copper, and by conversion tables the corresponding amount of sugar. The method has been more recently applied to the determination of copper in Paris green and arsenite of copper, and found equally satisfactory. The copper is precipitated from a hydrochloric acid solution in the presence of sodium acetate with a slight excess of sodium hydrate. The resulting cuprous oxide is transferred to a sugar tube and determined as above. While the first reading of this method might give the impression that it was rather difficult, in reality it is extremely simple, can be carried out rapidly and the titration is very sensitive.

READING THE BABCOCK TEST.

BY P. H. SMITH.

Introduction.

During the summer of 1909 an investigation was undertaken to determine the best method of reading the column of fat in the manipulation of the Babcock test.

Babcock [1] in his first description of the test advocates reading "the divisions which mark the highest and lowest limits of the fat," which would, of course, include the upper and lower meniscus. Subsequent experiments proved that such a practice gave too high results, especially for cream tests in cases where 30 and 50 per cent. 6-inch Connecticut cream bottles were used, and the method of reading to the *bottom* of the upper meniscus became quite prevalent in certain sections of the country. This station has held, however, that until recognized authorities advocated this method, it was better to hold to the original method, in order that results of different chemists and creamery men might be comparative. It was not, therefore, until 1908, when a widely used text-book [2] recommended omitting the upper meniscus from the reading, that it was considered by the Massachusetts experiment station.

An objection to reading tests to the bottom of the upper meniscus is founded upon the fact that the *depth* of the meniscus is influenced by several factors, including diameter of the neck of the bottle, color and clearness of the fat column and different light effects. Different persons conscientiously attempting to read the same test correctly may vary considerably in their results. In order to eliminate this error Eckles [3] recommends the use of

[1] Bulletin 24, Wisconsin Agricultural Experiment Station.
[2] Testing Milk and its Products, Farrington and Woll.
[3] Chicago Dairy Produce, July, 1908.

amyl alcohol, — colored a bright red by fuchsin or any common red dye, — a small quantity of which is dropped on top of the fat column at the completion of the test. Being lighter than butter fat it floats upon the fat, doing away with the meniscus and giving a sharply defined line between alcohol and fat. Farrington,[1] at the suggestion of Babcock, recommends ethyl alcohol saturated with butter fat, which is used in the same manner as the amyl alcohol. "The fat-saturated alcohol is prepared by adding about a teaspoonful of butter fat to 6 ounces of alcohol in a bottle. Warm and shake the bottle until the alcohol has dissolved all the fat possible; some of it will be left undissolved at the bottom of the bottle." Butter fat at the temperature when usually read has a specific gravity of 0.9. It is necessary to have the alcohol reasonably pure, otherwise there is a possibility of its being heavier than the butter fat, in which case it would pass through the fat column instead of floating on top. Ethyl alcohol containing 42 per cent. water has approximately the same specific gravity as butter fat.

Observations at this Station.

Six-inch test bottles having as wide a diversity in size of neck as could be brought together were used. These bottles were carefully cleaned, and before using were washed out with ether to remove all traces of fat. Pure butter fat was then weighed into the bottles on a delicate balance, and enough hot water added to make up to 18 grams. The bottles were then placed in a Babcock tester and whirled three times, five, three and two minutes, respectively, as for the regular test. Readings including and without the upper meniscus were taken immediately; alcohol according to the Farrington method was then added and readings again taken. The theoretical readings were then computed and the results compared. Following is the tabulated data: —

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[1] Special circular, Wisconsin Dairy School.

TABLE 1.

KIND OF BOTTLE.	Length of Scale (Millimeters).	Ten Per Cent. on Scale equals (Millimeters).	Each Division represents (Per Cent.).	Grams Fat taken.	Theoretical Reading.	Actual Reading, Top Meniscus.	Error (Per Cent.).	Actual Reading, Bottom Meniscus.	Error (Per Cent.).	Actual Reading, Farrington Method.	Error (Per Cent.).
5 per cent. double neck,	61.0	122.0	.1	.5816	3.23	3.20	—.03	3.15	—.08	3.20	—.03
8 per cent. milk,	73.0	91.2	.1	.9665	5.37	5.50	+.13	5.30	—.07	5.40	+.03
10 per cent. milk,	65.0	65.0	.2	1.0629	5.91	6.20	+.29	5.90	—.01	6.00	+.09
10 per cent. milk,	63.5	63.5	.2	1.1009	6.12	6.40	+.28	6.20	+.08	6.30	+.18
30 per cent. cream,	78.0	26.0	.5	4.0551	22.53	23.25	+.72	22.25	—.28	22.50	—.03
30 per cent. cream,	80.5	26.8	.5	4.0330	22.41	23.50	+1.09	22.50	+.09	22.50	+.09
30 per cent. cream,	77.5	25.8	.5	4.3870	24.37	25.00	+.63	24.25	—.12	24.50	+.13
30 per cent. cream,	71.0	23.7	.5	4.4060	24.48	25.25	+.77	24.75	+.27	-	-
30 per cent. cream,	66.0	22.0	.5	4.3572	24.21	25.50	+1.29	24.75	+.54	-	-
30 per cent. cream,	75.0	25.0	.5	3.2235	17.89	18.75	+.86	18.00	+.11	-	-
30 per cent. cream,	69.0	23.0	.5	3.0236	16.78	17.75	+.97	17.00	+.22	-	-
30 per cent. cream,	66.0	22.0	.5	1.7083	9.49	10.50	+1.01	9.75	+.26	-	-
30 per cent. cream,	74.0	24.7	.5	1.7188	9.55	10.50	+.95	9.75	+.20	-	-
50 per cent. cream,	72.0	14.4	1.0	6.6740	37.08	38.50	+1.42	37.00	—.08	37.50	+.42
50 per cent. cream,	57.0	11.4	1.0	6.6110	36.73	38.50	+1.77	36.50	—.23	37.00	+.27

The results reported were all made with 6-inch bottles, because we were attempting to find the most accurate method for reading tests made under conditions existing at the experiment station laboratory. It would have been quite instructive to have been able to run more tests, using the 9-inch bottles, which require a special machine on account of the longer neck.

Conclusions.

1. With one exception the readings taken to the top of the upper meniscus were too high, the amount of error being in most cases proportional to the diameter of the bottle neck.
2. Where the readings were taken to the bottom of the upper meniscus the results were much more uniform. In several cases, however, there was considerable variation, due very likely to the difficulty of determining accurately the lowest point of the upper meniscus.
3. The alcohol method, where used, showed more concordant results, especially for the 10 and 30 per cent. bottles. The difference between these results and the theoretical test was no greater than might be expected between duplicate tests by the gravimetric method. The tests made in the 50 per cent. bottles varied materially, which might reasonably be attributed to the difficulty of reading these bottles accurately on account of the large diameter of the neck.

It was suggested that the method might give somewhat different results if a mixture of a definite amount of butter fat and skim milk was used in place of butter fat and water, the former mixture more closely resembling milk or cream. In order to test this point butter fat was weighed into several 10 and 30 per cent. thoroughly cleaned bottles, together with sufficient separator skim milk (which had been previously tested) to make the contents of the bottles weigh 18 grams. Sulfuric acid was then added and the test completed as usual. The results are as follows: —

TABLE 2.

KIND OF BOTTLE.	Grams Fat taken.	Theoretical Reading.	Actual Reading, Top Meniscus.	Error (Per Cent.).	Actual Reading, Bottom Meniscus.	Error (Per Cent.).	Actual Reading, Farrington Method.	Error (Per Cent.).
10 per cent. milk,	.9740	5.41	5.60	+.19	5.40	—.01	5.50	+.09
10 per cent. milk,	.9823	5.46	5.80	+.34	5.55	+.09	5.60	+.14
10 per cent. milk,	.9880	5.49	5.80	+.31	5.60	+.11	5.70	+.21
10 per cent. milk,	1.0500	5.84	6.10	+.26	5.80	—.04	6.00	+.16
30 per cent. cream,	4.1509	23.06	24.25	+1.19	23.75	+.69	23.25	+.19
30 per cent. cream,	4.1512	23.06	24.00	+.94	23.50	+.44	23.00	—.06
30 per cent. cream,	4.1717	23.18	24.25	+1.07	23.75	+.57	23.25	+.07

As in the former trials, reading to the top of the meniscus gave high results, proportional in most cases to the diameter of the graduated neck; reading to the bottom of the meniscus gave results more nearly corresponding to theory, while the results with the alcohol method were quite uniform and consistent. The high results obtained by attempting to read to the bottom of the meniscus in the case of the three cream bottles was due to the cloudiness of the fat, which made an accurate reading difficult, if not impossible.

Webster and Gray,[1] as a result of experiment, recommend the following procedure, in reading cream tests: "Read from the bottom to the extreme top of fat column, then read the depth of the meniscus and deduct four-fifths of it from previous reading."

Hunziker[2] advocates reading to the bottom of the upper meniscus and adding one-third of meniscus to reading in cream tests.

The introduction of any factor in reading the test tends toward making the method more complicated, and one unacquainted with its scientific aspects may discredit it entirely. With our present knowledge, and pending further investigation, the writer would advocate reading the tests made in 10 per cent. milk bottles from the bottom to the extreme top of the fat column, including the meniscus, as is now generally practiced; while for 30 per cent., 6-inch Connecticut cream bottles the reading should be taken from the extreme bottom of the fat column to the bottom of the upper meniscus, preferably by the use of alcohol, as described either by Eckles or Farrington.

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[1] Bulletin 58, Bureau of Animal Industry, United States Department of Agriculture.

[2] Report read before annual meeting of Official Dairy Instructors and Investigators Association, at Milwaukee, 1909.

THE USE OF THE ZEISS IMMERSION REFRACTOMETER IN THE DETECTION OF WATERED MILK.

BY P. H. SMITH AND J. C. REED.

The campaign before the 1910 session of the Massachusetts Legislature, for a change in the milk standard, brought prominently to the public mind the question as to whether slightly watered milk might be detected and differentiated from normal low-grade milk by methods available to the analytical chemist. In addition to the relative proportion of solids and fat, the index of refraction of the milk serum, as determined by the Zeiss immersion refractometer, has been advocated as a valuable aid in the detection of added water. The details of this method were perfected by Leach and Lythgoe [1] who claim, after careful investigation, that " if a milk serum is found with a refraction lower than 39, it is safe to allege that the sample was fraudulently watered, especially if, in addition to this, the solids not fat stand below 7.3 per cent."

In order to obtain further light on the subject we have made a complete analysis of the milk from three herds, together with the analysis of several samples systematically skimmed and watered. The analytical methods used were those advocated by the Association of Official Agricultural Chemists, while for determining the refractive index the procedure given by Leach [2] was adopted. The results follow in tabular form: —

[1] Thirty-fifth annual report, Massachusetts State Board of Health, 1903, p. 483; Journal American Chemical Society, 1904, 26: 1195.

[2] Food Inspection and Analysis, Leach, p. 765, published by John Wiley & Sons, New York.

Northampton State Hospital (Holsteins).

Number.	Number of Months in Milk.	Approximate Daily Production at Time of Sampling (Pounds).	Specific Gravity.	Total Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).	Proteids N x 6.25 (Per Cent.).	Ash (Per Cent.).	Sugar by Difference (Per Cent.).	Refractive Index.
1,	3	26	1.0305	11.74	3.70	8.04	2.98	.70	4.36	41.12
2,	5	27	1.0320	12.24	3.50	8.74	3.15	.67	4.92	40.00
3,	8	24	1.0315	11.99	3.50	8.49	3.16	.67	4.66	43.00
4,	6	27	1.0300	12.33	3.90	8.43	2.97	.75	4.71	-
5,	8	26	1.0350	13.39	4.10	9.29	3.91	.76	4.62	-
6,	3	23	1.0315	11.72	3.40	8.32	3.08	.66	4.58	42.32
7,	4	28	1.0320	11.96	3.60	8.36	2.60	.65	5.11	43.82
8,	9	23	1.0310	11.95	3.70	8.25	3.06	.69	4.50	-
9,	6	27	1.0330	13.07	4.50	8.57	3.39	.68	4.50	-
10,	3	35	1.0300	12.61	4.60	8.01	3.10	.75	4.16	-
11,	5	29	1.0330	12.89	4.00	8.89	3.25	.67	4.97	-
12,	3	24	1.0325	12.69	3.70	8.99	3.23	.66	5.10	-
13,	6	26	1.0300	11.64	3.60	8.04	2.98	.66	4.40	41.26
14,	6	30	1.0330	12.17	3.80	8.37	3.11	.72	4.54	-
15,	1	34	1.0330	12.70	4.10	8.60	3.22	.75	4.63	-
16,	1	65	1.0300	11.63	3.60	8.03	2.78	.68	4.57	41.18
17,	9	21	1.0325	13.18	4.10	9.08	3.46	.67	4.95	-
18,	6	27	1.0310	12.21	3.70	8.51	3.10	.71	4.70	-
19,	6	23	1.0305	11.80	3.60	8.20	3.30	.67	4.23	41.85
20,	5	27	1.0335	13.15	4.20	8.95	3.49	.73	4.73	-

Massachusetts Agricultural College Herd.

No.	BREED.	Number of Months in Milk.	Approximate Daily Production at Time of Sampling (Pounds).	Total Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).	Proteids N x 6.25 (Per Cent.).	Ash (Per Cent.).	Sugar by Difference (Per Cent.).	Refractive Index.
1	Jersey,	3	24	14.68	5.70	8.98	3.71	.71	4.56	44.30
2	Jersey,	12	13	15.28	6.10	9.18	4.00	.77	4.41	44.56
3	Jersey grade,	8	13	14.19	5.70	8.49	3.34	.75	4.40	43.70
4	Guernsey grade,	2	26	15.21	6.10	9.11	3.72	.73	4.66	44.39
5	Guernsey grade,	4	23	13.14	4.50	8.64	3.18	.75	4.71	44.10
6	Ayrshire,	10	5	14.75	5.45	9.35	4.42	.85	4.03	44.45
7	Ayrshire,	3	41	12.04	4.20	7.84	2.81	.69	4.34	41.65
8	Ayrshire,	10	9	12.75	4.60	8.16	3.72	.69	3.74	41.70
9	Ayrshire,	10	13	13.77	4.85	8.92	3.50	.74	4.68	45.15
10	Ayrshire,	2	20	13.70	4.90	8.80	3.32	.69	4.79	45.60
11	Ayrshire grade,	1	36	14.11	5.55	8.56	3.60	.72	4.24	43.05
12	Ayrshire grade,	1	38	12.56	4.10	8.46	3.03	.69	4.74	44.27
13	Ayrshire grade,	1	43	12.46	4.00	8.46	3.04	.71	4.71	43.59
14	Ayrshire grade,	2	33	13.39	5.05	8.34	3.03	.71	4.60	44.14
15	Ayrshire grade,	5	23	12.16	4.00	8.16	2.85	.69	4.62	43.26
16	Ayrshire grade,	7	24	13.75	5.10	8.65	3.63	.70	4.32	43.28
17	Ayrshire grade,	–	17	12.37	3.50	8.87	3.27	.69	4.91	44.11
18	Holstein,	7	22	13.02	4.35	8.67	3.34	.70	4.63	43.84
19	Holstein,	15	5	13.43	4.40	9.03	3.85	.82	4.36	43.88
20	Holstein,	1	46	11.58	3.75	7.83	2.97	.74	4.12	42.08
21	Holstein,	6	29	13.98	4.80	9.18	3.95	.73	4.50	44.65
22	Holstein,	9	9	14.85	5.50	9.35	4.00	.74	4.61	45.15
23	Holstein grade,	–	22	13.62	4.80	8.82	3.63	.72	4.47	41.05
24	Holstein grade,	5	43	12.19	3.80	8.39	3.10	.72	4.57	43.30
25	Shorthorn grade,	3	33	12.32	3.90	8.42	3.12	.67	4.63	43.60
26	Mixed herd,	–	–	12.77	4.10	8.67	3.17	.72	4.78	43.22

Miscellaneous Analyses.

No.	Milk from —	Number of Months in Milk.	Approximate Daily Production at Time of Sampling (Pounds).	Total Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.	Proteids N x 6 25 (Per Cent.).	Ash (Per Cent.).	Sugar by Difference (Per Cent.).	Refractive Index.	Specific Gravity.
1	College herd,	–	–	12.77	4.10	8.67	3.17	.72	4.78	43.22	–
2	College herd,	–	–	11.76	3.70	8.06	2.99	.69	4.38	41.62	–
3	College herd,	–	–	11 49	3.69	7.80	2.85	.65	4.30	40.08	–
4	College herd,	–	–	10.22	3.28	6.94	2.54	.58	3.82	37.35	–
5	College herd,	–	–	11.06	3.30	7.76	2.88	.63	4 25	40.10	–
6	Holstein grade,	5	43	12.04	3.60	8.44	3.11	.71	4.62	42.90	–
7	Holstein grade,	–	–	10 84	3.24	7.60	2.80	.64	4.16	39.80	–
8	Holstein grade,	–	–	9 63	2.88	6.75	2.49	.57	3.69	37 15	–
9	Ayrshire grade,	–	17	12.97	4.40	8 57	3.07	.69	4.81	43.52	–
10	Ayrshire grade,	–	–	10.38	3.52	6.86	2.46	.55	3.85	37.52	–
11	Holstein,	1	110	9.87	2 30	7.57	2.69	.71	4.17	39.97	1 0300
12	Jersey-Holstein,	7	19	15.51	6.50	9.01	3.87	.77	4.37	44.20	1.0340
13	Jersey-Holstein,	–	–	13 41	5 00	8 41	3.56	.70	4 15	42.05	1.0315

Notes.

No. 2. Same as No. 1, with 5 per cent. water and 5 per cent. skim milk added.
No. 3. Same as No. 1, with 10 per cent. water added.
No. 4. Same as No. 1, with 20 per cent. water added.
No. 5. Same as No. 1, with 10 per cent. water and 10 per cent. skim milk added.
No. 7. Same as No. 6, with 10 per cent. water added.
No. 8. Same as No. 6, with 20 per cent. water added.
No. 10. Same as No. 9, with 20 per cent. water added.
No. 11. Pure-bred cow on forced test.
No. 13. One liter of No. 12 allowed to stand in cylinder over night, 20 per cent. of the cream (by volume) removed and 10 per cent. of water added.

Massachusetts Agricultural Experiment Station Herd.

No.	Breed.	Number of Months in Milk.	Approximate Daily Production at Time of Sampling (Pounds).	Total Solids (Per Cent.).	Fat (Per Cent.).	Solids not Fat (Per Cent.).	Proteids N x 6.25 (Per Cent.).	Refractive Index.
1	Jersey,	5	18	14.61	5.40	9.21	3.94	45.32
2	Jersey,	5	19	14.65	6.20	8.45	3.06	44.04
3	Jersey,	3	23	14.03	5.30	8.73	—	44.18
4	Jersey high grade,	4	19	14.82	5.85	8.97	3.88	44.20
5	Jersey high grade,	5	17	15.58	6.40	9.18	4.00	44.60
6	Jersey high grade,	4	20	13.91	5.55	8.36	3.31	42.75
7	Jersey-Ayrshire,	5	17	13.80	4.85	8.95	3.63	44.25
8	Jersey-Holstein,	7	19	15.58	6.55	9.03	3.81	44.25
9	Holstein grade,	6	15	12.84	4.30	8.54	3.44	43.55
10	Holstein grade,	6	20	13.81	5.05	8.76	3.44	44.11
11	Holstein grade,	6	20	13.31	4.45	8.86	3.50	44.25

The results secured and tabulated above justify the following tentative conclusions: —

1. The serum of a milk of known purity is not likely to have a refractive index below 40.

2. It seems probable that the refractive index depends, to an extent, upon the stage of lactation of the cow, being highest in the advanced stages, when the animal is giving but little milk. More data are needed, however, to confirm this statement.

3. Rich milk, containing 4 per cent. or more of fat, has a tendency to give a higher index of refraction than thin milk (less than 4 per cent. fat). This rule, however, does not always hold true.

4. Many milks, especially those produced by Jerseys and Guernseys and their grades, can be adulterated with 10 per cent. of water, or 5 per cent. of water and 5 per cent. of skim milk, and escape detection by means of the index of refraction. In case of very rich milk, *i.e.*, pure milk containing 6 per cent. of fat, it may be possible to add 20 per cent. of water, or 10 per

cent. of water and 10 per cent. of skim milk, without positively detecting its presence by the aid of the refractometer.

5. It is believed that the Zeiss refractometer will prove very helpful in the detection of added water in milk. The evidence furnished, however, must be considered in connection with that secured by direct chemical analysis.

It is believed that the percentage of ash in milk is likely to prove fully as helpful in many cases as the index of refraction in detecting the presence of added water. Mixed milk falling substantially below .70 per cent. of ash must be regarded with suspicion, and that testing below .65 per cent. of ash as watered.

The impression held by some milk inspectors and producers, that the immersion refractometer will detect very small amounts of added water, is erroneous. Such an impression, firmly fixed in the minds of unscrupulous producers and dealers might have a salutary effect, but it is not justified by results in actual practice.

MALNUTRITION.

BY G. E. STONE.

Malnutrition is a term referring to certain pathological conditions in a plant which result from the improper use of plant foods. It may occur from a lack of plant foods of any kind, or starvation; or it may result from an excess of some particular plant food.

An increasing number of troubles has been called to our attention the past five or six years which have been found to be typical cases of malnutrition, induced by an excess of some particular substance in the soil. By far the larger number occur in greenhouses, being found chiefly in the houses of growers of limited skill and experience in handling greenhouse crops. These troubles all originate from an injudicious use of commercial fertilizers, or from applying certain manures to crops in excess of what they can stand.

The symptoms of malnutrition, as might be expected, are more or less specific, the nature of the response depending not only on the crop but also on the nature and amount of plant food used. Identical stimuli may produce different effects upon different individuals, or plants remotely related to one another may react similarly. The reaction of the plant to stimuli is dependent more upon its individuality than upon the nature of the stimulus which might give rise to any series of responses; in other words, the principal factor determining the nature of the reaction is more a property of the individual than one associated with the stimulus.

In some cases an excess of fertilizers causes burning of the roots, which results in the death of the plant, but these are not necessarily cases of malnutrition, since by the rapid and more or less complete destruction of the root system little or none of the substances is absorbed. Burning and collapse of the root system also have been observed where an excessive amount of muriate or carbonate of potash had been applied, and an excess of tannin, such as is found in the sawdust from certain trees, will cause the roots of plants to turn yellow and eventually die.

The effects of chemical substances on roots are not always the same, although ultimate death may follow their use. Certain chemical substances, on coming into contact with the roots, may merely cause plasmolysis of the cells. The immediate result here may not be death of the cells, but if the cells remain in a state of plasmolysis for any length of time, the collapse of the plant follows.

Any substance in the soil which affects the osmotic tension or turgidity of the cell would naturally prevent root absorption, and if the plant was transpiring very freely it would sooner or later wilt and collapse. On the other hand, a large number of chemical substances act as direct poisons to the protoplasm, killing it the moment of contact.

By far the largest number of cases of malnutrition which have been brought to our notice are found in greenhouse plants, although outdoor crops are by no means wholly free from it. Conditions in a greenhouse are entirely different from those out-of-doors. The frequent rainfalls, together with the action of frosts in winter, naturally hasten the process of leaching, and soil in the field which might become abnormal from injudicious fertilizing is kept in a normal condition. In the greenhouse the leaching is not so thorough, since the water and plant food are usually confined to the surface in a concentrated form. Moreover, in the greenhouse new supplies of plant food are being constantly added, and in the end do harm. When the soil is treated with hot water or steam, as is often the case, additional soluble food becomes available, which, in a soil already rich, is likely to produce ideal conditions for malnutrition. It would appear from the results of our experiments and observations that by far the greater amount of trouble from malnutrition comes from excess of nitrates in the soil.

Some years ago a potted specimen of a Johnsonian lily which had a number of eruptions or blisters on its leaves was called to our attention. These reddish blisters, on careful examination, showed no evidence of the presence of fungi or insects. The cells in the vicinity of the blisters, however, indicated that they had been greatly stimulated. This had resulted in excessive cell division, causing rupturing and a ragged, wounded appearance of the tissue. An experiment with perfectly healthy lilies was made, in which the plants were liberally fertilized with Chili saltpeter, and in a short time we obtained practically the same characteristics, that is, the blisters or eruptions. Blisters developed on a cyclamen were also observed, and were shown to be due to an excessive use of nitrate of soda.

Many cases of injury from overwatering and forcing have come to our attention in connection with such plants as carnations, tomatoes, etc.

The effects of nitrates on plants have long been known, and instances are mentioned by Czapek. Cases have been brought to our attention several times where tomato plants have been affected by the excessive use of fertilizers, and tests of the foliage for nitrates revealed an excess in the leaves. The tomato leaves in such cases had a curled and crinkled appearance, caused by the contorted vascular bundles or veins. A somewhat similar contortion of the foliage has been observed by us in soy beans when grown under certain conditions. These symptoms have been occasionally found in the field as well as in plants growing in pots in the greenhouse, and analyses have revealed an excess of nitrates in the foliage.

Greenhouse cucumbers are more susceptible to injury from manures and fertilizers than any crop known to us, and produce more cases of malnutrition than any of the others grown under glass. The condition of the soil which will destroy a crop of cucumbers will not, however, affect lettuce or tomato plants, while a rose or carnation plant might appear underfed in such a soil.

From a long experience in growing cucumbers under glass, as well as years of experimenting with this crop, and annual observations on a large number of commercial houses in the State, we are convinced that it is not safe for the ordinary grower to apply commercial fertilizers to a crop of this kind. Commercial fertilizers undoubtedly could be used on cucumbers, but would have to be used very sparingly, and only with the advice of the expert.

The best soil for cucumbers is composed of loam, decomposed sod and horse manure. No other manure of any kind is necessary, and should not be applied except sparingly, and as for commercial fertilizers, none should be used except ground bone and wood ashes, and it is questionable whether these are of any value. Cucumbers require a porous soil, and this is furnished by the sod and horse manure. When growing in solid beds the crop can be treated with horse manure if necessary to furnish underground heat, but trenching of the horse manure should be at least eight inches or one foot below the surface.

Malnutrition in cucumbers is characterized by a rolling of the foliage, producing a convexity of the upper surface of the leaf. The edges or margins of the leaf may or may not be slightly burned or dead, but this symptom is often associated with malnutrition. This latter condition may also be caused by a lack of root absorption and excessive transpiration. In extreme cases, besides the more or less severe curling of the leaves, the vascular bundles or veins become badly contorted, the leaves arrested in growth and the apex of the stem curled up into a mass; and plants once in this condition may remain so for weeks. There is, however, a certain amount of plasticity in cucumber plants, as in all others, and they sometimes succeed in adapting themselves to extreme conditions, and showing some attempt to recover or outgrow these symptoms. In very severe cases, such as were found to be associated with a rich soil to which had been added an excessive amount of pulverized sheep manure, and which had received the hot-water treatment, the fruit becomes mottled and irregular in shape, the surface often presenting excrescences or tubercular growths.

We have had occasion to observe a large number of cases of malnutrition in greenhouses in this as well as in other States, and a few of the conditions which produce it may be mentioned here. It should be pointed out that practically all greenhouse growers of cucumbers start with a well-manured soil composed of sod, loam and horse manure. A soil prepared in this way is suitable, without the addition of anything else for the normal production of cucumbers, and even if well supplied with horse manure it is not likely to produce cases of malnutrition. There is, to be sure, much difference in horse manure, some being much more concentrated than others, but we have grown cucumbers in boxes in soil to which 75 per cent. of horse manure had been added without producing any abnormal symptoms. Excessive use of horse manure, especially if it is too strong, may cause symptoms of malnutrition, but no trouble should be caused by a careful use of this manure each year. Constant watering of cucumber plants with liquid fertilizer or manure of any kind will cause malnutrition, and the addition of pig or cow manure to the horse manure, or the use of either alone, is very likely to produce it. We have frequently observed trouble from the use of pig manure mixed with horse manure, and Professor Whetzel of Cornell University has called our attention to the injury caused by this combination in New York State. In one particular case the plants, in addition to being treated with horse manure containing considerable amounts of pig manure, were watered frequently with a strong decoction of these manures.

Some of the most severe cases of malnutrition we have observed resulted from the use of hen manure worked into soil already provided with an abundance of plant food, such as would be obtained from a constant use of horse manure. In practically all the instances which have come to our notice where hen manure had been applied rather freely, symptoms of malnutrition have followed.

A more recent tendency among cucumber growers is to make use of dried, pulverized sheep manure, either alone or in combination with cow manure. Two cases of malnutrition in cucumber houses have recently been brought to our attention, one extremely severe and the other more or less so. These were caused by the use of pulverized sheep manure and various fertilizers. One grower, having some 2,800 feet in length of houses, applied 3 tons of pulverized sheep and cow manure, with the result that the whole crop died. This house had been used for some years without changing the soil, and had received every year probably from 30 to 60 tons per acre of horse manure. The soil was naturally in good condition, and had plenty of plant food without the addition of the sheep manure. The malnutrition symptoms were so marked on this crop that even the young seedlings were affected. In addition to this the hot-water treatment was used, which only served to aggravate the trouble.

We have recently seen another case in which the plants in a range of houses about 1,800 feet in length were more or less affected. Besides the application of horse manure for a number of years, the houses had been treated with cow manure, various kinds of phosphates, nitrate of soda, lime, hen manure and pulverized sheep manure, as well as hot water. Different types of greenhouses were represented in this establishment, and the houses were also of different ages. The older houses, which had been manured and fertilized the most heavily, were decidedly the worst. The new houses, where less manure and fertilizer had been applied, were least affected. In the older houses it had become almost impossible to grow good crops of cucumbers, but fairly goods crops were growing in the new houses. These houses had been used occasionally for growing other crops, like tomatoes and radishes, which were not affected in any way. This practice of rotation is beneficial, and has a tendency to make the soil more suitable for cucumber growing.

The extensive use of nitrate of soda is responsible for many cases of malnutrition. We have demonstrated by experiments that potted plants of cucumbers watered with potassium or sodium nitrate will wilt in the sunshine more quickly than those treated with water alone. Nitrate of soda, when used in greenhouses, often acts by preventing root absorption. As a consequence of this reduction of the root absorptive capacity of the plant, particularly when the house is warm and dry and transpiration very active, the leaf edges of the cucumber wilt and die, which causes a rolling of the leaf or convexity of the upper surface.

Wetting down the soil with hot water, or steaming it, as already pointed out, is favorable to malnutrition, for the reason that a considerable amount of plant food already in the soil is by this practice made more available. This is shown by the greatly increased growth of plants in such soil, and the increased number of bacteria present.

In the growing of greenhouse crops of all kinds, manure is extensively used. For example, lettuce has been grown for forty years in soil which has been repeatedly manured with horse manure and straw, and no indications of malnutrition caused by this extensive manuring have ever been noticed. It is generally considered that the older a lettuce soil, the better it is for this crop, but if commercial fertilizers are employed indiscriminately in a lettuce house already well supplied with plant food, the chances are that a case of malnutrition will result.

Roses, carnations and violets require a rich soil, and a considerable amount of manure is used by floriculturists in their soil. Cases of malnutrition are prevented here by never growing these crops in the same soil more than one year, the benches being refilled with fresh soil each year. A typical rose soil is composed of one-third loam, one-third pulverized sod and one-third cow manure. In addition to this, the plants are watered once a week with a strong liquid manure. Cases of malnutrition with this treatment seldom if ever occur with roses.

A few years ago an experiment was conducted in one of our houses devoted exclusively to the growing of American Beauty roses. The soil was prepared as described above, and liquid manure was applied freely once a week or oftener. The first year the roses did well, and for the purpose of experiment we attempted to grow a new crop of roses in the same soil which had been used the previous year. The soil was partially renovated by the addition of new sod and some cow manure, and besides this it received its customary application of liquid cow manure. The plants had not been in the soil many weeks, however, before they commenced to die, and it was not unusual for a number to die in a single week. The results of this experiment were only what was expected, but a careful examination of the plants was made which showed them to be free from pathogenic organisms. The roots, however, were in a bad state, their condition showing plainly what was the matter. Since it was thought that this experiment had then proceeded far enough, we decided to flood the beds with water, and make analyses of the percolate which came through the bottom of the beds. The beds were flooded for two hours each, and the water that came through first was, as might naturally be expected, highly colored, while that which came through later was clearer. The last percolate, after two hours' drenching, was remarkably clear. Samples of this water were collected at intervals of every fifteen minutes, and chemical tests for acids and other substances were made. The results of the analyses were quite surprising, and it was difficult to conceive of any plant living under such conditions. After the soil had been drenched and the injurious substances washed out, not a single death occurred among the plants.

The question was put to a number of florists, through a leading florists' journal, why they changed their soil in growing roses, carnations and other plants. None of the growers gave a satisfactory reply; they simply knew from experience that it was not practicable to attempt to grow these crops in the same soil two consecutive seasons. An analysis of the percolated water showed such large amounts of soluble compounds that it is not surprising that the plants failed to grow.

One occasionally finds instances of what appear to be typical cases of malnutrition in the suckers on stumps of trees on cut-off woodland. Different species of trees develop different symptoms in their leaves when growing from the stumps. In some cases the leaves are abnormally large, and in others they are highly colored and more or less contorted or malformed. Here we have an instance of a small amount of foliage being supplied with food from a root system which formerly supported a large tree, and this excess of food supply causes, as it were, congestion. Chemical analyses of these abnormal leaves, made by Mr. G. H. Chapman in our laboratory, show them to be unusually rich in nitrates. A feature often observed by us in connection with these growths, but which may possibly be of no significance whatsoever, is their greater susceptibility to attacks of aphids. It is not improbable, however, that their abnormal chemical condition would affect their natural immunity to attacks from aphids and other insects.

From the nature of the conditions causing malnutrition, a remedy is not difficult to find. It is first essential, of course, to be careful in the use of manures and fertilizers. If the soil in a house has become unfit for use from the injudicious application of manures and fertilizers, subsoiling may be done to good advantage. Washing out the soil thoroughly, as previously described in our experiments with roses, would also prove helpful in some cases, but it should be pointed out that there is more danger in a soggy soil to cucumber roots than those of roses. If leaching out has to be done when the plants are in the soil, it should be done only in sunshiny weather, when the soil will dry out quickly, so that its original porosity can be regained by cultivating. It is always best to use any such treatment as this, if possible, when there are no plants in the soil.

Another succesful treatment consists in covering the surface of the soil with two or three inches of loam. We have frequently seen this done with the best results. New roots have quickly formed in the loam, and these have supplied the plant with food proper to its development.

CALICO OR MOSAIC DISEASE OF CUCUMBER AND MELON.

BY G. E. STONE.

For a number of years our attention has been called to mottled cucumber leaves occasionally found in greenhouses. This trouble has the same characteristics as the so-called "calico" on tobacco, or "mosaic disease," as it is often termed. It also occasionally occurs on other plants.

A case of calico was noticed on melon plants grown under glass in the department's conservatory the past summer. Only four plants were affected, and there was no evidence of contagion or infection. This disease, so far as is known, is not associated with pathogenic organisms, and little is known concerning it.

The trouble is characterized by a mottled or spotted appearance of the foliage, and the whole plant appears abnormal. The plants were growing in soil well enriched with horse manure, and in all cases the laterals were kept pruned, and the affected plants topped. A similar spotting and mottling occurred on pruned tomato plants, and was more abundant when the plants were topped than when the laterals were pruned.

A study of this peculiar and little known trouble is now being made by Mr. G. H. Chapman of this department.

NOTES ON THE OCCURRENCE OF FUNGOUS SPORES ON ONION SEED.

BY GEORGE H. CHAPMAN.

It has been found in the seed separation and germination work in this department that spores of various fungi are often found on market seeds. This has been especially noticed in the germination work, for in many cases, no matter how carefully the germinating dishes were sterilized and the tests carried on, some of the samples would mold much worse than others. It was also thought that in the case of onion seed the spores of onion smut might be carried from one locality to another, and thus spread the disease in that way.

Under the direction of the head of this department several samples of onion seed were examined during the past year and the different kinds of spores present noted. The method of examination was as follows: —

A representative sample of the lot was taken, and then of this sample about 15 grams were shaken up with warm, distilled water for ten minutes. The supernatant liquid was then drawn off in a pipette and drops placed on a slide for examination. Several examinations of each sample were made and the different kinds of spores found were noted. This method of detaching the spores may be open to objections, but it is thought that enough of the spores are detached to give an idea of the different kinds present.

In all, ten different samples of seed were examined, and in two, onion smut spores were found in small quantity. It has been the generally accepted opinion that the smut spores do not occur on the seed, but this idea is probably due to the fact that only in very few cases do these spores appear to be present. From our results we are forced to conclude that onion smut spores may be found on seed and may thus be transferred from one locality to another. They were also found last season by Dr. G. E. Stone of this department.

As stated above, in ten samples of seed, two were found to contain spores of onion smut, and in addition nearly all contained mold spores, such as *Penicillium* (blue mold), *Mucor* (bread mold), etc. These mold spores may to a certain extent be on the seed before it is gathered, but the probabilities are that the seed becomes contaminated after gathering, during the cleaning and drying processes, and results from improper drying and cleaning or dampness in the storehouse. Other spores and pollen grains were found which were in no way associated directly with onion diseases. These are perfectly harmless and come from various sources. Among these may be mentioned various conidia and rust spores which do not have the onion for a host.

Among the spores found which cause diseases of the onion were *Urocystis cepulæ* (Frost) (onion smut), *Macrosporium Porri* (Ellis) (brown mold) and *Peronospora Schleidenina* (D By) (downy mildew). The spores of these fungi do not, of course, inhibit the germination of the seed.

The presence of smut spores and others is objectionable in the seed since the ones just mentioned are capable of causing infection to the crop, and the molds cause the molding of the seed, thus lessening the vitality of the seed and sometimes killing it during a germination test.

Macrosporium Porri, the so-called brown or black mold, affects seed onions. *Peronospora* (downy mildew) spores were found in many cases, and this disease has occasionally caused some trouble in Connecticut and elsewhere. This disease, like the preceding one, is confined to seed onions, the fungus penetrating the tissue in all directions, causing a yellow, sickly looking growth, eventually killing the plant. The summer spores, or conidia, are very short lived, however, and do not retain their vitality for any length of time, but the oöspores or resting spores are capable of propagating the disease from year to year.

The kinds of spores found in each sample are shown in the following table.

Showing Spores found on Onion Seed.

Sample Number.	Spores Noxious to Onion.			Non-noxious Spores.	
	Onion Smut (Urocystis cepulæ).	Brown Mold (Macrosporium).	Downy Mildew (Peronospora).	Molds.	Other Spores.
1,	Very few,	Present,	Absent,	Penicillium, Eurotium,	Pollen.
2,	Absent,	Present,	Present,	Penicillium, Mucor,	Various conidia, Teleutospores.
3,	Absent,	Absent,	Present,	Absent,	Pollen.
4,	Absent,	Present,	Absent,	Penicillium,	Rust spores, pollen.
5,	Absent,	Absent,	Absent,	Penicillium, Eurotium, abundant,	Conidia, pollen.
6,	Absent,	Present, abundant,	Present, abundant,	Penicillium, scarce,	Pollen, conidia.
7,	Absent,	Present,	Absent,	Eurotium, Penicillium, Mucor,	Rust spores, pollen.
8,	Few,	Present,	Present,	Penicillium, Eurotium,	Rust spores, conidia, pollen.
9,	Absent,	Absent,	Absent,	Eurotium, Mucor,	Conidia.
10,	Absent,	Present,	Absent,	Absent,	Rust spores.

No attempt has been made to specifically identify many of these spores as that is not within the scope of this experiment.

By disinfecting and sterilizing the seed used for germination tests, and also for planting, it is believed that much of this excessive molding may be prevented. Work of this character is being carried on in this laboratory. Some favorable results have been obtained, but these have not been verified sufficiently to warrant publication at present.

PLANT BREEDING STUDIES IN PEAS.

BY F. A. WAUGH AND J. K. SHAW.

The department of horticulture has had various plant-breeding investigations under way for several years. These have included studies in variation, correlation and heredity in peas. Two reports on this general subject have already been made.[1] The year 1909 has enabled us to collect a large amount of additional data, the most interesting of which are here presented.

Character of Variation in Peas.

At the beginning of these experiments, a commercial strain of Nott's Excelsior was made the basis of study. The same strain has been maintained till the present time, so that we may now discover whether or not the range and character of variation have changed. In looking over the figures, it must be remembered that absolute figures have been greatly affected by the nature of the growing season. Thus, in 1908, with severe drought on naturally dry land, the size of plants and all other measurements fell very low. With this in mind we may profitably study the following table, giving statistics of variation for three years: —

[1] Massachusetts experiment station report, 20, p. 171 (1908), and Massachusetts experiment station report, 21, p. 167 (1909).

Variation in Peas — Nott's Excelsior. Series I.

	1907.	1908.	1909.
Number of vines measured,	179	225	1,770
Length of vine (centimeters): —			
Minimum,	20.00	19.00	6.00
Maximum,	88.00	61.00	83.00
Range,	68.00	42.00	77.00
Average,	54.70	38.22	45.90
Number of pods per vine: —			
Minimum,	1.00	1.00	1.00
Maximum,	13.00	12.00	37.00
Range,	12.00	11.00	36.00
Average,	4.68	3.91	6.74
Number of peas per pod: —			
Minimum,	-	-	-
Maximum,	9.00	8.00	9.00
Range,	9.00	8.00	9.00
Average,	3.46	3.44	-
Length of pod (centimeters): —			
Minimum,	2.00	2.00	-
Maximum,	9.50	8.00	-
Range,	7.50	6.00	-
Average,	6.88	6.10	-

Differences in Variability.

As was shown in our last report, there are great differences in variability to be seen in different strains, even within the same variety. The progeny of nine different parents, all belonging to the same variety, was compared in this respect. These same strains may now be compared again, bringing into comparison the progeny grown in another year's crop. In the following table CV stands for "coefficient of variability," which is simply a mathematical function showing the relative variability of the various strains. It is secured by dividing the standard deviation by the mean. The larger the figure the greater the variability indicated.

Comparison of Variability — Nott's Excelsior.

	CV.		Rank.	
	1908.	1909.	1908.	1909.
Vine length: —				
Strain A,	12.1	22.4	4	4
Strain B,	14.1	25.4	5	8
Strain C,	11.8	16.5	3	1
Strain D,	15.8	23.9	8	7
Strain E,	20.2	27.8	9	9
Strain G,	14.7	21.4	6	3
Strain H,	15.1	22.8	7	5
Strain J,	10.1	23.1	2	6
Strain K,	8.8	19.9	1	2
Pods per vine: —				
Strain A,	25.3	43.7	8	3
Strain B,	10.1	45.7	6	6
Strain C,	52.1	50.2	9	7
Strain D,	8.1	45.1	4	5
Strain E,	9.1	50.8	5	8
Strain G,	16.7	38.1	7	1
Strain H,	8.0	44.6	3	4
Strain J,	6.3	41.4	1	2
Strain K,	7.4	57.5	2	9
Total peas per plant: —				
Strain A,	40.6	49.3	6	5
Strain B,	23.7	54.1	1	8
Strain C,	49.0	51.6	9	6
Strain D,	41.7	41.1	7	1
Strain E,	46.2	52.1	8	7
Strain G,	31.3	45.9	4	3
Strain H,	40.2	46.5	5	4
Strain J,	23.9	45.6	2	2
Strain K,	27.7	57.8	3	9

Three interesting facts appear from this table: —

1. The plants were markedly more variable in 1909 than in 1908. This appears in all characters, and there is hardly a single exception to the rule. On the surface, it would seem that the dry season and unfavorable conditions of 1908 decreased the amount of variation, while the comparatively strong growth of 1909 increased the amount of variation.

2. The amount of variation is less and the fluctuations less in the case of vine length than in pods per vine or peas per vine. In other words, the vegetative characters seem to be more stable than reproductive characters.

3. There is a manifest (though not very strong) tendency to transmit the quality of variability (or stability). In a number of instances the strains which were most variable in 1908 were the most variable in 1909, and those which were most stable one year were most stable the next. Out of the 27 comparisons made in the foregoing table, 11 show a decided correspondence, while

only 6 show decided shift. Counting the disagreements in rank by units, the results are as follows: —

In vine lengths,	16
In pods per vine,	26
In peas per plant,	26

These figures indicate once more the relative stability of the vegetative character — vine length — as discussed in paragraph 2 above.

Correlation of Characters.

In former reports, some figures have been given on correlation of character, particularly between the average number of peas per pod and the number of pods per vine. It might be supposed that the vines bearing the largest number of pods would have the smallest pods with fewest peas. The general fact seems to be the contrary, — a fact which is of considerable practical importance in the development of prolific strains and varieties.

This year we have fresh figures at hand for three separate groups. Series I. consists of a number of strains of Nott's Excelsior, all having the same origin. They are, in fact, the same plants spoken of as Strain A, Strain B, etc., in the experiments reported herewith, p. 170, — the whole series being combined for the purposes of this computation. Series II. is the group of Nott's Excelsior from which the progenitors of Series I. were selected in 1907. Series III. is a strain of Earliest of All which we have had under study for two years.

Taking this material, therefore, and computing the correlation coefficients (in which complete correlation equals + 1 and no correlation equals 0), we get the following results: —

Correlation Coefficient.[1]

Series I. (Nott's Excelsior),	$-.0081 \pm .0012$
Series II. (Nott's Excelsior),	$+.1300 \pm .0095$
Series III. (Earliest of All),	$+.3200 \pm .0120$

[1] It is probable that the coefficient of Series III. most nearly represents the true correlation, and the lower coefficient for Series I. and possibly Series II. is due to rather strict selection that has been practiced, Series I. being the second generation from 10 selected plants. See Pearson, Phil. Transactions A, Vol. 193, p. 278; also Rietz, Biometrika, Vol. VII., p. 106.

In Series I. no relation between number of pods and peas per pod is shown. In Series II. there is exhibited a distinct tendency toward the production of the largest and fullest pods on those plants which produce at the same time the largest number of pods; and this tendency becomes fairly emphatic in Series III.

Heredity in Peas.

One of the prime objects in this series of experiments has been the study of heredity. We have wanted to know in what degree the various characters were transmitted in peas. Some figures in this field were published last year.[1] The figures this year are still more interesting, especially when compared with last year's results.

The reader may know that heredity is now commonly calculated by a mathematical formula which gives results theoretically varying between + 1 and — 1 (practically between + 1 and 0). Ordinary inheritance, in which parental characters are transmitted in the usual degree, will show a coefficient of +.25 to +.40. Larger coefficients are rare; lower coefficients are surprisingly frequent. Taking our peas in Series I. (omitting Strain C on account of its abnormal character), we secure the following heredity coefficients from the crop of 1909: —

Coefficients of Heredity.

Vine length,	$+ .2483 \pm .0164$
Pods per vine,	$+ .0792 \pm .0017$
Total peas per vine,	$+ .0544 \pm .0018$

Here it will be seen that vine length is transmitted much more fully than either of the other characters. This fact is apparently closely related to the one mentioned above (p. 170). The vegetative character is more stable and is more perfectly transmitted than the reproductive characters.

Prepotency.

In all old-time discussions of heredity, much was made of prepotency. Though this word and the idea have to a large extent been submerged in recent discussions of plant breeding,

[1] Massachusetts Experiment Station Report, 21, p. 171 (1909).

the idea is still sound and the word still holds. Moreover, the facts are of great practical importance to the actual breeder.

The question is, Does one individual transmit its characters more perfectly and surely than another? In order to answer this question, it was found necessary to adopt a new method of calculating coefficients of heredity, explained in the article referred to.[1] The study of the material which we then had in hand seemed to give a positive answer to the main question. Apparently, certain individuals did show decided superiority over others in their ability to transmit their characters to their offspring. This conclusion seems to be confirmed with all the other material which we have been able to study, and it would be very interesting to see the same method — or some improvement of it — applied to other plants and animals. For the present, the most interesting feature of our experiment lies in a comparison of the prepotency of parent and offspring, — in an attempt to answer the question whether prepotency is inherited or not.

In the following tables we will present first the figures showing the inheritance of vine length, then those dealing with pods per vine, and finally those dealing with total peas per vine. In each case we present first the coefficients of heredity (computed as shown in the footnote), followed by figures denoting the rank of the several strains in each comparison. The designations f_1, f_2 and f_3 will be understood at once by students of thremmatology. They refer to the three generations of peas compared: f_3 represents the crop of 1909, f_2 represents their parents (crop of 1908), while f_1 represents the grandparents, with which this experiment began.

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[1] *Ibid.*, p. 172. The formula is $C = \frac{1}{\sigma D}$.

C = coefficient of heredity.
σ = standard deviation.
D = difference between the numerical value of the parent character and the mean of the same character in the progeny.

This we have been calling "Waugh's formula," for the sake of a distinctive name.

Coefficients of Heredity — (Prepotency).

Vine Length.

	Coefficients.			Rank.		
	$f_1 : f_2$	$f_2 : f_3$	$f_1 : f_3$	$f_1 : f_2$	$f_2 : f_3$	$f_1 : f_3$
Strain A,	.0068	.0383	.0028	7	3	9
Strain B,	.0085	.0183	.0065	5	6	4
Strain C,	.0106	.0079	.0244	2	9	1
Strain D,	.0086	.0090	.0093	4	8	3
Strain E,	.0042	.0265	.0031	9	4	8
Strain G,	.0061	.0260	.0045	8	5	6
Strain H,	.0071	.0158	.0054	6	7	5
Strain J,	.0095	.0596	.0042	3	2	7
Strain K,	.0250	.0707	.0126	1	1	2

Pods per Vine.

Strain A,	.145	.193	.076	7	5	7
Strain B,	.011	.210	.222	9	4	4
Strain C,	.104	.023	.047	8	9	9
Strain D,	.512	.093	1.562	4	8	1
Strain E,	3.003	.144	.387	3	6	3
Strain G,	.327	.350	.145	6	1	5
Strain H,	.490	.279	.075	5	2	8
Strain J,	5.555	.262	.532	2	3	2
Strain K,	14.285	.121	.135	1	7	6

Total Peas per Vine.

Strain A,	.007	.010	.006	8	4	6
Strain B,	.027	.012	.221	3	2	2
Strain C,	.006	.001	.002	9	9	9
Strain D,	.013	.006	.068	5	6	3
Strain E,	.016	.006	1.000	4	8	1
Strain G,	.008	.009	.005	6	7	7
Strain H,	.007	.012	.004	7	3	8
Strain J,	.027	.012	.021	2	1	4
Strain K,	.068	.008	.013	1	5	5

It can hardly be claimed that these figures show any fixed lines in prepotency. Certain individuals are plainly relatively prepotent with respect to certain characters, though not always with respect to other characters. While the figures do not show any striking inheritance or prepotency, there are a few instances wherein such inheritance may be strongly suspected. Certain points will bear statement at least.

1. In the transmission of vine length, Strain K is notably prepotent, while Strain E is notably deficient.

2. In the transmission of pods per vine and total peas per vine (reproductive characters representing fecundity), Strain C is remarkably defective. This is curious from the fact that Strain C is notably the most prolific one in the experiment.

3. In the transmission of pods per vine, Strain J leads by a good margin; while in the transmission of total peas per vine, Strains B and J stand equal.

4. Strain K, which in last year's comparison stood first in every column, now, in the whole comparison, ranks first in the transmission of vine length, seventh in pods per vine and third in total peas.

It seems fair to conclude, in general terms, that a careful study of prepotency will sometimes reveal tendencies sufficiently strong and trustworthy to be useful to the practical plant breeder.

THE BEN DAVIS GROUP OF APPLES.[1]

BY J. K. SHAW.

It is generally agreed by pomologists that the most feasible and satisfactory method of classifying varieties of fruits is by segregating them in groups typified by more or less well-known sorts, each differing in considerable degree from the type of the neighboring groups. Many writers speak of the Ben Davis group, but so far as is known to the present writer the only real attempt to single out the members of this group is that given by Hedrick, Bul. 275 of the New York State Experiment Station.

Starting with the group as given here as a foundation, a somewhat thorough examination of all available literature and suggestions from several men, authorities in systematic pomology, gave a list of forty varieties which were considered as candidates for this group. In order to decide, with some feeling of certainty, just which of these properly belong here would require much longer time and more material than has been available. The personal study of material was necessarily limited to the fruit with nearly every variety, and with many of the varieties it was impossible to obtain specimens, making it necessary to rely upon printed descriptions and the opinions of others, and everything of this kind available has been carefully considered.

As a result of this study the following varieties are believed to belong here, and are separately considered and described in this paper: —

[1] This article is a condensation of a part of a thesis presented to the faculty and trustees of the Massachusetts Agricultural College for the degree of M.S. The work was done under the direction of Prof. F. C. Sears, and special thanks are due him and to Prof. F. A. Waugh for advice and encouragement in the work; also to many horticulturists, fruit growers and others who have supplied information regarding the different varieties.

Arkansas Beauty.
Arkansas Belle.
Ben Davis.
Ben Hur.
Black Ben Davis.
Coffelt.
Cole Davis.
Eicke.
Etris.
Extra.
Flat Ben Davis.
Gano.
Improved Ben Davis.
Nordhaussan.
Ostrakavis.
Paris.
Shackleford.
Shirley.
Sweet Ben Davis.
White Ben Davis.

Many of these are of minor importance, and doubtless some are not propagated and will soon disappear from cultivation. Almost without exception they are of southern origin and best adapted to growing under southern conditions. When grown north of the southern Missouri and Ohio valleys they are inferior in quality, though fairly hardy and bearing good crops.

The fruit is generally roundish conic in form, nearly regular, with regular cavity and basin, the latter generally more or less abrupt. In color, greenish yellow, usually overspread with bright red, more or less striped. The flesh is generally white and firm, of medium or coarse texture. They are of only moderately good quality but long keepers and good shippers. With one exception they are more or less acid in flavor, generally a mild subacid. A notable characteristic common to all varieties examined was the presence of a pistil point or the persistent base of the pistil, a character rarely found in apples not belonging to this group.

Description of Varieties.

Arkansas Beauty.

I have not seen this apple and have been able to learn little about it. Stinson gives the following description and notes concerning it: —

Size, medium to large; form, roundish, slightly inclined to conical; stem, very long and rather slender; cavity, small, smooth; basin, small; core, open, with a peculiar marking of a white growth or downy substance in seed cavities; color, skin yellow, striped with two shades of red, rather dull in color, giving it a brownish-red appearance; flesh, yellow, fine grained, subacid and very good, juicy. It is grown to some extent in a few sections of the State; it is probably more grown in Johnson County than elsewhere. It has not proved valuable.

Arkansas Belle.

This variety very closely resembles the Gano, and it has been claimed that the two are identical. A letter from Mr. D. Branchcomb of Rhea, Ark., states that he planted the seed from which grew the original tree. It does not seem to have been much planted and probably will not be, as it does not appear that it is in any way superior to the Gano.

Ben Davis.

The place of origin of this variety has always been in doubt. Downing, in "Fruits and Fruit Trees of America," edition of 1857, says it is supposed to have come from Todd County, Ky., but in the edition of 1872 he says that the origin is unknown. It has been attributed to Virginia, North Carolina, New York, Missouri, Kentucky and Tennessee. The statements giving New York and Missouri origins are without doubt erroneous. Those attributing it to North Carolina and Virginia are to the effect that the trees or scions were taken from one or the other of these States to Kentucky, from whence it was disseminated. So far as the writer is aware, there is no record of its occurrence in either of these States except as introduced from outside nurseries. It is extremely probable that the apple originated or at least was first propagated from scions in either Kentucky or Tennessee. The late Wm. M. Howsley of Kansas gives the following account of its origin: —

In the year 1789, Wm. Davis and John D. Hill emigrated to Kentucky and settled in that part of Logan County now called Butler County. They located near Capt. Ben Davis, the brother of Wm. Davis and the brother-in-law of Hill. A few years afterward, Hill returned to Virginia on business, and when he returned to Kentucky he brought some apple grafts with him. Hill and Wm. Davis raised fruit from these grafts. Capt. Ben Davis, finding the apple a desirable one, grafted the same for himself, as well as raised a young nursery of it. These were sold throughout the country. For want of knowing any other name, the people called it the Ben Davis apple. The Davis family, however, called it the Virginia Pippin.[1]

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[1] Watts, Bulletin Tennessee Experiment Station, IX., 1, p. 7.

Mr. J. C. Hodges of Morristown, Tenn., thinks it is a Tennessee apple, and gives the following story of its origin: —

During most of the first half of the present century, and up to 1860 or thereabouts, there lived on Nolichucky River, within this (Hamblin) county, a wealthy farmer whose name was Ben Davis. His son, R. A. Davis, resides now at White Pine, Jefferson County, Tenn. On the farm owned by Ben Davis originated the apple in question. From the original tree others were propagated, and for many years before the death of Ben Davis he raised and harvested large quantities of these apples. The house of Ben Davis was on the great stock route from Kentucky to the Carolinas. Many drovers made it a point to stop with him in going and returning to the south. It was his custom to supply their saddle bags with these apples, especially on their return trips. There was no name of the apple known to them, so they called it the Ben Davis. Grafts or scions were taken to Kentucky, and the apple was propagated and disseminated there before it was in Tennessee. I have obtained these facts on personal inquiry from the sons of Ben Davis, above mentioned. And besides, these facts are well known in the neighborhood among the older people.[1]

The writer has made considerable effort to follow up both of these accounts and to ascertain if either one is the true history of the variety.

Concerning the Kentucky account, Mr. Ben McKenney of Maquon, Ill., states that the Ben Davis mentioned, who was his grandfather, lived at Berry's Lick, Butler County, Ky., and that it was from a neighbor of his, Nat Porter by name, that Dr. Housely obtained the account above given. Ben Davis was a nurseryman as well as a farmer and introduced several other varieties.

Concerning the Tennessee account, a letter from Mr. Hodges expresses the conviction that this is the true origin of the variety. It is stated by a daughter of this Ben Davis, who is not connected with the Kentuckian of the same name, that the original tree, which was well known to her, was destroyed in 1860, and that it was eighteen years old at the time. This would seem to indicate that this was not the original Ben Davis tree, as the variety was well known over Kentucky, southern Indiana and Illinois at about this time. Mr. Hodges, however, expresses the belief that this particular tree was a sprout from the original,

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[1] Watts, Bulletin Tennessee Experiment Station, IX., 1, p. 7.

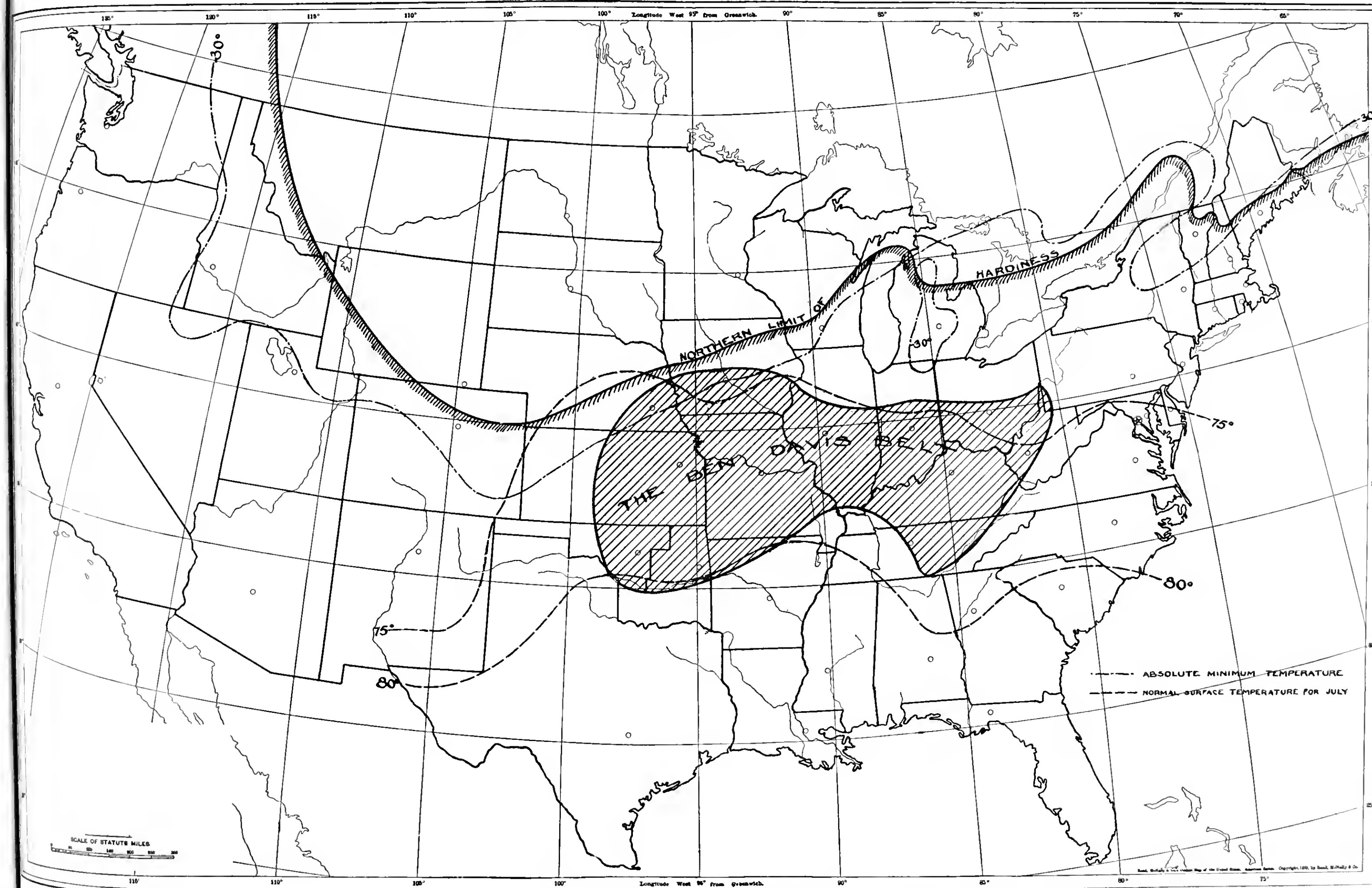
which would seem reasonable, for Ben Davis died in 1852 at the age of fifty-six, or soon after the earliest date at which this tree could have borne, and in this case he could not have been concerned with the growth and distribution of the fruit, as it seems beyond question that he was. The writer has attempted to learn the facts about this, but thus far without success.

It would seem possible that the apple originated in Tennessee, as related by Mr. Hodges, and that the fruit, carried by the drovers into Kentucky, came to the notice of the Kentucky Ben Davis, who lived on the route which would be traveled, and, being a nurseryman, he was attracted by the fruit and took steps to secure scions, by which he propagated and disseminated the variety. If this is true, however, it is hard to explain why the apple was called the Virginia Pippin.

Another possible explanation is that the apple may have "originated" twice, or, to put it in another way, two varieties appeared, one in Kentucky and the other in Tennessee, and both were called the Ben Davis and resembled each other so closely as to be confused; or it is even possible that the two were distinct, and that one of them was not the Ben Davis we now know at all. A third possibility is that it first appeared in Kentucky, and that the Tennessee tree was a graft derived from it.

That both the accounts are true in the main, at least, is not doubted by the writer, and the Tennessee story is vouched for by several people of prominence and reliability residing in that neighborhood. It is likewise evident that the whole truth is not set forth.

Wherever the place of origin may have been, the variety was first brought to public notice from Kentucky. The first published notice of it seems to have been in the "Horticulturist" for 1856, and Downing describes it in the "Fruits and Fruit Trees of America," edition of 1857, as received from Mr. J. S. Downer of Elkton, Ky. From this time on the mention of it in pomological publications is frequent. At the time when Downing described it it was spread over Kentucky, southern Indiana and Illinois, and was known in Missouri. It is stated by Ezekiel Honsinger of Burnt Prairie, Ill., that his father grafted the Ben Davis in White County, Ill., about 1825, obtaining the scions from a neighbor, Mr. Funkhouser, and he



DISTRIBUTION OF THE BEN DAVIS.

from Mr. Newman, who brought them from Kentucky before 1820. Here is explained how the variety obtained the names Funkhouser and Newman. A nursery was established in this neighborhood in 1839, and was instrumental in disseminating the variety far and wide.

With the rise of commercial orcharding in this region, after the civil war, the variety attained widespread favor, and it may justly claim the first place among commercial varieties, taking the country as a whole. No other commercial variety is so widely planted, and none succeeds so well under such widely varying conditions. It is a sure, abundant bearer, the tree is vigorous, reasonably healthy, a good grower in the nursery, and comes into bearing early, and the fine appearance and excellent shipping and keeping qualities of the fruit are well known. That it is of excellent quality as a dessert fruit no one will contend, but much of its evil reputation in this way comes through its being grown in localities where it should never have been planted. When well grown, near the region of its origin, it is not of poor quality; when grown in the colder north, it does not have time to fully develop, and is most decidedly an inferior apple.

An attempt was made by means of library research and by correspondence to learn something of the limits of culture of the Ben Davis. The map shown herewith shows approximately the northern limit of the variety, and also what may be spoken of as the Ben Davis belt, where this is easily the leading commercial sort. It will be noted that the limit of hardiness is a little north of the isotherm of an absolute minimum temperature of — 30° F., indicating that a temperature of between 30° and 35° below zero is likely to kill the trees. In the Rocky Mountains the limit of hardiness is indicated only in a general way, as it here depends largely on altitude, and would be difficult to accurately define.

It is interesting to note the coincidence of the limits of the Ben Davis belt with the normal surface temperature for July of 75° on the north, and, more especially, for 80° on the south. In as much as the line showing the limits of the belt is intended to show where it is actually grown, and not where it is possible to grow it well, it is probable that it would succeed equally well farther to the southeast in the mountains of northern Georgia and Alabama, and thus its southern limit of successful growth conform more closely to this isotherm than is indicated.

Ever since the Ben Davis became known, fifty or more years ago, there has been much unfavorable comment on its quality, and many have predicted its speedy disappearance from the orchard and market. All the while the Ben Davis trees have borne full crops and have filled the owner's pocket in years when other sorts were delinquent in these most important qualities of a commercial apple. During the past season (1908–09) reply postcards were sent to over 225 nurserymen in the United States and Canada asking the following questions: —

How do your sales of Ben Davis compare with those of other varieties?

In what States are your sales of Ben Davis increasing, and how rapidly?

In what States are they decreasing, and how rapidly?

In what States are they practically stationary?

Is it being replaced by other varieties, and if so, what ones?

One hundred and thirty-one of these cards were returned. A few gave no definite replies, owing to various reasons, but from the great majority the following facts are gleaned: —

Number reporting increased sales,	8
Number reporting decreased sales,	59
Number reporting no change,	27

From the replies to the question as to what varieties are replacing the Ben Davis the following summary is made: —

	Number of Times mentioned.		Number of Times mentioned.
Jonathan,	26	Baldwin,	5
Gano,	19	Esopus Spitzenburg,	5
Winesap,	17	McIntosh,	4
Arkansas (*Mam. Blk. Twig*),	15	Newtown Pippin,	4
Grimes Golden,	12	Delicious,	3
York Imperial,	12	Wagner,	3
Rome Beauty,	9	Missouri Pippin,	2
Stayman Winesap,	7	Oldenburg,	2
Northern Spy,	6	Paragon,	2
Stark,	6	Wealthy,	2
Arkansas Black,	5		

And the following, once each; Aiken, Black Ben Davis, Blenheim, Belleflower, Cox Orange, Fameuse, Gates, Ingram, Janet, Kinnaird, Maiden Blush, Oliver, Red Russett, Salome, Transparent and Winter Banana.

It is evident that, on the whole, the sales of nursery trees of this variety are decreasing, and with some nurserymen with considerable rapidity. One firm reports a falling off of one-half in three years, another of 90 per cent. in five years and another of 50 per cent. decrease this year. One says, "We formerly grew as many as of all others; now 5 per cent." A few say they have ceased to propagate it. None report any marked increase in sales. The firms reporting an increase are largely in New York, and a few in Canada and some parts of the south. Among the large nurserymen in the Ben Davis belt, the report is almost unanimous that there is a falling off, and often a large one. West of the great plains it is planted hardly at all. In some parts of Maine and in southern Ontario and the Georgian Bay district it seems to be slightly on the increase. In the northwest prairie States it has not proved hardy and has been discarded.

The variety mentioned the most times as replacing the Ben Davis is Jonathan, which is of much better quality, and of the others that are taking its place in the Ben Davis belt, York, Winesap and Grimes Golden are notably better. In the northeast Stark is coming in and the McIntosh is gaining in popularity. In the northwest the Northwestern Greening is increasing, and in New York and Ontario the Spy is frequently mentioned. In the Pacific northwest it is scarcely planted at all, and many of the bearing trees are being worked over to other sorts, such as Jonathan, Gano, Rome Beauty, Newtown Pippin and Esopus.

On the strength of this inquiry the writer ventures to predict that the long-looked-for decadence of the Ben Davis is at hand, and that twenty-five years hence it will have become a variety of minor importance.

Description of Fruit.[1] — Size, below medium to large, fairly uniform; form, roundish to roundish conic or oblong, base broad and flattened

[1] Descriptions are original where not otherwise noted. This description is intended to include all forms of the variety as grown in the United States and Canada.

to narrow and rounded, apex rounded to sharp conic, fairly regular, slightly compressed, fairly equal sides, fairly uniform in any given locality; color, clear greenish yellow, covered with dull pinkish red to bright or deep red, 50 per cent. to 90 per cent. mottled, splashed and striped, deepening almost to blush on sunny side; bloom, medium, greasy or waxy; skin, medium thick, rather tough, smooth and shining; dots, inconspicuous, few to medium, small to medium, roundish, whitish to yellowish or russet, scattered, slightly raised; cavity, shallow to very deep, medium to very wide, flaring to abrupt, acute to acuminate, fairly regular, filled with russet; stem, short to very long, medium to slender, curved, brownish red, smooth; basin, very shallow to very deep, medium to very wide, generally abrupt, round obtuse, almost always very regular; calyx, closed to partly open, medium size, pubescent; segments, medium size, long, pointed, reflexed; tube, very short to very long, medium width, conic or funnel form, median stamens, pistil point present; core, axile to very abaxile, medium or below, central, turbinate to oval, with clasping core lines; cells, closed to open, medium in size, symmetrical to asymmetrical; carpels, roundish to obovate, emarginate, usually slightly slit, medium concave; seeds, few to medium, fairly plump, medium in size, brownish red, oval, pointed; axis, straight, rather short to very long; flesh, white, sometimes slightly tinged with yellowish, rather coarse, generally very firm, medium juicy to dry; flavor, mild subacid, often slightly aromatic, sometimes rather flat, sometimes slightly astringent; quality, poor to good.

Ben Hur.

This a comparatively new sort, offered by Stark Brothers of Louisiana, Mo., who state that it originated in Perry County, Ind., and that it is a cross of the Ben Davis and Rome Beauty. Prof. J. C. Whitten writes me, "From the characters of both fruit and tree, I should unhesitatingly put Ben Hur in the Ben Davis type." Stark Brothers describe it as follows: —

Tree, a strong, thrifty grower, young bearer, productive; fruit, fully as large or larger than Ben Davis, brilliantly striped and splashed with red; flesh, tender, fine grained, juicy, highly flavored, excellent.

Black Ben Davis.

This variety is said to have originated near Fayetteville, Ark., about the year 1880. An earnest controversy has arisen as to whether it is identical with the Gano. A number of samples of apples were received under these two names and examined with some care. It was easy to distinguish two types of apples, but they were connected by intermediate forms in such a way as to render it difficult to say whether two distinct varieties were represented or not. The most striking difference was in color, this varying from a distinctly striped apple to those with a clear blush, with no sign of stripes, a rather remarkable variation to appear in a single variety, but which exists in the McIntosh. It was evident that if the varieties were really distinct the names were confused, for the apples that were the most typical of the Black Ben Davis were called Gano; and of another sample, consisting of two apples, one would be called Gano and the other Black Ben Davis. In addition to examining these apples, the writer has consulted all the available literature on this point, and after considering everything with care, is, on the whole, inclined to the opinion that these are two distinct varieties, and describes them accordingly.

Description of Fruit. — Size, below medium to above, not uniform; form, round conic, almost regular, slightly compressed, generally with unequal sides, rounded base and round conic apex; color, bright greenish yellow, covered with rich, dark red, 20 per cent. to 95 per cent., blushed and mottled, sometimes showing slight tendency to striping; bloom, medium to heavy, waxy; skin, medium thick, rather tough, smooth and shining; dots, inconspicuous, medium in number, small, round, gray, scattering, scarcely raised; cavity, medium in depth and breadth, sloping, acute, nearly regular, slightly compressed, partly filled with greenish russet; stem, long, very slender, curved, brownish red, smooth; basin, rather shallow, medium, generally abrupt, nearly regular, slightly compressed; calyx, closed or partly open, medium, pubescent; segments, medium, reflexed; tube, short, medium width, conic, medium stamens, pistil point present; core, axile, large, central, turbinate, core lines meeting or clasping; cells, closed, medium; carpels, broad oval, emarginate, smooth, medium concavity; seeds, few to medium, plump, medium size, medium brown, oval, medium pointed; axis, medium to rather long, straight; flesh, white, firm, medium coarse, rather dry; flavor, subacid; quality, good. Described from six specimens received from the New York Experiment Station.

Coffelt.

This apple originated with Wyatt Coffelt of Bentonville, Ark., and is said by Henthorn to be a seedling of the Red Limbertwig, though Beach says that some nursery catalogues state that it is a seedling of the Ben Davis. As received from the New York

Experiment Station, it strongly resembles the Ben Davis. It has been planted to a limited extent in Arkansas, but it does not appear that it is superior to others of this group.

Description of Fruit. — Size, small, uniform; form, roundish oblate, nearly regular, slightly unequal sides, rounded base and roundish, slightly conic apex, uniform; color, yellowish green, covered with rather dull deep red, 65 per cent. to 95 per cent., mottled, more or less obscurely splashed, deepening almost to blush on sunny side; bloom, medium, waxy; skin, rather thick, medium texture, fairly smooth and bright; dots, more or less conspicuous, few to many, medium size, angular, russet, slightly raised; cavity, rather shallow, wide, flaring, broad acute, nearly regular, sometimes partly filled with russet; stem, long, slender, inclined, brownish red, smooth; basin, shallow, broad, flaring, flat obtuse, pentangular; calyx, open, medium size, slightly pubescent; segments, medium size, long, pointed, reflexed, separate at base; tube, medium in length and breadth, funnel form, medium stamens, pistil point present; core, axile, small, central, oval, clasping core lines; cells, closed, small, symmetrical; carpels, obvate, emarginate, smooth, concavity medium; seeds, few, plump, medium size, medium brown, oval; axis, medium, straight; flesh, white, slightly yellowish, a little tinged with green, fine, medium firm, moderately juicy; flavor, mild subacid, almost sweetish; quality, good. Described from specimens received from the New York Experiment Station.

Cole Davis.

This variety originated with S. T. Cole of Lincoln, Ark., about a dozen years ago, the original tree appearing in an orchard of Ben Davis. According to Mr. Cole the apple was of higher color than the Ben Davis, but otherwise much the same. It was propagated for a time by the Stark Brothers, but so far as known is not now offered for sale.

Eicke.

Concerning this variety the writer has been able to learn but little. Specimens received from the New York Experiment Station resemble the Ben Davis, and Hedrick groups it here. Ragan gives its origin as Nebraska.

Description of Fruit. — Size, small, uniform; form, roundish, regular, slightly compressed, nearly equal sides, rounded base and apex, uniform; color, bright greenish yellow covered with bright, rather deep red, 50 per cent. to 85 per cent., striped, splashed and mottled, deepening almost to blush on sunny side; bloom, heavy, waxy; skin, rather thin, medium texture, smooth and bright; dots, inconspicuous, few to medium, rather small, roundish, light gray, general, very slightly raised; cavity, rather shallow, medium width, sloping, acute approaching obtuse, nearly regular, partly filled with russet; stem, long, slender, inclined or curved, brownish red, smooth; basin, shallow, medium width, abrupt, somewhat ribbed and plaited; calyx, closed or partly open, medium size, pubescent; segments, medium size, medium long, pointed, reflexed; tube, rather short, medium, conic, medium stamens, pistil point present; core, abaxile, medium size, central or distant, broad oval, slightly clasping core lines; cells, open, medium size, asymmetrical; carpels, obovate, emarginate, slightly slit, concavity medium; seeds, medium in number, plump, medium size or above, dark brown, oval, more or less straight on one side; axis, rather short, straight; flesh, whitish, slightly tinged with yellowish green, fine, medium firm, medium juicy; flavor, subacid to slightly acid; quality good. Appears to resemble Coffelt. Described from specimens received from the New York Experiment Station.

Etris.

According to Professor Stinson, this variety was first fruited near Bentonville, in the orchard of A. K. Etris, the trees coming from the nursery of John Breathwait, about fifteen years ago. It is not generally disseminated, but is considerably grown in the county of its origin. It is quite possible that it is identical with Gano.

Extra.

An apple was offered by Stark Brothers under this name about ten years ago, described as being larger and higher colored than Ben Davis. It is not now sold. It may have been a distinct or a special strain of Ben Davis.

Flat Ben Davis.

A distinct strain of the Ben Davis was observed by the writer in 1909 growing in an orchard in Monmouth, Me. It differed from the usual type in being larger and decidedly more oblate in form. The striping seemed to be coarser and more distinct than on neighboring trees of the common type. The tree also differed in being more open and apparently of rather less vigorous growth. There were several trees in this and a neighboring orchard. It appears to be in no way markedly superior to the ordinary Ben Davis.

Gano.

The exact origin of this variety is not perfectly clear. It is said to have been grown by Mr. Ely Jacks, in Howard County, Mo., in 1840, and to have been somewhat disseminated in that vicinity. It was first brought to general notice in 1884, when it was exhibited before the Missouri Horticultural Society, and about this time it was named Gano, for Mr. W. G. Gano who was concerned with its introduction. Mr. Gano states that the original tree came from a lot of Ben Davis, and was planted in the orchard under the supposition that it was of that variety, but on fruiting it proved to be different. Prof. S. A. Beach advances the theory that it is a bud sport of the Ben Davis.[1] He thinks that it is improbable that a seedling stock should prove to be so like the Ben Davis, the variety supposedly worked on the stock. If, however the Gano originated as a bud sport in the same way that Red Gravenstein has originated from Gravenstein, and Collamer Twenty Ounce from the original Twenty Ounce, then the fact that the Gano appeared under propagation in a lot of Ben Davis apple trees is easily and naturally accounted for.

As compared with the Ben Davis, it is a little smaller, not quite as prolific a bearer, considerably higher colored, perhaps slightly better in quality, and sells for a little more per barrel. It takes second place in importance in this group, and is being planted in the southwest in place of the Ben Davis to a considerable extent, but has been planted but little in a commercial way elsewhere.

Description of Fruit. — Size, medium, uniform; form, roundish, more or less conic, nearly regular, slightly compressed, nearly equal sides, rounded base, apex round or conic, not very uniform; color, clear greenish yellow covered with deep rich red, 15 per cent. to 70 per cent., mottled, blushed and striped, always blushed on sunny side, slightly russet; bloom, rather light, waxy; skin, rather thick, medium tough, smooth and shining; dots, inconspicuous, few, medium size, roundish, gray, scattering, slightly raised; cavity, medium in depth and breadth, sloping, acute, fairly regular, filled with greenish russet; stem, long, slender, straight, brownish red, smooth; basin, shallow, medium width, steep to abrupt, ribbed and plaited; calyx, closed or partly open, medium or above, pubescent; segments, medium to large, long, pointed,

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[1] Personal letter from S. A. Beach.

reflexed; tube, short to medium, medium breadth, conic basal stamens, pistil point present; core, axile, medium size, central, turbinate, core lines meeting; cells, nearly closed, medium or above, asymmetrical; carpels, slightly obovate, strongly emarginate, nearly smooth, concavity variable; seeds, medium in number, plump, medium size, oval or angular, rather short; axis, medium, straight; flesh, white, slightly tinged with greenish yellow, firm, medium texture, medium juicy; flavor, mild subacid, very slightly astringent; quality, good. Described from specimens received from the New York Experiment Station.

Improved Ben Davis.

It is stated in the report of the Illinois Horticultural Society for 1899, p. 89, that on several occasions an Improved Ben Davis has been brought to the attention of the society. It is rather probable that these were simply superior strains of the Ben Davis and not a distinct variety. So far as known, no variety of this name is being propagated.

Nordhaussan.

Scions of this sort were sent to the Division of Pomology at Washington by Mr. John Gabler of Springfield, Mo., in 1896, and by them distributed to various State experiment stations, including that of Massachusetts. Professor Waugh informs me that in both tree and fruit it resembled the Ben Davis. This tree was destroyed some few years ago, and I have not been able to secure either specimens or any further information concerning it. So far as known it is not offered for sale at the present time.

Ostrakavis.

A cross of the Ostrakoff and Ben Davis, originated at the Iowa Experiment Station. Distributed only for trial and not considered to be of value.

Description of Fruit.[1] — Fruit medium or below, conical, regular, surface oily; color, yellow, with faint bronze blush; cavity, regular, deep, obtuse, with faint trace of russet; basin, wide, very shallow, minutely wrinkled; core, wide open, meeting; cells, large, roomy, ovate, slit; tube funnel shaped; stamens, median; seeds, twelve, large, plump; flesh, white, sweet. Season probably late fall or early winter. Interesting as showing that a cross of two sour apples may produce a sweet apple.

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[1] From S. D. Bulletin, 76, p. 80.

Paris.

Reported by Mr. L. A. Goodman as a new apple of the Ben Davis family, sent by Mr. Ambrose of Paris, Mo., to the meeting of the Missouri Horticultural Society.

Shackleford.

This variety is first mentioned in the report of the Illinois Horticultural Society for 1883, at which time it appears to have been known in southern Illinois and adjacent parts of Missouri. Beach says that it originated near Athens, Mo. It has been planted considerably in the southwest, but has not attained great favor as a commercial sort. It is generally of rather poor color and is said to be a straggling grower. It does not appear to be in any way superior to the Ben Davis and in some qualities it is inferior.

Description of Fruit.—Size, medium, uniform; form, roundish oblate, slightly conic, nearly regular, slightly compressed, sides generally nearly equal, base rounded, apex round conic, uniform; color, clear waxy greenish yellow covered with bright red, 10 per cent. to 50 per cent., splashed mottled and short striped, deeper on sunny side of some specimens; bloom, light, waxy; skin, rather thick, medium texture, smooth, and fairly bright; dots, very inconspicuous, few to medium, very small, round, gray russet or greenish, seattering, even or submerged; cavity, rather shallow, medium width, sloping to flaring, nearly obtuse, nearly regular, markings none; stem, medium long, slender, straight or inclined, brownish red, smooth; basin, medium in depth and breadth, abrupt, truncate conic, fairly regular, sometimes slightly ribbed and plaited; calyx, closed, medium size, pubescent; segments, large, broad, pointed, reflexed; tube, short, medium width, conic, stamens median, pistil point present; core, abaxile, small, central, broad oval, core lines meeting; cells, partly open, medium size, symmetrical; carpels, oblong, emarginate, slit, concavity medium; seeds, medium in number and size, plump, medium brown, oval, medium long, pointed; axis, medium in length, straight; flesh, greenish white, medium firm, rather coarse, fairly juicy; flavor, brisk subacid; quality, good. Described from specimens received from the Ontario Agricultural College.

Shirley.

Mr. T. V. Munson of Dennison, Tex., gives the following history of this variety.

This apple was found growing in two old orchards, namely the A. Alkire orchard, some four miles west of Dennison, Tex., and the Alex. Shirley orchard, some five miles southeast of Dennison. The writer saw these trees in said orchards about the year 1880, and made diligent inquiry as to their origin, but neither Mr. Alkire nor Mr. Shirley (both now deceased some years) knew from whence they came. I presume they came from some local Texas or Louisiana nursery that passed out of existence soon and left no history of the variety. The orchards were planted before railroads were built into Texas. There was a small nursery at Paris, Tex., and another at Clarksville, farther east, and one at Shreveport, La., the latter conducted by G. W. Storer, the others by a Mr. Walker at Clarksville and his son, J. Q. A. Walker, at Paris, Tex. These nurseries were the first in Texas and sold trees all through north Texas. They handled only southern varieties. The elder Walker came to Texas from Tennessee about the year 1838.

In 1880 or 1881 I sent samples of the apples to Charles Downing, with whom I corresponded often for a number of years. Mr. Downing could not identify it. As the apple was a sure and prolific bearer, a large, handsome, salable fruit of fine keeping qualities, I began propagating and advertising it over twenty-five years ago. Mr. Shirley sold the apple in Dennison and Sherman markets, where it acquired the name Shirley apple or sometimes Shirley Keeper. I described it in my catalogue as Shirley, which name it has retained ever since.

In tree and fruit it resembles York Imperial more than any other variety. It was the first to point out before the public this similarity; but the two are distinct. The Shirley is better in tree and fruit, somewhat larger and brighter, and in quality a little better.[1]

As grown in Texas this apple resembles the York Imperial, but the specimens received from the New York Experiment Station are clearly of the Ben Davis type. The trees were received from Mr. Munson and the apples were identified by Mr. Munson as the Shirley.

Description of Fruit. — Size, small, uniform; form, roundish oblate, nearly regular, often slightly compressed, nearly equal sides, base rounded, apex rounded or slightly conic, quite uniform; color, clear greenish yellow covered with bright medium red, 40 per cent. to 80 per cent., mottled, splashed and striped, deepening almost to blush on sunny side; bloom, scant, waxy; skin, medium thick, rather tough, smooth and bright; dots, inconspicuous, medium in number, small, roundish, light gray, generally slightly raised; cavity, medium in depth, rather wide, flaring, broad acute, nearly regular, generally without markings; stem, long, slender, straight or inclined, brownish red, smooth;

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[1] Personal letter from Mr. T. V. Munson.

basin, medium in depth and width, abrupt, truncate conic, smooth and nearly regular; calyx, closed or partly open, rather small, pubescent; segments, medium, short, pointed, reflexed; tube, long, medium in breadth, funnel form, stamens median or basal, pistil point present; core, abaxile, medium to small, central, oval turbinate, core lines clasping; cells, closed, rather small, symmetrical; carpels, roundish to obovate, emarginate, smooth, concavity medium; seeds, medium to many, plump medium brown, irregular or oval, obtuse; axis, medium straight; flesh, white, slightly tinged with yellowish green, firm, moderately coarse, medium juicy; flavor, brisk subacid; quality, good. Described from nine specimens received from the New York Experiment Station.

Sweet Ben Davis.

Concerning this variety, Heiges makes the following statement in the report of the pomologist for 1895. The apples were from Prof. John T. Stinson of Fayetteville, Ark., who presumably furnished the facts of origin, etc.

Originated about 1870 on farm of Garret Williams in Madison county, Ark. The tree resembles Ben Davis in shape, wood and leaf, and is nearly as good a bearer. The fruit ripens about two weeks earlier than Ben Davis. Roundish, truncated, slightly oblique, slightly unequal; large, smooth, except for a few russet knobs; greenish yellow, washed with pale red, striped and splashed with crimson; dots, numerous brown; cavity, large, regular, deep, abrupt furrowed and russet netted; calyx segments, short, wide, converging or slightly reflexed; eye, large, partially open; skin, thick, tough; core, large, roundish, clasping, nearly closed; seeds, numerous, large, angular, brown; flesh, whitish satiny, juicy; sweet; good; season, winter.

White Ben Davis.

Professor Stinson says that this apple has been found in several orchards in Missouri. I do not know that it has been much disseminated or that it is now offered for sale.

It has been said that a list of forty varieties was under consideration. Only twenty are given as belonging to this group. Of the remaining ones the following varieties, that have by various writers been more or less clearly and definitely assigned to this group, are considered to properly belong elsewhere: —

Beach.
Dickenson.
Gill (Gill Beauty).
Loy.
Rutledge.
Wallace Howard.

Regarding the following the writer is in some doubt, owing to lack of opportunity for sufficient study, but considers it probable that they do not belong to this group: —

Breckinridge.	Hastings Red.
Chicago.	Highfill.
Collins (Champion).	King David.
Florence.	Marion Red.
Givens.	

The remainder of the forty are accounted for as synonyms.

In deciding whether or not any variety should be admitted to a place in the Ben Davis group as here given, the intention has been to be conservative. The study of varieties of fruits by groups has only recently begun and the writer feels that in constituting these groups it is best to include in any group under consideration only such varieties as seem beyond doubt to belong there, even if there are strays left that do not seem to belong anywhere. If any of these odd varieties are of great importance they will in time become the central types of new groups, while if only of minor account they may as well be left by themselves.

It is to be understood that the foregoing is not final, but of the nature of a report of progress. In order to be conclusive the study of the fruit in some cases and of the tree characters in many cases is necessary. It is hoped, however, that it may prove a contribution of some value on this subject and a basis for further study.

VARIATION IN APPLES.[1]

BY J. K. SHAW.

It is safe to assume that the Ben Davis is the most widely cultivated of any commercial variety of apples in America. It is known in almost every apple-growing section. It is therefore grown under a great variety of conditions of climate, from the short hot summers and long cold winters of Quebec to opposite conditions in Arkansas and Texas. It also flourishes in a great variety of soil conditions. Moreover, it seems to be in itself more variable than other sorts, and responds in a greater degree to varying environment than do most other varieties.

These considerations led to its selection as a variety for the study of variation in apples, and the results of two years' investigation are here reported. The matter is presented under two headings, (1) the variation in size and form as grown in the Clark orchard of the Massachusetts Agricultural College, and (2) the variation in form, quality and other characters when grown under widely varying conditions of climate and soil in the United States and Canada.

Variation in the College Orchard.

In the fall of 1908 the product of four trees in the college orchard was picked separately and divided each into four lots, comprising the product of the upper south, lower south, upper north and lower north quarters of the trees. These were studied with reference to size and form. This arrangement gave opportunity for two comparisons: (*a*) from different trees, (*b*) from different parts of the trees.

[1] Work on this subject was begun by the writer in 1907 as a part of the requirements for the degree of M.S. by the Massachusetts Agricultural College, and was continued and extended in 1908. It was done under the direction of Prof. F. C. Sears, to whom the thanks of the writer are extended for encouragement and suggestions, and also to Prof. F. A. Waugh, who has aided in many ways. Assistance and suggestions have also been received from many horticulturists and fruit growers from various parts of the country. It is impossible to name them here, but the debt to all is gratefully acknowledged.

(a) *From Different Trees.*

Table 1 shows the means,[1] standard deviations and coefficents of variability, with their probable errors, in the size and form of the apples from each of the four trees. It is evident that there are differences in both size and form.

TABLE 1.

	SIZE.[2]			FORM.			
	Mean.	Standard Deviation.	Coefficient of Variability.	Mean.	Standard Deviation.	Coefficient of Variability.	Number of Apples.
Tree 2, . .	71.02±.14	6.16±.10	8.67±.14	1.1422±.0014	.0576±.0009	3.04±.88	864
Tree 3, . .	68.80±.15	5.31±.10	7.72±.16	1.1399±.0016	.0543±.0011	4.73±.09	567
Tree 5, . .	68.35±.13	5.55±.08	8.12±.13	1.1666±.0019	.0626±.0013	3.76±.08	469
Tree 7, . .	72.80±.18	6.45±.13	8.86±.17	1.1716±.0019	.0578±.0013	3.37±.07	423
	70.23±.08	5.95±.06	8.47±.08	1.1515±.0008	.0589±.0006	5.29±.05	2,321

There seems to be little or no relation between the size of the apples and the yield. Trees 2 and 7 produced the larger apples,

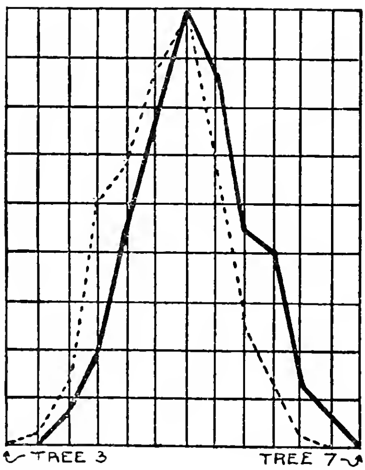

FIG. 1.

and one of these gave the highest yield of all and the other the lowest, less than half as many. There are seen to be slight

[1] For the method of making these calculations, see p. 198.
[2] All measurements are in millimeters.

differences in the variability in size of apples from the different trees.

More striking are the differences in mean index of form, though the variability of form is less than that of size. The difference in form of the apples from Trees 3 and 7 is shown graphically in Fig. 1. These differences in form were perceptible to the eye, and there were also differences in color, apples from Tree 5 being higher colored than the others.

These differences may be attributed to bud variation or to the influence of the stock, for the trees were near each other, and, so far as could be seen, on exactly similar soils. In passing it may be suggested that this method offers means of throwing light on these two disputed questions, namely, bud variation and the mutual influence of stock and scion.

(*b*) *From Different Parts of the Trees.*

The results of computations of the apples from different parts of the tree are shown in Table 2. It appears from this that apples from the top of the tree are a little larger than those from the lower branches and also slightly more variable. In form the differences in both mean and standard deviation are slight, those from the lower branches being a little longer than those from the top of the tree. The most important thing about this table is that it serves to bring out the greater differences in the products of the individual trees.

TABLE 2.

	Size.			Form.			Number of Apples.
	Mean.	Standard Deviation.	Coefficient of Variability.	Mean.	Standard Deviation.	Coefficient of Variability.	
Upper south, .	70.93 ± .18	6.40 ± .13	9.02 ± .19	1.1643 ± .0017	.0593 ± .0012	3.61 ± .07	518
Lower south, .	69.24 ± .14	5.68 ± .10	8.20 ± .14	1.1512 ± .0015	.0619 ± .0011	4.19 ± .07	714
Upper north, .	71.27 ± .20	6.14 ± .15	8.47 ± .19	1.1553 ± .0020	.0607 ± .0014	3.91 ± .08	414
Lower north, .	69.79 ± .12	4.96 ± .08	7.11 ± .12	1.1406 ± .0016	.0644 ± .0011	4.58 ± .07	676

Climatic Variations.

The variations in the college orchard are comparatively slight when compared with those observed when apples from widely separated localities are compared. This variation has been often observed and noted, but so far as the writer knows there has been no attempt to study systematically and record it. The work here reported is a beginning. The study is based on a careful examination and measurement of twenty lots of apples of the crop of 1907 and of twenty-five of the crop of 1908, received from growers in different localities in the United States and Canada. These lots were generally about a bushel each. The numbers are given in Table 3. An attempt was made to secure apples from the same orchards both years, but on account of crop failures and other reasons this was unsuccessful in a few cases. In addition to these, several smaller samples have been received from other localities which, while not large enough for the same sort of study, serve to indicate the gradual variation of the variety when passing from one region to another. In the following pages the variation of form, size, quality and other characters are separately taken up and considered.

Discussion of the Variation.

Form.

The most important character studied was that of form, and the variation of this was nothing short of remarkable. One familiar with the variety in a certain locality would hardly recognize it as grown perhaps not more than one or two hundred miles away. Much time was given to the study of this, and careful measurements of more than 9,000 apples from the different localities were made and calculated by statistical methods.

The different lots may be grouped in four classes as regards the general form, as follows: —

1. The oblong conic, more or less ribbed form from the Maine seacoast and Nova Scotia and Prince Edward Island.

2. The round conic type from the north central and northeastern United States and southern Canada, from as far south

as Pennsylvania and possibly farther in the mountain regions, and from the Pacific coast.

3. The oblate or oblate conic type from the Delaware peninsula and the valley of the Ohio and its tributaries.

4. The roundish oblate form from the Ozarks and from Colorado.

The outlines of specimens representing these four types are shown in Fig. 2. Each of these types seems to be pretty constant in the localities given, and they gradually shade into each other in passing from one region to the next. These differences in form are closely related with certain other characters which are discussed later.

Coming now to the mathematical expression of the form of the apples, the method was as follows. Each apple was carefully measured, ascertaining in millimeters its greatest transverse and longitudinal diameters, and the figures recorded. Then the transverse diameter of each apple was divided by its greatest longitudinal diameter. The number resulting from this calculation was taken as representing the form of the apple, and is called the index or coefficient of form. If the index is 1 the diameters are equal; if it is less than 1 the apple is longer than broad, and if more than 1 it is broader than long. The calculation of this index for a large number of apples gives an array of numbers representing the forms of the apples measured which may be dealt with by statistical methods.[1]

Calculating the means of the several arrays representing the different lots of apples measured gives the interesting and significant figures shown in Table 3. Translated into simple language these figures mean that in Port Williams, N. S., for example, the average Ben Davis apple of the crop of 1907 was about 1.0196 larger in transverse diameter than in longitudinal diameter, and, as shown by the probable error, the chances are even that this figure is not over .0035 of the transverse diameter away from the truth. This average apple is nearly as long as broad, and to one familiar with this sort of measurement indicates an apple that may be correctly described as oblong.

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[1] For these methods see C. B. Davenport, "Statistical Methods," or "Principles of Breeding," by E. Davenport.

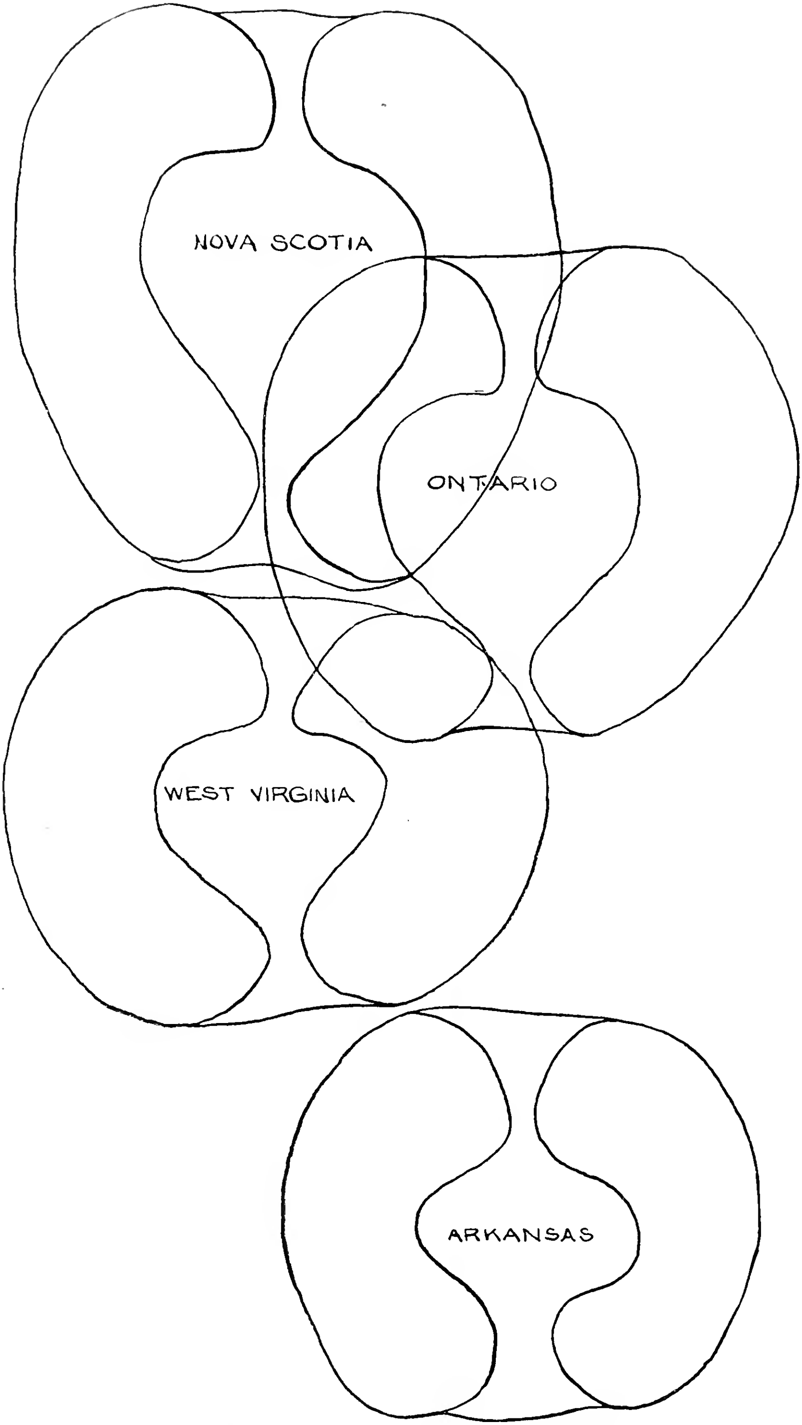


FIG. 2.—Typical Forms of the Ben Davis.
Nova Scotia, the oblong form. Ontario, the round conic form. West Virginia, the oblate form. Arkansas, the roundish form.

TABLE 3. — *Form.*

Apples from —	1907. Number of Apples.	1907. Mean Index of Form.	1907. Standard Deviation.	1907. Coefficient of Variability.	1908. Number of Apples.	1908. Mean Index of Form.	1908. Standard Deviation.	1908. Coefficient of Variability.
Charlottetown, P. E. I.,	74	1.0511 ± .0049	.0619 ± .0034	5.88 ± .31	122	1.1250 ± .0052	.0858 ± .0037	7.63 ± .33
Port Williams, N. S.,	135	1.0196 ± .0035	.0656 ± .0026	6.37 ± .26	102	1.1183 ± .0044	.0672 ± .0031	5.68 ± .26
Lower Gagetown, N. B.,	–	–	–	–	226	1.0948 ± .0031	.0465 ± .0022	4.25 ± .20
East Sangerville, Me.,	–	–	–	–	197	1.2013 ± .0028	.0587 ± .0020	4.88 ± .17
Skowhegan, Me.,	–	–	–	–	130	1.1041 ± .0027	.0474 ± .0020	4.27 ± .18
Farmington, Me.,	–	–	–	–	149	1.1108 ± .0031	.0565 ± .0022	5.10 ± .19
Livermore Falls, Me.,	–	–	–	–	128	1.1262 ± .0030	.0519 ± .0021	4.19 ± .18
West Paris, Me.,	–	–	–	–	116	1.0934 ± .0045	.0461 ± .0031	4.22 ± .29
Monmouth, Me.,	–	–	–	–	173	1.1128 ± .0024	.0483 ± .0017	4.34 ± .16
Turner, Me.,	237	1.0451 ± .0025	.0571 ± .0018	5.71 ± .18	–	–	–	–
New Gloucester, Me.,	–	–	–	–	97	1.0978 ± .0031	.0451 ± .0022	4.11 ± .19
Marblehead, Mass.,	–	–	–	–	192	1.1021 ± .0029	.0598 ± .0021	5.42 ± .18
Barnstable, Mass.,	–	–	–	–	162	1.1281 ± .0021	.0407 ± .0015	3.67 ± .14
Amherst, Mass.,	284	1.1656 ± .0023	.0581 ± .0017	4.98 ± .14	2,321	1.1515 ± .0008	.0589 ± .0006	5.29 ± .05
Storrs, Conn.,	147	1.1557 ± .0030	.0534 ± .0021	4.62 ± .18	131	1.1423 ± .0041	.0689 ± .0029	6.03 ± .21
Abbotsford, Quebec,	151	1.1788 ± .0039	.0735 ± .0028	6.23 ± .24	129	1.1739 ± .0041	.0683 ± .0029	5.82 ± .23
Isle la Motte, Vt.,	203	1.1547 ± .0024	.0735 ± .0024	6.28 ± .27	170	1.1406 ± .0027	.0526 ± .0020	3.74 ± .15
Guelph, Ont.,	147	1.1309 ± .0030	.0524 ± .0020	4.72 ± .18	–	–	–	–
Belleville, Ont.,	124	1.0829 ± .0026	.0442 ± .0019	4.08 ± .18	135	1.1111 ± .0025	.0436 ± .0018	3.92 ± .16
State College, Pa.,	209	1.1556 ± .0026	.0568 ± .0020	4.91 ± .14	–	–	–	–
New Brunswick, N. J.,	–	–	–	–	36	1.1525 ± .0051	.0460 ± .0036	3.99 ± .32
Middletown, Del.,	87	1.2010 ± .0060	.0831 ± .0042	6.92 ± .35	–	–	–	–
Martinsburg, W. Va.,	157	1.2272 ± .0035	.0603 ± .0020	4.91 ± .18	101	1.1537 ± .0036	.0563 ± .0027	4.78 ± .23
Tiptop, Ky.,	481	1.1914 ± .0018	.0592 ± .0013	4.97 ± .11	–	–	–	–
Mitchell, Ind.,	111	1.1928 ± .0038	.0599 ± .0027	5.02 ± .23	174	1.1758 ± .0033	.0560 ± .0020	4.76 ± .17
Bentonville, Ark.,	183	1.1588 ± .0024	.0492 ± .0017	4.24 ± .15	–	–	–	–
Lincoln, Ark.,	116	1.1536 ± .0042	.0677 ± .0015	5.87 ± .26	–	–	–	–
Manhattan, Kan.,	–	–	–	–	77	1.1629 ± .0059	.0520 ± .0042	4.47 ± .36
Stillwater, Okla.,	107	1.1550 ± .0035	.0541 ± .0025	4.68 ± .22	129	1.1861 ± .0035	.0584 ± .0024	4.92 ± .21
Grand Junct., Col.,	87	1.1409 ± .0039	.0544 ± .0028	4.77 ± .24	132	1.1465 ± .0036	.0617 ± .0025	5.38 ± .22
Redlands, Cal.,	79	1.1086 ± .0042	.0567 ± .0030	5.11 ± .27	87	1.1418 ± .0052	.0718 ± .0033	6.29 ± .37
Kaslo, B. C.,	108	1.0630 ± .0043	.0671 ± .0031	6.31 ± .29	73	1.1045 ± .0054	.0706 ± .0039	6.39 ± .35

At the other extreme stands the lot from West Virginia, with an index of 1.2272 ± .0035. The average apple grown under exactly those conditions under which these apples grew has a cross diameter about 1.2272 times larger than the longitudinal diameter, and we know that the chances are even that this figure is not more than .0035 of the transverse diameter out of the way. Stating this last in another way, it means that the chances are even that the true index of form is not less than 1.2257 nor more than 1.2307.

The third column of Table 3 gives the standard deviation with its probable error, which gives a measure of variability for each lot. This is affected by the selection or want of selection, as the case might be, of the person sending the apples, some growers sending the apples just as they came from the trees and some selecting them more or less, and doubtless throwing out many specimens which were off type, thus reducing the amount of variation in that lot. Several tests showed that the amount of variability among the larger apples and smaller apples of a given lot was about the same, and this was also true of the mean index of form. It is believed, however, that this selection has not greatly modified the figures, and that the mean indexes of form are scarcely affected at all.

The fourth column gives the coefficient of variability and its probable error. This is an abstract number giving, in percentages of the means, the variability of each lot of apples, and enables one to compare the variability in form with that of any other character of the apples, or any character which can be measured and expressed by this method.

The variation in form is shown graphically in the diagrams in plates I. to V. These are based on the same measurements as the mathematical calculations, each lot being reduced to the basis of 200 apples for the sake of uniformity. Many of them are somewhat irregular, owing to the small numbers of specimens measured. The ordinate representing the index of form of 1.1300 is in each case made heavier in order to furnish a standard for comparison, this ordinate being near the average of all apples measured. The shape and relative position of these diagrams show strikingly the differences in variability and in mean index of form of the various lots of apples.

Considering the diagrams and the figures given in the table, we find that in the extreme northeast the Ben Davis is much elongated, and as we go south and west it becomes less elongated and more flattened, till we reach West Virginia and Kentucky, where it becomes a decidedly oblate apple. In the Ozarks it is a little longer, and in southern California still longer, and in British Columbia it is almost as much elongated as in Nova Scotia and neighboring regions. This noticeable elongation of the apples from Belleville, Ont., as compared with those from Guelph, is significant, as Belleville is located not far from the north shore of Lake Erie, while Guelph is some miles inland. The same influence is perhaps shown in the Vermont lot, though the figures for those of Quebec and Massachusetts, which serve to bring this out, are themselves in some degree exceptions to the general rule that the apples are longer as one goes north. Nevertheless, it seems reasonable to conclude that, beginning in the southern Allegheny mountains and in southern California, and going north, the apples become more elongated, and that this elongation is much more pronounced in the vicinity of large bodies of water, either salt or fresh.

The comparison of apples from the same orchard both years shows reasonably close agreement in most cases. Several, however, are quite different. It will be noted that these are among the extremes of form. The maritime provinces and the Pacific coast, that furnished extremely long apples in 1907, gave shorter ones in 1908, and the extremely flattened ones from West Virginia were longer. On the other hand, those near the average form show very slight differences. Professor Sears states that in Nova Scotia there are two types of Ben Davis that differ much in both tree and fruit. The fruit of one generally approaches an oblong form, while the other is more conic. Most of the Nova Scotia apples of 1907 were of the former type, while those of 1908 were more like the latter. The same would apply in some degree to those from Prince Edward Island. Both lots were the run of the orchard, no selection whatever being made. It is possible that the difference in the forms of these apples in the two years may be due to their representing these different types.

The apples from Quebec are flatter than those from farther

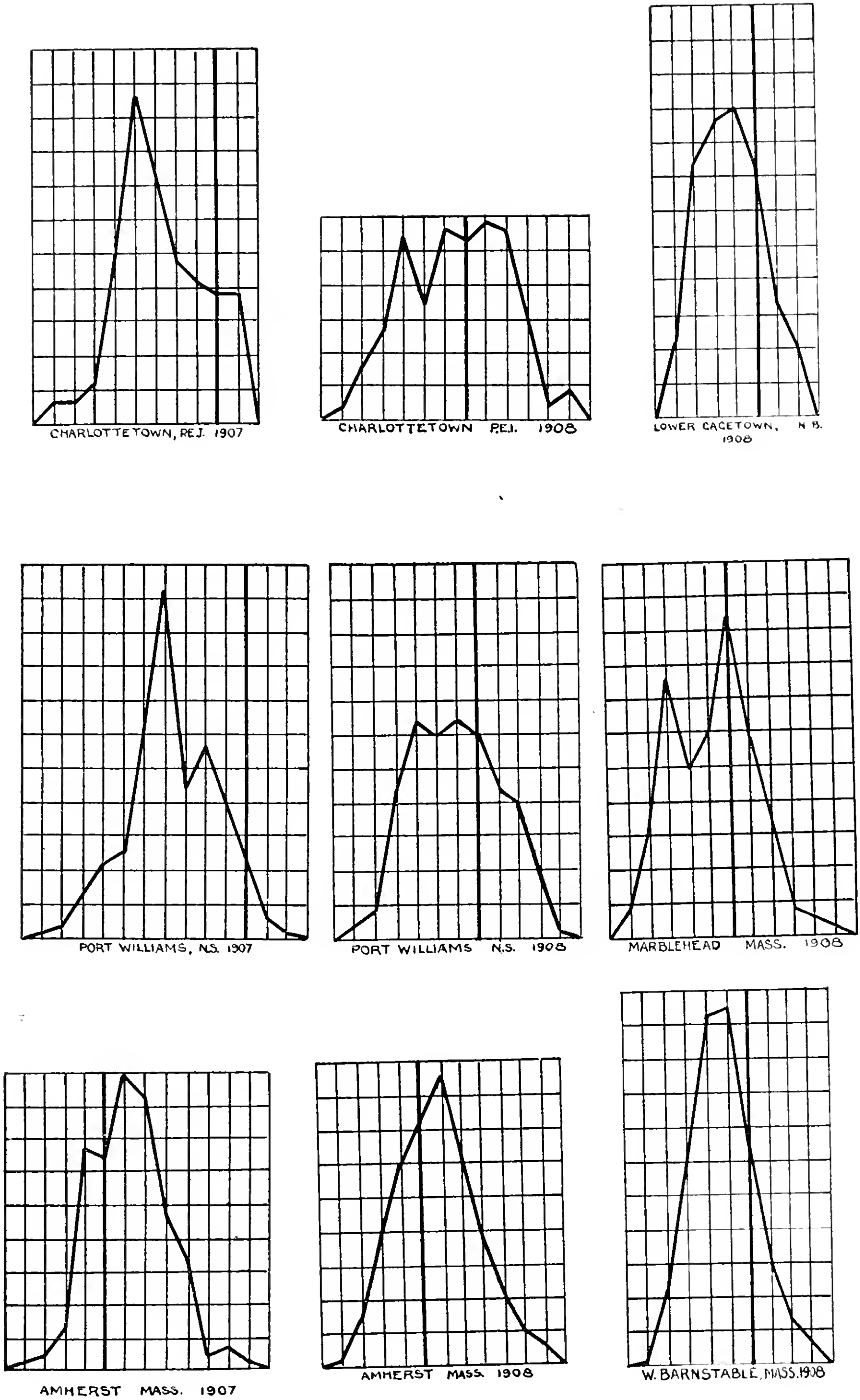

CHARLOTTETOWN, P.E.I. 1907
CHARLOTTETOWN P.E.I. 1908
LOWER GAGETOWN, N.B. 1908
PORT WILLIAMS, N.S. 1907
PORT WILLIAMS N.S. 1908
MARBLEHEAD MASS. 1908
AMHERST MASS. 1907
AMHERST MASS. 1908
W. BARNSTABLE, MASS. 1908

PLATE I.

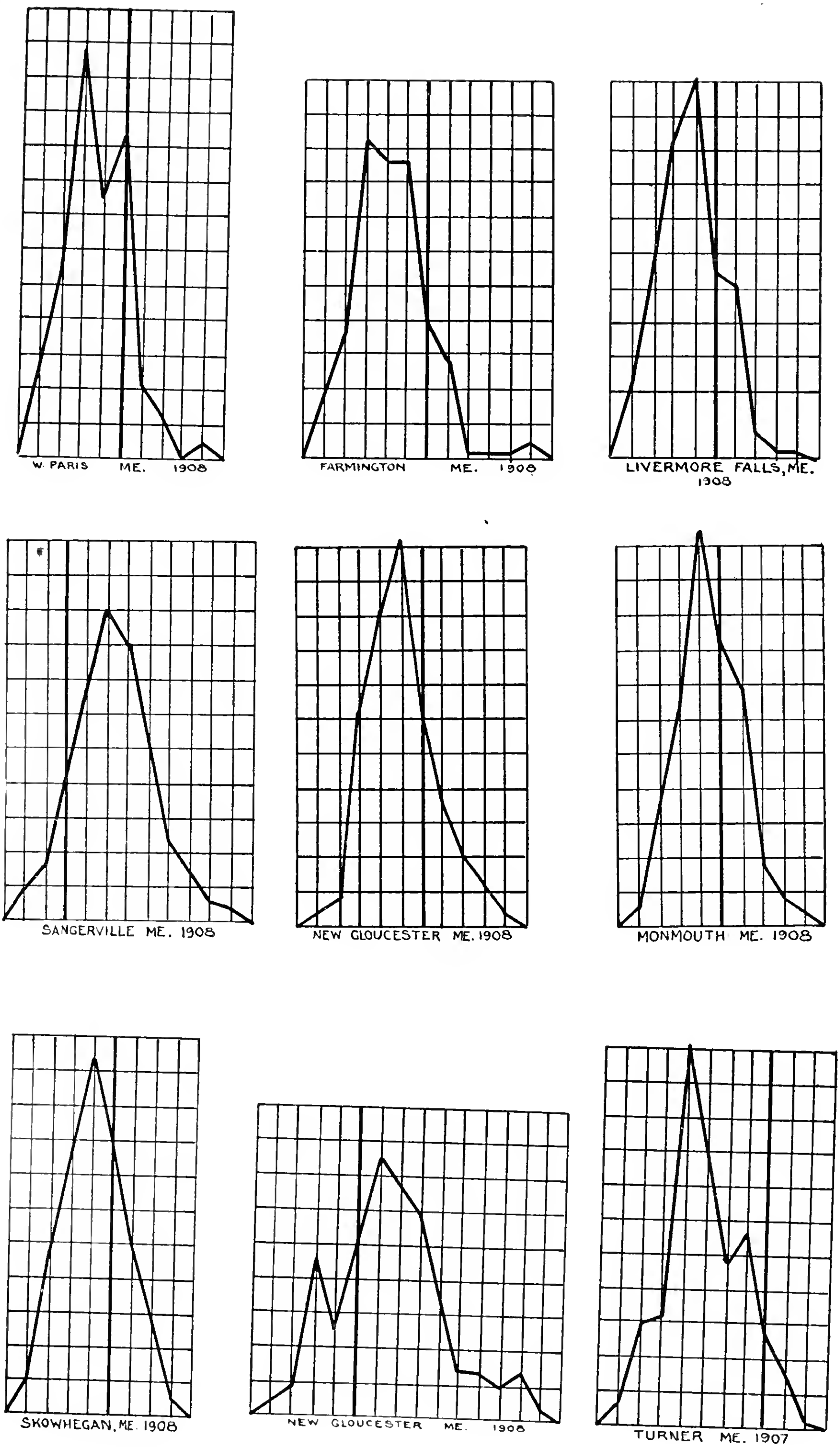
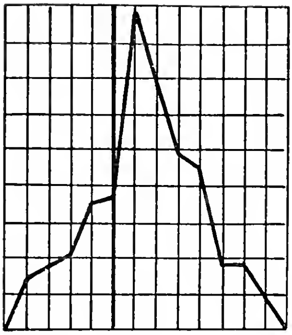
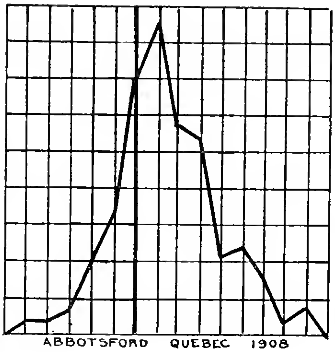
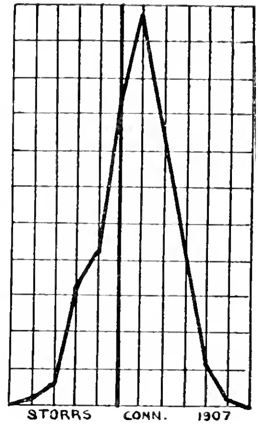
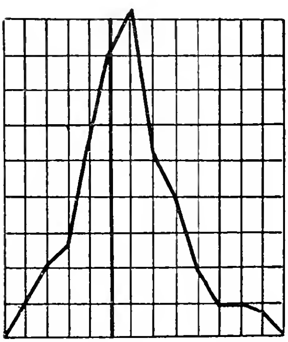

W. PARIS ME. 1908
FARMINGTON ME. 1908
LIVERMORE FALLS, ME. 1908
SANGERVILLE ME. 1908
NEW GLOUCESTER ME. 1908
MONMOUTH ME. 1908
SKOWHEGAN, ME. 1908
NEW GLOUCESTER ME. 1908
TURNER ME. 1907

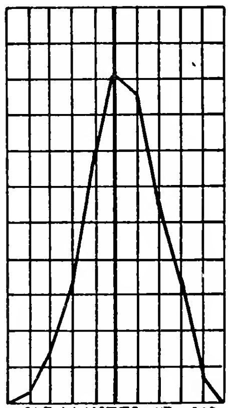
PLATE II.

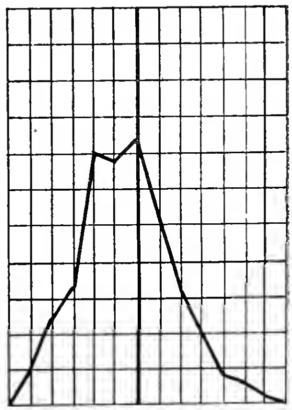

ABBOTSFORD QUEBEC 1907

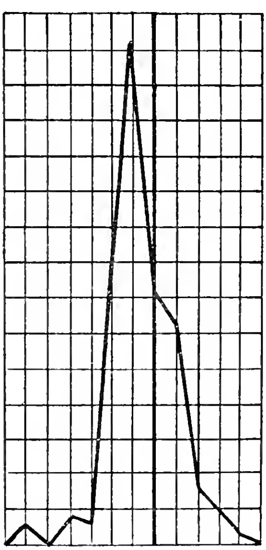

ABBOTSFORD QUEBEC 1908

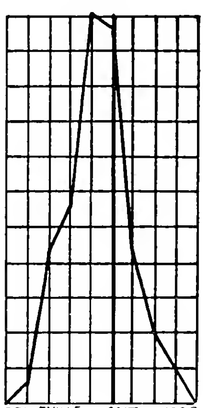

STORRS CONN. 1907


ISLE LA MOTTE VT. 1907


ISLE LA MOTTE VT. 1908


STORRS CONN. 1908


BELLEVILLE ONT. 1907


BELLEVILLE ONT. 1908

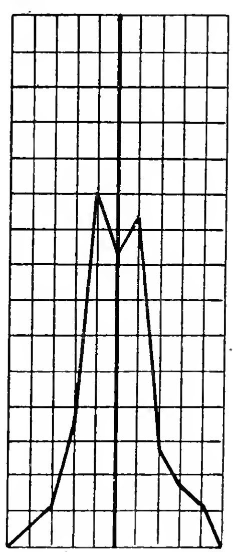

GUELPH ONT. 1907

PLATE III.

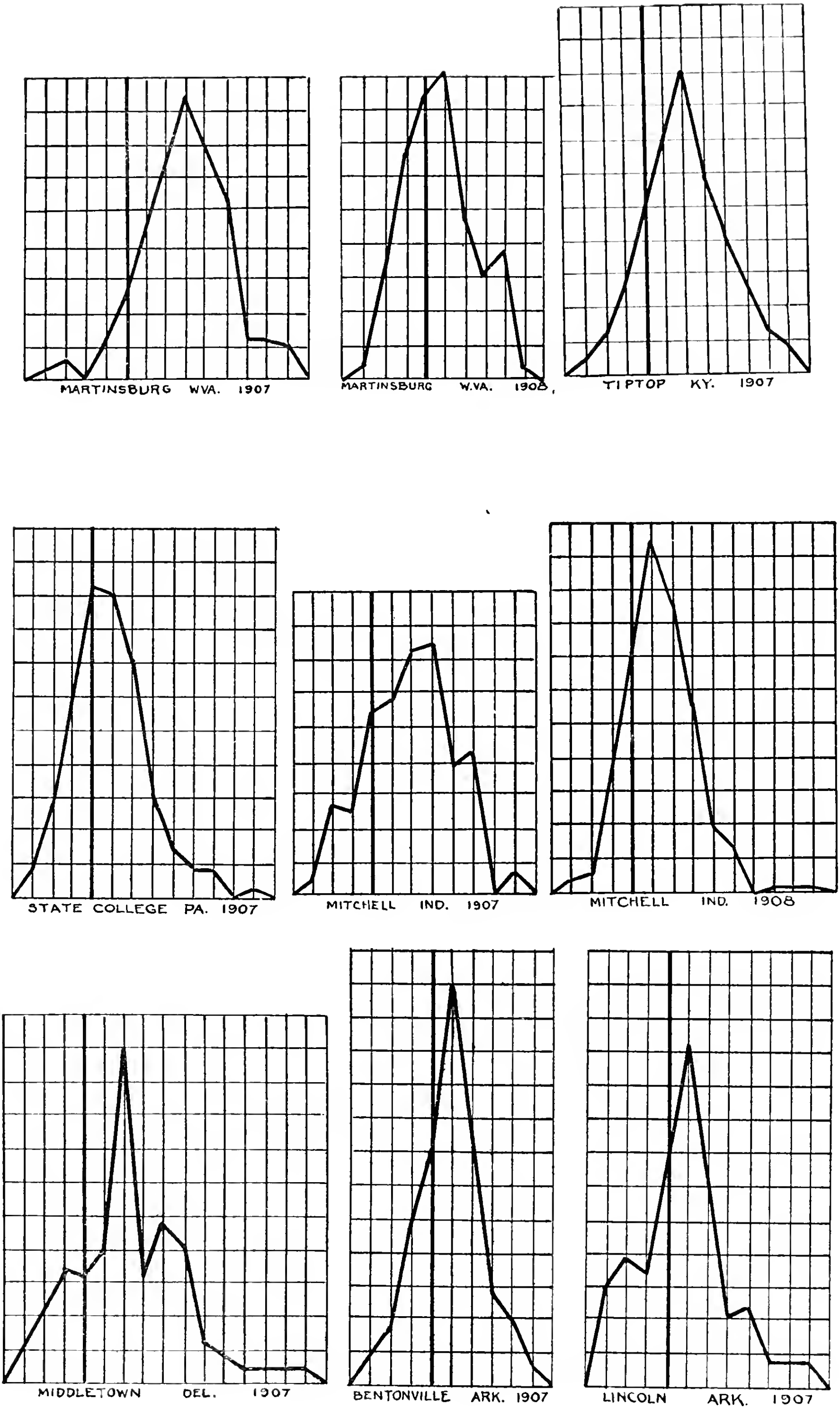

MARTINSBURG W.VA. 1907
MARTINSBURG W.VA. 1908
TIPTOP KY. 1907
STATE COLLEGE PA. 1907
MITCHELL IND. 1907
MITCHELL IND. 1908
MIDDLETOWN DEL. 1907
BENTONVILLE ARK. 1907
LINCOLN ARK. 1907

PLATE IV.

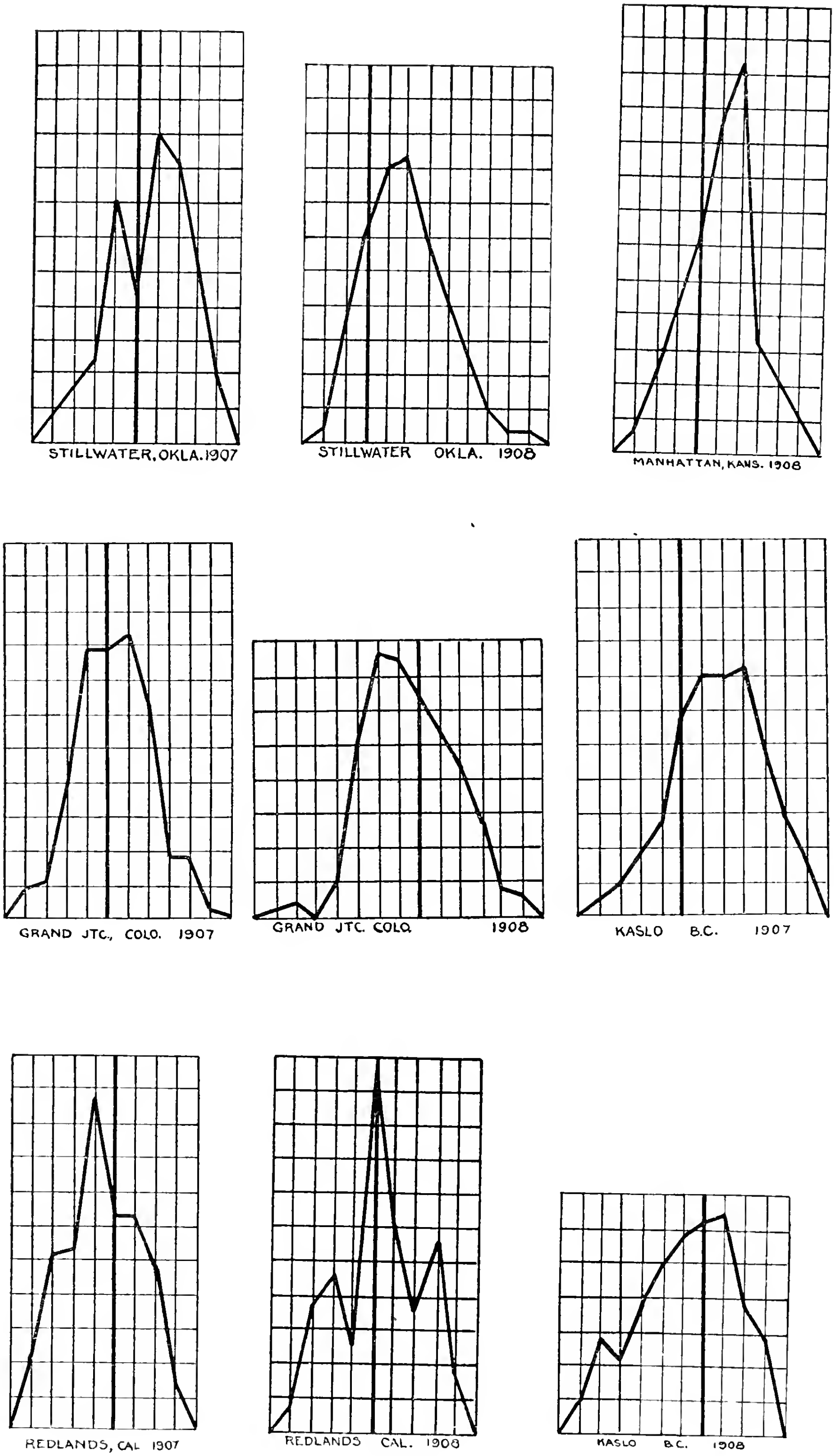

STILLWATER, OKLA. 1907
STILLWATER OKLA. 1908
MANHATTAN, KANS. 1908
GRAND JTC., COLO. 1907
GRAND JTC. COLO. 1908
KASLO B.C. 1907
REDLANDS, CAL 1907
REDLANDS CAL. 1908
KASLO B.C. 1908

PLATE V.

south, and those from Arkansas longer than those from farther north. This suggests the possibility that near the northern and southern extremes of distribution the general rule of elongation, as one goes north, is reversed, and that in the extreme north they are a little flatter than they are a little farther south, and at the extreme south they become slightly elongated. More data are needed to decide this question.

With a feeling that much could be learned by a more detailed study of the apples along the coast and adjacent region of New England and the maritime provinces, a special effort was made in the past season to secure apples from this section. These show the elongation towards the seacoast and northward, but among those from Maine the figures are not as harmonious as might be wished. Sangerville is farthest inland and New Gloucester nearest the coast, and they give the flattest and second longest apples, respectively; but the localities between do not show the gradual change in form that might be expected. These differences, however, are not large, and selection of the sample and local influences may account for it. More information is needed to clear this up.

Variability of the Different Lots.

An examination of the measures of variability of the different lots, bearing in mind the selection or want of selection of the shippers, indicates a somewhat greater variability in northern localities. This is shown both years, but is more pronounced in 1908.

Size.

The size of the apples was in many cases dependent largely on the selection practiced by the grower in making up the lots for shipment. Some were carefully selected and others were the run of the orchard. Any figures on size are, therefore, likely to be of little value. It is doubtless true that the apple attains a larger size in the south than in the extreme north. The season of 1907 was cold in the north and dry in the southwest, and may account for the inferior size of the apples from these regions. The season of 1908 was warmer in the north, and it appears that the apples were larger. Table 4 shows the results

TABLE 4. — *Size.*

APPLES FROM —	1907.				1908.			
	Mean.	Standard Deviation.	Coefficient of Variability.	Temperature (Degrees).	Mean.	Standard Deviation.	Coefficient of Variability.	Temperature (Degrees).
Charlottetown, P. E. I.,	61.36 ± .30	3.82 ± .22	6.20 ± .36	48.9	68.11 ± .53	8.75 ± .35	12.80 ± .52	51.3
Port Williams, N. S.,	63.63 ± .37	6.51 ± .26	10.23 ± .42	50.4	71.29 ± .42	6.37 ± .30	8.92 ± .42	51.2
Amherst, Mass.,	66.80 ± .20	5.53 ± .15	8.27 ± .23	55.9	70.23 ± .08	5.95 ± .06	8.47 ± .08	58.8
Storrs, Conn.,	70.83 ± .27	4.82 ± .20	6.80 ± .27	55.3	70.24 ± .24	4.32 ± .17	6.15 ± .24	58.8
Abbotsford, Quebec,	59.40 ± .24	4.32 ± .17	7.27 ± .28	49.9	66.89 ± .30	4.81 ± .21	7.19 ± .32	52.4
Isle la Motte, Vt.,	59.48 ± .23	4.85 ± .16	8.15 ± .27	53.0	64.40 ± .29	5.57 ± .20	8.65 ± .31	55.6
Belleville, Ont.,	65.45 ± .36	6.06 ± .26	9.25 ± .39	52.4	64.54 ± .16	2.84 ± .11	4.40 ± .18	54.8
Martinsburg, W. Va.,	73.30 ± .31	5.79 ± .22	7.89 ± .30	60.4	75.86 ± .13	1.99 ± .08	2.62 ± .11	63.9
Mitchell, Ind.,	73.89 ± .37	5.74 ± .26	7.76 ± .35	63.2	-	-	-	66.6
Stillwater, Okla.,	71.92 ± .24	3.61 ± .17	5.15 ± .32	68.9	74.49 ± .25	4.18 ± .18	5.61 ± .24	68.9
Redlands, Cal.,	73.21 ± .34	4.49 ± .24	6.13 ± .32	65.9	77.93 ± .33	4.64 ± .23	5.95 ± .31	68.5
Kaslo, B. C.,	71.10 ± .23	3.61 ± .17	5.07 ± .30	49.5	83.88 ± .30	3.77 ± .21	4.49 ± .24	50.9

of measuring a few lots from the same orchard both seasons, where it appears, from correspondence with the growers, safe to make comparisons. For comparison the average monthly mean temperatures for the growing season March to September, inclusive, for the different towns or some near-by station are given. It appears safe to infer that in any given orchard the size of the apple is governed largely by the temperature, but this by no means holds in different localities.

Flesh.

The whiteness of flesh which is characteristic of the variety was always maintained in considerable degree; those from Colorado were notably white of flesh. The less mature specimens had a greenish tinge, which, as the fruit ripened, gave way to a slight yellowish.

The firmness of the flesh likewise gradually gave way with ripening. The Colorado and in less degree the California lots were less firm and more of a spongy texture. Those from California carried well, but those from Colorado were soft enough to bruise quite badly, though this appeared to not seriously injure their keeping qualities, as the bruises showed a tendency to dry out rather than to decay.

The juiciness and quality were found to be variable. The apples were generally more juicy in the south, and of notably better quality. Northern-grown fruit was dry, flat, hard, and in some cases noticeably astringent, and these undesirable qualities did not entirely disappear with ripening.

In an attempt to learn something of the real nature of this, and of the general quality of the flesh, some chemical work was done.[1] Owing to a lack of time this was not as complete as might be wished, but the results, as far as they go, are interesting.

The methods used in this work may be briefly described as follows. One or two small slices, reaching to the core, were cut from three or more carefully selected apples, and dried in a water bath at 90° to 98° C. for about thirty-six hours. The weight of the residue gave the amount of dry matter. This dry residue, after cooling, was ground in a mortar until it

[1] For the opportunity to do this and for many suggestions as to methods, etc., the writer is indebted to the chemical department of the college.

would pass through a very fine sieve, and this fine powder used for the other work. The "insoluble matter" was determined by digesting 1 gram with about 200 cubic centimeters distilled water at room temperature, filtering through a tared filter paper and drying. The filtrate was titrated with n/5 alkali, using phenolphthalein as an indicator, and calculated as malic acid. For crude fiber the methods of the Association of Official Agricultural Chemists were followed, except that the sample was not previously extracted with ether.

The results of this work are shown in Table 5. From this table it appears that there is slight variation in the water content of these apples, those from Arkansas and Oklahoma having a little lower water content that those from the north. There is nothing in this column to account for the observed differences in juiciness and quality.

TABLE 5.— *Chemical Determinations (Per Cent.).*

APPLES FROM —	In Original Subsistence.						In Dry Matter.	
	Water.	Dry Matter.	Soluble Matter.	Insoluble Matter.	Crude Fiber.	Acid, as Malic.	Insoluble Matter.	Crude Fiber.
Prince Edward Island,	84.9	15.1	11.13	3.97	1.07	1.03	26.3	7.15
Nova Scotia,	85.4	14.6	11.11	3.39	1.13	-	23.9	7.75
Maine,	84.6	15.4	-	-	-	.70	-	-
Quebec,	84.2	15.8	11.80	4.00	-	-	25.3	-
Vermont,	84.0	16.0	-	-	-	.76	-	-
Guelph, Ont.,	83.6	16.4	13.52	2.89	-	-	17.5	-
Belleville, Ont.,	83.6	16.4	-	-	-	-	-	-
Pennsylvania,	85.8	14.2	-	-	-	.70	-	-
Massachusetts,	85.2	14.8	11.52	3.26	.99	.73	22.0	6.68
Connecticut,	84.2	15.8	-	-	-	-	-	-
Delaware,	84.3	15.7	-	-	-	.79	-	-
West Virginia,	84.8	15.2	12.00	3.21	.80	.79	21.1	5.28
Kentucky,	84.7	15.3	12.58	2.74	-	-	17.9	-
Indiana,	83.2	16.8	-	-	-	.76	-	-
Bentonville, Ark.,	82.4	17.6	-	-	.93	-	-	5.29
Fayetteville, Ark.,	81.2	18.8	-	-	1.03	.65	-	5.52
Oklahoma,	82.6	17.4	14.30	3.04	-	.66	17.6	-
Colorado,	84.8	15.2	12.82	2.39	1.00	-	15.7	-
California,	83.2	16.8	13.88	2.94	-	.63	17.5	-
British Columbia,	84.5	15.5	-	-	-	-	-	-

The constituents of apples, soluble in water, include the sugars, acids and doubtless some others of minor importance. These are lowest in Nova Scotia and highest in Oklahoma, and samples from intermediate points are generally between these figures in so far at least as determined.

The percentage of insoluble matter, which consists of pectin, cellulose and possibly starch and allied substances, are in general inversely proportional to those of soluble matter, being highest in the north and lower in the more southern part of the range of the variety.

Color.

The body color was, as a rule, closely correlated with the degree of ripeness of the fruit, the riper the apple the more yellowish in color. Aside from this, no variation was noted. The depth of overcolor was closely correlated with latitude, the farther north the deeper the color, and the variation was from a pale pinkish red in Arkansas to a deep crimson in the extreme north. The amount of overcolor did not seem to be dependent on latitude but was probably controlled largely by local conditions. The overcolor was especially good on the Pacific coast apples and on those from Colorado, Pennsylvania and Indiana, though in case of the last it was rather dull. The disposition of the color showed no striking variation. The mottling ran together into a blush on highly colored specimens, and there were always more or less stripes and splashes present. Probably all the russet that appeared was caused by Bordeaux mixture.

Bloom.

The amount of bloom seemed to be rather less in the north than in the south and on the Pacific coast. The nature of the bloom, whether waxy or greasy, seemed to depend largely on the maturity of the fruit.

Skin.

The skin was generally thicker in the south and west than in the northern localities. The texture did not vary greatly. The surface of the fruit varied much, but this seemed to be brought about by local conditions, and most of the roughness was due to Bordeaux mixture. The specially dull rough surface of the Massachusetts specimens was probably due to a heavy application of nitrate of soda the previous year.

Dots.

The size and color of the dots was variable, but the number and form were quite constant, and they were always very slightly raised above the surface of the apple. They are generally very small in the extreme north and become quite constantly larger as one goes south, being largest in the southwest and in Colorado. Almost all specimens showed some dots with russet and some without. Aside from this they are generally lighter in the north and more gray or yellowish toward the south.

Cavity.

The variation in the size of the cavity was marked. It was small and very shallow in the extreme northeast, of medium depth in the central and south central States and very deep in the Ozarks and in Colorado and California. It was very narrow in the Ozarks and generally wide in other localities. In cross-section there was little significant variation except that the cavity was generally more smooth and regular in southern-grown specimens.

Stem.

The stem presented little of interest. It was extremely variable in length and size, but the variation was nearly as great between specimens of almost any one lot as between those of different lots. The variability was perhaps greater in northern-grown apples than in those grown farther south.

Basin.

The remarks concerning the variation of the cavity will apply almost as well to the basin. A noticeable variation was the tendency towards a five-crowned fruit in Nova Scotia and to a less degree in neighboring regions. This was also seen in some degree in specimens from British Columbia, but was less pronounced. This tendency towards a pentagonal form extends more or less to the whole apple, giving somewhat of a pentagonal outline to the fruit as a whole. In the more southern localities, and particularly in the Ozarks and neighboring regions, the basin is remarkably smooth and regular and the sides abrupt, which make the basin one of the surest means of identifying specimens of this variety that may chance to be off type.

Calyx.

The calyx was generally more or less distorted by handling, and it was difficult to make very much out of it. The most striking thing about it was that in the small, poorly developed specimens it was nearly always closed, while in large, well-grown specimens it was at least partly open and sometimes a little separate at the base.

Calyx Tube.

The calyx tube was extremely variable, being sometimes very short, not more than one-fourth as long as wide, as in some of the Quebec specimens, and sometimes extremely long, extending almost to the cells, as in some of those from Arkansas and Colorado. This variability lay mostly in what may be called the stem of the funnel, this being very long in some apples and varying all the way to complete suppression, leaving a conical tube, in others. As a rule it was longer in the fully developed specimens and short in the poorly developed apples from northern regions.

Core.

The variation of the core closely followed that of the general form of the apple. In the elongated specimens it approached an oval form, and in the roundish and oblate apples it was turbinate. Likewise, in the elongated specimens it was usually abaxile, often strongly so, and in the more oblate ones it became axile or nearly so. The size as compared with that of the whole fruit varied but little, being possibly a little larger in the ill-developed apples, and it was always central and the core lines generally clasping.

Cells.

The variation of the cells very closely followed that of other parts of the core, being wide open and asymmetrical in the northern-grown apples and closed and symmetrical in those from the south. It was most open and asymmetrical in the larger apples. The carpels were never tufted but often were a little slit, especially in those from the north; they varied considerably in form, following pretty closely the general form of the apple. The concavity of the carpels was chiefly dependent on the development of the seeds.

Seeds.

The seeds showed little variation worthy of note. The number was somewhat variable; they were usually plump and of medium size. The color varied with the degree of maturity of the fruit, being generally lighter in poorly developed, northern-grown specimens.

Causes of the Variation.

The most interesting and significant variation is found (1) in the form of the apple and its parts, both external and internal; (2) in size, and (3) in the quality of the flesh. The variation in color is that usually found, being darker in the higher latitudes.

Form.

It appears beyond question that, speaking generally, and possibly excluding the extremes of distribution, Ben Davis apples become gradually more elongated as one goes from its Southern range northward, and this elongation is much more pronounced near large bodies of water. This is probably somewhat affected by local influences, but in general it appears to hold. That these differences are caused by climate, and not by different soils, sites, fertilizers or methods of cultivation, the writer has no doubt. Just what factor or factors of climate bring this change about is not so clear. It would seem probable that humidity has something to do with it, but the writer has been unable thus far to secure conclusive evidence on this point. The available records of humidity have been unsatisfactory, and more exact knowledge of this at the stations where the apples are grown and more data on their variation are needed. It is also possible that temperature may have an influence, either direct or through its influence on humidity.

It is entirely possible that other factors enter in, but a careful consideration of latitude, altitude, amount and intensity of sunlight, rainfall and other considerations fail to show anything that can be demonstrated as having any constant effect. To determine just what the cause is will require much patient investigation.

Size.

The size of the apples appears to be largely governed in any locality by the summer temperature. This is shown by the larger apples in the warmer season of 1908. In only two cases has a higher temperature failed to produce larger apples, and in one case the apples are larger while the temperature remains the same. The other eight comparisons in Table 4 show a higher temperature and larger apples. It may also be noted that a comparatively low temperature in the north produces as large or larger apples than a much higher temperature farther south. It is of course to be understood that methods of cultivation have an effect on size sometimes greater than temperature, and this fact, together with some possible selection on the part of the shipper, probably accounts for the above exception to the general rule.

Flesh.

During the winter of 1907 careful notes were kept on the quality of the apples from the different localities. In the judgment of the writer the various lots would rank in quality about in the following order with a notable difference between 9 and 10: —

	Degrees F.		Degrees F.
1. Colorado,	63.0	11. Connecticut,	55.3
2. Indiana,	63.2	12. Pennsylvania,	56.9
3. Bentonville, Ark.,	–	13. Massachusetts,	55.9
4. Oklahoma,	68.9	14. Guelph, Ont.,	–
5. Lincoln, Ark.,	69.0	15. Nova Scotia,	50.4
6. California,	65.9	16. British Columbia,	49.5
7. Kentucky,	66.3	17. Maine,	53.8
8. West Virginia,	60.4	18. Prince Edward Island,	48.9
9. Delaware,	61.8	19. Vermont,	53.0
10. Belleville, Ont.,	52.4	20. Quebec,	49.9

Accompanying the list is given the average monthly mean temperatures for the growing season of 1907, March to September, inclusive, as compiled from the records of the United States Weather Bureau and Canadian Meteorological Service.

It appears from this that an average monthly mean temperature for the growing season of at least 60° is required for the satisfactory development of the Ben Davis apple, and if grown where a lower temperature prevails the product is likely to be inferior.

That the poor quality of these northern-grown apples, as shown by their acidity, and dry, tasteless flesh, is due to lack of sufficient heat to fully develop the fruit is indicated by the results of certain work of the Bureau of Chemistry of the United States Department of Agriculture on the development of the Ben Davis,[1] where is shown the constant increase of sugars and decrease of acids with the development of the apples. It is also shown that the tannin which is present in the partially developed apples gradually disappears, and it is doubtless this substance that gives the apples their astringent taste.

Summary.

1. Apples vary greatly in response to the widely varying conditions of soil, and, more especially, climate, in the apple regions of North America. The Ben Davis variety seems to be especially variable.

2. This variability may be accurately measured and studied by means of statistical methods.

3. The most striking variation is in the external form of the apples, and this is accompanied by corresponding changes of the internal structure.

4. The cause of this variation is some factor or factors of climate, which are closely related to latitude and the proximity of large bodies of water. It is probable that humidity or temperature, or both, may be the controlling factors.

5. The differences in warmth of different growing seasons definitely affect the size of the apples for that season.

6. The most favorable temperature for development in size

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[1] Bureau of Chemistry, Bulletin 94, p. 44.

varies with the locality. It is lower in the north than in the south.

7. The cause of the variation in quality is chiefly the varying amount of heat prevalent during the growing season.

8. In order to develop satisfactorily in quality the Ben Davis should have an average monthly mean temperature of not less than 60° F. for the growing season, March to September, inclusive.

FUMIGATION DOSAGE.

I. TOMATOES.

BY W. V. TOWER, B.S.

Introduction.

BY H. T. FERNALD.

Tomatoes are extensively grown in Massachusetts in greenhouses. Unfortunately, they are subject to the attacks of several kinds of insects which under glass seem to be more than ordinarily destructive. The most important of these enemies are the greenhouse white fly (*Aleyrodes vaporariorum* West.) and thrips, and as these are most successfully controlled by fumigation with hydrocyanic acid gas, this treatment should be familiar to tomato growers. Unfortunately, however, this is not the case, many growers seeming to be afraid to use it for fear that when the gas is generated in sufficient quantity to destroy the insects it will also injure the plants.

The amount of hydrocyanic acid gas to which tomato plants can be exposed without injury, under varying conditions of light, temperature, humidity, age, variety, etc., has never been investigated, so that there has hitherto been some reason for this fear. To determine, therefore, just what tomato plants could withstand in the way of treatment, under all conditions likely to be met with in commercial work, the experiments which follow were planned by the writer and were carried out in the greenhouse of the department of entomology of the Massachusetts Agricultural Experiment Station during the winter of 1905–06, by Mr. W. V. Tower, then a graduate student in entomology at the Massachusetts Agricultural College. The experiments had just been completed when Mr. Tower accepted an appointment in Puerto Rico and was obliged to leave before the results were ready for publication. It is therefore desirable, for the sake of placing responsibility, to state that the experiments were planned largely by the writer, assisted to some extent by Mr. Tower; that the entire care of the plants, the fumigations and the observation of the results were the work of Mr. Tower; while most of the conclusions and the duty of editing the work for publication have fallen upon the writer. In fact, the original work herein contained should be regarded as Mr. Tower's, while for the planning of the experiments and the editorial work the writer should be held responsible.

Three varieties of tomato — Livingston, Lorillard and Freedom — were selected, these being the ones most generally raised under glass in Massachusetts. Two plants of each variety were used in each test. In the tabulations which follow, factors common to the entire set are given before the tabulation itself. The abbreviations indicating the results are as follows: —

B, burned.
BB, badly burned.
BC, burned and leaves curling.
BI, badly injured.
C, leaves curling.
I, injured.
K, killed.
N, normal (uninjured).
SB, slightly burned.
SI, slightly injured.
TI, temporarily injured.
TK, top killed.
VBI, very badly injured.

Wilted leaves are the first indication of injury. If this is not too severe they gradually become normal again. Curled leaves indicate more serious effects, but plants thus affected frequently become normal later.

The fumigation in all cases was with 98 per cent. to 99 per cent. potassic cyanide, the proportions of the cyanide, acid and water used being 1, 2, 4. The column marked "Time of exposure" gives the time at which the treatment began. Temperatures are given by the Fahrenheit scale.

The first two sets of experiments were carried on in direct sunlight. In the first set periods of ten, twenty, thirty, forty-five minutes' and one hour's exposure quickly showed that it was not necessary to make any long exposures with the greater strength of cyanide, and, accordingly, exposures of ten, twenty and thirty minutes only were made, even the shortest of these being too severe a treatment for the plants.

Experiment I.

Day Exposures with Direct Sunlight.

First four sets treated March 14; fifth set treated December 14.

Fumigation with .005 gram KCN per cubic foot; plants six weeks old; humidity for first four sets, 65°; for fifth set, 60°; amount of sunlight (March 14) for first four sets, four hours; for fifth set (December 14), five hours; plants of first four sets, watered the morning of the test; of the fifth the day before; all sets dry when treated; conclusions drawn five days after treatment with the first three sets, eight days afterward with the fourth set and about three weeks afterward with the fifth set. The sunlight was not as strong for the fifth set as for the others, it being December, while the other tests were in March.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	2.28	3.00	3.30	4.10	8.30
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature of house (degrees),	68	65	63½	65	67
Livingston,	B	BB	BB	BB	VBI
Lorillard,	N	B	SB	BC	VBI
Freedom,	B	B	BB	BC	VBI

Experiment II.

Day Exposures with Direct Sunlight.

First two sets treated December 14; third set March 14.

Fumigation with .01 gram KCN per cubic foot; plants six weeks old; humidity, 79°; amount of sunlight for first two sets five hours; for third set four hours; all plants watered at 8.30 A.M. the day of the test, but dry when treated; one plant of each variety placed under a bench in the house for fourteen to nineteen hours before treatment; conclusions drawn after three weeks for the first and second sets and after one week for the third set.

	Set Numbers.		
	1	2	3
Time of exposure,	11.20	12.00	1.45
Length of exposure,	10 m.	20 m.	30 m.
Temperature of house (degrees),	70	70	71
Livingston normal,	K	K	Bl
Livingston under bench,	I	K	K
Lorillard normal,	K	K	Bl
Lorillard under bench,	K	K	Bl
Freedom normal,	K	K	Bl
Freedom under bench,	K	K	Bl

This experiment would seem to indicate that the plants placed under the benches before treatment were not benefited in this way.

Experiment III.

Cloudy Day Exposures, December 19.

Fumigation with .02 gram KCN per cubic foot; plants six weeks old; humidity not taken till 8 P.M., when it was 81°; good sunlight for four days before the test and for two hours in the morning that day; all plants watered at 8.30 A.M. the day of the test, but dry when treated; half the plants of each variety were sprinkled just before the test; conclusions drawn after seventeen days' observation. It was dusk when the fourth set was fumigated.

	Set Numbers.			
	1	2	3	4
Time of exposure,	2.45	3.15	4.00	5.00
Length of exposure,	10 m.	20 m.	30 m.	45 m.
Temperature of house (degrees),	68	67	65	65
Livingston normal,	TI	TI	TI	TI
Livingston sprinkled,	TI	TI	TI	TI
Lorillard normal,	TI	I	TI	I
Lorillard sprinkled,	SI	I	TI	K
Freedom normal,	TI	I	TI	I
Freedom sprinkled,	I	I	K	TK

In addition to the effects noted, the sprinkled plants developed white spots where the drops of water stood, and in general were in worse condition than the others.

Experiment IV.

Day Exposures during Rain, Snowstorm and Cloudy Weather, January 12 and 13.

Fumigation with .02 gram KCN per cubic foot; plants nine weeks old; set 1 treated during a rainstorm; sets 2 and 3 during a snowstorm and set 4 during cloudy weather; no direct sunlight either day; plants of set 1 watered the day before the test; the others, the morning of the test, but dry when treated; conclusions drawn after three days for the first set; after six days for the second and after nine days for the third and fourth sets.

	Set Numbers.			
	1	2	3	4
Time of exposure,	10.30	9.00	11.00	1.15
Length of exposure,	1.30 m.	1.30 m.	1 h.	1 h.
Temperature of house (degrees),	65	65	55	68
Humidity before (degrees),	62	55	65	57
Humidity after (degrees),	80	84	82	80
Livingston,	K	BI	BI	I
Lorillard,	K	BI	BI	I
Freedom,	K	BI	BI	I

Experiment V.

Night Exposures, December 13.

Fumigation with .005 gram KCN per cubic foot; plants six weeks old; house humidity, 60°; six hours of sunlight the day of treatment, but cloudy the previous week; weather cloudy during the treatment of the first three sets; moonlight during the other two; treatment began on set 1 as soon as it was really dark; plants watered at 9 A.M., dry when treated; half the plants of each variety had been placed under benches for thirty hours before treatment; conclusions drawn three weeks after treatment.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	5.25	7.10	8.00	9.00	10.00
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature of house (degrees),	66	66	66	65	65
Livingston normal,	N	N	N	SI	SI
Livingston under bench,	N	N	N	N	SI
Lorillard normal,	N	N	N	SI	SI
Lorillard under bench,	N	N	N	SI	N
Freedom normal,	N	N	SI	SI	SI
Freedom under bench,	N	N	N	N	N

In this experiment it would seem that plants which had been shaded for a time before the treatment, by being placed under the benches, were at a slight advantage.

Experiment VI.

Night Exposures, December 14.

Fumigation with .01 gram KCN per cubic foot; plants six weeks old; house humidity, 79°; five hours of sunlight the day of treatment; dark during treatment of first two sets, moonlight during the last three; treatment began on set 1 as soon as it was really dark; plants watered at 8.30 A.M., dry when treated; half the plants of each variety had been placed under the bench for twenty-four hours before treatment; conclusions drawn three weeks after the treatment.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	5.20	7.20	8.30	9.30	10.45
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature of house (degrees),	55	58	62	60	58
Livingston normal,	C	TI	C	C	K
Livingston under bench,	N	N	N	C	BI
Lorillard normal,	N	C	C	C	K
Lorillard under bench,	N	N	N	N	I
Freedom normal,	N	C	C	K	K
Freedom under bench,	N	N	N	N	BI

Experiment VII.

Night Exposures, December 15 and March 15.

Fumigation with .015 gram KCN per cubic foot; plants six weeks old; house humidity, 83°; dusk during treatment of first set, cloudy during second and third sets, starlight during the last three sets; plants watered at 8 A.M.; half of each variety sprinkled before treatment, the others dry; conclusions drawn one week after treatment for set 5, three weeks after treatment for the others.

	Set Numbers.					
	1	2	3	4	5	6
Time of exposure,	4.45	5.45	7.20	8.30	7.30	9.55
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.	2 h.
Temperature of house (degrees),	65	65	64	65	58	65
Livingston normal,	SI	N	SI	C	C	K
Livingston sprinkled,	N	SI	SI	C	C	K
Lorillard normal,	SI	SI	SI	C	C	K
Lorillard sprinkled,	N	SI	SI	C	C	K
Freedom normal,	N	SI	SI	C	C	K
Freedom sprinkled,	N	SI	SI	C	C	K

The sprinkled plants showed spots on the leaves where the drops of water stood, as a result of the treatment; otherwise little difference in the two lots was noticeable.

Experiment VIII.

Night Exposures, January 8.

Fumigation with .015 gram KCN per cubic foot; plants eight weeks old; house humidity, 84°; amount of sunlight that day, four hours; plants watered at 10 A.M., dry when treated; night cloudy during the treatment; conclusions drawn after one week.

	Set Numbers.	
	1	2
Time of exposure,	8.30	9.30
Length of exposure,	30 m.	45 m.
Temperature of house (degrees),	58	65
Livingston,	SI	SI
Lorillard,	SI	SI
Freedom,	SI	SI

Experiment IX.

Night Exposures, January 9.

Fumigation with .015 gram KCN per cubic foot; plants eight weeks old; house humidity, 49°; amount of sunlight that day, six hours; plants watered at 8 A.M., dry when treated; treatment during moonlight; conclusions drawn after one week.

	Set Numbers.		
	1	2	3
Time of exposure,	5.15	7.00	8.30
Length of exposure,	30 m.	45 m.	1 h.
Temperature of house (degrees),	58	68	65
Livingston,	SI	SI	C
Lorillard,	SI	SI	C
Freedom,	SI	SI	C

Experiment X.

Night Exposures, January 31.

Fumigation with .015 gram KCN per cubic foot; plants eleven weeks old, rather weak, tall and spindling; amount of sunlight that day, one hour; plants watered at 8.30 A.M., dry when treated; moonlight during the treatment; conclusions drawn after four days.

	Set numbers.	
	1	2
Time of exposure,	5.30	7.30
Length of exposure,	1½ h.	2 h.
Temperature of house (degrees),	62	62
Humidity before (degrees),	58	62
Humidity after (degrees),	76	76
Livingston,	C	I
Lorillard,	C	I
Freedom,	C	I

Experiment XI.

Night Exposures, December 16.

Fumigation with .02 gram KCN per cubic foot; plants six weeks old; house humidity, 63°; amount of sunlight that day, four hours; plants watered at 9.30 A.M., dry when treated, except that half of the plants of each variety were sprinkled just before the treatment; first set treated at dusk, other sets treated in starlight; conclusions drawn after three weeks

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	4.30	5.40	7.05	8.20	9.50
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature of house (degrees),	68	60	65	66	64
Livingston normal,	N	N	C	BI	BI
Livingston sprinkled,	SI	N	C	BI	BI
Lorillard normal,	N	N	C	BI	K
Lorillard sprinkled,	N	N	C	K	K
Freedom normal,	SI	N	C	K	K
Freedom sprinkled,	SI	N	C	K	K

The sprinkled plants developed spots on the leaves where the drops of water stood during the treatment.

Experiment XII.

Night Exposures, January 10.

Fumigation with .02 gram KCN per cubic foot; plants nine weeks old; house humidity, 61°; amount of sunlight that day, four hours; plants watered at 8 A.M., dry when treated; sets treated in moonlight; conclusions drawn after five days.

	Set Numbers.			
	1	2	3	4
Time of exposure,	7.15	8.15	9.15	5.05
Length of exposure,	20 m.	30 m.	45 m.	1 h.
Temperature of house (degrees),	65	67	67	65
Livingston,	N	SI	C	C
Lorillard,	SI	SI	C	I
Freedom,	SI	SI	I	1

Experiment XIII.

Night Exposures, January 12 and 13.

Fumigation with .02 gram KCN per cubic foot; plants nine weeks old; weather cloudy the day of treatment of first two sets, clear the day of treatment of the third set; plants watered at 8.30 to 9 A.M., dry when treated; first set treated at dusk, the other two in starlight; conclusions drawn after five days.

	Set Numbers.		
	1	2	3
Time of exposure,	5.30	7.30	7.25
Length of exposure,	1½ h.	2 h.	2 h.
Temperatnre of house (degrees),	60	62	65
Humidity before (degrees),	65	65	46
Humidity after (degrees),	80	80	77
Livingston,	SI	BI	BI
Lorillard,	SI	BI	BI
Freedom,	TI	BI	BI

Experiment XIV.

Night Exposures, December 18.

Fumigation with .04 gram KCN per cubic foot; plants six weeks old; house humidity, 82°; eight hours of sunlight the day of treatment; plants watered at 8.15 A.M., dry when treated; clear, starlight night during the treatment; set 4 fumigated twenty-five minutes, aired and then treated ten minutes longer; conclusions drawn after two and a half weeks.

	Set Numbers.			
	1	2	3	4
Time of exposure,	8.00	9.00	10.00	5.05
Length of exposure,	10 m.	15 m.	20 m.	35 m.
Temperature of house (degrees),	68	70	68	68
Livingston,	N	C	C	C
Lorillard,	TI	SI	C	C
Freedom,	TI	C	K	K

The Freedom plants in sets 3 and 4 were weak and not in good condition.

Experiment XV.

Night Exposures, January 11.

Fumigation with .04 gram KCN per cubic foot; plants nine weeks old; house humidity, 73° six hours of sunlight the day of treatment; plants watered at 8 A.M., dry when treated; first three sets treated in dim moonlight, set 4 at dusk; conclusions drawn after four days.

	Set Numbers.			
	1	2	3	4
Time of exposure,	7.05	8.00	9.30	5.00
Length of exposure,	20 m.	30 m.	45 m.	1 h.
Temperature of house (degrees),	65	65	65	60
Livingston,	SI	SI	SI	BI
Lorillard,	SI	SI	SI	BI
Freedom,	SI	SI	SI	BI

Experiment XVI.

Night Exposures for Temperature and Humidity, February 26, 27, 28, March 5, 6.

Fumigation with .01 gram KCN per cubic foot; plants about seven weeks old; first two sets treated in starlight, third and fourth on a cloudy night, fifth and sixth in starlight, seventh and eighth in moonlight, ninth and tenth in a darkened box at night; plants watered at 8.30 A.M., dry when treated; all the plants vigorous; conclusions drawn after nine days.

	Set Numbers.									
	1	2	3	4	5	6	7	8	9	10
Time of exposure,	7.15	8.15	7.00	8.15	7.00	8.20	7.15	10.00	7.00	9.30
Length of exposure,	45 m.	45 m.	45 m.	1 h.	1 h.	2 h.	2 h.	2 h.	2 h.	2 h.
High temperature (degrees),	68	64	-	-	-	-	-	67	-	63
Low temperature (degrees),	-	-	58	55	58	56	57	-	52½	-
Humidity before (degrees),	45	58	50	55	50	51	52	70	45	60
Humidity after (degrees),	65	75	64	67	74	63	59	80	65	77
Livingston,	SI	SI	SI	SI	C	C	C	C	C	C
Lorillard,	SI	SI	SI	TK	I	C	I	C	I	C
Freedom,	SI	SI	SI	I	TI	C	C	C	I	C

Comments and Conclusions.

BY H. T. FERNALD.

The experiments were planned so that only one factor should vary at a time. It quickly became evident, however, that many of the factors were beyond control, and therefore entire certainty as to the cause of differences in results could not always be obtained. Thus, the treatment itself had the effect of increasing the humidity of the fumigator, and sometimes this change was quite considerable.

Morrill's experiments on the white fly (Technical Bulletin No. 1, Hatch Experiment Station, Massachusetts, p. 50, 1903) indicated that fumigation with from .007 gram to .01 gram KCN per cubic foot for three hours should control most stages of this insect, and that three such treatments at intervals of about twelve days would probably clear an infested house. Hinds's experiments on Thrips (Bulletin No. 67, Hatch Experiment Station, Massachusetts, p. 11, 1900), though less complete, indicate that these insects would probably be also controlled by this treatment.

An examination of the first two experiments given in this paper shows at once that under the conditions stated serious injury or the destruction of the plants would result long before the above-named insects were killed, and a comparison of the data in Experiments II., V. and VI. indicates that daylight treatment was, at least in part, responsible for this. Fumigation in cloudy weather, as shown in Experiment III., sustains this view, the injury being less than with plants treated in sunlight. Experiment IV. gives the results of treatment during rain and snowstorms with longer exposure, showing that even in bad weather daylight treatment is unsafe.

Comparison of the experiments carried on at night is also suggestive. Those treatments which were made on moonlight nights were always more injurious than those made in starlight, while slightly better results were obtained on cloudy nights. From the data at hand it would seem probable that the safest treatment for the plants would be on a cloudy night following a dark day; and the night experiments with plants which had been kept under the benches for a day or so before treatment, thus giving them partial shade, sustain this view.

The results of variation in temperature of the house during fumigation were by no means as noticeable as had been anticipated; indeed, as a result of these tests it would seem to make little difference whether treatment should be given in a warm or a cool house. Much the same can be said of humidity, though here it would appear probable that with high humidity — 75 degrees or over — there is more chance of injury than would be the case where the humidity is rather low.

It may be stated as a general conclusion that prolonged exposures to weak strengths of the gas are more liable to cause injury to the plants than are shorter exposures to greater strengths. As this does not entirely meet Morrill's directions for the control of the white fly, which would come under the head of prolonged exposure to a rather weak strength of gas, it would seem desirable to determine whether short exposures to greater strengths would be effective against the insects. Until this is determined it is probable that the best treatment for the white fly on tomato plants is to fumigate them with a strength of .015 gram of KCN per cubic foot for a period of from forty-five minutes to one hour, on a dark — moonlight, or perfectly cloudy — night, in a house where the humidity is below 70 degrees at the beginning of the treatment. Fumigation in this way will probably slightly injure the plants and may cause curling of the leaves; but the injury will be less than would be that caused by the insects if there were no treatment given, and three such treatments at intervals of twelve days should not prove serious to the plants, while they should reduce the white fly to a negligible quantity for quite a period, — probably until after the crop has been gathered from the plants concerned.

II. CUCUMBERS.

BY CHARLES W. HOOKER, PH.D.

Introduction.

BY H. T. FERNALD.

The experiments on cucumbers which follow were made during the year 1907 by Dr. Charles W. Hooker as a portion of his graduate work at the Massachusetts Agricultural College. More time being available for the purpose than was the case with the tomato tests, it was possible to make the tests more exhaustive, but the general ideas were the same for both series of experiments.

The two most common varieties of cucumber grown under glass in Massachusetts were used, viz., Rawson's Hothouse and White Spine. The latter variety seemed, on the whole, to produce the better plants. Two plants of each variety were used for each test.

The supervision of this work fell upon the writer of this introduction, but the work itself, the daily care and observations were made by Dr. Hooker, and the conclusions drawn are mainly his. For some editorial work on all the parts the writer is responsible. Abbreviations indicating the results are the same as those used for the tomato, which are explained on page 215. All the plants used were watered the day of the experiment, but their leaves were dry in all cases unless otherwise noted.

Experiment I.

Day Exposures with Direct Sunlight, April 4.

Fumigation with .01 gram KCN per cubic foot; plants nine days old; amount of sunlight the day of treatment, ten hours; conclusions drawn after three days.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	9.00	9.25	10.00	10.50	12.00
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	94	94	108	107	115
Humidity (degrees),	47	40	41	45	47
White Spine,	N	BB	B	B	BB
Hothouse,	N	BB	VBI	BB	BB

It is evident that, under these conditions, treatment long enough to be of any value against insects would seriously injure the plants.

Experiment II.

Cloudy Day Exposures, May 6, 7.

Fumigation with .01 gram KCN per cubic foot; plants of sets 1 to 5, ten days old; of set 6, seventeen days old; no sunlight the day of treatment; conclusions drawn after one week.

	Set Numbers.					
	1	2	3	4	5	6
Time of exposure,	9.40	10.05	10.40	1.25	2.25	2.10
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.	2 h.
Temperature (degrees),	59	59	60	62	69	67
Humidity (degrees),	70	84	90	85	81	98
White Spine,	N	N	N	N	N	N
Hothouse,	N	N	N	N	N	N

A comparison of the last two experiments shows how much less sensitive cucumbers are in cloudy weather.

Experiment III.

Cloudy Day Exposures with Older Plants, April 26, 29, May 8, 16.

Fumigation with .01 gram KCN per cubic foot; sunlight a portion of each day, but not during treatment; plants watered the day before the treatment; conclusions drawn after one week.

	Set Numbers.						
	1	2	3	4	5	6	7
Age of plants (days),	45	45	48	48	48	31	41
Date of treatment,	April 26	April 26	April 29	April 29	April 29	May 8	May 16
Time of exposure,	8.30	8.55	8.05	8.45	9.45	9.00	9.30
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.	2 h.	2½ h.
Temperature (degrees),	70	75	73	73	72	74	61
Humidity (degrees),	73	76	74	79	79	94	98
White Spine,	N	N	N	N	N	N	K
Hothouse,	N	N	N	N	N	N	K

Experiment IV.

Cloudy Day Exposures with Stronger Fumigation, May 23, 27.

Fumigation with .015 gram KCN per cubic foot; plants of first two sets sixteen days old, fumigated May 23; of the other sets twenty days old, fumigated May 27; amount of sunlight the day of fumigating first two sets, seven hours; on day of fumigating the other three sets, none; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	8.40	9.15	8.25	9.30	2.30
Length of exposure,	20 m.	30 m.	45 m.	1 h.	1½ h.
Temperature (degrees),	56	71	60	61	60
Humidity (degrees),	86	78	95	92	89
White Spine,	N	N	N	SB	SB
Hothouse,	N	N	N	SB	SB

Experiment V.

Cloudy Day Exposures with Older Plants, April 30, May 3, 6.

Fumigation with .015 gram KCN per cubic foot; amount of sunlight April 30, six hours; May 3, seven hours; May 6, none; plants of sets 2 and 5 watered the day before treatment; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Age of plants (days),	38	41	41	41	44
Date of treatment,	April 30	May 3	May 3	May 3	May 6
Time of exposure,	9.30	8.00	8.35	10.00	8.15
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	73	65	72	57	59
Humidity (degrees),	80	97	97	93	90
White Spine,	N	N	SB	SB	SB
Hothouse,	N	N	N	SB	SB

Experiment VI.

Cloudy Day Exposures with Stronger Fumigation, May 16.

Fumigation with .02 gram KCN per cubic foot; plants nine days old; amount of sunlight the day of treatment, four hours; plants watered the day before treatment; conclusions drawn after one week.

	Set Numbers.			
	1	2	3	4
Time of exposure,	8.30	8.55	9.30	10.10
Length of exposure,	10 m.	20 m.	30 m.	45 m.
Temperature (degrees),	69	67	67	76
Humidity (degrees),	91	81	81	83
White Spine,	N	N	SB	K
Hothouse,	N	N	SB	K

Experiment VII.

Cloudy Day Exposures with Older Plants, May 8.

Fumigation with .02 gram KCN per cubic foot; plants forty-seven days old; amount of sunlight the day of treatment, eight hours; plants watered the day before treatment; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	8.25	8.35	9.15	10.00	11.00
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	63	64	66	63	63
Humidity (degrees),	90	84	88	91	87
White Spine,	N	N	N	SB	SB
Hothouse,	N	N	N	SB	SB

Experiment VIII.

Moonlight Night Exposures, March 20.

Fumigation with .01 gram KCN per cubic foot; plants eight days old; amount of sunlight the day of treatment, nine and a half hours; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	7.00	7.25	8.00	8.45	9.45
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	62	59	58	60	65
Humidity (degrees),	58	52	44	43	51
White Spine,	N	N	N	N	SI
Hothouse,	N	N	N	N	N

Experiment IX.

Moonlight Night Exposures with Stronger Fumigation, March 20, 21.

Fumigation with .015 gram KCN per cubic foot; plants eight days old; amount of sunlight the day of treatment of the first three sets, nine and a half hours; of the last two sets, eleven hours; slightly hazy the evening the first three sets were treated; conclusions drawn after two weeks.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	11.00	11.25	12.00	6.35	7.35
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	76	75	73	63	70
Humidity (degrees)	36	40	44	55	61
White Spine,	N	N	N	SI	SB
Hothouse,	N	N	N	SI	SB

Experiment X.

Moonlight Night Exposures with Stronger Fumigation, March 21, 22.

Fumigation with .02 gram KCN per cubic foot; plants nine days old; amount of sunlight the day of treatment of first four sets, eleven hours; of fifth set, five and a half hours; conclusions drawn after two weeks.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	8.30	9.15	9.50	10.35	6.45
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	69	68	66	64	64
Humidity (degrees),	51	54	59	54	64
White Spine,	N	N	SB	SB	B
Hothouse,	N	N	N	SB	B

A comparison of the last three experiments would indicate that, under these conditions, an increase of .005 gram KCN was about equivalent to fifteen minutes' exposure.

Experiment XI.

Starlight Night Exposures, April 3.

Fumigation with .01 gram KCN per cubic foot; plants eleven days old; amount of sunlight the day of treatment, twelve hours; conclusions drawn after one week.

	Set Numbers.		
	1	2	3
Time of exposure,	7.25	8.10	9.10
Length of exposure,	30 m.	45 m.	1 h.
Temperature (degrees),	64	62	62
Humidity (degrees),	58	65	66
White Spine,	N	N	N
Hothouse,	N	N	N

Experiment XII.

Starlight Night Exposures with Older Plants, May 21, 23, 24, 1907; May 4, 14, 1908.

Fumigation with .01 gram KCN per cubic foot; conclusions drawn after one week.

	Set Numbers.						
	1	2	3	4	5	6	7
Date of treatment,	May 21	May 21	May 23	May 24	May 4	May 4	May 14
Age of plants (days),	14	14	16	18	13	20	25
Time of exposure,	7.35	9.00	8.00	7.30	9.20	7.15	7.15
Length of exposure,	1¼ h.	1½ h.	1¾ h.	2 h.	1½ h.	2 h.	2 h.
Temperature (degrees),	56	56	55	57	61	65	69
Humidity (degrees),	90	81	80	76	100	96	94
White Spine,	N	N	N	N	SB	SB	N
Hothouse,	N	N	N	N	N	SB	N

Experiment XIII.

Starlight Night Exposures with Still Older Plants, April 15, October 7, November 4.

Fumigation with .01 gram KCN per cubic foot; plants of first five sets, five weeks old; of the sixth and seventh sets, four weeks; of the eighth and ninth sets, thirty-two days; conclusions drawn after one week.

	Set Numbers.								
	1	2	3	4	5	6	7	8	9
Time of exposure,	7.10	7.35	8.10	8.55	9.55	6.30	8.15	6.30	8.45
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.	1½ h.	1¾ h.	2 h.	2½ h.
Temperature (degrees),	63	63	59	60	62	61	66	56	53
Humidity (degrees),	70	71	76	70	76	50	80	79	84
White Spine,	N	N	N	N	N	N	N	N	N
Hothouse,	N	N	N	N	N	N	N	N	N

Experiment XIV.

Starlight Night Exposures with Old Plants, May 20, 23, 31, June 7, 17.

Fumigation with .01 gram KCN per cubic foot; entire greenhouse full of plants used in each exposure; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Age of plants (days),	69	72	80	87	97
Time of exposure,	8.10	8.15	8.20	8.00	8.00
Length of exposure,	1 h.	1½ h.	1¾ h.	3 h.	3 h.
Temperature (degrees),	63	63	62	62	-
Amount of sunlight for day,	10 h.	3.8 h.	2.7 h.	6.8 h.	12 h.
White spine,	N	SB	SB	SB	SB
Hothouse,	N	SB	SB	SB	SB

Experiment XV.

Starlight Night Exposures with Stronger Fumigation, April 11.

Fumigation with .015 gram KCN per cubic foot; plants nineteen days old; amount of sunlight the day of treatment, eleven and a half hours; conclusions drawn after one week.

	Set Numbers.		
	1	2	3
Time of exposure,	7.00	7.45	8.45
Length of exposure,	30 m.	45 m.	1 h.
Temperature (degrees),	70	69	69
Humidity (degrees),	59	63	63
White spine,	N	N	N
Hothouse,	N	N	N

Experiment XVI.

Starlight Night Exposures with Older Plants or Longer Exposures.

Fumigation with .015 gram KCN per cubic foot; amount of sunlight May 13, nearly twelve hours; not taken on the other days; conclusions drawn after one week.

	Set Numbers.								
	1	2	3	4	5	6	7	8	9
Age of plants (days),	24	24	24	24	24	21	21	16	16
Date of treatment, .	May 13	May 13	May 13	May 13	May 13	Nov.11	Nov.11	Nov.12	Nov.12
Time of exposure, .	7.25	7.50	8.25	9.05	10.00	6.30	8.15	6.30	8.45
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.	1½ h.	1¾ h.	2 h.	1½ h.
Temperature (degrees), . . .	70	65	62	61	58	63	63	60	60
Humidity (degrees),	75	73	73	75	72	79	81	71	73
White Spine, . .	N	N	N	N	N	N	N	SB	SB
Hothouse, . . .	N	N	N	N	N	N	N	SB	SB

Experiment XVII.

Starlight Night Exposures with Still Older Plants, May 1.

Fumigation with .015 gram KCN per cubic foot; plants five weeks old; amount of sunlight the day of treatment, 8.7 hours; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Time of exposure, ...	7.00	7.25	8.00	4.45	9.45
Length of exposure, ...	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees), ...	60	56	56	54	53
Humidity (degrees), ...	90	87	90	82	87
White Spine, ...	N	N	N	N	N
Hothouse, ...	N	N	N	N	N

Experiment XVIII.

Starlight Night Exposures with Old Plants, May 14.

Fumigation with .015 gram KCN per cubic foot; plants seven weeks old; amount of sunlight the day of treatment, 11.5 hours; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	7.15	7.35	8.10	8.55	9.55
Length of exposure,	10 m.	20 m.	30 m.	45 m	1 h.
Temperature (degrees),	68	65	60	59	59
Humidity (degrees),	78	71	83	84	84
White Spine,	N	N	N	N	N
Hothouse,	N	N	N	N	N

Experiment XIX.

Starlight Night Exposures with Stronger Fumigation, May 17.

Fumigation with .02 gram KCN per cubic foot; plants ten days old; amount of sunlight the day of treatment, 2.3 hours; night slightly hazy, with the moon in the first quarter; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	7.20	7.40	8.10	8.55	9.45
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	58	58	58	60	60
Humidity (degrees),	71	71	88	86	86
White Spine,	N	N	N	BB	BB
Hothouse,	N	N	N	BB	BB

Experiment XX.

Starlight Night Exposures with Older Plants, April 18.

Fumigation with .02 gram KCN per cubic foot; plants thirty-seven days old; amount of sunlight the day of treatment, twelve hours; slightly cloudy just at the beginning of the experiment; conclusions drawn after one week.

	Set Numbers.			
	1	2	3	4
Time of exposure,	7.00	8.25	9.10	10.10
Length of exposure,	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	65	63	63	65
Humidity (degrees),	71	71	80	76
White Spine,	N	N	N	SB
Hothouse,	SB	SB	SB	N

Experiment XXI.

Starlight Night Exposures with Stronger Fumigation, May 20, June 4.

Fumigation with .03 gram KCN per cubic foot; plants of first three sets, three weeks old, treated May 20; of last two sets, twenty-six days old, treated June 4; amount of sunlight May 20, 10 hours; June 4, 6.6 hours; small amount of moonlight during sets 1 and 4; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	7.35	8.55	9.50	8.00	9.00
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	56	54	52	65	62
Humidity (degrees),	75	88	82	83	80
White Spine,	SB	SB	B	BB	B
Hothouse,	SB	SB	B	B	B

Experiment XXII.

Starlight Night Exposures with Older Plants, May 28.

Fumigation with .03 gram KCN per cubic foot; plants thirty-two days old; amount of sunlight the day of treatment, 3.8 hours; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	7.30	7.55	8.30	9.10	10.10
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	54	50	52	54	55
Humidity (degrees),	90	95	85	89	83
White Spine,	N	SB	SB	BB	BB
Hothouse,	N	SB	SB	BB	BB

Experiment XXIII.

Starlight Night Exposures with Strong Fumigation, April 22.

Fumigation with .04 gram KCN per cubic foot; plants five weeks old; amount of sunlight the day of treatment, 11.5 hours; small amount of moonlight during the first three sets; moon and stars nearly obscured during the last two sets; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	7.00	7.25	8.00	8.45	9.45
Length of exposure,	10 m	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	81	68	67	65	65
Humidity (degrees),	63	72	78	78	72
White Spine,	N	N	BB	BB	BB
Hothouse,	SB	B	BB	BB	BB

Experiment XXIV.

Cloudy Night Exposures, April 8.

Fumigation with .01 gram KCN per cubic foot; plants two weeks old; amount of sunlight the day of treatment one-half hour; conclusions drawn after one week.

	Set Numbers.		
	1	2	3
Time of exposure,	7.05	7.50	8.50
Length of exposure,	30 m.	45 m.	1 h.
Temperature (degrees),	69	66	65
Humidity (degrees),	63	70	60
White Spine,	N	N	N
Hothouse,	N	N	N

Experiment XXV.

Cloudy Night Exposures with Plants of Various Ages, May 6, Nov. 19, 1907; April 27, 1908.

Fumigation with .01 gram KCN per cubic foot; no sunlight any of the days when treatment was given; conclusions drawn after one week.

	Set Numbers.						
	1	2	3	4	5	6	7
Age of plant (days),	10	10	10	10	10	33	16
Time of exposure,	7.00	7.25	8.00	8.45	9.45	9.10	7.00
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.	1½ h.	2 h.
Temperature (degrees),	57	56	54	56	57	69	75
Humidity (degrees),	91	89	91	88	88	72	91
White Spine,	N	N	N	N	N	N	BB
Hothouse,	N	N	N	N	N	N	BB

Experiment XXVI.

Cloudy Night Exposures with Stronger Fumigation, May 10, 1907; April 27, 1908.

Fumigation with .015 gram KCN per cubic foot; plants of first five sets, two weeks old; of sixth set, sixteen days old; amount of sunlight the day of treatment of the first five sets, 7.4 hours; not taken for the sixth set; conclusions drawn after one week.

	Set Numbers.					
	1	2	3	4	5	6
Time of exposure,	7.10	7.40	8.15	9.00	10.00	9.10
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.	2 h.
Temperature (degrees),	65	61	57	57	55	72
Humidity (degrees),	79	77	83	78	84	93
White Spine,	N	N	N	N	SI	BB
Hothouse,	N	N	N	N	SI	BB

Experiment XXVII.

Cloudy Night Exposures with Older Plants, April 16.

Fumigation with .015 gram KCN per cubic foot; plants five weeks old; amount of sunlight the day of treatment, 11.5 hours; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	7.00	7.25	8.00	8.45	9.45
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	71	71	72	74	76
Humidity (degrees),	55	60	63	68	68
White Spine,	N	N	N	N	N
Hothouse,	N	N	N	N	SB

Experiment XXVIII.

Cloudy Night Exposures with Plants of Various Ages, April 25, May 13, 28.

Fumigation with .015 gram KCN per cubic foot; dim moonlight during treatment of the first three sets; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Date of treatment,	April 25	April 25	April 25	May 28	May 13
Time of exposure,	8.00	8.45	9.45	8.00	7.20
Length of exposure,	30 m.	45 m.	1 h.	1½ h.	2 h.
Temperature (degrees),	81	81	78	68	69
Humidity (degrees),	62	66	68	93	92
White Spine,	N	N	SB	SB	BB
Hothouse,	N	B	SB	SB	BB

Experiment XXIX.

Cloudy Night Exposures with Stronger Fumigation, May 15, Nov. 12, 1907; May 13, 1908.

Fumigation with .02 gram KCN per cubic foot; conclusions drawn after one week.

	Set Numbers.								
	1	2	3	4	5	6	7	8	9
Date of treatment,	May 16	May 16	May 16	May 16	Nov. 13	Nov. 13	Nov. 13	May 13	Nov. 19
Age of plants (days),	9	9	9	9	17	17	17	20	23
Time of exposure,	7.45	8.10	8.50	9.40	6.30	7.45	9.30	9.30	6.30
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.	1½ h.	1¾ h.	2 h.	2½ h.
Temperature (degrees),	66	63	63	61	58	58	56	66	71
Humidity (degrees),	90	90	91	95	74	56	76	95	73
White Spine,	N	N	N	N	N	N	N	K	BB
Hothouse,	N	N	N	N	N	N	N	K	BB

Experiment XXX.

Cloudy Night Exposures with Older Plants, April 26.

Fumigation with .02 gram KCN per cubic foot; plants five weeks old; amount of sunlight the day of treatment, five hours; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	7.00	7.25	8.00	8.45	9.45
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	64	62	63	68	74
Humidity (degrees),	75	73	80	72	72
White Spine,	N	N	N	N	N
Hothouse,	N	N	N	N	N

Experiment XXXI.

Cloudy Night Exposures with Still Older Plants, May 9, 13.

Fumigation with .02 gram KCN per cubic foot; plants of the first five sets, fifty-one days old; of sixth set, thirty-eight days old; conclusions drawn after one week.

	Set Numbers.					
	1	2	3	4	5	6
Time of exposure,	7.00	7.25	8.15	8.55	9.55	9.30
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.	2 h.
Temperature (degrees),	61	58	55	54	53	66
Humidity (degrees),	81	88	91	91	92	95
White Spine,	N	N	Sl	SB	B	K
Hothouse,	N	N	Sl	SB	B	K

Experiment XXXII.

Cloudy Night Exposures with Stronger Fumigation, May 27.

Fumigation with .03 gram KCN per cubic foot; plants twenty days old; no sunlight the day of treatment; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	7.15	7.40	8.15	9.00	10.00
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees)	60	60	59	62	58
Humidity (degrees),	95	95	94	85	88
White Spine,	N	SB	SB	SB	SB
Hothouse,	N	SB	SB	SB	SB

Experiment XXXIII.

Cloudy Night Exposures with Older Plants, April 19.

Fumigation with .03 gram KCN per cubic foot; plants thirty-eight days old; amount of sunlight the day of treatment, four hours; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	7.00	7.25	8.00	8.45	9.45
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	64	64	66	68	68
Humidity (degrees),	74	74	73	73	72
White Spine,	SB	N	N	N	N
Hothouse,	N	N	N	SB	N

Experiment XXXIV.

Cloudy Night Exposures with Strong Fumigation, March 23.

Fumigation with .04 gram KCN per cubic foot; plants eleven days old; amount of sunlight the day of treatment, ten hours; conclusions drawn after two weeks.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	6.55	7.25	8.00	8.45	9.45
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	73	68	65	66	67
Humidity (degrees),	60	62	60	59	61
White Spine,	N	SI	SB	BB	VBI
Hothouse,	N	SI	SB	BB	VBI

Experiment XXXV.

Cloudy Night Exposures with Electric Light, April 29.

Conditions in this series of experiments were about like those of the preceding set, except that a 16 candle-power incandescent bulb hanging near the fumigating box was left turned on during the exposures.

Fumigation with .01 gram KCN per cubic foot; plants thirty-seven days old; amount of sunlight the day of treatment, 4.6 hours; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	7.00	7.25	8.00	8.45	9.45
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	72	70	72	68	67
Humidity (degrees),	55	58	78	82	82
White Spine,	N	N	SB	BB	BB
Hothouse,	SB	N	N	BB	BB

Experiment XXXVI.

Cloudy Night Exposures with Electric Light, Stronger Fumigation, May 2.

Fumigation with .015 gram KCN per cubic foot; plants seven weeks old; amount of sunlight the day of treatment, 8.2 hours; conclusions drawn after one week.

	Set Numbers.			
	1	2	3	4
Time of exposure,	8.00	8.25	9.00	9.45
Length of exposure,	10 m.	20 m.	30 m.	45 m.
Temperature (degrees),	65	60	59	59
Humidity (degrees),	85	72	85	83
White Spine,	N	N	SB	SB
Hothouse,	N	SB	SB	SB

Experiment XXXVII.

Cloudy Night Exposures with Electric Light, Still Stronger Fumigation, May 7.

Fumigation with .02 gram KCN per cubic foot; plants seven weeks old; amount of sunlight the day of treatment, 3.1 hours; rather cloudy and with a heavy mist during the treatment of the first three sets; cloudy during the last two treatments; conclusions drawn after one week.

	Set Numbers.				
	1	2	3	4	5
Time of exposure,	7.00	7.25	8.00	8.45	9.45
Length of exposure,	10 m.	20 m.	30 m.	45 m.	1 h.
Temperature (degrees),	65	63	63	63	62
Humidity (degrees),	72	84	84	86	86
White Spine,	N	SI	SB	BB	BB
Hothouse,	N	SI	SB	BB	BB

From the last three experiments it is evident that even an electric light near the plants which are being fumigated has an effect upon them.

Comments and General Conclusions.

BY C. W. HOOKER.

1. Day fumigation in direct sunlight is unquestionably unsafe, as the plants are badly injured or killed.

2. Fumigation on a cloudy day is unsafe at best, the plants being generally more or less injured.

3. Fumigation on a bright moonlight night is also unsafe, often causing much burning of the foliage.

4. The best results are obtained by fumigating on clear starlight nights, with little or no moonlight, and on dry, cloudy nights.

5. A clear, dry evening without moonlight, with a temperature in the house of from 55 degrees to 65 degrees, or a cloudy evening with the same temperature, offer the best conditions for fumigation. This should be followed by a thorough ventilation for at least fifteen minutes, and the temperature should be kept rather low for twenty-four hours thereafter.

6. A general survey of the experiments seems to indicate that a small amount of KCN with a longer exposure is preferable, to a large amount for a shorter exposure.

7. Individual results obtained here and there in the course of these experiments which seem to contradict the others may, in general, be accounted for by the condition of the plants,

which frequently, at least, in such cases were not as vigorous as the others, though this was avoided whenever possible.

8. Comparison of the results of these experiments on cucumbers with those of Mr. W. V. Tower on tomatoes shows that the former are much the hardier, successfully resisting more cyanide and longer exposures.

INDEX.

INDEX.