THIRTY-FIFTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

MASSACHUSETTS BOARD OF AGRICULTURE,

WITH

RETURNS OF THE FINANCES OF THE AGRICULTURAL SOCIETIES,

FOR

1887.

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STATE BOARD OF AGRICULTURE, 1888.

Members ex officiis.

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CHARLES A. GOESSMANN, *State Agricultural Chemist.*

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Appointed by the Governor and Council.

	Term expires.
JAMES S. GRINNELL of Greenfield,	1890
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Chosen by the County Societies.

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Barnstable,	NATHAN EDSON of Barnstable,	1889
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Bristol,	AVERY P. SLADE of Somerset,	1890
Deerfield Valley,	F. G. HOWES of Ashfield,	1890
Essex,	BENJAMIN P. WARE of Beach Bluff,	1890
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Hampshire,	WM. W. SMITH of Amherst,	1889
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Highland,	W. H. SNOW of Becket,	1890
Hingham,	EDMUND HERSEY of Hingham,	1891
Hoosac Valley,	S. A. HICKOX of Williamstown,	1891
Housatonic,	J. H. ROWLEY of Egremont,	1891
Hillside,	S. W. CLARK of Plainfield,	1890
Marshfield,	GEO. J. PETERSON of Marshfield,	1891
Martha's Vineyard,	HENRY L. WHITING of West Tisbury,	1889
Massachusetts,	E. F. BOWDITCH of Framingham,	1891
Massachusetts Horticultural,	E. W. WOOD of Newton,	1891
Middlesex,	W. W. RAWSON of Arlington,	1891
Middlesex North,	A. C. VARNUM of Lowell,	1889
Middlesex South,	S. B. BIRD of Framingham,	1890
Nantucket,	GEO. W. GARDNER of Nantucket,	1891
Plymouth,	ELBRIDGE CUSHMAN of Lakeville,	1890
Union,	S. A. BARTHOLOMEW of North Blandford,	1889
Worcester,	C. L. HARTSHORN of Worcester,	1890
Worcester North,	GEO. CRUICKSHANKS of Fitchburg,	1890
Worcester North-West,	J. P. LYNDE of Athol,	1889
Worcester South,	BAINBRIDGE DOUTY of Charlton,	1889
Worcester West,	J. HENRY GODDARD of Barre,	1890

WILLIAM R. SESSIONS,

Secretary.

THE

THIRTY-FIFTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

BOARD OF AGRICULTURE.

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

The year 1887 has been, in many respects, a prosperous one for the agriculturists of the State. The corn crop was a good one. Potatoes were a failure. The hay crop was large in quantity, but was much damaged by unfavorable weather in the harvest season. The rowen crop was bountiful. Our market gardeners have generally been successful.

The season has been a peculiar one. The month of May and the early part of June were very hot and dry. Only 1.13 inches of rain fell in May; in June, 5.09 inches of water were precipitated. The rainfall of July was 8.93 inches, a larger amount than fell in any July since 1839. The wet weather continued through most of the month of August, giving us 7.75 inches for the month. In September the other extreme was reached, only 1.22 inches falling. No doubt the early drought shortened the early crop of potatoes, especially on dry land; while the excessive amount of rain, together with the unusual heat of July and August, were the cause of the rot that so generally destroyed the crop on land so situated that it could withstand the early drought The continuous rains of July and August also caused the serious damage to the hay crop.

It has been, on the whole, a favorable year for fruit. This product of the State is one of the most important. By the Census of 1875 we find that our sales of fruit brought to the producers an aggregate of about $3,000,000, while the market-garden crops, other than potatoes, were worth only $2,500,000. The butter production was valued at about

$2,700,000, the corn crop at $1,000,000, and potatoes at less than $2,500,000. In the last ten years the fruit product of the State has very largely increased. This increase has been particularly marked in the smaller fruits. By comparing the Census of 1875 with that of 1885, we find that the crop of grapes for 1885 was more than four times that of 1875. The strawberry and cranberry crops have trebled, and the currant crop doubled, in ten years The supply has become so abundant that prices have been reduced, and these healthful and most agreeable luxuries are now sold at prices within the reach of all classes. The future promises more abundant supplies and perhaps still lower prices. The capabilities of our State, in this direction, are almost unlimited. Should the demand increase and prices be remunerative, we may expect a still more wonderful increase in the amount of these products.

The business of dairying seems to be the favorite industry of the stock-growing portions of the State. While cheese-making proves unprofitable and is declining, butter-making and the production of milk for market have been receiving increased attention.

The system of co-operative cream-gathering creameries has commended itself to many farming communities that have no facilities for marketing milk. In most cases, ventures in this direction have proved successful, and are giving new impetus to agriculture in neighborhoods where they are located. By this plan, a market at the door is assured for all the cream the farm can produce. The price received is dependent upon the economy and business tact displayed in the management of the creamery. By making the butter from the cream of several hundred cows, at one place, the services of a skilled butter-maker can be afforded, and advantage can be taken of the best business talent of the neighborhood in making purchases and sales. The skim-milk all remains at home, to be fed to calves and pigs, thus retaining upon the farm very nearly all the elements of fertility that our products afford. Oleomargarine has not been able to crowd fine butter to the wall. Prices have been well sustained, and the demand for fine butter seems to keep pace with the supply.

The milk producers of the State appear to prefer to dispose of their milk to contractors at a low price, rather than to risk the slight uncertainty attending the financial returns from co-operative creameries; but, as the business increases and time brings experience and skill in the management, we believe that these establishments will furnish the needed competition with the milk contractors, and the milk problem will thus be solved.

I am enabled, by the favor of Mr. Carroll D. Wright, Superintendent of the State Census, to give the agricultural products of the State for 1885 in comparison with those of 1875, and the United States Censuses for 1870 and 1880.

When we take into consideration the very large increase in the fruit crop in connection with these statistics, we cannot but be encouraged at the substantial increase in the products of our soil.

	1870.	1875.	1880.	1885.
Horses, ...	41,039	53,218	59,629	61,004
Working oxen, . .	24,430	16,308	14,571	10,433
Milch cows, . .	114,771	126,034	150,435	162,847
Other cattle, . .	79,851	81,916	96,045	–
Bulls, . . .	–	–	–	6,284
Calves, . . .	–	–	–	38,226
Heifers, . . .	–	–		36,150
Steers, . .	–	–	–	8,246
Sheep, . . .	78,560	58,773	67,979	55,140
Lambs, . .	–	–	–	18,384
Swine, . .	49,178	42,255	80,123	–
Hogs, ...	–	–	–	65,749
Pigs, ...	–	–	–	69,680
Barley (bu.), . .	123,071	46,884	80,128	68,997
Buckwheat (bu.), .	58,049	52,127	67,117	61,021½
Oats (bu.), . .	797,664	457,710	645,159	619,667½
Wheat (bu.), . .	34,644	13,749	15,768	7,160½
Rye (bu.), . .	239,227	250,113	213,716	232,107½
Eggs (dozen), . .	–	3,446,530	6,754,179	7,072,187½
Tobacco (lbs,), . .	7,312,885	5,993,666	5,369,436	4,210,903
Hay (tons), . .	597,455	671,130	684,679	647,414⅔
Milk (gals.), . .	15,284,057	35,698,150*	29,662,953	72,528,628*
Butter (lbs.), . .	6,559,161	7,922,431	9,655,587	9,685,539
Cheese (lbs.), . .	2,245,873	1,280,234	829,528	359,124
Cream (lbs.), . .	–	–	–	263,158¾
Corn (bu.), . .	1,397,807	1,040,290	1,797,768	2,147,390
Potatoes (bu)., . .	3,025,446	3,630,546	3,070,389	3,584,505

* These figures show the total production of milk, not only what was sold, but the quantity used in the manufacture of butter and cheese. The figures in the other columns indicate only the number of gallons actually sent to market.

Our flocks and herds have suffered very little during the year from dreaded contagious diseases. Tuberculosis is said to be prevalent in some sections of the State, and is causing some uneasiness in the minds of cattle owners. The Cattle Commissioners, in their late report, say of this subject: "The facts of a year ago are in the main the facts of to-day. The disease continues with no apparent abatement or increase, though, as the veterinary profession increases in number, and attention is called to it more and more, there is a call for more active work. The disease could, doubtless, be eradicated by placing it in the same category with pleuro-pneumonia, and applying to it the same provisions of law; but it would, doubtless, necessitate the destruction of twenty animals to save one, and require the payment of many hundreds of thousands of dollars." The Massachusetts Society for the Promotion of Agriculture, with its accustomed liberality and promptness, has arranged for a thorough investigation of the disease by an accomplished veterinarian and microscopist. The plan includes the purchase of milch cows infected with the disease, and experiments by feeding their milk to calves, rabbits and other animals, to ascertain the danger to the human family by the use of such milk. It will also investigate the danger from contagion, by confining healthy animals with those that are diseased. For these purposes the society has secured a farm of sixty or seventy acres near the city, but sufficiently isolated from other farms where stock is kept.

The cattle-shows and fairs of the several societies have been held, and, in most cases, were successful exhibitions. In many instances a larger attendance than usual was reported. Each of the societies has held the required number of institutes, with interest and profit.

There is a growing interest in the progress of agriculture among the agricultural population of the State. They are learning to honor their calling, and to demand recognition and respect for those who follow it. This advance is largely due to the influence of the Grange. More than twenty new Granges have been organized during the past year, and more than fifteen hundred new members have been added to the organization.

The Board of Agriculture voted at its annual meeting that it was desirable to have the inspection of fertilizers transferred from the Board of Agriculture to the Board of Control of the Experiment Station, and a committee was appointed to ask the Legislature to make the necessary changes.

The country meeting at Springfield was attended by a large audience of interested farmers. The able papers presented at that time will be bound with this report

The Agricultural College, of which the Board of Agriculture are by statute made overseers, and the secretary a trustee, *ex officio*, seems to have entered upon a career of prosperity. The farming community of the State is now in sympathy with its management. The college was founded "to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life." The income of these classes, as a rule, is not large enough to enable their young men to bear the necessary expense of a college course. These young men have been brought up to useful labor, and would be glad to work their way through college. Student labor, sporadic as it must necessarily be, can be profitably employed for only a small part of the regular farm work. But there is an abundant field for the employment of such labor in the improvement of the farm and buildings, the making of walks and the cultivation of trees and shrubs, for the illustration of arboriculture and the adornment of the college grounds. These improvements would do honor to the State. There are no funds that can be expended for these purposes. The report of the trustees of the college suggests the annual appropriation by the Legislature of a moderate sum, to be known as a "labor fund," the same to be expended for these purposes. I believe the agricultural population of the State are heartily in favor of such an arrangement.

WILLIAM R. SESSIONS,
Secretary of the State Board of Agriculture.

BOSTON, February, 1888.

SPECIAL MEETING

OF THE

BOARD OF AGRICULTURE

AT BOSTON.

SPECIAL MEETING

OF THE

BOARD OF AGRICULTURE.

The Board met at the office of the Secretary in Boston, Aug. 23, 1887, at eleven o'clock, having been called together by order of the executive committee for the purpose of choosing a secretary to fill the vacancy caused by the withdrawal of Mr. Francis H. Appleton's acceptance of the office of secretary.

Present: Messrs. Bartholomew, Bird, Bowditch, Brackett, Brooks, Clark, Cruickshank, Cushman, Damon, Douty, Edson, Goddard, Goessmann, Goodell, Grinnell, Hartshorn, Hill, Howes, Lynde, Nichols, Owen, Peirce, Porter, Sessions, Slade, Smith of Amherst, Smith of Deerfield, Snow, Stockwell, Taft, Upton, Varnum, Ware, Wheeler, Wood.

Hon. James S. Grinnell was elected chairman. On taking the chair Mr. Grinnell spoke of the death of Captain John B. Moore of Concord, and offered the following resolutions: —

Whereas, we have heard with feelings of more than ordinary sorrow of the death of John B. Moore:

Resolved, That in his death we have lost one who, as a member of the Board, was most valuable, upright and faithful; as a friend, most positive and unswerving; as a practical and theoretical teacher in the science of agriculture, unsurpassed by any.

Resolved, That in his death, the farmers, the gardeners and the people, not only of this State, but of the whole country, will miss one whose long experience in his profession, and whose happy and intelligent manner of imparting its results, have been recognized and appreciated wherever he has spoken and wherever he has written.

Resolved, That a committee of five be appointed to attend his funeral to represent the sympathy felt by this Board.

Resolved, That a copy of these resolutions be sent to the family and also printed in the papers.

These resolutions were ably seconded by several members of the Board, in paying high tributes to the memory of the deceased.

The Board then voted unanimously to adopt the resolutions. The Chair appointed the following persons to attend the funeral: — Messrs. Bird, Brooks, Hartshorn, Slade, Ware.

The Chairman was also added to the committee.

It was then voted to proceed to ballot for a secretary, and on the twelfth formal ballot Mr. William R. Sessions of Hampden, having received a majority of the thirty-five votes cast, it was voted that his election be declared unanimous.

The Board then adjourned.

PUBLIC MEETING OF THE BOARD AT SPRINGFIELD.

PUBLIC MEETING OF THE BOARD

AT SPRINGFIELD.

The Country Meeting of the Board was held at Springfield, at City Guard Hall, on December 6, 7 and 8. The meeting was called to order at ten o'clock, on Tuesday, December 6, by Secretary SESSIONS, a good audience being in attendance.

Secretary SESSIONS. The hour has arrived for calling this meeting to order, and as we are here at the invitation of the Hampden County Agricultural Society, allow me to introduce to you the President of that Society, Hon. GEORGE S. TAYLOR.

INTRODUCTORY REMARKS BY MR. GEORGE S. TAYLOR.

Gentlemen of the Massachusetts Board of Agriculture, — It gives me pleasure, representing our society, to welcome you here to-day, and although it may be out of the usual course, still, as we all recognize a Supreme Being, the Author and Giver of all our blessings and comforts, I will ask the Rev. Dr. BURNHAM to lead us in prayer.

A fervent and appropriate prayer was offered by Rev. MICHAEL BURNHAM, D. D.

Mr. TAYLOR. Your secretary has introduced me, but as it will be impossible for me to be present at all your meetings, and as our local society is represented on your Board by a gentleman eminently fitted to perform the duties of presiding officer, I desire to give place to him. If there is no objection, he will preside at these meetings. He is well known to you all and needs no introduction,—Mr. ETHAN BROOKS of West Springfield.

Mr. BROOKS then took the chair and addressed the meeting as follows: —

OPENING ADDRESS.

BY ETHAN BROOKS OF WEST SPRINGFIELD.

Mr. President and Gentlemen of the Board of Agriculture, —In behalf of the Hampden Agricultural Society, at whose invitation we are here to-day, and in behalf of the citizens of Springfield and vicinity, I welcome you most heartily. First, because we feel honored by your presence; and second, because we confidently hope to be benefited by your stay with us and by the lectures and discussions to which we shall listen. We welcome you to this Connecticut Valley of historic fame, fragrant with the memory of Pynchon and his associates, who braved dangers and endured hardships that they might establish a settlement here. We welcome you to this city, which many here will remember as a thrifty town, the home of the late William B. Calhoun, time-honored secretary of our Commonwealth and one of the leaders in the organization of our Hampden Agricultural Society.

Since our meeting at Barre a year ago, two of our oldest and most honored members have passed away. Hon. Marshall P. Wilder,—of world-wide reputation as an horticulturist and agriculturist; active in bringing this Board into being and in sustaining it, and (with the exception of one term, from 1864 to 1868) a member from its organization till his death; the father of our Agricultural College; a man whose memory Massachusetts will ever delight to honor, — died soon after our last public meeting.

Capt. John B. Moore of Concord,— who had served this Board most faithfully a greater number of consecutive years than any other man, having been a member continuously since 1860, who was with us a year ago at Barre and again at our annual meeting in February,— died last August. He will be remembered by his associates as possessing rare qualities for the place so ably filled and his positive presence will long be missed. The counsels of these men are largely on record in the annual reports of this Board and through these they will continue to speak.

A year and a half ago we celebrated the 250th anniversary of the settlement of Springfield, which for a long time included every town now adjoining with some more distant. Holyoke, Agawam and Hampden are the grandchildren of Springfield, the two former having been set off from West Springfield and the latter from Wilbraham. Westfield was for a long time the west field of this settlement and Chicopee was a part of Springfield within the memory of this generation.

We shall be happy to show you, as far as opportunity on your part will permit, the many interesting features of this city.

In Court Square we have a statue to the memory of Miles Morgan,—one of Springfield's earliest settlers,—with blunderbus at shoulder and hoe in hand, showing the Puritan as he engaged in the every-day affairs of life. It was erected by a descendant who has just passed away. And also a monument by a generous citizen to the memory of those from this locality, who within our time offered their lives that "Government of the people, by the people and for the people, might not perish from the earth."

In Stearns Park, almost overlooked from the windows of this hall, has just been erected by the Chapin family a statue to the memory of Dea. Samuel Chapin, one of the first deacons of the first church of Springfield, designed to show the Puritan on his way to the Sunday meeting, with his back turned on all worldly things, with face firmly set and with Bible in hand, suggestive of kingly resolutions guided by truth.

Our churches, our schools, our free public library and our newspapers are all in line with those ennobling thoughts which made the Puritan the man for his time. We have those Government works which during the war turned out a thousand rifled muskets a day, of which the old Quaker said to his nephew, who had just enlisted for the war, "I understand they are the best." We have many and varied manufacturing industries, from the common sewing needle to the railway car and locomotive. We have, what perhaps may interest agriculturists as much as anything, an organized milk association, through which many of our hard-working farmers supply the varied products of their herds directly to the consumers.

We welcome you, not to an agricultural town, but to the centre of a large agricultural community,—a community in condition to be greatly benefited by this meeting, because realizing its need of all the knowledge to be gained through the scientific investigations and the practical experience of those who shall address us and who shall engage in discussion.

We shall bring as listeners an audience whose experience is as varied as the well-ordered programme which we are to follow, — who will come here hoping to gain that inspiration which shall enable us to do more and better thinking, and to put to practical use the conclusions of such thinking. This in all matters of business is the great demand of the day,— not to gain a few things desirable in an easy way, but so to direct our energies that constantly doing our best we shall constantly develop our best faculties and gain increasing results.

When we were at Barre, a year ago, we were told that dairying in some form had been the chief business of the farmers there for fifty years. The only one line of farming that ever held dominant sway in this Connecticut Valley was the culture of tobacco.

This Board held the first of these annual public meetings, —in compliance with a vote passed in January, 1863,—in this city, December 8 to 11 of the same year. There was a feeling then that the farmers of these neighboring towns did themselves injustice by neglecting that meeting.

May it not be that we were so enveloped in the smoke of tobacco that we could not see the importance of the topics then under consideration? It is now conceded by careful observers that for a series of years, up and down this valley, it has cost the tobacco-grower a dollar and a half to get a dollar. Farms have been sold and homes sacrificed to pay obligations assumed to buy fertilizers, build barns, and hire labor in the interest of tobacco.

We have learned a little wisdom at considerable cost, and now we are ready to listen to lectures on any subject of general interest. Not that individual farmers are likely to adopt the cultivation of a greater variety than at present, for the tendency (which seems a necessity of the times) is toward some specialties to be decided upon according to circumstances,— but that the undecided may gain light which shall enable them to decide wisely, and that those who may now have chosen a particular course may be able more perfectly to follow on.

It has sometimes been said, this or that can be raised at the West and brought here cheaper than we can raise the same on our farms, and therefore it does not pay to raise it here. While this may sometimes be true, it need not always be so; and it will not be, if we are true to our opportunities. Besides, these farms are to be occupied, — considerations aside from dollars and cents enter into our estimate of life.

Our climate, though sometimes severe, is generally healthful. We have an abundance of the purest water; our scenery is a constant delight; and, thanks to the wisdom and the sacrifices of those who have gone before us, our social, educational and religious privileges are nowhere surpassed and rarely equalled.

We have a great variety of soils, enabling one to make one branch of agriculture a specialty, and another some other branch, while very few, if any of us, are entirely dependent on any one crop. Herein our New England farmers hold a decided advantage over those where the entire energy of large sections is devoted to one product, so that when this one fails the loss brings suffering. Our potato crop this year has been largely a failure, yet no community will suffer from this loss, and but few individuals will be put to inconvenience thereby.

The question then is not shall we cultivate these limited acres, but how shall we *best* cultivate them? Not how to get along with as little thought and labor as possible, but how, by more earnest thought guiding more energetic labor, can we secure greater results?

Since competition with the wide world brings down the market price of many of our products, we must seek by all just and fair means to reduce the cost. And this is oftenest done by increasing the amount of production. It has been said that none are so far from market as those who have nothing to sell, and it is coming to be more and more a necessity to increase the sales from our farms.

It is a favorite theory with certain agitators that no one can gain the good things of this life without in some way robbing some fellow man; but the farmer who adds to his estate by making land more productive, and by increasing and improving his flocks and herds, robs no one.

The original reads, "In the sweat of thy face" (not thy neighbor's face, as too many seem in these days to read it) "shalt thou eat bread." The patriarch Jacob, in contending with his father Laban, who had become rich under his stewardship, explains it all when he says, "In the day the drought consumes me and the frost by night, and my sleep departed from mine eyes." And later on, declining the invitation of his brother to leave his flocks with others and go with him for a little vacation, he says, "If men should over-drive them one day, all the flock will die."

As farmers we do well to meet as we do to-day. We need all the stimulus and all the encouragement we can get. We do not risk as much as our neighbors in other business. Our opportunities do not come and go as quickly as theirs, and we are not pressed as they are to be constantly on the alert. Herein lies a danger we need to guard against. We must wait for results, therefore the more need of care and foresight.

We are not likely to do many great things in life, but we shall not lack opportunity to do numberless little things which will go to swell the aggregate of good accomplished in the world. We shall not make money like the most prosperous in other callings, and we shall not be subject to those crushing losses by which so many are overwhelmed.

We meet to consider the interests of Massachusetts agriculture, but the interests of our sister New England States are so nearly identical with our own, that we welcome to this meeting and to these discussions our brethren from neighboring States, and shall try to lead them to forget that any dividing lines exist between us. The interests of all industries are so intertwined and so mutually dependent that we welcome any and all to the full benefits in store for us. It has been said that in the old world the more necessary the work the more the producer of it was enslaved and ignored. Many winters ago, when the roads in our mountain towns were almost impassable, the young men of one of these towns forced their way every Sunday to church and were well repaid in a series of sermons expressly for them. In one of these, the Rev. J. H. Bisbee, then of Worthingon, said, "Every occupation that is necessary and useful is an honorable calling and ought so to be considered. Situation and circumstances may be favorable or unfavorable for the development of one's energies, still it is true worth that makes the man and secures our homage."

Our late lamented Sumner, in the days of his vigor and his power, standing on the platform of old Hampden Hall, in this city, gave utterance to this glorious prediction, which happily he lived to see fulfilled: "There are no political Joshuas who can bid the sun of progress stand still, and it will go on till its rays have reached the farthest plantation and melted the chains from the most degraded slave."

So let us, though we may not live to see all our prophetic hopes fulfilled, lift our standard so high that not only we shall be benefited but that those around us and those who shall come after us shall recognize more surely the first principles of our existence. Let us believe that there is in store for those in our calling a greater freedom than we have yet known, which shall come of greater knowledge to be gained of the needs of soils and animals and plants; of the nature and habits of destructive insects; of the many conditions with which we need to comply, and of skill to use this knowledge aright. May we not thus hope that much now waste may be made valuable, that materials now locked within our hills may be set free and turned to wise account, so that while we rest in the promise, "Seed time and harvest shall never fail," we may see our harvests increase from year to year?

The hour has come for the lecture which is on our programme for this morning. I am happy to introduce to you Prof. S. T. Maynard, of the Massachusetts Agricultural College, who will speak to us on fruit culture in Massachusetts.

FRUIT CULTURE IN MASSACHUSETTS.

BY PROF. S. T. MAYNARD OF AMHERST.

One of the most important productions of the soil of Massachusetts is its fruit crop. With a rough soil, not easily cultivated, it produces fruit of the finest color and best quality. Upon her high hills the peach and apple thrive,— on high southern slopes the grape reaches its greatest perfection. The pear, plum and quince grow well in its valleys, while upon the smooth plain, land easily cultivated, the small fruits are successfully grown. An abundant supply of fruit should be found upon the table of every farmer. It quickens the appetite and gives zest to other kinds of food. There is much pleasure to be derived from its cultivation and it is especially attractive to the young. Give the boys a hand in its cultivation, let them have a part of the income from its sale, and fewer young men will leave the farm.

The importance of the fruit crop in our State can be best understood by a comparison with that of other branches of agricultural industry.

We find, by consulting the census of 1875, that the total income derived from the sale of fruit for that year amounted to nearly $3,000,000. For the same year the value of the market garden crop, including all vegetables grown upon the farm, except the potato, was only $2,500,000. The butter product was valued at $2,747,878; the corn crop, $1,000,000; the potato crop, $2,349,205.

Since 1875 the production of fruit has increased very rapidly, but prices have diminished to such an extent that the profits derived from the crop have largely been reduced. This is shown by the following figures, which I have obtained, in part, from the advanced sheets of the census of 1885, through the kindness of the chief of the Labor Bureau, Carroll D. Wright: —

	1875.		1885.	
	Yield.	Value.	Yield.	Value.
Apple, ...	3,254,957 bush.	$1,450,252	4,545,550 bush.	$1,174,452
Pear, ...	59,259 "	118,302	153,374 "	147,013
Peach, ...	15,945 "	44,833	-	1,839
Plum, ...	1,769 "	3,481	5,984 "	12,381
Grape, ...	672,590 lbs.	67,259	2,975,824 lbs.	117,022
Strawberry, . . .	1,156,801 qts.	214,940	3,929,497 qts.	406,859
Currant, ...	146,558 "	10,605	318,588 "	28,631
Raspberry, . . .	-	28,000	176,168 "	34,854
Blackberry, . . .	-		382,163 "	38,624
Cranberry, . . .	110,184 bush.	288,113	315,387 bush.	788,467

It will thus be seen that in the apple and peach crop there was a decrease in income, though we shall find that the number of trees have increased, and in favorable seasons the crop may be much larger even than that of 1875. The largest increase is found, however, in the small fruits.

The prices obtained I have only been able to show from the census of a few of our large fruit growing towns and cities. Thus, in the city of Worcester the prices obtained by the grower are as shown in the following table: —

	1875.				1885.			
	No. of Trees.	Yield.	Value.	Value.	No. of Trees.	Yield.	Value.	Value.
Apple,	24,179	40,825 bush.	$19,451	$0 47 per bush.	27,092	15,233 bush.	$7,622	$0 50 per bush.
Pear,	5,181	1,962 "	4,471	2 40 " "	6,819	3,762 "	3,567	90 " "
Peach,	912	172 "	647	3 94 " "	5,930	–	–	–
Plum,	39	9 "	42	4 66 " "	1,021	286 "	1,165	4 08 " "
Grape,	2,857	5,235 lbs.	555	11 per lb.	4,255	19,234 lbs.	899	5 per lb.
Strawberry,	–	34,589 qts.	7,285	20 per qt.	–	84,300 qts.	9,658	11 per qt.

The price of apples is given for both years as not far from 50 cents per bushel. For the past few years it cannot have averaged much over 30 cents per bushel.

In the city of Springfield the average prices were as follows: — Apples, 1875, 58 cents per bushel; apples, 1885, 20 cents per bushel; pears, 1875, $3.00 per bushel; pears, 1885, $1.00 per bushel; grapes, 1875, 10 cents per pound; grapes, 1885, 5 cents per pound; strawberries, 1875, 17 cents per quart; strawberries, 1885, 9 cents per quart.

In order to make this paper as practical as possible, and afford more material for discussion, I will outline the most important points to be considered in the successful cultivation of each fruit.

The Apple.

1875.	No. of trees, 1,861,244;	yield, 3,254,957 bush.;	value, $1,450,256.
1885.	" " 2,507,468;	" 4,545,550 "	" 1,174,452.

The apple stands at the head of the fruit list, not only from the fact that it yields the largest income and produces the greatest amount of food material, but that it will grow upon a greater variety of soil, and thrive better under conditions of neglect than any other fruit.

There is no locality in the world where fruit of such color, flavor and long-keeping qualities are produced as in the so-called "apple belt," which extends from Connecticut to Southern Canada. It requires for its best development a deep, moist soil, with an abundance of plant food. It cannot be expected, however, that such a soil will continue to produce crops of large fine fruit unless we return to it annually an equivalent in plant food of those elements removed by the crop which are not supplied in abundance by the soil

Whether this want can best be supplied by cultivation with some other manured crop, whether by cultivation without other crops, or whether the land be kept in turf and all other vegetable production of the land be allowed to decay upon it, and such fertilizing materials be added as are necessary to keep up a vigorous growth, are questions which are difficult to answer. Each system has its warm supporters among orchardists. For myself, I believe in turf culture, generally, for the apple, for the reason that land that cannot be cultivated, — and we have hundreds of thousands of acres in Massachusetts, — may be made to produce paying crops of fruit; that the trees, when properly treated under such conditions, live longer than those that have their roots cut and torn by the plow; that the fruit is of more brilliant color and will keep longer. Under no conditions can we expect, however, to grow good apples or other fruit without supplying an abundance of plant food. The crop in its present condition is large enough, as we all know from the prices obtained; but if we can increase the size and quality of our fruit, both the demand and price will also increase.

Insects.

One of the great causes of inferior fruit is due to the ravages of injurious insects, but, as Professor Fernald is to talk to you upon the subject this afternoon, I will only touch upon the matter to urge more vigilant fight against them. We should depend more upon the use of swine, poultry, and other animals, and the cider press, for the destruction of the codling moth, the tar or ink band upon the trunk, and pyrethrum powder for spraying the trees for the destruction of the canker worm, rather than the dangerous method of spraying with paris green. The borers can be easily destroyed by the use of the knife and wire. The holes made by the escaped insects or by cutting out the larvæ should be filled up at once with grafting wax, putty or plaster of paris, to prevent decay.

Pruning should only be done to give the trees good form, to enable the pickers to gather the fruit easily, to remove such branches as are being injured by rubbing against each other and those that are decaying or dead. If large branches be removed they should be cut clean and close to the trunk, and the wound be covered with tar, linseed oil paint or grafting wax.

Varieties.

In giving a list of the best varieties it is impossible to name one which will be entirely suited to all locations or popular in all markets. The list that will perhaps give the best general satisfaction for market is as follows: — Red Astrachan, Williams Favorite, Alexander, Gravenstein, Fall Pippin, Fameuse, Hubbardston, R. I. Greening, Baldwin and Roxbury Russet.

The Pear.

1875.	No. of trees, 203,229;	yield, 59,259 bush.;	value, $118,302.
1885.	" " 356,991;	" 153,374 "	" 147,013.

The pear will not succeed upon such a variety of soils as the apple; it grows best upon a deep, rather moist, rich soil. Like the apple, for the best results, it must have an abundance of plant food.

For this and all other kinds of fruit, if well decomposed stable manure is not to be had, nothing will give better results than from five hundred pounds to one ton of bone and potash (five parts of bone to one of high-grade muriate of potash) to the acre.

One of the greatest obstacles to overcome in the cultivation of the pear is the liability of the tree and foliage to be attacked by blight. The pear blight is more destructive in wet, warm seasons, especially when the trees have become weakened from any cause. Among the causes that may render trees liable to the disease are over-bearing, late cultivation or the application of fertilizer or manure late in the spring.

If the trees do not mature their wood in the fall, the destruction of many of the cells is almost certain by the cold; and during the warm, close weather of spring or early summer rapid fermentation will set in, and destroy the tree or a part of it. Sudden changes of temperature during the summer, or excessively moist weather, may also bring on both the leaf and fire blight, as it is called.

To avoid this disease we must cultivate and manure so as to keep the trees in a healthy condition. To this end, all manures or fertilizers used must be applied late in the fall or very early in the spring, and cultivation should cease early in August.

It is claimed by some investigators that this disease is contagious, and that it may be transmitted to healthy trees. This may be the case, but we generally find it confined in many orchards to a few varieties, or only to a few branches of the trees attacked. While it is admitted that it may be transmitted, — that the spores or germs of the disease may be found everywhere, — I am confident that if the trees are kept in a healthy, vigorous condition, few cases of blight will occur. The atmospheric changes we cannot control, but healthy, vigorous trees will be more certain to resist the attack of disease than weak ones. I have never seen a case of pear blight where there were not some conditions that might have resulted in a weakening of the tree.

Varieties.

Clapp's, Bartlett, Bosc, Sheldon, Seckle, Clairgeau, Anjou and Hovey are among the best.

The Peach.

1875.	No. of trees, 82,844;	yield, 15,945 bush.;	value,	$44,893.
1885.	" " 276,846;	" – –	"	1,839.

Although a native of Asia and China, where the climate is much less severe than ours, the peach with us is perfectly hardy as to growth of tree, when the wood is vigorous, and ripens perfectly.

The land best suited to its growth is a strong, sandy or gravelly soil, on the tops or western exposure of high hills. In such locations and on such soils the trees are more hardy, live longer and produce more fruit.

One of the great causes of the short life of the peach tree is the want of a sufficient supply of plant food, or its application at an improper time. If manure, or chemicals that are not readily soluble, be applied late in the spring or early summer, the trees will not get the benefit of it until late in the summer, and grow late in the fall. Such a growth is very liable to be injured during the winter.

The disease known as the yellows, probably, only attacks the trees when they are in a weakened condition from various causes, such as exhaustion of the soil, over-bearing, injury from cold and from borers. This disease is not incurable, for by the liberal application of such fertilizers as bone and potash and some additional nitrogenous manure, — if the soil be very poor, — trees that were thoroughly diseased have been made to start into vigorous growth again, and lived many years, — bearing two crops of fine peaches.

It may be more profitable, however, if such natural conditions as are beyond our control should bring on the disease, to dig up the trees and plant new ones. If the proper amount and kind of fertilizer be used, new trees may be planted where others have died, yet following an economical system of rotation, it would probably be more profitable to plant upon new land.

Perhaps the most important cause of weakening next to improper location, cultivation and fertilization, is the injury caused by the peach borer (ægeria exitiosa).

While the only perfectly reliable remedy is probably the knife, the use of washes, like linseed oil and paris green paint, lime, glue and paris green, or lime and gas tar, which are applied to the trunk for protection of the trees against mice, may also destroy many of the larvæ as they eat through the outer bark of the tree.

To insure a peach crop in New England every year, some method must be devised to protect the fruit buds from winter killing. Since 1882 we have had no crop north of Connecticut. Theories are numerous as to the cause of this destruction of fruit buds. Generally, they are destroyed if the temperature falls lower than fifteen degrees below zero and remains for a considerable time at that point, but not always. In the fall of 1885, many of the buds were destroyed when the temperature had not fallen below eighteen degrees above zero. Last season many buds were destroyed before December 1.

Among the plans proposed for the protection of the fruit buds, are bending over the trees by loosening the roots on the north side, and covering with soil, corn-stover or some other protecting material, tying the branches close together, and also tying them up in mats, straw or pine boughs.

In the experiments made at the College last fall, it was found that those trees protected produced no more blossoms than those that were unprotected, except, possibly, one or two branches that were covered with soil. The theory advanced by some parties, that the injury is caused by the washing off of the varnish or protecting substance of the bud scales, and the drying out of the moisture of the bud in very severe windy weather, led to the suggestion that this might be prevented by applying some solution which would harden over the buds, thus protecting them, and to the application last fall of a thin solution of paste made of wheat flour and a thin solution of common glue. This was applied early in December, but with the same results as the other experiments.

This fall, to make a more thorough test of the matter, we have used other materials. First, the thin glue solution; second, turpentine; third, linseed oil; fourth, turpentine and linseed oil; fifth, turpentine and hard oil finish; sixth, benzine and rosin; seventh, benzine and oil; eighth, shellac, a thin solution. These were applied with a hand-pump with a fine spray nozzle. It was found that one quart of the mixture was sufficient to cover trees with trunks four inches in diameter.

The past year or two has developed the fact that the white-fleshed varieties are more hardy and withstand our cold winters better than the yellow-fleshed kinds; but it has also developed the fact, that except upon very favorable soil and location, they are much more liable to rot upon the tree. They are also clingstones, which is a great objection.

It is very difficult to decide from our own limited experience what are the best varieties to grow. Alexander, Amsden, Waterloo and Early Canada are so nearly alike that it matters little which we plant. Coolidge Favorite, Mountain Rose and Old Mixon I would add to the list of white peaches. Of the yellow-fleshed peaches the early and late Crawford are perhaps among the best, and the self-perpetuating kinds, like the Pratt, Excelsior and Wager should be thoroughly tested.

The Plum.

1875.	No. of trees, 3,950;	yield, 1.769 bush.;	value, $3,481.
1885.	" " 67,590;	" 5,940 "	" 12,381.

The rapid increase in the importance of this crop is evidence that its fine qualities and ease of production are appreciated. It is perfectly hardy and only under conditions of neglect does it fail to produce an abundance of fruit. It will not be injured by extreme high cultivation and manuring, not making that late and immature growth that the peach and pear does under similar conditions.

The principal obstacles to be overcome in the cultivation of this fruit are the plum weevil or curculio, rotting of the fruit, and the black wart. The first is easily overcome by planting the trees in poultry yards, or by jarring them and catching the insects upon screens. Rotting of the fruit is perhaps remedied by thinning when not over one-half inch in diameter, by planting where there is a free circulation of air and by stirring the soil once a week during the summer until the fruit is nearly ripe. The black wart must be cut away with the knife and a vigorous growth encouraged.

Very early and very late varieties of large size are found to bring the highest prices. We have had so little experience with the varieties of plums in this State for the past few years that it is impossible to say which will be the best. We would name, in order of ripening, the following: Bradshaw, Washington, Lombard, Yellow Egg, Pond's Seedling, Coe's Golden, German Prune, and Victoria.

The Quince.

1875.	No. of trees, 3,000;	yield, 3,011 bush.;	value, $9,334.
1885.	" " 51,913;	" 5,406 "	" 11,770.

The quince is not a fruit that will probably ever be very extensively called for in our markets. Used for cooking only, but a limited quantity can be sold, and should the large number of trees planted the past few years all over the country come to maturity they will yield such a crop that very low prices will rule. The past season, New York quinces have been quoted in our markets at $2.50 and $3.00 per barrel.

It requires a deep, rich, moist soil for its best development. It is slow in growth and upon light land does not bear much until it is six or eight years old.

It is very much injured by the flat-headed apple borer (chrysobothris femorata). This borer does not work very deep into the wood and is easily destroyed with the knife.

A blight called twig blight, similar to that of the pear, is often injurious in wet seasons, but seldom destroys more than the end branches. The past season, which has been unequalled in the past forty-eight years for moisture and heat during July and August, has done great injury. A well-drained soil and good cultivation are the best preventatives.

Of the varieties, the Old Orange still retains its place at the head, Reas Mammoth is doing well in some localities, and the Champion and Meeches Prolific are promising, but require further test to prove their value.

The Cherry.

1875.	No. of trees, 12,040;	yield, 5,441 bush.;	value, $15,124.
1885.	" " 36,643;	" 5,030 "	" 12,048.

Although the number of trees has increased three-fold in the past decade, the product has fallen off. There is no fruit that is more delicious and healthful or more generally liked; but, unfortunately, our birds are as fond of them as we are, and the difficulty we experience in securing our crop from them, and the many insects that attack the tree and fruit, have greatly discouraged their planting in large numbers in the orchard.

The cherry succeeds best in a light, deep loam, and is less liable to injury from cold if the roots are covered by turf. The best trees we find now are those growing along roadways, where brush and decaying leaves supply the needed protection and plant food. In a rich, cultivated soil the trunks are often split open by frosts in winter. The plum curculio lays its eggs in the fruit, but may be destroyed as recommended for the plum. Of the best varieties, I would recommend Early Richmond, Yellow Spanish, Black Tartarian, Gov. Wood and Downer's Late

The Grape.

1875.	No. of vines, 224,352;	yield, 672,590 lbs.;	value, $67,259.
1885.	" " 356,553;	" 2,975,824 "	" 117,022.

While grapes are being planted in this country by the thousands of acres, there is little danger of an over-supply of choice, home-grown fruit in our local markets. While grapes were being shipped from the South and West to our local markets by the ton the past season, and sold at wholesale for from three to five cents per pound, choice native Concords, brought into market in a fresh condition, sold for from five to ten cents per pound, wholesale.

High, light, gravelly or sandy soil, with a southern exposure (upon which little else will grow), can be made to produce paying crops of the best quality. Thorough and constant cultivation, liberal manuring, careful pruning and training and a rigid system of thinning of the fruit are the secrets of success. Few insects are seriously injurious; disease seldom attacks vines in a vigorous, healthy condition, and the crop ripens four years in five.

Enough manure or fertilizer must be used to produce a vigorous growth, for upon the vigor of vine and leaf depend the size and quality of the fruit.

Pruning.

In all of the many methods of training and systems of pruning, one thing must be kept in mind, — that the growth of a small number of strong, vigorous canes and leaves will give better results than if a large number be allowed to grow.

The system known as that of renewal, — where fruit is grown upon one part of the vine, and upon another part new canes are being developed without fruit, which will bear fruit the following season, while that bearing fruit this season will be cut away, — gives the best results. Pruning may be done at any time after the leaves fall until the first of March. After that time vines will bleed more or less, which may or may not injure them, but certainly can do them no good.

Varieties.

Worden, Moore's, Concord, Brighton, Delaware, Lady, Empire State and Niagara are among the best.

STRAWBERRY.

1875.	Yield,	1,156,801 qts.;	value,	$214,940.
1885.	"	3,929,497 "	"	406,859.

The strawberry is pre-eminently a home fruit. Propagating itself as it does very rapidly, and yielding a return within one year from planting, there is no possible reason why every farmer's table should not be supplied with an abundance of fruit during its season.

For the past few years the crop has not been a very paying one, but I fear the growers are more to blame than the purchasers. The tendency of the markets has been to call for large, showy fruit, while growers in general have been adopting a sort of cheap method of cultivation, which could only produce small, inferior fruit, especially with such varieties as the Crescent.

What seems to be needed is better cultivation, better fertilization and more care in the preparation of the fruit for market. Of the two systems of cultivation, — the hill and matted row system, — it is unquestionably the fact that the former will produce the largest and best fruit, and if by economy of labor in the use of the horse cultivator more and the hand hoe less, we can reduce the cost of production a little, it will be the most profitable, for large, fine fruit will always sell at good prices, while small and inferior fruit will often not sell at any price, and only injures the market for that which is better.

Few insects injure the strawberry in this section, and under good cultivation most varieties are free from leaf blight. The white grub or larvæ of the June bug or May beetle is sometimes injurious when the plants are set on newly turned turf land, and are to be avoided by cultivating the land, for two years previous to planting with strawberries, with some clean hoed crop.

The varieties which have given the best results with us are the May King, Miners Prolific, Sharpless and Golden Queen. All of the new candidates for public favor have been planted, but require further trial to prove if they are any better for general cultivation than those mentioned.

The Currant.

1875. Yield, 146,588 qts.; value, $10,605.
1885. Yield, 318,588 " " 28,631.

The refreshing acid contained in this fruit makes it during the hot summer weather one of the most healthful and acceptable fruits. Its increase in cultivation in the past ten years has not been as rapid as its importance deserves.

For the production of large, fine fruit, and none other will readily sell, it must be planted in a moist, rich soil and given the best of cultivation. An abundance of manure must be used and all wood over four years old cut out, to encourage the growth of young vigorous canes. The best fruit is borne on wood two and three years old.

The Cherry and La Versaillaise are both good varieties, and both will produce large fruit, if properly treated.

Blackberries.

1885. Yield, 382,163 qts.; value, $38,624.

This is the most easily grown of the small fruits and yet one that is grown more under neglect than any other. For the best results a rather high, strong, gravelly soil is best. It requires good cultivation and a liberal supply of plant food. This especially during the ripening of the fruit. If the land is very light, some mulching material must be used during summer, while the berries are ripening. It is best grown in low hedges or hills and is kept low by pinching or cutting off the new canes when they are about two feet high. A second pinching or cutting back may be required during the summer if the canes grow so as to interfere with cultivation, but it is best not to prune after August 1st, until the leaves have fallen.

Of the varieties which are perfectly hardy and give general satisfaction, I mention the following in order of merit: Agawam, Snyder, Wachusett. Early Harvest, Early Cluster, Wilson and Wilson, Jr., are not hardy.

Red Raspberry.

1885. Yield, 335,694 qts.; value, $32,841.

This requires almost the same treatment as the blackberry. The fruit is rather more perishable and ships best in pint or third boxes, but some of our markets prefer them in quart boxes.

The varieties that may be said to be hardy, or nearly so, are Cuthbert, Turner, Marlborough, Hansel, Caroline and Golden Queen. Of these, the Cuthbert is the most vigorous and more largely planted. The Turner succeeds best upon a rather heavy soil. The Marlborough and Hansel are very early and promise to be valuable, although not as vigorous or productive as the Cuthbert. The Caroline is yellow, perfectly hardy, but too soft for market.

Black-Caps.

1885. Yield, 22,794 qts.; value $2,583.

This is the best of the so-called briers to grow on account of its not throwing up suckers from the roots, but remaining in permanent hills. If properly planted and pruned, the cultivation may be almost wholly done with the horse, cultivating two ways between the hills in the fall, and again during the spring, but letting the plants come together in rows during the summer.

The demand for large berries is large and increasing, and it will prove a profitable crop. It is more subject to the attack of insects and diseases than the red raspberry, but under good cultivation a plantation ought to remain in good condition for from eight to ten years. It is the practice of many growers to plant new fields every five or six years. Of the standard varieties the Doolittle or Souhegan, Centennial and Gregg, are among the best.

New Fruits.

In any list of varieties of fruits that we may make we find that few, if any, of them, are just what we would have them. We have no perfect varieties; there are always some points wherein they might be improved, and great interest has been awakened in the production of new varieties.

We want an early apple of large size, good color and fine quality, and a late one of as large size and fine quality as the Gravenstein, with the color and productiveness of the Baldwin. We want a pear that will keep as late as the Easter, of large size, good color and quality, equal to or better than Dana's Hovey. We want an early peach of large size, a freestone, of good quality and more hardy than any we now have; a plum, very early, of large size, good color, and of as good quality as the Green Gage. We want a grape as early, vigorous and hardy as the Moore, of better quality, and one that will adhere to the stem as well as the Iona, and that can be kept until the holiday trade. In the blackberry, we want a fruit as large as the Kittattiny or Wilson, perfectly hardy and of better quality than the Agawam or Snyder; in the raspberry, a berry as large as the Cuthbert, as vigorous and productive, but of better quality and ripening as early as the Hansel and Marlborough. We want a strawberry of the quality and form of the Hervey Davis or Henderson, with the size of the Sharpless or Jewell and the productiveness of the Crescent or Wilson.

There is a great deal of pleasure in testing new varieties, but more disappointment, as nineteen out of twenty prove of less value than the old standard sorts. New varieties should be tested at the public expense. For the past two or three years all promising, new varieties of fruits have been obtained at the College in hopes of learning their real value; but limited funds, which make it necessary for us to pay expenses by the income derived from the crops, must prevent our doing the work as thoroughly as otherwise we might.

Equipped with established plantations of all of the old, standard varieties of fruits, with a great variety of soil, as to quality, location and exposure, few places can offer such promise for success in this work. If a part of the fund to be derived from the Government, under the Hatch Experimental Station law, can be devoted to this work at the College, we can promise results very valuable to the people many years before any results whatever can be obtained from the Experiment Station, where there is hardly an apple tree even upon the ground, for comparison.

Cold Storage.

In the business of fruit growing we meet everywhere the necessity for some method of preserving a crop, or part of it, for a greater or less length of time, — to carry it through a glut or beyond its season, in order to realize paying prices.

Upon every fruit farm there should be a cold-storage house or cellar of some sort. It may be only a deep cellar, kept moist, if the crop is only to be carried over for a few days; but if to be preserved for a considerable length of time, some artificial means must be employed to lower the temperature. If ice is used for this purpose, air spaces must be arranged between the body of ice and the walls of the fruit room; and the inner wall must be made from six to ten inches thick, and filled with some non-conducting material, as sawdust, shavings or spent tan bark. If above ground, it must be made of two filled walls, with an air space between.

An underground fruit room has some advantages and some disadvantages over that above ground, but for economy of labor and cost it will probably prove more satisfactory.

After a careful study of the subject (in which I find few small fruit cellars that have proved entirely satisfactory), I would recommend a modified form of the fruit house successfully used by some of the Ohio grape growers. It can be easily constructed in any cellar where there is a room overhead for storing ice.

Fig. 1 shows a cross section, which explains itself. Should it be found that there was need of ventilation, windows or ventilators might be arranged in the double brick wall at *a*, *Fig. 1*, and if there should be too much moisture condensed upon the stone wall it will be readily carried off in the tile at *b*. The floor should be concreted.

Fig. 2 shows the ground plan. It is divided into a packing-room, a tempering room and the permanent storage room. One end should open on a level with the road, for convenience in loading and unloading. Such a fruit room could be easily and cheaply constructed, and I see no reason why it should not work as satisfactorily as if built above ground.

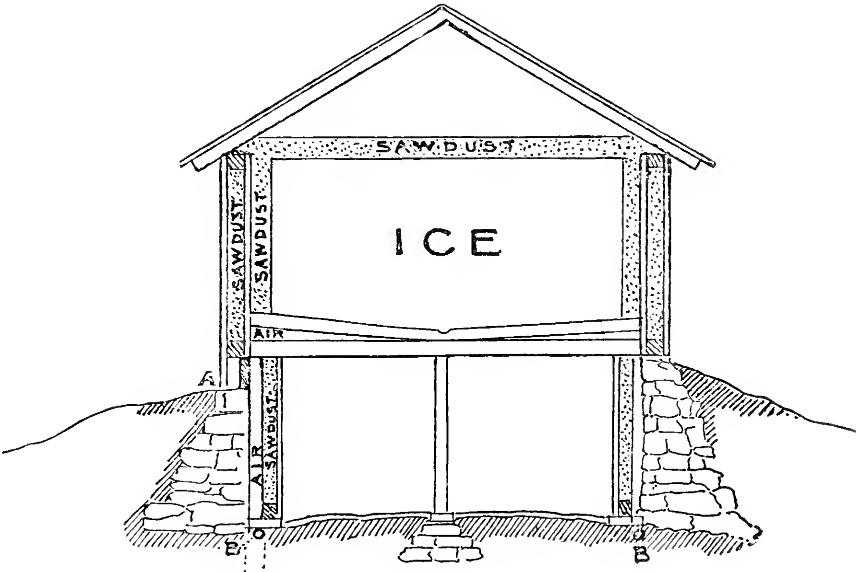
SAWDUST
SAWDUST
SAWDUST
ICE
AIR
A
AIR
SAWDUST
B
B

FIG. 1.

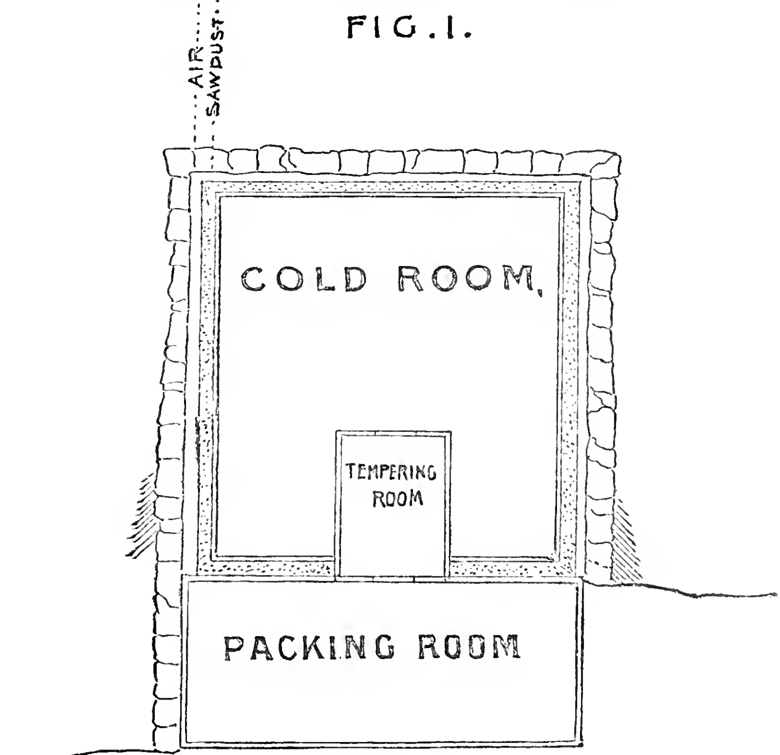
AIR
SAWDUST
COLD ROOM.
TEMPERING ROOM
PACKING ROOM

FIG. 2.

The CHAIRMAN. The Professor has given us abundant food for discussion. It is understood that discussions are to follow these lectures, and any questions or any remarks will now be in order. If gentlemen in the audience have any questions they would like to ask the Professor, they will never have a better opportunity to ask them than now.

Mr. WILLIAMS of Sunderland. What shall we do with the rose bug, that eats our grapes in the blossom? I have lost my crop entirely by the insect.

Prof. MAYNARD. In the vineyard there are very few cases where they cause serious injury. Where the vines are single a few are destroyed. Perhaps the best means of overcoming the rose bug would be to lay the vines down upon the ground, which would cause earlier blossoming, and in that way they ought to escape. Upon warm hill-sides they generally bloom before the rose bug appears in any great numbers.

Mr. GRAVES of Sunderland. I would like to inquire as to the best fertilizer to be applied to the apple and the quince?

Prof. MAYNARD. The best fertilizer for the apple I should say is wood ashes, but there are few orchards that would not be benefited by stable manure.

Mr. GRAVES. When should it be applied?

Prof. MAYNARD. Late in the fall, or very early in the spring. The apple is not a tree that is injured by winter killing very often.

Mr. GRAVES. Do you apply the same fertilizers to a bearing tree as to a young tree?

Prof. MAYNARD. Yes, sir. I do not know of any reason for not applying the same.

Mr. O. B. HADWEN of Worcester. I would like to inquire of the Professor if pyrethrum in solution will destroy the canker worm?

Prof. MAYNARD. It will do so. In the experiment made at the College two years ago pyrethrum was used at the rate of a pound to a hundred gallons of water, and within half an hour the younger and smaller insects that were not over half an inch in length were all destroyed; the larger ones were only paralyzed, and after a time began to crawl back. Jarring the tree will prevent that. If applied early it will certainly destroy them all.

Mr. MYRICK of Springfield. What is the comparative cost of paris green and pyrethrum?

Prof. MAYNARD. I believe we figured the cost of the paris green at about ten cents a tree. Pyrethrum costs sixty cents a pound and paris green about twenty-five cents.

Mr. HADWEN. I would also like to inquire if it has proved destructive to the codling moth?

Prof. MAYNARD. No, sir; we have not been able to affect them at all. But perhaps we were not as thorough and as careful in our experiments as we might have been.

Mr. UPTON of North Adams. One gentleman has made a very practical inquiry: What shall we do with the rose bugs? I have had that question to meet from year to year by the destruction of a certain portion of the blossoms upon my vines by the rose bugs. I got rather desperate one year. I did not know exactly what to do, but I said to myself, "I will apply the same remedy to the rose bug that I apply to the potato bug. I don't know what the result will be and I don't care; I only know this: it will either prevent the rose bugs from eating up the blossoms or it will kill my vines." So I applied paris green to my grape vines the same as I would apply it to the potato vines to destroy the potato bug. I gave them a thorough sprinkling with paris green, and the result was most satisfactory. The vines were covered with the insects, but I destroyed them entirely, did not injure my vines at all, and got a large and abundant crop that year. I am satisfied that paris green will do the work which nothing else will do.

Mr. BRIGGS of Springfield. You will often find small peaches covered with rose bugs. For the last six years I have used this means to get rid of them: I take an old rubber boot or shoe and put it on a bed of coals in an old pan or kettle, and in the early morning carry it around among my peach trees and grape vines, as close as I can get to them. The smoke is so offensive to the insects, that after two or three experiments you will not find a rose bug on a peach tree or grape vine.

Mr. BROOKS. I want to say a word about the apple. I have an apple orchard of about an acre and a half and I have applied three tons and a half of ashes to those trees. The result has been that I have got a good crop of nice apples the off year.

Mr. BRIGGS. The rubber smoke has the same effect on apple trees. I have never found an apple that was worm-eaten after using it in the way I have described. I have smoked the trees once a week for three weeks. The leaves seem to retain the smoke, so that the insects go away from them. I apply it as soon as the apple, grape or peach sets.

Mr. SLADE. Do you use rubber chips or whole pieces?

Mr. BRIGGS. I take pieces of rubber boots or shoes, put some coals in a pan, and set the rubber on fire. One panful will do the work on forty trees, walking just as fast as you can.

QUESTION. What time in the day?

Mr. BRIGGS. In the morning, when the dew is on.

Prof. MAYNARD. I do not understand what insects the gentleman destroys by the rubber smoke.

Mr. BRIGGS. It seems to destroy all insects that infest the apple, and particularly the rose bug on grapes and peaches. After two or three applications a rose bug will not touch a peach tree or grape vine.

Mr. SLADE. Does it actually kill them? Do they fall down dead?

Mr. BRIGGS. No, sir.

Mr. SLADE. What becomes of them?

Mr. BRIGGS. It leaves a stench on the leaf so that they do not go near it after that application.

Mr. SLADE. Do they go over to your neighbor's orchard and leave yours?

Mr. BRIGGS. Yes, sir. [Laughter.] Within six rods of my grape vines there are vines which are all eaten up by the rose bug.

The CHAIRMAN. We have with us a gentleman who makes fruit a life study, and who is always ready to speak on this matter. We ought not to allow him to be silent through this meeting. I am happy to introduce to you, Mr. P. M. AUGUR, the State Pomologist of Connecticut.

Mr. AUGUR. I came here rather to hear and learn than to communicate, and before I say anything I have a question which I would like to ask Prof. Maynard, which interests us very much, and it is this: "Will the Professor please state whether he has found any way of preventing the black knot on the plum, aside from cutting off and burning?"

Prof. MAYNARD. I do not know of any other remedy.

Mr. AUGUR. The black knot has been a very serious trouble with us. We have cut off the infected part and burned it, but the disease has still insisted upon staying with us.

Mr. Chairman, — I have been greatly interested in Prof. Maynard's remarks. I think there have been many excellent points brought out. He has gone over a great deal of ground, and it is hardly necessary that I should touch on anything where we agree. I will allude more, perhaps, to the results of my own observation and experience than aught else, — letting theories go. In regard to the apple, I will say that I have had very serious doubts whether it is best to plant it on hillsides, or in rocky, inaccessible places. We have not tried it, so I cannot say it is not, from my own experience; but I have an idea that in planting an apple orchard we should, in the first place, get the best trees we can obtain. I would avoid root grafts, unless they are crown grafts, where a single stalk is allowed to make the tree. A nurseryman at the West, who has had long experience, assured me that it was bad policy for nurserymen to grow anything else, because they had so many culls in the nursery. I feel very sure that it is a bad thing for the planter to take anything else, because the young trees are likely to be imperfect, and to lean as they grow up. Having got the best trees which we can obtain, large enough to have good heads, we plant the orchard on land which we can cultivate for three or four years, at least. That has seemed to me the best policy. I think we ought to avoid anything which seems like neglect in our orchards, and it is very satisfactory to me to see, three, four or five years after planting, an orchard which is beautiful and promising. I have seen orchards that have been planted in neglected places, where they have not been cultivated, and I know they sometimes do make good bearing trees, but I think such orchards are rather the exception than the rule.

Another point that I was thinking of in connection with orchard management is the matter of pruning, to which the Professor alluded, and in regard to which I agree with him. I think that sometimes trees are over-pruned and sometimes neglected in pruning. But I think, from my own experience, that the true way of treating an apple orchard is to prune the trees just as we want them when we plant them, leaving but very few leading branches, and no branches that we shall have to saw off afterwards. It is seldom that we do that, but I think we ought to do it; then we shall have beautiful, symmetrical trees. Of course, we must do a little pruning every year, as may be needed. In that way we shall get a very satisfactory orchard, and have no scars to heal over, and shall not have to resort to the various mixtures for covering large wounds.

In regard to the peach, I should feel disposed to make rather more of the disease often denominated "the yellows." I would not say that it is incurable, but I have had a considerable number of trees that I have not been able to cure. I have watched with a great deal of interest the investigations at the Massachusetts Agricultural College, an institution to which the whole country is indebted — [applause] — and I have hoped that Professor Penhallow's, Dr. Goessmann's and Professor Maynard's theories would prove to be correct. At the meeting of the American Pomological Society in Boston, knowing that the matter of the peach yellows was coming up for discussion, I took along some samples of diseased wood. President Lyon of Michigan said there was no question but what that was the specific disease, so we did not have any controversy about that. But what I was going to say was this: We have been believers in the use of potash. We have sometimes used eight or ten tons a year, largely in our peach orchard; and we have also used the muriates and different grades of potash salts. I have been hoping, — in fact, I have believed, — that a liberal use of potash would remedy the difficulty. But I am sorry to say we have not been able to report complete exemption from the disease. I sometimes think that a tree may have yellow blotches simply from neglect or from lack of cultivation, and not be seriously diseased. That is not what we call "the yellows." But when a tree throws out those wiry shoots, even if its foliage be a deep green, then we know that we have something to contend with. The first indication of the yellows we notice is that every small branch will have a few peaches that ripen prematurely, and instead of the color being shaded very evenly, we find it in spots, flecked, instead of being nicely shaded over. When trees have that disease we have not been able, — to any great extent, at least, — to cure them, and we have had to resort to pulling out. I would be very glad to believe that there is a specific, an absolute cure, for the yellows, but I certainly am skeptical about it.

In regard to the grape, we have an experimental vineyard which we have watched with a great deal of interest for quite a number of years, and as Professor Maynard, if I recollect right, did not say a great deal about varieties, with your permission I will say just a word in regard to them. Of course, the Concord is the standard for the grape as the Baldwin is for the apple, and among the newer varieties the Worden has given us very great satisfaction. I do not think it is quite as good a shipping grape as the Concord, but I think it is better for home use. The berries are larger, it is a little earlier, and for the million, for the little homesteads all over the country I think the Worden grape is one that should never be overlooked. Among the red varieties we find the Brighton, a most excellent grape. It is, perhaps, taking it all in all, as good a red grape as we have; at least, we think so. We have great hopes of the Ulster, a new grape, which we hope will make itself known. The worst thing which we find about it is that it seems to lack vitality. That may be from its propagation, as these new vines are often propagated from weak buds.

The Lindley (Rogers' No. 9), if it could escape mildew (we suffered badly from it this year), is a grape that we esteem very highly indeed. The Hurlburt (Rogers' No. 44) gives us very great satisfaction, and it is less subject to mildew than the Lindley. I consider it a very excellent grape and one that should be more widely known. The

Ives is a grape that produces well, but the quality is poor.

I do not know but I might differ with Professor Maynard in regard to manuring the grape. We have come to the belief that it is not best to manure the grape very heavily with nitrogenous manures, on account of the danger of giving a too succulent growth and of being troubled with anthrax, mildew, and the various troubles that come in consequence of a too rapid growth; so that we have resorted to the use of ashes, bones, and potash salts, with perhaps sulphate of ammonia or something of that sort, to give a moderate amount of nitrogen. But in manuring the grape I think that green, unfermented manures should be avoided. I agree most heartily with Professor Maynard in what he has said in regard to applying manure in the autumn. I think that is certainly the best time to make the application of manure to any kind of fruit.

With regard to the quince, Prof. Maynard spoke of the probability that there would not be a very extensive demand for this fruit. I think that is so, but I think the demand should be greater, for of all fruits for canning the quince, properly canned, is one of the very best, and I think it is exceedingly healthful. If families would use ten quinces where they do one, I think they would enjoy it and be the better for it. A few years since I was in Newark, N. J., and had an opportunity of calling on a gentleman there, Mr. C. F. Jones, who is an expert cultivator of the quince and very successful. He has raised quinces very much larger than any apples I see here, — so large that he has sold them by count at six dollars a hundred. I asked him what the variety was. He said, "The Orange Quince;" but they are different from any orange quinces that I ever saw. There comes the point. Mr. Jones has been heroic, if I may use that word, in the management of his quince trees. In the first place, he prunes them very carefully, taking out all dead and superfluous wood, and then in the fall of the year he takes well-rotted manure and spreads it around his trees, covering the ground a little farther than the branches extend. He puts on two inches deep of clear manure to lie during the winter and then to be forked in in the spring. I have tried that method. I have been so liberal with the use of manure that many would call it extravagant, but I will assure you that it tells. When you get quinces, fifteen of which will make a peck, and well colored up, people will buy them. I think we can afford to manure quince trees pretty heavily and take good care of them when we can raise quinces that will sell for six dollars a hundred; and when of that size they are not only good, but they are profitable. [Applause.]

Prof. J. W. Clark. I would like to ask Mr. Augur if he cuts his peach trees back when he applies potash?

Mr. Augur. In some instances we have; but we have not been able to eradicate the disease. When we cut a tree back, of course we get a stronger growth of young wood. So far, that is favorable. Now, since Prof. Clark has called my attention to that matter, I want to relate a little colloquy that I had with one of our fertilizer manufacturers, Mr. Hubbard, of the firm of Rogers & Hubbard, in Middletown. He wrote me last fall and said, "Come and see me; I have something that will interest you very much." Then he went on to say that he had completely cured a peach tree of the yellows; that the fruit was very large and fine, and that unless he had resorted to the use of manure the tree would probably have been dead. I called and looked at the tree. It had a beautiful, vigorous growth, the leaves were of a dark color, and the fruit was just as large as he said it was. As we went to the tree he said, "There, Mr. Augur, is not that a triumph?" I felt disposed to look a little critically at the tree and I saw that the fruit had those unnatural spots of red, and on a closer examination I found there were some of those wiry twigs coming out low down towards the trunk of the tree. I did not want to combat his views very seriously, but I said, "Mr. Hubbard, you have some large fruit there, but that tree is going to give out by and by. You may keep it along one year or two years, but you have got the disease in it and it will show itself. If it does not, just let me know." The greenness of the foliage is not always an indication of health. But I think the best possible treatment that can be given to a diseased tree, if you let it remain, is to cut it back and then apply your manures freely. Another thing in regard to a peach orchard is this: We have found that when an orchard reaches its maturity and begins to fail, then it is best to apply manure very freely indeed, and, as Prof. Maynard says, either in the fall or very early in the spring.

Prof. CLARK. The reason why I asked the question was this, that I have seen trees where fertilizers had been applied that did not seem to improve under the treatment, but when they were cut back severely then there was a strong growth, with good, thrifty-looking leaves. I do not undertake to contradict Mr. Augur and say there was no disease there; but still the trees made a good, strong, thrifty growth and were brought back to a condition of some value.

Mr. AUGUR. I think there is no way of rejuvenating a tree more thoroughly than by cutting back and getting a new growth.

Prof. CLARK. In regard to the quince, I found this year that the flat-headed borer was doing more damage than I expected. In looking for this insect, you need to look only on the south or southwest side of the tree. Where you see a spot which perhaps looks a little moist, as if the dew had stayed there longer than it ordinarily would, if you dig there you will be likely to find a very small flat-headed borer, and it is sure death to the tree if you do not get it out. In regard to applying manure to an orchard in the fall, I think it makes a difference where that orchard is. If it is on a hillside I should say, wait until spring; if on level land, where it does not wash, apply it in the fall.

Mr. AUGUR. A single word more in regard to paris green. I do not apprehend the least danger from its use if it is mixed in the right proportions. If you get paris green that is strictly pure and in good condition, use a teaspoonful to a pail of water, and make three applications with a hand-pump to the tree, one early and two later, I think you will secure perfect immunity from the codling moth, the canker worm, and even from the apple maggot.

Mr. BRIGGS. In regard to the black knot on the plum, I have tried for the three last years linseed oil. I take a paint brush and daub over those knots, and I find they stop growing and the tree keeps on as usual. I have tried it on forty trees where the black knot appeared and have had no trouble.

Prof. Maynard. Several questions have been handed in: —

First, "Peaches were formerly abundant in Massachusetts and all from home-grown trees, while there are very few grown now: what is the reason?" I think in the early growth of the peach the trees were not budded at all, and I find in many sections of New England the old stock of peach still existing. I found last summer trees forty years old near which were numerous younger trees that had come from the pits. They were of very good quality, — probably similar to the Pratt and the Excelsior, which are recommended as reproducing themselves from seed. It is probable that such trees would be more hardy and live longer than those that are budded. The fact that peach trees do not live longer is perhaps to be accounted for from the injury produced by borers. Whether the borers were abundant in the earlier growth of the peach we do not know; we have no proof, but it is possible that disease has increased more rapidly of late years and the trees have suffered in consequence. It may be that they have been increased by budding upon Southern stock, or any stock the wood of which is readily susceptible to injury. The fact that they have been budded would perhaps tend to produce weakness throughout the entire tree.

Second, "Can progress be made by importing seeds or stocks from colder regions?" That has been suggested, but I do not know of any experiments that have been made in the use of such stocks. If we can get varieties like the Pratt and Excelsior, which reproduce themselves from seed, it is desirable to grow them, from the fact that they are so easily grown that any one can produce his own trees.

Third, "The almond is said to be very free from the yellows. Would it make good stock to bud peaches upon?" I do not know that that has been tried at all. It is a matter worthy of experiment, and yet the yellows is not a thing which we need seriously to fear, if we plant upon high land, carefully cultivate, watch our trees and do not let them get weakened. The peach is not a long-lived tree. We can hardly expect to keep them a great many years, — not more than eight or ten on an average.

Fourth, "Is there any sure and available method of preventing the attacks of borers upon peach trees in gardens?" I know of no certain way except by careful examination. An examination in June and again in August, if thoroughly made, will prevent injury by the borer.

Sixth, "Are there any varieties of peaches that are hardy and bear every year?" Probably not. The buds of all varieties that we know of are injured by severe cold.

Seventh, "Which are the best three varieties for this State?" It is very difficult to say. We have grown so few peaches that we do not know which would be the most profitable. One year one variety perhaps produces more than another; the next year another variety is more prolific. Among the early varieties the Amsden, Alexander, Waterloo, and Early Canada, are hardy trees and they produce as much as any. The Early and Late Crawford are valuable, but all trees of the yellow varieties are tender. The Old Mixon, a white-flesh peach, is one of the oldest varieties and very hardy and productive. The Mountain Rose is also desirable.

Eighth, "My winter pears do not ripen well; how can I ripen them? They shrivel and are woody." There are very few winter pears which ripen well under ordinary treatment. Perhaps the best way is to keep them in a cool, moist atmosphere, and at the time of ripening bring them into a warm, dry atmosphere.

Mr. Cruikshank. I would like to inquire of Prof. Maynard if he knows any remedy for a disease in the apple tree known, in the northern part of Worcester County, as the canker. It will appear on a limb here and there throughout a tree. The bark will crack and turn black, and eventually the tree will die back to the stump. It is very seriously affecting a great many trees in the northern part of the county. I will say that it comes upon otherwise healthy trees. There will be a healthy growth of the rest of the tree, but these infected limbs will be found here and there, throughout the tree.

Prof. Maynard. I have noticed in connection with this disease, which attacks trees generally where they are perhaps wanting in plant food, that there are insects upon those spots. The mealy aphis is almost always found upon those spots. If Professor Fernald is here, he can probably give us the history of that insect and tell us of the remedy.

Mr. Cruikshank. I would say that we have been informed that an insect is the cause of it, but we have not been able as yet to find anything of an insect nature to which to attribute it. The only remedy we could find was to amputate the limb. The question is, what is the cause and what the remedy, otherwise than that?

Prof. Fernald. I do not know the insect at all. It does not hail from where I came from. There are many varieties of the aphis. I do not know the one to which reference is made. That must be a Massachusetts insect.

Mr. A. W. Cheever of Dedham. I would like to ask Prof. Maynard if this mealy aphis cannot be properly called the cotton aphis?

Prof. Maynard. Yes, sir. It has a white cottony substance on its body.

Prof. Fernald. We have a long list of names which might be applied to them, because their number is legion. I do not think I would harbor plant lice of any kind. Whether they are able to carry contagious diseases from one place to another is an open question. This raises the whole question of what is the cause of the yellows, pear blight, and so on. If they are contagious diseases, the question is whether these plant lice may not transport the disease to other trees? That is a queston of great interest. So I would not harbor plant lice at all.

Question. Whether or not, over-bearing is one of the prominent causes of pear blight?

Prof. Maynard. Not necessarily; and yet anything that weakens the growth of the tree renders it liable to the attacks of these fungoid growths. It is undoubtedly a growth similar to those. Fermentation sets in and the plant is not vigorous enough to overcome it. The spores are everywhere present; but pear blight always, or almost always, implies some weakness in the tree.

Mr. Myrick. What do you do for the apple maggot?

Prof. MAYNARD. Feed the apples to the hogs and cattle, or make cider of them.

Mr. MYRICK. Mr. Augur spoke about paris green as a remedy for the apple maggot. This insect is becoming a most serious pest in a great many parts of the country. I believe last year in Vermont it was exceedingly injurious. Some experiments up there with paris green have been very successful this year in protecting grape vines and orchards. The vines and trees were sprayed, and the trees were not only protected from the codling moth and the canker worm, but were also rendered more secure from the attacks of the apple maggot. Perhaps Mr. Augur might speak a little more in detail upon that particular point.

Mr. AUGUR. We have been very much troubled and not a little alarmed about the depredations of the apple maggot. Our tender-flesh varieties of early apples and some of our fall and winter apples, like the Hurlburt, the Hubbardston and the Fameuse, have been so badly infested that we hardly dared to sell them, because the internal damage was so great; they appeared to be almost worthless. We have never used, perhaps, insecticides so freely as this year, and not for ten years have we been so exempt from the apple maggot. I cannot prove that it is the effect of the insecticides, but I am strongly inclined to think so. Not one apple in fifty, even of our tender-flesh varieties, has been troubled. I cannot say that we have not found evidences of the ravages of this insect occasionally, but it has been very seldom, whereas some years we have found it almost universal among the tender-flesh apples.

Mr. MYRICK. Was it prevalent in neighboring orchards or in other parts of the town?

Mr. AUGUR. There are no orchards in our immediate vicinity of much account, but it has prevailed among other orchards in our town this year.

Mr. CHEEVER. I wish to ask about another trouble that fruit growers are having, which is what is called, I think, the apple scab. It is a disease that comes in blotches on the skin of the apple and the pear and also on the leaf of both of those trees. It increases after the fruit is harvested and put into the cellar. It hurts the looks of apples and pears very much and hurts their sale in Boston. If the Professor or any one in the audience knows of a remedy I should be glad to hear of it.

Prof. MAYNARD. I know of no remedy. It is certainly a fungus growth and it is caused by the wetness of the season, brought on by moist, close weather. For many years the Northern Spy has been almost wholly destroyed in our section by the same thing. It appears first on the outside and then works through, forming black and brownish spots through the tissue. Perhaps by improving the vigor of the tree we may overcome the difficulty, — to some extent, at least.

Mr. CHEEVER. It has been recommended to rake up the leaves in our orchards and burn them in order to kill this fungus. I do not like to burn leaves, I want to turn them in as a fertilizer; but if any one knows that burning the leaves will destroy this fungus and prevent its attacks in the future, I will burn my leaves and buy fertilizers.

Prof. MAYNARD. It is possible that the application of a solution of salts of potash might destroy the apple scab. We use this to destroy rust and mildew, and it is possible that a spraying of this kind might destroy the fungus. We have found this year that apples are much less affected by the maggot than they are usually. The Fameuse is very much less affected than last year, when it was totally destroyed. The Seek-No-Further was almost completely destroyed two years ago; there was hardly a specimen which was not riddled by the maggots. This year they are very few, and yet we have used no paris green. I doubt very much whether paris green can be used so as to destroy the apple maggot. It is possible it may be.

Mr. MYRICK. I see a gentleman here of whom I want to ask a question. He has always refused to answer the question I am about to ask, and perhaps his experience when I have asked him before has been such that it will be no use to ask him now. I remember three or four years ago visiting one of the best farms in the State of Connecticut and one of the best peach orchards of that State, and brother Van Deusen had drenched all those trees with a certain solution, evidently of sulphur and some other materials, which I believe he then claimed was a perfect protection against the borer. Whether that is a secret compound or not I do not know, but Mr. Van Deusen has had a little experience there which ought to be brought out, if it is possible to get it out of him.

The CHAIRMAN. Will Mr. Van Deusen favor us with his experience. If he has any valuable secrets he is not under any obligation to divulge them, but if there is anything which he can afford to tell us we shall be glad to hear from him.

Mr. VAN DEUSEN of Shaker Station, Conn. I will say that it is no secret, because we have sold it, and anything that has been sold is no secret. The orchard which my friend speaks of I remember very well. I have left it for four years and I do not think it has been kept in perfect order since; but for eight years, when it was under my immediate charge, I think it was a success. I will not say that the application which was made to the trees was so entirely successful that the orchard was absolutely free from the borer, but it was almost so. It would be an impossible thing to find a person in any profession or trade who was without fault and without failure. But the remedy is very simple and effective when properly applied. The orchard referred to has borne good crops the past five years, and probably it is as old an orchard and as good an orchard as there is in the country.

As regards fruit culture, we have heard quite a good deal which is interesting, comprehensive and covering a great deal of ground, and a great deal of truth has been said; but, in my opinion, it will become more and more apparent as we go on that every man cannot be a master in more than one department. If a man undertakes to be an architect, a horticulturist, and all those other things combined, it is an impossible thing for him to be perfect, I was going to say, in any one of them. If a man makes up his mind to become a horticulturist and loves his profession well enough to spend years and money to perfect himself in it, he will undoubtedly make a success. There is no question about that; but if a man does not have that feeling, he had better let it alone. It is a pet scheme with most of our friends to set out a few fruit trees, because the nurseryman comes round and shows them his fine pictures and induces them to buy his trees. They think it will be a very nice thing to have fruit in their gardens, and it will be; but when they have set out the trees they know no more about taking care of them than they do about tending a steam-engine, — and very few know anything about that. But when the time comes that a man will make it a business, and set out an orchard and take care of it, he can get somebody from Boston or somebody from New York who will be ready to buy his fruit. Why? Because they seek the best. When a man goes on to some mountain and sets out an orchard, and then lets his yoked-up oxen into it, to push his trees over and scrape off the bark, if a man comes from Boston to buy his fruit, although he may have forty or fifty acres of apple orchard, the man will look it over and say, "Those apples will not sell in the market; they are not what I want." A man came to our place from Boston this past season and wanted to buy our apples. He went into an orchard of about ten acres, looked the trees over, and said, "Well, Richard, what is the price of those apples done up in barrels and delivered at your station?" I gave him my price. He said no more until about the time of his departure and then said, "I will give you within five cents a barrel of what you ask. You ask $1.80 and I will give you $1.75." Now, my friends and neighbors have been glad to get $1.50 or even $1.25 a barrel for apples. That orchard had been well taken care of and this was the result.

One thing that has been spoken of to-day, and a very important thing, is in regard to marketing fruit. This man to whom I refer has had our apples once before and when I sent them to him I said, "I will never hear another word from those apples after they are delivered at the depot;" and sure enough I never did, except that he sent a check to pay for them. I said this year, "I am going to put those apples up so that there will be no fault found with them," and there never was until the man found that somebody would let him have apples for $1.15, $1.20 or $1.25 a barrel, — a little less than I offered them for; but he said, "The apples are very good and I am going to stand it."

The secret is, always grow a good article and you will find enough people ready to buy it. My method is to have the apples picked and handled carefully. I have said to the hired man, "Handle them just as carefully as you would eggs; don't dump them as you would stones." I have for three years kept Greening apples into May. I think that one of the most important things is to be honest. When a buyer sees that you put all your best apples near the head of the barrel, perhaps two or three rows deep, he will be suspicious of you. I have been taught by my Shaker religion to be about as good one day in the week as another — [applause]; — but a good many people want to put their best garments on the outside. When a woman goes to catch you she puts on her finest dress and finest bonnet. [Laughter.] But I say, when the buyer finds your apples just the same throughout the whole barrel he believes in you and in your apples, too. A man in Hartford the past year, my friend Hale, put an advertisement in the paper saying, "Any basket of peaches that I offer for sale, if it is not just as good all through as it is on top, I will take them back and refund the money." I went into his shop and said, "You have made a great assertion, with as many thousand baskets as you have got." Said he, "Richard, I hold to it to-day." If he did that he has done something for which he is entitled to the gratitude of the community and set an example which every one should follow. If you sell a man second quality fruit he is never satisfied afterwards, he is always complaining; but if you sell him a good article, one that is just what you recommend it to be, he always comes back to you again. And so it is with all the products of the farm. A man who never expects to sell but one barrel of apples or one crop to the same man will not care so much about his reputation; but when a man cares about his reputation, and is careful to see that his products are what they should be, his customers will come to him a second time.

Mr. ———. Mr. Van Deusen has told us how to dispose of our apples after we have got them, but he has not told us the secret of how to get them. He seemed to avoid the point that he was called upon to answer. He has approached it, but has worked right round it. Now let us know how to produce the good apples.

Mr. Van Deusen. I said there was no secret. I will sell it to you if you want it. [Laughter.] To be honest about it, I don't know as I can tell here what it is. It is really nothing that I need keep from the public. It was made from linseed oil, whale oil soap and sulphur. I believe there was one other ingredient. I have not used it for the past three years; I have been growing Durham steers. I have got into another line of business and my mind has rather left it. [Laughter.]

Mr. Myrick. You have forgotten what the other ingredient is?

Mr. Van Deusen. Yes, sir. If anybody is very desirous to have it, I can forward it to him. [Renewed laughter.]

Mr. Briggs. The gentleman last up spoke of the price he received for his apples. For the last two years I have been selling apples in the city, and this year I obtained from $3 to $3.25 a barrel.

Question. What varieties?

Mr. Briggs. They are Baldwins. I have sold in this town to quite a number of men whose word is probably as good as their bond, and they say they have kept until the last day of August.

Mr. Myrick. Those were sold to families for consumption, not to dealers?

Mr. Briggs. No, not to dealers.

Mr. Van Deusen. I want to say that selling 800 barrels at once, and putting them all in at our station, is a very different thing from selling them in town, carrying them up two or three flights of stairs, and delivering them a bushel at a time.

Mr. Briggs. I had 150 barrels of apples from a young orchard this year. I have not sold a barrel for less than $2. There is no secret about raising them. [Laughter.] Every apple is packed stem down from bottom to top. If it takes a small apple to fill a space when I am going round the circle I take a small one and put it in.

Mr. THOMPSON of Thompsonville, Conn. What time of the year do you commence picking your apples? This year the Baldwins dropped unusually early. If there is any remedy for early dropping I would like to know it.

Mr. VAN DEUSEN. I think that is an important thing. Where a man has a good many apples he will have to pick some of them a little before the proper time for doing it. About the first of October a party came to me and said, "I don't want you to pick those apples until about the middle of October." I said, "Some of them must take harm; some must be picked a little bit too quick, and others a little bit too late. If you will leave this to me I will do just as I am a mind to. I am not going to leave them so; they will drop on the ground, and you don't want dropped apples, you want picked ones." So I went to work and picked them, put them into barrels, left one head out and put them into the barn. This party found that I was picking the apples, and he wrote me, "Methinks you are picking your apples too early." I sat down and wrote back, "Methinks I ain't; methinks I know my business." I went on picking and after a time there came a gale, and a good many of the apples of our neighbors, and some of ours, went to the ground. We ought to be careful not to delay picking our fruit too long. When an apple is ripe it has reached its best; from that time forward it goes the other way. If you want it to keep well, pick it a little before it is ripe. It is a great deal better than to wait until it begins to decay.

Prof. CLARK. I have found that apples this year have ripened a good deal earlier than usual. It is a great deal better to pick them a little early, rather than to pick them a little late. I think this is a good rule that any of you can follow. Take an apple from the ground, cut it open, and if you do not find a worm inside, it is time to pick your apples.

Adjourned to two o'clock.

Afternoon Session.

The meeting was called to order at two o'clock, Mr. Brooks in the Chair.

The Chairman. We are to have first this afternoon a lecture on Forestry and Arboriculture in Massachusetts, by Prof. John Robinson, of the Peabody Academy of Science, Salem. I have the pleasure of introducing Prof. Robinson.

FORESTRY AND ARBORICULTURE IN MASSACHUSETTS.

BY PROF. JOHN ROBINSON OF SALEM.

Ladies and Gentlemen, — It has been concisely stated in the report of a forest commission of a neighboring State that "a wise economy in the use of the natural resources of a country should recognize the fact that certain regions of the earth's surface are adapted by nature to remain covered with forests, and that any attempt to devote such regions to other purposes can only be followed by failure and disaster." *

Through the work on the forests of the United States, published in connection with the census of 1880,† it is now possible to form a correct estimate of the immense economic value of our forests. In this volume full accounts are given of the four hundred trees which make up our forest flora, and nearly every one is shown to possess some special value or adaptation to special surroundings.

A knowledge, too, of the physical importance of the forests, as shown by a careful study of the effect produced by their removal, both in this country and in Europe, is becoming widely disseminated.

With the destruction of the forests the springs disappear and the flow of water in the rivers is often so much reduced in summer that navigation is suspended and machinery stopped, while in the spring the rains and melted snows pour down in destructive torrents the waters which the for-

* Report For. Commis. State N. Y 1885, p. 5.

† Forest Trees of N. A., Rep. U. S. Census, 1880, Vol. IX.

mer forests in a great measure held back for gradual distribution throughout the season. Storms of wind and pelting hail sweep resistlessly over the bared lands, the fury of which was checked, or entirely abated, by the tall forests of the past. Our seasons are considered hotter in summer and colder in winter than formerly, and the frosts reach deeper into the soil and remain there longer in the spring.*

It would be difficult to determine just what percentage of the land should remain covered with forest growth in order to meet all the requirements of man, and at the same time preserve a proper climatic balance. According to the soil and atmospheric conditions of the locality, its distance from the ocean and the direction of prevailing winds, a variation of from ten to thirty-five per cent. of forest cover may be given as some indication of the proportion required.†

Here in Massachusetts, one of the most important services which can be rendered by the forest trees is that of binding together and retaining in place the shifting sands which cover such large areas of our sea coast. In many cases a thoughtless destruction of the trees which formerly grew near the shore has allowed the encroaching sands to overwhelm territory once under cultivation. In one familiar instance an apple orchard at Ipswich lies buried to the upper branches of the trees in a mass of fine white sand.

It is gratifying to know, however, although we have suffered by this destruction of trees on our exposed coast, that one of the very few examples of the ability to successfully replant these waste shore lands, and at a comparatively small cost, is to be found in the plantation of pitch pine in the south-eastern portion of our State. Of these it has justly been said: — "The real progress in sylviculture in Massachusetts has been made by the farmers of Barnstable and Plymouth counties, who have taught us how to plant and raise forests successfully and profitably, under the most

* "The Earth as Modified by Human Action." G. P. Marsh, chap. III., pp. 148 to 397.

† *Ibid.*, also Fernow, Report Forestry Bureau. 1886, p. 153, note.

unfavorable conditions."* The cause of their success is that they took their lessons from nature and not from foreign books, and used for their plantations the trees natural to the soil.

Owing to the nature of our American institutions we have in this country a much more difficult problem to solve, in determining the methods by which to preserve existing forests and to replant those already destroyed, than is encountered in Europe, where public opinion is already educated to comprehend the necessity of stringent forest laws. To quote again the report first referred to:† — "A forest law to effect its purpose must rest on a broad and solid basis of public interest. The only real safety for the forest will be found in the appreciation of its value by the community."

The terrible destruction of the forests in this country, pursued of late years in the most wickedly wasteful manner, combined with the forest fires, but little restricted as yet (and which annually destroy more timber than is used for all mechanical purposes together), if continued, will transform into deserts some of the most beautiful and valuable territory in the United States, and convert lands which might be perpetually covered with timber into woodless, uninhabitable barrens.

It has been estimated that the immense consumption of white pine, together with the wasteful methods practised in cutting it, will entirely exhaust the marketable supply in the three great pine-producing states of Michigan, Wisconsin and Minnesota in "a comparatively short time."‡ And even if the vast resources of the South be added, and all the woods capable of being used interchangeably with pine be summed together, it will take but fifty years,§ at even the present rate of consumption, to produce a similar effect in the whole United States. This has led speculators to purchase large areas of Western and Southern forests.

* Some additional notes on tree planting. C. S. Sargent, Rep. State Bd. Ag. Mass. 1885, p. 377.

† Report Forest Commis. State N. Y., 1885, p. 28.

‡ Report U. S. Census 1880, Vol. IX., p. 490. "Twelve or fifteen years" is given as an estimate of the time by the N. Y. Nation, Feb. 16, 1882.

§ See Rep. U. S. Ag. Div. Forestry, B. E. Fernow, 1886, p. 157.

It is stated in the last report of the forestry division at Washington, by Mr. B. E. Fernow,* that the Bavarian government recently sent an expert to this country to examine into our forest resources and the demands made upon them, with the view of profiting by our miserable plight. Upon being questioned as to his mission this agent answered: — "In fifty years you will have to import your timber, and as you will probably have a preference for American kinds, we shall now begin to grow them in order to be ready to send them to you at the proper time."

It may not be possible for a German State to grow timber for the American market in fifty years, but the statement shows, however, the superiority of German over American methods in forest management. It also shows that an expert from a country where forest questions are fully understood agrees with American writers in estimating the time we shall take to destroy the lumber-producing forests of the West.

Our special interest is of course centered in the effects of the removal of the forests in our own State and the necessities for reforestation and the extent to which it should be carried on here. We are, according to the way we look at the matter, in a fortunate or an unfortunate position in Massachusetts.

The geographical position of New England, coming as it does within the influence of the moisture-laden, ocean breezes, assures for us a sufficient and evenly distributed rainfall, and makes the forest of less climatic importance than in the interior of the continent.

Therefore, although the data and the startling conclusions to be drawn from them, in relation to the calamities which must inevitably follow the destruction of the forests, are all important, and as patriotic citizens we should seek to avert those dangers which threaten, through forest destruction, our national prosperity, still, here in Massachusetts, the destruction of the forests outside of New England, however improvidently it may be pursued, will never in any probability injuriously affect our climate, water supply, or gen-

* See Rep. U. S. Ag. Div. Forestry, B. E. Fernow, 1886, p. 155, note.

eral health. In fact, it is quite possible, if the present methods of lumbering are persisted in, that the price of timber will advance sufficiently to enable our people to engage in forest culture on quite a large scale.

Our original forests were long ago cut, but owing to the decline of some other agricultural pursuits and the growing interest in forest culture, the woods throughout the State are likely to increase rather than diminish in quantity and to occupy many of our pastures and present bare and rocky hillsides. It therefore becomes important for us to care for our growing forests, and by judiciously selecting species and properly planting new ones, be prepared to have what timber we can to sell to our friends and neighbors when the fifty years' supply now standing in the American forests is exhausted. In the position we hold in this respect we may be considered as fortunate, or, at least, there need be no danger of meeting with misfortune.

Taken by itself, however, Massachusetts is in one way unfortunately situated, for the reason that the two great rivers of importance in connection with our manufacturing interests, the Connecticut and Merrimac, both take their rise a long distance to the north of us in New Hampshire. Any attempt, therefore, to control the flow of their waters by systems looking to a retention of a forest growth on the mountain slopes at their sources is absolutely impossible, as far as the power of Massachusetts to do so is concerned.

The same may be said of some of the smaller rivers which furnish water power to mills in other portions of the State. In fact, the only streams at whose sources the State could by any means within itself regulate the cutting of the forests or replant denuded hillsides are some of the smaller tributaries of the Connecticut and the Housatonic.

As this state of things has long existed here, many manufacturing corporations have supplemented their water power with steam, or have provided themselves with reservoirs which control in a more or less satisfactory degree the flow of the water in the streams upon which their business depends. Thus, at great expense, provisions have been made to take the place of the forests, the natural regulators of the rivers, although, even with these safeguards, a system of protective forest management is of the utmost importance at the sources of our two great rivers in New Hampshire.

In 1883 a commission was appointed in New Hampshire to inquire into the condition of the forests of that State and report what action might be advisable for their protection. The report, which was printed in 1885, is of much interest to us in Massachusetts, for it is encouraging to know that, aside from the effects of forest destruction in New Hampshire alone, it considers the effect of such destruction on the rivers upon which so many manufacturing towns in Massachusetts are situated. There is also much information of practical value to be gathered from this report in relation to methods of re-forestation and the selection of species to use, which, owing to the similarity of soil and climate, are as applicable to the Massachusetts as the New Hampshire plantations.

These suggestions naturally point to the importance of co-operation in matters of forestry. We are as a country admirably situated to control our forest affairs for the protection of our rivers, and to prevent, as far as it is possible to do so, undesirable changes of climate and injurious mechanical influences.

Except, however, in a few instances like that of New York, which contains within its own borders the sources of its most important stream, the individual States, cut out regardless of natural divisions, are without power to establish any system of forest management which will be of the slightest benefit to themselves or protective of the industries carried on by their citizens. On the other hand, it may be possible for a single State, by a bad forest policy, or by no policy at all, to injure or even ruin the property in a neighboring State, while having no vital interests of its own to suffer.

It is hardly to be expected that legislatures will be so bound by the golden rule as to enact laws for the protection of their neighbors when they are as yet too often indifferent to the importance of such action to protect the interests of their own citizens, and hence we are forced to the conclusion, that to be effective and just for all, our forest policy must be a national one. Such a policy should be paternal in its nature, and yet leave in the hands of the individual States the power to regulate forest matters not inconsistent with the welfare of the country as a whole.

We Americans do not like to be hedged about with legal restrictions. The land in a great measure, especially in the older States, is in the hands of the farmers. Outside of New York but very little of it is in the hands of the State governments. It therefore becomes evident that the people must be educated to their necessity, before sufficient and satisfactory laws can be enacted and carried out to protect and preserve our existing forests, or to reforest regions already stripped of their cover.

The forests of this country are its most valuable property. They are perhaps the most important as they are the most accessible forests in the world. They are of the utmost value physically and commercially, and their destruction is imminent. We have no forest policy, no school of forestry, and but few educated forest experts to look to for advice or to direct a forest policy, provided one is ever adopted. What then is to be done? We must have a national forest policy and establish a national forest school.

Much has been said and written of late in relation to forest schools and instruction in forestry in our colleges and agricultural institutes. As far as this may serve to give the student a general knowledge of the underlying principles of the subject, and through him diffuse a sense of the importance of governmental action and the reasons therefor, it is well and good that such instruction should be given. With a majority of students, however, the time devoted to their college work is so short, and their desire for other courses of study is so great, that any attempt to produce skilled foresters by the system now in vogue, or with the present available corps of instructors in any of our colleges, or in connection with other courses of study, must inevitably result in miserable failure.

One very important factor in connection with the study of forestry is too often overlooked. Taking it for granted that it is possible to produce an expert forester in this country by a course of study in any of our institutions of learning, or that a fully equipped forest school should be established, the man who desires to become a forester will naturally ask the question, "What employment can I obtain when my education is completed to warrant this great outlay of time and money?" And under the present condition of things the answer must be, "There is none."

A nurseryman may find employment, or a landscape gardener, even, to take charge of some public park or private plantation; but there is not now in this country a single opening for a trained forester. Therefore, until some occupation is guaranteed, there can be no students of forestry, for the demand must first come in this case to create the supply.

It is absolutely necessary that the establishment of a forest school should be preceded by the adoption of a national policy of forest protection and by the appointment of forest commissioners, forest inspectors or a forest guard; for, until it has been irrevocably determined to preserve and maintain public forests, the forest school would be useless and no student would join it on account of the uncertainty of future legislation.

The policy being determined upon, it would have to be carried out for the first ten or fifteen years by comparatively inexperienced persons, but, eventually, students trained in the school would be available for administrative positions.

Private forest schools, however munificently endowed, would bear the same relation to a national school that the private military academies, which have sprung up throughout the United States, do to the West Point Academy. Their graduates would not be sure of Government employment and there is no one but the Government, now at least, to employ foresters.

The forest school should be conducted on precisely the same principles as the United States Military Academy. Students should be accepted on a competitive examination and receive pay or allowance from the Government as provided for the West Point cadets at the present time. The course of study should extend for a term of five to eight years and the students be given, when graduated, a permanent appointment in the forest service, with opportunity for promotion. In this way and in no other may we expect students to attend a school of forestry, if one should be established, or can we ever have a forest policy or a system of forest protection and preservation worthy of the name.

If the first work of the Government was merely the establishment of a forest guard, and nothing more be accomplished than to partially restrict the forest fires which are now so destructive, it is certain that an amount of timber would annually be saved much exceeding in value the cost of such service.

Even here in Massachusetts, notwithstanding the comparatively small size of the trees and the isolation of the forests themselves, and in the face of the penalties affixed for setting forest fires, there was destroyed in 1880 alone wood to the value of upwards of one hundred thousand dollars,—covering fourteen thousand acres of land.* This fear of fire discourages investments in woodlands and sends capital, which naturally would be used for this purpose, in other directions in search of greater security.

The injury done to woodlands by browsing animals, by exterminating seedling trees, and barking those of larger growth, is, on the whole, as great, and in many cases greater, than that done by fires. Browsing domestic animals not only injure the woodlands directly, but they prevent a future growth by eating the seeds as well as the young trees.

The preference shown by hogs for the sweet fruit of the white oak, beech and chestnut is causing these species to become replaced in our forests by less valuable but bitter fruited trees. In California, too, the sheep are endangering the life and perpetuation of some of the finest forests in the world.† The unscientific methods of farming which permit this practice are to be condemned and should be corrected at once.

It would be a wiser economy for us in Massachusetts to provide pasturage for browsing animals by a higher cultivation of the land, so that the largest number could be pastured on the fewest acres. It is certainly a bad policy which obliges cattle to travel all day for a miserable subsistence.

* Forests of N. A. Rep. U. S. Census, 1880, Vol. IX., p. 500.

† *Ibid.*, p. 492. See also "The Earth as Modified by Human Action," G. P. Marsh, p. 382.

The land which is naturally adapted for a forest growth is not suitable for pasturage: and inversely, the land which is suitable for pasturage is too valuable to be given up to forests.

The economic value of the forests of Massachusetts may be summed up in a few words, — enough, however, to show the importance of fostering care to preserve our present forest growth and of encouraging its increase. The value of the wood used for fuel in Massachusetts reached, in 1880, a sum of upwards of four million six hundred thousand dollars; and, aside from this, capital to the amount of two and one-half millions of dollars is invested in lumber manufacturing in this State, in which business thirty-one hundred hands are at times engaged, to whom nearly half a million dollars are annually paid for wages.*

This is in a State which is hardly considered in making up the lumber statistics of the country; and yet we have at Winchendon some of the most important wooden-ware manufacturing establishments in the world.† We must feel, therefore (small as we appear on the map, and insignificant as is our position in the list of lumber-producing States), that we have industries in wood by no means to be despised, and which, owing to the favorable condition of the climate and soil for the production of certain useful woods, and the changes taking place in the uses of land for agricultural purposes, may be profitably encouraged and greatly developed.

The only forest planting, however, likely to become general here must be upon a small scale. For such plantations no tree is so well adapted both to soil and climate, or so free from destruction by drought, disease or the attack of insects, as the white pine. It is readily obtained, easily cultivated, and is more certain to bring profitable returns, — and that too in a shorter time, — than almost any other species. For drier soil and upon the sandy coast the red pine or the pitch pine may, of course, be substituted, with a success proved by actual experiment.

Profitable plantations of European larch have also been

* Forests of N. A. Rep. U. S. Census, 1880, Vol. IX., p. 486.

† *Ibid.*, p. 501. "The most important point in the United States."

made here: and the Douglas fir, to which attention was called in a previous paper* (in a small plantation in the eastern part of the State†), has shown promise of rivalling some of the native conifers by its strong growth; but the seeds and young plants of this species must of course be of Colorado stock to succeed in this climate.

Of the deciduous trees, the hickory, ash, chestnut and rock maple are the most desirable for us. They furnish a sufficient variety of this class and are sure to produce timber of marketable value. To reduce this list still further, the farmers of Massachusetts are safe if they centre all their efforts on the white pine, ash, hickory and chestnut.

The ash thrives here in perfection, and as its wood must always be in demand for tool handles, for which purpose alone immense quantities are annually used, it is a most important and valuable tree for our plantations.

The hickory, also used for tool handles and wagon wheels, is no less important, and as good hickory wood, like ash, is growing scarcer every year, it should be planted whenever possible.

The chestnut is a tree of rapid growth and is, for various reasons, the most desirable species to plant here for the production of fence posts and railroad ties. To be sure, these trees require good soil, but they could be planted by the roadsides and along division walls and fences much more than at present.

Too much cannot be said to urge our farmers to plant each year some hickory nuts or chestnuts, or to care for the natural seedlings of these trees. This is the simplest form of forest tree culture, the easiest and the least expensive. It would occupy but little time, and if generally pursued the value of the farms of Massachusetts would be immensely increased.

By enclosing any young natural plantations, protecting them from fire and from browsing animals, and weeding out worthless over-topping trees, a sure profit may be obtained from thousands of acres of land in Massachusetts now practically of no value.

* Ornamental Trees for Mass. Plant. Rep. St. Bd. Ag. 1880, p. 23.

† Estate of Mrs. John C. Phillips, N. Beverly, near Wenham Lake.

Many accounts have been published, substantiated by figures, of the profits of tree planting in New England, and even if we allow an enormous margin for accident and occasional failure, an average result of fair profit is most certainly assured, larger in proportion than can be shown for most agricultural crops where the original outlay is no greater.

A recent editorial in one of our leading daily journals* on "abandoned farms" in Massachusetts, gives a gloomy picture of the deserted fields and rapidly decaying houses of the once well-kept and profitable farms, and asks the question, Why is this so? The answer given, is: first, because the expense of fertilizing is so great; second, that less labor in other directions will bring larger profits; and third, man's instinctive dislike to isolation.

The ease, cheapness and rapidity with which all produce can now be delivered at our doors, even from places as far off as California and the tropical islands to the south of us, have brought the fruit and vegetables from these distant regions in direct competition with the earliest forced products of the farm and market garden. This, together with other causes, has made a great change in farm practice in New England, and renders it imperative that means should be devised to meet this competition, and also to find the best ways of utilizing these deserted farm lands; although it should have been stated that no really good farming lands have ever been deserted.

The article referred to suggests one remedy in the theory of "ten acres enough," and says: "If would-be farmers would content themselves with ground which they and their children could cultivate unaided, and devote themselves to selected products, there would be less disappointment and fewer failures among the farmers of New England." But strangely enough, nothing is said in relation to planting these worn-out and deserted farms to forests, although a hint is thrown out in this direction when reference is made to "trees which have grown up in the fields formerly plowed and sowed, so that the owner is already counting their value at some lone saw mill."

* Boston Daily Advertiser, Nov. 2, 1887.

These very lands, however, which nature never intended should be farmed, might be wisely and profitably planted with white pine, and as the taxes in that case would be remitted under our laws, and hence be no further burden in that respect for ten years, the owner, while following the advice previously given as to small farms and selected products, could at the same time be making an investment which would at least insure profit to his children.

So many sources are available for obtaining information in regard to tree planting, the proper varieties to select for certain soils, methods of cultivation, thinning and pruning, it is not necessary to speak of these matters here in a merely general way. It is certain, however, that a studious man of ordinary intelligence and tact will bring about better results for himself than any hard and fast rules, laid down in books, can do for him. It is to the practical application of lessons taught us by observing our natural forests, and the results of patiently conducted experiments, that we may look for the exact rules which will govern the work of the future planter, and which, inasmuch as this subject is for us a new one, we must find out for ourselves. To use the words of a recent writer:* — "As in the medicine the charlatan will prescribe without diagnosis, so in forestry he must be called a charlatan who would attempt to give rules applicable to all conditions and under all circumstances. A diagnosis not only of the local conditions as to soil, climate and flora, but also of the objects and financial capacity of the would-be forester, must precede special advice."

Aside from the question of forests and their relation to commerce in forest products, which pertain comparatively to a few, there is very much to be gained here by the encouragement of roadside and ornamental tree planting. This should not be lost sight of for a moment, as in this nearly every one of us may participate.

Any observing person, during the last twenty-five years, must have noticed the rapid and gratifying increase in yard and window gardening in almost every village and town. Not only in quantity but in their quality, too, a marked improvement is to be seen in the plants grown. This prac-

* Rep. Forestry Div. Dep. Ag. Washington, 1886, B. E. Fernow, p. 223.

tice is already being extended to the cultivation of attractive trees and shrubs, and it only requires the encouragement of good examples to develop it to a far greater degree.

Good opportunity, too, is offered in our rural cemeteries for planting a great variety of ornamental trees. There is no place where they could be grown more appropriately; and yet there are but few cemeteries in our country towns where much if any attention is paid to this matter, and in some cases they are positively repulsive in appearance.

Vast improvements have been made in the cemeteries in the vicinity of cities during the last fifty years, but most of the others are as yet nothing more than modern graveyards, which do not even possess the quiet attractiveness of those of the earlier colonial period where, without the pretentiousness of modern "monuments," the inconspicuous slate head stones, scattered among the trees, harmonize with the scene. There is room for much good work in this direction by the village improvement associations.

"The new industry," as the increase of summer visitors to the shore and country is now called, has a considerable influence on the cultivation of ornamental trees throughout the State. Those who establish summer homes on the sea shore, or in the rural districts, are favorably disposed to the trees; and indeed, the value of many estates for this purpose is in a great measure dependent on the condition and position of the trees upon them.

It is to this class of residents and their influence that we are indebted for the greater beauty and healthfulness of many towns. This work of beautifying country homes is being so far extended, that some of our older villages in the western part of the State are being transformed into charming parks and will in time vie with the much praised countryside of Old England.

In a paper read before this board in 1880,* the subject of suitable trees for ornamental plantations was fully considered as based upon the study of the climatic conditions under which the trees best thrive. The conclusions drawn were that, for New England (with few exceptions), New England trees are the best; that many additional species may be

* Ornamental Trees for Mass. Plant. Rep. St. Bd. Ag. 1880, p. 23.

taken from the forests of the middle States and Alleghany Mountains and a few from the Rocky Mountain region, and also that the exotic species used should come from eastern Asia rather than western Europe.

There are many matters to be especially considered in making an ornamental plantation, and still others in selecting trees for the streets and roadsides. Trees naturally grow massed together, and, therefore, when one is planted in an isolated position it will be exposed to very different influences than when surrounded by its fellows in the forest. The additional exposure to the wind and to the sunlight, which reaches even to its lower branches, has the effect of encouraging a more spreading growth with a decrease in height. Single trees, too, are inclined to fruit more freely, especially the conifers which, under certain conditions, over-bear to such an extent as to check their development, thus exhausting the trees and shortening their period of growth and beauty.

For these reasons it may be found that certain native trees which attain perfection here in a forest will not withstand the exposure if planted in the field or by the roadside, while others (including some foreign species which are not to be recommended for ornamental purposes), may prove suitable for forest planting.

The evergreens should, if possible, be grown in a light soil, with a richer upper soil, for a tree will flourish in such a situation, while in a cold, heavy soil it will make a late start and a slow growth that will be overtaken by the autumn frosts before opportunity has been given for the ripening of the new wood. The trouble arising from such soil, however, may sometimes be overcome by under draining.

For our city streets there are comparatively few suitable trees from which to make selection, for many species which are desirable for plantations and ornamental purposes in parks and lawns, and for roadsides in the rural districts, do not meet the requirements of the city.

The tree most frequently planted now is the rock maple, which is well enough when used in reasonable numbers and when planted in suitable places, but it should not, as is too often the case, be used to the exclusion of all other species.

For a wide street there is no tree that can equal the American elm in producing the arched effect so much admired in many of our older towns, but the elm requires a good soil and is impatient of drought, and should not, therefore, be planted in dry, poor land. The desire for immediate effect ought not to cause this tree to be cast aside in places where it is possible for it to flourish, of which there appears to be a great danger, for the beautiful streets of arching elms which have made the towns of the Connecticut Valley so famous should never be allowed to become merely traditional, for here this tree grows in its utmost luxuriance.

In the more crowded streets of the cities, however, the European elm, a tree of naturally wide range, has proved more satisfactory. For more than one hundred years this tree has been grown in New England. Its habit is more dense and it retains its foliage much longer in the autumn than the American tree. It better endures the poorer atmosphere of the city, and it is free from the attacks of the canker-worm, which so often disfigure the American elm. It is, therefore, a much better tree for our city streets than the native elm, and one which may be considered as fairly tested here by actual experiment.

In the vicinity of the sea shore the Norway maple is a most desirable tree, but in the interior its leaves often become rusty as the season advances, making it less suitable for such situations than the native rock maple. The white maple, too, is a tree of most graceful habit, but it is best seen when planted in parks or lawns, although it answers well for the less frequented streets. The white ash may also be used in some cases with good effect, and the bass wood, red maple and Dutch elm, are of value in proper situations. The red oak has proved in many places a fine street tree, growing in one instance faster than the rock maple, and for many streets in the country towns the hickory, birch, chestnut, necklace poplar and some other species may be used which would not be suitable for city streets.

The selection and planting of trees for our streets should always be placed in the hands of some general committee or permanent board. If left to the abutter, a scattered, irregular collection of all sorts of trees — good, bad and indifferent — will be the result; whereas, in the hands of a properly constituted body, the streets can be planted uniformly with the sort of trees best adapted to the particular situation and desirably varied as the work proceeds in different localities.

Tearing up trees from the swamp or hillsides, stripping them to bare poles and squarely cutting of their tops, so commonly practised in planting the maple and some other species, cannot be too severely condemned. The trees thus treated may at first put out luxuriant heads, and for a time appear to do well, but, as the branches fork at the place where the top was cut off, a large exposed space is left in which water collects, rotting the centre of the tree and sooner or later causing deformity or death. This is the principal reason why so many maple trees of a certain age are failing all over New England.

It would be much better to plant nursery grown trees in our streets. We are far behind the rest of the world in this respect. In Germany and France, and even in Japan, trees are selected and planted with the utmost care. There is no reason why our cities and towns and perhaps the local improvement associations should not establish nurseries for the special purpose of producing suitable trees for streets and roadside planting.

In the streets of many of the cities and larger towns the old trees, which in many cases seem to have been planted with great care and good judgment, are now disappearing through loss by old age, the march of improvement and the demands of commerce. In such streets as are devoted to business purposes, often too narrow already, it is not to be expected that trees will ever be planted. There are, however, entire streets, with either decrepit and miserable apologies for shade trees, or often none at all, where there is abundant room to plant them, and where they would greatly improve the appearance of the street, as well as add comfort to all persons frequenting it. But even if the abutter or the local improvement society, or even the town or city authorities themselves, plant street trees, there are many vexing obstacles to the accomplishment of the best results.

Those in charge of the laying of drains or the setting of edgestones do not think for a moment of arranging their work to avoid a tree, but instead, roots and buttresses are cut and slashed without mercy. Horses are tied to young trees and old by the hour together, and many a succulent luncheon is made from the bark and nascent wood. Trees are often seen in city streets where a few feet from the ground only a small portion of the circumference of the bark is left, and many fine shade trees are annually destroyed from this cause.

Another source of great loss of trees in cities arises from the leaks into the earth in which they live from poorly and improperly laid gas mains. In some cities, to avoid interference with the systems of sewer and water pipes, the gas mains are placed so near the surface that every winter they are thrown and broken by the frost. In one instance, twenty distinct gas leaks were found in the mains of a single street, not one quarter of a mile in length, in one of the cities of our eastern seaboard. When thoroughly permeated with the gas, the earth retains it for years, and tree after tree may be planted; and even if a large amount of fresh earth be added each time, the trees will fail to live. Trees in streets and parks, it is stated, have been killed by having the land about their trunks filled to a depth of two or three feet, thus showing that trees, no more than animals, will endure being buried alive.

In roadside tree planting, even in the rural districts where many of the obstacles met with in the cities are avoided, it is impossible to produce the best results unless the roads are properly laid out, and, together with the roadsides, are well cared for.

Many country roads are made unnecessarily wide at the outset. It is not uncommon to see a poorly built, poorly kept, broad expanse of gravel, wider than many of the most crowded thorougfares of the city, where the travel is confined to one or two cart tracks meandering through its weary length.

A narrower roadway could be maintained in better condition at less cost, and, if it was desirable to retain a greater width for future use, by allowing the grass and bushes to grow at the sides, a minimum of gravelly surface would be exposed to the winds, and much of the nuisance arising from the great clouds of dust be avoided through the dry season.

The desirability of good and attractive roads for ordinary travel, as well as for pleasure driving, must be admitted. Here, too, the formal effect of regularly planted street trees should give place to a more natural grouping, with a greater variety of species, and a judicious growth of bushes, herbs and climbing plants should be encouraged at the roadside and along the walls and fences.

Where such already exist, the shrubs and other plants are frequently cut down and left in rough piles, thus transforming into a rubbish heap that which was before an interesting garden bed. For what reason this is done, or why, as is too often the case, the little gullies at the roadside are allowed to be filled up with refuse from the shoemaker's shop or with tin cans and other discarded household effects, it is difficult to imagine.

Another pernicious custom, in vogue in the vicinity of Boston, is to burn at the roadside the leaves and brush collected during the spring and autumn clearings of the road. These fires, of course, disfigure a certain space each time and in many instances spread into the surrounding bushes, injuring the appearance of the roadside and endangering the life of any trees which may be growing there by burning the bark about their trunks.

As the care of the country roads is usually subdivided among the farmers of the town, no special system is adopted, and a variety of treatment is given the roadside as well as the roads themselves. A systematic management in the hands of one competent man has been shown, where it has been tried,* to give much better results, without additional expense.

To quote a little volume recently published as a law book: † "Good roads have a tendency to make the country a desirable dwelling-place, and a town which is noted for its good roads becomes the abode of people of taste, wealth and intelligence." There is law enough to protect the road-

* Town of Chelmsford, Mass., 66. "The Road and the Roadside," Potter, p. 25.
† *Ibid.*, p. 10.

side and shade trees, but the lack is in the public sentiment to enforce it.

These matters are of interest to the roadside tree planter, for the condition of the roads, the shrubs at their margins, and the neatness of the walls and fences, all contribute to the general effect, and must receive the attention they deserve, if we are to take the trouble to plant trees at all, or desire to make our country-side what it should be.

There is no royal road to success in tree planting, and the ultimate accomplishment of good results must often be reached through many disappointments and discouragements. The trees are frequently attacked by mysterious fungi on their leaves and at their roots and insect enemies innumerable are to be encountered, to a far greater extent in ornamental plantations than in the thicker growth of the forest. Every locality has its peculiar surroundings, — currents of wind, conditions and quality of the soil, and, in ornamental plantations, associated scenery and buildings. These must all be carefully considered before accepting the advice of the essayist, who can only lay down general rules and give general lists of trees from which the planter must make selection for special cases.

A great mistake is often made, in attempting to get quick results, by planting trees of too great size. Smaller nursery-grown trees, if well chosen and properly planted, will always prove the best and soon outstrip the larger ones set out at the same time. It is well in tree planting to "make haste slowly."

The observation of Arbor Day, which originated in Nebraska in 1874, has gradually extended to other States, until it has now become a generally established institution. To be sure, the lists of exercises which are published for use on the occasions of its celebration are poetic and sentimental rather than practical, yet if, as suggested in the last report of the United States Forestry Bureau, Arbor Day and its observation really offers a means "for getting the facts relating to tree growth and the practical uses of trees before the minds of the old and young alike, and for creating and diffusing throughout the community a sentiment which promises much good to the cause of forestry," it is an invention not without some value.

It may possibly be necessary, in order to call the attention of busy people to this subject, to set apart a special day for tree planting and to make it a public holiday; but it would be much better if these matters could be kept in mind every day, and the children in our schools, and the older people as well, could become more generally informed as to the necessity for forests and their importance in political and domestic economy, and more familiar with the trees met with in every day life, rather than by condensing all their efforts into one day of poetical effusion and song.

That such knowledge is sadly needed is evidenced by daily illustrations. To give one example: — A class in an advanced school desiring to celebrate the centennial anniversary of our independence of British authority, planted a tree on the school grounds; but, not being familiar with these matters, they took without question what a dealer sent them, and celebrated the event by planting an English oak, an emblem of royalty, and naturally a poor tree in this climate, which may now be seen starved and puny, and looking as if it fully appreciated the inappropriateness of its selection.

Although there seems to be a very general interest shown in the forests and in the cultivation of ornamental trees, there are, however, but few persons who are sufficiently familiar with our native trees to call them by name. There are of course many who can tell an elm from an oak, or a willow from a pine, but there are not many who can name the different species of oak or pine, or even distinguish the pines from the spruces, — who can see the difference between birches and hornbeams, or separate the many foreign trees in cultivation from the native species. In fact, the native trees and the grasses and sedges, by far the most conspicuous plants in our flora and forming its greater bulk, are the ones least known and the least studied by the people.

The trees are neither numerous in species, nor is there any difficulty whatever in distinguishing one from another among those of native growth, and it certainly seems that the pleasure and satisfaction of their intimate acquaintance would be a sufficient inducement to reward any one for the time expended in studying them.

For the purpose of aiding a class which met last spring at the rooms of the Peabody Academy of Science for botanical study, a list of trees and tree-like shrubs was prepared, including such species, native and introduced, of which good growing specimens could be seen in the immediate vicinity of Salem, and to show how few species it was necessary to know in order to become familiar with the trees in one's neighborhood.

This list included but 113 species, of which 64 were natives of eastern Massachusetts, 17 were introduced from other portions of the United States, and 32 came from foreign countries.

If to this list a dozen less common trees be added, making the total number 125, it will cover all the species that are required to be known in order to name, at sight, every tree met with in our walks in the woods, along country roads or in the city streets and parks of this State, outside of a botanical garden or the collection of some enthusiastic arboriculturist. It does not seem, therefore, that the task of becoming acquainted with them presents great difficulties or is likely to exhaust much time to master it.

Classes or clubs for the study of native trees and so much of structural botany as might be applicable to them, or the introduction of such study into clubs and classes already formed, would be the means of bringing a knowledge of these matters to our young people in a very pleasant way. It would at the same time offer a rational excuse for social meetings in many places where public exhibitions and lectures are infrequent.

There is, without doubt, in every town, some one sufficiently familiar with the subject to act as a leader for a class in tree study; and a small assessment in a class of twenty persons would purchase all the available books required for reference. Of course, it would be desirable that as much of the work as possible should be done during the summer months; but as it would probably be more convenient to meet on winter evenings, specimens could be collected the previous summer for winter use.

The knowledge acquired in this way, practically applied afterward in going about the country in ordinary pursuits, would soon familiarize the student with the trees and add much pleasure to daily walks and drives.

The interest which would undoubtedly be developed could not fail to lead, in many cases, to further study and a more general diffusion of practical information in regard to trees and kindred subjects. The formation of such classes is to be commended in every way and might profitably supplant the clubs, now so fashionable, formed to struggle with the intricacies of Browning and Shelley. For however desirable it may be to become acquinted with profound writers, there is a morbid tendency just now in these literary matters not well to encourage. Any study, therefore, which takes one out of doors, and with all things fresh and healthful, can be cheerfully recommended. To study the trees is as good for the body as the mind. Through walks and drives our system is invigorated and the blood is sent coursing more freshly through our veins, while a fund of valuable and practical information is being gained at the same time.

The study of trees, both in their botanical and economic aspects, — the establishment of ornamental plantations, or tree planting in the street or by the roadside, as well as the care or the creation of more extensive forest reserves, — all tend to the good of the Commonwealth and the prosperity of its citizens. It is fitting, therefore, to close this essay with the words of one who unceasingly felt the deepest interest in these subjects; and although only remembered personally by the passing generation has left us, in his volume on the "Trees and Shrubs of Massachusetts," a work which will ever cause him to be held in grateful esteem.

In the closing paragraph of a chapter on the physical and economic importance of the forests to our State, and which wears well the forty years it has been written, Mr. Emerson says* : —

But why should it be thought important to reclaim or render valuable the waste or worthless lands of Massachusetts?

There are millions of acres in the western States far richer than

* Emerson. "Trees and Shrubs of Mass.," 1846, p. 36. 2d. ed, 1875, p. 43.

any in our State. Why not go thither and occupy the rich, wild lands? There are various reasons. Every improvement in agriculture, in the management of the forests, and in the use of the other natural resources of our State, makes it capable of sustaining a larger population and thus enabling more of our young men and women to remain with us. The advantages of our life in the long-settled parts of the Bay State are greater than can be expected, for more than a generation at least, in newly settled regions.

We live in a climate and on a soil best adapted, from their very severity and sterility, to bring out the energies of mind and body, and to form a race of hardy and resolute men. We have our churches, our schools, our lyceums, our libraries, our intelligent and virtuous neighbors, and we wish our children should grow up under the influence of the institutions which our forefathers have formed and left to us, and which we have been endeavoring to improve.

Mr. Taft. I have been very much interested in the learned and instructive essay just read, but from some of the conclusions I should beg most respectfully to differ. Is it a fact that the forests of this State are being denuded? In my judgment, in the county of Worcester there is to-day a quarter more acreage of wood growing than there was forty-five years ago; not so heavy wood, but the land is covered. And when the essayist advises the farmers of Worcester County to set forests with a view to profit, it seems to me I would rather he would do it than do it myself, if I were a young man. Forty years ago in South Worcester good hard wood was worth eight dollars a cord; to-day it is a drug at five or six dollars. There is no call for it; we are burning something else; and the great question with many people is, What are we to do to keep these hill farms from growing up to wood? Why, within rifle-shot of my house is the site of a saw-mill that has sawn logs ever since 1712. Forty or fifty years ago my father owned it and he used to saw thirty, forty and fifty thousand feet a year; but last year four hundred thousand feet were sawed at the saw-mill standing on that site, and there is more wood growing in that neighborhood, I think, than there was forty years ago. I agree with the idea of setting out trees by the roadside, certainly, but if the essayist had spent his life in a town with fifty or eighty miles of road, if he happened to be one of the fathers of the town and was called upon to keep the brush from the carriages that travel on the roads, he would find that there were too many trees by the roadside, — not in the villages. That is the great complaint to which the highway surveyors and county commissioners have to listen: "Why don't you keep the roads clear of trees?" My friends come down from Worcester in their nice carriages and they say, "We can't drive in these roads; they are all trees and brush." There is no need of setting out trees there.

Another thing. He says we want to set out trees in cemeteries. In 1848, when I was a young man, I helped to lay out, with my friends, a cemetery in my town, and spent a good deal of money, a good deal of time and a good deal of labor in setting out trees, and there has not been a year for the last twenty years that the selectmen have not been petitioned and begged and entreated to have those trees taken down. Why? Because they were injuring the tombstones; it was *unfashionable*. That has a good deal to do with it. This very year a cemetery is being laid out in my neighborhood by a corporation where I am told thirty thousand dollars are to be expended, and one of the provisions of the deeds is that no trees are to be set out. It is not fashionable. Green grass, fountains and flowers inside, trees on the outside. It is all right, I suppose. I have always objected to cutting down the trees in this cemetery that I assisted in laying out, but I have always been beaten. This very last year two trees that I helped set out in 1848, more than a foot and a half through, were cut down and carried off because the owners of the lots near them said they could not have any tombstones or any monuments if the trees were allowed to remain. In waste places, I agree, sir, and in some cases, along the roadsides, and through the villages, trees may be planted; but my friends in the city of Worcester have been cutting down the elms on Main street that I have looked at for sixty years. Some people opposed it, and went to the Supreme Court to prevent it, but the city cut them down and everybody says, "How much better it looks!" Trade comes in, and trade does not want any trees in the streets of a city.

Now as to fires: I agree with the essayist that anything that can be done to prevent the burning of the woods should be done. I would agree to a law providing no man should go into a wood lot with a gun or with a dog. [Applause.] They are perfect nuisances. Every Sunday, not only from the villages, but from the cities, men go up and down over our fields with their dogs and guns, and the first you know almost every Sunday in the summer there is a fire in the woods. I would do anything to stop that. Then the railroads. There are gentlemen here who know the damage that is done by fires started by sparks from locomotives on the New England road all the way down from Woonsocket Falls to Putnam. Almost every year one, two, three or four hundred acres of heavy chestnut wood are burned. This very last year I was called upon as a referee to appraise the damage to sixty acres of chestnut wood that was destroyed in this way. Again, I would prevent the village hoodlums from going to our chestnut trees in the fall and pounding them, as they do about six feet from the ground, with sledge-hammers and axes to bring the chestnuts down. When those trees come to maturity and are cut down we have to throw away about six feet of the trunk of almost every tree. I will agree to anything to keep those hoodlums out of the fields.

I do not want to be misunderstood. There has been a good deal said about planting forests, having foresters, and all that. I tell you that in my judgment the forests of New England will take care of themselves, if you will take care of the fires and dogs and guns. When my friends talk about setting out trees near school-houses and along roadsides, I agree; but when they talk about setting out pine trees for profit, I say I can get as much pine in Worcester for nine dollars a thousand, five-inch stock, as there is money to pay for. When you count the cost of cutting it and getting it to market you will see there is more profit in lecturing than in raising pines. [Laughter and applause.] If I lived near Malden, where they are going to set out a lot of trees, I should not object to that. When I was down there they told me I was only six miles from the State House, and I was just as much in the wilderness as if I had been in the Adirondack woods; I could not see out. But when you come into this county and talk about setting out trees, I say they will grow faster than you can take care of them.

Mr. Robinson. I rather think the gentleman agrees with me more than he thinks he does. I said that the national forests were being destroyed, but the forests in Massachusetts are rather increasing. But no essayist can lay down rules for everybody in every locality; the people of each region must act in these matters according to their circumstances. In Essex County there are many places where we could grow trees and the wood would find a market at home; but in Worcester County it may be that there is no such market for wood as fuel. With reference to cemeteries, there are practical reasons, as the sextons will tell you, why it is not desirable to have the roots of trees running through the ground, but it is proper to have them planted in groups and around the borders.

Question. I would like to inquire how much colder our winters are now than they were a hundred years ago?

Mr. Robinson. It is impossible to say. It is probable that the average is about the same; the frost does not penetrate so deeply in the forests as in the open country, and the removal of the forests has probably had a tendency to make the spring later in coming, and the sun of summer pouring down with greater heat upon the ground, it continues longer into the fall. The radiation is greater from the bare land than from the woods, and the temperature of the woods, on the average, is more nearly equable than in the open country. Experiments have not been carried on long enough, even in Europe, to determine the question.

The Chairman. It would be pleasant and instructive to continue this discussion, but time forbids and we must proceed with the programme. I am happy to introduce to you Prof. Fernald, of the Agricultural College, who will deliver a lecture on the subject of injurious insects.

INJURIOUS INSECTS.

BY PROF. C. H. FERNALD OF AMHERST.

The insects of Massachusetts far exceed in number, both of species and individuals, anything we can ever realize till we make a careful and prolonged study of the group. In fact, the insects of the world comprise four-fifths of all the animals in existence.

So rapidly are new species of insects discovered, that a large corps of scientists are compelled to work very industriously in classifying, naming, describing and publishing their researches, to dispose of the material as fast as it is discovered and brought in. These newly discovered species are not only from the more remote and little known regions of the globe, but here in our own Commonwealth are thousands still unknown to science as well as to our farmers. Of all the vast hordes of insects in existence, not more than four or five are directly beneficial to mankind. The honey bee, the silk worm, the cochineal insect and the insect which produces shellac comprise nearly the entire list. A comparatively small number are neither beneficial nor injurious, while a larger number are indirectly beneficial, since they destroy the injurious kinds; but by far the largest number are directly injurious, as they feed, in one stage of their existence or another, on the crops of our fields, on our forests, our orchards, our gardens, or infest our stock; while others invade the sanctity of our homes and even devour our garments, and still others, more blood-thirsty, lie in wait for our persons. Although a vast number of insects have already been described and named, yet nothing whatever is known of the early stages of the great majority of them; in fact, the entire round of life is known of only a comparatively small number. An immense field here presents itself for investigation, the results of which will be of direct advantage to our farmers. What more legitimate work than this can be undertaken by the experiment stations of the country? The first question which arises in the mind of a farmer when he meets an unknown insect which attracts his attention is, what is its name? The next question is, what does it do, or what does it feed on? and next, how can it be destroyed or held in check? The first is a question in systematic entomology, while the other two belong to economic entomology, yet investigations on these latter must always follow the former. We can never learn from the books what has already been published about an insect till we recognize its name.

The losses caused by the devastations of the insect tribes on our productions are vastly greater than are generally supposed. A few years ago, I estimated the loss on a single crop caused by one species alone, in one field during the summer, to be not less than twenty-five per cent. of the whole, and yet the owner was entirely ignorant of his loss. Farmers consider it pretty hard times when they know that they are getting only three-fourths of a crop, but if they are unconscious of their loss they are comparatively happy.

> "If ignorance were bliss
> 'Twere folly to be wise."

If a careful examination of any given surface, as one square rod of grass field, be made as often as once a week through the entire summer, one will find such a series of insects arising and disappearing in succession that, when he bears in mind that they feed on the plants growing there, he will wonder that anything is left to be harvested. While careful study is being made on the food of plants and the most economical methods of obtaining and applying it, little, comparatively speaking, has thus far been done on the study of those insects and parasitic plants which destroy so large a percentage of our cultivated crops. While I would not have the researches in other lines in any way abated, I would have extensive researches made into the life, history and habits of our insects and critical investigations on insecticides. I have selected for consideration at this time a few of the insects that have come under my notice in this State, and will first direct your attention to the

Canker-worms.

There are two different species of insects known under this name, one of which is the spring canker-worm and the other is the fall canker-worm. The females of both species are entirely destitute of wings, and so closely do they resemble each other, that unless a careful examination be made, one might suppose them to be the same. The spring canker-worm (*Anisopteryx vernata*, Peck), Fig. 1, is by far the more common of the two. Early in the spring, as soon as the snow is clear from the ground, or even before, the perfect moths emerge from under the ground where they passed the winter in the pupa state, and the wingless females crawl up the trunks of the trees, while the males fly about and pair with them on the trunks or branches, after which the eggs are laid in clusters in the crevices of the bark, without any regularity or order in their arrangement, sometimes to the number of a hundred. These eggs, Fig. 2, *b*, are oval in outline, about one-thirtieth of an inch long, and of a delicate pearly yellowish color, and hatch about the time the leaves burst forth from the buds. The larvæ have three pairs of true legs, situated on the three segments following the head, and two pairs of abdominal legs, and therefore they move by alternately looping and extending their bodies, and are known as loop-worms, inch-worms or measuring-worms. When fully grown they are from seven-tenths to eight-tenths of an inch long, of a dark brown color, with five broken lines of a lighter color running lengthwise (Fig. 2, *a*). At this time they often let themselves down from the trees by a silken thread and hang suspended in the air, much to the annoyance of persons passing under the trees, and they are often caught by passing vehicles and carried to places more or less remote, and thus their distribution greatly facilitated.

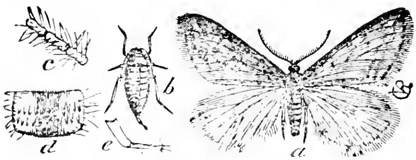

FIG. 1.

a, male; *b*, female; *c*, a portion of one of the antennæ; *d*, an enlarged joint of the abdomen; *e*, ovipositor.

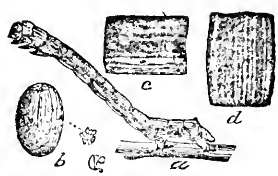

FIG. 2.

a, larva; *b*, eggs, natural size and enlarged; *c*, side view of a segment; *d*, top view of a segment.

They now descend to the ground and burrow to the depth of three inches or more, where they spin a fragile cocoon of dull yellowish silk, within which they transform to pupæ, and remain in this state till the following spring, when the moths emerge, ascend the trees and lay their eggs for another generation. Some of the individuals, however, emerge in the fall and lay their eggs. but these do not hatch till the following spring. The wingless female is of a pale ash color, and the male is of the same color, with a pale broken band across the fore wings, near the outer margin, and three interrupted brownish lines between that and the base. The hind wings are of a very pale ash color or very light gray, with a darker dot near the middle.

The fall canker-worm (*Anisopteryx autumnata*, Peck), Fig. 3, emerges from the ground late in the fall, after the leaves have fallen from the trees and the frosts have destroyed all the tender plants. The females climb the trees attended by the males,

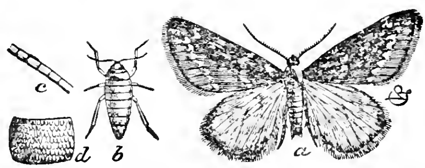

Fig. 3.

a, male; *b*, female; *c*, a portion of her antennæ; *d*, abdominal segment enlarged.

who hover around on the wing. After the mating of the moths the females lay their eggs side by side, in regular masses, Fig. 4, often as many as a hundred together, in an exposed situation on the twigs or branches of the trees. Sometimes the females, through mistake, crawl up on the side of a building and deposit their clusters of eggs on the exposed surface.

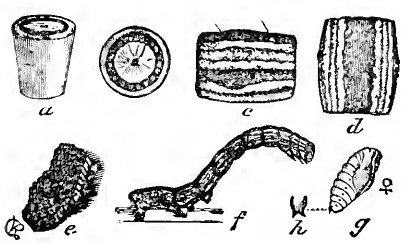

Fig. 4.

a and *b*, eggs, enlarged; *c* and *d*, enlarged segments of the larva; *e*, cluster of eggs; *f*, larva; *g*, pupa; *h*, end of the pupa.

The eggs are cylindrical, but somewhat smaller at the basal end; while the other end is flattened and has a dark rim with a depressed centre (Fig. 4, *a* and *b*). These hatch in the spring, at about the same time as the other species, and the larvæ have habits similar to those of the spring species.

The full-grown larvæ are nearly an inch long, varying in color from greenish yellow to dark brown, with pale stripes running lengthwise; and they differ still further from the other species in having three pairs of abdominal legs (Fig.

4, *f*). After they are done feeding they descend from the trees and burrow into the ground, where they pass their transformations, and the moths emerge late in the fall. The female of this species is wingless, about three-tenths of an inch long, and of a pale gray or ash color (Fig. 3, *b*). The males have well developed wings, which expand nearly an inch and a half, and are of the same color as the female. The fore wings have two rather irregular whitish bands across them, and the hind wings have a faint blackish dot on the middle, and a more or less distinct whitish band outside of it (Fig. 3, *a*). Canker-worms feed on the leaves of the apple, plum, cherry, elm, linden and many other trees.

Remedies for Canker-worms.

As the females are wingless and pass their transformations under the ground, and are obliged to crawl up the trunks of the trees to deposit their eggs, one method is to prevent their ascent by putting bands of heavy paper around the trunks, and painting them with some sticky preparation, as printers' ink, or tar softened with oil.

Another method is to put a trap of tin or zinc around the trunks of the trees, over which they cannot pass. Care must be taken that the trap or paper fits so tightly to the tree that neither the female moth nor the newly-hatched larvæ can find a passage beneath. Some make the mistake of putting on the traps in the spring only, overlooking the fact that there is a species which emerges late in the fall, and also that some individuals of the spring species emerge at the same time. The trees, therefore, need protection from the canker-worms both in the fall and spring. Still another remedy is to shower the trees with paris green in water about the time the eggs have hatched in the spring.

The White-marked Tussock-moth.

This species was first described by Abbott and Smith in their great work on the natural history of the rarer lepidopterous insects of Georgia in 1797, under the name of *Orgyia leucostigma*. This moth has received so many common names as to cause no end of confusion, and it would be far better to use only the scientific name, and then there would be no doubt about the species. Abbott and Smith called it the pale vaporer-moth, Harris called it the white-marked orgyia or tussock-moth, Fitch called it the American vaporer-moth, Packard called it the tussock-moth, and so on.

The male moth, Fig. 5, has an expanse of wings of about one inch and a quarter, and is of a dull grayish color, lighter along the front edge of the fore wings, which also have several wavy cross-lines of a blackish color and a small white spot near the lower outer (anal) angle. The hind wings are without marks. The females are of a light ash gray color, oval in outline and about three-fourths of an inch long. They are without wings, but have minute scales in their place.

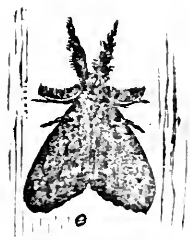

Fig. 5.

Soon after emerging from their cocoons, and while resting on them, Fig. 6, *a*, the males appear, and, after pairing, the females deposit their eggs on the outside of the cocoon. Professor Saunders states that each female lays from 375 to 500 eggs in a cluster,—the smallest number counted being 375, and the largest 500. The eggs are white, globular, slightly flattened above, and with a slight depression in the centre, which is yellowish, and there is also a yellowish ring surrounding the egg just below the flattened portion. To the eye these eggs appear smooth, but under the microscope the surface appears to be roughened. The diameter is about one twenty-fifth of an inch.

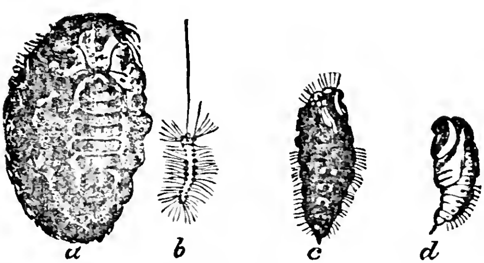

Fig. 6.

a, female resting on an empty cocoon; *b*, young larva suspended; *c*, pupa of the female; *d*, pupa of the male.

The eggs laid in the fall hatch the next spring, giving rise to very small, dark-colored and very hairy caterpillars, which drop themselves down from the leaves by a thread at the least disturbance; but when they have become assured that there is no danger, they ascend again, very much as a sailor climbs a rope, "hand over fist," Fig. 6, *b*. The young caterpillars feed on the pulp of the leaves, skeletonizing them; but when larger, they eat from the edge of the leaf, taking all clean to the midrib. As they grow their skins become too tight, so that it becomes necessary to cast them off, or molt.

The full-grown caterpillars, Fig. 7, measure about an inch and a half in length, and are the most showy and beautiful caterpillars known to me. They are of a bright yellow color, sparingly clothed with long, fine, yellow hairs on their sides, and have four short and thick brush-like yellowish tufts on the top of the fourth and three following segments, two long black plumes or pencils of hair extending forward from behind the head, and a single plume on the segment before the last. The head and two warts on the ninth and tenth segments are coral red. There is a narrow black or brownish stripe along the back, and a wider dusky stripe along the side. They spin their cocoons on the branches or trunks of the trees, often with a leaf attached, and by this they can be the more readily detected.

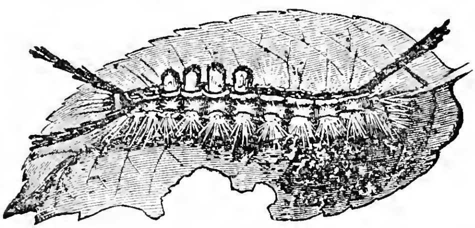

Fig. 7.

Gentry, in his "Life Histories of Birds," mentions quite a number of our species which feed on the larvæ of this moth, among which are the Baltimore oriole, cedar bird, swallows, warblers, etc. Fitch and others describe several parasites which prey on it, and were it not for these pigmy parasites and our little feathered friends we should be entirely overrun by this very prolific insect. I have found it feeding on the leaves of apple, pear, plum, rose, hop-vine, elm, alder; and it has been reported as feeding on oak, maple and horse-chestnut.

As the females are unable to fly, their distribution cannot be very rapid; and if our fruit-growers will carefully search their trees during the fall, winter and spring, and remove all the clusters of eggs and burn them, they will prevent the depredations which would otherwise occur.

Some have thought that because the female is wingless, they could be kept in check by the traps or bands of printers' ink around the trunks of the trees; but these, of course, are no protection whatever, since this species never descends to the ground, but passes all its transformations in the tree. This insect has two broods in a season. The eggs which have remained over winter hatch about the middle of May, and the eggs of the second brood hatch in the latter part of July. If, therefore, the trees be showered with paris green in water about the middle of May, the first brood would be destroyed along with the canker-worms, and there would be few, if any, left for the second brood.

The Eye-spotted Bud-moth.

This insect (*Tmetocera ocellana*, S. V.) was first described in 1776, in Europe, its native country, by Schiffermuller, in his catalogue of the Vienna Collection, and was afterwards redescribed as a distinct species under different names by Fabricius, Huebner and others. In 1841, the insect was described for the first time in this country by Dr. Harris, in his report on the "Insects of Massachusetts Injurious to Vegetation," but this author was not able to refer his insect to the European species, and therefore gave it a new name, — the eye-spotted penthina (*Penthina oculana*). In 1860, Dr. Clemens of Easton, Pa., discovered this insect destroying the buds of pear and plum, and failing to recognize that it was already named, he described it anew and gave it still another name. An examination of the types a few years ago, both in this country and in Europe, revealed the fact that this one insect had received no less than fifteen different names, a fact which it was necessary to learn in order to discover what had already been published about its habits.

This moth appears on the wing in Massachusetts during the latter part of June, flying only in the night. Its wings expand about half an inch and are of an ashy gray color, with a broad lighter band across the middle of the fore wings. This band is very much lighter in some specimens than in others, Fig. 8. The sexes pair at this time, and the females deposit their eggs singly near the ends of the twigs, where they remain during the winter. These eggs hatch in the following spring, about the time the buds swell and the young leaves begin to appear. The young larva burrows at once into the bud and entirely destroys it, so that the onward growth of the twig is prevented and the lateral buds which have escaped develop, and thus an irregular, scraggy appearance is given to the tree.

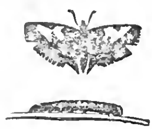

FIG. 8.

These larvæ are especially fond of the flower buds, and by destroying them, reduce the amount of fruit to a very great extent. Not unfrequently they attack the buds of newly-grafted scions, eating out the whole inside, so that nothing is left but the outer covering of scales, and of course the scion dies. The full grown larva is about three-fourths of an inch long, cylindrical, naked and of a pale brown color, with the head and top of the segment following it of a jet black color. The surface of the body has minute warts over it, from each of which arises a very fine short hair.

A few years ago I found a most curious parasite (*Phytodictus vulgaris*) attacking this caterpillar It was the young of a hymnopterous insect. but, unlike all I had ever seen or heard of before, which feed inside of the victim, this one placed itself across the back of the neck of its prey, on the outside and out of harm's way, and there grew fat at the expense of its host, which died a lingering death. There are no remedies, probably, which will prove more satisfactory than showering the trees with paris green when the buds first begin to swell in the spring.

The Codling Moth.

This well known insect (*Carpocapsa pomonella*, Linn.), Fig. 9, has a world-wide reputation and is now found wherever apples are raised. It is one of those ubiquitous pests which holds its own wherever it finds an apple to devour, notwithstanding the great varieties of climate and all attempts of man for its extermination. The females are on the wing about the time the young apples are beginning to set, and lay a single egg in the blossom end of each apple, and very successful are they in searching out the young fruit, however hidden among the leaves. Each female lays about fifty eggs, which are minute, flattened, scale-like bodies of a yellowish color. They hatch in about a week, and the young larva bores at once into the interior of the fruit. The habits and appearance of the larva are too well known to require description. After reaching maturity they escape from the apple and seek for some sheltered place in which to pass their transformations.

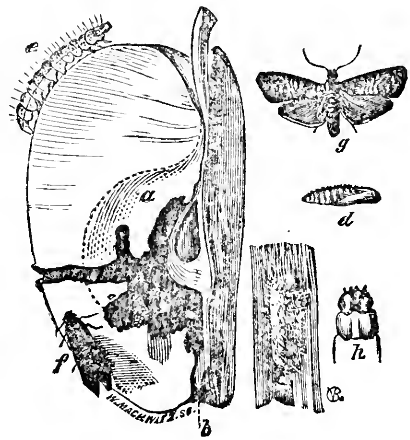

Fig. 9.

a, burrowings of the larva; *b*, the point of entrance; *c*, the full-grown larva; *h*, the anterior part of the body; *d*, the pupa; *i*, the cocoon; *f*, the moth with the wings closed; *g*, the same with the wings expanded.

In Maine there is only one generation in a year, while farther south there are two. I am not sure how it is in this State, but I have as yet seen no evidence of a second generation. Some of the worms escape before the apples fall from the trees, while others remain in the apples till after they fall, when they escape and seek some place of shelter, as in the crevices of the bark or corners of the boxes or barrels in which the fruit is stored, where they spin a tough whitish cocoon, in which they remain unchanged all winter and transform to pupæ the next spring, and the perfect moths emerge in time to lay their eggs in the new crop of apples.

It has been recommended to put bands of cloth or hay around the trunks of the trees for the worms to spin their cocoons under, and to remove them at the proper time and put them into scalding water to destroy the worms. It has also been suggested that swine be kept in the orchard to eat the infested fruit as soon as it falls and before the worms escape. No doubt in this way many of the worms will be destroyed, and if this plan should be carefully followed up by all the fruit growers, without exception, in any given region, great good would, undoubtedly, follow; but there is generally one shiftless farmer in every region who will neglect his trees, and thus furnish a supply of worms for all of his neighbors. Experiments that have been made with paris green by Professor Forbes, State entomologist of Illinois, and also at the New York Experiment Station, give every promise that this insecticide will prove of far greater value than anything hitherto recommended.

Professor Forbes found that the spraying of the trees with paris green in water once or twice in the spring resulted in the saving of seventy-five per cent. of the apples exposed to injury by the codling moth, and he further estimated the cost of the application at ten cents per tree. The proportions that he used were three ounces of paris green to ten gallons of water, while at the New York Experiment Station, one ounce of paris green was used to ten gallons of water.

The Grape-berry Moth.

This insect (*Eudemis botrana*, S. V.), Fig. 10, has been known in Europe for more than a hundred years, but first appeared in this country about 1860, in which year it was described by Dr. Clemens, and in 1869 it was re-described by Dr. Packard, in his excellent "Guide to the Study of Insects," at which time it had reached as far west as Missouri.

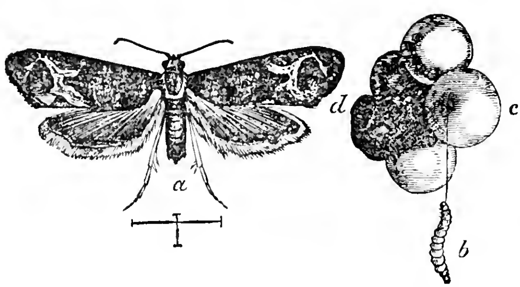

FIG. 10.
a, moth; *b*, larva; *c*, a grape with a discolored spot; *d*, a grape destroyed by the larva.

At the present time it is distributed from Canada to the Gulf of Mexico, and from the Atlantic to the Pacific. There are two generations in a year; and when abundant, as sometimes happens, it is very destructive, causing, in some instances, a loss of nearly half the crop. The first brood feeds on the leaves not only of the grape, but has also been found feeding on the leaves of the tulip, vernonia, wild raspberry, sassafras, and in the swollen stems of amorpha. The second generation feeds on the fruit of the wild raspberry as well as on that of the grape.

The young larva bores into the interior of the grape, making a discolored spot where it enters, Fig. 10, *c*, and feeds not only on the pulp but also on the seeds. If a single grape is not sufficient, the larva attacks a second, or even a third, drawing them together into a cluster by means of its silken threads.

The mature larva, Fig. 10, *b*, is dull green, with a reddish tinge, and has the head and top of the following segment dark yellowish green. They cut out a flap on the leaves, which they fold over, or fold the edge of the leaf, and within these places they transform to pupæ.

The perfect moth, which expands about four-tenths of an inch, has the fore wings of a dark purplish brown color from the base to the middle, beyond which they are marked with spots and stripes of light and dark brown, Fig. 10, *a*. The second generation spends the winter in the pupa state, attached to the leaves which fall to the ground; and, therefore, if all infected fruit and the fallen leaves be burned, the most of these insects would be destroyed.

The American Bean-weevil.

This native American insect (*Bruchus obsoletus*, Say.), Fig. 11, causes a great amount of damage to the beans in certain parts of this State, and my attention has often been called to the injury they are doing. The female lays her eggs on the outside of the young bean pods, and as soon as they hatch the young larvæ bore through the pods and into the beans, sometimes as many as a dozen entering a single bean. These larvæ rarely injure the embryo or germ, and when

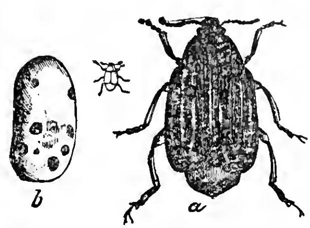

Fig. 11.
Bean-weevil, natural size and enlarged at *a*; *b*, an infested bean.

only a few occur in a bean it will doubtless grow; but when the substance of the bean is destroyed, even though the embryo remain intact, the bean either will not grow, or will produce only a feeble plant.

While the larvæ are growing in the beans they are quite liable to be overlooked, and are, undoubtedly, cooked and eaten with them without our knowledge; but before they complete their transformations, they cut a circular hole out to the shell of the bean, and after the final changes they are easily seen in white or light-colored beans. Some of these beetles emerge in the fall, and the remainder in the spring; therefore, the beans intended for seed should be tightly tied up in stout paper bags, so that the beetles cannot escape, and kept over till the second year, when all the beetles will be dead. If the beans are badly infested, they should not be used for seed.

The Pea-weevil.

This species (*Bruchus pisi*, L.), Fig. 12, is also a native of this country, and is now widely distributed over the world. The beetles begin to appear as soon as the peas are in blossom, and when the young pods form the female beetle deposits her eggs upon the outside of them, without any attempt to pierce the pod. These eggs are of a deep yellow color, about three-hundredths of an inch long, one-third as thick and somewhat ovoid in form. They are fastened to the pod by a fluid, which is white when dry, and glistens like silk. The work of depositing the eggs is accomplished mostly by night. The newly-hatched larva is deep yellow and has a black head. It makes a direct cut through the pod into the nearest pea, the hole soon filling up, leaving only a mere speck. The larva feeds until it reaches its full growth, generally avoiding the embryo or germ; then, with an apparent knowledge of its future needs, eats out a circular hole on one side of the pea, leaving only the thin shell covering the hole.

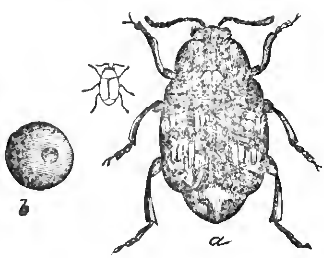

FIG. 12.
a, pea-weevil, enlarged and natural size; *b*, an infested pea.

As only a single weevil infests a pea, and this one does not destroy the germ, a large proportion of the peas will grow if planted; but we can never get so vigorous plants as from seed which is not infested, other things being equal.

These insects are more common than is generally supposed, and are often overlooked while in the larva state in our green peas; but it is authoritatively stated that in this state they are perfectly harmless in our food; nevertheless, it is not very appetizing if we know that we are eating large numbers of luscious worms in our green peas. The remedies for this species are the same as those for the bean-weevil.

Insecticides.

I desire to call your attention to some of the substances used for the destruction of insects and the methods of using them.

Paris green is well known, and has long been in use among the farmers all over the country, for the destruction of the Colorado potato beetle, but there seems to be a prejudice against using it for other insects because of its poisonous properties. That it is a rank poison every one knows, yet all are familiar with its use on potatoes, and since it has been proven to be quite as destructive to all the leaf-eating insects of our fruit and shade trees, I can see no reason why it may not be as carefully and successfully used on these as on potatoes. It is of course unnecessary for me to give any directions how to apply it to the potato crop, but when it is desirable to apply the poison to tall shrubs or trees, it is necessary to use a forcing pump, of which many kinds have been prepared and put on the market. The main point is to be able to send the water in a fine mist high enough to drench every part of the tree, and this should be continued till the water begins to drip from the leaves. If a stream of water be thrown through the ordinary nozzle above the tree, and allowed to break into drops in its fall, the momentum will allow but a small portion of the poison to adhere to the leaves. The water with the paris green in suspension may be taken by the barrel on a cart, and hauled around in the orchard when a large quantity is to be used, or when a small quantity is required it can be carried around in a pail.

Different experimenters have recommended different proportions of paris green in water, but it is necessary to use a mixture strong enough to kill the insects and at the same time not strong enough to injure the foliage of the plants. When used dry, it should be thoroughly mixed with flour or plaster of paris, in the proportion of one part of the poison to fifty by measure of the flour or plaster of paris, and dusted on to the plants when they are wet. When the substance is to be used in water the proportion should not be over one pound to fifty gallons of water if the paris green has not been adulterated in any way, and even this proportion may prove too strong for the foliage of the more tender plants. I have no doubt, however, that a proportion of one pound to a hundred gallons of water will prove quite sufficient for all practical purposes.

London purple may be used in the same manner as the paris green, and the proportions which have been recommended are one-half a pound of the London purple to forty gallons of water. This substance has the advantage of being cheaper than paris green. If one or the other of these substances be showered on to our fruit trees when the leaves first begin to burst from the buds, it will destroy both species of canker-worms, the bud-moth, tent caterpillar, forest tent caterpillar and a host of other leaf devouring insects, and if, when the fruit is first set, the apple tree be again showered, a large percentage of the apple-worms will be destroyed, as has already been shown.

Hellebore, when it can be obtained pure and has not lost its strength, is an infallible remedy for the imported currant-worm (*Nematus ventricosus*, Klug). An equally destructive substance may be made by soaking the roots of our common poke-weed in water and sprinkling the currant bushes with it. Hellebore or poke-weed may be used for the destruction of all our troublesome saw-flies, as the slugs on the rose bushes, pear trees and raspberries.

Pyrethrum or insect powder is now grown and prepared in this country and sold under the name of Buhach. It is composed of the finely pulverized flowers of different species of pyrethrum and may be used as a dry powder, as a fume, as an alcoholic extract diluted, as a tea decoction, or in solution in water. This last method is believed to be the most efficient. The greater part of the powder is dissolved in the water, to which it at once imparts the insecticide principle. Experiments have shown that half an ounce stirred in two gallons of water will destroy all but the most hardy caterpillars and such as are protected by long dense hairs. For these a stronger solution is necessary. A tablespoonful of the powder mixed with a gallon of water and sprinkled on cabbages will destroy the cabbage-worms, though it may be necessary to repeat the application. When the dry powder has been used the success does not seem to have been as good as when applied in water.

Kerosene Emulsions. — Kerosene oil seems to be particularly destructive to insects when brought in contact with them, but it is also injurious to the plants if applied without being diluted. It has sometimes been mixed with water and strongly agitated while it was being applied, in order to keep them well mixed. It has now been found that an emulsion of kerosene may be made with soap or milk, which may be diluted with water to such an extent that the mixture will not injure the foliage. The most satisfactory formula for the soap emulsion is, kerosene two gallons, water one gallon and common soap one-half a pound, "Heat the solution of soap and add it boiling hot to the kerosene. Churn the mixture by means of a force pump and spray nozzle for five or ten minutes. The emulsion, if perfect, forms a cream, which thickens on cooling, and should adhere without oiliness to the surface of glass. Dilute before using, — one part of the emulsion with nine parts of cold water. The above formula gives three gallons of emulsion, and makes, when diluted, thirty gallons of wash. The kerosene and soap mixture, especially when the latter is warmed, forms, upon very moderate agitation, an apparent union; but the mixture is not stable, and separates on standing or when cooled or diluted by the addition of water. A proper emulsion of kerosene is obtained only upon violent agitation. It is formed not gradually, but suddenly. The temperature should not be much above blood heat."

The milk emulsion is made by churning two parts of kerosene and one part of sour milk with a force pump, keeping the liquids at about blood heat. This emulsion may be mixed with twelve times its amount of water and applied with a force pump, spray nozzle, or even with a strong garden syringe.

Kerosene is a safe insecticide only when it is properly prepared, and it is claimed that all failures in its use have resulted from carelessness in making the emulsion. Kerosene emulsion is undoubtedly the best remedy for plant lice of all kinds, and also for the squash bug, provided it be so applied as to fall on the under side of the bugs. It is also valuable for the destruction of lice on our domestic animals, and is an exceedingly useful substance with which to shower an infested hennery.

Finally, let me urge you to use all these insecticides, especially the poisonous ones, with great care, both with regard to the danger to human life, and also the injury which may be done to the plants by using an excessive quantity. I would recommend that you experiment with them till you personally understand just how to use them, and then I have no doubt they will prove as useful for the destruction of the insects described above, as paris green is on the Colorado potato beetle.

The Chairman. We have a little time now for the discussion of this most interesting subject, and if gentlemen wish to ask the Professor questions, I have no doubt he will be ready to answer them.

Mr. Williams of Sunderland. The lecturer has not said anything about the worm which causes the club-foot in cabbages. I want to ask two questions: First, what is the cause of club-foot in cabbages? and, second, how shall we get rid of it? I have lost my crop the past season in consequence of it and I would like to know how to act another year.

Prof. Fernald. Did you see the worm? Are you sure that a worm was the cause?

Mr. Williams. I argued from cause to effect. The worms were there and there was no cabbage, and I argued that the worms were the cause.

Prof. Fernald. I have had no experience with the club-foot in cabbage. I have an idea that it may be caused by a fly, which deposits its eggs at the root and gives rise to maggots which eat there. It may be that I am not familiar enough with them. I think my colleague, Prof. MAYNARD, could give some information on this subject, because he has been so many years right here in Massachusetts and is familiar with the insects of this State, while I came from a more northern region, where the insects are many of them very different from what they are here. I have not happened to see what you call the club-foot.

Mr. EDSON. I will state that I have always been successful in raising cabbage plants by applying salt. When I transplant my cabbages I drop a pinch of salt into the holes and have never failed to raise a good crop.

Mr. WILLIAMS. I have tried salt and I would not recommend any one to try it.

Mr. SMITH. What amount of salt did you apply per acre?

Mr. EDSON. I never applied it to an acre, but to a hundred or two hundred plants. I have never found any trouble from putting a pinch of salt, as much as can be held between the thumb and finger, into the hole when transplanting. I have always been successful in growing cabbage in that way.

Mr. SMITH. You can raise successive crops of cabbages by the application of salt as you recommend?

Mr. EDSON. I have raised them for twenty-five years in the garden, year after year.

Prof. MAYNARD. There are two difficulties in growing cabbages. There is a fungus on the root, which is the club-foot, and there is the maggot that destroys early cabbages. The maggot, I believe to be the larva of a fly. The egg is laid near the root and the larva destroys the entire root. The remedy which we have applied has been salt put around the root, close up to it; but this is not effectual unless we have rain soon after its application. Lime may be used and will destroy these larvæ. Last season a gentleman called to know what he should do with his cabbage. He said that he had a large quantity of beef brine that he could use, and this was poured around the plants, several tablespoonfuls to each plant, and saved the crop. This season the brine was applied after the plants were attacked and the plants all recovered. Hilling up around the plants will be a benefit; new roots will be formed if the old roots are destroyed, as they often are.

QUESTION. What strength would you advise making the brine?

Prof. MAYNARD. The brine is a saturated solution.

QUESTION. Would not water have done it? One of my neighbors told me that when he set out his cabbage plants he made a hole around the root and filled it with water and saved his crop in that way.

Prof. MAYNARD. The maggot goes into its pupa form, and if new roots can be formed, which would be facilitated by water, the crop may be saved in that way. I do not know of any remedy excepting to plant upon new land, or perhaps the use of abundance of lime. It is stated that lime will prevent the ravages of this insect. But it is very rarely that we can grow a crop of cabbage on land that has been planted with cabbage or turnip more than one year.

Mr. ———. I have used barrels of brine made of fine damaged salt, which I have bought by the ton and mixed with water, but it did not have the effect upon my cabbage that Prof. Maynard says it had upon his. They were in all stages; some were wilted, some partly wilted, some very fresh; but they all died. I got no crop.

Prof. MAYNARD. You probably had both club-foot and maggot.

Mr. WILLIAMS. The raising of cabbage has become a pretty serious matter in my section, thirty miles above here. We could not raise any this year because of club-foot, and I have come down to this meeting more to learn how to raise cabbages, perhaps, than any other one thing. I would like to find out. I have studied on it for the last twenty years and confess myself beaten. If there is any one here who will help me out he will render a service, not only to me, but to all the farmers in this valley who raise cabbages.

Mr. VAUGHN of Middleborough. What kind of dressing did you use on your cabbages?

Mr. WILLIAMS. I have used nearly every kind. One year a gentleman recommended the use of ashes, and I turned over a piece of turf, after mowing a crop of hay, and sowed ashes in the drill, thinking that perhaps the ashes would trouble these worms. I had no cabbages. I then turned the furrows and scattered in fertilizers, but the club-foot has beaten me every time. If you pull up one you will find a bunch as big as your fist, full of worms. I have never used green manure; I certainly would not recommend that. When I have used manure I have used fine compost.

Mr. Vaughn. I use night soil and green manure from my barn cellar, and have raised good crops of cabbages.

Question. Was that on land that had grown a variety of crops or was it new land?

Mr. Vaughn. Part of it was old land and part of it was new. It had never had a crop of cabbages on it before.

Mr. Perry of Worcester. I have raised cabbages for the last thirty years, varying from one to ten acres. Some years my cabbages have been considerably affected with club-foot and some years very little. My opinion is this. You take, for instance, an old pasture that has been laid down for a great many years, plough that up and manure it, — I don't care what manure you put on it, — put your phosphate on it, and you will have a splendid crop of cabbages and will not have club-foot. But take a field where you have had cabbages or turnips, and there will be spots in that field where you will have club-foot. If there is any little depression in the field you will see the club-foot come in. I do not think it is the result of any maggot, but I think that it is because something has been withdrawn from the soil. I remember that some few years ago my father had a very fine field of cabbages and the next year he said he was going to have them again. I said, "I would not do that, father." Said he, "I am going to try the experiment and see whether I can raise a crop of cabbages where they were raised before." I said, "All right; go ahead." He set out his plants on a three-acre lot and they lapped over on new ground about ten rows. Where he had the cabbages the year before they were all club-foot, and beyond that point they were as nice cabbages as you ever need to look at. That is my experience. I have tried hard to ascertain the cause, but have never been able to satisfactorily explain the reason why.

Dr. Cragin of Athol. I would like to tell the experience I have had in raising cabbages. We oftentimes can learn as much from our failures as from our successes. I have frequently lost my crop by planting my cabbages on the same ground in successive years. I then tried corn land with a similar result, although not as bad. Two years ago I employed a young man who had been in the employ of a market gardener in my neighborhood, and when I spoke to him about cabbages he says, "I want a new piece of land for cabbages." I told him he could have a piece of a corn field. He says, "If you want to raise cabbages on such land as that you can do it; I don't want to." "Well," I said, "take such a piece as you please." He went into a pasture that I suppose had not been ploughed for fifty years, ploughed up a piece for ensilage corn, selected the poorest of it and put out from two to three hundred cabbage plants. I never saw a handsomer growth of cabbages in my life. I had so many that I did not know what to do with them. I believe he lost but one plant in the whole. He said in explanation of it that the cabbage invariably demands new land. I have tried the same experiment since in raising cabbage in my garden, which is shifted from one locality to another, but on old land, and I have been very successful. I am never troubled with the club-foot or the maggot there. I occasionally have a man who insists upon using the old garden for cabbages, and when that occurs we seldom get enough for our own use, and are obliged to buy from our neighbors.

Mr. Smith of West Springfield. I have been raising cabbages to the extent of several acres for a number of years, and each year it has beome more and more difficult to raise early cabbages; but with late cabbages I think we have never had a failure. We always put our late cabbages on old land, taking care, however, that neither turnips nor cabbages have been grown on that land for three or four years. That is, every three or four years we think we can reasonably expect a good crop of cabbage from a piece of land. We plough in horse manure early (I don't want hog manure) and expect to set out the plants about the 4th of July. I do not know that we have ever had a failure.

Mr. WILLIAMS. I understand you to mean by "new land," land that has lain in grass?

Mr. SMITH. Yes, lain in grass; new to field crops.

Adjourned to evening.

EVENING SESSION.

The meeting was called to order at 7.30 by Mr. BROOKS, who introduced as the lecturer Mr. W. L. WARNER of Sunderland.

OUR HOMES.

BY W. L. WARNER OF SUNDERLAND.

Man's daily necessity is food, and in a state of civilization it is largely drawn from the earth. We may conceive of a time when men subsisted upon the fruits and vegetables obtained with little exertion in the pleasant regions where the human race is supposed to have originated. But, previous to the first record in which Cain appears as a "tiller of the ground," all must be largely left to conjecture. Egypt was undoubtedly the cradle of our civilization, and was in a comparatively civilized state when Europe was in a state of barbarism. From Egypt a knowledge of agriculture extended to Greece, and we find it in a flourishing condition a thousand years before the Christian Era. But the Greeks took a deeper interest in other arts, and looked contemptuously upon the tillers of the soil. They cared much more for building up their cities than for cultivating the land. Rome at this period was interested somewhat in agriculture, and it is said that no greater praise could be bestowed upon an ancient Roman than to call him a "good husbandman." From the downfall of the Roman Empire in the fifth century to the sixteenth, we have no authentic record of the progress of agriculture. We may look upon the sixteenth century as the time when Europe awoke from its long slumber. The invention of printing and the discovery of the New World excited activity and aroused a spirit of enterprise. The art of agriculture is older than history, while the science of agriculture is modern. As agriculture is the most essential of our productive industries, so it has been the most conservative. For a period of nearly four thousand years, during which population increased enormously and the race advanced in general culture, there was little advance in the art of agriculture. If it made any progress at all, it was so small that it appeared as nothing when compared with the progress in other arts. To possess a farm or landed estate, in those times, gave the owner dignity and conveyed with it special privileges and social honor; but the laborers and actual tillers of the soil were held in social inferiority. The degradation that has been associated with labor in general, and with field labor in particular, has been a very great hindrance to the development of agriculture. Perseverance, intelligence and education are necessary to the sure success of agriculture. Wherever we find the laborer ignorant we are almost sure to find the farming tools heavy and unsuitable for rapid work. We see this on the large cotton and sugar plantations, where we often find the most improved machines for the preparation of the crop used alongside of the most clumsy tools and implements in the field. Labor-saving machines are constantly coming into use, and the inventions come from places where the workmen are bright and intelligent. Competition in America is not merely a competition of land, soil and climate, it is a competition of methods and of men. People are beginning to learn that it requires a bright intelligent man to become a successful farmer. He must study his business closely, if he expects to succeed and make the farm pay. The competition of our farmers with the farmers of the West is sharp and he needs to know what to produce and how to produce it, and whether to be a general or a special farmer. In some places hay may be the special crop, in others apples or cranberries, while in the South cotton and rice are the principal crops. In our Commonwealth, mixed farming may be preferable, as it must constitute the occupation of most of our farmers. The more dense the population the greater the necessity of mixed farming. By rotation of crops in mixed farming the land will produce a greater aggregate product and the quality of the crops will be better. The waste of one crop may be used as a fertilizer in the production of another. There is a better distribution of labor when mixed farming is followed, as the various crops are planted and harvested at different seasons. In a locality where only one crop is grown, labor is very scarce and dear during the busy season, as harvesting comes all at once and lasts but a short time. A good year for one crop is not always a good year for another. All crops sometimes fail, but by a proper combination the success of one helps out the losses in the other. The declaration of Holy Writ is: "In the morning sow thy seed, and in the evening withhold not thy hand, for thou knowest not which will prosper, whether this or that."

One great trouble with the farmer is, he occupies and tills too much land. The number of farms in Massachusetts is 38,406, and the average of the State is sixty-four acres to each farm. A small farm well tilled is the kind of a farm to possess. Upon a small farm greater care is taken in the selection of seed, and this has much to do with the success of the crop. The intelligent farmer (and no one should engage in the pursuit without intelligence) should be free to produce what he will and by such methods as seem to him best, only guided by the demands of the market. Whether a man tills the soil, practices law, preaches the Gospel, works in a factory, teaches in a college, or is a merchant, it is only a matter of choice, and whatever that choice may be he should follow it closely, with a desire and determination to succeed, and the chances are that he will succeed. One vocation is as honorable as the other. The tillers of the soil should own the land they till and receive the benefits of the improvements they make and the wealth they create. If the farmer owns the land he tills it can be bought and sold like other property.

In a report of the Massachusetts Board of Health, the statement is made that the value of the farm products in Massachusetts is greater, both per farm and per acre, than in any other State in the Union, outside of New England. The same report says in regard to life and health: "The farmer of Massachusetts lives on an average about sixty-five years, or nearly fourteen years beyond the average human life." When it becomes necessary for the farmer to run into debt in obtaining a farm, let him purchase a good one, containing buildings suitable for occupancy and land in good condition to produce good crops. A man without capital cannot often succeed when placed upon a poor, worn-out farm.

The valuable or important crop for the farmers of Massachusetts to prepare for the market is one that brings the quickest and most substantial returns. If vegetables, milk, butter, poultry and eggs will do this, they become the important crops. Fancy farming will not always pay; earnest, intelligent farming will. There are many farmers in our State who are at the present time sending large amounts of money into the Western States, to be placed at interest or invested with associations, in expectation of obtaining large returns for their money. Such investments may prove beneficial to some, while others are robbing their own farms to benefit the cities and lands of the West. If this money were invested in repairing their buildings, in obtaining the best farm implements, and in enriching their own land, it would be a safe investment, bring in sure returns, and give healthy satisfaction as well as lasting benefits. When the land is in a high state of cultivation it can be made remunerative, and when the farms are made to pay you will experience no more trouble in keeping the boys on the farm.

When the young men and boys of New England are ready and willing to engage in the healthful occupation of cultivating the soil, they will find that the inducements held out at the present time in our own State are greater and more certain of bringing in safe returns than those of the prairies of the West or in the gold and silver mines of Colorado. Here, in the homes of our own State, one is not obliged to endure the privations and hardships that generally have to be experienced in the newer sections of the West, where it often requires many years of hard, discouraging labor to obtain the pleasures and receive the benefits of home life. There are many pleasantly located houses in all parts of New England that are rapidly going to decay, and yet they are more suitable for occupancy than many buildings that are called homes in the West. My advice to the young men would be, "Go West"; not, however, for permanent abode, but only to visit the country and associate with the people, then return and make for themselves homes on the hillsides or in the valleys of their own New England. Let us have home comforts and social life in the country, leaving the dazzling elegancies, showy pretences and imposing wealth to the cities where they belong. Life in the country is not given wholly up to style and excitement. Home in the country signifies comfort with abundance.

One great trouble with those engaged in cultivating the soil is want of confidence. They do not work together. There is not that hearty fellowship that is pleasant and desirable. Those of other callings meet together and agree upon scales of prices for their services or products, while the farmer will not even tell his neighbor what he obtained for his apples or his last crop of wool. There are not as many farmers elected to the Legislature as there should be. They do not claim all their rights and are too easily discouraged. The weather is objectionable, the temperature is not satisfactory. It is too hot or too cold, too wet or too dry; nothing appears to be right.

The elements have very much to do with the success of those engaged in agriculture, for they need and must have both sunshine and rain. There is really no reason for complaining, since we have the sure promise of "seed time and harvest." There are those born and reared upon the farm who look upon the shovel and the hoe as tools fit only for the day laborer. They consider the occupation of cultivating the land as beneath them, — not honorable or genteel. They would have white, delicate hands, like the clerks and counter-jumpers of city stores, who handle the pen, the tape-measure or the yard-stick. They believe that if they follow these occupations money will flow into their pockets like a river. But, alas! how easy it is to be disappointed! Farming at the present time is a more popular pursuit than it was twenty-five years ago; the laws of progress appear to be that the returns for labor shall increase.

In all business pursuits there are pleasures to enjoy, difficulties to be overcome, and hardships to be endured. The merchant talks of his bad debts and constant confinement; the mechanic will tell you there is no demand for his labor on account of dull times. Men receiving large salaries are not contented, but fear another day will find them out of employment. Of all occupations farming appears to be the safest. Farmers do not always become wealthy, but most of them own a good home and can obtain a comfortable living for themselves and their families, and this is more than can be said of many that are engaged in other pursuits. There are successes and failures in any calling. No business occupation or employment is as sure as farming, providing the necessary conditions of success are complied with. At the present time farming affords better opportunities to laboring men of moderate means than any other business, if they possess the necessary knowledge of the business. To-day the life of the agriculturist is as honorable and pure as that of any class of men. Men have a natural love for mother earth, and the young man who makes his home in the busy city looks back with longing eyes to the old country homestead, in some rural spot beneath the shady trees, and as he turns back to visit it after many years what memories crowd upon him in his anticipations of seeing his old home once more!

> Ah! here it is, that dear old place,
> Unchanged through all these years!
> How like to some familiar face
> My childhood home appears!
> The grand old trees beside the door
> Still spread their branches wide:
> The river wanders as of yore,
> With sweetly murm'ring tide.
> The birds are singing in the lea,
> The flowers are blooming wild;
> And things appear the same to me
> As when I was a child.

Home may be the largest as well as the most pleasant part of this earth, if we will make it such. There is no one who possesses as many opportunities for making home pleasant and delightful as the man who lives in the country. Sunlight, pure air, trees and flowers can be enjoyed almost without money or price. No home can be made more pleasant than the farmer's. Notwithstanding all that, there are many wasting their lives in fretfulness and discontent because their lines are not cast in pleasanter places. The ownership of a home is something which neither the Irish peasant nor the German laborer has any conception of The desire to own a home is distinctly an American characteristic. The country home can and should be made pleasant and attractive, and it is the duty of the farmer to study his home as well as the soil and embrace every opportunity to improve and beautify it.

There are no words that can describe the influence the wife and mother exerts upon the home, and the home contains no member that can soothe and relieve the pain and sorrow like her gentle hand. Yet with all her kindness and tender sympathy, she is too often left alone, tired and weary, and sometimes in sorrow, amid her perplexing cares, which are often more trying and harder to endure than the cares of the husband. Then why should they not be in possession of our secrets as well as our joys and sorrows? It is not always what we give, but what we share, that affords us happiness and sweetens home.

There are men and boys among the farmers, who, when their day's work is done and their evening meal taken, start immediately for the hotel or the country store, where they are free to converse upon any topic of the day except home. Most men are obliged to provide for their families and many have to obtain food and necessary articles for the home at the close of the day's work. It is hardly necessary, however, to spend every evening away from home. When the father and the boys are willing to pass their unemployed evenings at their own firesides, the home will be greatly improved. Our homes are what we make them. They should be more than stopping places. They should be the abodes of contentment and happiness. Some travellers have said that America is the country in which there is less happiness and less enjoyment than in any other in the world. Certainly we have not cultivated the art of enjoying ourselves as we should. We are always in a hurry. It is work, work,—toil, toil,—from early morn to dewy eve, giving ourselves no recreation or rest. We are so eager to accumulate wealth that we give ourselves very little time for recreation or enjoyment. We have not yet learned an art the Germans might teach us,— that of enjoying a little simple pleasure every day.

We must make our children happy if we would make them good. We should show them the bright side of life, for there is a bright side to be enjoyed in every home. We should provide them with entertainment, or they will provide their own. Surround them with an atmosphere of affection and enjoyment, if you would teach them to love their homes. Improve and beautify your homes, fill them with good influences, let the members be refined and cultured. The children in a home where politeness reigns will grow up polite men and women. Habits formed in childhood are permanent. The chief end of life with many is to gather gold, and that gold is counted lost which hangs a picture upon the wall or purchases a toy or a book for the eager hand of childhood.

We need money to make pleasant homes, but the worship of the dollar does much to degrade them and to cause discontent among the children. It is not necessary to adopt a luxurious style of living, — it is not well to run into debt for that which you cannot pay for, — for every man and wife, blessed with good health and who are of industrious habits, there is enough to be won to afford them a generous and comfortable living. Social intercourse and meetings of neighbors and friends for mutual improvement should be encouraged by every member of the family. The years of our life will be few at most. Then why should we not enjoy them as we pass along, and take and use the blessings which Heaven confers. We strive to accumulate beyond our needs and beyond the needs of our families. In doing this, we deny ourselves leisure, recreation and culture. When wealth has been won the power to enjoy has often gone, and it soon passes into the hands of our children, who do not appreciate its value and to whom it is an injury, for it removes all incentive to enterprise and industry, and often leads to temptation and crime.

Society accords to wealth, no matter how it is obtained, a more influential place than to honesty or to education. If our homes are pleasant and cheerful, our sons and daughters will not desire to leave them for the overcrowded cities, but will remain upon the farm, where more perfect health and pure enjoyment can be obtained. Furnish the home with good books and papers; let every home, if possible, be supplied with a daily and at least one good agricultural paper, and let them be read by every member of the family. A farmer's home without papers and books is like a farm without the sunshine. Pleasant rooms and comfortable furniture are desirable. Expensive furniture will not make rooms pleasant and cheerful.

The charm of a cheerful home depends much upon the housekeeper. The bright sunshine and a pleasing prospect from the window make some rooms cheerful and very desirable. In others, recourse should be had to other things, to in part make up for this want. Such rooms should be furnished in bright and joyous colors; the walls should be hung with simple ornaments, made by the skilful hands of the wife and daughters. The comforts and pleasures of some homes are sacrificed to a mania for neatness, while in others domestic disorder banishes contentment. In some homes the parlor or best room, furnished expensively, is thought too good for use except on special occasions, such as the minister's annual visit or the meeting of the Dorcas Society, and at all other times kept closed for fear the sun will fade the carpets or the children soil the furniture. No home should have rooms too good for the use of the whole family; a room may be attractive without being excessively orderly. A singing bird, and plants growing and blossoming in the window, will help make home pleasant. Pictures and books people a room. Good humor should always be encouraged. A good hearty laugh is always music. We must have bright and cheerful fathers and mothers, if our homes are to have happy, loving children.

While the house should be neat and social inside, the outside should not be neglected. Every farmer's home should have a well-kept garden; fruit trees should be grown in abundance. The question is often asked by people that are unable to obtain fresh vegetables and well-ripened fruit, why it is that the farmer's table is so poorly supplied with these luxuries, so easily grown, and which afford such a large amount of health-giving food. No country home can be complete without flowers. They help the weary to rest, they are company for the sick and lonely, and help to cheer the downcast and afflicted. Flowers in a room will do what nothing else can accomplish, — a single rose lights up a room. The cultivation of flowers may not add to the bank account, yet the happiness and good which they afford will well repay their cultivation, and their little blossoms contain a passport that gives them entrance into all hearts.

"In palace and in hovel, in science and in art,
They speak of love and beauty, they cheer the lonely heart;
They work their mission, given by their creator God,
Who planted them in beauty on many a velvet sod.
They never grow weary of the work they have to do,
But bud and bloom, in beauty so faithful and so true;
And in the coming ages, as knowledge holdeth sway,
Will be added laurels to the flowers of to-day."

Music should not be forgotten or neglected. It should occupy its place and form one of the principal entertainments of the home circle. A piano, organ, violin or other musical instrument adds greatly to the pleasures of the home. Then give the children singing-books and teach them their use. It cannot be expected or desired that all the boys and girls will remain upon the farm. The men and women that were born and brought up on the farm give to the city its health and life. More than one-half of our presidents, statesmen, clergymen, professors and merchants, received their early education upon the farm. They grew upon the hills and in the valleys, surrounded with the noble work of nature; they there gained the power to accomplish what they have in life. The city and country are bound closely together by ties that can never be broken. Our country homes will grow and educate for the nation, its presidents, statesmen, clergymen, etc.; they may give to the western cities and prairies a part, but retain the best upon the farms of New England.

There is one evil that is being felt in New England to-day, an evil that is giving our houses and land into foreign hands. It is the childlessness of our homes. The home in which there are no children is often a lonely one. They may have no children to disturb or soil their costly furniture; no little finger-marks on the window-panes or mirrors. They may not be obliged to read or sing for their amusement, nor be confined at home on their account; but can have perfect order and neatness in the house, — enjoy amusements, money, and, indeed, everything but happiness. With all their blessings the greatest of all is missing. We may live without children, but the best part of home is gone. Home is a word that has a definite meaning in New England. It cannot be defined in the dictionary, yet there is no word the meaning of which is better understood; but how often its true meaning is ignored and forgotten. How often does the boy leave his home and the farm, simply because it is in no way made pleasant and attractive to him. In this, the parents are at fault. When the country home is made the dearest place on earth to its inmates, then we may hope to keep some of the boys on the farm. Home! — the name, the word, is very dear to all. There is something in the word which carries us back to our childhood, to the good old home we left many years ago; and while many of us have pleasant and happy homes in cities and villages, still we cannot help turning back to the good old farmer's home in the country where we first breathed the pure air and drank from the cooling spring that flowed down the mountain side, or from the "old oaken bucket that hung in the well." In a word, there is no home so pleasant, attractive and healthy as the country home of the farmer.

The CHAIRMAN. There is only one side to this question and therefore there is no room for discussion. We are not very often favored with the presence of *ex officiis* members of our Board, — they have so many other duties to occupy their time, — but this evening we have Lieutenant-Governor BRACKETT with us, and of course we expect to see him on the platform and to hear from him.

ADDRESS OF HON. J. Q. A. BRACKETT.

Mr. President, Ladies and Gentlemen, — The subject of the address which we have heard is a familiar one, but it is one which never fails to interest. It has been a pleasure to me to listen to its treatment by our friend who has just spoken. I notice that some of the newspapers have stated that I was to lecture before the Board this evening. This is a mistake. They have done me an unmerited honor. I came here for no such purpose, but simply as a member of the Board, without any intention of doing more than to take part in an informal and off-hand way in its discussions. One of the honors enjoyed by the person who happens to hold the position of Lieutenant-Governor of the Commonwealth is that he becomes, by virtue of his office, a member of the Board of Agriculture. The statutes, in establishing this Board, have provided that the Governor, Lieutenant-Governor and Secretary of the Commonwealth shall be members, and in my view it was not the intention of the Legislature that this membership should be simply nominal, but that the occupants of these positions, as far as they can consistently with their other duties, should take an active interest in the work of the Board. I have come here this evening because entertaining that view, and should be glad to stay through the remaining sessions in Springfield; but an engagement with the Governor and Council in another part of the Commonwealth to-morrow will prevent.

I do not know that I can contribute anything of practical value to the consideration of the subject which is before us. Although I live in one of the most thriving and productive of the agricultural towns of the Commonwealth, the town of Arlington, yet my vocation is not that of a farmer, and I therefore do not live in a farmer's home. I can, nevertheless, appreciate, and do appreciate, the importance of this subject, not only to farmers themselves as a class, but to the whole community. The Commonwealth needs the influences which spring from the farmers' homes of Massachusetts. In the struggle which is constantly going on in behalf of good government, for the maintenance of public order, and for the protection of the public morals, these influences are demanded to offset the forces which are adverse to these great objects and which unhappily are too prevalent in our great centres of population. Jefferson once said, speaking of the growth of cities, that "when we get piled upon one another in large cities, as in Europe, we shall become corrupt, as in Europe." The history of municipal government in our large cities, their business and social characteristics, the fierce struggles for wealth and power, the pursuit of these objects regardless of the means resorted to or of their effect upon the public, the vanities, frivolities and shams which take all the heart out of social intercourse, the corruption and chicanery in politics, — these afford startling proofs of the truth of Jefferson's prediction. To aid in counteracting the effect of these conditions upon our national life and character we need the saving influences which emanate from the farmers' homes of the country. John Fiske, in his "American Political Ideas," puts this matter pointedly when he says: "It will be long, I trust, before the simple, earnest and independent type of character that has been nurtured on the Blue Hills of Massachusetts and the White Hills of New Hampshire shall cease to operate like a powerful leaven upon the whole of American society." [Applause.] I see that you all endorse that sentiment. To multiply the examples and extend the influence of that type of character is one of the nation's needs to-day. The greater the number of happy, thrifty farmers' homes we have in Massachusetts the better it will be for Massachusetts. Whatever can be done to increase their attractions and their comforts, to make them more desirable, to prevent their being abandoned, to cause them to be occupied not by a less but by a greater number of people, ought to be done. Every effort in that direction and for this purpose is deserving of the support and the encouragement of all public-spirited men and women, of all who are concerned for the welfare, the progress and the happiness of themselves and their fellow-men. There is, unhappily, a tendency on the part of the people, especially on the part of young people, to desert these rural homes. This fact is often adverted to and the cause and cure are common subjects for discussion. The greater facilities afforded in our cities for the acquisition of wealth and power, their social attractions, their activities and their excitements, allure the fancies of the young and they become wearied with the quiet and retired life of the country home. Their ambitions are enkindled. They long to mingle in the busy throng, and to take their chances at winning the great prizes which excite their boyish dreams. The deserted homesteads passed in journeying over our country roads tell the story of the depopulating effects of these aspirations and desires. Standing silent and tenantless, with its doors closed and its windows boarded up or broken in, its shingles and clapboards dropping off, its front yard filled with grass and weeds, no smoke curling up from its chimney, no light or warmth within, — one of these deserted homesteads forms a suggestive and at the same time a pathetic spectacle. It fills the mind of the passer-by with dreamy fancies as to the persons who may have occupied it and the scenes of which it has been the theatre in the past. He pictures in his imagination the young couple who there may have begun their married life, the joy and love which centered about their early home, the children who enlivened it with the music of their merry voices, the joyous festivals, the paring bees, the huskings, the quiltings, and other like gatherings, when neighbors came to render their friendly services and to have a good time; the Thanksgiving dinners, with their heavily-laden tables, when the members of the family, after separation, were united again; the bright wedding days, when relatives and friends came to bring their gifts and their greetings to bride and bridegroom; and those darker days, when the family circle was broken, and the house was filled again with friends and neighbors tendering their sympathy and condolence to those who mourned. The old home is now forsaken. Its charms, its joys, its sorrows, have all departed. Its original occupants are in their graves in the little village church-yard, and their children have gone to seek their fortunes elsewhere.

These scenes are far too common in the rural districts of Massachusetts, New Hampshire and the other New England States. These districts are being drained of their population to swell the current of city life. As a great river, whose water power has built up the cities which line its banks, and which, after ministering to their industries, finally pours its wealth of waters into the sea, is fed by numberless rivulets which issue from the country hillsides, so the population of those cities is largely made up by contributions from these same country regions. They are contributions which are of great value to the cities. As our friend has said, they give strength and vigor to city life. But what is the cities' gain is the towns' loss, and it is a loss which, in so large a measure, they ought not to bear. Their growth should be proportionate to that of the cities, that both may share alike in the national prosperity and progress.

The influence of these farmers' homes is a conservative one. By this I do not mean that it is an old-fogy influence, that it is adverse to progress, but that it is *conservative* in the sense that it is a safeguard against these dangerous tendencies to which I have alluded and which are so rife in the cities. This influence derives its character largely from the fact that the homes of the farmers are usually owned by the persons who occupy them. They are, therefore, more permanent than city homes. A great portion of the residents in cities live in hired dwellings. They are constantly changing their residences. What is a residential quarter of the city at one time becomes a business section at another; the homestead of this year becomes a place of business next year. A friend of mine the other day was telling me about taking his boy to see his old home in Charlestown, and when they arrived there they found that what was once his mother's parlor was now a cheap bar-room. The boy thought that that was a pretty poor place for his father to be brought up in. That is the way homes change in the cities. It is different in the country. What is once a homestead usually remains so, and the fact that these homesteads are generally owned by their occupants is one of the reasons why they retain their character as such. Home ownership is an important element in civilization. It not only contributes to the material welfare of the people, but its influence, — morally, politically and socially, — is salutary. It promotes love of country. When a man has a proprietary interest in the soil, he naturally feels an attachment for the whole land of which his little plot constitutes a part. Under the fuedal system, as you know, the homes of the people were owned by a comparatively few feudal lords. They constituted the governing class, and the landless many were dependent upon them. The effect of any such system always is, that while the few are blessed with abundance, the great majority of the people are poor and dependent. We have an illustration of the effect of the absence of home ownership in Ireland, that land to which the attention of this country has been largely attracted for so many years. The homes of Ireland are, as a rule, owned by men who do not live in them. They are owned by absentee landlords. The tenant farmers have no vested interest in the farms they occupy. The landlords have no interest in the tenants, except to squeeze out of them the greatest possible amount of money in the shape of rent. The tenant has no inducement to improve the farm he occupies, for the moment he increases its value, that moment up goes his rent. The wealth of the country is constantly drained to support a class of people who spend their incomes elsewhere. The hard earnings of the industrious many go to support in luxury the idle and useless few. Prosperity can never exist under such conditions. A state of things like that is not calculated to promote the growth of patriotism or to develop a respect for law. Roman history, to which our friend alluded, also furnishes an illustration upon this point. When the Roman farms were many in number and small in extent, and were cultivated by their owners, the Roman republic was prosperous and powerful, and its people were patriotic. But there came a change, and with it the decline of Rome began. The homes of the people were monopolized by the nobles, and the farmers, no longer interested in the ownership of the soil, lost their love of country and became unpatriotic, indifferent and degraded. Gibbon says that the lands of Italy, which had been originally divided among the families of free and indigent proprietors, were insensibly purchased or usurped by the avarice of the nobles; that in the age which preceded the fall of the republic there were not more than two thousand citizens of Rome who possessed any independent subsistence; and he adds, that when the prodigal and thoughtless commons had imprudently alienated, not only the use but inheritance of power, to wit, their own homesteads and free life, they sank into a vile and wretched populace.

The man who owns his homestead not only enjoys a higher social position and has a greater opportunity for sharing in the good things of life, but he has an additional incentive for being a good citizen. He realizes more clearly that he has an interest in the country, that he is a more important factor in the body politic. His position as a tax-payer, while it imposes a burden, adds to his sense of dignity and self-respect. He feels more keenly the necessity for good government, for economy in public expenditures, for the preservation of law and order. "Only those who have nothing to lose ever revolt," says Holyoke. A man who has something to lose through disorder and tumult is under the strongest of bonds to keep the peace. Therefore, to promote home ownership on the part of the people, especially on the part of the agricultural people of the State, is in every way an object which those who have the welfare of the State at heart ought to seek to promote in every possible way. Our laws provide that a homestead shall be exempt, to a certain amount, from attachment or levy on execution. I believe it would be well if they also provided for their exemption, to a certain amount, from taxation—[applause]—in order thereby to encourage more of the citizens of Massachusetts to become owners of the soil of Massachusetts, and in that way to promote the stability of the government and the good order of society. Whatever the Legislature can do in that direction, and whatever this Board of Agriculture can do towards promoting the ownership of homes in Maassachusetts, will in the highest degree contribute to the material, the moral, the social, the intellectual and political development and welfare of the Commonwealth which we all love so much, and the well-being and happiness of all the people whose good fortune it is to dwell within its borders. [Loud applause.]

Prof. STOCKBRIDGE was called for by a number of gentlemen in the audience, and in response to the call spoke as follows: —

Mr. Chairman, Ladies and Gentlemen, — Of course, as you all know, I did not come here to make a speech, and I know that I am not going to make one. I have been delighted with the words and the sentiments of the lecturer and of his Honor the Lieutenant-Governor; but as I stand here and look over this audience, it seems to me that every thought that has been uttered upon this platform to-night has been driven from my head. I remember to have attended a meeting of this Board of Agriculture in Springfield once before. The lecturer to-night has spoken of the changes which have taken place in the agriculture and in the agricultural community of Massachusetts within the last few years, and what more perfect and astounding proof do we find of the changes which have taken place than the contrast of this audience with the one which assembled in Springfield something like twenty years ago, at the first country meeting of the Massachusetts Board of Agriculture? When we met here twenty or twenty-five years ago, to get up a boom and to wake up the lethargic farmers of Hampden County, we came here with Prof. Agassiz, Prof. Johnson of New Haven, Dr. Loring of Salem, and with all the boom, with all the advertising and with all the noise we could make, with these men as the speakers, we hardly got more than three citizens of Springfield to hear them; and when we had Prof. Agassiz deliver a lecture in the hall across the way, there was scarcely anybody there to hear even him on a most interesting subject and one which was then attracting the attention of the whole scientific world. The farmers were not here and the citizens of Springfield were not here. Here you are, brother farmers, to-night. Has not a change come over the spirit of your dream? Prof. Johnson was here and delivered a valuable lecture, but a baker's dozen was all that he drew that afternoon.

It is natural that I should think of these things. I do not see a man here to-night who was here then. [Two gentlemen, Mr. STEDMAN and Mr. BROOKS, said they were here.] Well, you were here, but where were the rest of the crowd then? The truth of the remark of the lecturer that there has been a great change in the agricultural community within the last twenty or twenty-five years in this immediate section is shown by the audience that has been drawn here to-night, as well as in a great many other directions. You will find it, as has already been said, in the implements on the farm, the style of farming, the crops we grow, the general management of land and the whole round of agricultural industry. We find that there has been a great change, and a change, in my judgment, for the better. We do not grow the same crops and our mode of farming is not the same; there has been almost an entire change in these respects. While on this point a statement comes to my mind that I saw in a book to-day, accidentally, that away back in 1662, when the whole Connecticut Valley consisted of the towns of Springfield, Northampton and Hadley, the Great and General Court of Massachusetts passed a law that the people of Springfield, Northampton and Hadley might pay all their county rates in fat cattle and other cattle fit for market, and in corn. They did not have any money. In 1662 fat cattle and other cattle fit for market, and corn, were the great market crops of this valley, and they remained so down until within about twenty-five years, did they not? You remember that the "river gods" were fattening cattle here for two hundred years for the markets in the eastern part of the State. What are they doing to-day? The "river gods" are not making cattle nor fat cattle — what are they making?

A Voice. Tobacco.

Prof. Stockbridge. Oh, no, that has gone up. The filling up of this valley and of the whole of New England with a different class of population, engaged in a different business from that which was followed by our fathers, has created a demand in Massachusetts and all over New England for a different class of crops. Cattle cannot be grown profitably here in competition with the West; we cannot afford to grow them; but we make milk, we make butter, we make cheese, we make poultry, we make vegetables, and we shall continue to make men and women as of old, and we shall find in this New England an open market for all the crops of this kind that we can make. [Applause.]

Now, these changes of which the lecturer has been speaking lie right along on this line,— changes which have been absolutely necessary ; and I am proud to see that the farmers of New England have had the wit to recognize the demands and requirements as they have arisen and to fit themselves to the circumstances of the case. It is a great deal better than it would have been for us to try to grow cattle on our hills or to make fat cattle, as the "river gods" of the valley used to do, when my friend Taft and the rest of them were driving fat cattle on the hoof from here to Brighton. They cannot afford to do that thing now.

There is one subject on which Brother Warner touched where I do not agree with him. He said we ought to cultivate small farms. Now, from the way that he said it and from the way we very often hear it said, it seems to me that the acres are supposed to be at fault. I say no. I do not care how many acres of land a man cultivates, whether one, or a hundred, or a thousand, provided he cultivates each and every acre as it should be cultivated. The point is just here. The more land a man cultivates the more crops he grows, the more he has to sell of any crop that he can grow upon his farm the more profit there is per bushel or per acre in what he grows, provided that that cultivation is as it should be, provided the land is manured as it should be, provided he gives the care to the crop that he should give. If a man cultivates a thousand acres of land he should give the same care to manuring the soil, the same care to the crops, the same care to economically harvesting them in order to save them all, that he would give if he did not cultivate but one acre. Then he can make more money per pound, or per bushel, or per acre, and for a great many reasons. I want to know if a man in Sunderland who makes five thousand bushels of onions does not have a greater influence on the market, a greater control over it, does not bring more purchasers to him from all over the country where there are onion dealers, than a man who grows but a hundred bushels? The latter is utterly unknown in the market, has no influence on it, and must sell his hundred bushels of onions as best he can and where he can. This principle runs through every branch of agriculture.

Do your work well, cultivate every acre of your thousand acres as you would cultivate a single acre, and your profit will be proportioned to the number of acres you so cultivate.

Then there is another thing I will mention in that connection. The man who cultivates two, three or four hundred acres can afford to keep all the machinery and appliances that have been produced in these modern times for the economical cultivation of crops, while the man who has but twenty-five acres cannot afford to do it. A man in these days, in order to cultivate a farm economically, must have all sorts of implements of tillage. Compare the implements of tillage on the farm to-day with the implements that were on the farm when I was a boy! Think of the old plough, with its wooden mould-board; of the old three-cornered harrow, with teeth three inches long and as large as your arm, and always blunt; then go into the tool shed of any one of these successful farmers and look at the implements of tillage. What do they have there? Look at the cultivating tools, the harvesting tools, and the multitude of implements of husbandry there that a man who is the owner of a hundred-acre farm can afford to have and must have! How can a man who is cultivating a twenty-five acre farm afford to have such implements? Of course they cost a great deal of money. It costs him more to cultivate his land per acre, it costs him more to harvest his crop per acre, it costs him more to market his crop per acre, per bushel or per hundred bushels. The more a man has to sell, the more land he cultivates, the more tools and implements he can use, the cheaper is all this work done.

A VOICE. He can hire.

Prof. STOCKBRIDGE. I know he can, but he cannot pay. [Laughter.] I want to lay great emphasis upon thorough manuring, thorough cultivation, the management of the farm on strictly business principles, and the selling of the crops on strictly the same principles. If you will do that, you can go ahead and make your farm just as large as you please; or, in other words, up to the measure of your individual capacity as business men; the larger the farm the greater is the per cent. of profit. [Applause.]

The CHAIRMAN. There are others here from whom we should be glad to hear to-night, but we have spent a very profitable evening, and we want you to go away with a very strong desire to come here early in the morning, for we are to come again at half after nine. Our programme for to-morrow is a full one, as you will notice.

Adjourned to Wednesday, at 9.30.

SECOND DAY.

The meeting was called to order at 9.30 by Mr. BROOKS, a fine audience being in attendance. Prof. HENRY E. ALVORD, of the Massachusetts Agricultural College, was introduced as the first lecturer of the morning.

IS ENSILAGE A SUCCESS IN NEW ENGLAND?

BY HENRY E. ALVORD OF AMHERST.

Is ensilage a success in New England? This question has been submitted to me for consideration and reply on this occasion. Meeting the question directly, I answer: Where silos have been properly and economically made, well filled with suitable material, resulting in a good product, and the ensilage fed out with judgment,—this system of preparing and preserving succulent food for the live stock of the farm has proved a success in New England and in numerous other parts of the world.

While this reply is and is intended to be decidedly in the affirmative, several conditions are stated which give rise to further questions. How can silos be properly and economically built? How and with what should they be filled to make good ensilage? And in what quantity and manner should ensilage be used as forage for domestic animals, to obtain the best results?

These questions in turn require even longer replies. They open the whole subject of silos and ensilage as viewed with our present knowledge. This is quite a task, but as it was probably the intention of the committee of the Board in propounding the original question, I will endeavor to go over the entire field as far as is possible within reasonable limits.

Based upon practical and considerate experience for six years in England, twelve years in America, and more than twice as long in France and Germany, this statement is fully justified and lays the foundation of our subject: Any plant or vegetable product or refuse, good for cattle food when green or fresh, may be preserved as ensilage in an edible and succulent condition throughout the year, or for several years.

Before proceeding to describe the best methods for accomplishing this result, a brief historical sketch may be permitted, to show more in detail the experience which is relied upon to substantiate the statement already made.

The words silo and ensilage have come into use, adopted from the French, in connection with a system of providing green forage for domestic animals throughout the year. The plain terms pit, pitting and pitted would better suit our language and serve the purpose, but it seems too late to make the change. We must therefore accept the term *silo* for the receptacle, *ensilo*, *ensiloing* or *ensiling* for the verb, and *ensilage* for the product or pitted material. As different plants are preserved by this method, the word *ensilage* alone is incomplete, and "ensilage of corn," "ensilage of clover," etc., is necessary to a clear understanding of the article referred to. Yet custom already allows "ensilage" to be interpreted as pitted corn plants, maize being the crop used in this connection so much more than all others. Silo means a pit, and this word in different forms can be traced back across Europe, through Rome, Greece and Egypt, into Persia, in very ancient times. In the earliest agricultural writings, the silo or *siro* is described as an underground excavation used for the storage of grain and of green crops also. The requirements of the ancient *siro* were those deemed essential to the modern silo, — protection of the contents from contact with the sides of the pit (if of earth), dryness and perfect exclusion of air. A knowledge of this method of preserving green forage came to the present agriculture of Europe in a manner that cannot be traced, but is known to have been in practice in Hungary at the beginning of the present century and probably as long in Germany. An account of what was called "Sauer-kraut for Cattle" can be found in Arthur Young's "Annals of Agriculture," in the form of a letter from Berlin, dated August 25, 1804. The process in vogue in East Prussia was well described by Grieswold in 1842, and other similar accounts exist of its application in Spain, France and Mexico to the preservation of different vegetable products, including the leaves of trees and vines. In Germany it was especially useful in keeping beet leaves and beet pulp in sugar-making districts. Its application to corn seems to have been accidental about thirty years ago. It passed from Germany into France, and August Goffart is to be mainly credited with bringing the system to a state of greater perfection and economy than exists elsewhere in Europe. It was also mainly through the efforts of M. Goffart, and the attention his work attracted, that the silo was introduced into the United States.

In the year 1873, and again in August, 1874, a description of the Hungarian method of making "sour-fodder" in the crude, trench form, appeared in the "American Agriculturist." The same journal published in June, 1875, an illustrated account of the European experiments with ensilage based upon reports in the *Journal d'Agriculture Practique*, of Paris. It is worthy of note that the much-abused United States Agricultural Department Report contained, in the volume for 1875 (pp. 396–408), the first full description of silos and ensilage published in this country, if not the first in the English language. So our ignorance of this subject ten or twelve years ago was due to a want of appreciation of that freely-distributed public document. This article is entitled, "The French Mode of Curing Forage," and deals with its origin, the silos, the usual methods of cultivating and manipulating crops for ensilage, the effects of fermentation and the value of ensilage in stock feeding. The general principles of ensilage were applied to the preservation of different products in numerous places in America between 1870 and 1880. Prof. Manly Miles, at the Illinois Industrial University, kept broom-corn seed and the green-corn plant, whole, in this way for months. In dairying districts brewers' grains were similarly preserved in pits. In September, 1877, the "American Agriculturist," under the title of "An American Silo," described and illustrated a dairy barn at Katonah, Westchester Co., N. Y., which contained a cellar or pit, specially constructed for storing brewers' grains and preventing their fermentation and decay, by pressure and exclusion of air.

Mr. Goffart published his book on ensilage in 1877. This work was noticed in a paper read by ex-Governor R. M. Price, of New Jersey, on Friday, Dec. 6, 1878, at the International Dairy Fair in New York City, and subsequently published in the Fair "Proceedings." I remember the attention given to the subject by the farmers and dairymen present on that occasion, and believe it was then discussed for the first time in a public meeting in America. A translation of Goffart's book was published in New York in 1879, and since that time, half a dozen books on the subject have appeared, besides the numberless articles in the agricultural press, with which we are all more or less familiar.

The first person who built silos and made ensilage of corn for cattle food in the United States was Francis Morris, a large Maryland farmer. He saw an account of Goffart's operations in a French newspaper, early in 1876; at once opened a correspondence; that same year raised five acres of corn in drills and preserved it in silos, and repeated the trial in the following year. It was the experience of Mr. Morris that was given at the New York meeting above mentioned. From this beginning, the system has rapidly spread in America, and there are now hundreds of silos in use in different parts of the country. They are chiefly in the Eastern and Middle States; over one hundred in Vermont, for example; but they are also as far south as the Gulf States, and as far west as Nebraska.

So general has been the discussion of this subject for several years, that it is useless at this time to enter upon a minute description of the process, or the forage thus produced, or to make an argument upon the practical success of this mode of preservation. But we may well consider the leading points on which there remain differences of opinion, and the best lessons derived from practical experience.

I. *Silos — Location, Construction and Cost.*

Local circumstances will largely govern all three points. The silo may be a new building, an annex, an old cellar, or a hay "bay" refitted. The location should be such as to prevent unnecessary expense in construction, and economize labor in filling it and in removing the contents. As a rule, these conditions are best secured by placing the silo within, or adjacent to, a hill-side barn. Thorough drainage is essential, and the general requirements for a good ice-house apply very well to a silo. It may, therefore, be wholly underground, or wholly above ground-level. It is preferable to have the silo excavated, or partly so, to secure and maintain fairly an even temperature at all seasons. For materials, stone, brick, concrete, wood and paper may be used, and a simple trench, or hole in the ground, will serve the purpose. Excavations in an impervious soil, or a well-drained gravel-bed, which may or may not be lined with boards, to prevent caving or ensure cleanliness, make good silos. Such were the first made in this country, by Mr. Morris, — the first, if I am not mistaken, in this State and in this valley. I know such trenches in Illinois, simply dug in the open field, through a tenacious soil and a hard-pan sub-soil, to a stratum of gravel below, filled with uncut corn, grown in the field, and covered with the earth thrown out of the pit, which have made good ensilage, and proved unquestionably profitable for several years. Yet I believe a substantial masonry silo is true economy in the end. It should be water-tight, and preferably, but not necessarily, air-tight and frost-proof. Oval or rectangular is the best shape — if the latter, the corners may be filled and rounded or concave. The walls should be smooth and vertical, although some prefer them to flare or slope outward a little near the top. Make the silo small and deep, rather than large and shallow, the depth considerably greater than the length, width or diameter. Several small silos are greatly to be preferred to one large one; they may, of course, be built adjoining, and if desired, communicating by doors at bottom of the partitions. But the silo should not be too small in surface. While I have preserved ensilage pretty well in boxes and barrels, with and without pressure, well housed and exposed to all temperatures of the year, I am convinced that, for best results, a silo should not be less than ten feet in its least dimensions, and prefer twelve feet, or even fifteen. Still, a good rule is to have the silo so suited in size to the quantity of ensilage to be used from it, that at least three inches in depth over its entire surface shall be removed daily, or every other day, at any rate, while the pit is open. Although more labor is involved in the method, unless hoisting apparatus is provided, the best plan seems to be to have no openings in the bottom or walls, and to remove all the ensilage by lifting out. Side doors will often be found convenient, however, and may be used, although a certain cause of more or less loss of material; if used, make these doors as small as possible, and take every precaution for their being made air-tight. If circumstances make the use of a door advisable, and thus empty the silo from the bottom, let the silo be built deep and narrow, but long, with the door at the end, instead of deep, narrow and short, where the ensilage is removed from the top. The idea is, to have the least possible surface of the packed ensilage exposed to the air, while the silo is open and its contents being daily removed. A curb, apron, or upward extension of the walls should be made, equal to one-third of the depth of the permanent structure, to allow for the settling, and this may be of wood in all cases. In planning the size of a silo, allow twenty cubic feet for every month's feeding of one thousand pounds live-weight of animals to be fed. This is to be for the space occupied by the ensilage when fully settled, and makes due allowance for loss and waste, sure to occur to some extent. (For example: A silo ten feet wide, twelve feet long and twenty feet deep, in full, the contents settled to fifteen feet deep, would hold 1,800 cubic feet of packed ensilage, or about forty tons, enough to feed ten cows thirty pounds of ensilage daily, including waste, for nine months.) The silo should be built strong enough to bear all strains of holding its entire cubic capacity, rated at fifty pounds to the cubic foot. In converting a hay bay into a silo, it must be recollected that there is no loss of storage room. The cubic space required for one ton of hay will hold eight tons of ensilage, although the latter contains but little more than twice as much dry food material as a ton of hay. As to the cost of a silo, the range is from fifty cents, or even less, to five dollars, for every ton of capacity; from two dollars to two and a half dollars per ton is a fair estimate. A forty-ton masonry silo can be built under an existing shelter for $100. One of 80 tons capacity, of wood, has been built in the corner of a barn, at a total cost of $50. I have in mind an excellent concrete silo, built some years ago, and as solid to-day as a single block of stone, which holds 165 tons, and cost $500, or about $3 per ton. The cost of labor and materials and other local conditions vary so as to make closer estimates impossible. But enough has been said to show that any person who wishes to try making ensilage for a year or two, to satisfy himself in regard to it, need not be prevented by the first cost of a temporary but efficient silo of moderate size.

Brief but sufficient directions are added for making cheap silos: —

The Earthen Silo.— If the location is high enough to prevent water rising in the bottom, and the soil is stiff enough to prevent caving of the walls, this form of silo is the simplest and cheapest. It is nothing more than a pit dug in the earth, with smooth, vertical or inclined sides and preferably with a shelter over it. As ensilage when filled in rapidly shrinks about one-third, it is well to extend the walls above ground by means of plank, so as to use the entire depth of the pit. This can be done by nailing rough inch-plank edge to edge on the inside of 4 in. by 4 in. posts, set four to six feet apart, the lower ends being let into the bottom six to eight inches, and the posts themselves counter-sunk in the walls one inch below their surface — this inch being filled out with plank nailed over the post. In this way the plank and clay portions of the walls are made flush with each other.

The Wooden Silo above Ground.— A very common form of wooden silo is made by covering 2 in. by 6 in. or 2 in. by 8 in. studs, inside and out, with rough plank and filling in between with dirt. This answers the purpose, but one made as follows is neater, stronger and fully as cheap. Lay four 8 in. by 8 in. sills level on the ground and fasten their ends together securely, notch them across their upper surface every two feet,— notches two inches wide and one inch deep. Rest on the sills the lower ends of 2 in. by 10 in. studs set in the notches. Toe-nail these to the sill and drive a forty-penny nail into it just at the outer edge of the studs to help hold them against the outward pressure of the ensilage. Saw off the tops of the studs on a level. Place on their level tops a 2 in. by 10 in. plate. Set on this plate supports for a roof. Cover this with clapboard or shingles. Put in braces wherever thought desirable, but not to interfere with the interior space. Line the inside with narrow tongued-and-grooved flooring, put on horizontally. If a door is wanted, make it four feet wide, in one end, by putting battens on the outside of the flooring and sawing it out, together with a section of one stud. The door must open outward. If the wall should be covered with tarred paper and another thickness of flooring laid on inside of that, running up and down, it would be better, and enough better to pay for the extra expense. Washing the inside thoroughly with crude petroleum, applied with a whitewash brush, is of advantage, as aiding in the prevention of rotting — the weak point in wooden silos. In New England this form of silo ignores the action of frost upon the contents; but, if weighted, this is not serious.

II.— *The Crops for Ensilage — Cost of Cultivation and Harvesting.*

At different times I have made ensilage (relished by stock) from eight or ten different plants or crops, although never more than seven kinds in one year. For excellence of food produced, I should place them in this order: Hungarian grass, sorghum (Early Amber Cane), Soja or Japanese bean, Indian corn, peas and oats, Southern cow peas, meadow grasses, rye and clover. I never saw better ensilage than that made from Hungarian grass, or millet, cut when just beginning to show the heads. Yet, all considered, the one favorite, most successful and almost universal crop for ensilage, is maize or Indian corn, — *the* great agricultural plant of America. Corn, as a crop for ensilage, has conspicuous and unrivalled merits, — adaptation to a variety of soils, ease of cultivation, rapid and luxuriant growth resulting in a product per acre far exceeding any other plant, ease of handling and quality in preservation. For quantity I would recommend the tall Southern, or Virginia "horse-tooth" corn, white and semi-flint. The best quality of ensilage is claimed for the larger kinds of sweet corn, but unless great care is taken, the product resulting will be very acid. For general economy, the common field corn of the neighborhood is, perhaps, as good as any. If one wishes to make a crop of corn (grain) and also a crop of ensilage, and does not care to have the ears go to the silo, there can be little doubt about it. The crop can be raised in the usual ways, in hills or drills, the ears plucked from the stalks while "in the milk," and of course, without husking, and thrown in small piles, or spread a foot deep under a shed, to cure, and the stalks then cut and ensiloed. In this way, the usual crop of ear corn can be obtained and from six to eight and sometimes ten tons of ensilage to the acre, and the ensilage thus made usually comes as near to being "sweet" as any I have ever seen.

Ordinarily, however, a special kind of corn will be specially grown for ensilage, to secure the greatest possible tonnage per acre. For this purpose select a strong soil, in good heart, and manure heavily with stable manure, broadcast or in the drill. I prefer manure broadcasted, plowed in lightly if green, and if well composted harrowed in after plowing. Get suitable seed, and plant in drills from $2\frac{1}{2}$ ft. to $3\frac{1}{2}$ ft. apart, according to size of corn, condition of soil and mode or facilities of cultivation. Hand labor must be avoided as much as possible, and may be entirely superseded on good land, until the cutting. The plant should grow from three to five or six inches apart in the row. The aim is to have every plant receive light and air enough to grow rapidly and reach maturity, if allowed time. The quantity of seed corn will vary from one-half bushel to a bushel for an acre.

It is economy to stimulate the young plant and crowd the growth by feeding generously. Super-phosphate or any good commercial fertilizer may be applied in the drill. But I have never succeeded in growing a large crop of ensilage corn without plenty of ammonia, and that, too, in the form of animal manure. Commercial fertilizers alone, even when largely used, have not, in my experience, produced satisfactory results with corn grown for the greatest possible weight per acre. The plant should approach maturity before being cut for the silo; this rule should be applied to any crop grown for ensilage. For the best effects in feeding, we want plants that are just about to perfect their seed. In corn, wait till the ears are fully formed, or till the kernel is glazed, before cutting. Thus treated, a crop of twenty to thirty tons of green fodder, and an almost equal quantity of ensilage, may be obtained from an acre. Crops of thirty tons per acre are rare, however, and the average is rather below twenty tons than above it. There are publishers who do not hesitate to sell books professing to preach the true gospel of ensilage, which books tell you it is easy to raise not only thirty, but forty, fifty and even sixty tons of ensilage corn per acre. And every year I meet reputable citizens who assure me, with every appearance of good faith, that they have actually raised forty tons or more to the acre. Now, I do not wish to directly deny such statements; but I do say, that while I have seen many acres of good ensilage corn, I know I never yet saw thirty-two tons of green corn growing on an acre,—have yet to be convinced that thirty-two tons ever did grow on an acre,—and at present I never expect to believe that one acre in New England ever produced forty tons. John Gould of Ohio, a man of accuracy in writing, reports twenty-three tons of ensilage corn per acre from eleven acres, and that this, with the product of five acres of field corn and one ton of wheat "shorts," kept fifty-four head of cattle and three horses through the winter; the field corn was fed as cob-meal and its stalks dry.* He

* If the winter comprised six months, the fifty-seven animals thus kept that period on the crops from sixteen acres, each received daily fifty pounds of dry corn fodder, two and one-half pounds of cob-meal and about two ounces of bran. This seems

further states that he has a neighbor, who has produced on twelve acres, corn which made into ensilage proved equivalent in feeding to the usual hay crop from two hundred acres of the same farm, being average Ohio meadow land. The best crop of ensilage corn I ever saw weighed was raised under my supervision, at Houghton farm, in 1883, and I have seen few crops growing that appeared to me to be heavier. We used in the same field some special ensilage seed corn, common white Southern corn and early amber cane, — the latter alone, and scattered thinly in the drills of corn to grow with it. The weights obtained from accurately measured acres, the material weighed while passing fresh-cut from the field to the silo, were as follows: Special ensilage corn, $27\frac{1}{2}$ tons; common white Southern corn, 21 tons (showing the value of good seed); the latter mixed with cane, $29\frac{3}{4}$ tons, and the sorghum alone, $20\frac{1}{4}$ tons. Although, unfortunately, no cane was tried with the best corn, I was satisfied that there was room for enough to have grown to make up thirty tons.

Next to corn, all considered, I would place sorghum and Hungarian grass, although, if I had the experience of others with clover as ensilage, that might be preferred. Rye is largely grown for the silo, and well liked by some. I have examined pretty fair ensilage made from rye, but have never been fortunate to so preserve this crop as to make what was to me a satisfactory article of food. It yields far less tonnage to the acre, but is more substantial than corn; an animal which will eat up thirty pounds of corn ensilage, clean, will hardly dispose of twenty pounds made of rye. The advantage of using rye for this purpose lies in the fact that where land is scarce and high, and manure plenty, the fields can be kept constantly at work. After a crop of ensilage corn has been secured, rye can be sown, which will be ready for the silo before it is time to plant corn again; then another crop of corn, to be followed with rye. This means much manure; but that is necessary for all these great crops of green herbage, whether they are dried or pitted. Plants

pretty light feeding, although bulky. Yet it is said this herd was milked all winter, and exceeded in milk produced any other herd contributing to the neighboring butter factory, and that the milk was regarded as excellent in quality.

don't grow without food, and the more food the greater the growth; that is the first lesson in raising any crops for ensilage.

All the leguminous plants that have been tried make good ensilage: but they are so highly nitrogenous as to make too rich a food to use alone in any quantity, and ensilage made from nearly all of them is very disagreeable to handle, because of its pasty character and strong odor. The Japanese soja bean makes a reasonably dry and pleasant article, but it is uncommon and the seed hard to obtain; it deserves more attention. The cow pea is one of the best plants in the South for ensilage, being easily grown on poor soil, and now quite extensively used in the silo,—alone and mixed with corn. This plant will not ripen its seed in New England, but will make a profitable growth of green forage almost anywhere in Massachusetts. Oats and peas mixed give a heavy crop and make better ensilage than either alone. The clovers are largely used in some sections for ensilage, and although usually extremely unpleasant, I have never seen clover ensilage so black, slimy and altogether nasty, or with so "loud" a smell, as to prevent cattle from eating it with avidity. The most satisfactory way to use clover, or any similar growth, for ensilage, is to cut it and put it into the silo in alternate layers, six or eight inches thick, with dry straw or swale, or other coarse hay or fodder, also cut. The result is a mass much more comfortable than clover alone, safer to feed and of almost equal feeding value, judged by actual results. In England, any grass suitable for hay is cured in the silo, instead of drying, if the season is unfavorable for haying.

In storage, I have found by careful trials that plants stand in this order, as regards compactness in the silo, when cut in equal lengths: clover, cow peas, rye, corn, soja bean, early amber cane and Hungarian grass. In other words, a cubic foot of clover ensilage weighs more than one of cow peas, and so on. The order of shrinkage or settling of the same list is therefore exactly the reverse,—Hungarian grass and sorghum settled very little, and the soja bean not much more; Indian corn, cut short and levelled off in the silo, without packing, usually settled from one-fourth to one-third its bulk.*

The average cost, all items included, of raising corn and converting it into ensilage ready to feed is not far from two dollars per ton. The harvesting expense alone, which is the main item, has been variously reported at 10 cents, 15, 33, 50. 87½ cents and $1 per ton, but the low figures are found not to include allowance for labor of the farmer, his teams and regular help, and therefore it is really the extra outlay and not the total cost of the work that is thus stated. The Messrs. Smiths & Powell of Syracuse, as the result of a very careful account with a crop of 18 tons per acre, report the cost of cultivation at 50 cents a ton and of harvesting, 87 cents a ton, — a total of $1.37, to which being added the use of land and other proper charges, would bring the amount to about $2 per ton. In a good many instances I have known of ensilage sold in the silo at $2 to $2.50 per ton, and this indicates that its market value, so far as it yet has any, is just about the same as its average cost.

III.—*Filling the Silo.*

In connection with this part of the work the greatest opportunity occurs for system and economy. The location of the growing crops, with reference to the silo, and the arrangements for cutting, loading, hauling, chaffing, storing and pressing, require good judgment and close supervision. It is useless to discuss details, so much will depend upon the circumstances peculiar to every case. But it is certain that, with like conditions, one man will make the operation of harvesting a job costing a dollar a ton, and another man will so order and manage the same work as to do it with comparative ease and at half the cost.

Rainy weather and wet material need not interrupt the

* Several trials have been conducted by me with a view to determining with some exactness the relative feeding value of different forage plants in the form of ensilage, but thus far without satisfactory results. I find the consumption of the different articles depends upon the tastes of the animals to which they are fed, rather than any law relating to their nutritious properties. So I have as yet only found that generally more ensilage of corn will be eaten than of rye or clover, less of cow peas than the others named, and of Hungarian more than all other kinds; but this Hungarian grass ensilage was the best silo product I ever saw, — apparently the true "brown hay" of Germany and Austria, at its best.

harvest and storage of an ensilage crop, unless so serious as to drive teams and workmen to cover. An addition of water causes little loss; but it does increase the acidity developed, and hence is to be avoided. To secure the best ensilage, I would not only have the plant so mature as to show that it is beginning to naturally dry, but would cut and wilt for half a day, or over night, in the case of corn, for the purpose of reducing the proportion of water contained in the stored materials. Luxuriant fodder corn at time of tasselling contains 85 per cent. of water, and often more; at the time the kernels of the ear are glazing the water is usually about 80 per cent., sometimes only 75. This material, or any other green forage, may be dried to advantage till it contains not to exceed 70 per cent. of water before being pitted. It may be stated, as a rule, that the less water in the material, down to half its weight, the better the ensilage. I have seen a very good article of ensilage made from rye straw and corn stalks, dry and poor, cut up, mixed, thoroughly wet and then put into a silo under pressure.

The question of cutting the fodder in short pieces as it goes into the silo, or putting it in whole, has been much discussed and radical difference of opinion prevails. If pitted whole, time, labor, and the cost of the cutting machinery may be saved,—all large items. It is not difficult to pack whole clover, cut with a mower and soon raked and hauled in; other of the small plants are also easily handled. Corn twelve to fifteen feet high presents greater difficulties. In a small silo, it is next to impossible to pack it evenly; in a large one, it should be placed all one way, in lap layers and closely packed. Long ensilage, as such may be called, is cut out with an axe, a strong hay knife, or a special tool like a pointed and sharpened spade; all these operations are hard work and a deal of it. The stalks may be taken out in lengths of four or five feet and run through a fodder cutter. For my own part, I much prefer cutting short, into about half-inch lengths, at time of storing, and I believe the labor involved is not much greater, although concentrated and necessitating extra help for a few days in September. There is certainly some waste of butts and joints in feeding long corn ensilage, as in long dry fodder, and there is next to none in ensilage cut short. Of course, the ease of handling to feed, in the case of short ensilage, is infinitely greater. In a comparative trial, carefully made by Mr. Hazen of New Hampshire, all expenses being exactly determined, it was found to actually cost more per ton to put a large quantity of corn ensilage into a silo uncut, in proper shape, than to cut it short while storing; the figures were furnished to me to verify this statement.

There is almost equal dispute as to the advisability of filling the silo slowly, with intentional delays, and settling to the work as one would for threshing several hundred bushels of grain, pushing the job till done and getting all the extra help needed. From its first introduction the chief fault found with ensilage has been the acid character of the material at the time it is fed to animals. This acidity results from fermentation in the silo, caused by living organisms, known as bacteria. Enthusiastic friends of this process of preserving forage claimed, a few years ago, that they had discovered a method of making "sweet ensilage." "Sweet ensilage," it was claimed, was made in numerous places. The way to do it was to fill the silo slowly, letting every lot of chopped stuff put in heat up well before putting in more. For example, our estimable friend, Captain Morton of Vermont, in 1884, filled only a foot in depth at a time; got the lowest layer, by active fermentation, up to 140° F., and then kept the heat moving up to the top. He maintained a temperature of 122° F. or over, *in certain parts of his silo*, and he said, "often up to 150° F." When the top layer had reached 130° F. he covered with tar paper and earth. The temperature held at 130° F. for two weeks and then cooled down to 90° F. within a month. The good captain adds that when he opened the silo "the ensilage was honey-like." (Sweet pickles?) The theory upon which this method is based is that the bacteria of the ensilage fermentation are destroyed and the fermentation thus arrested by a certain degree of temperature, placed variously at 120° to 140° F. The little creatures are induced, as it were, by favorable conditions, to work themselves into such a state of excitement as to die of apoplexy from their own fervent heat. It is a very pretty theory,— or was, as long as it lasted, but that was not long. As well try to fan a fire to such intensity that it would extinguish itself and without injury to the fuel. Careful students soon discovered that the bacteria of the silo were particularly happy and active at the very temperatures which it was claimed would destroy them. Temperatures from 120 to 160° F. are most favorable to their development and activity, and it requires at least 185° to destroy them, while fermenting ensilage does not often exceed 140°, and no authentic record of 150° F. can be found. How men could so deceive themselves,— and some of scientific reputation have been among them,— it is hard to understand; but the evidence is conclusive that they were wrong. I have never yet been so fortunate as to see any ensilage which I could call "sweet." Of course, the material differs greatly in the degree of its apparent acidity, and as comparative terms, sour and sweet may be convenient as applied to ensilage, although deceptive. I see no evidence that any relation exists between the method of filling the silo — the slow process or the quick process — and the acidity of the product. On the whole, I prefer the straight-ahead way,— no undue haste, but pushing the job of harvesting and filling to completion without unnecessary delay. It is most economical of labor, especially if the task is a large one, and gives ensilage of full as good quality. Yet, if circumstances make slower work desirable, or if an accidental detention occurs, there need be no fear of serious loss. On this subject of quick and slow filling, I may refer, for excellent experiments and discussions, to the annual reports of the Agricultural Experiment Stations of Massachusetts and New York.

Evening and tramping cut fodder as it goes into the silo, is not essential; but both seem desirable, for several reasons, if carefully done. The evening process, especially, tends to uniformity in quality throughout the pit. This is a valuable property and seldom true of the whole contents of a silo. Let the even spreading be continual as the chopped forage falls into the pit; assign a man of judgment to this task, and if tramping is done also, let it be particularly around the edges, next to the walls and in the corners.

M. Goffart, after more than thirty years' experience, — which means constant experiment, — with silos and ensilage, and always with a keen business eye to the useful and economical results, relies chiefly upon the Indian corn plant. He claims to secure nearly forty tons per acre, in drills, with flat culture, and his plan is to let the plant mature well, cut in one-inch lengths, fill the silo quickly, evenly and thoroughly pack the contents, cover at once and weight with two hundred pounds or more to the square foot. He says one cannot press too hard or too tight. He mixes a little dry straw or coarse hay, finely cut, with the corn ensilage.

My own experience and studies lead to the conclusion that, so far as sour and sweet ensilage is concerned, the relative maturity of the plant and consequent dryness of the material is the governing factor. The more mature the plant, if still in a succulent condition, the freer the ensilage will be from sharp acidity.

IV. — *Covering and Weighting.*

Covers and pressure on top of the ensilage, after the silo has been filled, are not essential, but are usually economical. If desired, the upper part of the material can be left to decompose, settle and itself form cover and weight for what is below; it is simply a question whether about two feet in depth of the fodder, which will be lost in such case, is worth more or less than some further labor and provision to be used instead. For covering, boards or plank, single or double, may be laid directly upon the ensilage, or, to better exclude the air, a well lapped cover of tarred building paper may be laid under the boards. Or tarred paper or canvas may be used, with sand or earth above, for weight. In any case, the cover must be so arranged or fitted as not to touch the side-walls of the pit, that it may move freely with the ensilage, as it settles. There is usually more or less material lost by decay just under the cover. Rather less perhaps with tarred paper than with boards only. Elder Evans has stated that if hemlock boards are used, the ensilage next to them will not spoil.

There is undoubted advantage in pressure, by weights or otherwise, in keeping a nearly air-tight cover and reducing the opportunity for fermentation. If the side-walls of the silo are not air-tight, heavy weighting becomes a necessity. Yet it must be remembered, that your weights added to cover are simply for use on the upper five feet in depth of the ensilage. That part of the contents of the silo — at 40 pounds to the cubic foot, which is a low estimate for corn — exerts a pressure of 200 pounds to the square foot upon all that is below, and this increases toward the bottom. Where the forage itself is worth two or three dollars per ton, I advise weighting the cover with from 50 to 200 pounds to the square foot. Fry of England says 100 pounds. Goffart has been already quoted as in favor of 200 pounds or more; he has written, — "the greater pressure, the surer the success." Screws, levers and mechanical devices have been tried, but none have succeeded very well. A dead weight or following pressure is needed. Hence stones, loose or in barrels or boxes, concrete blocks, sand bags, earth and sand, and barrels of water (where protected from freezing) have been successfully used. Water barrels have been arranged so as to fill and empty with pipes and syphons. Where grain is purchased in quantity, sacks of bran and like material may be piled on the cover, and storage is thus provided as well as pressure.

If a silo is very deep, the pressure upon the material near the bottom may become so great as to express the liquid from the mass. All below twenty-two feet depth sustains a pressure of over a thousand pounds to the surface foot.

V. — *What are the Changing Processes in the Silo?*

To tell exactly what goes on in the silo after it has been filled, closed and weighted is impossible. There are certainly chemical changes, some of which are known. I venture the opinion, that with all the careful investigation that has been made, the chemist cannot yet explain all the processes of the silo, and I do *not* venture in this presence to describe technically the chemical conversions that are known to occur.

Fermentation there is, commencing soon, rapidly increasing unless arrested. And with fermentation heat is produced. Fermentation is but another name for combustion.

And wherever there is combustion or fermentation, there must be consumption of fuel or destruction of material. Fermentation is not a preservative, but is always a step towards putrid decomposition and actual destruction. If allowed to run its full course with any food product, fermentation produces disastrous results. How absurd, then, for our "sweet ensilage" friends to advocate inducing an advanced stage of fermentation, raising temperature to 130 or 150° F. before attempting to check the process. When the grain of green corn is canned to preserve it, who thinks of starting an active fermentation before shutting it up? On the contrary, the air is expelled as thoroughly as possible and the can then immediately closed and sealed. When we pit the green corn fodder, we should follow the same course, as nearly as we can. Ensilage is simply an addition to the long list of modern "canned stuff!" The way to avoid bad fermentations is to endeavor to prevent any fermentation at all. But a silo of size cannot be filled fast enough to avoid fermentation commencing before it is closed. The fermentation, like the combustion, must have the oxygen of the air to sustain it. The looser the material lies in the silo, the more abundant the supply of oxygen and the more active is fermentation. Rapid filling and good packing alike tend to expel the air and arrest fermentation. Stop the draught and the fire will languish and die out, — live coals may be quickly smothered. Here we have additional reasons for quick filling and immediate covering, with abundant pressure. I would endeavor to prevent the temperature of the silo contents from rising above 110° F. at any stage.

But, with every precaution, some air remains in the silo and more or less fermentation takes place. It is to the degree of fermentation and the results, that great differences are found in different silos and in ensilage of the same silo in different seasons, where the operations and conditions *seem* to be alike. This fermentation is at first of the simple alcoholic character, involving the starch and sugar, and it unquestionably results in a greater or less loss of the carbohydrate elements of the material ensiloed. A table of authentic analyses of ensilage material, fresh, of ensilage as fed, and of standard roots, for comparison, is appended: —

Table of Chemical Composition of Corn Ensilage and other Forage Crops.

No.	MATERIALS. (100 lbs.)	Water, lbs.	Protein, or Nitrogenous Matter.	Fat.	Non-nit. Matter, or Carbo-hydrates.	Crude Fiber.	Ash.
1	Hay, average mixed,	10.80	7.30	2.20	45.50	28.50	5.70
2	Corn fodder, field,	32.65	4.29	1.24	35.96	22.14	4.32
3	Corn fodder, cured,	8.83	7.87	1.88	50.51	26.48	4.43
4	Green fodder, corn, average,	81.08	1.48	0.38	10.74	5.24	1.08
5	Green fodder for ensilage,	70.77	2.49	1.00	17.40	7.28	1.56
6	Corn ensilage, cut,	71.60	2.21	1.72	18.27	5.26	0.94
7	Corn ensilage, whole,	83.18	1.52	0.62	9.62	4.95	0.71
8	Corn ensilage, cut,	84.90	1.10	0.40	7.80	4.90	0.90
9	Corn ensilage, average,	80.69	1.49	0.68	10.15	5.72	1.27
10	Roots, average of 5 below,	88.26	1.41	0.20	8.12	1.04	0.94
11	Sugar beets,	84.00	2.10	0.10	11.70	1.10	1.00
12	Mangolds,	91.60	1.80	0.40	4.40	0.80	1.00
13	Carrots,	87.20	1.00	0.20	9.30	1.40	0.90
14	Swedes,	87.00	1.30	0.10	9.50	1.10	1.00
15	Turnips,	91.50	1.00	0.20	5.70	0.80	0.80

GENERAL NOTES.

No. 1. Average of many analyses.
2. Connecticut Agricultural Experiment Station tables.
3. Massachusetts Agricultural Experiment Station, 2d report; corn in tassel, cured after being badly frost bitten, Sept., 1883.
4. Connecticut Agricultural Experiment Station tables.
5. Massachusetts Agricultural Experiment Station, bulletin No. 26; corn of Clark variety, grown on well-fed land; cut Sept. 4, 1886; kernels glazed, yet soft.
6. Massachusetts Agricultural Station, bulletin No. 26; best samples ensilage recorded. Same corn as No. 5; cut short and pit quickly filled and closed Sept. 4, 1886; opened Jan. 4, 1887.
7. Massachusetts Agricultural Experiment Station; 3d report; whole corn, kernels in the milk, pitted and covered at once, Sept. 1, 1884; opened Feb. 23, 1885.
8. Very poor quality.
9. Average of a large number of analyses.
Roots: Analyses taken from average of standard tables.

When quickly filled and at once weighted, the highest temperature of the contents of a silo, ordinarily ranging from 95° to 120° F. in the case of corn, is reached between the third and sixth day after closing; then a gradual cooling off occurs, occupying three or four months. Even when silos are opened at the end of five or six months, the contents are often found somewhat warmer than the atmospheric air outside.

VI. — *Removing Ensilage from the Silo and Feeding it.*

If a silo is of the approved form, with a comparatively small surface, the whole cover is removed at once and the ensilage taken out from the top, going over the entire surface every day or two. This frequently exposes fresh material to the air and prevents excessive fermentation and moulding, which would otherwise occur.

With a silo of different form and a door at the bottom from which the ensilage is removed, it is usual to first tunnel or mine the material around the door, and then secure a vertical surface or wall of ensilage, the face of which is cut from daily, as often done on a mow of hay. Although moulding is somewhat greater in this way, there is compensation in not being obliged to remove weights and covers all at once. There need be but a small top surface uncovered at a time, and the weights and cover constantly moved back, so as to keep all that has not been exposed, under constant pressure.

More or less loss from spoiling in the silo must be expected whenever the air which enters from outside is above 60° F. If the silo is to be used in warm weather, or its contents carried over a season, it is much better to have it underground, to keep at a low and even temperature. Ensilage unused, or left over at the end of a feeding season, need not be rejected or removed. It may be again re-covered and weighted till wanted. Or, to refill the silo, remove the surface ensilage of the old lot until it is bright and fresh, and refill on top of this. Ensilage has been preserved perfectly good at Fairview Farm, Brewsters, N. Y., for three years, and other examples might be given to show that ensilage undisturbed may be kept for years uninjured.

The pungent odor and more or less acid taste usual to corn ensilage fresh from the pit may be greatly modified by loosening the material and exposing to the air, from six to twenty hours before feeding, the time varied according to ensilage and weather. A good plan is to remove from the silo in the afternoon the ensilage for the next day; spread it on a floor and thoroughly mix in the grain food to be used with it, leaving it in an even layer about a foot thick till time for feeding. It will usually be found quite warm in a few hours and remain so for a day, If the ensilage has been put up uncut, cut it up as short as convenient, with hay-knife or spade, or run it through a cutting box when taken from the silo, and then prepare with the grain.

Big baskets or wheeled trucks are the most convenient means for carrying ensilage to the animals. But it must be remembered that ensilage at its best is about three-fourths water and too heavy a material to make it pleasant or profitable to be carried far from the silo for feeding. Locate the silo with reference to convenience both in filling it and in feeding out its contents.

VII. — *Ensilage as Food for Farm Stock.*

Nearly all farm animals eat ensilage with a relish the first time it is offered to them. Horses, mules, cattle of all kinds, sheep, swine and poultry, show a decided fondness for ensilage as a general rule. It is only now and then that an animal of any one of these classes persistently refuses to eat it. (I have known a few men to whom potatoes were not only distasteful, but an active poison.) The acidity of ensilage seems no objection to the animals. Although they generally prefer its sharpness removed and its color brightened by a few hours exposure to the air, I have seen ensilage in its most acid stage eaten by cattle with avidity. When we think that fermentation is but an early stage of decomposition, it certainly seems as if this liking for fermented food showed an unnatural and perverted taste. But examples are so numerous of bipeds of the *genus homo* evincing an extreme fondness for food and drink in a fermented state, that we ought not to be surprised at similar peculiarities on the part of other and lower orders of the animal kingdom.

That ensilage is very palatable to cattle is shown by the fact that they will eat as great a weight of ensilage per day as of the same plant in its growing state. Among the records of feeding experiments, there is abundant evidence of the advantages of succulent food when forming a large part of the daily ration at all seasons for fatting animals and those giving milk. Ensilage will furnish succulent and palatable food on the farm every day in the year. From the many practical results, however, it is plain that corn ensilage cannot be fed alone with profit, unless it be simply as a maintenance ration for store stock. The best results have been those where ensilage has been fed in limited quantities, — forty, fifty and certainly not exceeding sixty pounds per day to 1,000 pounds live weight, and accompanied with liberal grain feeding to secure the proper nutritive ratio. Many careful feeders prefer that ensilage should not constitute the only coarse forage, and so use forty or thirty pounds only, with five to ten pounds of hay, or its equivalent, added, and also grain. Some well-conducted trials show most satisfactory results from using ensilage chiefly as a condiment, or addition to the usual dry, winter diet, and as a substitute for roots. In nearly all cases where ensilage is used as a considerable portion of the daily ration for horses and cattle, but not exclusively, its excellent hygienic effect is apparent. Ensilage tends to increase and maintain the flow of milk like any other succulent food, but no more. Milch cows on an ordinary winter diet show a marked gain in quantity of milk and some in quality, if ensilage be added to their daily ration, but no more than if an equal quantity of good roots were used.

In comparing ensilage with other kinds of food the primary question is as to the effect of this process upon any forage plant thus preserved. What is the feeding value of rye or clover as ensilage, compared with the same plant in its growing state, or cured as hay? Likewise, corn ensilage must be compared with green maize, cured corn (fodder or stover) and grain. Some very careful chemical and practical comparisons tend to show that the nutritive value, digestibility, waste in feeding and the result at the pail, are substantially alike in equal quantities of corn, whether cured as fodder or as ensilage. The same of other forage plants. There is some margin in favor of ensilage, but no more than its succulent form may account for. These results being verified, reduces the problem almost wholly to one of convenience and economy in the method of curing, storing and feeding out the forage crops. With the exception of the labor in feeding, the advantages are on the side of ensilage when managed judiciously, under favorable circumstances. With well-cured corn stalks, about one and a third tons must be handled to give animals a ton of solid food; with corn ensilage, at least four tons are needed to accomplish the same result. The larger proportion of water in ensilage is not a direct loss, however, for animals fed largely upon it drink very little, and the effect is doubtless better when the water is thus combined with the food, than when taken separately.

Feeding trials with ensilage of the same kind, but differing considerably in condition or quality, give results much alike. Where ensilage is decidedly sour, the quantity eaten is generally somewhat greater than of the kind which some call sweet, to produce like results. At the State Farm at Tewksbury, cows remained healthy, thrifty and productive, averaging over 3,100 quarts of milk per year, after four seasons of ensilage feeding, sometimes quite sour. The stomachs of a number slaughtered were found to be in a normal condition. Hon. Rufus Prince of Maine states that when he substituted ensilage for dry fodder and hay, in two daily feeds out of five, his cows increased 12 to 15 per cent. in milk and 15 to 18 per cent. in butter yield.

There are two ways in which the feeding value of ensilage of any kind can be compared with any dry forage. One is upon a purely chemical basis, considering the total dry matter in each and its component parts or nutritive elements. The other notes the results of practical feeding, and determines how far a ton of ensilage will go towards supporting an animal and how much other forage it will take the place of and yet give equally good results. At the present time many of the conclusions reached by these two methods of comparison differ radically, and one cannot see how they will ever be reconciled.

The chemist insists that it requires at least four and a half tons of average corn ensilage to furnish the dry substance and nutritive elements of one ton of hay of average quality.

According to the foregoing table, three tons of the very best ensilage (No. 6.) do not equal a ton of hay, chemically, as food. But farmers, as the result of practical feeding tests, generally agree in considering two and a half or three tons of corn ensilage equal in its effects to a ton of hay, and some observant feeders say that two tons is nearer right. An eminent English author says, on this point (Smith's "Veterinary Hygiene," p. 224), that men competent to judge, "estimate the value of green forage, well preserved in a silo, at somewhat more than one-third, weight for weight, of the value of the same material made into hay under favorable conditions." On this basis,—the ratio three to one being, in my opinion, a perfectly safe one to depend upon,—when hay can be sold at $12 to $18 per ton and replaced with ensilage, the latter becomes worth from $4 to $6 per ton, which is two or three times its necessary cost. The immediate profit is thus at least one hundred per cent.; but the increased production per acre of ensilage over hay is another source of profit. John Gould of Ohio reports fields in his neighborhood producing twenty-five tons of corn ensilage per acre, which proved equivalent in feeding value to eight tons of hay per acre, or three times as much as the land ever produced. In actual practice, it has been proved that when ten acres of good land are in mowing and yielding twenty-five tons of hay, two acres of this land can be devoted to corn ensilage, and the same number of animals being supported, fed half ensilage and half hay, there will be at least ten tons of surplus hay, which can be sold for enough to pay all the expenses of the change, including a permanent silo, to hold fifty tons, built out of the first year's profits.

According to the most approved feeding tables, a cow of 900 pounds weight should have at least 25 pounds of average hay for a day's ration, and this will furnish something over 22 pounds of dry substance. But the same cow, fed corn ensilage of average quality, will need only 65 or 75 pounds per day, and this usually contains but 14 pounds of dry substance, and never as much as 20 pounds. Chemistry and animal physiology say that this is insufficient feeding. But the cow says it is enough. There is certainly something in these practical results of ensilage feeding which chemistry has yet failed to explain and reconcile with well-accepted theory. It has long been contended that in making hay or fodder we simply evaporate water from the material, without otherwise changing it. But notwithstanding the apparent correctness of this theory, practical feeding trials, comparing dry forage with succulent materials and especially with ensilage, shows that it is untrue. According to this theory, dry forage should give the same feeding results per acre as green forage; but every practical farmer recognizes the difference, and it is especially noticeable in the case of dairy stock fed largely upon ensilage.

Reference to the foregoing table shows that, as compared with roots, sugar beets, mangolds, carrots, swedes and common turnips, average corn ensilage gives more dry substance to the ton than any of them, and is in all respects, chemically considered, a better food than the average of the five roots named, while the sugar beets alone are better, in some respects, ton for ton.

There has been comparatively little hesitation about feeding store stock of all kinds upon ensilage, but many have thought that it might be objectionable in the case of milch cows, and opinions still differ as to the effect of ensilage feeding upon milk and the quality of milk products. There are large quantities of milk and milk products now going into the best markets of the country, and subjected first to the close scrutiny of dealers, and then to the final judgment of consumers, and all highly approved, which are produced upon farms where ensilage is regularly fed. Yet there are conspicuous cases where the use of this food with dairy stock has been reported as resulting in loss. A few years ago, the Borden milk-condensing factory at Brewster's Station, N. Y., refused to take milk from any farms where ensilage was fed, asserting that its use had caused a heavy loss by spoiling a large quantity of the condensed milk. Several silos which had been in use in Putnam and Dutchess counties have been necessarily abandoned in consequence, but a careful investigation, by an outsider, proved that not one of their owners had discovered any unpleasant effect upon milk, or believed from his own practice that any evil resulted from the use of ensilage with dairy stock. One of these men wrote: "It has always seemed to me that the milk would have been satisfactory to the company under a fair test; but several customers who used ensilage were feeding indiscriminately and just before milking, some just after, and some almost exclusively. As this was the case at the time the company experimented with ensilage milk, I was not surprised that it proved unsatisfactory. It is not surprising that a feed with the flavor and nature of ensilage should have produced such a result under the above conditions. Fed in reasonable quantities, and immediately after milking, I have no doubt it would produce the best of milk, and as a food for milch cows or dry stock give the best results obtainable from maize in any shape whatever, and fully one-third cheaper than any other." A letter to me from Mr. Borden admits that the factory managers never demonstrated to their own satisfaction that ensilage caused their trouble; all they really knew was, that trouble occurred while ensilage-fed milk was received, and the same had not recurred since reception of such milk had been discontinued. Prof. Roberts, of Cornell University, gave up the use of ensilage, because his customers for milk, most of them the families of professors in the immediate vicinity of the barn, complained of the odor and taste of the ensilage. But the farm barn at Cornell is a very close one, the silo was in it, the ensilage made was very poor, and its strong and extremely unpleasant smell not only permeated the whole premises, but was perceptible at the neighboring houses. Specially unfavorable circumstances caused the first trouble in this case, and a prejudice was created which a change in the conditions could not overcome. One of the choicest dairies in Massachusetts, selling its butter at a price near the very top, had a complaint of impaired quality come from its Boston agents, a couple of years ago, accompanied by an inquiry whether ensilage was fed. Replying frankly that it was used in small quantity, the agents at once sent back word that that was the trouble and all ensilage feeding must be stopped or the butter could not be sold. This was done, but the next season ensilage feeding was again begun, and care being exercised in the methods more ensilage was fed than before. The proprietor was satisfied as to the good results in his own mind, but wanted endorsement, so wrote to his agents to enquire their opinion of the winter's product. The reply came promptly, that the butter had never been better and the improvement caused by discontinuing ensilage was very marked! Having given this matter long and careful examination, I have satisfied myself fully, that where good ensilage is fed with discretion to cows which would otherwise have no succulent food, or instead of a small allowance of roots, there is an improvement in the quality of the milk and butter made from it which will be noticed and approved by the consumers, unless unreasonable prejudice intervenes. I have yet to be convinced that, unless carelessness prevails, any unpleasant odor or taste is given to dairy products by feeding ensilage. And when such results do occur, my belief is that they are due to lack of judgment or care in the stable, and that the milk gets its objectionable odor from the air and not through the cow. Whenever feeding ensilage to dairy cows, the same precautions should be taken as in using turnips and cabbage. With proper care I never experience any difficulty from such feeding.

In response to a call for facts in regard to the effect of ensilage upon milk among English dairymen, replies were sent as indicated in the following table, published by the Agricultural Department of Great Britain: —

	Milk.	Butter.
No change,	22	1
Improved in quantity and quality,	95	18
Decreased quantity and deteriorated quality,	1	–
Increased quantity,	93	13
Decreased quantity,	5	2
Improved quality,	34	26
Deteriorated quality,	5	3
Improved quality and decreased quantity,	4	–
Increased quantity and deteriorated quality,	5	–
Favorable results (whether in quantity or quality not stated),	30	15
Unfavorable results,	–	1
Total opinions,	294	79

Upon this important branch of the subject, — the food value and effect of ensilage, I offer the following condensed record of a number of careful experiments and practical tests, most of them made under my own supervision: —

(A.) A herd of the choicest dairy cows, numbering over one hundred, received for eight months nothing but grass, ensilage (of different plants) and grain; absolutely no dry forage. The health and general condition of the herd was of the best, strong calves were produced, and the milk yield, although not remarkable in quality, produced butter which under the market test won the very highest reputation. But after a few additional months of similar feeding, this herd showed unmistakable signs of having been under too high pressure. Cows broke down, the best young animals looked two or three years older than they were, abortion appeared, and the herd actually went to pieces and became unprofitable for dairy and breeding purposes.

(B.) An evenly matched pair of beef cattle, steers, 5 years old, were fed on dry food only, fattening rations, 70 days. No. 1 weighed 1,270 pounds at start, 1,390 at close; gain, 120 pounds. No. 2, 1,220 pounds, and 1,320 pounds; gain, 100 pounds. For next 35 days, 50 pounds corn ensilage was substituted for the coarse dry forage, in ration for No. 2, that for No. 1 remaining unchanged; the grain the same as before in both cases. Result: No. 1 gained 10 pounds, and No. 2 gained 92 pounds. For the next 35 days the rations of the two were reversed, and No. 1 gained 75 pounds, while No. 2 lost 20 pounds.

(C.) A five-year-old common cow weighed 847 pounds, which had with the last calf given 10 quarts of milk per day, when at her best; was fed hay alone from time of drying until she calved, and then corn ensilage alone for 65 days; average consumption, 64 pounds per day; milk yield averaged 13 pounds 8 ounces. For the next 30 days a ration of grain was added, consisting of 2 pounds corn meal, 1 pound cotton-seed meal and 2 pounds wheat bran; average milk product, 17 pounds 3 ounces per day (a daily gain of two quarts of milk, at an added cost of seven cents). For the next 30 days the same grain was continued and dry forage substituted for the ensilage, 12 pounds corn stover and 5 pounds hay, cut; average milk product, 18 pounds per day; last day, 18 pounds 4 ounces. (The dry fodder cost about nine cents and the ensilage seven cents.) While fed ensilage alone, this cow rarely drank more than once in two days, and for a month drank an average of only 19 pounds of water daily, but took 48 pounds more in her food; she maintained a very even weight through the trial. Her milk averaged 12.67 per cent. solids, 3.85 per cent. fat and showed 14.5 per cent. cream in test tube.

(D.) Ninety three-year-old steers were divided into three lots, as even as possible. Lot No. 1 fed 20 pounds hay and 3 pounds grain daily; allowed to run in yard with sheds for shelter. No. 2 kept in warm stable and stanchions, and fed $17\frac{1}{2}$ pounds hay, 15 pounds mangolds and 3 pounds grain. No. 3 fed 85 pounds corn ensilage and 3 pounds grain, in stanchions. Lot No. 3 gained one-quarter pound per head and day more than No. 2, and one-half pound more than No. 1. The cost of food was 5 per cent. in favor of No. 3.

(E.) Two lots with six milch cows in each, carefully selected as mates, two and two, with reference to age, condition, period of calving and milk yield, were fed and treated alike for twelve weeks, except that one lot had its long forage dry, and the other had corn ensilage instead. The grain ration was 4 pounds corn meal, 4 pounds wheat bran and $1\frac{1}{2}$ pounds cotton-seed meal. The Lot A received 12 pounds cut stover and 5 pounds hay per head daily; and Lot B, 60 pounds ensilage per day. The milk products were as follows: at the beginning, Lot A, 816 pounds 6 ounces per week; Lot B, 825 pounds 2 ounces. At the close Lot A, 722 pounds 14 ounces; Lot B, 731 pounds 12 ounces. Average for 12 weeks, Lot A, 781 pounds 8 ounces per week, or 18 pounds 10 ounces per day per cow, and Lot B, 774 pounds 10 ounces per week, or 18 pounds 7 ounces per day per cow. The weights of the different animals varied from time to time, but there was no material difference in the two lots. The ensilage was then discontinued and Lot B changed to same rations as Lot A, and after one week's intermission the two were compared for four weeks more: Lot A gave 702 pounds 2 ounces per week, or 16 pounds 11 ounces per day and cow, and Lot B, 687 pounds per week, or 16 pounds 6 ounces per day and cow. The quality of the milk of the two lots, tested several times, varied very little. The averages were: Lot A, spec. grav., 1029; solids, 13.81; fat, 3.63 per cent. Lot B, spec. grav., 1033; solids, 14.16; fat, 3.75 per cent. The cream from Lot B was, however, much easier to churn, and made decidedly better butter. Lot B, while ensilage fed, drank an average of 25 pounds of water per day and head, often drinking but once in three days and rarely twice in a day. Lot A, during the same period, seldom failed to drink twice a day, and averaged 76 pounds 6 ounces water daily per head. The ensilage in this trial was very acid and poor in quality.

(F.) Two pens of lambs, ten or eleven months old, three in each, were selected from a large number for evenness of weight and feeding capacity. They were treated alike for two weeks, then weighed. Pen No. 1, 213 pounds; Pen No. 2, 216 pounds. They were then fed for 42 days as follows: To each pen, 2 pounds corn meal and 1 pound cotton-seed meal per day; to Pen No. 1, 1 pound cut hay and 1 pound cut oat straw; to Pen No. 2, 12 pounds corn ensilage (fodder corn in tassels, without ears). Gain in weight, 6 weeks: Pen No. 1, 32 pounds; Pen No. 2, 28½ pounds. No. 1, dry fed, drank an average of 10 pounds water per day; No. 2, ensilage fed, 1¾ pounds per day. The gain of Pen No. 1 was worth $3.20, and cost $2.98; the gain of Pen No. 2 was worth $2.85, cost $2.48 (manure and labor reckoned as offsetting one another).

(G.) A young Jersey bull was fed on ensilage alone, but of different kinds, for the months of April and May, 1884. After he became accustomed to this diet his weight, at the beginning of the test, was 712 pounds; at its close, 710 pounds; meanwhile the range was 707 to 718 pounds. Of corn ensilage, he ate an average of 59 pounds per day, 75 pounds being the most in one day. Of amber cane he consumed 76 pounds a day. Of mixed amber cane and rye he ate 75 pounds a day. Of winter rye ensilage alone, 47 pounds. Of clover ensilage, 51 pounds a day, and of ensilage of the Japanese or Soja bean, 63 pounds. For days at a time he drank no water, and averaged but 9½ pounds per day while fed on ensilage alone. His best drink was on a very rainy day, while fed rye ensilage; he then drank 26 pounds at one time and 7 pounds at another, or 33 pounds during the day; but none the day before or the day after.

(H.) In English publications there are records of trials with breeding ewes, both before and after lambing, where some of the most noted flock-masters of Great Britain substituted ensilage for roots with most satisfactory results. This has led to the extensive adoption of ensilage for breeding ewes in that country. I made a trial with a breeding flock of Southdowns at Houghton Farm, and while exceedingly pleased with the effect of ensilage feeding upon the ewes, I found it difficult to prevent lambs from eating it also, while very young, and the ensilage being sour and poor certainly injured the lambs; some died.

The following are more accurate experiments with other classes of sheep: —

1. *Store Sheep.* — To ascertain the efficiency of maintaining "store sheep" on ensilage, two wethers, $2\frac{1}{2}$ years old, were selected in December, separated and fed separately until January 5. Then, having become accustomed to the changes and their new rations, the record was begun and continued 80 days. During the period the sheep No. 1 was fed daily, 1 pound each of wheat bran, whole oats and cut hay, 3 pounds dry forage; sheep No. 2 was fed 7 pounds 3 ounces of corn ensilage daily.

Periodical weighings gave this record: —

Sheep, Jan. 5, 1883.	Jan. 17.	Feb. 3.	Feb. 17.	Mar. 3	Mar. 17.	Mar. 28.	80 Days.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
No. 1, 122 lbs. (dry fed),	122	119	121	117	114	113	Loss, 9
No. 2, 135 lbs. (ensilage),	134	136	136	130	131	132	Loss, 3

During the trial, No. 1 drank an average of 4 pounds 2 ounces of water daily; No. 2 drank *none* during the 80 days.

The effort was to maintain the sheep at a fixed weight; but the one on ensilage alone would not eat enough to prevent loss. It was fed, in the 80 days, 674 pounds of corn ensilage, — nearly $8\frac{1}{2}$ pounds a day, — but of this it refused to eat 107 pounds, or about $1\frac{1}{3}$ pounds per day. The other sheep would have eaten more grain, but it was kept as closely to its mate as possible. During the trial the food of the hay and grain fed sheep (No. 1) cost $2.80; and that of the ensilage fed sheep (No. 2) cost 70 cents; or at the rate of $1.05 and 28 cents per month respectively.

Another Sheep Trial. — Two wethers were selected and prepared as before. Fed just four weeks, — March 30 to April 26, 1883, inclusive, — with the following record: —

	Weight, March 30.	Weight, April 27.	Food Consumed in 23 Days.				Cost of Feed, 4 Weeks.
			Hay.	Grain.	Ensilage.	Water.	
	lbs.	lbs.	lbs. oz.	lbs. oz.	lbs. oz.	lbs.	
Blackface,* .	121¼	121	15 2	43 5	–	133	80 cents.
Greyface,† .	128	131	–	–	143 4	28	59 cents.

During the next twelve days the following record was made by the same sheep: —

	Weight, April 27.	Weight, May 9.	Loss, 12 days,	Food Consumed in 12 Days.			Cost of Food, 12 Days.
				Hay.	Grain.	Water.	
	lbs.	lbs.	lbs.	lbs. oz.	lbs. oz.	lbs.	
Blackface, .	111	113	8	9 1	12 12	52	28 cents.
Greyface, .	131	123	8	11 2	12 0	63	29 cents.

Note. — Apparently, in this trial, 135 pounds of ensilage was equivalent to 45 pounds of hay, or to 15 pounds of hay and 15 pounds of grain.

(J.) A trial was made at Houghton Farm to answer this question: Can young animals be maintained *and grow* on corn ensilage alone?

We did not care to try this experiment with valuable heifers, but selected two thrifty young bullocks, viz., a Swiss, born in April, 1882, and a Jersey, born in November,

* Dry fed. † Ensilage and grain.

1881. So when the trial began, Feb. 1, 1883, they were respectively 9 months (Swiss) and 14 months (Jersey) old. They had been fed previously during the winter rather a poor quality of hay, and to each $1\frac{1}{2}$ pounds wheat bran and $\frac{1}{2}$ pound cotton-seed meal daily, 2 pounds grain food and hay *ad lib.* They weighed Nov. 1, 1882, the Swiss 372 pounds, the Jersey 540 pounds. They weighed Feb. 1, 1883, Swiss 415 pounds, Jersey 600 pounds. It required over two weeks to change their diet to ensilage alone and get them to regularly eating it. This was accomplished so they began recorded ensilage rations on Feb. 17. They then weighed, the Swiss 412 pounds, the Jersey 575 pounds. Forty days feeding of ensilage alone then followed, the rations being, for the Swiss 36 pounds per day, for the Jersey 46 pounds. They sometimes rejected a portion, which was also weighed and removed. The next result shows an average consumption of 34 pounds 3 ounces for the Swiss, and 43 pounds 8 ounces for the Jersey.

Periodical Weighings.

ANIMALS.	Feb. 17.	Feb. 24.	Mar. 3.	Mar. 10.	Mar. 17.	Mar. 28.	40 Days.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	
Swiss, . .	412	415	420	410	410	410	Loss, 2 lbs.
Jersey, . .	575	555	$572\frac{1}{2}$	575	$572\frac{1}{2}$	580	Gain, 5 lbs.

We have substantially maintenance rations for these animals fixed, but *not growing* rations, say $34\frac{1}{4}$ and $43\frac{1}{2}$ pounds respectively, and costing less than ten cents per day for the two. Although offered water twice daily, neither animal tasted it for forty days and more.

(K.) No records are at hand giving definite results of feeding ensilage to horses and mules. I have in mind some cases of injury to horses from injudicious use of this class of food. The small stomach of the horse is well known, and he is so sensitive to flatulency that bulky and fermented food must plainly be used with the greatest care. Ensilage has been so used for work horses, without injurious effects, and reports have been published of its more liberal use with brood mares and colts. Mules have been kept almost exclusively on ensilage, usually of the richer, more concentrated kinds, with excellent results. In one case in North Carolina a large farmer and vineyardist has for several years made ensilage of cow peas the chief forage for a number of mules constantly at work, and has found it very economical and in no way objectionable.

(L.) Swine are proverbially fond of fermented food. I have known several cases where breeding stock and store pigs have been carried through a winter in good condition upon absolutely nothing but ensilage. In one instance all that three large hogs received was the refuse from ensilage fed to a dozen or fifteen cows. The material being of inferior quality, the cows did not eat it clean, and what they left the hogs received. Such practice can hardly be approved, but the owner in this case was satisfied and said he wintered his three hogs well, virtually without expense.

(M.) To compare the feeding qualities of ensilage exposed to freezing and thawing and that kept from frost, a trial was made at Houghton Farm, in the winter of 1884–85. Duplicate miniature silos were filled during the summer and autumn of 1884 with clover, Hungarian grass and corn, cut while the ears were forming. One set of these was stored in a barn basement, kept free from frost, and the contents fed out in December, 1884. The other set was exposed all winter, but under a roof, and the contents used after slow thawing in April, 1885. Young cattle of the same class were fed in both cases all they would eat. The average consumption per day and per head was as follows: —

	Clover.	Hungarian.	Corn.
December, 1884, ...	36 lbs.	42¼ lbs.	24¼ lbs.
April, 1885, ...	32½ lbs.	48½ lbs.	37¾ lbs.

This was a very imperfect trial, but apparently the last lots of ensilage were as palatable as the first, although perhaps less nutritious.

The evidence is overwhelming of the safety and economy of feeding ensilage to the extent of at least one-third of the total long forage of nearly all classes of domestic animals, during the season when they would ordinarily be kept on dry food, as well as its usefulness in supplementing short pasturage. But if there be any lingering doubts as to the expediency of feeding ensilage to even this moderate extent, none can exist as to its admirable effect when used simply as a condiment or appetizer, in addition to the usual ration. Treating the fatting steer or the milch cow as a machine, it is often desirable to increase the appetite or give tone to the system by a gentle laxative. In such case a good article of ensilage can be positively asserted to answer as well as the same weight of the best roots. Fed as little as ten or fifteen pounds a day to an animal of 800 to 1,000 pounds weight, which would be equivalent to a peck of roots, its effects are soon seen in the improved condition of the bowels, increased appetite, brightened coat and generally thrifty appearance of the creature.

Examined with care and an effort to view the subject as an impartial student of the facts, I have found in the silo system of storing and preserving forage no royal road to fortune, and no such "magical results" as were announced by the enthusiastic friends of the system eight or ten years ago. We surely do not take any more food out of the silo than we put in, and generally a good deal less. But I am led to believe that the material is preserved in a form more acceptable to animals and productive of better results than when dried and fed dry. There is no evidence that ensilage is soon to "revolutionize farming in New England," yet it is surely an important and valuable auxiliary to the successful farm practice in this region, and is gradually, healthfully, growing in popular favor. The number of silos in New England is steadily increasing, together with the acreage devoted to ensilage crops. The work is yearly being systematized and performed with greater economy, and the average product is yearly improving in quality. Here and there one hears of an abandoned silo; but when such a case is investigated, the true facts are found to furnish a full explanation of the occurrence without prejudice to the system itself.

The general economy of the system depends mainly upon the local conditions where applied. The circumstances attending numerous points of detail, which I have already indicated, will largely determine the question of economy. The system is certainly better adapted to intensive than extensive farming. Where land is dear, labor fairly abundant and strong reasons existing for an increase of live stock kept upon a limited acreage, the silo can in most cases be profitably adopted. Yet I know instances of the use of ensilage on a large scale by dairy farmers on the broad prairies of Illinois and Nebraska, where hay can be put up for two or three dollars a ton, and those who thus practice the system prove its profit to them, literally "by the book." I do not expect to see many acres of our best meadow land in the Connecticut Valley converted into fields of ensilage crops, although this can be certainly done, within reasonable limits, at a greater profit than is yet generally believed. But there are many farms and larger areas, in New England, where grass has never been grown at a profit; but which, properly treated, produce abundant crops of fodder corn and other ensilage plants. On such lands the most conspicuous examples of the good effects of the silo system may already be seen in this section of the country. Similarly, ensilage is proving a boon to cattle raisers on the old, abandoned cotton-fields of the South, where permanent pasturage and good hay are almost unknown.

Two things, which are often overlooked, should be kept prominently in view when considering the production and use of ensilage. Plants, like animals, must be fed well, to grow well. Where large crops of forage are to be raised,— and the larger the crop to the acre the greater the profit,— the land must be *heavily* manured. The more manure, the more ensilage. And ensilage, in most forms, is not in itself a complete and well-balanced food for animals. Where it is largely fed, it should be supplemented with *liberal* grain feeding. The more ensilage and grain, the more and better the farm manure.

Speaking without enthusiasm, — moderately, but positively, — I say ensilage is a success in New England to-day, and is daily becoming better appreciated. In my opinion, the time is not far distant when, if the silo system is not largely incorporated in the farm practice, every farm of medium size or larger will count a silo of moderate size a part of its regular equipment, as useful and economical as an ice-house or a manure-spreader. Even if ensilage crops are not regularly raised to fill it, a silo may be found a handy and profitable thing to have on the farm. There are always waste products, green or half-dry, with coarse materials like swale hay, that are generally used for compost or bedding, which may be made into palatable ensilage. A mixture, in equal parts, of rag-weed (Ambrosia artemisiæfolia), swamp grass or swale hay, old corn stalks or straw and second crop green clover, nearly three-fourths of which would otherwise be almost useless, will make, as ensilage, an article of forage surprising to those who have never tried it.

As an example for using a silo as a sort of catch-all, I may quote the described contents of one filled by Mr. Cromwell, at Rye, New York: "(1) 18 inches deep of green oats; (2) 6 inches of red clover; (3) 6 inches of Canada field peas; (4) 3 inches of brewers' grain; (5) 2 feet of whole corn plants, sowed broadcast and more rag-weed than maize; (6) 5 inches of second crop grass; (7) 12 inches of sorghum; (8) lot of immature corn, cut in short lengths. The ensilage came out pretty acid, but good forage, all eaten up clean." And for one, I have not yet abandoned all hope of seeing the pulp of the beet root coming back to the farms in large quantity from the neighboring sugar factory, in various parts of New England.

There are seasons, too, when a crop of clover, or a few loads of half-made hay, are certain to be lost if field curing is depended upon; at such times an empty silo may be used to save the whole. Sprouted oat-sheaves and rye "grown" in the straw can likewise be preserved by the silo and transformed into a valuable article of forage. It is to the vicissitudes of haying and harvesting in Great Britain, within recent years, that the great British interest in this subject is mainly due.

Although individuals and experiment stations have done good work in the United States, in the study of ensilage and the practical value of the system, there has been here nothing like the systematic and comprehensive investigation of the subject, which has taken place in Great Britain. Public interest in England was first aroused in 1882, and soon a Royal Commission was established, and pursued its elaborate enquiry, — the Royal Agricultural Society of England, and Sir John Lawes at Rothamsted, conducted correlative experiments, and exceedingly interesting and valuable reports resulted. While the British have used silos but half as long as the Americans, the English literature of the subject is already more voluminous, more exhaustive and more reliable. I thought of quoting at some length from the final report of the British Ensilage Commission, but find that the conclusions agree substantially with the views of the subject already presented in this paper, and will therefore only give two corroborating paragraphs : —

The experience of dairy farmers in England and Scotland does not appear to justify the assertion which has been more or less circulated, that dairy produce is in any way injuriously affected by ensilage food. On the contrary, much reliable evidence has been received to show that feeding with well-made ensilage distinctly improves the yield of milk and cream and the quality of butter.

The commissioners have already had sufficient evidence to justify them in encouraging the development of the system of storing undried, green fodder crops, as a valuable auxiliary to farm practice. In addition to other advantages, losses occurring through weather unfavorable for hay-making may be avoided, and some crops not hitherto grown in this country, on account of the impossibility of ripening their seed, may be successfully cultivated for ensilage, to increase and diversify our present means of feeding various kinds of live stock on arable or partly arable farms. If carried out with a reasonable amount of care and efficiency, this system should enable the farmer to largely increase the number of live stock that can be profitably kept upon any given acreage, and proportionately, the quality of manure available to improve its fertility.

As this paper has proved unexpectedly voluminous, and presented parts of the subject in much detail, I conclude by adding, for convenience, a condensed summary of the most prominent of the facts regarding silos and ensilage now so well established as to need no further proof: —

1. Silos may be made with any of the various building materials, and some very crudely and cheaply constructed have been found to do good service.

2. Silos may be above ground, or under ground, or partly both; they should be water-tight and preferably air-tight and frost-proof, although these two points are not essential.

3. The situation and construction of the silo, and the arrangements for filling, covering and emptying, should be largely governed by local conditions.

4. Several small silos, independent or connecting, are better than one large one, and the depth should be considerably greater than the length, width or diameter.

5. A silo that will prove efficient may, therefore, be built at a cost varying from twenty-five cents to five dollars for every ton of ensilage it will hold. But, like an ice-house, a substantial, well-built structure, costing about two dollars per ton capacity, will probably prove in the end the most economical.

6. Silos may be filled slowly or quickly, in all weathers, the forage plants cut or pitted whole, and the cover may be heavily weighted or not weighted at all; the ensilage produced will vary in condition and quality, but these variations of management do not materially affect the result. If the silo is not air-tight on the sides, however, it must be well-covered and heavily weighted.

7. Any plant or vegetable product, good for cattle food when green or fresh, may be preserved as ensilage, in an edible and succulent condition, throughout the year, or for several years.

8. As a rule, all horses, mules, neat cattle, sheep, swine and poultry, are fond of ensilage, if its material is ever such as eaten by them. Most farm animals prefer it to the best dry forage.

9. The best time at which to cut any growing plant to make good ensilage, is when the plant approaches maturity and has begun to decrease in the percentage of its water contents.

10. The cost of preserving a given crop as ensilage does not materially differ from curing the same crop by drying, in a suitable season; but crops can be ensiloed and

preserved in seasons when they would be lost if drying was attempted.

11. All considered, Indian corn makes the most economical and satisfactory ensilage in most parts of the United States, and with a crop of twenty to twenty-five tons to the acre, when cut, which is a good average, the ensilage may be made, ready for use, at a total cost of two dollars per ton, and for less, under favorable circumstances.

12. An acre of corn as ensilage will weigh four times as much as the same crop dried as fodder.

13. An acre of corn, field cured, stored in the most compact manner possible, will occupy a space eight or ten times as great as if in the form of ensilage.

14. The chemistry of the silo is still somewhat in the dark. The contents of any one silo filled with crops from the same land, apparently managed in the same way, year after year, will differ in condition and quality in different years. Knowledge of the subject is not yet accurate enough to prescribe with certainty the procedure which will ensure the best ensilage. Yet any forage crop can be preserved in a moist, fresh form, substantially unimpaired as food, although there is generally a considerable loss in the carbhydrate elements, and with sometimes a partially compensating gain in the percentage of protein, and an increase in the digestibility of the material.

15. Correct theory, reasoning on scientific principles, and the great preponderance of testimony resulting from the longest practical experience, agree in recommending this process to get the best ensilage: Cultivate corn so every plant may have abundant air and sunshine to perfect itself and bear ears of grain; harvest when the kernels of the ear begin to glaze, or even a little later, when the plant leaves show some signs of drying; harvest preferably in good drying weather; run the corn through a machine that will cut it into lengths less than one inch; carry on the work as rapidly as possible; keep the cut fodder leveled in the silo, and when full, level the top, cover at once and weight with at least 150 pounds to the square foot of surface.

16. As food for cattle, as well as other kinds of farm stock, ensilage forms a good and very cheap substitute for roots, and its condimental effects are especially apparent. But the usual ensilage crops fail to fill the place of the root crop in a judicious farm rotation.

17. In feeding, the best results follow a moderate ration of ensilage, rather than its entire substitution for dry, coarse fodder. Except in the case of animals fed to maintain their weight, ensilage cannot be recommended as a substitute for more than half the long forage consumed.

18. Ensilage, and especially good corn ensilage, when compared with dry corn fodder, or with other feeding stuffs, produces results so satisfactory as to surprise the chemist and which chemistry cannot explain. As the result of practical feeding tests, it is very generally agreed that three tons of corn ensilage will equal in its effects as food a ton of average hay. This means that a farmer is as well off, if not better, with thirty tons of good corn ensilage and twenty tons of hay, as with thirty tons of hay. But it does not mean that a man can winter stock as well with ninety tons of ensilage and no dry forage, as with thirty tons of hay and no ensilage.

19. A silo or two, well built but not too large or too expensive, will be convenient and economical on most farms, to convert waste products into edible forage and to save crops which at other times might be lost, if not to preserve some crop specially grown for ensilage.

20. The silo system is best adapted to high-priced lands and so-called high-farming, and to farms not suited to profitable grass growing.

21. The extensive use of ensilage upon any farm is chiefly a question of convenience and economy which local conditions must decide.

The CHAIRMAN. I want to call before you a gentleman whom we shall not have the pleasure of hearing unless I call him at this time. He is a gentleman long tried in the service of agriculture and we shall all be glad to listen to him — Secretary GOLD of the State Board of Agriculture of Connecticut. [Applause.]

ADDRESS OF MR. THEODORE S. GOLD.

Mr. President, Ladies and Gentlemen, — It gives me great pleasure to be here with you on this occasion, and allow me to congratulate you upon the success of the work in which you are engaged. I was here last evening, and when Prof. Stockbridge gave his account of the first meeting of the Massachusetts Board here in Springfield, and of the earlier meetings of this organization, my heart was deeply stirred. I felt those things most forcibly, for I have been through that kind of work in my own State. I have been familiar with your work in this State, and, instead of waiting until the close of the meeting (for I am called away at this time necessarily) to offer my word of congratulation upon the success of your meeting which would properly come then, allow me to give it now.

I am happy to endorse the very careful and considerate presentation of the subject of ensilage that has been brought before you. I believe that that cause has been injured and the introduction of ensilage hindered by the extreme claims that have been made by many of its advocates. They have made statements that threw discredit upon the whole process, because they were so far beyond what we knew could be possible.

There is one thing about your Massachusetts meetings that I think is subject to criticism. You had here last evening an essay upon the subject of the Home, of its influences; and that class most interested in it, most relied upon to make the home what it should be, where were they? One or two solitary examples only were present. I have in my pocket a little text or sentiment that I propose to read now and not detain you, because you are anxious to proceed with the more practical work of the session; but you must allow me the privilege of calling your attention to your dereliction in that matter. I think when I have read this you will know the class to whom I refer.

A man can build a mansion and furnish it throughout;
A man can build a palace with lofty walls and stout;
A man can build a temple with high and spacious dome;
But no man in the world can build that precious thing called Home.

So it is the happy faculty of woman far and wide
To turn a cot or palace into something else beside,
Where brothers, sons and husband, tired, with willing footsteps come;
A place of rest where love abounds, a perfect kingdom — Home.

[Loud applause.]

The CHAIRMAN. We are now to have a lecture from Dr. GOESSMANN, of the Agricultural College.

THE HAY-FIELD AND ENGLISH HAY.

BY DR. C. A. GOESSMANN OF AMHERST.

Mr. Chairman and Members of the State Board of Agriculture, — Your committee on "Country Meeting," has assigned to me the task of opening a discussion on "The Hay-field and English Hay." I have been instructed in this connection to speak in particular of the best methods of keeping up the annual yield of the hay-field, and to state also the views at present entertained by progessive agriculturists regarding the economical value of English hay, as compared with other fodder articles, for the support of farm stock.

Every one familiar with our current systems of farm management will concede that it would be ill-advised to attempt, on an occasion like the present, an exhaustive presentation of the varied and numerous actual observations relating to the topics proposed for your consideration. It is for this reason that I take the liberty to invite your attention, first, to a brief statement of a few important lessons, which more recent systematic investigation into the laws which promote a successful production and growth of plants and animals have taught to practical agriculture. This course, I believe, will enable me to define in the outset the position I take in regard to the subject under discussion. A careful study of the history of agriculture down to the middle of the present century cannot fail to show, as a rule, that the general decline in the productiveness of farm lands in all civilized countries, even in the most favored localities, can be traced back, in the main, to two circumstances,— namely, to a gradual reduction in the area occupied by pastures and meadows, and to a steady decline in the annual yield of fodder upon large tracts of land but little suited for an economical production of grasses; in the majority of instances, to the influence of both circumstances.

This statement applies with particular force to those times and systems of farm industry where pastures and meadows were still considered the almost exclusively reliable resources of fodder for the support of horses, cattle and sheep. A serious falling-off in the yield of the grass crop under the described circumstances necessitated a reduction in the farm live-stock, which in turn caused a decrease in the production of manure. Adding to this result the current practice of using the manure obtained from the feeding of the crops secured from the grass lands for the improvement of the ploughed lands, with scarcely any material assistance from outside sources of manurial substances, it is but natural that the productiveness of the former became in the course of time seriously impaired. A scanty supply of suitable manurial matter for the production of the crops raised is to-day universally considered the most fatal circumstance in any system of farming for profit. The recognition of this fact belongs to our time. Three circumstances in particular may be charged with having delayed the recognition of what is deservedly the true cause of a gradual decline of remunerative farming in preceding periods: first, the existence of large areas of cheap grass lands; second, the exceptional recuperative quality of good grass lands, *i. e.*, their superior fitness for securing a liberal share of plant food from the air and the soil by the aid of natural agencies; and third, the almost entire absence of efficient means to obtain an intelligent insight into the relations of the air, the water, and the soil to plant growth, as well as into the mutual dependency of a remunerative production of plants and of animals in a mixed farm management of the present day.

The grass farm management in its more primitive form, as described above, is to-day almost exclusively confined to localities, which for some cause or other are less advanced in general improvements. It proves, to-day, remunerative only in cases where the lands are in an exceptional degree well qualified for the production of grasses, so called natural meadows, or where still larger areas of natural pastures at low cost compensate for an indifferent yield.

The change from the older system to a more rational one of to-day has been gradual, and more or less thorough under different conditions. The introduction of modern improvements in means of communication and transportation, accompanied by an increase in population, has been invariably followed by an increase in the cost of farm lands. The increase in population necessitated a corresponding increase in the area of lands required for the production of food for man.

A steady growth in this direction soon furnished ready markets and secured frequently a higher pecuniary compensation for money invested and labor spent than the crops obtained on indifferently managed grass lands. Remunerative returns, from a large proportion of original pastures and meadows became, under these circumstances, in the same degree, a matter of doubt and uncertainty as these lands proved to be better adapted to the raising of garden and field crops. None but the better class of grass land in populated districts could stand the competition.

This history of changes in the current system of farming has repeated itself in every country, ours not excepted, when passing from a more primitive condition of society to that of a dense population.

The fact, that the serious influence of a rapid and material decrease in the original grass lands on the supply of fodder for farm stock, is less striking with us to-day than at an earlier period in other countries, is mainly due to the three following circumstances: —

1. The requirements for a successful management of grass lands are to-day much better known than in preceding periods; we are for this reason better prepared to secure larger and better crops, and to maintain at the same time a high state of fertility of the lands engaged in the raising of grasses. A more intensive system of cultivation replaces, every day more and more, the extensive one of former times.

Comparatively recent investigations into the life of plants in general have taught us, that all of them need not only the same kind of constituents of the soil for their useful growth, but also in different relative proportions in case of different plants. This fact imposes upon us the task of regulating the supply of the essential plant constituents. The successful introduction of the trade in commercial fertilizers is a practical illustration of the relations of scientific methods of inquiry to practical agriculture. In the light of our present information, it appears but natural that a system of farming which does not provide in an economical way for a return in an available form of the soil constituents carried off by the crop raised, cannot otherwise but prove ultimately a financial failure. The less the variety of crops raised in succession upon the same lands, the more one-sided is usually the exhaustion of the soil, and the sooner, as a rule, will be noticed a decrease in the annual yield.

A change from the beaten path of the older systems of farm management only can reveal to us the extent of this condition in the case of many of our so-called exhausted grass lands.

From a practical point of view, not less important than the previously stated results of scientific methods of inquiry, are the observations made regarding the botanical and physiological characteristics of grasses.

The more prominent species of grasses have been of late more closely studied in that direction; and some valuable foreign varieties have been added to our home supply.

The special adaptation of different species as well as of different varieties of the same species to different kinds and different conditions of soil has been investigated.

The duration of their life; their time of blooming; the special character of their root system, whether compact and short, or loose and extensive; their natural tendency of producing mainly tall, blooming stems, with a limited leaf development, or a liberal leaf growth with but a few blooming stems; and last, but not least, their chemical composition and nutritive value in different stages of growth and in case of different systems of cultivation and of manuring, have been made more or less special subjects of scientific research. The additional information gained in consequence of these and similar labors cannot well be over estimated, as far as its influence on a more judicial management of grass lands is concerned.

The causes of unsatisfactory returns of meadows and pastures are at present fairly understood; it remains our work to benefit by the lessons of the past, and make ourselves, as far as possible, familiar with the result of more recent experiments.

The of late increasing practice of cultivating upon ploughed lands for a short period some varieties of grasses, single or mixed, or as an admixture to other fodder plants, is evidently a movement in the right direction.

The grasses are in many instances well qualified to serve advantageously as a link in a rational system of a rotation of crops.

2. Our supply of suitable fodder articles for farm live-stock in general has been of late materially increased from two directions: a greater variety of fodder plants is offered for our choice, and large quantities of by-products and refuse materials of various branches of industry have proved efficient helpmates in the compounding of healthy fodder rations.

The introduction of a greater variety of fodder plants enables us to meet better the differences in local conditions of climate and of soil, as well as the special wants of different branches of farm industry.

The merits of some comparatively new fodder plants, as several varieties of clover, of vetch and of millet, are already well recognized in New England, whilst others, as the horse bean, the Southern cow pea, the serradella, the prickly comfrey, the lupines, the alfalfa and others invite our attention. On the other hand, we notice a steady increase in the valuable refuse materials from various industries in consequence of an increase in the existing ones and addition of new ones.

The by-products of flour mills and vegetable oil works, as the brans, middlings and oil-cakes, are already highly appreciated; the refuse products from starch works, glucose works, breweries and others, the starch feed, gluten meal, spent brewers' grain, etc., deserve a more general trial.

The steady increase of suitable fodder materials from these new sources tends to revolutionize our system of feeding farm stock, and it cannot otherwise but exert a controlling influence on the market price of our home-raised fodder crops, the hay crop included, rendering a remunerative production of it more difficult.

3. Inquiries into the circumstances which control animal nutrition have given us a more rational basis for the recognition of what constitutes a complete food for various kinds of farm stock, as well as under different conditions.

The former practice of ascribing to each of our fodder articles one definite numerical nutritive value, taking the hay as the standard crop, has been proved to rest on a misconception of what constitutes a complete nutritious food under various circumstances.

We have learned from actual trials, that a complete animal diet ought to contain a certain proportion of three distinctly different groups of compounds, namely, certain organic nitrogenous and non-nitrogenous constituents, and certain saline or mineral substances.

The entire absence of one or the other of these groups in a food renders it unfit for the support of any of our farm animals; the latter die in a short time, with the symptoms of starvation, if exclusively fed with a food of that kind. An excess of one or the other groups of essential food constituents in a daily diet is ejected as worthless for the support of the life of the animal; and it may, if consumed in exceptionally large quantities, endanger life. Considerations of health and good economy advise us to feed our animals with reference to their special wants under different circumstances and for different purposes.

Good economy in stock feeding requires that the daily diet in every case should contain the largest amount of each of the three above stated groups of food constituents, which the animal under treatment is capable of assimilating; and that this circumstance should be complied with at the lowest attainable cost.

As no single fodder article has been found to meet these requirements equally satisfactorily under varying circumstances, as far as different kinds of animals, their age and functions are concerned, it becomes, as a rule, necessary to supplement every one of our fodder plants with one or more different suitable fodder substances to secure a diet most efficient at the time. The hay crop furnishes no exception to this rule; our every-day practice confirms that statement.

Whenever a high nutritive character of the feed is considered essential for success, — as, for instance, in the dairy business or in case of growing dairy stock, — we add shorts, corn meal, oil cakes, etc., to the hay ration, to secure the best results. We have succeeded in making of the hay by these additions a more complete food for some special purpose.

Taking into consideration, in this connection, that our success in the dairy industry is largely due to the peculiar character and composition of the commercial fodder substances which we have added to the daily hay rations, it seems but a step in the right direction, to attempt, in the interest of economy, a substitution of the hay, in part or in the whole, as circumstances may advise, by some other fodder crop of a similar coarse mechanical condition and a similar chemical composition.

The current high market price of a good meadow hay strongly advises that course, in the interest of a desirable increase of our fodder resources and of a lower cost of production of milk and beef.

In estimating at present the agricultural value of a fodder substance, we consider, — first, its degree of adaptation as a fodder article for special or general purposes; second, its current market price; third, the manurial value of the residue it leaves behind after having served as food.

Applying this standard of valuation to the meadow hay, and to the growth upon the better class of natural pastures in particular, we have to concede to them a well-earned reputation of a superior degree of adaptation as a suitable fodder for young and old of our most important kinds of farm live-stock, as cattle, horses and sheep.

On the other hand, it cannot be denied that the current market price of a good meadow hay seriously affects the cost of production of milk and of beef, when compared with other coarse fodder articles recommended for our trial. The comparative moderate pecuniary value of the manurial residue left when feeding hay does not materially alter the financial results.

Under these circumstances, we cannot otherwise but notice with satisfaction the daily increasing interest manifested in our farming community regarding feeding experiments to determine the economy of introducing, in particular, corn stover, corn fodder and corn ensilage as substitutes in part, or in the whole, for meadow hay in our farm industry.

The Indian corn, or maize, is pre-eminently the most valuable grass we cultivate. Judging from personal experience in this direction, I am persuaded to believe that the solution of this problem is much advanced, and I feel confident that the pecuniary advantage derived from its consummation will be marked. With these prospects in view, it seems but proper that the discussion of a fodder article ought to assume a more comprehensive character, considering not only its individual inherent merits, but also its relation to other fodder substances of a similar character, and with reference to a complete diet under given circumstances.

To stake the financial success in any branch of farm industry on the successful production of one single crop is, to say the least, very risky. The experience of the past does not endorse that course, nor do we know at present of any mode of operation which promises better results in the future.

We have learned of late to raise, under certain circumstances, all kinds of farm crops successfully without the material assistance of the standard fertilizer of the past, the barnyard manure; and we will know better, before many years have passed by, what particular place to assign to the hay-field in a more extensive and intensive system of raising remunerative fodder crops. A due consideration of the preceding remarks requires apparently no farther argument to recognize the fact that local advantages, supported by a systematic management of the work involved, are more needed than ever before to secure remunerative returns from grass lands.

Within a few subsequent pages I propose to give a short description of the course recommended for the successful production of a good English hay, and also relate our own experience at the Experiment Station, of comparing the feeding value of a good average meadow hay with other fodder articles at our disposal at the time of the experiment.

The successful production of most of our important meadow and pasture grasses depends in a less degree on the particular kind of soil than on a well-regulated supply of moisture.

Light sandy soils furnish good meadows and pastures whenever the necessary amount of moisture and of plant food is provided for during the entire growing season. A deep loam, or clayish loam, is looked upon as the typical grass land. Our best meadows are found located upon lands containing either a liberal admixture of a fine clayish silt, or are receiving periodically additions of that kind by overflow or otherwise.

Deep plowing, and a good mechanical preparation of the soil before seeding down, are most efficient treatments to economize natural sources of moisture. The ground should, however, be well settled before the seeds are imparted, — the roots are better protected in that case than in a newly stirred up soil; rolling the ground after seeding does not work as well upon a heavy moist soil. An excess of water, as well as a high degree of dryness, changes the general character of the growth upon grass lands. A wet condition of lands favors the appearance of an inferior class of grasses, and an exceptional state of dryness of the soil that of an inferior class of herbaceous plants common to dry pastures. These results become in the same degree more marked as the undesirable conditions continue.

Under-draining and irrigation are efficient means for the protection against these serious influences, if practicable under existing local conditions.

In case neither of these remedies prove available on account of unfavorable local circumstances, the adoption of one or the other of the following modes of operation suggests itself. Wet lands are quite frequently decidedly improved for the production of grasses by an extensive system of ditching, and in raising the level of the lands by covering them with a layer of light sandy soil. A periodical serious dryness of the soil is ruinous to the majority of our better grasses; its serious influence can be somewhat modified by the introduction of some valuable broad-leaved herbaceous fodder plant, — for instance, certain varieties of clover, as red clover (*Trifolium pratense*) and white clover (*Trifolium repens*), for the purpose of shading the surface, and thereby economizing existing sources of moisture.

After having accomplished all the good results that an efficient use of these means is capable of securing, much benefit may still be derived from a study of the character and the comparative fodder value of the plants which prosper under existing circumstances. To favor an increase of the best of them, by seeding and otherwise, tends to improve, materially, the chances for more satisfactory crops. The same rule works well in the case of somewhat dry grass lands.

Dry grass lands, which are in an exceptional degree inclined to a spontaneous overgrowing by an inferior class of fodder plants and weeds, if at all fit for a more thorough system of cultivation, ought to be turned by the plough and subsequently planted with some hoed crop, to kill off the foul growth and to improve the physical and chemical condition of the soil. These lands prove, in many instances, ultimately a far better investment when used for the raising of other farm crops than grasses.

Next in importance to a certain degree of natural adaptation of the soil for a successful and remunerative production of grasses, is the presence of a sufficient amount of available, suitable plant food.

No one definite rule of manuring grass lands can be laid down in sight of the diverse conditions of existing meadows and pastures, as well as of the special requirements in that direction of lands designed for the cultivation of grasses, beyond the general advice, to provide for those soil constituents in particular which the grasses in exceptionally large proportions abstract, and of which the soil of the locality contains, comparatively speaking, but a limited amount.

We have learned how to ascertain pretty closely the character and the approximate amount of the soil plant food which a given amount of a crop abstracts, — the larger the crop, the heavier the loss to the soil. A few numerical statements regarding the grass crop may show in what direction and in what varying quantities the same weight of the crop may consume the different articles of plant food.

Green grass at time of forming seeds (per ton), containing 75 per cent. moisture and 25 per cent. vegetable matter: —

Moisture,	1,500.00 lbs.			
Vegetable matter,	500.00 lbs.			
Mineral constituents,	36.00	to	44.00 lbs.	
Nitrogen,	8.00	to	14.00 lbs.	(17 cts.)
Phosphoric acid,	2.40	to	4.40 lbs.	(6 cts.)
Potassium oxide,	9.00	to	16.00 lbs.	(4¼ cts.)
Calcium oxide,	2.00	to	5.60 lbs.	
Magnesium oxide,	.80	to	2.40 lbs.	
Sodium oxide,	.60	to	1.60 lbs.	
Sulphuric acid,	1.60	to	2.00 lbs.	
Chlorine,	2.20	to	4.20 lbs.	
Manurial value,	$1.88		$3.32	

Meadow hay (per ton), containing from 14 to 15 per cent. of moisture: —

Moisture,	28.00	to	30.00 lbs.
Vegetable matter,	1,972.00	to	1,970.00 lbs.
Mineral constituents,	100.00	to	160.00 lbs.
Nitrogen,	30.00	to	50.00 lbs.
Phosphoric acid,	7.00	to	14.00 lbs.
Potassium oxide,	32.00	to	64.00 lbs.
Calcium oxide,	6.00	to	20.00 lbs.
Magnesium oxide,	3.00	to	10.00 lbs.
Sodium oxide,	2.60	to	6.00 lbs.
Sulphuric acid,	5.50	to	9.00 lbs.
Chlorine,	7.50	to	16.00 lbs.
Manurial value,	$6.88		$12.06

Experience tells us that a liberal manuring pays better than a scant one; yet, if we should try to restore to the soil from outside sources a corresponding amount of all the fertilizing constituents which the grass crop abstracts, it would make, in most instances, there munerative production of the hay crop rather an exception than the rule.

Good economy advises us to manure our lands with a particular reference to special wants. To do this intelligently requires a fair knowledge regarding the following points: —

1. The general character of the soil, the location of the lands, the history of their former treatment, as far as the

system of manuring is concerned, as well as the kind of crops which have been previously raised upon them.

2. The quality and relative quantity of the various essential articles of plant food which a satisfactory yield of the contemplated crop requires.

3. The degree of natural fitness of the plant to be raised, to avail itself not only of the atmospheric plant food, but also of the existing inherent amount of plant food in the soil to be used for its production. The development of their root and leaf system, as well as the shorter or longer period of time required for their growth, deserves a most serious consideration in this connection.

Perennial plants are as a rule better qualified to benefit by existing and inherent resources of plant food of the air and the soil; our best meadow grasses are perennials.

A general system of high manuring pays, not infrequently, for this reason in a less degree if applied to naturally good grass lands, than if applied to other farm crops. The advice quite frequently noticed in the publications of writers on agricultural topics, "Do not put your manure on your grass lands as long as your ploughed lands are benefited by it," is based on that observation. It ought to be acted upon with an intelligent discrimination to avoid serious mistakes; for, however applicable the stated advice may have proven in the past, in case of meadows and farms in favored localities, it is not safe to carry it out as a general rule. A superior natural fitness of the soil for the production of remunerative grass crops, without the temporary assistance of some kind of manurial matter, is more an exception than a common occurrence.

The low average yield of a large proportion of our grass lands proves the correctness of the previous statement.

Under these circumstances it seems advisable to discriminate between the better class of permanent grass lands and the periodical grass lands, when discussing modes of manuring, for they represent different conditions.

The cultivation of one and the same crop year after year upon the same land, without some system of a periodical manuring, changes, gradually but surely, the composition of the soil, and renders it sooner or later practically unfit for that purpose. The slowness of that process, in case of naturally good grass lands, has concealed that result to such an extent, apparently, that we cannot point out to-day the existence of a generally recognized more comprehensive system of manuring permanent grass lands. We treat them still quite largely without any well defined idea in regard to the particular way of action of the substance we supply for manurial purposes. A short discussion of some of the more prominently mentioned manurial substances recommended for use upon grass lands may illustrate that point.

Common salt is known quite frequently to act beneficially on grass lands; it acts, however, more decidedly on the physical qualities of the soil than as a direct plant feeder; it assists in the absorption of moisture from the air and economizes inherent resources of moisture, and is thus apt to act better on dry lands than on moist ones; it assists in the diffusion of potash and phosphoric acid, but does not materially benefit the supply of the most essential article of plant food. The beneficial effect usually ceases after a few applications of from 400 to 500 pounds per acre; the lands are more exhausted after its exclusive use as manure than before.

Gypsum, or plaster, has the reputation of assisting in the absorption of the ammonium compounds of the air; it counteracts the tendency of a clayish soil to become hard and impervious in dry weather; it assists, like the salt, in the general diffusion of potash and phosporic acid present by causing favorable transformations of existing compounds; a few repeated applications of from 600 to 700 pounds per acre usually terminate its good services, which are frequently marked rather by a more liberal growth of clover and of leguminous plants in general than by that of grasses. Aside from lime and sulphuric acid, nothing is added to the future fitness of the soil, as far as essential articles of soil plant food are concerned. Gypsum, as the sole manurial matter used on grass lands, assists in bringing nearer the time of their failure as a remunerative fodder source.

Air-slaked lime, lime-kiln ashes and various other kinds of lime refuse, are noted for their frequent good influence on grass lands; they assist in producing a favorable composition of organic matter and aid in the disintegration of potash-containing silicious soil constituents; they render thereby inherent sources of plant food more available and improve the general physical conditions of the soil by rendering it more mellow and permeable. As a direct addition of plant food, they are only in exceptional cases of real importance, on account of a more general distribution of lime containing minerals in the soil.

Marls and clayish marls, free from any perceptible amount of potash and phosporic acid, act in the main similar to the previously mentioned lime refuse.

Earthy composts of various descriptions, if applied in large quantities, frequently act very beneficially on exposed portions of the upper part of grass roots, by protecting them against an undesirable exposure to light and atmosphere, and thereby favoring the formation of new and more numerous shoots. They benefit the inherent stock of plant food only as much as they contain one or more of them in an available condition, which is usually an unknown quantity. Other substances, quite frequently of a mere local interest, might be added to the previous list, if time permitted.

Most of these manurial substances, it will be noticed, are only temporary remedies, if any. They assist more or less in economizing existing local resources of plant food; their general tendency of action defers the time of failures and makes it more ruinous in the end. They may, however, if used intelligently, quite frequently serve as valuable helpmates in a more rational and more comprehensive economical system of manuring grass lands capable of a remunerative improvement.

No system of manuring any of our farm plants can be pronounced, to-day, efficient, which does not recognize the necessity of compounding our manures with reference to the special wants of the plant under consideration, as far as the different kinds of plant food are concerned, and at the same time carefully considers its particular botanical and structural characteristics, as far as the duration of growth and the development of leaf and root systems are concerned.

Grasses are, comparatively speaking, large consumers of plant food. Their long period of growth, supported by a liberal development of leaves and roots, enables them to benefit in an exceptionally high degree by existing natural and local resources of plant food of air and soil. They are for this reason less exacting, as far as an additional supply of plant food is concerned; and they can be raised upon a naturally good soil, fit for grass production, at a less expense for manure than the majority of general farm crops.

Good grass lands pay well, yet they are to-day more the exception in many localities than the rule.

A safe general fertilizer for grass lands has to be compounded by the same rules which guide us in making provisions of that kind for other crops upon ploughed lands.

Wood ashes, barnyard manure, if necessary supplemented by commercial manurial chemicals,* or a suitable combination of commercial manurial substances, may be used in that connection with more or less advantage under different local circumstances.

The grass crop contains, on an average, one part of phosphoric acid to three parts of nitrogen and four parts of potassium oxide. In case of new grass land it is well to adhere to that proportion of these constituents in the manure to be used. In case of old grass land, with an abundance of vegetable refuse matter, the amount of nitrogen may be safely reduced to smaller proportions; whilst an extra occasional application of some potash compounds alone, as muriate of potash (150 to 200 pounds per acre), or kainite (500 to 600 pounds per acre), judging in this matter from personal observations, secures quite frequently satisfactory crops. It is difficult to state collectively the exact amount of nitrogen, potash, and phosphoric acid for a given area, which will secure the best results, on account of the widely varying conditions of grass lands, as far as locality and their state of fertility is concerned. To apply about one-half of the fertilizing constituents contained in an average crop seems to be a good rule, under otherwise fair conditions. Taking two tons of hay as an average yield per acre, the fertilizer to

* 2,000 lbs. of barnyard manure contains, of—

Nitrogen,	8 to 10 lbs.
Phosphoric acid,	4 to 5 lbs.
Potassium oxide,	9 to 12 lbs.
Value,	$1 94 to $2.52

be used ought to contain from thirty to thirty-five pounds of available nitrogen, from eleven to twelve pounds of available phosphoric acid, and from forty-five to fifty pounds of soluble potassium oxide, — such fertilizer, made of the best ingredients, would cost from eight to nine dollars. It is not advisable to reduce the nitrogen in our grass manures to too small quantities, for the best grass crops contain the largest amount of valuable nitrogen compounds.

No single article of plant food acts independently of the rest; a liberal amount of nitrogen assists in the liberal assimilation of phosphoric acid and potash; these elements have a close relation to each other in many of our fodder crops.

As a phosphoric acid source for grass lands, ground bones may obtain the preference, although all kinds of phosphoric acid-containing materials may be used, provided they furnish in due time the desirable amount of available acid.

Our main commercial sources of potash for plant growth are unleached vegetable ashes, as hard-wood ash and of late cotton-seed hull ash, and so called German potash compounds.

Wood ashes are a valuable fertilizer for grass lands if applied in sufficient quantity; our average unleached Canada wood-ash contains from 5 to 6 per cent. of potassium oxide, 1.5 to 2.5 per cent. of phosphoric acid, from 30 to 35 per cent. of calcium oxide (lime), besides small quantities of every other essential mineral element required for a successful growth of plants.

This circumstance imparts to it a special fitness for a general fertilizer. The absence of nitrogen is somewhat compensated for by the presence of a liberal amount of lime, which favors a rapid decomposition of the vegetable matter, contained in the soil. The nitrogen of the vegetable refuse matter becomes thereby in a high degree available.

The good effects of wood-ash is for this reason more striking upon moist grass lands, rich in vegetable refuse matter than upon dry lands, which as a rule contain less of the latter.

Dry grass lands benefit usually more by an application of some suitable German potash salt, muriate of potash or kainite, with some available phosphoric acid (four potassium oxide to one phosphoric acid), for these salines absorb in a high degree moisture from the air, and economize the inherent moisture of the soil by making the latter more retentive in that direction.

A liberal state of fertility of the soil is an indispensable requirement for a successful production and propagation of our most valuable grasses.

Quite frequently the entire character of the growth upon grass lands has been improved by changing from a scanty to a liberal manuring, without any assistance from new seeds. Those grasses which are best adapted to the altered conditions of the soil take the lead.

Some of our most reputed grasses differ widely in regard to their preference for one or the other condition of soil and of climate. Careful local observations furnish, therefore, most valuable information regarding a selection of grasses for cultivation which promises satisfactory results under existing local circumstances.

A higher degree of local adaptation, under otherwise corresponding circumstances, often changes materially the comparative economical value of different species and varieties of grasses.

The nutritive value of one and the same species or variety of grasses is liable to differ in a more serious degree, when raised under more or less advantageous circumstances, than many of our more reputed meadow grasses are represented to differ among themselves, when raised under conditions which favor their successful growth.

The same relation has been noticed as far as quantity is concerned.

The comparative nutritive value of one grass as compared with another can only then be considered fairly established when each has been raised under circumstances which best promote their complete development.

The well-known great diversity of special wants of many of our prominent grasses renders the existence of equally favorable local conditions, for even a limited number of different grasses, rather an exception, than the rule.

Many of our current reports on experiments with grasses give us but little information regarding the circumstances under which the trial has been made.

The majority of the results reported have for this reason only a local value, and are to be accepted with a due allowance for special local conditions. The fact that many of our foremost practical agriculturists, on both sides of the Atlantic, differ widely in regard to the relative and absolute merits of many of our reputed grasses even, can only be reconciled by assuming different local conditions of the experimenters.

Under these circumstances it seems, for these and various other reasons, advisable to point out on the present occasion merely some general considerations which ought to guide us in selecting suitable grasses for meadows and for temporary grass lands, and to close subsequently this chapter by relating some of our own results of experiments with single grasses upon the fields of the State Experiment Station.

It is a well-established fact in practical farming that the yield of fodder upon a given area of land is frequently much larger when raising a mixture of several fodder plants than when raising but one of them at a time, provided the selection of the mixture is made judiciously.

The grasses are no exception to that rule. A good meadow furnishes the best illustration in this direction. In studying the botanical characteristics of the grasses, with reference to their mode of growth, we notice a more or less marked difference among different species and varieties. Some show decided tendency to send out, soon, numerous upright shoots, bearing liberally flowers, whilst others show this tendency more sparingly, and spend their vital energy in the production of numerous low, knotty shoots, clinging more or less closely to the ground.

This class of grasses requires frequently from two to three years after seeding before it contributes liberally to the hay crop; it furnishes meanwhile valuable pastures. As the selection of suitable grasses for permanent meadows ought to be made with a view of forming, within a limited number of years, a close and compact sod, the last-named class of grasses ought to take the lead in grass mixtures for that purpose.

To secure upon recently seeded grass lands, designed for permanent meadows, during the earlier years a liberal supply of hay, requires a fair addition of seeds of tall-growing grasses and other fodder crops, as clover and other leguminous plants. These fodder plants ought to be selected largely from short-lived species and varieties, to make, in due time, room for the formation of a close sod.

In case of temporary grass lands, it becomes necessary, for a good and early annual yield, to choose mainly the seeds from those grasses, otherwise suited for existing local conditions, which send out, at once, many tall blooming shoots. The shorter the period designed for keeping the lands covered with grasses, the more ought low-growing perennial grasses to be excluded, — except the lands shall serve subsequently for pastures.

The degree of success upon permanent meadows, as far as the quality and the quantity of the annual yield is concerned, depends largely on the care taken to ascertain the most advantageous relative proportion of both mentioned classes of grasses under existing local circumstances. To secure the highest attainable yield requires careful local observations.

Grasses raised upon one and the same lands should be selected as far as practicable with reference to a corresponding period of blooming; they should be cut for hay when the majority of them are fairly advanced in blooming. The adoption of this course imparts to the crop the highest attainable nutritive value.

Observations at the Experiment Station.	Moisture.	Dry Matter.	Analysis of Dry Matter (100 parts).					Approximate Nutritive Ratio.	Total Manurial Value per Ton.
			Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.		
English hay in last stage of blooming,	10.55	89.15	4.69	29.21	2.65	9.02	51.43	1 : 10.6	–
English hay,	8.30	91.70	6.12	30.19	2.55	9.75	51.39	1 : 9.5	$6 68
English hay, station fields, 1887,	10.78	89.22	7.11	35.55	2.63	8.75	45.96	1 : 10.55	–
Rowen, station fields, 1887,	8.84	91.16	10.50	29.46	3.05	13.20	43.79	1 : 6.11	–
Herd's grass, Phleum pratense, in bloom,	7.80	92.20	5.29	33.28	1.95	8.20	51.33	1 : 11.52	5 93
" " after blooming,	8.70	91.30	4.01	36.59	2.12	7.21	50.01	1 : 14.83	–
" " after blooming,	10.55	89.15	4.69	29.21	2.65	9.02	51.43	1 : 10.6	–
Red-top, Agrostis vulgaris, collected July 22,	8.24	91.76	4.81	33.49	1.50	6.44	53.76	1 : 15.07	8 41
" " collected July 5,	6.81	93.19	5.69	34.11	1.56	8.32	50.32	1 : 11.24	9 60
Meadow fescue, Festuca pratensis, collected June 28,	7.40	92.60	7.17	34.46	2.17	7.02	49.18	1 : 13.85	–
Meadow fescue, small variety, collected June 28,	8.03	91.97	8.18	34.61	1.78	7.27	48.16	1 : 12.67	–
Orchard grass, Dactylis glomerata, in bloom,	9.09	90.91	7.90	34.12	2.11	8.91	46.63	1 : 10.20	6 99
" " " " in seed,	8.38	91.62	6.17	35.48	3.56	7.57	47.22	1 : 12.62	–
Barnyard grass, Panicum crus-galli, in bloom,	6.65	93.35	10.82	33.72	1.95	15.27	38.24	1 : 2.94	–
Common rye grass, Lolium perenne,	11.30	85.70	7.80	30.20	2.70	10.20	36.10	1 : 7.30	–
Italian rye grass, Lolium Italicum,	11.30	85.70	4.50	22.90	3.20	11.20	40.60	1 : 6.30	–
Common millet, Panicum milliaceum, in bloom,	6.15	93.85	4.67	29.80	2.01	7.69	55.80	1 : 8.32	–
Pearl millet, Penicillaria spicata, in bloom,	6.20	93.80	4.80	35.91	1.63	7.20	50.46	1 : 8.00	–
Pearl millet, collected Sept. 10,	7.80	92.20	6.68	34.31	1.47	7.88	49.66	1 : 7.15	–
Hungarian grass, Panicum Germanicum, in bloom,	7.45	92.55	5.73	31.96	2.22	9.45	50.64	1 : 6.22	–
" " " " in bloom,	74.07	25.93	7.15	24.66	1.01	9.38	57.80	1 : 6.86	–

Green oats, collected in bloom July 5,	78.61	21.39	7.38	33.12	2.02	7.10	50.38	1 : 13.02	–
" " collected July 13,	71.18	28.82	6.99	32.83	2.11	7.05	50.69	1 : 13.32	–
Hay of ripe oats, collected Aug. 26,	8.70	91.30	6.11	36.51	2.61	6.05	48.92	1 : 15.01	–
Hay of oats, in bloom, collected Aug. 1,	6.43	93.57	6.11	34.06	2.92	6.58	50.93	1 : 11.23	–
" " in milk, collected July 9,	9.55	90.45	6.08	34.32	2.69	10.89	46.02	1 : 7.9	–
Hay of winter rye, in full bloom,	8.55	91.45	6.1[illegible]	32.97	2.57	10.66	17.10	1 : 8.28	–
Hay of barley, in milk,	10.25	89.75	4.95	29.42	2.76	10.26	52.91	1 : 9.59	–
Fodder corn, Zea maize, collected July 22,	88.61	11.39	8.51	25.01	3.21	17.19	42.02	1 : 4.06	–
" " collected July 29,	85.76	14.24	8.00	27.29	2.65	14.42	47.64	1 : 5.57	–
" " collected Aug. 5,	84.64	15.36	5.95	26.10	2.26	11.86	53.53	1 : 6.60	–
" " collected Aug. 13,	82.08	17.92	5.69	24.11	2.13	11.23	56.84	1 : 7.25	–
" " collected Aug. 27,	81.15	18.85	4.70	24.30	1.81	8.87	60.32	1 : 9.46	–
" " collected Sept. 3,	76.81	23.19	4.22	20.93	2.63	9.17	63.05	1 : 9.30	–
" " collected Sept. 4,	72.27	27.73	3.16	24.32	2.89	9.64	59.99	1 : 8.97	$1 69

LIST OF REPUTED GRASSES (PERENNIALS).

I. For Dry or Moderately Moist Soils.

(a) First Class (tall growing grasses.)

Meadow Fox-tail (Alopecurus pratensis), ...	May to June.
Meadow Fescue (Festuca pratensis), ...	June to July.
Red Fescue (Festuca rubra), ...	June to July.
Timothy (Herd's Grass) (Phleum pratense), . . .	June to July.

(b) Second Class (low growing grasses).

English Bent (Agrostis alba), ...	June to July.
Sweet Scented Vernal Grass (Anthoxanthum odoratum,)	May to June.
Yellow Oat Grass (Avena flavescens), ...	May to June.
Sheep's Fescue (Festuca ovina), ...	June to July.
Downy Oat Grass (Avena pubescens), ...	July.
French Rye Grass (Tall Oat Grass) (Arrhenatherum avenaceum), ...	May to July.
English Rye Grass (Lolium perenne)	June.
Italian Rye Grass (Lolium Italicum)	June.
Kentucky Blue Grass (Poa pratensis)	May to June.

II. For Moist and Wet Soils.

(a) First Class (tall growing grasses).

Timothy (Herd's Grass) (Phleum pratense,) . . .	June to July.
Fowl Meadow (Poa serotina), ...	July to Aug.
Rough-stalked Meadow Grass (Poa trivialis). . . .	June.
Meadow Soft Grass (Holcus lanatus), ...	June to Aug.
Orchard Grass (Dactylis glomerata), ...	May to June.
Soft Brome Grass (Bromus mollis), ...	June.
Italian Rye Grass (Lolium Italicum), ...	June.
Tufted Hair Grass (Aira cæspitosa), ...	June.

(b) Second Class (low growing grasses).

Red-Top (Rhode Island Bent) (Agrostis vulgaris). .	July.
English Rye Grass (Lolium perenne).	June.
Crested Dog's Tail (Bynosurus cristatus), . . .	June to July.
Common Manna Grass (Glyceria fluitans), . . .	June to July.

Much more might be said here in regard to other circumstances which exert an influence on the quality and the quantity of the hay crop, if time permitted.

Sufficient has been mentioned to recognize the fact that hay-fields and hay crops are apt to differ widely under different managements.

The great variations in the nutritive value of the hay renders its services as a fodder for a specified purpose more or less uncertain; it lessens its claim as a standard for fodder.

We have learned to improve its good services by supplementing it in various ways and for different purposes, and we are now engaged, on account of its high market price, to substitute it in part or in the whole by some other cheaper, suitable, coarse fodder article. A short description of a series of personal observations in that direction forms the closing chapter of this paper.

A rational attempt of compounding fodder rations for different kinds and different conditions of farm live-stock has to begin with a due consideration of the general adaptation of the various fodder articles for the designed purpose. We have to discriminate in this connection in our choice with reference to the particular kind, age and function of the animal concerned.

My experiments, below related, were carried on with milch cows. The special fitness of an animal diet depends on certain physical characteristics of the feed, whether liquid or dry, coarse and bulky or fine, and on its nutritive effect; the more adapted in both directions the more satisfactory are the results as far as health and function of the animal are concerned.

To meet the craving of the animal for food, and to support a vigorous manifestation of life, are two distinctly different requirements of a food. The bulky condition of the feed tends to satisfy the craving or the hunger of the animal; the amount and relative proportion of digestible essential food constituents required for a healthy and normal performance of all animal functions decides the nutritive value of the feed, — its feeding effect.

A judicious selection from among the various suitable fodder articles with reference to net cost controls the degree of financial success of the operation.

Our observations at the Experiment Station have been thus far confined to a trial with English hay, as compared with corn fodder, corn ensilage, stover, and root crops (Lane's sugar beet and carrots), and a second trial, as compared with some green crops, as vetch and oats, Southern cow pea, and serradella.

These coarse and bulky fodder substances were supplemented by corn meal, wheat bran, rye middlings and gluten meal.

The standard diet consisted of three and one-quarter pounds* each of corn meal and wheat bran, besides all the hay the animal would consume (from 20 to 25 pounds).

Two cows of corresponding milking periods served in the first two series of observations, and three cows on each side in the experiment with green crops.

Our results may be summed up in the following statements: —

1. Dry corn fodder compares with English hay, pound for pound of dry matter.

2. Corn ensilage compares well with English hay, when substituting the latter from one-half to two-thirds, pound for pound, dry matter.

3. Corn stover compares well with both corn ensilage, fodder corn and English hay, pound for pound, dry matter.

4. Root crops (used pound for pound of dry matter) exceed in nutritive value that of corn ensilage; they raised the yield of milk about one-sixth, when fed in place of one-half of the hay.

5. Vetch and oats, serradella, and Southern cow-pea, when fed as green crops, in place of three-fourths of the hay (counting pound for pound of dry matter), had a similar effect on the increase of milk as the root crops, — one-sixth increase.

6. The influence of the various diets used on the quality of the milk has been more controlled by the constitutional characteristics of the animals than by the particular composition of the feed; the effect produced in one animal has been not infrequently the reverse in case of the other.

7. The manurial value left behind in case of the various fodder rations used has amounted in most instances to more than one-third of the cost of the feed, after allowing a deduction of twenty per cent. lost in the sale of milk.

A few subsequent tabular statements may serve as illustrations of our results as above reported.

* Three and one-quarter pounds of shorts are equal to four quarts; and three and one-quarter pounds of corn meal are equal to two quarts.

Some of the Fodder Rations adopted in Feeding Experiments at Experiment Station during the past few Years.

TABLE I.

RATIONS PER DAY.		Dry Matter in the Daily Rations.	Cost of Rations per Day.	Total Manurial Value of Daily Rations.	Nutritive Ratio.
		lbs.	cents.	cents.	
English hay,	20 lbs.	24.06	22	9.4	1:8.2
Corn meal,	3.25 "				
Shorts (wheat bran),	3.25 "				
English hay,	5 lbs.	20.44	13.8	8.1	1:7.72
Corn fodder,	12 "				
Corn meal,	3.25 "				
Shorts,	3.25 "				
English hay,	10 lbs.	21.57	18.4	9.1	1:8.15
Ensilage,	30 "				
Corn meal,	3.25 "				
Shorts,	3.25 "				
English hay,	15 lbs.	23.91	25	9.4	1:7.1
Roots (sugar beet),	27 "				
Corn meal,	3.25 "				
Shorts,	3.25 "				

Prices of the Articles of Feed (per ton).

English hay,	$15 00	Roots (carrots),	$7 00
Corn fodder,	5 00	Corn meal,	23 00
Ensilage,	2 75	Shorts,	20 00
Roots (sugar beet),	5 00	Gluten meal,	23 00

TABLE II.

RATIONS PER DAY.		Dry Matter in the Daily Rations.	Cost of Rations per Day.	Total Manurial Value of Daily Rations.	Nutritive Ratio.
		lbs.	cents.	cents.	
English hay, Corn meal, Shorts (wheat bran).	25 lbs. 3.25 " 3.25 "	28.66	25.7	10.9	1 : 7.9
English hay, Corn meal, Shorts, Gluten meal,	20 lbs. 3.25 " 3.25 " 3.25 "	26.21	25	12.3	1 : 6.1
Corn fodder, Corn meal, Shorts,	20 lbs. 3.25 " 3.25 "	22.51	12	8.7	1 : 7.7
English hay, Ensilage, Corn meal, Shorts, Gluten meal,	5 lbs. 30 " 3.25 " 3.25 " 3.25 "	21.76	18.4	10.2	1 : 6.2
English hay, Roots (carrots), Corn meal, Shorts, Gluten meal,	10 lbs. 35 " 3.25 " 3.25 " 3.25 "	21.36	30.5	11	1 : 5.9

Prices of the articles of feed same as in Table I.

TABLE III.

RATIONS PER DAY.		Dry Matter in the Daily Rations.	Cost of Rations per Day.	Total manurial Value of Daily Rations.	Nutritive Ratio.
		lbs.	cents.	cents.	
English hay,	19.88 lbs.	23.45	21.70	9.75	1 : 8.54
Corn meal,	3.25 "				
Shorts (wheat bran),	3.25 "				
English hay,	20 lbs.	26.34	26.20	10.34	1 : 9.39
Corn meal,	3.25 "				
Rye middlings,	6.50 "				
English hay,	20 lbs.	26.42	26.00	11.57	1 : 6.96
Corn meal,	3.25 "				
Rye middlings,	3.25 "				
Gluten meal,	3.25 "				
English hay,	5 lbs.	18.39	19.43	9.93	1 : 5.60
Vetch and oats,	64.23 "				
Corn meal,	3.25 "				
Shorts,	3.25 "				
English hay,	5 lbs.	30.80	25.86	11.49	1 : 5.38
Cow pea,	97.37 "				
Corn meal,	3.25 "				
Shorts,	3.25 "				
English hay,	5 lbs.	29.03	25.91	13.58	1 : 9.06
Serradella,	97.12 "				
Corn meal,	3.25 "				
Shorts,	3.25 "				

	Yield per Acre.		Valuation per Ton with Hay at $15 as the Basis.
	Green Material.	With 15 per cent. Moisture.	
Cow pea,	9.6 tons,	4,777 lbs.	$12 60
Vetch and oats,	10.9 "	3,553 "	16 80
Serradella,	9.5 "	4,342 "	13 80
Hay,	6.8 "	4,000 "	15 00

COMPOSITION OF FODDER ARTICLES RAISED AT THE EXPERIMENT STATION.	Moisture.	Dry Matter.	Analysis of Dry Matter (100 Parts).					Approximate Nutritive Ratio.	Total Manurial Value per Ton.
			Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.		
Fodder corn, kernels glazed but soft,	70.27	29.73	5.24	24.50	3.38	8.36	58.52	1 : 10.36	$1 86
Corn ensilage,	80.70	19.30	9.17	33.32	3.21	8.08	46.22	1 : 10.34	–
" " corn in tassel,	86.88	13.12	6.89	33.66	3.88	12.58	42.99	1 : 6.57	–
" " cut corn,	81.88	18.12	5.07	26.23	3.49	7.83	57.38	1 : 11.8	–
" " whole corn,	83.18	16.82	4.23	29.44	3.69	9.03	53.61	1 : 9.71	–
Corn ensilage,	77.48	22.52	4.19	19.08	3.49	7.82	65.42	1 : 11.3	–
" " kernels just beginning to glaze,	78.05	21.95	3.16	20.48	3.84	7.37	65.15	1 : 12.2	–
" " kernels just beginning to glaze,	71.60	28.40	3.32	18.52	6.07	7.78	64.31	1 : 11.9	1 68
Corn stover,	8.73	91.27	3.12	34.28	1.27	6.58	54.75	1 : 21.16	–
" " shredded,	6.95	93.05	5.16	33.46	1.71	12.15	47.52	1 : 7.23	–
Corn stover,	15.40	84.60	4.22	20.93	2.63	9.17	63.05	1 : 9.3	–
" " of Western Dent corn,	16.67	83.33	4.17	35.44	1.71	6.63	52.05	1 : 13.14	–
" " of Top-over corn,	25.00	75.00	6.12	36.10	2.49	6.47	48.82	1 : 13.43	–
Vetch (Vicia sativa), collected in bloom,	8.35	91.65	7.97	30.68	2.30	15.76	43.29	1 : 4.02	–
" fully matured,	9.45	90.55	8.50	30.05	2.69	14.42	44.34	1 : 4.09	–
Vetch and oats (90% oats and 10% vetch),	86.11	13.89	12.37	34.20	2.74	10.59	40.10	1 : 6.85	1 58
Serradella (Ornithopus sativus), collected in bloom,	7.20	92.80	5.87	24.37	2.37	17.85	49.54	1 : 4.72	–
" fully matured,	8.70	91.30	6.46	25.14	2.91	15.26	50.23	1 : 5.47	–
" collected in bloom,	84.60	15.40	11.85	26.21	2.65	17.75	41.54	1 : 4.07	2 05
" collected Sept. 20,	80.58	19.42	11.53	38.76	2.09	12.17	35.45	1 : 5.03	1 80

Luzerne (Alfalfa) (Medicago sativa), beginning to bloom,	16.00	84.00	10.15	25.42	2.50	16.34	45.29	1: 4.71	–
Sand Luzerne (Medicago media), in bloom,	8.80	91.20	9.57	21.27	2.59	16.26	50.31	1: 3.5	–
White Lupine (Lupinus albus), in bloom,	85.35	14.65	5.03	31.18	2.41	18.71	42.67	1: 3.4	3 39
Horse bean (Vicia faba), whole plant, in bloom,	84.83	15.17	5.75	28.17	2.31	16.68	47.09	1: 2.71	3 86
" " straw from matured plants,	9.15	90.85	9.59	41.44	1.51	9.69	37.77	1: 8.55	–
" " beans from matured plants,	10.28	89.72	4.27	8.11	1.11	30.03	56.48	1: 2.24	–
Cow pea (Dolicos sinensis (?), variety Clay, collected Aug. 1,	9.30	90.70	9.53	23.53	3.81	17.02	46.06	1: 4.75	–
Cow pea, variety Whippoorwill, collected Aug. 1,	9.65	90.35	10.16	22.36	3.87	16.95	46.36	1: 4.74	–
" " collected Sept. 2,	78.81	21.19	5.97	23.02	1.81	8.58	60.62	1: 10.74	1 51

Mr. Myrick. I think Major Alvord did not cover in his address the experiments where no weight was applied to ensilage. Mr. Brooks, who is here, has made some experiments in that line very successfully, and perhaps Major Alvord has some data on that point which would be of interest here. It is a great inconvenience to many farmers to haul a load of rocks or something else with which to weight their ensilage.

Prof. Alvord. I thought that was alluded to in the paper, though perhaps not very explicitly. If the ensilage is left without any cover the upper portion of the material will decay. The thickness of this decomposed layer will differ under different conditions of weather and other circumstances. I remember going into a silo at Geneva, N. Y., with my friend Dr. Sturtevant (who is fortunately here now and can verify what I have to say on that point), in December or January. This silo had been undisturbed from the time the filling was completed. The ensilage was not even levelled off. I recollect we poked through about five inches of poor material for any feeding purpose, and then came to what seemed to be a pretty fair quality of ensilage. My recollection is that about eight inches from the top we found good eatable material. The upper layer, that was spoiled, became a cover for the rest. So that it becomes simply a question of the value of the material itself. I have seen it spoil for a foot and a half or two feet in depth over a surface of considerable extent. The larger your silo the greater the extent of surface and the more expensive the cover. It seems to me it is simply a question of comparative values; whether your corn, or whatever you put in for your ensilage, is more valuable than the straw and boards that you use on top to cover it and for weight.

The Chairman. We have with us one of our Massachusetts men, — always a Massachusetts man, although he has of late been laboring in a neighboring State, — Dr. Sturtevant. I am sure you all want to hear from him. [Applause.]

Dr. Sturtevant. I certainly did not expect when I came here to speak, but this question of ensilage is a very interesting one to me, because I want to get a thorough understanding of the practical methods of its preservation

For two years we have tried the experiment of filling a silo without any weights, and the result has been a marked success in both years, and yet there has been enough difference in the degree of success to give us a clew to some of the conditions which have produced the results. When a silo is filled slowly, and each layer allowed to become very solid before the next layer is applied, the loss from decay is very slight indeed; but when it is filled more rapidly, in thicker layers, so that the fermentation has not reached its extreme point before the next layer is put in, then the loss, as Major Alvord says, may be from a foot to a foot and a half; but we think that the average loss need not necessarily exceed four to six inches, when filled in this way.

But this is not the most interesting thing in regard to the silo. There is yet another method to be developed which is as yet in the experimental stage. I refer to the stacking of it in the open air. In England a process has been devised of making an open-air stack of ensilage, and by means of levers compressing it into about one-half in bulk, and then leaving it, and the claim is that the loss from decay is very slight. This last summer we had some of the apparatus sent us and we put up a stack of ensilage, and, not having made any preparation for it, we simply filled it with what we could get; some corn, some Hungarian grass, some clover, and anything that we could pick up. We put on a layer about a foot deep and the next day that would be so hot that we could not bear our fingers in it; then we put on another layer, and so built it up day after day. That ensilage is well preserved and is the only absolutely sweet ensilage I have ever yet seen. Now, "one swallow does not make a summer." This is simply one experiment, not enough to draw any conclusion from, and we can simply say that if next month the ensilage turns out as we think it is going to from the partial examination we have made of it (we took off about four feet and examined it), it will solve the ensilage question as to cheapness, because we can make a compact stack in the open air and not apply any weight to it. It is just like a stack of hay, and the loss will be far less than inside of the silo. I think it is a promising field for future work.

Mr. Myrick. You compressed it?

Dr. Sturtevant. We compressed it, but that operation is entirely unnecessary.

Prof. Alvord. What was the shape of the stack?

Dr. Sturtevant. Perfectly level on the top, with perpendicular sides. The weight of the upper foot is sufficient to give all necessary compression. We placed a sloping roof over it of common boards to keep the rain from striking in. At the present date the ensilage is in perfect condition.

Question. It is open on the sides?

Dr. Sturtevant. The sides are open. I think ten by fourteen feet on the ground and is built up about eight feet high.

Question. Is there any decomposition on the sides?

Dr. Sturtevant. Yes, sir; but it is irregular.

Question. How far?

Dr. Sturtevant. It had gotten in about three inches in some places and in a few spots running in a foot. But we have not yet opened the whole stack, so that we cannot speak conclusively. We know that in some places the decomposition extends in only about three inches. But the curious thing is, that the great solid mass inside is apparently in as perfect condition as hay would be.

Question. Was the material cut?

Dr Sturtevant. The Hungarian grass and hay were not cut; the coarser materials were. The apparatus came so late that we could not prepare for it, and hence put on whatever we could get. We simply laid down boards to keep the material from the earth and to get a bearing for the compressing apparatus, which we do not consider necessary now.

Question Would you make the stack right up as soon as you could, or would you rather wait?

Dr. Sturtevant. In putting in ensilage our experience is that it wants to be put in slowly, so as to allow each layer to get its maximum heat before the next layer is applied.

Question. Was this Hungarian grass and the other grass cut before the dew was off?

Dr. Sturtevant. It was cut according to convenience. In experiments of this kind we want to do as the average farmer would do, so as to obtain a result under similar conditions to those of practical farming. We do not want to have everything perfect.

QUESTION. Why not put it right into the barn at once?

Dr. STURTEVANT. I should want the barn insured.

QUESTION. I would like to inquire what this apparatus was?

Dr. STURTEVANT. Some patented English apparatus. It amounted simply to putting some beams across the stack, attaching chains to them, and then by levers bringing the beams in contact with the material. We do not attach any importance to the compression at all.

Prof. ALVORD. How hot have you found it?

Dr. STURTEVANT. I have never put a thermometer in, but it was so hot I could not bear my fingers in it.

QUESTION. If it was in a barn, would it set the barn on fire?

Dr. STURTEVANT. No, I really do not think it would; still, I should be a little afraid of it.

QUESTION. Was the ensilage dried at all?

Dr. STURTEVANT. No, sir. We cut it and carried it right to the spot.

Mr. ———. I once saw a mow of hay in which a spot of five or six inches in the centre had burnt to charcoal; it would black the cattle's noses. I suppose if air could have gotten in there the barn would have been burned. The cattle would eat the hay that was burnt to charcoal as readily as any part of it.

QUESTION. I would like to ask Dr. Sturtevant if he does not believe that those crops are better preserved by the most perfect exclusion of air from them that can be obtained?

Dr. STURTEVANT. The whole principle seems to be the exclusion of air.

QUESTION. Packed outside in that way is the air so thoroughly excluded as it would be from the same material in a silo?

Dr. STURTEVANT. That is a question I will not answer. As I said, I have not seen that silo opened; but I think the air is excluded in all essential particulars most thoroughly.

QUESTION. Is not the air more thoroughly excluded by rapid filling of the silo and putting on the cover than by any other process?

Dr. Sturtevant. No, sir. I think the best conditions are obtained by slow filling and allowing each layer to settle.

Question. After all this work did you save any time or money as compared with putting it into the barn?

Dr. Sturtevant. I must answer that entirely from belief, based upon experiment. I believe that ensilage has great value when fed properly; when fed improperly I do not think it is any better than the material of which it is composed would be if fed dry. The first effect of feeding acid ensilage is to increase the appetite of the animals, and they will eat more food. If milch cows, they will give more milk on account of the more nutriment that they take; and if fatting animals they will take on more fat. I believe in ensilage, and I believe, if fed judiciously, it can be used to great advantage by any farmer.

Mr. ———. At one of the farmers' meetings held in Boston one of the advocates of ensilage claimed that all food turned acid before being digested, and that by feeding ensilage to our animals we saved their digestive organs a great amount of work. I have tried feeding ensilage without anything else, but sooner or later it has been a detriment to the animals. I find, according to my own experience, that its greatest value is in judiciously feeding it with other materials. I do not want to feed too much of it.

Question. I would like to ask Dr. Sturtevant how much ensilage he would feed?

Dr. Sturtevant. My own experience is that about fourteen pounds to a cow weighing seven hundred pounds does very well indeed.

Mr. ———. My experience is that we can use forty pounds a day.

Dr. Sturtevant. I have known even more than that to be used for some time without ill effects on large animals; but toward the latter part of the season, the ill effects are developed.

Question. What will be the ill effects then?

Dr. Sturtevant. You will find that the hair will be a a little staring and there will be a tendency in the animal to become tender in the fore feet. The same ill effects which follow from feeding excessively of cotton seed meal, gluten meal, and the like.

QUESTION. What will be the result on a milch cow?

Dr. STURTEVANT. The result of over-feeding is detrimental if long enough continued, but there are some individual cows that can stand it without showing any ill effects. In speaking of these things, we must speak of the average herd. We recognize the fact that there are some people who can eat almost anything without injury, and there are some cows that have such good appetites that they can eat anything without injury. But my remarks apply to the average herd and to the average feeder, and, so far as ensilage is concerned, to the average quantity which, in my own experience, I have found to be safe.

QUESTION. What kind of green feed is best combined with ensilage to produce a whole cattle feed?

Dr. STURTEVANT. You are out of my line now, sir.

Mr. MYRICK. Apple pomace is fed in the Eastern part of the State, and I would like to inquire if there is any one here who has fed it.

Mr. SHEPARD of Westfield. Have you ever experimented with sprinkling air-slaked lime on your hay? There is a farmer in our vicinity who cuts his grass in the morning, when the dew is off, and his men cart it directly to the barn, when it is in a very green state, and he sprinkles a small amount of air-slaked lime on it. He says that his hay does not heat and comes out very green in the winter and is very palatable. I would like to know if anybody in the hall has ever practised that and can tell us what the result has been.

Mr. FITCH. If you will call upon Mr. N. B. Douglas of Sherborn you will probably have the best authority in Massachusetts upon the use of apple pomace.

Mr. DOUGLAS. I did not expect to be called upon to say a word upon this or any any other subject, although I am frequently asked in regard to this matter of apple pomace as cattle food. It has been considered a bi-product of cider making. I have been using it in my own herd for four years and I find that, taken in connection with other feed, it makes a very good animal food. I do not consider it a perfect ration at all, any more than I do any other food; but feeding it as one feed during the day, when I would feed three other kinds, I consider it can be used to advantage. My ration is apple pomace in the morning, ensilage at noon, dry hay just before milking time, and dry grain after milking at night. I find that by feeding in that way the cattle eat the pomace well, relish it, they keep in good flesh, and their appetites remain good through the winter. The results in butter are good. By feeding in that way I find that I can feed a considerable quantity of it and get no bad taste or smell in the milk or in the butter. I know from my experience that if pomace is fed injudiciously evil will result, and you see bad effects in the milk; but feeding it in this way I get nothing but good results from it. The storing and keeping this pomace is a very easy matter, — at least, it has been with me. I have kept it now for four months. I simply put it into my silo, on top of the corn. The cider season comes directly after the corn is cut, so, instead of weighting my corn ensilage with rocks or sand, I simply put boards over it, to keep the pomace from working in among the corn. I have never covered my ensilage with anything but this pomace, and it packs it so thoroughly that it excludes the air and keeps it perfectly. There will be, perhaps, from one to three inches on top, towards the centre of this apple pomace, that is damaged.

I am reminded by my friend Cheever that I should say that in the pomace which I use there is no straw used; it is made in mills where they use press-cloth instead of straw. I do not believe it would be possible to keep pomace made in the old-fashioned mills, pressed with straw, because the straw would prevent the pomace from packing so but what the air would get in and cause fermentation and decay in a very short time. Then there is another thing. Those old-fashioned mills do not remove a sufficient portion of the cider. This pomace apparently has not as much acid in it after standing three or four months as it had in the beginning. It smells and looks in March or the first of April almost exactly as it does when it goes in, with the exception that it has settled and is very compact.

Mr. Hartshorn of Worcester. Will you tell us how much you give at a feed?

Mr. Douglas. I am one of those people who are very apt to guess at some of these things, as farmers usually do. I should say twenty pounds to a large cow. Some cows want thirty pounds, others do not want more than twelve or fifteen. You have to be governed by circumstances.

Mr. Smith of West Springfield. About how much pomace by measurement?

Mr. Douglas. A little more than a peck, I should say, as it comes out. After having been in the silo a month or two it becomes very compact and we have to break it up, and then we take a scoop-shovel and take up as much as we can conveniently for each cow.

Question. Do we understand that that constitutes the whole morning feed of the cow?

Mr. Douglas. Yes, sir.

Question. How much ensilage would you feed at noon?

Mr. Douglas. As much as the cow would eat.

Mr. Waterhouse of New Hampshire. Relative to the time of milking, do you feed just before or just after?

Mr. Douglas. Just after milking. I would never feed anything of that nature before milking.

Mr. Waterhouse. Are they where they can smell it?

Mr. Douglas. Part of the cows are within fourteen feet of the silo.

Mr. Waterhouse. You have never had any bad effect in the milk?

Mr. Douglas. No, sir. To satisfy myself I have fed before milking and have been able to detect a smell and taste in the milk.

Question. Will you state whether you have made any experiment to ascertain what value there is in feeding pomace? Whether your cows give any more milk or butter from feeding the pomace over any other feed?

Mr. Douglas. I am not prepared to state as to that. We consider the value of the pomace the same as that of any other food of which it takes the place. If the pomace takes the place of five pounds of hay in the morning, it is worth just as much as five pounds of hay is worth; if it fills the bill of five pounds of hay, it is worth just as much as five pounds of hay.

QUESTION. Suppose the same amount of sawdust would fill the bill, would it be worth as much?

Mr. DOUGLAS. Yes, sir. If it filled the bill it would be worth just as much.

Mr. A. A. FITCH. With regard to straw in pomace, in my journeys over the State in connection with the milk question, I have had occasion to examine a good many silos in that particular, and I have found several persons who are using the common pomace with the straw in it, and I have tried it myself this fall with success. It makes no difference. The ensilage is good.

Adjourned to two o'clock P. M.

AFTERNOON SESSION.

The afternoon session was called to order at two o'clock by Mr. BROOKS and Dr. AUSTIN PETERS, M. R. C. V. S., read the following paper: —

THE VALUE OF VETERINARY SCIENCE TO THE STATE.

BY AUSTIN PETERS, V. S., OF BOSTON.

Mr. Chairman, Ladies and Gentlemen, — I have been requested to address you at this meeting of the State Board of Agriculture upon "The Value of Veterinary Science to the State." By the term State is meant the people of the State, for the State would be nothing without its people, and the value of a profession or of a man to the State means the usefulness of that profession or man to the people in the community.

It cannot be denied that it is a benefit to a locality to have a man residing therein who is conversant with the nature and treatment of the diseases of the domesticated animals, and able to render surgical interference in case of injury, or when, for any other reason, his services are required. This is the popular idea among many people, that a veterinary surgeon is simply a horse and cow doctor, useful to be called on in case of a horse having colic or lung fever, or a cow having garget or getting choked, and that his usefulness ends there. This opinion is correct as far as it goes; but such an estimation of the value of an educated veterinary surgeon would be very limited if it did not comprehend more. Besides being useful as a general practitioner, his opinion should be sought, and his advice followed, in outbreaks of contagious disease among animals, and in matters relating to the public health, as far as it is influenced by the diseases of animals. Admitting, then, that the educated veterinarian is a useful member of the community in the generally accepted sense of horse and cattle doctor, let us look at him from the broader point of view, and see what he has done at home and abroad to protect the farmer from animal plagues, and of what benefit he may be to them in the future.

Let us, also, look at the veterinarian as a sanitarian in protecting the public health by his knowledge of diseases common to animals and man, the inspection of slaughter-houses, dairy cattle, etc.

Disease among animals has been known since the earliest antiquity. We read of it as one of the Plagues of Egypt, attacking various creatures, and, in this case, it was very likely some form of anthrax. Glanders was mentioned in the fourth century, and probably existed prior to that time.

The earliest writers upon medicine devoted some of their energy to describing diseases of animals, among them being Aristotle, Hippocrates, Celsus (the Father of Medicine), and many others of the ancient Greek and Roman period.

While the diseases, especially the contagious diseases of animals, have been recognized as of the utmost importance from a very early period, yet there was no effort to give men systematic education as veterinarians until the last century. Previous to that time veterinary education was acquired by those who had a taste for it, by reading the works of others on the subject, and by observation. Of course, the earliest observers had no books to consult, but they recorded what they saw, and their successors had the benefit of these works, and added to them the results of their own experience, and thus veterinary knowledge accumulates century after century, until the establishment of the veterinary schools of Europe by the various European governments.

The value of veterinarians was early recognized. Those in the days of ancient Rome came from the same ranks which supplied the philsophers and the doctors. They were employed to attend the animals used in the gladiatorial arena, and most of them were both human and animal practitioners combined. They attended to the surgical needs of the gladiators at the same time. The cavalry of the Roman armies was also supplied with veterinary surgeons. During the feudal period the masters of the horse to the various princes and barons acted in the capacity of veterinarians, and some of them wrote upon the diseases and management of the horse. To France belongs the credit of being the first nation to recognize the value of veterinary science to the State to the extent of founding institutions for the education of veterinarians, and affording them government support.

The first veterinary school was founded by Claude Bourgelat, in the city of Lyons. He, through the influence of a friend, received permission from the government, August 5, 1761, to found a school for the study of diseases of the domesticated animals. The government assisted him by giving the school 50,000 livres, payable in equal portions in six consecutive years. It was opened for students Jan. 2, 1762, and soon acquired a continental celebrity.

The first year there were three Danes, three Swedes, three Austrians, three Prussians, three Sardinians and ten Swiss among the students, sent there by their respective governments, to study the elements of the new medicine.

Louis XV. thought so highly of the Lyons college, that he named it the "Royal Veterinary School," in 1764.

In 1765, the veterinary school at Alfort, a suburb of Paris, was founded by the French government, and Bourgelat was called from Lyons to assume the directorship of the new institution.

We have not time to refer at length to the history of the continental veterinary schools. What information I have on the subject has been gleaned from Dr. Billings' "Relation of Animal Diseases to the Public Health," and I shall refer to them as briefly as possible.

France, as I have said, was first to found veterinary schools They were under control of the government from the start, and remain so up to the present day. In 1777, the French government published strict rules for the management of its veterinary schools, and they have since undergone but few modifications. The other veterinary schools of Europe were founded by the various governments (except Great Britain), because they recognized the importance of having educated veterinarians to call upon in case of an outbreak of any of the contagious animal plagues.

To France we must credit two more veterinary schools, — one at Turin, Italy, founded by Napoleon I., during the extension of his empire, and another founded at Toulouse, in 1825.

The early directors and professors of the other similar institutions on the Continent were educated in France at the expense of their governments, and upon returning home, after completing their education, took charge of new schools for the instruction of their fellow countrymen.

The Veterinary Institute at Vienna, Austria, was one of the earliest schools founded after the one at Lyons. It dates from 1767. Its first two teachers studied at Lyons, one being an Italian. Later two Austrians visited Alfort as students, and on their return in 1777, the school was improved and modified by them, and is still in existence.

A royal Danish veterinary college was founded at Copenhagen in 1773, and reorganized in 1858. Belgium organized a veterinary school at Brussels in 1835. The Russian government supports three schools for the study of veterinary medicine. Sweden founded a veterinary institution in 1774, its first director having been educated in France, chiefly at the Lyons school.

During the latter part of the last century veterinary schools were established by the various principalities and kingdoms which now constitute the German Empire. The German veterinary schools are located at Stuttgart, Hanover, Munich, Dresden and Berlin.

The course at the leading schools on the Continent, I believe, is four years, with a preliminary examination sufficient to prove that the applicant has a good common school education. England, I am sorry to say, with the best horses, cattle, sheep and swine in the world, did not follow the example set by her neighbors across the Channel. The Royal Veterinary College was established in London in 1792, by a Frenchman named Saint Bell. It had no governmental encouragement and support, but has always existed on the receipts of its hospital and the fees of the students.

The other veterinary schools of Great Britain are in Scotland, — one in Glasgow, the other two in Edinburgh.

One of the Edinburgh colleges was founded by the late Prof. Dick, who left it money when he died. The other, known as the New Veterinary College, is managed by Prof. W. Williams, who founded it a few years ago.

The graduates of this profession in Great Britain are practitioners of veterinary medicine, but not veterinarians in the broader sense, as they are on the Continent. Many of them have large practices, and some have even made fortunes in private practice, but I do think that their field of usefulness is restricted by their not occupying more important positions as guardians of the public health.

The course of study at the Continental schools is four years, and instruction is given both in the general practice of veterinary medicine and inspection of slaughter-houses, and other veterinary sanitary regulations as well, besides training the students to original scientific research.

In the English schools the course of study occupies three years, and is almost entirely practical.

In the United States and Canada we have a number of colleges for the study of veterinary medicine. They have no uniform standard of education. Like our medical schools, they range from diploma mills—striving to turn out as many graduates as possible regardless of fitness and education — to institutions that are endeavoring to raise the standard of the profession and accomplish useful, honest results.

Our American veterinary colleges, like those of Great Britain, are the results of private enterprise, and depend on the tuition fees of their students and the proceeds of their hospitals for the means of carrying on their good work, or, possibly, in a few instances, evil.

The veterinary department of the University of Pennsylvania is an exception to the rule, and has an endowment fund, I think, of about $20,000. As it has the confidence of the public, I have no doubt this fund will be increased in course of time.

I will refrain from giving a detailed account of our veterinary institutions, as I confess to having prejudices in favor of some and against others, that might lead me to say more than I care to, concerning them.

In this country it has not been customary for the General Government to aid or manage educational institutions of the higher order, excepting our agricultural and industrial colleges, but our universities and classical colleges have been richly endowed by wealthy friends. It is to be hoped that at no distant day individuals with large means may recognize the fact that the sciences are no less important than Latin and Greek, and that before long our agricultural colleges and veterinary schools will receive a liberal share of the donations and bequests which now fall to the lot of our classical institutions. Let us also hope that our General and State Governments will give veterinary subjects that encouragement and recognition they deserve.

As I have already remarked, the course of study at the Continental veterinary schools is four years; at those in Great Britain three years (it was but two years until quite recently), and here two or three years. Two years is too short a time for the study of veterinary medicine. Much of the knowledge acquired during a short term is obtained by what students call "cramming"; that is, hard, continuous study, whereas we know that the mind assimilates what it gets better if more time is taken to digest its food.

Three years is a better course than two, and four years is preferable to either; still, a student's success depends largely on himself, and he should always bear in mind that his college training is only a preliminary education, and that an enthusiast in any profession or field of research is in reality a life-long student.

Our American veterinary schools educate their pupils with a view to making their livelihood as private practitioners after graduating; but Yankees are always ready to grasp an idea, and emergencies develop men for new situations. Consequently, we find graduates of our veterinary colleges occupying positions on the National Bureau of Animal Industry, as State veterinarians and members of boards of health, filling them as creditably as in any other country. When I say that they fill these positions as creditably as in any other country, I do not mean that they do as good work in all cases as veterinarians in Germany and France; but if they do not, it is because of the inadequacy of proper legislation and the insufficiency of funds placed at their disposal, to always carry out the most effective work.

Germany has probably the most thoroughly organized veterinary sanitary police system of any nation in the world, both for the suppression of contagious disease among animals and the protection of the health of the people, by a system of meat inspection, all supervised by competent veterinarians, aided by the police and, if the emergency requires it, by the military. For the suppression of contagious animal diseases, the Minister of Agriculture — (not commissioner; they recognize the importance of agriculture, both in Germany and France, sufficiently to make the position a cabinet one, and do not make it a "Secretary of Agriculture and Labor" either) — is at the head of affairs, assisted by able veterinary and legal counsel. The country is divided into departments, each having a department veterinarian, and each department is divided into districts, each having a district veterinarian. In the event of an outbreak of contagious animal disease, the police, or other local officials, are to report it at once to the district veterinarian, and he reports at headquarters.

In local outbreaks, the police carry out the orders of the veterinary officials in regard to slaughtering and quarantining infected herds and animals. In more extended outbreaks the military may be called on for similar duty. This quarantine not only applies to diseased and susceptible animals, but in outbreaks of rinderpest, for example, may include men, raw animal products and, as far as possible, every living thing. A dog or cat trying to cross the line is instantly shot. Railroad trains even are not allowed to stop at stations in infected districts. Such iron-bound regulations as these might clash with our ideas of personal liberty; but when we view them at a safe distance, we cannot deny their wisdom. Department and district veterinarians are appointed from general practitioners, and they practice their profession when governmental duties do not call upon them. Besides the officials, there are a number known as "frontier veterinarians," whose duty it is to protect the country from the invasion of animal plagues. This is their sole employment. For this they get a salary, and in case of need carry out any regulations necessary to protect animals of the Empire from attacks from abroad. As a protection to the public health, veterinarians are employed at all the large abattoirs to examine the meat of animals killed for food, the flesh of pigs with trichinæ, measley beef and pork, and the meat of animals badly diseased with tuberculosis is all condemned, and sent to the renderers as unfit for human consumption. Beef which is slightly tuberculous is marked in such a way that it is sold as an inferior article at a low price, to be thoroughly cooked before eaten. These regulations governing the inspection of meat are more important in Germany than among ourselves, because the people there consume large quantities of ham and sausage without any cooking whatever; while we, on the contrary, generally subject our meat to the influence of sufficient heat to destroy disease germs and parasites.

Careful records are kept at these slaughter-houses of the number of animals destroyed, the number diseased, what the disease was, and the age of the diseased beast, making a valuable addition to the statistics of the country. In Germany, no one can practice veterinary medicine unless a graduate of one of the German schools, under a severe penalty. In France, as in Germany, the veterinary schools and veterinary sanitary regulations are in charge of the Minister of Agriculture, and are in many respects similar.

In the former country much has been accomplished in preventing many of the contagious animal diseases by protective inoculation. The credit of this work belongs to M. Louis Pasteur, the greatest scientist in this particular line that the world has as yet seen. Although a chemist by education, his work is so closely connected with the value of the veterinarian and the medical man to the people, that it would, I think, be interesting to review, briefly, his career and some of his methods, before proceeding.

Pasteur and his work is a subject on which a small volume might easily be written, but we have time to devote only a few words to him and to what he has done.

Louis Pasteur was born about sixty-five years ago, and was educated as a chemist; in 1854 he was appointed professor of chemistry at Strasburg, and soon after was made "Dean of the Faculty of Sciences," at Lille. During his investigations and experiments, his attention was called to microscopic forms of life seen in connection with certain chemical changes. Some of these fungi had been observed before, but they had been supposed to retard the chemical changes rather than to assist them, and it was thought that these changes were due to the action of oxygen. Pasteur was the first to find out that very many of these chemical changes were due to the presence of these organisms, and could not take place without them. He demonstrated that the formation of alcohol was due to the presence of the yeast plant. Soon after he discovered the bacterium of the lactic acid ferment, and the acetic acid ferment; the acetic acid ferment being what we know as the "mother of vinegar." He also investigated other similar ferments, which we have not time to mention. Pasteur thus gradually became a biologist, instead of a chemist, and his time was henceforth to be devoted to the study of the lower forms of vegetable life, especially those which are now believed to be the causes of various contagious diseases of animals and man, and popularly known as "disease germs."

Pasteur's first work in the field of animal plagues, if you will allow me to speak of a worm as an animal, was his investigation of the silk-worm disease, which had almost destroyed the silk industry of France. He occupied himself with these researches from 1865 to 1869, when he brought his labors to a successful termination, and restored to his country what might be called a lost industry. He found that the moths suffered from a disease due to a microscopic organism, and that this disorder was transmitted from the female moths to the eggs, being both hereditary and contagious. If the female moth was pounded up in a mortar after death, and the debris examined microscopically, it could be ascertained whether she was diseased or not. By keeping each female with the eggs which she laid, he could tell from the health of the moths whether her eggs were healthy or not. If the moth was diseased, her eggs were burned; if she was healthy the eggs were allowed to hatch, and thus a healthy supply of worms was assured.

After completing his investigations of the silk-worm trouble, he turned his attention to contagious animal diseases, experimenting, at first, with anthrax and fowl cholera. He found that these maladies were due to germs, which, in certain media, could be cultivated outside the animal body, and when a creature was inoculated with a small quantity of the artificially cultivated bacteria, the disease was reproduced. He discovered, also, that in some instances the virility of the bacteria was increased, and that, under other conditions, it was decreased, and thus the disease could be induced in a severer or milder form at will, and these experiments finally led to one of the discoveries of the age, viz.: The protective inoculation of animals or man against contagious disorders, by means of the use of an attenuated virus. Bacteria, in order to live, require a certain amount of heat and moisture, a suitable food, and either the presence or absence of oxygen, and Pasteur discovered that, by growing them at a greater heat than that of the temperature of the animals they attacked, or by allowing them an abundance of air, or by drying them, that their virulency might be decreased. He has, also, found that the intensity of the virus of some diseases can be increased by inoculating them upon certain species of animals, and diminished by carrying a series of inoculations through other species. For example, the virulence of rabies is increased by inoculating rabbits from mad dogs, and carrying the disease through a series of rabbits, while by inoculating apes in the same way it was lessened.

The idea occurred to Pasteur, that if an animal having recovered from a contagious disease acquires immunity from it, why should it not be possible to inoculate an animal with an attenuated virus, which would not give the disorder, but at the same time confer immunity upon it? His first attenuated virus was that of chicken cholera. The vitality of the germs of this plague he found could be lessened by simply cultivating artificially and allowing them plenty of oxygen. The fowls were first inoculated with a very mild virus, and in a few days a stronger one was used, and these two inoculations were sufficient to protect poultry from the ravages of chicken cholera. He then undertook to attenuate the bacilli of anthrax, and found that this could be done by cultivating them at a higher temperature than that of the animal body, and in 1881 astonished the scientific world by proving the efficacy of his vaccine for anthrax.

Pasteur has also prepared a vaccine for rouget, a disease of the pig, resembling our hog cholera, but not identical with it. About two years ago he announced the discovery, which has interested the world more than any of his previous ones (although it is not as important to agriculturists as much of his former work), that he could protect persons from rabies, after they had been bitten by a rabid animal, by means of a series of inoculations, beginning with a very mild virus and ending with a strong one.

This virus was made by hanging the medulla and part of the spinal cord of a rabbit just dead of rabies in a perfectly dry jar for a certain number of days, and then beating it up in a mortar with a little distilled water and a little veal broth, and inoculating with a hypodermic syringe. A cord dried for fourteen or fifteen days was first used, followed by a fresher one for ten days, until a perfectly fresh one was used, and the patient's life was thus saved, — provided the inoculations were commenced soon after receiving the original wound.

A man like Pasteur is of incalculable benefit to his day and generation. Few have done more to advance the physical well-being of the world than this man, that our great nineteenth century has shown. We cannot all be geniuses, but we can all aim to do our best work for the improvement of our fellow-man and of the lower creation.

Inoculation is not altogether a new idea, for it was used to produce a mild form of small-pox before Jenner introduced vaccination, and has been known to the Chinese for hundreds of years.

There is a disease of young cattle, formerly supposed to be an anthrax, — now known as symptomatic anthrax scientifically, and commonly as "black leg" and "black quarter," — in which French veterinarians have successfully employed inoculation to protect the young creatures which are susceptible to its attacks. Inoculation has been tried with contagious pleuro-pneumonia and rinderpest; but the wisdom of resorting to it in these diseases is questionable, as it seems wiser to stamp them out than to perpetuate them.

In England the regulation of contagious animal diseases has been left to the Privy Council by Act of Parliament. They can issue the necessary orders for suppression in case of outbreak among the live stock of the kingdom, and these orders are carried out by their officers and the police. The veterinary department of the Privy Council was not organized until 1865, when rinderpest threatened the cattle of Great Britain with destruction. It was decided that "stamping out" was the most effectual way of dealing with the pest. By stamping out a contagious disease is meant the slaughter of infected and exposed animals, and is the most effectual way of dealing with rinderpest and contagious pleuro-pneumonia. When this means is resorted to the work should be thorough, and the owners should be reimbursed by the government for the loss they sustain.

Rinderpest was brought to England in 1865 (there had been outbreaks in the last century, but the disease had disappeared) and raged for two years. It was eradicated in 1867. Since that time there have been a few outbreaks, the result of importing diseased cattle, but they were speedily suppressed, as the regulations bearing on the disease are very efficient. The affected and exposed animals are killed and buried in an out-of-the-way place,— or, better still, burned,— stables disinfected and kept empty for awhile, and this ends the trouble.

Dr. Fleming, in his "Veterinary Science and Police," estimates the loss from rinderpest in Great Britain between 1865 and 1867, at eight million pounds sterling.

Contagious pleuro-pneumonia and foot-and-mouth disease have both existed in England since 1839, and have occasioned almost incalculable losses. If the government would awake to the importance of checking these disorders, as they did rinderpest, they might have been free from them years ago.

In England they have veterinary inspectors at the ports to examine cattle from abroad upon arrival. Cattle from certain countries can be landed only for immediate slaughter. I believe the United States is on the proscribed list now, on account of contagious pleuro-pneumonia.

In England but little has been done by veterinarians towards advancing the scientific side of their profession. Their education and ideas seem to be entirely practical, and scientific research into contagious animal diseases has been delegated to medical men, such as Klein and Burden Sanderson.

The value of veterinary science is certainly appreciated in one way in Great Britain. That is, in the recognition of the usefulness of the veterinarian by the large agricultural societies. At the Royal Agricultural Society's Show, Smithfield Fat Cattle Fair and the Cart Horse Exhibition, the veterinary officer is an important individual. All animals, even pigs, are examined for their ages. An animal whose mouth indicates it to be older than the class for which it is entered, is disqualified. The veterinarian does not say that it is such and such an age, but simply that its mouth indicates a certain age. That is enough; the creature cannot compete for a prize. Horses are examined for soundness by the veterinarian, and, if unsound, cannot compete for premiums. Cattle, sheep and swine are examined before entering the grounds, and if found to have foot-and-mouth disease, or any other contagious disorder, they are not admitted. This is quite a contrast to most of the "cattle shows" in this country, where unsound horses obtain prizes over sound ones, and animals may be entered in a class with younger ones as of the same age, and receive premiums on account of their superior size, and no one any the wiser. Fortunately, we have as yet little to fear at our animal fairs from contagion, but the day is not far distant when greater precautions must be taken. Besides these duties, the veterinarian of an agricultural society, when at an exhibition, should prescribe for any sick creature, if the owner wishes it, free of expense to him, the veterinarian receiving his remuneration from the treasury of the society.

The Fat Stock Show at Chicago has employed a veterinarian for several years during the exhibition; as has also the New York State Agricultural Society. Aside from these two, I do not know that agricultural societies have employed veterinarians; certainly not in New England, until last year, when I was elected veterinary surgeon to the Bay State Society. At the show this society held in Boston a year ago last October, I found plenty of work in attending to the health of the animals, although no critical examination of age and soundness was required as abroad.

Last spring there was a show in New York City of dairy cattle and dairy products, of which President Burnett, of the State Agricultural Society, was president. Dr. Coates of New York acted as chief veterinarian, and I was in the capacity of assistant; besides, Dr. Rose, of the Bureau of Animal Industry, was present. There we were obliged to inspect all the cattle carefully as they arrived, in order to guard against contagious pleuro-pneumonia, and take every precaution for their health during the exhibition, and their removal afterwards; but this was in the neighborhood of contagious pleuro-pneumonia, and cattle came also from localities where the disease existed; consequently, we surrounded our valuable charges with every possible safeguard.

On the Continent many veterinarians rank with the medical men as scientists. Prof. Bouley, a French veterinary surgeon, was president of the Academy of Sciences in Paris, at the time of his death, two years ago. When the French government appointed a commission of scientists to investigate Asiatic cholera, Prof. Nocard, of the Alfort Veterinary School, was among the number. Last year a commission of medical men was sent to Paris by the English government to investigate Pasteur's method of inoculation to prevent hydrophobia. Among them was Dr. Fleming, chief veterinarian of the English army.

In Germany, veterinarians oftentimes rank with the leading medical men as scientists. On the Continent they are always among the delegates to the international medical congresses, but I am unaware of a veterinary surgeon in

England or this country being elected to serve in such a capacity. This, however, may be largely due to the fact that English and American veterinarians do not receive as thorough an education in comparative and sanitary medicine as their Continental brethren, but doubtless they will receive such recognition when they deserve it.

Having glanced at the value of veterinary science to the State on the Continent and in England, and noted the appreciation it there receives, it remains to be considered what work the veterinary profession has done in this country, and how it has developed within a very few years.

The first successful work of importance in America was the stamping out of contagious pleuro-pneumonia in Massachusetts, by the Massachusetts Cattle Commission,—the first cattle commission being appointed by Gov. Banks, in 1860; all other cattle commissions, State veterinarians, and the Bureau of Animal Industry, being later creations.

The value of veterinary knowledge and the propriety of prompt action were well exemplified in the outbreak of contagious pleuro-pneumonia in this State in 1859, the malady landing May 23 of that year, in Boston, with three cows and a heifer imported from Holland by Mr. W. W. Chenery of Belmont. Two died soon after landing, and a third was taken sick soon after arriving at Belmont. Before the disease was recognized, three calves were sold from Mr. Chenery's farm, to go to North Bookfield, and thus the disease spread. In the spring of 1860 it had assumed such alarming proportions that legislative interference was called for, and after some delay Gov. Banks appointed the first Massachusetts Cattle Commission, consisting of Paoli Lathrop, Amasa Walker and Dr. G. B. Loring, and an appropriation of $10,000 was granted for wiping out the disease. The plague still continued to spread to such an extent that an extra session of the Legislature was called for May 30, 1860, and the commission was enlarged to five members, and a medical board established to co-operate with the commission and investigate more fully the nature of the disorder.

The additional members of the Cattle Commission were Cyrus Knox of Palmer and E. G. Morton of Fairhaven. The Medical Board consisted of two medical men, Drs.

Oramel Martin and Calvin Ellis, and one veterinarian, Dr. J. H. Stickney, then a young man recently returned from his studies abroad. This Medical Board wrote a report on the nature of the disease, and in it recommended that the United States Government establish quarantine stations for imported cattle at the principal Eastern ports. This suggestion was carried out about twenty years later, and the cattle quarantine stations, now under the charge of the Bureau of Animal Industry, established.

To Dr. Thayer belongs largely the credit of eradicating pleuro-pneumonia in Massachusetts. He was one of the old-time veterinary practitioners; not a graduate of a veterinary school, but self-educated, — a man who had read and observed a great deal, and had read and heard of the contagious lung plague of cattle, and recognized it when he saw it, and urged the importance of exterminating it as the only effectual means of getting rid of it.

In 1861 little was done towards the extirpation of contagious pleuro-pneumonia. In 1862, James Ritchie, E. F. Thayer and Henry L. Sabin constituted the Board of Cattle Commissioners, and Dr. Thayer was prominently identified with it for a number of years thereafter. The Cattle Commissioners, in their annual report for 1865, the commission then being Dr. Thayer and Mr. C. P. Preston of Danvers, congratulate the State on the "eradication of one of the worst forms of contagious disease which has been found among cattle."

Stamping out contagious pleuro-pneumonia cost the State about $67,500, besides which various towns where it appeared expended about $10,000, making a total of $77,500. If it had been allowed to run on unchecked until the present time, there is no estimating what the loss to this State might have been, to say nothing of the damage that it might have inflicted upon sister States.

We have all read of the Pharisee and publican who went up into the Temple to pray, and know that a man should not take too much sanctity to himself, yet I cannot help feeling that if the States of New York and New Jersey had done their duty as nobly and bravely as the Old Bay State, and put their hands in their pockets to pay for the slaughter of diseased and exposed cattle, there would not be a case of contagious pleuro-pneumonia in the United States to-day.

The outbreak of lung plague in Massachusetts was not by any means the date of its first importation into the United States. It was first (according to the most reliable information to be obtained) introduced into the country in 1848 from a cow purchased by Peter Dunn, a Brooklyn milkman, from the captain of the English ship, Washington. This cow soon sickened and died. Other cattle became diseased, and the malady spread until it assumed its present vast dimensions. It was not at first recognized as contagious pleuro-pneumonia, but was called "milk sickness," and was supposed to be due to feeding cows on distillery slops, and keeping them under the worst hygienic surroundings. The disease spread through the distillery stables of Brooklyn, over Long Island to Staten Island, to New Jersey, down the coast into Maryland, the District of Columbia, and part of Virginia near Norfolk; it has also appeared in the neighborhood of Philadelphia. It remained in these localities for many years, because the traffic in cattle was always towards, and never away from, these centres. Veterinarians have constantly prophesied that it would some day get west of the Alleghanies, and that means should be taken to extirpate the disease before it was too late, and in return have been ridiculed and derided by the New York dailies as "horse doctors trying to create fat salaries for themselves by alarming the public."

The prediction of the "horse doctors" was finally fulfilled, and in 1884, contagious pleuro-pneumonia crossed the Alleghanies with a lot of grade Jersey cows picked up around Baltimore, and taken to Ohio to improve the butter industry of that State. These cows were taken to Troy, Ohio; thence the disease was carried to Dayton, Ohio, where it was checked, and to Virginia, Illinois. From Virginia it was carried to a number of towns in the State, among them Geneva. From Geneva it was conveyed to three more towns in Illinois, and also to Cynthiana, Kentucky. Later it spread also to Missouri. The Bureau of Animal Industry, with the co-operation of the authorities in the various States where it occurred, finally annihilated, — or, at least, imagined they had, until it was found to exist last year among the swill-fed cattle in the distillery stables of Chicago, having been brought there, probably, from some of the towns outside of the city, where it had ravaged a year or two before.

The last Congress appropriated $500,000 to help exterminate contagious pleuro-pneumonia by paying for diseased and exposed animals, which was to be expended under the direction of the Department of Agriculture, the work being carried out by the veterinarians connected with the Bureau of Animal Industry.

This appropriation was secured by the pressure of Western cattle owners, who realized the danger to their business, if contagious lung plague ever appeared among the cattle on the great ranges beyond the Mississippi. One of the great New York dailies called it a "steal of the horse doctors," when, in reality, the influence that secured the money came from another source; although I do not think it would have been any disgrace to the "horse doctors" if they had been the ones to procure the necessary legislation. The various States where contagious pleuro-pneumonia existed were invited to pass the necessary laws for the State authorities to co-operate with the Federal officials, and it was amusing, and at the same time melancholy, to see with what alacrity they complied, in comparison with their apathy and dilatoriness when they had no choice but putting their hands in their own pockets and paying the bills, as Massachusetts did twenty-five years ago.

The United States Department of Agriculture this year secured the services of Prof. James Law, of Cornell University, to go to Chicago and take charge of stamping out contagious pleuro-pneumonia there. He has recently reported that he has completed this work, and it is to be hoped that the disease is once more confined to the Atlantic seaboard.

There are reasons why the States should do this work without the help of the Federal Government, and also reasons why they should receive the assistance of the United States Government, but a discussion of the matter at this time would be a departure into the field of politics, and has no place here. Right or wrong, it is to be hoped that the next Congress may grant another appropriation to continue the good work (for $500,000 will not suffice), and that before many years contagious pleuro-pneumonia may be a thing of the past. If the United States Government does not do the work, I have little faith that the individual States ever will.

It is an ill wind, however, that blows nobody good, and if this plague ever reaches the range cattle, it will make beef raising profitable in New England once more.

The Bureau of Animal Industry, of which mention has been made, belongs to the United States Department of Agriculture, and, in speaking of the value of veterinary science to the State, this paper would be incomplete without some account of it.

This Bureau was established by act of Congress, May 29, 1884, and was organized the same year, with Dr. D. E. Salmon as chief, and a number of veterinarians as his assistants. He has since remained in charge, and the nation would be fully repaid for all the Bureau has cost in the work it has done in connection with contagious pleuro-pneumonia alone, even if it had done nothing more. But it has investigated other diseases as well, and the annual report of the chief makes a fair-sized volume, which is issued separately from the report of the Department of Agriculture. This Bureau also has charge of the quarantine stations for neat stock at our various seaport cities, where all neat cattle imported into the United States must remain for ninety days after landing, before being allowed to proceed to their destinations. In case of any disease lurking among them, it has ample time to develop before the cattle can carry it into a healthy locality.

These quarantine stations were established at the suggestion of the Treasury Cattle Commission, appointed to investigate contagious pleuro-pneumonia, under the Secretary of the Treasury, in 1881; but the Secretary concluded that they should properly be in charge of the Department of Agriculture, and they were transferred to it in 1884, and the Bureau of Animal Industry placed in charge, because it consisted of veterinarians.

These quarantine stations are of great value, although they are not all that could be desired. They are quite a distance from the place of landing, and the cattle being taken to them might convey disease to other animals *en route;* still, in case of an outbreak of a contagious disorder, it could be limited to a circumscribed area. This was well illustrated in 1882, when some cattle landed at Portland, Maine, were attacked with foot and mouth disease, after reaching the quarantine station. They were driven there over the public highway, a distance of about three miles. A yoke of oxen soon after passing over the same road contracted the ailment, and conveyed it to several farmers' herds in the vicinity; but the trouble was soon ended by the Maine authorities quarantining the infected herds and disinfecting the premises after the cattle recovered.

The Treasury Cattle Commission issued a very good report on contagious pleuro-pneumonia in 1882. This commission consisted of Dr. E. F. Thayer, Prof. James Law and Mr. J. H. Sanders of Chicago, and accomplished some very good work.

Before the establishment of the Bureau of Animal Industry, the Department of Agriculture had employed veterinarians from time to time to investigate and report on contagious animal diseases.

Having spoken of the value placed upon veterinary science by the General Government, let us see how different States and Territories have recognized its usefulness. The appointment of State veterinarians by various States and Territories dates back but a few years, the continual increase of their herds in numbers and value, and the greater danger from contagious animal disorders each year, demanding it.

Wyoming was the first to have its governor appoint a Territorial veterinarian. Dr. J. D. Hopkins of New York was given the position in 1882, and has occupied it ever since. That his services have been appreciated by the people is amply proved by the fact that his salary, at first $2,500 a year, was doubled two or three years later. That is, he is worth as much to the State out there as a governor is to Massachusetts.

Wyoming's example has been followed by a number of her sister States and Territories, until many of them have veterinarians, and some employ two or three.

Nebraska has a regular State veterinarian, Dr. Julius Gerth, and also enjoys the services of Dr. F. S. Billings, as an investigator of hog cholera and Texas fever, assisted by Dr. Thomas Bowhill.

Illinois is armed and equipped with a cattle commission, consisting of three of the laity, as well as a chief, and an assistant State veterinarian. The balance of New England has followed the example of Massachusetts, in having cattle commissions, with the exception, I think, of Rhode Island. Maine has five cattle commissioners, one of whom, Dr. Bailey, is a veterinary surgeon. New Hampshire has a Board of three; Vermont of three; Massachusetts of three; one, Dr. Winchester, being a veterinarian; Connecticut has also three. These Boards can employ veterinarians, however, if the public service require.

Massachusetts allows the Cattle Commissioners five dollars a day each and expenses when on duty, but they are not on duty continually, some years doing much work, and other years but little, as the exigencies require. Five dollars a day is a small amount to pay men who are liable to be called upon at any time, no matter how inconvenient for them to leave their business. This is especially true in the veterinarian's case, who may be summoned at a busy time, when he may have valuable patients to attend. The propriety of having a State veterinarian to investigate outbreaks of real or supposed contagious disease among the live stock of the Commonwealth has often occurred to me. One who should be continually on duty, with headquarters in Boston, and a clerk in attendance when he is not there, to inform enquirers as to his whereabouts and time of return. The Board of Cattle Commissioners might be retained to co-operate with him in case it became necessary to stamp out an extensive outbreak of any contagious malady. By keeping careful records of what he did he might compile a very useful and valuable mass of information relating to animal diseases and the public health, and devise means for the better protection of our live stock from infectious disorders; besides increasing our knowledge of some diseases not yet thoroughly understood. Our Cattle Commissioners have extraordinary powers, surpassed only by such men as the Czar of Russia and Emperor of Germany. They should not have the slightest regard for public opinion when it conflicts with their knowledge, and must carry out their duties, no matter how unpleasant, in the most conscientious manner. Other States and Territories to employ State veterinarians are New York, Kansas, Missouri, Pennsylvania, New Jersey, Minnesota, Iowa, South Carolina, Montana, Arizona, and possibly others which I have not on my list.

Although we have not all the animal plagues of the old world to contend with, yet we have plenty of work in this country to-day for the educated veterinarian; contagious pleuro-pneumonia, glanders, rabies, hog cholera, contagious abortion among cows, Texas cattle fever, sheep scab, some forms of anthrax, dourine and tuberculosis are some of the diseases that form an ample field in which he can demonstrate his usefulness to the State, if the State will only give him an opportunity to do so. Of these diseases, the two last named require a special word of mention.

"El Dourine," as it is called by the Arabs, or "Maladie du Coit," as the French call it, is an equine venereal disease found in France and among Arabian horses. It was imported to this country from France a couple of years ago, in an importation of Percherons, taken to Illinois, and now several stallions and quite a number of mares are suffering with this malady. The State authorities have quarantined the animals diseased, and it is to be hoped that prompt measures may be taken for its eradication. This outbreak is only the fulfilment of a prophecy made years ago by veterinarians, that dourine would be imported into the United States unless means were taken to prevent it, by a proper inspection, and, if necessary, quarantine of horses from infected countries by the Federal authorities. This inspection should be made by a competent veterinarian at the place of landing.

Tuberculosis, the second one of the two last mentioned diseases, is the same malady as is commonly known as consumption. It is identical in animals and man, is due to a germ, the bacillus tuberculosis, and is both hereditary and infectious. It is only within a few years that its infectiousness has been accepted by medical men and veterinarians, and many of the older doctors will not yet acknowledge that this is the case. Whether the milk and flesh of tuberculous cows are dangerous as articles of food is a grave question; very rare beef from tuberculous animals is probably injurious; if thoroughly cooked, I do not think it is. How much the milk from tuberculous cows has to do with many infantile disorders is another subject to be investigated.

This disease is one of vital interest to us all, as it causes 10 per cent., at least, of the human deaths. It is frequent among the milch cows of Eastern Massachusetts, and is scattered more or less all over the State. Furthermore, it is gradually increasing. Although there are no statistics regarding it, I am satisfied, from all I can learn, that it is more common now than it was twenty-five years ago. A farmer may own a perfectly healthy herd, and introduce a tuberculous cow without suspecting that she is diseased; she will communicate the trouble to other cattle, and the owner some day discovers that he has a tuberculous herd; it may not be until two or three years after the purchase of the cow which introduced the ailment, so subtle and insidious is it in making its appearance. More than this, he may sell diseased animals (often not knowing that they are affected) into healthy herds and thus disseminate it far and wide.

I wish that our farmers would raise more stock, where they are sure that they have perfectly healthy animals, for I know of nothing that spreads disease more than constantly buying and selling cows. Breed from sound, healthy parents on the side of both sire and dam.

In speaking of the unrestricted traffic in live stock, I wish to say a word about cars. Animals are carried from one end of the country to another, the empty cars go back for more, and are seldom, if ever, cleaned beyond scraping the floors a little; these trains sometimes carry diseased animals, and oftentimes outbreaks of hog cholera, Texas cattle fever, strangles and glanders in horses, and similar diseases, might be traced to them. There should be a State law, and it should be enforced, requiring the thorough cleansing and disinfection of stock cars and boats, after conveying creatures to their destination, before allowing them to depart.

Some of our contagious animal distempers, such as hog cholera, and anthrax especially, might be better controlled if some veterinary scientist could prepare an attenuated virus, such as Pasteur has so successfully used in France. I have no doubt of the discovery and application of such viruses at some future day.

Before concluding, I wish to speak of three other spheres of usefulness for the veterinarian. The first is the appointment of veterinary surgeons to boards of health. There are so many diseases common to animals and man that come under the jurisdiction of these boards, that it seems as if a properly educated veterinarian's services would be most valuable. New York, Brooklyn, and Jersey City, each have a veterinarian on its board of health, and it is to be hoped that other large cities will soon follow their example.

Another field for veterinary science is the inspection of meat. This is done upon the Continent, but has not been attempted, to any extent scientifically, either in this country or in England.

The third field of usefulness is one which is of little importance to farmers, but I see no harm in mentioning it here. That is, the recognition the veterinarian receives in the army, both abroad and in the United States. In all the European countries of importance the army veterinary surgeon ranks as a commissioned officer; he must be an educated man in order to be in the army, and enters on much the same footing as young medical men, and associates with other officers on an equality with them; he is promoted from time to time, as age or merit demands, and retires with a suitable pension when old age approaches. The chief veterinary surgeon in the English Army ranks as colonel, and those under him descend through the various grades to the second lieutenant. The United States is the only civilized country of its size where the army veterinarian does not rank as a commissioned officer. He is a sort of nondescript, neither an officer or a soldier; but it is to be hoped that this state of affairs may be changed ere many years, and that the veterinarians of our army may rank with those of other civilized countries in education, position and pay.

The CHAIRMAN. There is a little time for the discussion of this very important subject. If gentlemen have questions to ask the doctor, now is their best opportunity.

Mr. HAZEN. I would like to ask the speaker if it is not only possible, but very probable, that we have many cases of tubercular disease that are pleuro-pneumonia?

Dr. PETERS. Tuberculosis is of the nature of consumption. Tuberculous consumption is the same as tuberculosis. We call it "consumption" because the person wastes away. But the contagious pleuro-pneumonia is a distinct disease from tuberculosis.

Mr. HAZEN. Is not contagious tuberculosis often taken for the contagious pleuro-pneumonia?

Dr. PETERS. It is, sometimes.

Mr. HAZEN. Has it not been so taken in Vermont the past year, to a great extent?

Dr. PETERS. Up in Vermont they had a sort of an epidemic of pneumonia among the young stock this last summer. That was not the contagious pleuro-pneumonia; it was not tuberculosis; it was just like ordinary lung fever, only it existed among quite a number of young cattle. I know they had it in Vermont and in New Hampshire. At the request of the Vermont and New Hampshire Cattle Commissioners I visited those States last summer to investigate the outbreaks of this disease, which they were afraid might be the contagious pleuro-pneumonia, though it was not. It was this epidemic pneumonia among young cattle.

QUESTION. What would be the symptoms of that disease?

Dr. PETERS. The animals are feverish, breathe fast, are dull and stupid, and generally isolate themselves from the well cattle, — go off in one corner of the pasture by themselves and remain there. I do not know that any treatment was adopted last summer. They only noticed that the cattle were sick and they either died or got well. Some got well and some died.

QUESTION. The trouble was in the lungs?

Dr. PETERS. The trouble was in the lungs.

QUESTION. What would be the condition of the lungs?

Dr. PETERS. The lungs were congested. If you opened an animal the lungs, if they were not firm and normal, would not sink to the bottom of a pail of water, as a solid lung would, and they would draw more water than a healthy lung. They looked redder and the little tubes were filled with mucus, showing that there was some inflammation there.

QUESTION. Would not the symptoms be, to an unpractised eye, identical with the symptoms of pleuro-pneumonia?

DR. PETERS. Yes, sir, they might be, to the unpractised eye. The symptoms of a cow in the last stages of tuberculosis might be the same.

QUESTION. The pneumonia would not be contagious, as I understand it?

DR. PETERS. I think that the form of pneumonia which prevailed last summer was contagious from the way it acted. If it was not contagious, it was all due to the same cause. It prevailed among a good many cattle over certain sections of country up in southwest New Hampshire, and across the river, up through Rutland, Vermont. I believe the Vermont Commissioners took action up there and killed and paid for some of the animals; but there was no need of it.

QUESTION. Can you give us any light upon abortion in cows? I have been troubled with it this season myself and in some seasons previously.

DR. PETERS. I have not a great deal of light to shed on it, yet I am in hopes to be able some day to prepare a special paper upon it.

QUESTION. Is that contagious?

DR. PETERS. Yes, I think it is.

QUESTION. What would you do if you had thirty cows and one aborted?

DR. PETERS. I would isolate her just as quick as I could; put her in another barn and disinfect the place where she stood.

QUESTION. How long would you keep her isolated?

DR. PETERS. Oh, four to six months.

QUESTION. Is a cow that has aborted likely to do so another year?

DR. PETERS. They seem to vary in different herds. In some herds you will find that they only abort once and then recover and you do not have any more trouble with them.

In fact, I think cows in certain barns where they have that sort of abortion are worth a little more after they have aborted and gotten over it than they were before, because we feel a little surer of them. But in some cases they are apt to abort a second time and sometimes a third; in other cases they become sterile. It varies considerably. I have seen it act differently on different farms.

QUESTION. After a cow aborts a second time and then bears a calf, do you feel assured that she will never abort again?

Dr. PETERS. I do not think it is always so, but it is apt to be so. In a majority of cases it is so, but we cannot lay down any hard-and-fast rule for it.

QUESTION. What are the symptoms of abortion in cows?

Dr. PETERS. Generally you do not get very many symptoms. They generally abort the first thing you know. They may show some slight symptoms beforehand. I have heard of people checking it in some cases. I met a farmer from Vermont last summer, who had used the fluid extract of buckthorn, and he said he had had a good deal of success. If the calf is going to be born prematurely you can sometimes stop the cow from aborting by giving her some such medicine, but generally you cannot.

Mr. HAZEN. Excuse me for suggesting the idea, but I think there are always premonitory symptoms, if you watch the cows closely enough.

Dr. PETERS. I think there are for a day or two. I have heard farmers say that they could tell from a week to a fortnight beforehand.

Mr. HAZEN. Those symptoms are the same that a cow manifests in calving naturally.

Mr. DOUGLAS. I would like to ask the speaker, or any other gentleman present, if he can give me any information in regard to calves that come into the world apparently all right and seem to be smart and bright for two or three days, and then for some reason or other droop and die, in spite of all that we have been able to do for them.

Dr. PETERS. I have heard complaints of that kind, but I have not had a chance to see many cases of that sort. What are the symptoms generally?

Mr. DOUGLAS. They seem to take no interest in life and then get sick of it altogether.

Dr. PETERS. I think in such cases a stimulant is as good as anything.

Mr. JOHN M. SMITH of Sunderland. Perhaps I can give the gentleman a little light from my own experience. The only remedy which I can suggest is one that I have tried over and over again and always do where calves are born in the barn; I never knew such an instance where a calf is dropped in the field. Where a calf is dropped in the barn it is almost immediately tied up and allowed to have but very little milk. Overloading the stomach is, in my opinion, the cause of their drooping and dying. I have had a good many calves that were apparently very healthy at first, that in twenty-four or forty-eight hours appeared to be sick, their eyes glazed over, they grew worse for forty-eight hours, and finally died. I cannot give the cause, but the remedy is what I have stated, — not to let them have access to the cow's udder. That is the course which I adopt. I tie them up almost immediately after they are dropped and they only suck at my pleasure.

Mr. DOUGLAS. The gentleman does not hit the case at all. My calves have been treated in all ways. They have been taken immediately from the cow and have been fed the milk of other cows in the same dairy, and cows of other dairies; they have also been allowed to run with the mother, and in some cases I have known almost every calf in a herd of cows to be affected in this way.

Dr. PETERS. I have had no experience in such cases, but I see Dr. Winchester and Dr. Osgood in the audience and they have both had more or less country practice, and perhaps one of them can enlighten the gentleman.

Mr. ——. I would like to ask the gentleman if he thinks apple pomace has anything to do with it?

Mr. DOUGLAS. The question is very well put, but it does not happen to apply to a herd where apple pomace is fed.

Mr. BOYCE of Sheffield. I have had a little experience with this disease, and it seemed to me that there was something contagious about it. Whenever it has attacked one calf more have been attacked. In two instances we have lost several calves each year. We have had them taken sick after they had been taken from the cows nearly a week.

QUESTION. Is there any special breed of those cows or are they native or grade cows?

Mr. BOYCE. Mine are grade Durhams.

Mr. SMITH. Mine are grade cattle of all sorts. It may be possible that there may be contagion in that matter, because we have in some years lost a good many calves; but it is rarely that we lose one if we adopt the method I have described.

QUESTION. When those calves are born, don't they have the diarrhœa?

Mr. BOYCE. No, sir, they do not have it when they are born, but they have it afterwards, if they are allowed to suck all they want to. Some individuals have said it was because I fed cotton-seed meal, — everything is laid to cotton-seed meal; but it does not make any difference. Calves that come from cows which never had any cotton-seed meal have sickened and died in the same way.

Mr. WINCHESTER. I have seen a little of this trouble and oftentimes it is associated with tuberculosis. That has been my experience with it.

Dr. LYNDE. I would like to ask Dr. Winchester if he has ever made a post-mortem examination of any of these creatures that have died in this manner?

Dr. WINCHESTER. Yes, sir, I have, quite frequently, — more than I wish I had; and we usually find some tubercles on the covering of the bowels. Then, again, we find some ulceration of the womb passages.

Dr. LYNDE. How are the lungs?

Dr. WINCHESTER. The lungs are usually right; but you will sometimes find tubercles in the young animals.

Mr. MYRICK. Can you do anything for it?

Dr. WINCHESTER. Yes, sir, a great deal. They generally die, though. [Laughter.]

Mr. WILLIAMS, of Sunderland. I had a case of that kind last spring. I bought a cow and a calf when the calf was about a month old, and it acted as if it didn't care whether it lived or died, and it did die. On opening the calf its lungs were found to be almost entirely gone. I turned the cow out to pasture. She did not do anything all summer, and I was as well satisfied that she had lung difficulty as I was that the calf had after I had seen the lungs.

Dr. Lynde. I believe that this subject of tuberculosis is one that ought to enlist the attention of all breeders of cattle, and, indeed, of every person in the community. If it is a fact that our domestic animals are suffering from tuberculosis, that we are eating the bodies of those animals, and are in danger of becoming infected with tuberculosis from eating such food, it is high time that the people should know it and that we should take care of this matter. Then, again, it is well known that milk is the natural food of the young mammalia, and if we are feeding to our young children the milk from tuberculosed animals and our young children are liable to get tuberculosis from this milk, it is a fact pregnant with importance and should command the attention of every man in the community. I believe, sir, that it is a fact that tuberculosis may be conveyed through the milk of a diseased animal to a healthy child. I think it was found at one of the public institutions in the State of New York that almost an entire herd of cattle was affected with tuberculosis. The cattle, as soon as they became diseased, were isolated, and when they died they were examined, and it was found that the disease affecting those cattle was tuberculosis. I understand that it is the opinion of some men in this State that there is not a herd of ten cattle in the eastern part of the State in which more or less of the animals are not affected with tuberculosis. If this is a fact it is one of significant importance to the people of this State. And it is further found that the cattle which we call thoroughbred, which are brought in here from abroad and are bred here, — cattle that are pampered and delicately treated and kindly cared for, — are more apt to be affected with tuberculosis than other cattle. If that is a fact, it is one to be considered by every thoughtful man who breeds cattle. One day I asked my butcher at home, who brings my meat daily, if he found any diseased cattle among those that he slaughtered, and what was his answer? He said that he found over one-fourth of the old cattle diseased in their internal viscera. On inquiring what the appearances were, he described to me the appearances on the liver, in the mesentery and in the lungs. He described to me the appearance of tuberculosis. I have no doubt that he told me the truth, for he did not know the object of my inquiry; and when he told me that one-fourth of the old cattle that he slaughtered, the meat of which he brought to our homes for our food, were affected by a disease of this kind, which undoubtedly was tuberculosis, if that is a fact, it is a serious matter to every one who consumes the meat he brings. And if this was his experience as a butcher, can it be possible that his experience is exceptional and that the other butchers of the State do not meet with a like experience? Now, it is a fact in relation to this disease that it affects old cattle, that young cattle are apparently exempt from it; but, as Dr. Winchester has told us, this fatality among young stock is due probably to tuberculosis, and I have no sort of doubt that when this subject is investigated the result will be that the cattle that are slaughtered for food will be inspected before or after being slaughtered, as they are to-day in Germany.

Mr. Myrick. Dr. Winchester said he could do a good deal for those calves; will he please tell us what he can do and what he cannot do for them? That is the point I want to bring out.

Dr. Winchester. Young calves are seldom affected with tuberculosis; but speaking, as Dr. Lynde did, of tuberculosis, I will guarantee that at least twenty-five per cent. of the herds in Eastern Massachusetts are diseased with tuberculosis.

Mr. Smith. I am unwilling to have the statement go out to the public that one-fourth of our cattle in any portion of our State have this disease. I have been conferring with our Franklin County butcher, Mr. Felton, of Greenfield, who kills 1,200 head of cattle a year, and I would like to have him state what has been his experience in regard to this disease and any other disease which beef cattle may have.

Mr. Felton. I shall need but a few moments to give you all the experience I have had. For eleven years a part of my business has been that of butchering cattle, and I have, also, as a farmer, had experience in fattening in summer a good many cattle and a few in winter. We have killed, for the last seven or eight years, an average of about twenty-five cattle a week. I have thus far confined myself almost entirely to home-dressed beef, and largely to cattle that have been fattened on the hills of Franklin County. Until within about six or seven years it had not occurred to me that there was any danger from disease, but some six or seven years ago we killed a creature which, although we did not know what the disease was at the time, I suppose was probably in an advanced stage of tuberculosis, for we found these little tubercles even on the shoulder-blade, on the fore quarters and flank, on the hind quarters, and also largely on the vitals. I went immediately to the man we bought the creature of. He came and examined the carcass. "Now," I said, "if you can do anything with that, do what you please with it; I don't propose to use it, although the loin and the leg are apparently as free from any disease as any creature." He said at once: "I don't propose to do anything with it; I don't want you should pay anything for it. If you like to boil it up for the hogs, do so; I certainly should not dare to feed it to them without boiling it." I did not boil it, but I fed it to my hogs. I do not know that I ever saw any harm from it. Since that time I have been very particular to say to my butchers, if they found anything that looked like disease or unhealthiness about the liver or the lungs, to report to me before they destroyed the liver or the lungs, that I might examine them, and sometimes, if I have any suspicion that we have a creature that may be troubled with any disease, I have made it a point to be there and see the animal dressed myself. During the last seven or eight years, we have not found more than five or six animals a year that we had any suspicion, before killing, or any proof after killing, that they were in any way affected with this disease; but occasionally we do have one. Sometimes the disease is in quite an advanced stage, sometimes only just making its appearance. It has been confined usually, as has been stated, to the older cattle; but one year ago we killed a two-year old steer that had the disease in quite an advanced stage.

That is about all that I can say. I do not know, of course, anything about the prevalence of this disease in other sections; but I can say that, in my judgment, not one creature in a hundred of those killed in Franklin County has been anything but perfectly healthy.

The CHAIRMAN. No doubt this is a wide and interesting field for discussion, and inquiries would doubtless draw out remarks which would be of great interest, but we are under the necessity of proceeding. We have another lecture this afternoon and it is full time. I have the pleasure of introducing to you Dr. GEORGE A. BOWEN, of Woodstock, Ct.

THE BUSINESS SIDE OF FARMING AND THE VALUE OF ORGANIZATION.

BY DR. GEO. AUSTIN BOWEN, WOODSTOCK, CT.

Mr. Chairman, Ladies and Gentlemen, — I am very glad to meet with the people of Massachusetts on this occasion. I was very glad when your Secretary invited me to speak on this subject, — "The Business Side of Farming." I only regretted that he had not asked some one with more eloquence than I possess to present the subject to you; but when I reflected that Shakespeare, in the play of King Richard III. puts in the mouth of Elizabeth the words, "An honest tale speaks best being plainly told," I thought I might venture to come here, because this is "an honest tale" I bring you, and I trust that, "being plainly told," it will speak well [Applause.]

The primitive agriculture of New England, rude and unscientific as it was, filled well its mission, and was fully on a level with the other great industries of the world, and in accord with the advanced thought of those times. The Old World, or that section which we so denominate, was trammeled with the traditions and bigotry of the past, which by their very nature utterly checked all civilizing influences, or greatly retarded their growth. The settlement of New England was the outgrowth of the most progressive idea of the century, and brought to these shores progressive men and women, who little dreamed that they were founding a mighty nation, the equal whereof history had no knowledge, and whose ultimate conditions are now in our hands for developing.

All national prosperity depends upon agriculture. This is a truism that none can deny: history has proved it times without number. Nations which have encouraged it have progressed in civilization, while those who have given it but little thought or attention have either lost position or existence. Our considerations to-day, infinitesimal as they will be in our ultimate agricultural history, will still have a bearing upon that magnificent future.

To fully understand the business side of farming, we must have a full knowledge of the basis of agriculture, — that is, the amount of land available, and its capacity for production: and that other equally important question, the consumption of the output. Pardon me, then, for giving you a few statistics; dry morsels to masticate, I know, but call all your national pride to your help, — it may aid in their digestion, and thereby strengthen your belief in that comprehensive word, — *business*.

A little party of men, who went out to explore the country around the Massachusetts Bay Colony, penetrated the wilderness some fifteen miles west of the present town of Lynn, but returned and settled that town, believing that beyond it the country was worthless. And the good old fathers of that day decided that there could never be a large population west of Boston's suburb, — Newton. What have we to-day? An area of 2,970,000 square miles, according to the census of 1880, with over 1,500,000 square miles of arable territory, not including Alaska: and a population of 50,000,000. A seaboard of 12,000 miles, giving us intercourse with foreign nations. The river flow east of the Rocky Mountains is about 40,000 miles, exclusive of all rivers under 100 miles in length, offering 80,000 miles of river bank to commerce, against the 17,000 of Europe, — the Mississippi and its affluents alone giving 35,000 miles. The navigable waters of the Mississippi and Missouri rivers aggregate 3,900 miles. Add to these the great lakes, which are said to contain one-half of the fresh water of the globe, and the system of canals which connect them with rivers, and we have an immense power aiding us in the development of our enormous acreage.

This subject of area, can we comprehend it? A difficult task, but let us endeavor to. At the first glance we see a vast country, stretching from the North where the snow never melts, to the far South where it never falls; its area, including Alaska, almost equalling the whole of Europe, with its twenty-two different nationalities. It is eighteen times larger than Spain; forty-one times larger than Great Britain and Ireland. Great Britain, France, Germany, Austria, Italy, Spain, Portugal, Switzerland, Scandinavia and Greece could be placed within its limits once, twice, thrice. This is simply the size of Uncle Sam's farm.

To give some idea of the capabilities of this vast farm, I quote Dr. Josiah Strong's figures as found in his volume, "Our Country." "The crops of 1879, after feeding our 50,000,000 of inhabitants, furnished more than 283,000,000 bushels of grain for export. The corn, wheat, oats, barley, rye, buckwheat and potatoes, — that is, the food crops, — were that year produced on 105,097,750 acres, or 164,215 square miles. But this is less than one-ninth of the smallest estimate of our arable lands. If, therefore, it were all brought under the plough, it would feed 450,000,000 and afford 2,554,000,000 bushels of grain for export." But this is not all. So excellent an authority as Mr. Edward Atkinson says, that where we now support 50,000,000 people, "one hundred millions could be sustained without increasing the area of a single farm or adding one to their number, by merely bringing our product up to our *average standard of reasonably good agriculture;* and then there might remain for export twice the quantity we now send abroad to feed the hungry in foreign lands." If this be true (and it will hardly be questioned by any one widely acquainted with our wasteful American farming), 1,500,000 square miles of cultivated land, less than one-half of our entire area this side of Alaska, are capable of feeding a population of 900,000,000, and of producing an excess of 5,100,000,000 bushels of grain for exportation; or, if the crops were all consumed at home, it would feed a population one-eighth larger, viz., 1,012,000,000. This corresponds very nearly with results obtained by an entirely different process from data afforded by the best scientific authority.* It need not, therefore, make a very severe draught on our credulity to say that our agricultural resources, if fully developed, would sustain a thousand million souls.

Why are these statistics at the beginning of this paper? Simply that we may have a comprehensive idea of our "stock in trade," for it is easier for us to develop the business side of agriculture by way of the nation than by the way of localities. The subject given me is a broad one. It is not how the farmer in Massachusetts can realize a higher price for his butter and eggs, his veal in the spring, and his apples in the fall. It relates to the American farmer, whatever section he may dwell in. Why should he and how can he enhance his whole condition by the application of business rules? A system must be developed whereby the cranberry grower of Cape Cod, the fruit and wheat raisers of California, the small farmer of the North, and the extensive planter of the South, may be alike benefited.

Having seen our land, our farm as it were, and studied its capability, let us glance at our farmer. In New England he is a descendant of the English Puritans, with a few from the Scotch and Welsh. The Dutch peopled New York.

Pennsylvania was settled by Quakers and Germans, Maryland by English Roman Catholics, Delaware by Dutch and Swedes, Virginia by English cavaliers, the Carolinas in part by French Huguenots, Louisiana by French, Florida, Texas and California by Spanish, Utah by Mormons, chiefly from England, Wales and Denmark. Immigration from Ireland, Germany, England and Scotland, France, Switzerland and Sweden, has been large and progressive, and now Italy is sending heavy consignments. To this conglomeration of humanity we may add a large percentage of Africans throughout the South, and a few Chinese in the West. By reason of the social and political situations in Europe, this immigration will continue with increasing proportions for at least the next few decades. This, then, is our land, and from these nationalities come our seven millions of farmers, — men inheriting different modes and methods of farming and marketing, — bringing with them from the old country many

* See Encyclopædia Britannica, vol. 1, p. 717.

national dislikes and prejudices, — many of them ignorant of the ways of business as it is carried on in commercial circles, and all living comparatively isolated lives. These are the discordant elements that must be united. The kindred ties of agriculture will not do it, any more than the tie of mercantile life will unite the trader and dealer. Business, or the organized effort to secure the almighty dollar, blends them into one body; unites and harmonizes the varied interests, and whatsoever the nationality or calling, it alike receives and gives support.

Possibly the American farmer has heretofore had but little need of business aids. The country merchant took the few articles raised for market, and gave him in return articles which his farm or household could not supply. His wants were few, and home industries mostly supplied them. But times have greatly changed and are to change yet more. Wants multiply; what were once luxuries of life are now necessities. The spirit of the times is progressive. Rapid changes are being made in all our domestic surroundings. Steam, electricity and printing have wrought a social revolution; levelling all class distinction, giving equal opportunities to all who are keen enough to grasp them. Town and country are becoming more intimately blended. The ordinary farm home of to-day is more luxurious than the dwelling of the man of wealth of a few decades ago. The farmer is no longer known by his dress. His sons and daughters acquire the same accomplishments as do those of business and professional men. The great peculiarity of these changes is, that they have all come so suddenly. With them has come a great change in the methods of business, fully as great as steam has wrought in the system of transportation, or electricity in the art of conveying intelligence. The time when the country trader was the recognized exponent of all business requirements is within the memory of us all. To-day he represents the lowest place. All the great and confusing whirl of business excitement that we witness abroad has been developed and is controlled by the expression of one word, *co-operation;* it is the life of business, — the vitality of the nation depends upon it. It is revolutionizing the world. Modes and systems heretofore considered as all sufficient have been overturned by it. Trades, manufacturing interests, transportation companies, banking and commercial circles, land improvement companies, fire and life insurance companies, and the hosts of interests that constitute the business of the country have been quick to see its advantages, and to secure them by adopting it. All but agriculture. Individuality, both of purpose and resources still characterize it. Co-operation is now the progressive idea of the times. Farmers of Massachusetts, — descendants of the Pilgrim Fathers, who were the leading representatives of the progressive idea of their day, — are you ready to accept of it, and prove the purity of your lineage; or have you lost the keenness and acumen that charactized them, and feel content to take a low position in the social scale reserved for the unsuccessful business man? The successful business man is always the one who is in the channels of business, and thereby gets his share of it. The one who is without these channels receives but a stray position now and then, insufficient for his maintenance.

Should I ask any intelligent farmer in this audience, — or in New England, for that matter, — to state the greatest drawback to Eastern agriculture, his reply would be *the want of capital*. Granted that I am right in this, let me ask, how do you, — an ambitious man and desiring to succeed in the world and give a respectable maintenance to your family, — expect to acquire it? To my mind there are only two ways, — waiting for an aged father or aunt to die and leave it to you, or to get it through the business of the farm. Unfortunately for us of the present generation, aged and wealthy parents are not numerous enough to make a class of, and the aunties who own dividend-paying stocks and bonds all have more deserving nephews elsewhere; leaving us to look to our farms as our only hope. The questions, then, that are pertinent are: Is the business of our farms bringing us in capital to-day? are we receiving gold, silver, or Uncle Sam's promissory notes for our crops, or are we trading them away at ruinously low rates for "jack boots," overalls, treacle, kerosene oil, codfish, baking soda, and the prominent soap of the day? Useful articles in themselves, but like the Chinaman's "too muchee samee alle time, but no will buy circus ticket."

As you are at present situated, will your farm enable you to become a progressive member of this progressive generation, and thus contribute your share towards keeping up New England's reputation for mental superiority? I will answer the question for you, and save you the humiliating acknowledgment. No. It is now your turn to question, and your interrogation will be: Is there a way out? Is there brightness ahead? Can the gloom that comes from financial depression be dispelled? Can the New England farmer maintain himself and his family, keeping abreast with the times, developing his material resources, and leave the farm the better for his occupancy? Unhesitatingly, I answer yes. But not by the old system of farm business; but by co-operation. In other words, by following the modern system of business. I believe in New England agriculture, and beyond that I believe in the people her soil has developed; in their perception, keenness, and good judgment, which prompts me to say that I have faith in their future actions.

Can I offer you any help by indicating how the individual farmer can enhance his prosperity by co-operation with his neighbor? Possibly. I will endeavor to; not, however, by any device or scheme of my own, new and untried. I have not the vanity or egotism to sustain me in that; but by relating to you the action that is going on in other sections, — the same as the traveller in foreign lands will describe to you the scenes he has witnessed or perhaps participated in, — for here and there co-operation has reached the farm at last, and we are not wanting in many successful examples.

Before the general farmer can begin to co-operate with his neighbor, he has a few things to learn. The old divines used to recommend an occasional self-examination as being of great good to the individual, taken from a theological standpoint. If we shift the point of observation from the theological one, with its futurity of the soul, to the material one of present business (which is not a violent action, as a person's religion depends much upon his financial relations), we shall find an examination to be equally beneficial. All farmers cannot co-operate, "they are not built that way:" but the man that cannot must drop out of existence, — there is no place for him. The world does not want him, farewell!

Requiescat in pace. But the farmer who has mingled enough with his townspeople to know that there are others in the world who know at least as much as he does, has a sufficient foundation for his business salvation. There are as good men in your town as you are; possibly better, brighter, keener, and better educated, and withal fully as honest. Therefore put away *mistrust*, which should only belong to the savage, in whose mind it is always a leading characteristic, and receive and nurture in its place *confidence*, which is the woof that holds together the web of business. He must learn the value of integrity of character, — that those who are engaged in business with him may have a confidence in return. And this little point also, — that none but honest goods should receive honest prices. He must learn that breeding has at last told upon the human race and that brain power is now more potent than brawn, and has taken the lead of it, for the successful farmers of every section, as well as those of other callings, are the brain workers. Having learned these fundamental facts, cultivate energy and activity, and learn to value time. These are the grand essentials, which, if closely followed up, will give a positiveness to a man's character that brings him to success by its own inherent force.

Two neighbors, having learned these points, can easily co-operate. The old-fashioned system of "changing work" was a good one, and can to-day be carried to other things. Expensive farm machinery can be owned in common. Stock for breeding purposes on neighboring farms need not be duplicated, but made a subject of joint ownership, thereby securing a far better animal, and lessening the expense, both of purchase and of keeping. A one-hundred dollar bull will do far more towards improving the stock of a neighborhood than two fifty dollar ones will, not to speak of the time spent in the care of an extra beast, which is considerable in the course of a year. This is practical co-operation, and here and there we find it carried out successfully. Go a step higher,— form partnerships. Some of the most successful farmers of my acquaintance have made their money in this way. Extend the system further; let it embrace the dairies of all the farms of a section; for if two can work together to an advantage, greater numbers can secure greater advantages. Carry your thoughts back to your own neighborhoods. How many churns have dashed the cream to-day? How many children have been kept at home from school to supply the motive power for them, learning to hate the farm, and at the same time are losing their education? How much of that butter made is a first-class article? The milk set at all temperatures and by many methods, creamed at all lengths of time, salted and finally marketed in all manner of ways,—the latter operation requiring many hours' time of fifty men and as many horses That butter has been produced at a great cost to each individual, and is, perhaps, worth, on an average, twenty-five cents a pound, store pay. (Oh, how it makes the boys and girls love the farm when they make a requisition on the paternal pocket-book and find only store pay!) Glance at the co-operative system. A regular method of proceeding is carried out by all in the feeding of the cows, setting the milk and creaming it. It only requires the labor of three men and a pair of horses to collect the cream, make the butter, salt, work and market it, and cleanse the utensils,—greatly lessening the cost, with a far better result in the butter yield, giving a uniform quality, that brings from three to five cents per pound more than dairy butter, which, although a strong point, is backed up by a stronger one yet, in the fact that it brings cash, a medium that we are each year forced to use more and more of. It does not require the aid of figures to prove the advantage of organization here. Then why have we not a creamery organization in every town in New England? Many of them have endeavored to establish them, but failed simply for lack of confidence; mistrust and suspicion of neighbors have been allowed to keep dollars out of the pocket. The sweet hill pastures and pure streams of New England should place her at the head of the dairy interests of the world. She will take that position yet, but not till her farmers have christianized their moral natures, as well as reformed their business habits. Her ministers can aid them more in the former by preaching good-will, fellowship and toleration while in the life, rather than Andover's scare-crow of no probation after death.

Carry this system into other branches of farm production and money will accrue in the same manner. Neighboring farmers can raise pork, beef, or special crops, or unite in the marketing of them. The apple crop of New England, which is now about one-third wasted, should be sold by organization through a fruit exchange,—as the cotton of the South is sold, or the peach crop of Delaware,—or held in cold storage at convenient points on the railroads. Farmers raise enough on their farms to all grow rich, but how few of them do it; mainly because they act as individuals in their sales, and not as organizations, as do those of other callings. Is this a showing of business management?

To look at the purchase side of the question. Every item brought to the farm is bought at the extreme retail price,—fertilizers, grain, implements, dry goods and groceries, all require it. Again, it requires no arithmetical calculation to show that could these articles be purchased in quantity they could be had at wholesale figures, as the merchant secures his. Co-operative purchasing and distributing is largely carried on in many sections by means of organization, to the great advantage of the farmer, and is a strong evidence of his business sagacity. The business of organization, if we may so term it, has been brought to a finer point yet. The wholesale dealer has not only expressed a willingness to sell to co-operative organizations at wholesale rates, but actually agrees to sell to the individual member of the association small lots at regular wholesale rates; articles need not be ordered in quantity, the trade of the organization being concentrated to this dealer brings large sales in the aggregate.

Organization not only aids the farmer to sell and purchase to more advantage, but is able to open up new outlets for farm production. The cranberry grower of Cape Cod could not afford to visit Europe to develop the market there, but the American Cranberry Growers' Association can well afford to send out one of its members and open up an immense business, and add a handsome percentage to the price now received. This course is often adopted by manufacturing associations, to their mutual advantage, by creating a demand for their goods in new sections.

But it is not in the purchase and sale of goods alone that the farmer sees the benefit of an organization. A far stronger point is in the help it gives him in maintaining his business in its integrity, and not allowing the organized efforts of others to despoil him. How can this be; can the business be wrested from his hands? Perhaps not; but it can be so crowded down by customs, by unjust legislation, by the avarice and greed of those who have no sympathy with it, by the unjust extortion of those who live by handling its productions (middle men, so called), as to render it unremunerative as a calling; and unremunerative agriculture is a national disaster. Our American farm homes, as we look at them, are perfect pictures of peace and tranquillity. They are the preservers of the ideas that have built up this republic. They have been the homes of the strong men who have guided and controlled it. They have produced the educators of the people, and to them we look for the highest examples of purity, honesty and uprightness. They are essentially American. The cities are more than one-half European. The future greatness of America will come from her farms; depress them, curtail the income, reduce the farmer in the social scale, as is his European brother, and it will in corresponding ratio reduce the country's greatness. But, on the other hand, enhance the condition of the farmer, give him comforts and the means of education, and it will show in the greatness, goodness and power of the nation. Is there a need of investigating this feature of guarding the business of farming? I answer, yes. The business of farming ought to be the best paying one in the country to-day, but it is not, and if left without guidance, it will be worse in the future. The individual farmer can do nothing to avert this; he may see the threatened danger, and exclaim against it, but will be powerless to act. Let us enumerate some of the threatened dangers, and then examine them a moment in detail. The dairy interests are threatened by the evil of oleomargarine. Unjust extortions by railroad corporations. The injudicious clearing of forest lands. The organized efforts of speculators to depress prices. Changes in the tariff rates. Foreign landlordism. The effects of immigration, and many like questions we find in the list, giving the idea at the start that the farmer needs to be a statesman as well.

If there is a farmer present who thinks that it is not necessary to secure the help of his brother farmer by organization, I hope that he will give attention while we glance at the dairy problem. According to a carefully prepared statement in the New York Herald, the capital invested in the dairy business is almost five times larger than the aggregate banking capital of the country, the latter being nearly $671,000,000, while the dairy employs above $3,000,000,000. There are estimated to be 21,000,000 milch cows, with an aggregate milk production of 7,350,000,000 gallons. Of this ocean of milk 4,000,000,000 gallons are used for butter, 700,000,000 for cheese, 2,480,000,000 are consumed in a pure state. The output of butter is about 1,350,000,000 pounds annually, and of cheese 6,500,000 pounds. The annual value of our dairy products is stated to be nearly 500,000,000, or twenty millions more than the value of the wheat crop, and closely approximating that of the corn crop. To support this immense dairy herd 100,000,000 acres of pasture land, having a value of $2,500,000,000, are required. A gigantic business, truly. Cheating, greed and avarice could easily creep in here at the many unguarded doors, and it silently did. Artificial or bogus butter became known, 60,000,000 pounds being placed on the market in one year, manufactured in thirty-seven factories known to the internal revenue department, with probably much more from factories unknown. The output was distributed through two-hundred and sixty-six wholesale dealers. Shoddy butter can be manufactured at a cost of three cents per pound, but a real good creamery article costs a trifle more. Sixty different articles entering into its composition are mentioned in the letters patent which protect it to seventeen patentees. Many of these articles are very questionable, to say the least, and others highly injurious. The immense dairy interests of the country, producing a healthy, nutritious and necessary article for human consumption, and maintaining thousands upon thousands of families throughout the land, was threatened with almost total extinction by a handful of unprincipled men, who, through avarice, sold unjust and unwholesome goods as pure butter. The price of butter was materially lowered. The fraud was growing fast, and threatened still greater injury. Individual farmers throughout the land raved and protested, with about the same effect as would have been produced had their ire been directed against the keen blasts of winter. It was taken up, however, by an organized body of farmers, who were trained to think and act in harmony, who, after many trials and defeats in both State and National legislatures, saw the entire trade placed under the control of the law, with the effect of restoring the price of butter, and restricting its imitation. Did not that organization attend to the business side of farming? That battle has been fought and the enemy routed; but they are gathering again, and another trial of strength will take place. Organization must be made now to meet it.

Mr. Chairman, it would take too long to tell the history of the railroad interests of this country. How, originally constructed by the will of the people, to be the servant of the people, they gained strength, and finally declared themselves to be the masters of the people, and in many ways robbed and burdened the very ones whose vote created them. The fraud and trickery and disgraceful acts of the majority of these corporations should lodge each director in the penitentiary. A large part of the burden fell upon the farmers; and repeatedly have I heard them cry out against it, but without avail. They acted as individuals without organization. But the same body of farmers that fought bogus butter, fought the railroads, and placed over them the power of the Inter-State Commerce Commission, the best act that Congress has done in many years. But here again the battle, though fought and won, still requires organization to maintain it. Individual farmer! who think organization unnecessary, how do you propose to do your share?

The influence of forests upon agriculture is well known. To a certain extent they must be preserved, or agriculture suffers or perhaps perishes. This is especially true in our hot, dry climate. Organized effort of the farmers of the whole country is needed to check the waste and destruction that is going on. Who else beside farmers are interested in this vital question? Statesmen who love their country and protect its interests because of that love? Alas, I know of none. Farmers, that question is in your keeping,—you must organize and protect yourselves. All you can do alone and unaided is to spare the old button ball tree in the side yard, and perhaps neglect your alder swamp; but that is not the question of forestry. There are large tracts of forest lands in all sections that the wanton spirit of destruction is ruining; drouth and barrenness will surely follow. It is our business to protect ourselves in this matter.

As one of the threatened dangers to agriculture against which we must guard by organization, I have mentioned speculation. Humanity has always been prone to indulge in it, but I think that the genus homo as produced on American soil is more of an adept at it than the European variety. Abroad gambling is not looked upon with much disfavor. Here all good society discountenances it. The would-be gambler turns speculator, and is honored by all classes, except the farmer; he has learned that the prices of the great staple crops are not regulated by the law of supply and demand, but by "corners," "puts," "calls," "futures," etc., and every one of these acting as a depressor to his interests. At the first glance we should say that it could not be checked, but upon investigation we find that it has been very effectually restrained by farmers who have by organization learned of the true state of the market, have built their own elevators, stored their grain, organized their own banks, from which they could obtain loans upon their crops so stored if necessary, and thus defy these deliberate acts of systematized robbery. Repeatedly have these co-operating farmers saved their crops by so doing. I am of the opinion that they understood the business side of farming.

Tariff rates. A bone of contention, producers desiring that it shall be one way, and manufacturers insisting upon another, and neither just agreeing with the consumer. The merits of this subtle question we will not pause to discuss at present, but content ourselves with the statement that a protective tariff benefits the farmer, and in order to secure and maintain it, organization and co-operation of labor are necessary. Sheep husbandry in the United States offers us a suitable example. Why is the industry declining? Simply because the wool it produces does not bring a high enough price in market. Unfortunately, Americans are not mutton eaters, and we cannot value the carcass of a sheep very highly, — its whole merits must rest upon the wool clip. This is a national question, affecting alike the farmers of all sections, and it is to our business interests to investigate it and see it righted. For sixteen years of our history Congress imposed a fair protective tariff on wool, with the effect of increasing the wool industries more than all the preceding one hundred years. In 1883 Congress reduced the wool tariff, since which a steady decline has taken place in the wool-growing interests of the country, — the decrease from July, 1886, to July, 1887, being three and a half million head; while the wool we imported in 1886 cost $13,794,213, besides $40,536,509 worth of manufactured woollens. Farmers, this should not be. It was not disease that carried off the three and a half million of sheep last year; neither was it dogs. American dogs, like their masters, only indulge in a mutton diet on special occasions; they were killed by the tariff. Had this amount of imported wool, and that required for the imported manufactured goods, been grown in this country, and manufactured by American working men and women, in turn fed by American farmers, the business of farming would not show the depression it does to-day. France protects her farmers by fixing the tariff so high on beef, pork and grain, as to make them prohibitory. And while our Congress was discussing the advisability of making raw sugars free, Spain increased her tariff on cereals twenty-five per cent. There are a host of other minor industries, that, were they protected, would materially help the farmer. We learn that there were over sixteen million dozens of eggs imported last year, mostly from France, free of all duty; surely a discouraging prospect for all ambitious Yankee hens. The British Provinces send us large quantities of potatoes every year, and I noticed in a recent newspaper an announcement that a cargo of them had just arrived from Scotland, the small import duty being no hindrance. Whether I am right or wrong in my deductions, this is an important question for farmers to consider. Tariff tinkers are busy now, and during the coming session of Congress the free admission of raw materials of all kinds—and all farm productions are raw materials—will be agitated by men whose sympathies are not with the producer. Here again the farmer can only help himself by organization.

If I am right in my position, that the farmer has to-day a need to protect his business by a concert of action, I must not pass by a threatened peril to American agriculture, which farmers should be the first to perceive, to warn against, and to oppose,—actuated thereto by a love for their calling as well as a love for their country. I allude to the growing evil of foreign landlordism. It certainly is not desirable that any considerable tract of land should be owned by persons more interested in another country and form of government than our own, that owe allegiance elsewhere and will never aid in advancing the progress of our country. As Americans, we should oppose them, because we love our country and desire its development. As farmers, we should oppose them, because we believe in the right of every farmer to own the soil he tills. It makes him a better farmer, a better citizen and a more patriotic one. We do not wish the tenant farming system, with all its attendant evils, introduced here. But it has been, and only last spring I read of evictions in Iowa for non-payment of rent to a foreign landlord. Of late years, the ownership of land in Great Britain has not been as profitable as formerly, which has prompted capitalists to look elsewhere for investments. The cheap lands of America were tempting baits and have drawn them hither, many of them presumably for speculative purposes; but not in all cases, by any means, as their large tracts are being divided into farms and let to tenant farmers, and in some instances the tenant farmers of England brought here and placed upon them. So silently has this evil grown that few are aware of its proportions, and when I tell you that *more than twenty millions of acres* of land in the United States are thus owned by aliens, you will be surprised by the statement. Among the largest of these foreign landowners are the Duke of Sutherland, Duke of Hamilton, Earl Dunraven and Marquis of Tweedale, the last of whom owns a tract of 2,300 square miles, while his English holdings are only 67 square miles. These four men own 23,000 square miles of our territory, — equal to the area of Massachusetts, Rhode Island, Connecticut, New Jersey, and Delaware, — nearly one-half of the original thirteen colonies. The State of Texas is largely attracting this foreign capital. Land agents and surveyors are busy locating and securing lands for them. What the future developments will be are watched for with interest. But this certainly is a question demanding concerted action by farmers to have such laws enacted as to prevent large holdings by aliens. This is not the only land question before the public to-day. There are others of equal interest and import, but this is sufficient for our subject.

Following these questions we see that the farmer requires to co-operate with others, his immediate neighbors, for small items of personal business. With his neighborhood or section for the sale of staple crops and large purchases; and for State legislation, and beyond that, he should in some manner co-operate with the farmers of the entire nation to secure just and equitable laws whereby he may be protected. Thus the foundation of the business is secured and made permanent.

I am aware that thus far I have talked *at* the subject in a general way, and have not offered any plans by which co-operation can be carried on in the complete manner it should be. My duty on this occasion is to present practical plans to your knowledge, and I should fail in that duty were I to leave my subject here, — as many do who insist upon reform, — but offer no plans by which to carry it out.

Some twenty years ago, an order was devised and systematized for this very purpose of aiding the farmer to aid himself, by educating him in business and general information, by promoting his social welfare, and assisting him in the necessary purchases and sales incidental to his condition. Its projectors named it the Grange, or in other words, the farm. In the short period of its history it has proved itself to be the most practical of the beneficial orders in existence. Simply stated, it consists of subordinate granges, which are local in their action. These by representatives form a State Grange; and all State granges by representatives form the National Grange. A number of subordinate granges may also unite and form a county or district grange. It is the strongest order, numerically speaking, in the United States. It was created for the benefit of the farmer and his family, and receives into its membership the farmer's wife and his children who have attained the age of fourteen years. It is the most practical example of organization and co-operation that I know of; therefore I introduce it here, and commend it to your consideration. In fact, I could not do otherwise and develop the subject, for it is the only means thus far devised by which farmers unknown to each other can co-operate in the three ways named: locally, by sections, and nationally; and co-operation in agriculture, to be perfect, must embrace them all. It is a grand order, comprehensive in its conception, lofty in its aims, noble in its perceptions and wonderfully successful in its achievements. Wherever it locates it brings the aid of organization to its members, and offers them its own distinctive business helps. It possesses its own banks, fruit exchanges, fire and life insurance companies, grain elevators and warehouses, co-operative stores, purchasing agents, and systematized trading arrangements, and thus exemplifies the idea of a farmer minding his own business, by giving him the facilities for so doing.

The incumbent of the chair of agriculture of the Storrs Agricultural School of Connecticut, Professor Chamberlain, writes me under a recent date, and speaks of the Grange as having but "one purpose, of lifting agriculturists, and through them agriculture, out of their and its degradation, and up to a level with other industries, honored as they are by the name of profession." This earnest man and careful thinker concludes his letter with these words: "You will think, perhaps, that I am too radical. Let me tell you that I believe in the Grange as the only hope of our New England agriculture. Hence my radicalism." If my friend is right, if that is true, would I be justified in omitting to present the Grange to you as the strongest business consideration of the day, the light in which I regard it?

To my mind, the strongest point in favor of organization is the effect upon the individual. It develops the mind, sharpens the perceptions and quickens the intellect, and to a certain extent makes the person a disciplined one. We know the value of disciplined men in war; they are equally so in business. A few months ago I met a gentleman on the train. He proved to be a New York business man. In conversation he gave me an incident illustrating this point. Desiring to obtain situations for two nephews of his, who were cousins of about equal ages and qualifications, he called upon a neighboring merchant and asked if he could give them positions in his store. He could make room for one. The question came which one. In discussing their merits the fact was developed that one of them was a member of one of the finest regiments of the State militia. At once the merchant said: "I will take him; he is the man I want." My acquaintance was rather in favor of the choice being given to the other, and asked why he chose the military man. The answer was: "Because he is a disciplined man. He can receive commands and execute them, and when required, give them. He will be worth more money to me." Here is an instance where discipline brought dollars. Is it not wise for us to look at it in that light also? The Grange gives a uniform discipline to its membership. The various peoples who are represented by our farmers, whatever their section or nation, are thus brought to a unity, as were the members of our regiments in the late war.

However much organization may benefit an individual, he will find that he cannot rest there; he must seek the good results that come from the ordinary forms of business in use, and apply them to his farming business. As a class, farmers are sadly deficient in business detail. Should a manufacturer conduct his operations in such a loose, unsystematized way, he would be sure to fail, and receive the verdict of "served him right." There is too much guesswork about farm business. The bookkeeping is not systematic enough. I have seen much of farmers' bookkeeping, and while admiring its simplicity, I have been impressed with its want of completeness. The day book, journal and ledger frequently consist of one book, — generally, a patent medicine almanac kept hanging from a nail under the clock shelf in the kitchen. Here and there, on the margin of the leaves against certain dates, are entries made of farm events. The sale of the brindle heifer, the weight of the fat hogs, the payment of the last instalment of pew rent, and the number of loads of apples delivered at Deacon Ransom's cider mill. I venture the statement, that not one farmer in five hundred keeps a regular set of books, and yet they are ready to contend that farming does not pay. That will be a more happy question for discussion when they have reformed their business system and can prove their statements by actual figures.

The great lack of the present system of farming in the Eastern States is the cash income. Goods enough are sold, but not for cash. They are traded away on the store pay system, which is an utter disgrace to any man's business history; the merchant fixing the price both ways, and the farmer oftentimes taking goods he does not want. The custom is behind the times, and the quicker it is changed the sooner prosperity will follow.

Specialties of farming can be followed to advantage. The drift of the times is that way. They can be made leading features of general farming. When the special branch is decided upon, push it, as business men. Talk upon it when occasion offers. Advertise it on your letter-heads, a thing that farmers seldom do, and occasionally in the papers. Let the public know what you are doing, and you will find some of them ready to help you by their purchases. Trying to do business without advertising is said to be like throwing a kiss to a pretty girl in the dark, — you may know what you are doing, but no one else does.

Politically speaking, farmers are a strong power, and in these severely practical days business must seek the aid of every power. By their concentrated vote they can do much towards the election of men who are either directly connected with agriculture, or in sympathy with it. They can introduce bills into legislative bodies, and thus secure laws that will regulate the sale of milk, butter and cheese and punish for their adulterations, fix standards for weights and measures and size of packages. Make quarantine rules and regulations for animals, pass laws which will prevent contagious diseases from entering their flocks and herds, guard against fraudulent predigrees in stock. Direct congressional and other appropriations of money for agricultural purposes to their proper uses, like the moneys of the Hatch Fund, so called. Who will interest themselves in these matters if farmers do not? Trained together in an organization like the Grange, where these questions are discussed, they make a power that the politician would fear to oppose, but seek to conciliate. Farmers are apt to fear the political strength of others and underrate their own. To such we can commend Shakespeare's words, —

> "Take thy fortunes up:
> Be that thou knowest thou art, and then thou art
> As great as that thou fearest."

Is not this attention to business? Yes, the very foundation of it, for without proper laws the business would soon be overthrown.

The business of farming is a good one, and for the amount of money invested yields a larger percentage of profit than most others. It gives a home for the family, produces most of the food consumed and fuel used, affords a horse and carriage for occasional outings, all of which make the farmer the most independent of all classes. It is not conducted on the borrowed capital plan that we find so much the case in callings carried on in towns. It oftentimes has a part of its capital borrowed, which is generally put in one shape, a mortgage on the farm, which is handled only at stated times. It is not conducted by a system of notes given at bank, causing a perpetual worry of mind and necessitating a speedy turning of goods into cash. Neither has it the system of long credits, that cause the failures of so many. Its hours are long in summer, but the average working hours of the year are no more than those of the mechanic and tradesman. The heavier labor of those hours is fully offset by its being carried on out-of-doors, in the pure air and stimulating sunshine, and the good health it brings.

I would speak of education as a business point, but surely in these days of enlightenment it is not necessary to enlarge upon it. Knowledge is power wherever it is exerted. The farm needs it, and responds to it as quickly as in any profession or calling. Ignorance and superstition are incompatible with progress, and it is for progressive modes and conditions that we are living, and not the conservative ideas of the past. Those who would win the golden prize of a successful life must rely upon a strong intellect that can only come from mental exercise.

It is for ourselves that we should seek for business success, for the manhood that is within us, which feels the stimulation that comes as a reward for honest labor; for those who are dependent upon us, and can thus enjoy the comforts success affords them, and for others that they may be stimulated by our success and be encouraged to emulate it. To this end let us all take to heart Dickens' comment, that "To be thoroughly in earnest is everything, to be anything short of it is nothing."

Mr. Taft. I want to ask the essayist if he is in favor of a law limiting the number of acres that one individual may own, and, if so, how does he propose to bring it about?

Dr. Bowen. The old Roman law, I believe, limited the number to seven acres, and it was a very good law for the Roman Empire; but I hardly think that any average Yankee would be contented with any such limit as that. Neither would I, at this time in our national history, limit the possession of homesteads to any number of acres; but I would limit the holding of American land by foreigners. They have no business here. I believe that America was created for Americans and not for English capitalists [applause]; — and I would be in favor of a law saying that an Englishman can come here and buy our land, live upon it and derive his living from it; but he shall not come here to bring the feudal systems of the old world and impose them upon Americans. [Applause.] Our ancestors had the English yoke on their necks once; they threw it off, and it is not for us to allow Englishmen to put it upon us again. [Renewed applause.]

Mr. Taft. I rather agree with that kind of talk, but I am somewhat of a practical man, and the question is, how are you going to do it? In this matter of emigration, I am about of the opinion of Josh Billings, when he was asked if he believed in universal salvation. He said, "I do; let me pick the men." I presume the essayist may be in that frame of mind. He is willing that foreigners should own land in this country; but, as I understand him, he believes that they must come here and become American citizens.

Mr. Bowen. That is the idea. America is open. We welcome all immigrants who come here with good feelings towards our country and will adopt the country as their own; but we do not wish them to come here for speculative purposes.

Mr. Taft. There is another question I would like to ask. I understood the essayist to say that he was in favor of a higher tariff on wool. About two years ago the Board heard a very eloquent essay at Boston, at one of their meetings, on this question: "What does the tariff do for the farmer?" and the essayist in the course of his address said: "I have on a suit of clothes for which I paid seventy-five dollars in Boston; repeal the tariff laws and I will buy them for twenty-five dollars, and you can get your clothes for thirty-two per cent. less than you have to pay now." He was applauded by the members of this Board. I believe I was the only member of this Board — no, the present Secretary was with me — who did not echo the sentiment. There was a motion made by a good doctor down here in Fitchburg to thank the essayist for his essay. I said: "That is very well, gentlemen, if you thank him for its literary character; but as a matter of business, I question whether it is right for this Board to adopt the views presented by the gentleman." I think the essayist was Mr. Joseph S. Fay of Boston. I got the idea there that the members of the Board of Agriculture believed, contrary to my judgment, that the tariff was too high.

Dr. Bowen. I will say that that is substantially the opinion expressed by our worthy President in his message. He took up the subject of the tariff and illustrated it in the same way to which the gentleman has referred. He did not go a little deeper and see that the American manufacturer, when obliged to compete with the foreign manufacturer, would say to his operatives: "I cannot go out of business; I must sustain myself and my family; therefore, I must reduce your wages. Where I have paid you two dollars a day, I will pay you one;" and the operatives would turn round to the farmer and say: "Mr. Farmer, we have been paying you forty, fifty, and sixty cents a bushel, from year to year, as the case may be, for your corn; now that we are receiving only one dollar a day where we had two, we shall pay you twenty or twenty-five cents a bushel for your corn, and everything else in proportion." That would bring the thing back again on the farmer. You would curtail his income, you would lower his condition, and, as I said in my paper, suppress the American farmer and you suppress the underlying power of the nation. [Applause.]

Mr. Taft. I have succeeded in bringing out just what I wanted to; but as you know, sir, and as many of those here know, that is not the sentiment of Massachusetts, if we can gather it from the votes of the people, but rather the contrary. We have just elected in the old ninth district, of which the city of Worcester forms a part, a man who believes in free trade, or, at any rate, in materially reducing the present tariff. I am very glad that we have got the opinion of the gentleman; it agrees with my own. I asked the essayist to whom I have referred, after he got through, this question: "Suppose you bought that suit of clothes for twenty-five dollars instead of seventy-five, would the men who spun and wove that cloth get as many dollars per day as they do now?" "That has nothing to do with the question," the essayist said. But it seems to me that what the operatives of that valley receive for their daily wages has a good deal to do with the income of those who sell potatoes and cabbages and a great many other things.

Dr. Bowen. I hope the operatives are wise enough to put that question to themselves, and if they do, I think they will say that it makes a difference to them whether they receive one dollar a day or fifty cents.

Mr. Sedgwick of West Cornwall, Conn. The gentleman said in his paper that France and other countries had put an inport duty on cereals and breadstuffs. That is a fact; but he did not state that those countries named are not countries that have those articles to export. He did not state the fact that America has a large amount of agricultural productions the only market for which is abroad, and the price that we are receiving to-day in this country for beef and pork, is the price that is made in Liverpool, or in those countries abroad to which those products go; and the fact that our manufacturer here is paying two dollars a day as wages to his workmen has nothing whatever to do with that price. If the tariff was reduced and the workmen in New England only got one dollar a day, the price of wheat, of pork and of beef would be just as great, because the demand would be just as great, and that is the only thing that controls and regulates the price. [Applause.] I say, — and I know whereof I speak, because for nine years I have been travelling among farmers in the eastern States, — I say that farmers are suffering more injustice from the present tariff, they are feeling the effects of it more seriously, than any other class of people in this country. It is an unjust thing from which in great mercy they ought to be delivered. [Applause.]

Mr. Myrick. It is about twenty minutes past five, a little too late in the day to open the question of the tariff. Can we not take up one or two other subjects which were brought out in the very excellent address to which we have listened? The essayist referred to the matter of co-operative fire insurance. I have made some study of that question. I know that in some States, notably in the State of New York, the farmers are saving an immense amount of money by insuring their property themselves in their own companies, limiting their risks to their own property, so that the expense is limited to the actual loss by fires on farms, and they do not have to pay the losses by fires in cities, as they have to do when they insure in the ordinary stock companies. I would like to hear from any gentleman who has had experience in this particular. I believe a co-operative insurance company has been started in this State, the president of which is here, Mr. Douglas.

Mr. Douglas. It is pretty late in the day for me to attempt to say anything that will enlighten this audience. It is so late that they are rapidly going out, and I believe if I should talk here for ten minutes I would clear the hall entirely.

We farmers of Massachusetts, belonging to the Order of Patrons of Husbandry, have been looking up this matter of fire insurance for years; it is part of our farming business that we have been giving some attention to. We thought it was costing our people here too much to do this work, — that the expense was too great. Then, too, we thought the class of risks which represented our property was not insured as it ought to be. We found that it was costing more in the State of Massachusetts every year to do the business, to move the machinery of fire insurance, than to pay the losses. We found that it was costing the people of Massachusetts more than a million dollars a year to pay the big and little agents. We put these things together and said, "We can do this business for ourselves; we can save this money." About a year ago we commenced really talking this matter up in earnest, and at our annual meeting in the city of Worcester in December, we appointed a committee and instructed them, if in their judgment they thought it advisable, to go on and organize a company. After canvassing our membership throughout the State, and looking up the laws of the Commonwealth relating to insurance, it became apparent to the committee that it was worth while for us to make the attempt. We were under very great obligations in the beginning to the pioneers in this line, as it were. Co-operative fire insurance companies have been in existence in several States for a number of years. We found that there were in New York some seventy co-operative fire insurance companies who met every year and whose secretaries reported to the general organization. We were able to get from those reports figures and facts which were just what we wanted. We then found that it was necessary, of course, to comply with the laws of this Commonwealth. We had to go before the Insurance Commissioner, get out our papers, and go to work business-like. Some of us learned considerable about business before we got this thing going. On the 23d of May last we applied for and secured our charter. We had at that time no agents, no printing done, nothing to begin with except the bare charter, which authorized us, when we should have received and placed on our books *bona fide* applications for $500,000 of insurance, to go before the commissioner and apply for authority to issue policies. About the middle of June we commenced putting out our circulars and applications for insurance and appoint-ing our agents, and on the first day of August we were able to commence issuing policies. A little before that time our secretary was able to take five hundred and some odd thousand dollars of applications under his arm and go down to the insurance commissioner, show them to him, and say, "Mr. Commissioner, we want authority to issue policies on this property." After looking them over the commissioner granted the authority, and on the first day of August we commenced issuing policies covering something over $500,000 worth of farm property, no one policy exceeding $2,500. I tell you it took some hard work. It was a thorough organization that we mapped out.

Mr. TAFT. I want to get my barn and house insured for $1,200; what will you insure them for?

Mr. DOUGLAS. Are you a member of the order?

Mr. TAFT. No, sir; but I am a farmer.

Mr. DOUGLAS. We will not insure your property unless you are a member. We are doing this thing for our own benefit.

Mr. TAFT. Supposing I was a member, what would you insure me for?

Mr. DOUGLAS. If you have a good risk, one-half of one per cent. for five years on your house, with a contingent liability for three times the amount of the cash premiums.

Mr. TAFT. I got it insured for seven dollars.

Mr. DOUGLAS. We are learning to do our own business for our own benefit, as long as we hurt nobody else. We have been going on quite rapidly since we commenced to issue policies on the first of August. I think we have this matter of fire insurance so arranged that it is going to be a benefit to us, at least, and will injure no one else.

Mr. TAFT. Of course the gentleman would not go into it unless he thought it would be a benefit to himself and his friends, but I wanted to know whether it would benefit anybody else.

Adjourned to 7.30, P. M.

Evening Session.

The evening session was held in the Opera House, where a lecture was delivered by Surgeon-General Alfred F. Holt of Cambridge, on Contagious Diseases in our Homes, and how to prevent them. The lecture was illustrated with stereopticon pictures, and was attentively listened to by a large audience.

CONTAGIOUS DISEASES:

HOW THEY ARE CAUSED AND HOW TO PREVENT THEM IN OUR HOMES.

During the long history of medicine, reaching far back into the older civilization, there have been many theories entertained by the medical profession as to the cause or causes of disease; but all of these theories, except the one generally accepted by the scientific world to-day, have been purely speculative and theoretical. Some of these were evolved by a subtle reasoning from false premises, some from an ignorance of physiological laws, while still others were based wholly upon a blind and ignorant superstition.

Each of these medical theories has had its day. Each, for a time, has been bolstered up and sustained, as all false hypotheses have been, by the addition of new propositions and new guesses, until it has fallen by its own weight, or perhaps has been dispelled by an advance in knowledge; when another, possibly equally as absurd and false as its predecessor, has arisen to take its turn. But all of these speculative theories as to the cause of disease are matters of history, and to-day they only serve to show us the methods of reasoning of our predecessors and the darkness and ignorance in which they were groping.

The present theory of the cause of the diseases with which sanitary science has to deal, — the so-called contagious or preventable diseases, — and the one almost universally accepted by the medical profession, rests upon no such insecure basis as a speculative supposition, but has for its foundation the firm, strong groundwork of careful and extended experimental research. In fact, it is rather an inevitable conclusion, that has been forced upon us by the teachings of the microscope and the laboratory, than a theory at all. This is known as the germ theory of disease, and it is that the contagious or infectious diseases — or, in other words, diseases that may be communicated from one person to another — are caused by minute vegetable germs finding lodgment in some of the tissues, or some of the cavities of the body, and there growing or reproducing themselves. For example, one kind of germ or germs fixing themselves in the mouth or throat, and by their growth producing diphtheria; another kind finding their way to the lower part of the bowels, and by their growth producing typhoid fever; another, entering the stomach and the upper part of the intestinal canal, and by their growth producing cholera, etc.

Now, as I have said, it is with these contagious diseases that sanitary science has to deal, and how to prevent these diseases in our homes, and how we can best manage them to protect our families, as well as the families of our neighbors, is the subject that is to engage our attention this evening.

As every one acts more intelligently when they know the why and wherefore of a thing, — or, in other words, when they know just what they are doing, and why they are doing it, — I have thought best to try and explain to you, in a plain, conversational way, some of the experiments that have led to the adoption of this germ theory of disease, believing that even such a slight knowledge of this theory as can be got in a single evening, and the researches that have led to it, will not only add greatly to the interest of this occasion, but it will enable you to act much more intelligently in the way of protecting yourselves and families from these terrible maladies. After a half hour spent in this direction, we shall then consider how these contagious diseases may be communicated from one to another, how best to guard against them in our homes and elsewhere, and finally, how best to protect our families and others when one of these diseases has entered a household.

Every housewife is familiar with the fact that, in damp places, and particularly in damp weather, many articles, if left undisturbed for a few days, become covered with a fine bluish mould. This is particularly liable to happen to bread, cheese, vegetables, leather, and often to articles of clothing and furniture. Now, let us take a little of this mould and place it under the microscope, when we shall see what is pictured here on the screen. (Picture of one of the common forms of mould shown.) This mould, like every other form of vegetable life, grows from a germ or seed, and to grow and develop so extensively in our houses and elsewhere as we know it does, under proper conditions of moisture and warmth, the germs or seed must first be sown. Now, let us see if we can learn, by investigation, how these germs of this little plant are so universally distributed.

As this plant, like all others, requires some form of matter to feed and grow upon, we will select for our experiment a small piece of blackened leather, as everyone knows how readily mould grows upon this material, — in fact, we can hardly keep our shoes from becoming mouldy in damp, summer weather, if they are put away for a day or two, — we will take three small glass tubes, such as you see represented on the screen (illustration shown), into each one we will put a little water and also a small piece of the leather, fixing the latter so that it will rest just above or on the surface of the water. Into the mouths of two of the tubes we will put plugs of cotton wool. Then we will place these three tubes, with their contents, in an oven and heat them until the temperature is at or near the boiling point. This will destroy any kind of germ life that may be in the water or air in the tubes. Then we will put these tubes away in a warm, damp place. In three or four days we examine them, when we find the piece of leather in the tube without the cotton plug covered with a fine mould or mildew, while the pieces of leather in the other tubes remain unchanged. We will put them away for a few days more and then examine them again, when we find a vigorous growth of mould in the open tube, but none in the tubes with the cotton plugs. Now, these tubes were all prepared alike, and they have been under the same influence of warmth, moisture and air, — for the air passes into the tubes through the meshes of the cotton almost as readily as it would if they were removed, — still, there has been no growth in the tubes with the cotton plugs. Now, we will remove the plug of cotton from one of these tubes, and allow it to remain open for an hour or two, and then replace it, and in a few days examine the tubes again, when we find a growth of mould in the tube from which we removed the cotton and allowed it to remain open for an hour, but there is no growth in the tube in which the cotton has not been disturbed. Experiments like this have been repeated over and over again, and always with the same result. What is the explanation of the fact that the mould grows in the unplugged tube, and also in the one from which we removed the cotton for a short time and then replaced it, and not in the other? Simply this: The air, in getting into the latter tube, must pass through the fine meshes of the cotton, and in doing so it is throughly filtered; every particle of dust and every germ is caught and retained by the fine fibres of the cotton plug, and only pure air is admitted to the tubes with these cotton plugs; while in the other, the air — carrying many particles of matter, among them the germs of this mould plant — entered without filtering, and these germs being so carried and falling upon the piece of moist leather at once begin to grow; and in the tube from which we removed the cotton for a short time, no growth appeared so long as the cotton remained undisturbed, because no germs could get into it, as they were arrested by the meshes of the cotton, and we had destroyed by heating any that may have been in the tube when we commenced the experiment; but, when we removed for a short time the cotton, we allowed the impure air to enter the tube, carrying the seeds of our plant, and so in a few days we find it growing as in the open tube. As I have already said, such experiments as this have been repeated over and over again, and with uniform results, until it is a fact as well established as any in science, that this mould, as well as all other low forms of vegetable life, do not grow spontaneously, — if they grew spontaneously we should have found a growth of mould in the tube in which the cotton plug remained as well as in the others in our experiments, — but that their seeds or germs are carried from place to place by the air, and when falling on a proper soil, and under proper conditions for their development, they grow and multiply.

Now, another example of germs being distributed through the medium of the air. Everyone knows that when cider is first made that it is sweet, but that soon after it begins to work, as it is called, and in a little while it becomes sour. This process of working goes on not only in apple juice, but in the juices of all other fruits after they have been expressed and left to themselves, as well as in many artificial mixtures, and it is called fermentation. Let us take a drop of one of these fermenting liquids and place it under the microscope. Here we have the picture presented by such a preparation. (Yeast plant shown.) These oval bodies, some of them single while others are linked together, some having knobs or buds on them, are specimens of the yeast plant. This plant is always present where fermentation is going on, for it is the growth of this that causes the fermentation, and without its presence and growth the cider and all other fruit juices would remain sweet. Everyone knows how very difficult it is to prevent this process of fermentation in these liquids. The reason of this is, that the germs of this little plant, like those of the mould, are so generally in the air and are so universally distributed by it, that some of them are sure to find their way into these liquids, as well as elsewhere, and as these fruit juices afford the proper soil for their growth they multiply with great rapidity. That the germs of this yeast plant are carried from place to place through the medium of the air we might readily prove by experiment, had we the time.

One other example of germs floating in the air and then we will pass to something else. If we take a piece of meat, and put it in a fairly warm place, it soon begins to undergo a marked change. It becomes darker in color, offensive to the sense of smell, grows soft, and if left undisturbed it is reduced in time to a liquid mass, dries up, is reduced to dust and disappears. Let us take a drop of the juice of this meat after this process of decomposition is well under way and examine it under the microscope, and we shall have such a picture as is shown here. (Photograph shown.) Countless millions in a single drop of these minute bodies represented in this photograph of them, moving and dodging about in ceaseless, tireless motion. These minute bodies represent another form of vegetable life much smaller and of simpler organization than the mould or yeast plant we have described before. In fact, they are so very, very minute they require the very best microscope that can be made to study them at all. They are so small that 200,000,000 of them could move about (with a little crowding) in a square inch surface. Let us see if we can determine where these minute bodies came from. We will take the three glass tubes again, and into them put a little water, and also into each a small piece of meat. (Illustration.) Into the mouths of two of the tubes we will put the cotton plugs, and place all three in a hot oven until we have destroyed any kind of life that may be in the tubes, and then set them away in a warm room.

In a few days we examine them, when we find the meat in the open tube has commenced to undergo a change. We put a little of it under the microscope, when we see millions of these minute bodies in active motion, while the meat in the other tubes has remained unchanged. Now we will remove the cotton plug from one of the tubes for a single moment, and then replace it, and in a few days we find the meat in this tube decomposing, for when we removed the cotton we allowed some of the unfiltered air to enter the tube, carrying with it some of the germs of this form of life we have just seen on the screen; falling upon the meat they at once begin to grow, reproducing themselves with astonishing rapidity. These little bodies are called bacteria. As we have seen that the growth of the yeast plant is the cause of fermentation, and that it grows in solutions containing sugar, decomposing the sugar by taking away certain of its chemical constituents required for its growth, and producing among other products, alcohol, so these bacteria, growing in animal and vegetable substances, bring about by such growth their decomposition, and were it not for this minute form of vegetable life there would be no such thing as decomposition after death, except by the slow process of chemical changes, which would require ages to bring about the destruction of the bodies of even the smallest animals.

You will begin to ask, I presume, "What has all this to do with contagious diseases and the protection of our homes from their ravages?" That I am about to try and tell you, and I hope that I have not tried the patience of the audience too much in considering matters that perhaps may seem unconnected with the subject before us. But, as I have already said, everyone acts so much more intelligently when they understand why they are doing a thing, I have thought it best to risk the trying of your patience with the matters that have so far engaged our attention, the bearing of which I am sure you will see later. There are many different forms of this minute vegetable life, the bacteria, notwithstanding they are so very small and simple in structure; they grow, many of them, under different circumstances and conditions; they differ in size and shape, so that by studying their different life histories the expert is readily able to recognize and classify them. Now, it is the growth of some of these germs, the bacteria, in some part of the human body that produces the contagious diseases; one kind of germs fixing themselves in the throat or nostrils and by their development producing diphtheria, another kind finding their way into the intestinal canal and by their growth producing typhoid fever, another scarlet fever, another cholera, etc.

That these bacteria are the real factors in the causing of contagious disease is believed by nearly all who are familiar with the teachings of sanitary science. As has already been said, this conclusion has not been drawn from theory and guesswork, but it has been the result of careful, patient work and study in the chemical laboratory and the workshop of the microscopist. These careful and exact observations and experiments have been carried on, not by a single observer, but by investigators in all countries, and all have arrived at the same general conclusion. In fact, the truth that these bacteria, developing in some part of the human body, produce disease has been proven over and over again by exact and painstaking experiments.

Many of these experiments are ingenious and interesting, but we have only time to briefly allude to some of them, and to show on the screen some of the different forms of bacteria that are believed to cause by their growth in some part of the human body the different forms of contagious diseases, as we must pass on to the important part of our subject, namely, how to protect ourselves from these potent enemies.

Among the many diseases men and animals are subject to there is one known as anthrax, one of the most terrible and rapidly fatal of diseases. For example, a little pimple appears on some part of the face or neck, caused by the bill of an insect that has been feeding on the body of an animal dead of the disease; in a very short time it begins to swell and becomes painful; in a few hours the vicinity of this pimple becomes hard and of a bluish black color and perhaps the whole head and neck are swollen, blackish spots appear on other parts of the body, the pulse becomes quick and feeble, the breathing labored, the vital powers fail rapidly and at the end of forty-eight or sixty hours death closes the scene. It was known more than thirty years ago that the blood of one suffering from this disease was filled with these minute bodies, such as you see upon the screen (photograph shown); but it was supposed that these were rather the result of the disease than the cause of it, until a few years ago an observer introduced some of these germs from a body dead of this disease into the body of a healthy animal, and in a few hours this animal sickened and died of this disease. This experiment was tried a great many times and always with the same result. While such experiments indicated perhaps that these bacteria were the cause of the disease, they by no means proved it, for, in taking some of these germs from the blood of a body dead of the disease with which to inoculate the animal, some of the blood itself must have been taken, and that, or some other poison it might contain, may have produced the disease in the animals experimented upon.

Later a great discovery was made, and one that has enabled us to solve the question of the relations of these bacteria to contagious disease; that discovery was, that these germs could be cultivated and grow outside the body, some requiring one set of conditions, and some another, for their development. For example, nearly all of them will grow in solutions of meat juice, others will only grow in blood serum, while still others require vegetable substances for their development.

One of the first of these disease-producing germs to be experimented with was the one we see here. (Photograph of bacillus anthrax.) A little beef tea, or other meat solution properly prepared, was put in one of the little glass tubes, boiled, to destroy any form of life it might contain, and then some of these germs from a case of this disease were introduced by means of a fine wire into the meat juice, and the cotton plug placed in the mouth of the tube to prevent the ingress of any other germs. After a few days the meat juice in the tube was found swarming with these deadly bacteria. Then the experiment was carried a step further by taking some of the germs from this meat juice and introducing them into another tube containing meat juice, prepared in the same manner that the first tube was, and in a few days this was found swarming with the same form of bacteria. Then some of this second generation was introduced into another tube, and so on, until these germs were removed some six or seven or more generations from the original germs taken from the diseased person or animal. Then some of these, by means of a proper instrument, were thrown under the skin of a healthy animal, when it was found these cultivated germs were as potent to produce the disease as were the original ones taken directly from the body of the person or animal suffering or dead with the disease. These experiments were repeated and always with the same result.

A few years ago Dr. Koch, a German physician, whose name has since become famous, commenced the study of these bacteria and their relation to disease, and one of the first diseases he studied was the one so common all over the world, — consumption.

By a careful examination of the matter expectorated by patients suffering from this disease, by means of the best microscopes, — and I might say here it is only by the great improvement in microscopic lenses that has been made in the last few years that we are enabled to study these minute bodies with any degree of accuracy at all, — this observer found these expectorations from the lungs filled with the bacteria or germs seen here on the screen. (Photograph of bacillus tuberculosis.) These are very minute, and appear like short blunted rods. It was found by further experiment that these germs could also be cultivated, in a proper medium, outside of the animal body, and that after carrying them through a number of generations, in a way similar to the one used to reproduce the bacteria of anthrax, that we have just described, they were still as potent to produce consumption, when injected into the bodies of rabbits, as those taken directly from the body of the person or animal suffering with the disease. It was also demonstrated that these cultivated germs could be communicated to animals through the medium of the air by the following experiment. After confining a number of animals in a convenient room, it was arranged so that all of the air these animals breathed must first pass over material filled with these germs. In a few weeks all of these animals sickened and died, while other animals confined and fed in the same way, except that they were supplied with uncontaminated air, remained healthy.

Now, experiments like those just described, and similar ones, have been made,—not only in the study of anthrax and consumption, but also in the study of nearly, if not all, of the contagious diseases, such as cholera, typhoid fever, the pleuro-pneumonia of cattle, the swine plague, etc.,—not by a single observer, but by Pasteur, Koch, Sternberg, and hundreds of others, who have either carried on original experiments, or else have imitated those of these three great masters I have named, and all have come to the same general conclusion, namely, that the contagious diseases are produced by a minute form of vegetable life, called bacteria, finding lodgment in some part of the human body, and there reproducing themselves, or in other words, growing,—different species of these bacteria producing different forms of contagious diseases. Further, that contagious diseases are communicated from the sick to the well by the germs causing the disease being conveyed in one way or another from the sick to the well, each person infected and developing the disease making a new focus or starting point from which it may be communicated to others.

I will now show you upon the screen a few of the different species of these disease-producing bacteria that have been thoroughly identified and studied, Nos. 7, 8, 9, 10, 11, 12, 13 and 14. (Photographs of different forms of bacteria.)

How may these disease-producing germs be conveyed from the sick to the well, or in other words, how may a person sick with a contagious disease communicate such disease to another. Take for example, diphtheria, and I select this disease because it is one with which we are all more or less familiar. How may a child sick with diphtheria give it to other children? I say children because we all know they are much more liable to this disease than adults, although the latter do have it. In this disease the germs producing it, as I have already said, fix themselves usually in the throat or nostrils, and there reproduce themselves. Because the seat of the disease is in the throat or nostrils, the secretions that come from the parts are the most dangerous, for they are swarming with the germs of the disease. In a child suffering with diphtheria these secretions are generally very profuse, and in spite of the greatest care some of them will fall on the dress of the attendant, the bedding, the floor and the furniture, and where no care is used, as is often the case in the homes where the disease is the most rife, these articles soon become covered with these secretions, every drop of which contains millions upon millions of these disease-producing germs.

These secretions are soon dried in the warm room, and by the handling of the bedding and furniture, and the movements about the room, they are worked up into a fine dust that readily floats about in the air. Therefore, contact or approximate contact as you would suppose between the sick and the well, offers the greatest danger of infection, so contact with the clothing of the patient or attendant that has been worn in the sick room is of the greatest danger. Another very great danger of conveying these contagious diseases is by means of the knives, forks, spoons and dishes that have been used in the sick room. So the towels, cloths, etc., that have been in the sick chamber, whether they have been used or not, may be a fruitful source of contagion.

We saw in the early part of the evening how readily these minute forms of life float about in the air, and diphtheria may be conveyed from one person to another in this way, although practical experience teaches us that the danger from this source is not very great.

I have selected diphtheria to illustrate the dangers of contagions simply because it is so common and well-known; but what I have said of it is true of scarlet fever, measles, small-pox, whooping-cough, cholera, etc., so far as danger of contagion is concerned, although there is a difference in degree of the contagion of some of them; for instance, whooping-cough and measles appear to be carried from one to another through the medium of the air much more readily than some of the others.

There is another broad highway from the sick to the well through which contagious disease may travel, and one that has the most important bearing on all sanitary work, — in fact it is the chief corner-stone of sanitary science, — and that is by means of filth and decomposing animal and vegetable matter. We have repeatedly referred to the fact that these little germs are transported from place to place through the air. We have also learned that many of these disease-producing germs grow outside the body, that they require for their growth a certain degree of warmth, moisture and some kind of vegetable or animal matter. Now, suppose that near one of your houses there is a pool of dirty, stagnant water in which there is decomposing grass and other vegetable and perhaps animal matter. Here are all the conditions for the growth of some of these germs, and such a pool would make an admirable garden for their cultivation; or, suppose a waste-pipe or spout from the sink is discharging its filthy water directly on the ground at the side or back of the house (and there are many such in the county districts and small villages), and there creating a little pool, and running from this there is a small stream extending perhaps a number of rods. Such a pool and stream of dirty slop water is another and a most excellent place for the growth of these germs, the sowing of the seed being the only necessity to ensure their development. And how readily this may be done. For, suppose a neighbor a half mile or more away has been unfortunate enough to have a case of one of these contagious diseases in his house, and after recovery the housewife thinks it necessary to clean the room where the person has been sick. She takes the carpets, mats, bed-clothing, etc., covered as they must be with these disease germs, and hangs them upon a line or perhaps throws them upon the grass. The winds of heaven blowing over and through these articles catch up some of these germs, — and I repeat, we have seen how readily these microscopic bodies are transported by the air — and carry them hither and thither we know not where; but at last some of them find their way into the stagnant pool, or the sink-water at the side of the house, and thus all of the conditions necessary for the growth of these disease-producing germs are completed; and so we have a new focus for the spread of contagious disease. The children playing about the stagnant pool may become infected with the germs of disease there, or perhaps some of these germs have been sucked up the sink-pipe or spout from the pool of sink-water, where they find lodgment in some decomposing animal or vegetable matter that has been caught in the joints or other irregularities of the pipe, or the sink itself, and from such a place they may readily find their way to the dishes used on the table, and so to the members of the household. I have no hesitation in saying that I believe that offensive smelling, untrapped sink-pipes have been one of the most common causes of the spread of diphtheria, and that often cases of other contagious diseases can be traced to this source.

So these diseases may be communicated by means of defective and improperly constructed sewer and house-drains. This danger applies particularly to cities and towns having sewers. For example, there is an odor of sewer-gas that comes from a defective drain-pipe, or untrapped sink or other connection. Now the danger under such circumstances, of contracting contagious diseases, is, not from the sewer-gas itself, although this may produce headache, nausea and vomiting, and a general depression of the vital powers that probably renders one more liable to take such diseases, and if the exposure to these offensive gases is long continued, the result to health may be serious, but the real danger from contagion is the presence of sewer-gas in a house. It is a positive evidence that the inmates of such a house are in direct communication with the interior of the sewer or drain-pipes where these disease-causing germs may abound, and that may be readily carried up with the sewer-gas directly into the house, and so find ready access to its inmates.

There is another means by which contagion may be communicated from one to others, and that is through the medium of a water or food supply. This danger seems greater in cases of typhoid fever than in any of the other diseases we are considering that are common to New England. In typhoid fever the disease is in the lower part of the bowels, and is an ulceration of some of the small glands that are situated there, and for this reason excretions from the bowels are the great source of danger in this disease.

How water and food supplies may become contaminated, and be the means of most serious attacks of this disease is well illustrated by the following well authenticated cases. Dr. Budd in his work on typhoid fever, relates the following. In one of the public houses of one of the country villages in England, there was held a ball, attended by one hundred and forty people, many of them coming from the adjoining counties and from different directions. During the evening many of the party partook freely of lemonade, and other light drinks prepared with water drawn from a well, the water supply of the house where the ball was held. Within the next ten or fifteen days, over eighty of these people were attacked with typhoid fever. Such an outbreak of course caused great excitement, and an investigation was had but with no satisfactory results. Later, Dr. Budd visited the house for the purpose of investigation himself, when he found that a short time before the ball there had been a case of typhoid fever in this very inn, and that the excretions of the bowels had been thrown in a vault a few feet away from the well, supplying the water for the cool drinks used by the people attending the ball. Further examination showed that the water was contaminated with sewage. The connection between this contaminated well and this epidemic seemed to be clear and conclusive.

Four or five years ago there was reported in the daily papers in New York, Boston and other cities, the outbreak of a terrible pestilence in one of the larger towns of Pennsylvania of eight or nine thousand inhabitants. A physician was sent from Philadelphia to investigate the cause of these reports. This physician found by post-mortem examinations that the disease in question was typhoid fever. He also found that this town obtained its water supply from two sources. One, a public supply furnished by a small mountain stream, the water being stored in basins and carried to the consumers in the usual way by under-ground pipes, the other, from individual wells. The epidemic was confined almost wholly to the people using this public water supply. Continuing his inquiries, this physician found that a part of the year this mountain stream did not supply a sufficient quantity of water for the part of the town using it, and at such times it was pumped directly from the Susquehanna River into the water mains. Up to the 30th day of March, and some time before, the public water supply was from this source, but on that day the water was let on from one of the basins supplied by the mountain stream. On the 9th of April, or ten days after, the first case of typhoid fever occurred. On the 10th, two or three more, and from that time they increased with such frightful rapidity that in a few days over 900 cases were reported, and subsequently over 100 deaths occurred. Further investigation revealed the fact that some time before this outbreak there had been a case of typhoid fever in a house near this mountain stream, supplying water to the stricken part of the town, and that the stools from this patient had been thrown on the snow near the bank of this stream, and in a sudden freshet caused by the melting of the snow and rain, these excretions from the bowels, loaded with the germs of the disease, had been swept into the current and carried to the basin below, causing the terrible results we have seen, and the reports to which I have alluded, that some new and fatal pestilence had appeared.

Another case is reported where a water supply was the cause of an outbreak of typhoid fever. A little English village of about 800 people was supplied with water from a small stream running through the town. Although this stream was known to be polluted with sewage, and had been for years, no cases of this fever occurred until a case was brought there from a neighboring village. The excreta from this patient was washed into this stream, and between the months of June and October over seventy-five cases occurred, and the experience here was that those who were supplied with water from a source other than the polluted stream escaped. I relate this case to show that pollution of a water supply alone cannot cause this or other contagious disease, but that something else must be added, and that something else is the disease germ

Outbreaks of this disease have been traced to milk supplies. A few years ago there occurred in a certain district of the city of London an experience of this kind in which nearly three hundred cases of typhoid fever occurred. On investigation it was discovered that nearly all of the people sick with this disease were taking milk from the same milkman. This milk was traced back to the farm where it was produced, when it was learned that there had been a fatal case of typhoid fever in that farm-house a few weeks before this outbreak in the city, and that the excretions from the bowels had been thrown into a vault that was located thirty feet from the well, from which the water was procured to wash the milk cans. This well was found foul with the leakings from this vault.

We had an experience much like this in Cambridge only last year. In the last half of November the cases of typhoid reported to the Board of Health began suddenly to increase, and in the next four weeks eighty cases above the usual number occurring in the corresponding time of previous years were reported. Inquiry was made as to the cause of this sudden and alarming increase in the number of cases of this disease, when we found that seventy-four of these cases were in families taking milk from one milkman, and further, that the persons attacked were mostly those who were in the habit of drinking more or less milk daily. As this milk came from a town in New Hampshire, the State Board of Health were informed of the facts, and one of their officers was sent there to make further inquiry. This officer learned that the milk supplied to this milkman was raised on three or four different farms, and that on one of them a mild case of typhoid fever had occurred a few weeks before, and the excreta from this person had been thrown into a vault about twenty feet from the well used as a water supply for the house.

Many other cases might be related where communities have suffered from an epidemic of this disease caused by the infection of a water or food supply had we the time, but I am sure those already cited are sufficient to show the danger from this source. There can be no question that very many cases of these contagious diseases have been caused, particularly in the country, by the direct pollution of wells from existing cases of these diseases, either from the germs finding their way into them through some underground water passage, or in some other way. The more impure our water supplies the greater the danger from these disease-producing bacteria, for, as we have already seen, they must have some form of organic matter for their support and growth, and they cannot live for any length of time in pure water.

How can we best protect ourselves against these contagious diseases? First of all, avoid all unnecessary contact with those sick with any of these diseases. See that there is no festering pool of stagnant water near your dwellings, and particularly see that there is no filthy sink-drain discharging its contents directly under your windows. Replace such a dangerous fixture with a tight metal pipe, with a good trap immediately under the sink connection, and conduct the water from this by a proper drain some distance from the house, or into the public sewer if you are living where there is such a thing. See that there is no rotting wood or decaying vegetables in your cellars, and that the cellar bottom is dry and its walls are neatly whitewashed. Any and all of these precautions require but a brief expense of either time or money, and they may be the means of saving your children from sickness and perhaps death. In houses having bath-rooms and closets, all of the piping should be of iron with leaded joints. While clay pipes with cemented joints may with great care be kept tight, still they are never safe, and the inmates of a house with such a drain are living over a volcano that sooner or later is pretty sure to break forth and do its deadly work. If there is an odor of sewer gas in your house, don't rest until you find the cause of it and have it remedied. The plumbing of every new house should be planned and constructed with the greatest care; there should be as little piping as possible; it should all be on one line, laid with a good and regular pitch, exposed to view as much as possible, and where boxed in, it should be done with screws so that the pipe can at any time be examined. The soil pipe should extend through the roof and should be of sufficient size to prevent clogging by snow or ice, all connections should be trapped and in such a way as to ensure the prevention of the escape of sewer gas. Every water-closet should have a good flush so arranged that the water will reach every part of the bowl liable to be soiled. Such a system of drainage is not expensive out of proportion to the cost of other parts of the house, neither does it require the highest kind of mechanical ingenuity and training to construct it, and any plumber of fair experience with an average amount of skill ought to be able to plan and construct a house drain that will in every way comply with the demands of sanitary science. I do not mean by this statement to underrate in the least the great good that has resulted from the application of the highest skill and ability to some of the sanitary problems that have presented themselves in the past in relation to house drainage, nor do I desire in any way to detract from the well-earned reputation of some of our sanitary plumbers. I only wish to protest against the idea that now these problems are solved, that it still requires the same great ability to do good sanitary plumbing. I refer more particularly to houses of moderate cost, of from two thousand to six or seven thousand dollars. Houses of higher cost are usually planned by professional architects who provide for the drainage.

For the protection of our public water supplies we must rely upon the State and municipal authorities; still, every householder living near a stream or pond used for such a purpose should, as a public duty, see that such water is not in any way, even to the smallest degree, polluted by any act of his either by carelessness or otherwise. We have seen what terrible results have followed the pollution and infection of public water supplies by excreta from persons suffering from typhoid fever, and every precaution should be taken to prevent such pollution, not only in cases of this disease, but in all others. Physicians attending cases of contagious disease near our public water supplies should especially instruct those having the care of the sick in this matter.

How can we best protect our families and others when a case of contagious disease occurs in one of our homes? We have seen that the real source from which these diseases emanate is the bodies of those suffering from them; that in the bodies of such persons, these germs of disease are being multiplied in enormous numbers and that through the secretions they are constantly being thrown off, contaminating everything in the immediate vicinity; therefore, the first and most important step in the way of protecting others is, to place the patient in such surroundings as to exclude contact with others, except so far as is necessary for proper care. In other words, isolation is of the first importance. This isolation of the infected person should be as complete as possible, for no half-way measures will insure protection to the other members of the family. In fact, I might say generally, that half-way or imperfect sanitary precautions are always dangerous, and often may prove worse than no precautions at all, for they lull us into a feeling of security that does not exist and so lead us to neglect precautions that we should otherwise take.

The patient should of course be placed in a room by himself, and kept there until all danger of his communicating the disease has passed. When possible, an adjoining room should be set apart in which the nurse and attendants may change their clothing before visiting other parts of the house. The sick room, after the removal of all unnecessary articles, should be supplied with two or more wash-basins, a large slop jar, a generous supply of small cloths, and a large bottle or jug containing a solution for disinfection. This disinfecting solution is an all-important matter in preventing the spread of contagious disease, for on its potency to destroy all forms of germ life depends the safety of the household, the safety of the community. This solution should always be prepared under the directions of the physician. I beg of you to remember this, never to rely on the patent mixtures that are hawked about the country, and with which every drug-store, and some of the groceries are filled under the name of germicides, deoderizers, etc., no matter what miracles their proprietors may claim they have accomplished; for, in caring for one of these contagious diseases, you are dealing with the most important and weighty concerns of the community, for upon you they must rely for protection against this common enemy, and the principal weapon with which you are to defend them is this disinfecting solution. Let me say to you again, be sure of its potency before you rely upon it. The best disinfectant where solutions can be used, is the bi-chloride of mercury, one part to a thousand of water. You may say this is a deadly poison and its use is dangerous, but all disinfections are poisonous, and so are the germs with which we are dealing, and where the chemical has destroyed one life, contagious disease has destroyed millions. This bottle of disinfecting fluid should be plainly marked.

All of the soiled linen or clothing that is to be washed should be kept by itself. It should be thoroughly soaked in the disinfecting fluid, or else placed in a kettle and thoroughly boiled before any other than the nurse is allowed to handle them. All of the dishes, knives, spoons, etc., used by the patient should be scalded in boiling water, or else washed with the disinfecting solution before, or as soon as they leave the room. No pieces of food should ever be carried from the sick room, they should at once be burned.

In cases of diphtheria we have seen the great source of danger is from the secretions of the mouth and throat. These should receive especial attention. They should be received on small pieces of old cloth, and these should be burned, or if a spit-cup is used it should contain a quantity of the disinfectant, more of which should be added from time to time. In cases of typhoid fever, as the great danger is from the excretions from the bowels, these should be carefully disinfected before they are carried from the sick chamber. The nurse or attendant before visiting other parts of the house, should wash her hands in the disinfecting fluid, step outside the door of the sick-room, exchange her wrapper for another and remove her cap.

When a patient has recovered from one of these contagious diseases, before he is allowed to leave the sick-room, he should be thoroughly bathed, and then dressed in an adjoining room if possible. All of the clothing, bed-linen, etc., that has been used about the patient, should be thoroughly boiled. Articles that cannot be so treated should be hung about the room, and the room, after being made as tight as possible by stuffing the cracks of the windows and doors with sheet wadding, should be fumigated. This should be done by burning at least two pounds of sulphur to every thousand cubic feet of space. For instance, a room twelve feet square and ten feet high would require nearly three pounds. It is far better to use a little more than is required than not quite enough. This fumigation is easily done by using an old iron kettle, coal-hod or any other convenient receptacle that will stand fire. The bottom of this should be covered two or three inches deep with earth or ashes, and on this the sulphur is placed. This can be readily lighted by a cloth or piece of paper saturated with kerosene. This kettle or other receptacle should of course be so placed as to preclude any danger from fire, and left to burn out. The room should remain closed at least twelve hours. At the end of this time, if the fumigation has been properly done, all germ life will be destroyed. It is also well to fumigate the rooms adjoining the sick chamber; at least the one through which the communication with the household has been had should be thoroughly fumigated. Such precautions as these against the spread of contagious diseases are not difficult or expensive, they only require care and thought on the part of nurses and attendants, although it is all important that those precautionary measures may be carried out intelligently; that they know something of the cause of contagion, and wherein the greatest danger lies, and it is for this reason that I have spent so much of the evening in trying to explain the generally accepted theory of the contagious or preventable diseases. One can hardly expect to teach in a single evening, in anything like a clear and connected way, the whole of this theory and what we know of these diseases with which sanitary science has to contend, for the subject is altogether too long for that; neither is it essential to ensure the protection of yourselves and families that you should all be sanitarians, but it is, I believe, very necessary for you to know what is dangerous and what is not, to know how these diseases are communicated from the sick to the well, and above all, to know just what part filth and bad drainage plays in propagating and spreading them. Certainly you cannot know these things without some knowledge of the real cause of contagion. If these terrible maladies that destroy the lives of such a large number of children every year are ever to be eradicated, as I believe they may be, it will be through the intelligent and hearty co-operation of all the people, and such co-operation will only come through the knowledge of the facts I have tried to explain to-night; for I repeat, it is only through such knowledge that they will act intelligently.

We have boards of health in all of the cities and towns of the Commonwealth who have been given great powers by the Legislature, such as are given to no other board or department of the government, for the purpose of preventing and controlling contagious diseases. But that is not all that is necessary to protect the people in this direction, — no matter how able and energetic such boards may be, or how arbitrary their powers, for if they are to be successful in their efforts, they must have the hearty and intelligent co-operation of all the people, and more can be done to destroy and prevent contagion by the individual efforts of those having immediate charge of patients sick with these diseases by careful and considerate work, than any or all of these boards with their great powers. Yes, if sanitary reform is to come at all, it must, like all other reforms, come through the active, energetic and intelligent action of the people themselves, and if I have said anything to-night that has given you a better understanding of these contagious diseases, and that will lead even one of you to a more careful consideration of the safety of your families and neighbors from these diseases, I shall feel that I have done something for my fellow-men, something for my State, and that I have added something to the sum total of human happiness.

Adjourned to Thursday, December 8.

THIRD DAY.

The last session of the meeting was held on Thursday morning, beginning at 9.30, Mr. BROOKS in the chair.

The CHAIRMAN. We are to have this morning, for our opening lecture, a paper on milk farming by a gentleman who keeps a large dairy and furnishes milk to the city of Holyoke and to the village of South Hadley Falls, making it his business — Mr. NEWTON SMITH of South Hadley Falls.

MILK FARMING.

BY NEWTON SMITH OF SOUTH HADLEY FALLS.

Mr. Chairman and Gentlemen of the Board of Agriculture: —I am very far from coming before you as a volunteer. I appear rather as a drafted man; inasmuch as it is at the unexpected and urgent solicitation of our worthy Secretary that I have written a short article. Those who remember our Civil War will recall the fact that the drafted man was either obliged to pay his commutation, furnish a substitute, or go himself. I cannot get excused by paying commutation, the Secretary will not accept a substitute, and there seems no way but for me to do my best, leaving you and the Secretary to suffer the consequences.

Milk is one of the prime necessities of life. While the luxuries of life are generally costly, its necessaries are often otherwise. No doubt the milk producer would sometimes reverse the order of things to his own good fortune and to the misfortune of the consumer. I imagine that if our milk would always command a generous price most milk farmers would consider themselves equal to its production without further discussion of the subject. But milk does not command a generous price. It would seem, then, that a part, at least, of the task in hand is to ascertain, if possible, how, in the present condition of things, we can make milk producing profitable; or, in other words, to show how to be successful in milk farming. Very likely some of you would like to find a way to make it easy also. I assure you that the former is all I care to undertake. But if there are any persons present who think they can show us an easy way to run a milk farm we shall be glad to listen.

The world calls the man successful who amasses wealth. While some through the "illusions of hope" may be sanguine enough to expect to become millionaires, most of us have had the experience of hope deferred so long that we do not expect to be over-burdened with this world's goods. Still, it is well for us to cling to the desire for success, for only by stimulating our ambition can we accomplish sufficient to enable us to claim a position among those who have served their day and generation. We, as farmers, ought to at least be able to leave to our successors a farm free from incumbrance and provided with all the equipments essential for its successful cultivation, with buildings in good repair, the dwelling furnished with all that can make home pleasant, a barn filled with thrifty stock, and fields so fertile that they will be a fountain of income to those who may come after us, and will attest to the success of him who went before. We need not ask the advice of our relatives about the propriety of leaving an investment, larger or smaller, in the bank.

Within the memory of many of us the agriculture of New England has greatly changed. The ready means of transportation from remote sections have brought the crops of the fertile West into competition with our products, reducing the prices of many of our crops below the cost of production. But, with the growth of our manufacturing interests, milk, fruit and vegetables have assumed a much greater prominence. We find farmers successfully making a specialty of the production of each of these, or producing all of them on the same farm, if the soil and location are favorable. The demands of an accessible market will influence a far-sighted farmer to the choice of crops to raise. But we have to consider successful milk production. A very successful farmer has declared that the maintenance of an ever increasing fertility of the soil is essential to successful agriculture.

If this be true of farming in general it must be of prime importance to the milk producer. We should never content ourselves with cutting one ton of hay or harvesting twenty bushels of corn per acre, but rather endeavor to make our acres produce three to five tons of hay, fifty to seventy-five bushels of corn each, and other crops in proportion.

Such an accomplishment would give the ambitious farmer much pleasure, as well as most surely enlarge the margin of profit. When we can gather as much from fifty acres as we formerly did from one hundred we may safely dispose of one half our land. This would enable us to reduce our debts and give us a working capital, or we might invest the proceeds for a rainy day. If we desire to enlarge our farms instead of selling our land we might enlarge our barns, increase our stock, and add to our income by the sale of coarse or over-ripe hay, replacing it with bran purchased of the dealer, for bran is a much better milk-producing food. It may seem to many a visionary or impracticable plan to dispose of part of the farm, but it still remains a pertinent question whether, under the changed condition of things, the farms of the State are not generally too large. If we are to double our crops we should learn how to fertilize them. First, we should save all our stable manure, liquid as well as solid. It may be necessary to cement the cellar bottom to accomplish this, or perhaps it may be done by the use of absorbents. Dry horse manure is excellent for use as an absorbent in the cow stable. If it can be procured at a reasonable price, it is one of the best fertilizing materials in which the farmer can invest money. The solid and liquid excrement of the cows mixed with horse manure makes a better fertilizer than either would be alone. We may safely invest in good wood ashes, also in ground bone and potash, as they are particularly adapted to the production of grass. There may be prepared fertilizers that are equally as good, but so far my experience has not been as favorable to them as I could wish. I have some reason to believe that thus far they have brought more farmers into debt than they have helped out. It is a familiar saying that "out of nothing comes nothing." But when I have seen farmers applying three or four hundred pounds of some highly advertised fertilizer to the acre, I have thought their rendering of it must be "out of nothing comes something." We often read testimonials which say that "in such a year I plowed up an old pasture that produced no grass, and by applying a few hundred pounds of such and such a fertilizer I harvested so many bushels of corn or potatoes." No doubt the statement was correct, but I think the fine crop was due to the years of rest that the old pasture had enjoyed, and improved in accumulating plant food, which, with a little stimulating influence from the fertilizer, caused the grand success. Were I to recommend the use of prepared fertilizers I would say use a generous quantity. Give them a fair show. Carefully observe the result. If permanent benefit be the result I would continue their use. If the contrary, then I would be very cautious about future investments in that line. The proper method of applying stable manure is more easily ascertained than the way to obtain a sufficient supply at a price that we can afford. We have plowed it in and wheel harrowed it in both on sod and on old land. The results in each case have been equally satisfactory. We have top-dressed mowings, not run-out, with good results, while we have felt that our manure was thrown away when applied to mowings that were run-out. We think plowing, cultivating hoed crops, and re-seeding to be the part of true economy for such fields.

Success in milk production depends largely upon the class of cows kept. We may find desirable animals in almost any breed. As a rule the Durham, Dutch, and the Ayrshire are preferable. We have been most successful with medium sized cows. I have no doubt that large cows do better in small herds. Some of the best cows we ever owned were Ayrshire grades. It is not generally believed to be economy for the milk farmer to raise his own cows, but some of the best cows we find among our milkmen were raised by them, though at the expense of considerable extra trouble. Those who have bought many cows know that a large percentage are undesirable and are sold because their owners desired to weed them out. We know that some milk producers are better situated to rear calves than others, and, while I would not advocate it to any great extent, I regret we did not commence a good many years ago by raising a few each year from the best milking stock to be obtained. Some of the essentials for success in milk production are an abundance of proper food, comfortable stables, regularity in feeding, watering and milking. I think there is no doubt about the economy of warming the water in winter. Milking stock should have access to it twice a day. Plenty of good water is very desirable in the milk business. We should not fail to impress upon our help the importance of gentleness, which should be taught by example as well as by precept. I suppose there is no better food for cows giving milk than good pasturing. In a poor pasture they are obliged to work harder than they ought in order to gain their subsistence. Where the feed is poor and the land hilly a small or medium sized cow will do better than a large one. Some meet with good success by keeping cows confined summer and winter, thereby making a largely increased supply of manure. Our cows have some pasturing, but are largely fed at the barn. I think this plan, all things considered, may be best for most of us. I hope the day is dawning when the margin of profit may be further enlarged by feeding a well balanced ration at less cost, and while making milk fully up to the standard, we may do it without sacrificing so many cows. The losses we have met with in our own experience compels me to believe it worthy of our attention. Next we should consider how large an item of saving we can effect by purchasing feed in quantities. By purchasing in car loads at certain seasons of the year a saving of from fifteen to twenty-five per cent. on the winter retail price can be made.

Perhaps a word or two about the care of milk would not be out of place at this point. Every reasonable precaution should be exercised to keep stock and stables tidy. All articles to contain milk should be thoroughly cleansed. Milk should be carefully strained, and that for market would be of a more uniform character if a large can were used for its reception, drawing or turning from that into smaller cans after mixing. These cans should be put into cold water, that should come as high as the milk in the can, so that the animal heat may be removed as soon as possible. Spring water at a low temperature is most desirable and reliable.

If running water is not convenient, greater care should be used in cooling to prevent it from becoming tainted. Cold milk that has been well cared for will give better satisfaction to customers than warm, even to those near at hand, while with those at a distance cold milk is a necessity.

We come now to the disposal of the milk. I have sometimes thought that persons patronizing well-managed creameries, if they did not have to furnish a stated supply and had their skim-milk to raise choice stock with, were better off than those who sell their milk at the low price they are obliged to accept. Those living near a good market for milk, and engaged exclusively in its production, will find it the safest course to dispose of it themselves, especially if dependent upon it for a living. If one can secure a trustworthy man to peddle the milk it will greatly relieve the producer from the strain that comes from carrying on a farm at the same time. It will also give him an opportunity to look more carefully after things at home. This is not always an easy thing to do. Those selling milk at their doors would naturally produce other things and look to the milk as only a partial source of income. Each person must decide for himself after considering his situation in life, the character of his farm, its location, and his willingness to be confined. Perhaps it may be well to glance at some of the things in the business that are obstacles to success. Though we usually have good seasons, with an abundance of forage, we sometimes have dry ones, with a scarcity. If we buy a few superior cows that please us, we also purchase many inferior ones that disappoint us. If we pay high prices for new milch cows, we afterwards trade them off or sell them at an exceedingly low price. Sometimes they become new milch when we expect them to; at others, they surprise us by calving too soon, to their own injury and our consequent loss.

Sometimes sudden death overtakes them, while at other times they linger along with obscure ailments until we are quite ready to welcome their removal. I might speak of our trials as milk pedlers, telling how kind but unappreciated friends come on to our milk route with skim-milk added to new, and with a lower price for a fraudulent article crowd down prices and thus deplete our profits. If we sell milk at our doors there are the irresponsible pedlers who fail to take our product according to contract, or with sadly deficient memory forget to pay for that which they have taken. But I forbear. I feel that I need not allude to the pleasures of milk farming, but will pass on to say that so far as I comprehend the situation, the things essential to success in milk production may be very briefly enumerated. A naturally good farm, well located, is a great consideration. To have it highly cultivated is more than desirable. Let it be stocked with carefully selected cows, well cared for; and let their food be ample and suitable. And to these we may add the need of wise supervision; while all that is lacking should be made up by close application.

As our farm is devoted to milk production, it may be of some interest, and not entirely out of place in closing, to give some account of it together with crops and feeding of stock. There are in the farm ten acres of pasturage, seventy acres of mowing and tillage land and twenty-five acres of light land in a fair state of cultivation. The remainder is unsuitable for cultivation, being covered with wood and brush. It is all together and the interior fences have been removed, leaving only those around the pasture.

The building of a silo two years ago last spring created something of a revolution in our methods. Not that we intended this, so much as that we could not find time to do anything else than to produce material to fill it. Whereas we formerly grew strawberries, potatoes, cabbages, melons, with a little other garden truck, we now grow only corn and hay. We look for an income from the sale of new milk, with a little skim-milk, cream and butter, all sold to consumers. We also sell some hay, and hope to be able to dispose of more when the farm gets in better condition. Our corn for filling the silo is raised on light land and run-out mowings. The grass land is re-seeded as soon as the corn is removed. We use the common kind of corn, that grows eight to ten feet high, for the silo. It is planted in hills seventeen inches apart, it ears out heavily, and is cut when just beginning to glaze. We use Canada ashes, and nitrate of soda to some extent, for top-dressing mowings. So far they have proven quite satisfactory.

We rarely put anything except plaster on pastures. We depend upon our cows being well fed at the barn. Although the pastures have been grazed quite close, there seems to be a gradual improvement. We feed in summer about one-half the grain and ensilage that we do in winter. We are feeding now to each cow, giving milk daily, on an average from ten to twelve pounds of hay and thirty of ensilage, with a grain ration of five pounds of wheat bran, three of linseed meal, and one and a half of gluten meal. The grain is well stirred in with the ensilage at the time of feeding. This ration is proving quite satisfactory, considering its cost.

With reference to warming the water for cows to drink, I will say that when the cold weather set in this fall our cows fell off from forty to fifty quarts a day, but as soon as we began warming the water the yield of milk increased and the percentage of cream also increased about one-half a space, so that we are now getting about ten and a half spaces of cream where we were getting from nine and a half to ten a short time ago. Our cows are neither bought nor fed with any reference to butter-making; they are sort of "go-as-you-please" cows, and the skim-milk seems to have a very good body indeed after the cream is taken off.

QUESTION. How many cows do you keep?

Mr. SMITH. We have 74 in all. We have been getting from 62 cows, for the last few days, 650 quarts of milk a day. We were down as low as 560 quarts at one time before we commenced warming the water. As soon as we commenced warming the water they went up to a little over 600 quarts.

QUESTION. How warm is the water?

Mr. SMITH. About eighty degrees, though we do not always get the same temperature.

QUESTION. How do you warm the water?

Mr. SMITH. We have a steam boiler standing in a building near the trough the cattle drink from and the water runs through a pipe to the trough. Sometimes we merely let the hot water run through the boiler, and at other times we get up a little more steam and heat the water to a higher temperature.

Mr. Edson of Barnstable. I understood the gentleman to say that he planted his corn only seventeen inches apart and it eared out well. Does he mean both ways?

Mr. Smith. No, sir, I mean in the rows.

Mr. Edson. Do you plant it about three feet the other way?

Mr. Smith. Three and a half feet. If you put on manure enough it will ear out well, but if you put it on light land, without any dressing, the corn will run up a single stalk without foliage or ears.

Mr. Edson. I must say I have been very much pleased with the paper and I hope it has opened a discussion of the silo question so that we will all learn something from the experience of one another. I think these experience meetings are worth a great deal to every farmer. I believe the silo has come to stay. I have been in favor of the silo for the last ten years, but the expense and trouble of getting steam works and a cutter to cut the ensilage before it goes into the silo has always held me back. I did not want to go to the expense of getting a steam engine and cutter to cut what little ensilage I wanted; I knew it would not pay. But when they began to put it in whole and found it kept well, I built a silo, and I think, as far as my experience goes, that the ensilage that comes out of my silo is better than that which comes out of silos where it is cut up fine, and I think it keeps better. My mode of packing is to begin at one end, put the butts out in the silo and then lap them over, just the same as you would shingle a building, being very careful in packing them and tramping them down. Then I commence at the other end, go back, pack them very close, and tramp them down in the same manner. I think the ensilage keeps better and there is less air in it. If we cut it up into inch pieces the juice is apt to run out and the ends of the pieces are filled with air, so that we get a good deal more air into the silo with cut ensilage than we do when we put it in whole. After hearing Prof. Goessmann some years ago state that the proper time to cut the corn fodder for the silo was when the corn was just glazed, I adopted the plan of going through the field and gathering the corn when it was just glazed over, throwing it upon the ground, and cutting my fodder right up and putting it into the silo. I found that in that way I got very good ensilage. This year I took an acre for an experiment. I have kept an accurate account of the cost of everything, — plowing, harrowing, tilling, and the dressing put on the field. I planted my corn three feet apart one way and eighteen inches the other, with four grains in the hill. The variety was what they call the capped Canada. I got eight tons of ensilage from that acre, which, according to the professor's statement, is worth $4 a ton, making $32. The whole cost of that acre, including the interest on the value of the land and the taxes, amounted to $32.10. I got forty-five bushels of corn, which cost me just ten cents. I think I can do it again right along every year, and if we can raise corn in New England for less than a cent a bushel I think we can do a good thing. According to the statements that have been made of the value of ensilage, we can raise corn so that the ensilage will pay the whole expense of raising it and we get our corn for nothing. We can get from forty-five to seventy bushels to the acre in that way. I do not know that any other corn than that small Canada would ear out and perfect itself planted so close together. Mind you, that is about three times as close as we generally plant corn. You get a large amount of ensilage and that corn will perfect itself just as well planted close in that way as it will planted further apart.

QUESTION. How much forage are you able to sell from that small farm besides supporting those seventy or seventy-five cows?

MR. SMITH. Last year we sold about sixty tons of hay, but the year previous we did not sell any, so that to state it fairly, inasmuch as we sold some hay that we had left over the previous year, I should say we sold between forty and fifty tons, as we had twelve or fifteen tons left over.

MR. MYRICK. How much ashes do you put on your mowing land?

MR. SMITH. We put on from twenty-five to thirty-five bushels of unleached ashes and about a hundred pounds of nitrate of soda. Last year, where we used Canada ashes and nitrate of soda, it was on ground which had been mowed the previous year. I should say that the previous year was the first year of mowing after we had had ensilage on the field. We planted Southern white corn, which grew enormously, but the grass crop the succeeding year disappointed us; we did not get as good returns as we expected. We supposed it was because of the heavy draft the corn made upon the soil. But this last year we applied, after our manure was exhausted, about thirty-five bushels of Canada ashes and a hundred pounds of nitrate of soda to the acre, and the first crop, I think, was as much as three tons to the acre and two tons the second. I do not know but it was equally good as where we put on fifteen heavy loads of manure to the acre. I think it was.

QUESTION. What will be your chance for the next crop?

Mr. SMITH. I think it will be first-rate, because we top-dressed it this fall with manure.

Mr. FITCH. I was exceedingly glad when I saw the subject that was announced for yesterday afternoon's lecture, and, lest I mistake, I will just read it,— "Business Side of Farming and Value of Organization." It seemed to me that the lecturer handled the business side of farming very well, in general. Now, the question comes, what about the business side of farming? How much does it mean? How much did he make it mean? He made it mean, I think, a little more than this Board, that I am now addressing, has made it mean for the last fifteen or twenty years. If you will take the reports of this Board for the last fifteen or twenty years and read them through, you will find this statement to be true in respect to every one of them, without a single exception. You will find that they are occupied with telling how to feed hens; with telling how to feed cattle; with telling how to improve the breeds of cattle; with telling how to build a silo; how much corn to feed; how much cotton-seed meal to feed; exactly how many ounces of ensilage and how many ounces of this, that and the other; how much manurial value there is in different articles of food, and so on. You have not said one single word about the business matter of disposing of the products of the farm. Now, to-day the milk which was forty cents a can twenty years ago is from twenty to twenty-five cents, and all this while you have been telling farmers how milk could be made a great deal cheaper than they have been making it; but who has got the benefit of making that milk cheaper? Is it business-like to tell a farmer how he can make milk much cheaper and not say one word about the disposal of it? It seems to me it would have been better if you had adopted the sentiment that was expressed by the lecturer yesterday afternoon, that the business side of farming covers both the production and the sale.

As secretary of the Milk Producers' Union I have had this subject under consideration for some time, and I will tell you what has been the result of one business operation of that sort. A few years ago some milk producers got together and formed an association. They wanted to know about this great milk question. Boston consumes between four and five million dollars' worth of milk every year, and has in the past six years increased its consumption fifty per cent. I have it from Mr. Babcock within three days. But during that time something has happened. The Milk Producers' Association succeeded in getting a law passed to prevent the adulteration of milk. Just before that law went into operation in 1884, it was ascertained, as nearly as could be, that about sixty per cent. of the milk that was sold in Boston was more or less adulterated. In 1885, under the operation of the law, the percentage of adulteration went down to some thirty per cent.; in 1886 it was only from twenty to twenty-five per cent.; and so far in 1887 it is only about twelve per cent. These figures are from newspaper reports and are not, perhaps, exact, but they will be accurately presented in the official report of the inspector in the course of another month.

Now we will come to business. In 1884 Boston was paying one hundred thousand dollars, at least, a year for water that was put into the milk which it consumed. During the past year the probability is that the city has not paid over twenty-five or thirty thousand dollars for water put into milk. The milk association has saved that amount of money to the city of Boston alone.

I say we mean business, and now we ask you, the State Board of Agriculture, the State Board of Health, and any other public officials who have anything to do with this matter, that they shall do for the farmers of Massachusetts just exactly what the Boston Milk Inspector does for the consumers of milk in that city. If the producer takes a quart of milk to him and asks him to inspect it he will not do it; he told me so. He cannot do it; he cannot protect the producer at all. But the State Board of Health can take your milk and tell you whether it is fit to go to Boston or not. We ask that the State Board of Health may be memorialized by this Board for such action by them as shall put the producers of milk in Massachusetts on an equal footing with consumers in this respect.

Now in regard to the law. We want it changed so that a contractor can be prosecuted for having bad milk in his possession just as much as a pedler or a farmer. If you will find me a case where a contractor has been punished by a fine of fifty dollars within two years I will agree to pay you ten dollars, unless it was a case where the contractor pedled milk also.

The Chairman then called upon Mr. Z. A. GILBERT, Secretary of the Maine State Board of Agriculture.

Mr. GILBERT. Mr. Chairman and Gentlemen, — I am here only to acknowledge your call at this time and to express thanks for the compliment tendered to me. I am here primarily for the purpose of gaining something of inspiration from meeting with you farmers here assembled, and also to gain something in the way of information which may aid me in carrying on a similar work in my own State. I wish to congratulate you at this time, and especially your Secretary, on the excellent programme which he has succeeded in bringing out and on the high character of the papers which have been presented. They certainly are a compliment to his good judgment and a high compliment to those who have presented them. It would be interesting if I had the time to refer to some of the salient points, and I will venture to do so in one direction, and that only.

I have been especially interested in the matter of business principles applied to agriculture. I feel that this is a feature of the agriculture of the present day which has been overlooked in our efforts before the public. There is business in agriculture; there is a call at the present time for the application of business principles in agriculture. We have been teaching our boys as we have brought them up on the farm and engaged them in the work of the farm, that "to dig and to hoe, to eat and to grow" was the business of New England agriculture. This is all wrong. There is something more to it than simply to dig and eat. We want to inculcate in them and to realize ourselves that there is something of ambition connected with agricultural affairs, that there is some chance for the rising generation and for ourselves to gratify this ambition. There are ample opportunities for doing this. Modern methods are opening to view that which we have not heretofore been able to see, and many of us old fellows, who are engaged in the work of the farm, are carrying on that work in accordance with the ideas that we gained in our early days instead of in accordance with the developments which have recently been made. These developments in the way of farm implements, farm appliances and methods of work are presenting New England agriculture in a different light from that in which we have heretofore been accustomed to look at it, and opening up a more hopeful view than we have heretofore entertained in regard to it. There are opportunities, let me repeat, for the gratification of ambition here in New England, and we want to hold that fact out as an inducement to our young men to remain on the farm. You have some worthy examples of this application of business principles and the application of capital to agriculture here in your own State; we have them in Maine, every New England State has them, and the extent to which this capital can be applied, and profitably applied, has not been measured. I was gratified by the statement of the speaker yesterday when he said, — and he might have put it much stronger, — that the capital invested in New England agriculture was paying a handsome percentage of profit to-day. I would put it even stronger than that. I would say that there is no business carried on in New England at the present time that on the average yields so large a percentage of profit to the investor as the business of New England agriculture does to-day. [Applause.] And, gentlemen, as a single illustration which occurs to me at this point, let me say to you that in the most productive sections of Massachusetts, or on your good land here in this State, are opportunities for carrying on the business of butter making, through the creamery system, which afford to capitalists a chance for investment that is worthy of their attention, and I am confident that it can be carried on to a large extent. You may see in Berkshire County in this State, you may see in my own County of Androscoggin in the State of Maine, and in Kennebec County, creameries carried on where every pound of fodder fed to the animals is purchased and where experts are employed in every department of the work, that are realizing a handsomer profit from the investment than is now realized from the manufacturing establishments in Lawrence, Lowell or Lewiston. [Applause.]

Mr. Myrick. I should like to ask Mr. Smith what he calculates it costs to peddle milk?

Mr. Smith. If a person's time is not worth much of anything, if he would not do anything else, it would not cost much. That is what I think of my time sometimes, so I keep on peddling. I cannot tell you exactly what it costs. There is this much about it. If you are engaged in a large milk business it would be hardly safe for you to entrust the sale of your milk to others, for they might leave you at any time and you would have all your milk on your hands and no sale for it. It would be an unsafe business.

Mr. Myrick. What do you get for your milk at retail?

Mr. Smith. Six cents a quart.

Mr. Myrick. Would you sell it on your farm at four cents?

Mr. Smith. In the winter season we cannot do anything else.

Mr. Fitch. I can answer that question as far as Syracuse, N. Y., and Lowell are concerned, for I have investigated that thing in both places. It costs a very small fraction of a mill over three-quarters of a cent a quart to handle the milk of the city of Syracuse. In Lowell it is just about one cent a quart, and a fraction over one cent in

Boston. We have allowed in our calculations a cent and a half, but it does not cost that according to the figures.

Mr. BROOKS of Springfield. It costs the Springfield Association a good deal more than three-quarters of a cent a quart. It costs about three-quarters of a cent to send our wagons into the country, bring the milk in here, and then it costs us to hire men, carts and horses to distribute it, two cents a quart. We sell milk at six cents a quart; we sell buttermilk at a good price sometimes; we sell what skimmed milk we can. We do not buy any milk; we bring our stockholders' milk in here, we pay our expenses and what is left we divide among the producers *pro rata*.

QUESTION. I would like to ask Mr. SMITH if he can tell us how many quarts of milk his cows average per day throughout the year.

Mr. SMITH. I could not. We change our cows more or less. It is more profitable to change them than to keep on with the same animals. We rarely run below nine quarts a cow, and we are milking from that up to eleven quarts. Then we have a certain percentage of dry ones. We think it is better to sell some cows pretty cheap and replace them with others, in order to keep up our yield of milk.

QUESTION. How many pounds of feed do you give your cows per day?

Mr. SMITH. I think I stated that in the paper. Twenty-five pounds of ensilage, five pounds of wheat bran, three pounds of linseed meal, one-half pound of gluten meal. But you must bear in mind that all our corn goes into the silo. Instead of harvesting our corn, as the gentleman spoke of over there and saving it, we prefer to let it go into the silo.

Mr. BURGESS. Can you give us an estimate of about what it costs to produce the milk at your farm?

Mr. SMITH. I could not. It has been our intention always to keep our bills paid as we went along, and if we got out of money we knew that the business was not paying. (Laughter.)

Mr. FITCH. I will answer two of the questions. From as careful calculations as can be made it is found that not far from seven quarts a day, taking the average through the year, is the production of the cows of Massachusetts. There are certain farmers that get considerably more, but those cases are where the herds are small ones and the animals are taken excellent care of.

Now as to the question of cost. That we have figured very carefully. We find that, reckoning simply the cost, no profit whatever, and taking the year together, the average cost is not far from two cents and six mills a quart.

The CHAIRMAN. We are now to have a paper on Creameries from Mr. L. T. Hazen of Hazen's Mills, N. H.

CREAMERIES.

L. T. HAZEN OF HAZEN'S MILLS, N. H.

Mr. President, Ladies and Gentlemen: — When your honored Secretary wrote asking me to read a paper at this time upon the subject of creameries, I felt I could not; that there would be so many present who knew so much more than I did and were so much better able to express themselves that I would appear insignificant beside them. After considering the matter for a time, the old saying, that the strong often gained strength from the weak, came to my mind, and gave me courage to feel that I might be able to throw out at least one idea that would be of value in the discussion of the subject. Your Secretary suggested an outline for me to follow, as far as I might be able, and the first topic suggested was the building. We may have different ideas as to what would be a suitable building. One says get everything into as compact form as possible, while others, and I am one of them, say give us room enough so that we may have space for everything and then see that everything is in its place. To best illustrate my views I will describe my own creamery, which I do not know how I could improve according to my own ideas, although, to save work perhaps, my men would like to change some things which I will mention later. My building is 24x48. The basement is used for creamery work, and overhead is a tenement for my butter maker. The basement is four feet under ground and six above. As you go into the end of the building you enter a room 12x16 that is used as a wash-room for the cans, bowls and all other articles used in the creamery and also for steaming tubs, boxes, etc. In this room are running water and steam works for heating water, steaming tubs and boxes. The next room is 16x24 with an 8x12 from the end of the first room. This room is used for churning, working, printing and tubbing the butter. The next room is divided into one 10x22, in which are an ice-water tank for shot-gun cans, so called, and a Cooley creamer of the largest size. The other part is fitted for a first class refrigerator. On the back side of this building is a lean-to 12 feet wide, in the basement of which is my engine. Above is my separator, the milk of which is carried out in a movable iron pipe into barrels, from there to the hogs and calves. I put the engine and boiler out here so as not to heat up the rooms where we do our work. The upper floor is just the right height to handily take milk cans from wagons for the separator. I have a ten-horse power boiler in which I make the steam to carry in pipes to my barn and silo, where I have another engine to do my thrashing and cutting of ensilage. The cost of this building was about $1,200. Where stone are less plenty and lumber higher, of course the cost would be correspondingly increased. The expense for machinery would be, — for the separator, if you used one, $350; two churns $80 (I like two that will churn about 100 pounds better than one larger one); butter worker $20, and about $300 for boxes, cans, etc. With this outfit you are prepared for the product of from 600 to 1,000 cows. I have all of the buttermilk carried outside in cans and emptied into barrels. The men think this unnecessary work and that we could carry it out in a pipe. My idea is that there would be an odor from such a pipe, and it would be hard to convince me to the contrary. The universal testimony of all that visit my works, is to the sweetness of the creamery. A Boston dealer was there last summer, and the first remark he made was, "How sweet it smells!" He afterwards said he had been in a good many creameries, but was never in one that smelled so sweet, and, as I afterward learned, he told his men that they could tell their customers from him that they could depend upon the butter being clean.

We will now enter upon dangerous ground, viz., the manner of conducting the creamery. I call this dangerous ground as I am aware that there are advocates of both systems present, — the whole-milk and the gathered-cream system. Notwithstanding the contrary opinion of many present, I must advocate the whole-milk system. Where the patrons live near enough to make it practicable, I can do it with good grace, as I honestly believe, and my experience backs me up in that belief, that better butter can be made where the whole milk is brought. It brings the whole work under the control of the butter-maker, who knows that he is alone responsible if the quality is not up, and knowing that his reputation is at stake, he will be more watchful to have everything just right. If the business is run by the gathered-cream system, and any of the butter is a little off, the butter-maker can say, "I noticed that such a lot of cream was not just right, but I did not think it was quite as bad till I had it churned;" or, "it was the cream of the president or superintendent and I did not dare speak of it," and knowing that he can thus excuse his failures he would be more than human if he did not sometimes get careless. Again, the creamers should be emptied and thoroughly scalded every other day. I mean by this the tank. Methinks I hear some one say, "That is all bosh. I don't scald mine once a month, and my cream is all right." Allow me to say to such a one that you are the very man that your butter-maker has been scolding about all summer. I have cream raised by the Cooley process and in large open pans. The milk in the open pans always sours a little so they know that they must always scald their pans, but the Cooley cans are so sweet that they say they are all right and put the milk in day after day. Some use ice and are more particular to empty and scald the cans, while others use running water and think their cans cannot require cleansing. We soon detect a very little off in their cream. Next time a little more. So we give them a blowing up and the quality is up again. I said blowing up, as we have found that mild persuasion did not always answer, any more than grass did for the boy in the apple tree we read of in our old spelling books. Again, many of our farmers have not suitable milk-rooms, and some have them so near their kitchens that the cream becomes impregnated with the mingled odors of onions, cabbage, turnips, fried ham and doughnuts from the cook stove. All of these are good in their place, but combined in the butter I do not think them any improvement. Now if the whole milk comes to the creamery, all of these troubles and many more not enumerated, will be obviated. Now if it comes to the creamery as whole milk, how will you get the cream? I should say by the separator process. First, because I believe you can get more butter; second, that properly handled, it will be as good; third, it is much less work; fourth, the skim-milk is fresh and much nicer to feed, particularly to calves. Cleanliness is absolutely necessary in making good butter. In creameries it is always observed. The butter-maker knows this fact. He also knows that the eyes of all of the patrons are upon him, and to hold his position, he must at all times have everything in shape for inspection. In the home dairies some are very particular to have everything perfect, some do very well, others would if they had suitable arrangements, while still another class have not the faculty and could not do well if they would. I have now described my idea of a creamery, — what it should be and how, according to my views, it should be managed. We will now consider a few of the needs and benefits of the system. First, if you have thirty or fifty patrons you would have as many different kinds of butter, if it were made in farm dairies, while in the creamery it is all brought to one uniform quality.

Perhaps it is not as good as some of the dairy butter, but much better than the average. Next, who are the ones most benefited by the creamery system? First, those that cannot, for various reasons, make a good article at home, and they are many. Some of the reasons are perhaps beyond their control. One, for instance, may be the health of the wife. She is not able to put the necessary work into it, and if they do not feel able to hire, she, day by day, works along, doing each day more than she is able, making an inferior article of butter. Another reason, and one we often meet with, is the want of suitable rooms and machinery. To illustrate that, I will give one item of my experience when I was a butter buyer in Vermont. I called at one house, examined their butter, found it nice and bought it for forty cents a pound. I then drove to the next house, examined theirs and offered them thirty. They asked if I had bought Mr. C.'s and what I paid. I told them, and said that Mr. C.'s butter was very much nicer than theirs. The man then commenced abusing his wife for the poor quality. I stopped him and told him that there were many things required to make good butter. First, it required good cows. He said, "I have as good cows as Mr. C." Then I told him it required good feed and care. He said, "My cows are as well fed and cared for as his." I then said it required a good butter-maker, calculating that I would next come to what I considered the main cause. He again commenced abusing his wife, making her feel badly, and, being an excellent, hard-working woman, I could but feel for her, and I again stopped him and told him that there was one more very important thing to have, and that was a suitable place to keep the milk and butter in. He said, "I know that Mr. C. has a much better milk-room than I have, but I had thought mine would do until I was able to build better." I proposed looking at his milk-room. We did so, and I saw that there was not a single convenience, nor was there a proper place for doing any part of the work. I gave him a Scotch blessing for abusing his wife, and he took it kindly. I then showed him how he could easily and cheaply make suitable changes, bought his butter for the thirty cents and left. The next year I was over the same ground again, called first on Mr. C., then went to this house and found some fine butter and everything nice and convenient. I told him that I had bought Mr. C.'s butter and would give him the same price on one condition, and that was that he should first ask his wife's pardon for the way he treated her the year before. He said he thought that was pretty tough, but he guessed he ought to do it, and he did.

He then said he would not have believed that a good place in which to make it could make so much difference with the quality of the butter, if he had not tried it. He said it had also made as much difference in the work of his wife. I have occupied your time telling this, believing that in this way I could better and more plainly show you the importance of having everything just right.

Another class have good cows, feed them well, take excellent care of them, have perfect arrangements in the house, and make a first-rate article of butter, which sells for a good price. They will not perhaps get quite as much money out of it at the creamery, but they will be more than paid in seeing the restful look in the countenances of their wives and daughters, which will ten times pay them for the small deficiency in their receipts. One of the greatest benefits of the creamery system is its influence as an educator. It introduces new associations, new practices, new ideas and provokes new trains of thought.

The example of the creamery with its improved methods, turning out improved goods, that bring improved prices, is a powerful stimulus to thought and progress. With it not only come new methods, but they are fully discussed and, as the different patrons meet and discuss the success of the enterprise, they bring the thoughts home to themselves and find that some with an equal number of cows are producing much more than others. Why is that? is asked, and they find such a one has improved cows that he feeds well, has good warm stables, weighs the milk of each cow, keeps a record of each one, and when he finds one that does not pay he sells her and buys another; therefore he concludes he will get a bag of meal, a little bran, batten his barn a little and see if it makes any difference. He finds the difference so great that he begins to test his cows and finds that, while he has some good ones, he has others that are almost worthless. The result is a continued improvement in his stock, and the improvement does not stop here. He improves his barns and sees the benefits in increased receipts. He begins to look over his farm to see where he can increase his products so as to enable him to keep more stock. You will soon see an improvement in his whole place, and a general degree of thrift is manifest in his whole surroundings. The creamery thus becomes a stepping-stone in the path of progress, leading to a higher condition both agriculturally and socially. It is a good missionary station introduced into any neighborhood where there are cows enough to sustain it. Show me a section where there is a successful creamery and I will show you good farms under a high state of cultivation, good buildings, and better yet, happy households filled with choice reading, both agricultural and literary.

It may be a little off the subject to speak of breeds and feed, but they are so important to the success of the creamery that I shall ask you to bear with me while I briefly touch upon them. The patrons, as well as the creamery men, have duties to perform. It is not enough that they milk what their cows give, strain into the cans and wait for the wagon. It is important that the most perfect cleanliness is observed in every department. It is their duty to feed and care for their stock in such a manner that the milk will be of good quality, for on the quality of the milk depends the quality of the cream and butter. The best butter-maker in the world cannot make gilt-edged butter from poor milk. Many things may affect the quality, but good feed and care are fundamental requisites, without which the best quality cannot possibly be secured. The quality depends, also, to some extent, upon the breed of the cow as well as upon her individual peculiarities. I would reiterate that, whatever the breed, feed and care are important factors in the quality of the butter obtained.

How shall we dispose of our butter? This is a question that causes all butter-makers much thought, and it is one I do not as yet feel competent to answer. All of the different ways have their advantages and disadvantages. By making a strictly first-class article, advertising it well and sending about ten pounds at a time, so that it will always be fresh, we can work up a good retail trade at good prices, but there is lots of work in it. It also requires a superior force of book-keepers to keep the run of it all, especially if you are doing a large business. Again, with less effort you can work up a retail grocers' trade; and, if he is in a good locality for first-class trade, you can work up good prices from him. But the difficulty here is that so many of that class are not responsible, you must needs know your man to be safe. Taking all things into consideration, as things now are, I am of the opinion that we will be as well off to put our butter up in the best possible style. If in tubs, get the best. If in small boxes, have the different styles so that you can give each customer what he wants. I find that some want the square five and ten pound boxes, while others won't have them, but want the round. Then have good style of print and good packing-boxes to send your prints in and you are ready to send at any time just what is ordered. I find that at different seasons of the year it is wanted in different styles. Now select a good reliable commission house and send it to them every week, or twice a week, and let them work up a trade and I think you will be as well off in the end as in any other way. Another plan has been talked of by creamery men, and that is to form an association of creameries, rent a store in the city and put competent men into it, and let the association of creameries send their butter there. I am not prepared to decide to my own satisfaction as to the advisability of this plan, but am of the opinion that, properly managed, it could be made to pay. There are objections to the plan, the greatest of which I think is, we should have the combined forces of the commission houses to fight. But with proper care in putting our butter up, with salesmen that are honest, and that would take pains to court good trade, I think this objection could be overcome and in time a good business could be worked up and good prices obtained.

Mr. Fitch. Is not the difference between cream-collecting and milk-collecting the question of the purchase by the farmer of a creamery and the other things necessary? He can ship his milk immediately in the one case, in the other he has the trouble of collecting the cream.

Question. I would like to ask if it is anything more than theory that the milk-gathering system produces better butter than the cream-gathering system?

Mr. Hazen. It is the actual fact in my own experience.

Question. May I ask what it is based upon?

Mr. Hazen. It is based upon fact. As I stated, there is greater care exercised over the product from milk or cream in a creamery than can be exercised in the very best farm-house.

Question. What is the test of good butter?

Mr. Hazen. The mouth and the sense of smell.

QUESTION. I am speaking of the sale of the product. Is it the amount that it brings, or what is it?

Mr. HAZEN. The amount that it brings and the satisfaction it gives the consumers.

QUESTION. Is it a fact that butter produced under the milk-gathering system brings more in the commission houses of New York and Boston than butter produced under the cream-gathering system?

Mr. HAZEN. The best answer that one can give to that is his own experience. We have patrons who have for the last three or four years, previous to this year, brought us cream; this year they have brought milk, and the butter from the milk brought by those patrons has been at least five cents a pound higher than it was the years before.

Mr. ———. Mr. Hazen states that he uses a separator to separate the cream from the milk, that he gets more butter from the milk with the separator than by any other process, and that the skim-milk is better for feeding purposes. The question I would like to ask is, does the separator add anything to the value of the milk for feeding?

Mr. HAZEN. In regard to that I will briefly say that I raise from fifty to seventy-five calves per year, and I have never been able to shift from separator milk to whole milk as food for calves without making sick calves.

QUESTION. Do you lay the sick calves to yourself or the milk?

Mr. HAZEN. I lay it to the milk. I do not consider that it is because the milk was so much richer, but because the condition of the milk rendered it more easily digestible by the calves.

Mr. FITCH. I can furnish to any community that wishes to make a trial of this thing, machinery which will enable them to do it for $500, provided they have a room 24x30 and two sheds in addition, 12x8. If they have a room as large as that, well situated, and can get ice, I will show them the figures which will satisfy them that for $500 they can put in sufficient machinery and every appliance necessary to handle the milk from 100 to 300 cows. Then if they choose to sell their milk they can sell it; if they choose to churn it right away they can do that. They can try it both ways. The other way is to go and ask somebody who has creamery apparatus to sell, and he will tell you you must have $2,000 for a building and $3,000 for your machinery and appliances.

Mr. PARSONS of Northampton. I would like to inquire of the writer of this interesting paper what cows he keeps; and I would also like to inquire the price he gets for the article he makes, so that we can judge for ourselves in regard to the value of the separator.

Mr. HAZEN. The breed of cows which I keep myself are pure Jerseys. The price of the butter varies materially. I have a certain class of customers. I look them over before setting the price and see how much they will stand, and my price varies all the way from thirty-two cents on commission to seventy-five cents retail.

Prof. ALVORD. I want to ask Mr. HAZEN one question before he leaves the platform. Has he made any comparison between the keeping qualities of the butter made from what I may call sweet milk and from milk separated?

Mr. HAZEN. When I first commenced running my separator I had not quite learned how to handle the cream, and I shipped to New York some butter made in three ways, — one by the "shot-gun can," so called, — that is, an open can set in a tank of ice-water; one by the Cooley process, and one by the separator. It was shipped in open cars, without any protection against the heat, and before it got to New York it struck a temperature of 95 degrees, and the butter melted down a good deal. It was all very much damaged, but the separator butter was more damaged than either of the other kinds, the "shot-gun can" butter the least. But I think I have since learned how to handle the separator butter so that it will stand shipping better.

Mr. WILKINSON of Holyoke. I would like to know the difference between the keeping qualities of skim-milk by the ice system and the separator system.

Mr. HAZEN. I have not had very much experience in that. During the season of summer travel we do ship, to some extent, skim-milk to the mountain hotels, and make no charge for it. We sell them our butter at good prices, and give them the skim-milk. We run the milk directly through the separator and ship it at once. But there are two processes of preparing that milk which will enable us to keep it. One is to put it into ice-water and chill it down at once. Another is to heat it up to a temperature of 130 or 140 degrees. I will say that one of the Greenfield, N. H., creameries is the only one I know of where the skim-milk is all carried back to the farms from which the new whole milk comes. They found a great deal of trouble there, and they tried the experiment of heating the separator milk up to 140 degrees, or about there, and then cooling it down, and they claim that it will keep perfectly sweet for three or four days when treated in that way.

Mr. Clark of Wilbraham. I would like to ask Mr. Hazen how much he pays per pound to his patrons for their butter? In our co-operative plan, all through here, we publish every month just how much our patrons get. I do not understand from him what his patrons get. Will he please state, for instance, what his patrons realized in October for their butter per pound?

Mr. Hazen. For the milk that is delivered to me I pay one dollar a hundred the year round. They are to furnish me, on an average, through the winter months, one-quarter what they do through the summer months. They deliver it at the factory.

Mr. Clark. How much butter will that hundred pounds of milk make in the separator system of making butter?

Mr. Hazen. That is a very broad question. In my own herd the largest amount that I have ever found in the month of June was eighteen pounds of milk for one pound of butter. The average for the year is between sixteen and seventeen. We have one patron whose milk has averaged for this summer about nineteen pounds; another about twenty-one pounds. The food has more to do with the quantity of milk that it takes to make butter than the separator, the so-called "shot-gun can," the Cooley system, the churning of the milk, or anything else.

Mr. ———. It seems to me that there are two or three points, or features, which have not been brought out in this discussion. I would like to refer to them very briefly. One of them is the matter of delivering the milk to the creamery, which results in depriving the farm of the skim-milk. There are some of us who believe that that system has gone by years ago, and that this cream-gathering system is the most successful; that the old method of hitching up our teams and delivering milk once or twice a day is entirely out of the question. I do not think that many in these days would be willing to go into any such arrangement.

Mr. HAZEN. In regard to that I would say that all of my patrons who deliver milk have the privilege of taking the skim-milk at one-fourth of a cent a pound or twenty-five cents a hundred, or such a proportion of it as they want. On the question whether it pays or not, I will say that we have one patron who lives about two miles from me and keeps twenty cows. He made a test of one week each way with the Moseley, a standard creamery, and with the separator process, to see whether it would pay him best to keep his milk at home or bring his milk to us, and he became satisfied, after one week's test each way, that it paid him better to bring his milk to the factory than it did to be at the expense of getting the ice and making his butter at home. Then I had a breakage of my separator, and had to send it away to be repaired, and during that time he made another test of eight days. That was in the month of June, when milk was supposed to be the richest of any part of the season. He was more thoroughly convinced by that test than he was before that it paid him to bring that milk every morning.

Mr. STOCKBRIDGE. I want to know Mr. Hazen's opinion in relation to the policy of managing a farm in that way, by carrying the milk all off.

Mr. HAZEN. I say they have the privilege of taking the skim-milk back if they see fit.

Mr. STOCKBRIDGE. I do not ask what the farmers think about it. I want Mr. Hazen's opinion.

Mr. HAZEN. That method would apply just as well to them as it would to the milk-seller. Where you carry the milk from the farm you take off from 20 to 22 per cent. of the material that would otherwise go to increase the fertility of your farm. Where you carry off nothing but cream, you only take about three per cent.

QUESTION. You think, then, that they better keep the milk at home?

Mr. HAZEN. It is possible that they can make more by selling the milk and buying fertilizers to bring the farm up.

Mr. F. H. WILLIAMS of Sunderland. Let me ask this question: Did the man who brought this milk raise any pigs or calves?

Mr. HAZEN. Yes, sir; he raises his calves and a pig or two to furnish him with what pork he wants to eat. It may pay him better to feed it out.

Mr. MYRICK. I understand that you pay one dollar a hundred pounds for milk delivered at your factory, and that the patrons of the factory can have the skim-milk back for twenty-five cents a hundred pounds. In other words, the patron who returns the skim-milk to his farm gets seventy-five cents a hundred for the milk furnished, and carries the hundred pounds of milk both ways, to and from the factory. Is that the size of it?

Mr. HAZEN. That is the size of it.

Prof. ALVORD. In the first place, let me remark that I should advise that man who tried the creamery against the separator to try again before he came to a final conclusion. In the second place, I want to ask Mr. HAZEN whether his patrons who bring their whole milk to the factory bring it once or twice a day?

Mr. HAZEN. Once a day.

Prof. ALVORD. At what time?

Mr. HAZEN. In the morning.

Prof. ALVORD. How do they take care of the night's milk?

Mr. HAZEN. They strain it and set it in a tank with the covers on over night.

QUESTION. Do you allow them to bring the cream, or must all your patrons bring milk?

Mr. HAZEN. I allow them to bring it in any way they choose?

QUESTION. Do you consider butter made from the separator equal to that made from the open setting?

Mr. HAZEN. I do, sir.

Question. Do you consider butter-milk of much value as a food for calves or pigs?

Mr. Hazen. It helps to fill up the pigs. I have not tried it on calves.

Question. What separator do you use?

Mr. Hazen. The Davol.

Question. I would like to ask whether it is as advantageous to the patrons to be paid by the pound for their milk as it would be to be paid for their cream under the Cooley cream-gathering system? We have dairies in our town which will vary from five to ten per cent. in the amount of cream from a given quantity of milk. I should hate to put my milk into a separator creamery where I was to be paid for it by the pound.

Mr. Hazen. I would state in answer to that, that I am doing the creamery business simply for the accommodation of my neighbors. (Laughter.) I told my neighbors last year if they would build a co-operative creamery in the part of the town where most of them lived I would give them the benefit of whatever knowledge I have of the business and give them $200 out of my own pocket rather than take their cream or milk. I should run my creamery for my own herd to the best of my capacity. I do not ask any man to bring his milk in and sell it by the hundred pounds. You cannot make the milk of all farmers equal, but there is a test churn manufactured whereby the milk can be churned and each patron day by day given the exact percentage of butter realized from the amount of milk delivered by him, so that, with the assistance of this test churn, you can judge very nearly whether or not you are getting your exact dues.

Mr. Cushman. We have heard from the manufacturers' side of this milk question, but the question which interests a large proportion of the milk producers before me is, how they are to get out from under the control of the milk contractors of whom we have heard this morning. We have heard how little we can make when selling our milk at three cents a quart, while our brothers in New York and elsewhere are selling their milk at two cents a quart during the year. Nevertheless, many of us have been engaged for a score of years in furnishing milk to the Boston market. I believe that it is best for every milk seller to work up his surplus milk on his farm. I suffered myself to be kept for many years under the iron heel of the Boston contractors, but finally I made up my mind to be independent, so far as the production of milk was concerned. You can, any of you, if you have the Cooley system of raising cream, purchase a butter-worker, a swing churn and all the apparatus for making butter on your own farm, for a sum not exceeding $60 or $70, and then when the Boston contractors or the New York contractors say to you that they will not take your milk, you will have a system on your own farm by which you can manufacture your own butter. I believe we cannot afford to have our milk taken from our doors, much more harness our teams and carry it to a butter factory, even at one cent a quart more than our friend is paying. Any farmer can put milk into the Cooley creamery any day he pleases; he can churn the cream with his churn and work it with his butter-worker; he can keep a detailed and accurate account of every hour's labor, and when he gets through he will know something about what his milk is worth to work up at home and whether he can afford to sell it to a Boston or New York contractor or not. He can make some simple experiments with his skim-milk that will satisfy him whether it is worth half a cent a quart, or one cent or two cents. The point I want to make is, if you are keeping anywhere from ten to twenty cows, if you cannot get capital in any way to buy this system, sell one or two of those cows and invest the money in apparatus for butter-making, and you do not know how much better you will feel, knowing that you can control your own business and are not in the iron grip of any man.

Mr. Fitch. I want to say Amen!

Mr. Williams. I would like to ask the gentleman last up, one question. He says we want to be thinking men. He seems to be a man who has experimented with the Cooley creamery. I want to ask him how many spaces of cream it takes to make a pound of butter?

Mr. Cushman. I was fortunate enough to find a market for my cream in the city of Boston. I have made very little butter for the last three years. But I will say that I have never been able, when I have experimented, to get as good results from milk that has been carried two or three miles as I get from milk directly from the cow. I put the temperature right down from 90 degrees to 45 as quickly as possible, and under the most favorable circumstances I have been able to get a fine yield of cream.

On motion of Mr. HARTSHORN of Worcester, the meeting then adjourned *sine die*.

SPECIAL MEETING.

A special meeting of the Board was held in Springfield, Thursday, Dec. 8, 1887, at nine o'clock A. M.

Members present: Messrs. Brooks, Burgess, Clark, Cushman, Edson, Goddard, Goessmann, Hartshorn, Hersey, Howes, Porter, Slade, Smith of Amherst, Smith of Deerfield, Stockwell, Taft, Upton, Ware, Wheeler and Wood.

Mr. Velorous Taft was elected chairman.

In conformity to the vote passed at the last Annual Meeting concerning the holding of Farmers' Institutes, Mr. Hersey, as chairman of the committee then appointed, reported the following: —

While your committee do not recommend the adoption of rigid rules, they would suggest that the Board recommend that societies decide as early in the season as possible the number of Institutes, if more than three, they will hold during the year, the subjects they wish to have discussed, and also the speakers desired, and send their decisions to the Secretary of the Board, whose duty it shall be to arrange the meetings and assign the speakers in such a manner as shall be most convenient.

Your committee would recommend that where societies are favorably located for holding a union meeting, that two or more unite and hold a Union Farmers' Institute; and it is recommended that it shall count as one Institute to each of the societies thus united.

Your committee would recommend that the Secretary of the Board be requested to be present at such Union Institutes and take part in the exercises, providing it does not interfere with his other duties.

Your committee would recommend that the Secretary of the Board be requested to ask of the State an appropriation of one thousand dollars, to be expended under chapter 20, section 10, of the Public Statutes, for lectures before the Farmers' Institutes.

In conclusion your committee would suggest the employment of home talent. The local farmers should be encouraged to take part in the discussions, and speakers from abroad be the exception rather than the rule.

After some discussion by Messrs. Ware and Hersey the report was accepted and adopted.

The Board then adjourned.

ANNUAL MEETING.

The Board met at the office of the Secretary, in Boston, on Tuesday, January 31, 1888, at 12 o'clock, it being the Tuesday preceding the first Wednesday in February. In absence of the Governor, on motion of Mr. Bowditch, Mr. GRINNELL was called to the chair.

Present: Messrs. Brackett, Brooks, Bowditch, Bird, Clark, Cushman, Cruickshanks, Damon, Douty, Edson, Grinnell, Goddard, Goessmann, Hill, Howes, Hersey, Hartshorn, Porter, Smith of Deerfield, Snow, Stockwell, Taft, Upton, Wood and Wheeler.

Voted, To dispense with the reading of the minutes of the last Annual Meeting. The records of the special meetings were read and accepted.

Voted, To appoint a committee of three to examine and report upon the credentials of newly elected members: Messrs. Hartshorn, Bird and Cushman.

Voted, To adopt the order of business of 1885, with an amendment so that the hours of meeting for the second and succeeding days be from 9.30 to 12.30, and from 2 to 4.30 o'clock.

Reports of delegates being in order, Mr. Sessions reported on the Amesbury and Salisbury; Mr. Edson reported on the Berkshire; Mr. Upton reported on the Blackstone Valley; Mr. Brooks reported on the Deerfield Valley; Mr. Damon reported on the Hampden.

The Board then adjourned until 2.30 P. M.

The Board was called to order at 2.30 P. M., Mr. GRINNELL in the chair.

The Committee on Credentials, to which was referred the credentials of newly elected members, reported the following members duly elected: —

At large, appointed by the Governor, Dr. George B. Loring.

Massachusetts Horticultural Society, .	E. W. WOOD.
Massachusetts, ...	E. F. BOWDITCH.
Amesbury and Salisbury, . . .	WM. H. B. CURRIER.
Blackstone Valley, ...	VELOROUS TAFT.
Berkshire, ...	ALONZO BRADLEY.
Hampshire, Franklin and Hampden, .	F. K. SHELDON.
Hampden, ...	GEO. S. TAYLOR.
Housatonic, ...	J. H. ROWLEY.
Middlesex, ...	W. W. RAWSON.
Marshfield, ...	GEO. J. PETERSON.
Hingham, ...	EDMUND HERSEY.
Hampden East, ...	WM. HOLBROOK.
Hoosac Valley, ...	S. A. HICKOX.
Nantucket, ...	CHAS. W. GARDNER.

It was voted that the report of the Committee on Credentials be laid upon the table.

On motion of Mr. Hersey, a committee of three was appointed to prepare resolutions on the death of Dr. James R. Nichols of Haverhill: Messrs. Grinnell, Hersey and Varnum.

Mr. Hartshorn reported on the Barnstable; Mr. Clark reported on the Hampden East; Mr. Snow reported on the Hampshire; Mr. Douty reported on the Highland; Mr. Goddard reported on the Hoosac Valley; Mr. Howes reported on the Hillside.

Mr. GRINNELL, being called away, asked Mr. UPTON to take the chair.

Mr. Cruickshanks reported on the Marshfield; Mr. Taft reported on the Martha's Vineyard; the Secretary read the report of Mr. Bartholomew on the Middlesex; Mr. Stockwell reported on the Housatonic; Mr. Hersey reported on the Middlesex South.

The Governor, coming in, took the chair.

Mr. Stockwell reported on the Plymouth; Mr. Zeri Smith reported on the Union; Mr. Wheeler reported on the Worcester; Mr. Porter reported on the Worcester North; Mr. Cushman reported on the Worcester West.

On motion of Mr. Hersey, a committee of five was appointed to consider and report what changes should be made in the Law for the Inspection of Fertilizers: Messrs. Hersey, Hartshorn, Goessmann, Cushman and Taft.

The Board then adjourned.

SECOND DAY.

The Board met at 9.30 A. M., Mr. GRINNELL in the chair.

Present: Messrs. Bird, Bowditch, Bradley, Brooks, Clark, Cruickshanks, Currier, Cushman, Damon, Douty, Edson, Goddard, Goessmann, Goodell, Grinnell, Hartshorn, Hersey, Hickox, Holbrook, Howes, Loring, Lynde, Peterson, Porter, Rawson, Rowley, Sheldon, Smith of Amherst, Smith of Deerfield, Snow, Stockwell, Taft, Taylor, Upton, Varnum, Ware, Wheeler, Whiting and Wood.

Minutes of the previous day read and approved.

Mr. Hersey, for the Committee on Changes in the Fertilizer Law, reported that the committee were unanimously of the opinion that several changes should be made in the law.

The report of the committee was accepted.

Voted, That a committee of three be appointed to bring the matter to the attention of the Legislature: Messrs. Goessmann, Hersey and Cushman.

Mr. Varnum reported on the Bristol; Mr. Wood reported on the Essex; Mr. Goodell reported on the Massachusetts Horticultural; Mr. W. W. Smith reported on the Middlesex North.

The several reports of the delegates were taken up, read by their titles and accepted.

Voted, That the time for the election of Secretary be fixed at 11 o'clock, Thursday, and that the election of a member of the Board of Control take place immediately afterwards.

Voted, To appoint a committee of three on assignment of delegates: Messrs. Stockwell, Lynde and Bradley.

Mr. Damon read the report of the Committee upon the Agricultural College, which was accepted and adopted as the report of the Board to the Legislature.

Report of the Committee on Credentials was taken from the table and adopted.

Voted, To appoint a committee on time and place for holding the Country Meeting: Messrs. Cushman, Hartshorn and Hickox.

Voted, To appoint a committee of three on the changes of time for holding fairs: Messrs. Bird, Holbrook and Snow.

Voted, To appoint a committee of three on Essays: Messrs. Wood, Taylor and Cruickshanks.

Dr. Lynde read an essay on "The Chemistry of the Kitchen," which was accepted, adopted and ordered to be printed in the Secretary's report.

The Board then adjourned until 2 P. M.

The Board was called to order at 2.15 P. M., Mr. GRINNELL in the chair.

Mr. Grinnell, from the committee, then submitted resolutions of respect to the memory of James R. Nichols: —

Resolved, That by the death of Dr. James R. Nichols of Haverhill, long a member of this Board of Agriculture, those of us who enjoyed the pleasure of his personal acquaintance have lost a friend endeared to us by the loveliest traits of humanity; this Board one who up to the limit of his health and strength was an earnest, devoted co-laborer; and the people of this State one foremost in the development of scientific agriculture, who united the theories of science with the practical operations on the farm in a manner, and in language, clear, forcible, attractive and intelligible to all.

Resolved, That this action of the Board be sent to the family of Dr. Nichols, and printed in the papers of the day.

Dr. Lynde moved the adoption of the resolutions, and made a feeling and eloquent address upon the life and accomplishments of Dr. Nichols.

Mr. Ware seconded the motion of Dr. Lynde, and addressed the Board in eulogy of his deceased friend.

Mr. Hersey advocated the resolutions in well-chosen words, expressing his affection and respect for Dr. Nichols; also alluding to the long and faithful services of Captain Moore.

Mr. Grinnell also paid an eloquent tribute to the memory of his friend and long-time associate on the Board.

The resolves were unanimously adopted.

Mr. Stockwell moved that a committee of three be appointed to consider the subject of Tuberculosis among Cattle, and report to the Board at some future time. Laid on the table.

Mr. Stockwell read an essay on "Our Homes, their Power and Influence," which was accepted, adopted and placed on file for printing.

President Goodell read an essay on "Agricultural Education," which was accepted, adopted and ordered to be printed.

Voted, That a committee of three be appointed to nominate members of the Examining Committee of the Agricultural College: Messrs. Varnum, Taylor and Zeri Smith.

The Board then adjourned.

THIRD DAY.

The Board met at 9.30 A.M., Mr. GRINNELL in the chair.

Present: Messrs. Bowditch, Brackett, Bradley, Clark, Cruickshanks, Currier, Cushman, Douty, Edson, Goddard, Goessmann, Goodell, Grinnell, Hartshorn, Hersey, Hickox, Howes, Loring, Peterson, Rowley, Sheldon, Snow, Smith of Amherst, Smith of Deerfield, Stockwell, Taft, Taylor, Varnum, Ware and Wood.

Minutes of the previous day were read and approved.

Voted, That a committee of three be appointed to nominate members of the Executive Committee: Messrs. Goddard, Cruickshanks and Snow.

Mr. Ware reported on the Franklin; Mr. Bird reported on the Hingham.

Accepted and adopted.

The Committee on Time and Place for holding the Country Meeting reported by their chairman, Mr. Cushman, that the meeting should be held at Easthampton, on Tuesday, Wednesday and Thursday, December 4th, 5th and 6th. The report was accepted and adopted.

Voted, That a committee of five be appointed on Country Meeting: Messrs. Sheldon, Zeri Smith, W. W. Smith, Taylor and Clark.

The Committee to report names for the Executive Committee reported as follows: Messrs. Slade, Bowditch, Hersey, Hartshorn and Rawson, — who were elected.

Voted, That they be made a Committee on Printing.

The Committee on Changes of Time for holding Fairs, reported that the time for holding the Massachusetts Horticultural Society Fair be September 18th, 19th, 20th and 21st. The report was accepted and adopted.

The Committee on Essays reported as follows: —

ESSAYS.

Market Gardening,	W. W. Rawson. G. B. Loring.
Massachusetts Agriculture,	J. S. Grinnell.
A Hundred Acres, or More,	E. Cushman.

The Committee to report names for the Examining Committee of the Agricultural College reported as follows: Messrs. Taft and Taylor, — who were elected.

Dr. C. A. Goessmann, State Inspector of Fertilizers, presented his report, which was accepted and adopted.

Mr. Stockwell made a report on the assignment of delegates as follows: —

Amesbury and Salisbury,	Zeri Smith.
Bay State,	J. S. Grinnell.
Barnstable,	A. Bradley.
Berkshire,	E. Cushman.
Blackstone Valley,	S. A. Bartholomew.
Bristol,	B. Douty.
Deerfield Valley,	G. S. Taylor.
Essex,	W. H. Snow.
Franklin,	E. F. Bowditch.
Hampden,	F. G. Howes.
Hampden East,	V. Taft.
Hampshire,	J. H. Rowley.
Hampshire, Franklin and Hampden,	N. Edson.

Highland, ...	S. A. Hickox.
Hingham, ...	C. W. Gardner.
Housatonic, ...	W. W. Smith.
Hoosac Valley, ...	S. W. Clark.
Hillside, ...	F. K. Sheldon.
Massachusetts Horticultural, . .	G. Cruickshanks.
Marshfield, ...	S. B. Bird.
Martha's Vineyard, ...	C. L. Hartshorn.
Middlesex, ...	W. H. B. Currier.
Middlesex North, ...	E. W. Wood.
Middlesex South, ...	B. P. Ware.
Nantucket, ...	J. H. Goddard.
Plymouth, ...	W. W. Rawson.
Union, ...	H. L. Whiting.
Worcester, ...	A. C. Varnum.
Worcester North, ...	G. J. Peterson.
Worcester North-west, . . .	Wm. Holbrook.
Worcester South, ...	E. Hersey.
Worcester West, ...	G. B. Loring.

It being 11 o'clock, the special assignment was called up, and Messrs. Taft, Hartshorn and Rowley were appointed a committee to receive, sort and count the ballots for Secretary. The committee reported the unanimous re-election of William R. Sessions. W. W. Rawson was elected a member of the Board of Control, also by ballot.

The motion to appoint a committee to consider whether any action on the subject of Tuberculosis in Cattle is necessary was taken from the table, discussed and carried.

Messrs. Loring, Taft and Lynde were appointed a committee.

Voted, That all unfinished business, and any new business that may arise before another meeting of the Board, be referred to the Executive Committee, with full power to act for the Board.

The Board then adjourned to 2 P. M.

The Board met at 2.30 P. M., Mr. Grinnell in the chair.

Voted, That the time for holding the fairs of the several societies in the future be the same as recorded on page 415 of the Secretary's Report of 1885.

Voted, That the Executive Committee, with the Secretary, compile the laws regulating the action of the Board of Agriculture and the several agricultural societies of the State, together with the rules of the Board regulating the action of the societies, and cause them to be printed in pamphlet form and also in the Secretary's Report.

Voted, That the Secretary be instructed to examine the historical sketches of the several societies now on file in the office, and that he request the delegates from those societies of which no sketch appears, to cause one to be prepared and forwarded to the Secretary. Also to instruct the Secretary to report at the next annual meeting on the propriety of printing the same in the next annual report.

Voted, That the Executive Committee and Secretary consider the propriety of holding a public meeting in Boston on the fourth day of the next annual meeting, and report at the Country Meeting in Easthampton.

The minutes of the last day were then read and accepted.

Adjourned.

WILLIAM R. SESSIONS,
Secretary.

THE FINANCES OF THE SOCIETIES.

FINANCES OF THE SOCIETIES.

SOCIETIES.	Amount received from the Commonwealth.	Income from Permanent Fund.	New Members and Donations.	All other Sources.	Receipts for the Year.	Premiums Offered.	Premiums and Gratuities Paid.	Current Expenses for the Year, not including Premiums and Gratuities Paid.	Disbursements for the Year.	Indebtedness.	Value of Real Estate.	Value of Personal Estate.	Permanent Fund.
Amesbury and Salisbury, . .	$309 50	$60 61	$138 44	$785 81	$1,294 39	$585 00	$367 85	$449 17	$817 02	-	-	$2,458 74	$2,096 49
Barnstable, . .	600 00	16 00	147 60	1,161 35	1,924 95	1,631 75	1,037 85	874 83	1,912 68	-	$5,800 00	900 00	6,700 00
Berkshire, . .	600 00	649 86	246 00	7,050 31	8,546 17	3,463 50	2,883 75	1,421 45	8,172 70	$5,000 00	11,500 00	373 47	11,873 47
Bristol, . . .	600 00	-	857 70	12,202 10	13,659 80	6,000 00	5,109 20	8,745 04	13,854 24	17,500 00	30,000 00	500 00	12,500 00
Blackstone Valley,	465 00	-	34 00	1,162 26	1,661 26	827 75	636 81	696 04	1,332 85	400 00	3,000 00	300 00	3,300 00
Deerfield Valley, .	600 00	-	164 50	1,066 50	1,831 00	840 00	703 05	845 46	1,548 51	-	8,000 00	1,000 00	9,000 00
Essex, . . .	600 00	773 32	246 25	650 00	2,269 57	3,620 00	1,629 00	905 26	2,534 26	-	5,000 00	1,000 00	18,303 05
Franklin, . .	600 00	19 01	155 00	1,796 95	2,570 99	1,117 00	805 25	1,162 48	2,422 73	-	10,000 00	800 00	10,800 00
Hampden, . .	565 00	-	17 50	2,437 65	3,020 15	2,033 20	870 07	939 07	1,809 14	-	-	-	-
Hampden East, .	600 00	-	136 63	2,208 99	2,945 62	975 45	975 45	1,957 71	2,932 96	850 00	7,000 00	-	7,000 00
Hampshire, . .	600 00	-	96 34	895 52	1,591 86	773 00	691 95	788 36	1,480 31	918 45	4,100 00	150 00	3,300 00
Hampshire, Franklin and Hampden,	600 00	325 09	263 00	3,001 27	4,011 27	1,040 50	828 25	1,043 25	3,675 74	5,213 00	8,800 00	460 53	-
Highland, . .	600 00	-	41 00	1,299 18	1,940 18	894 55	622 95	1,328 90	1,928 90	275 00	3,000 00	-	3,000 00
Hingham, . .	600 00	-	167 35	3,640 09	3,867 44	1,664 05	772 07	2,478 18	3,178 45	2,700 00	18,000 00	2,000 00	18,000 00
Hoosac Valley, .	600 00	-	589 00	3,976 35	5,165 35	1,745 00	1,338 25	2,681 54	5,019 79	2,000 00	12,900 00	450 00	11,350 00
Housatonic, . .	600 00	1,196 36	284 67	4,089 46	6,170 49	3,134 50	2,787 00	3,950 21	6,844 04	265 15	8,500 00	1,290 63	9,790 63
Hillside, . . .	600 00	-	238 20	825 01	1,663 21	702 00	658 94	1,004 27	1,663 21	400 00	4,487 99	122 02	4,087 99
Marshfield, . .	600 00	-	389 25	2,260 80	3,244 05	1,175 00	1,295 95	1,986 40	3,179 35	4,500 00	11,806 92	1,392 78	7,306 92
Martha's Vineyard,	600 00	146 20	14 00	269 28	1,029 48	760 50	616 03	319 23	935 26	-	2,200 00	1,150 00	3,350 00
Middlesex, . .	600 00	-	80 00	1,479 20	2,159 20	1,208 00	798 25	1,313 29	2,111 54	20,920 00	15,000 00	-	2,080 00
Middlesex North, .	555 00	389 75	33 00	853 58	1,841 33	1,223 00	622 50	918 83	-	1,700 00	20,000 00	200 00	20,000 00
Middlesex South, .	600 00	-	620 15	11,599 79	12,819 94	1,038 35	888 90	10,845 04	13,883 94	6,500 00	15,000 00	-	15,000 00
Nantucket, . .	600 00	50 00	48 25	548 05	1,246 30	1,259 50	633 55	530 32	1,146 87	475 00	3,000 00	200 00	3,200 00
Plymouth, . .	600 00	200 00	616 90	5,274 36	6,521 26	3,051 25	2,214 95	4,781 85	6,996 80	8,600 00	43,000 00	2,000 00	40,000 00
Union, . . .	600 00	-	121 00	1,530 25	2,251 25	1,628 25	1,004 97	966 09	1,971 06	-	7,270 78	1,532 89	9,539 47
Worcester, . .	600 00	-	445 00	2,914 28	3,959 28	10,000 00	3,165 00	472 16	3,637 16	46,000 00	130,000 00	100 00	84,000 00

Worcester North, .	600 00	-	943 00	500 00	12,409 68	1,300 00	1,157 06	1,071 07	11,885 80	-	4,500 00	700 00	3,500 00
Worcester North-west, ...	600 00	-	115 00	3,300 36	4,015 36	2,004 75	1,396 81	1,373 97	4,170 78	900 00	13,000 00	811 17	12,911 17
Worcester South, .	600 00	1,538 87	84 00	3,893 36	4,577 36	2,566 00	2,183 00	2,438 49	-	-	15,300 00	1,000 00	16,000 00
Worcester West, .	600 00	1,010 87	440 00	274 45	2,325 32	1,567 60	1,142 09	710 96	2,292 96	-	11,600 00	806 11	12,406 11
Massachusetts Horticultural. . .	600 00	-	1,510 00	29,890 00	32,000 00	6,873 00	5,565 00	19,435 00	25,000 00	37,000 00	250,000 00	43,250 00	220,000 00
	$18,094 50	$6,375 91	$9,312 73	$112,835 56	$154,533 51	$66,712 45	$45,351 75	$78,432 92	$138,339 05	$162,116 60	$681,765 69	$64,948 34	$580,395 30

PERMANENT FUND.—HOW INVESTED.

AMESBURY AND SALISBURY.—Deposited in bank.
BARNSTABLE.—Real estate and government bonds.
BERKSHIRE.—Real estate.
BLACKSTONE VALLEY.—Real estate.
BRISTOL.—Real estate.
DEERFIELD VALLEY.—Bank funds and real estate.
ESSEX.—Bank stock and farm.
FRANKLIN.—Real estate and bank stock.
HAMPDEN.—
HAMPDEN EAST.—In land and buildings.
HAMPSHIRE.—Real estate.
HAMPSHIRE, FRANKLIN AND HAMPDEN.—Real estate and personal property.
HIGHLAND.—Real estate.
HILLSIDE.—Land and buildings.
HINGHAM.—Land and buildings.
HOOSAC VALLEY.—Real estate.
HOUSATONIC.—Real estate, railroad bonds, bank funds.
MARSHFIELD.—Land and buildings.
MARTHA'S VINEYARD.—Land, buildings, notes.
MASSACHUSETTS HORTICULTURAL.—Real estate.
MIDDLESEX.—
MIDDLESEX NORTH.—Land and buildings.
MIDDLESEX SOUTH.—Real estate.
NANTUCKET.—Land and buildings.
PLYMOUTH.—Real estate.
UNION.—Real estate and cash.
WORCESTER.—Real estate.
WORCESTER NORTH.—Real estate.
WORCESTER NORTH-WEST.—Land and buildings.
WORCESTER SOUTH.—Land and buildings.
WORCESTER WEST.—Real estate.

ANALYSIS OF PREMIUMS AND GRATUITIES AWARDED.

SOCIETIES.	Total Amount offered for Management and Improvement of Farms, Orchards, etc.	Total Amount paid for Management and Improvement of Farms, Orchards, etc.	For Neat and Dairy Stock.	For Horses.	For all other Farm Stock.	Total Amount offered for Live Stock.	Total Amount paid out for Live Stock.	For Cereals and Seeds.	For Roots and Vegetables.	Total Amount offered for Grain and Root Crop.	Total Amount paid out for Grain and Root Crop.	For Fruits, Flowers, etc.	For Dairy Products.	For Bread, Honey, and Preserved Fruits.	Total Amount paid out under the head of Farm Products.
Amesbury and Salisbury,	$100 00	$70 00	-	-	$18 00	$25 00	$18 00	$10 00	$31 00	$160 00	$61 50	$95 10	$3 25	$3 50	$145 35
Barnstable,	182 00	38 50	$141 00	$64 00	115 25	442 75	320 25	27 25	69 60	140 50	96 85	91 50	20 50	41 00	249 85
Berkshire,	203 00	164 00	455 00	219 00	304 00	1,325 00	978 00	158 00	131 00	317 00	289 00	138 50	43 00	63 50	534 00
Blackstone Valley,	110 00	103 00	263 00	21 00	94 00	518 00	394 50	7 00	16 50	29 75	23 00	34 50	9 00	8 00	58 86
Bristol,	250 00	136 00	862 00	332 00	256 50	1,700 00	1,450 50	25 00	109 50	275 00	134 50	242 40	61 00	33 00	470 90
Deerfield Valley,	-	-	168 00	129 00	137 75	615 00	434 75	9 25	4 00	21 50	13 25	49 50	13 00	19 25	95 00
Essex,	385 00	128 00	283 00	207 00	88 00	1,770 00	608 00	29 50	95 50	255 00	100 00	414 25	24 00	27 50	670 75
Franklin,	-	-	169 50	122 00	212 50	707 00	504 00	10 00	35 75	71 00	45 75	97 25	15 00	25 25	183 75
Hampden,	191 00	22 00	131 00	43 50	59 75	733 00	166 63	5 75	39 75	226 25	45 38	113 00	5 00	10 00	142 75
Hampden East	98 00	-	173 00	91 00	103 00	657 00	357 00	25 00	25 75	95 50	58 75	45 25	15 00	13 00	124 00
Hampshire,	-	-	96 00	131 00	208 00	549 00	435 00	6 00	19 50	47 00	31 00	72 00	9 00	14 25	127 25
Hampshire, Franklin, and Hampden,	20 00	-	303 00	162 00	120 00	636 00	539 50	14 00	43 50	105 00	56 25	88 00	31 00	24 00	189 50
Highland,	40 00	30 00	176 00	111 00	70 00	579 00	357 00	16 50	28 75	47 00	45 25	20 75	9 50	17 00	92 50

Hillside, . . .	-	17 00	161 00	114 00	32 00	309 00	365 00	29 35	13 60	-	40 85	38 25	23 00	17 00	105 60
Hingham, . .	224 75	19 00	244 50	69 00	168 30	809 25	481 80	-	33 75	187 00	33 75	121 77	15 50	21 65	192 67
Hoosac Valley, .	75 00	69 00	153 00	178 00	250 50	796 00	579 50	158 50	81 50	253 00	240 00	97 75	47 00	45 50	430 25
Housatonic, . .	212 00	179 00	442 00	253 00	795 00	1,576 00	1,382 50	347 00	106 00	509 00	490 00	160 00	51 00	88 00	752 00
Marshfield, . .	73 00	34 00	179 00	71 00	132 50	482 50	357 50	-	60 75	99 00	-	97 00	19 00	38 00	204 90
Martha's Vineyard,	28 00	7 00	91 50	50 00	124 50	350 50	266 50	35 50	31 79	124 50	54 50	52 75	19 00	28 70	167 74
Middlesex, . .	-	-	96 00	114 00	253 00	1,024 00	360 50	6 25	50 00	134 50	42 25	207 25	6 00	33 00	293 50
Middlesex North, .	9 50	9 50	193 00	151 00	102 50	703 00	446 50	11 00	38 00	54 00	42 00	190 50	10 00	44 75	-
Middlesex South, .	45 00	24 00	114 00	80 00	111 50	376 50	259 50	14 25	30 25	69 00	43 75	65 85	5 00	21 25	105 55
Nantucket, . .	123 00	-	133 00	70 50	54 00	660 00	256 00	20 75	46 75	225 75	-	68 50	14 00	17 75	167 75
Plymouth, . .	201 00	-	385 00	122 00	221 00	832 00	728 00	9 25	18 50	54 00	12 75	163 55	36 00	21 25	248 55
Union, . . .	86 00	-	286 75	121 00	120 25	885 75	498 50	5 75	17 75	66 50	35 00	42 50	13 75	5 75	86 25
Worcester, . .	-	-	1,320 00	293 00	310 00	4,357 00	1,763 00	57 00	130 00	300 00	196 00	357 50	145 00	18 00	682 00
Worcester North, .	24 00	24 00	125 75	69 00	85 05	279 80	224 50	5 75	13 30	-	19 10	64 25	10 00	12 00	105 35
Worcester North-west, . . .	22 00	21 67	323 00	148 00	134 00	971 50	588 17	48 00	13 00	87 00	56 34	40 75	15 00	12 00	121 42
Worcester South, .	95 00	45 00	618 00	863 00	211 00	2,088 00	-	14 50	19 50	131 00	63 50	99 75	32 00	30 00	225 25
Worcester West, .	65 00	30 00	281 00	167 00	81 50	752 00	514 50	10 50	5 00	62 00	9 00	40 80	18 00	14 50	168 30
Massachusetts Horticultural, . .	750 00	50 00	-	-	-	-	-	90 00	175 00	250 00	175 00	6,044 00	-	-	5,465 00
	$3,612 25	$1,220 67	$8,397 00	$4,566 00	$4,973 35	$27,599 55	$15,635 10	$1,216 60	$1,534 54	$4,396 75	$2,554 27	$9,454 72	$737 50	$768 35	$12,606 54

ANALYSIS OF PREMIUMS AND GRATUITIES AWARDED.— *Concluded.*

SOCIETIES.	For Agricultural Implements.	Offered for raising Forest Trees.	For experiments in Manures.	Amount awarded for Objects strictly Agricultural, not already specified.	Amount awarded and paid out for Trotting Horses.	For Objects not strictly Agricultural; Domestic Manufactures.	Number of Persons who received Premiums and Gratuities.
Amesbury and Salisbury,	$9 50	$10 00	$15 00	-	-	$107 00	185
Barnstable,	-	30 00	-	-	$230 00	199 25	446
Berkshire,	27 00	-	-	$52 00	750 00	378 75	430
Bristol,	150 00	23 00	60 00	-	2,223 00	662 00	450
Blackstone Valley,	-	-	-	-	-	80 45	172
Deerfield Valley,	-	-	-	4 00	50 00	119 30	310
Essex,	27 00	30 00	25 00	88 00	-	180 75	367
Franklin,	-	10 00	-	-	450 00	118 00	274
Hampden,	50 00	30 00	15 00	18 00	400 00	133 05	125
Hampden East,	-	25 00	-	-	405 00	-	112
Hampshire,	12 00	16 00	-	23 00	15 00	94 70	159
Hampshire, Franklin and Hampden,	16 00	20 00	-	-	333 05	87 76	184
Highland,	-	-	-	-	37 00	106 45	185
Hingham,	-	63 75	-	-	-	99 60	325
Hoosac Valley,	10 00	-	10 00	33 00	950 00	218 50	275
Housatonic,	-	-	-	31 00	665 00	375 00	492
Hillside,	11 00	-	-	-	-	97 60	387
Marshfield,	1 50	50 00	-	-	414 00	147 12	408
Martha's Vineyard,	-	5 00	9 00	-	-	171 79	182
Middlesex,	5 00	50 00	-	-	100 00	-	-
Middlesex North,	-	-	-	-	-	-	282
Middlesex South,	-	45 00	-	1 35	350 00	88 45	182
Nantucket,	-	21 00	15 00	-	-	132 55	250
Plymouth,	5 00	60 00	-	-	975 00	208 40	370
Union,	3 00	-	-	-	312 00	135 40	224
Worcester,	-	-	-	-	2,355 00	198 00	298
Worcester North,	13 00	25 00	-	25 00	480 00	297 46	283
Worcester North-west,	7 25	30 00	-	-	595 00	78 99	156
Worcester South,	13 50	35 00	-	-	575 00	108 25	202
Worcester West,	2 00	30 00	10 00	-	488 00	63 15	192
Mass. Horticultural,	-	10 00	-	-	-	-	213
	$362 75	$618 75	$159 00	$275 35	$13,152 05	$4,687 71	8,120

OFFICERS OF THE AGRICULTURAL SOCIETIES, 1888.

AMESBURY AND SALISBURY.

President — F. W. SARGENT of Amesbury.
Secretary — JOHN Q. EVANS of Salisbury.

BARNSTABLE.

President — AZARIAH ELDRIDGE of Yarmouthport.
Secretary — FRED C. SWIFT of Yarmouthport.

BAY STATE.

President — EDWARD BURNETT of Southborough.
Secretary — W. S. LINCOLN of Worcester.

BERKSHIRE.

President — HENRY A. BARTON, Jr., of Dalton.
Secretary — WM. H. MURRAY of Pittsfield.

BLACKSTONE VALLEY.

President — DANIEL W. TAFT of Uxbridge.
Secretary — WM. L. JOHNSON of Uxbridge.

BRISTOL.

President — PHILANDER WILLIAMS of Taunton.
Secretary — D. L. MITCHELL of Taunton.

DEERFIELD VALLEY.

President — Dr. JOSIAH TROW of Buckland.
Secretary — M. M. MANTON of Charlemont.

ESSEX.

President — B. P. WARE of Beach Bluff.
Secretary — DAVID W. LOW of Gloucester.

FRANKLIN.

President — JOHN S. ANDERSON of Shelburne.
Secretary — FREDERICK L. GREENE of Greenfield.

HAMPDEN.

President — CHARLES F. FOWLER of Westfield.
Secretary — ETHAN BROOKS of West Springfield.

HAMPDEN EAST.

President — DR. WILLIAM HOLBROOK of Palmer.
Secretary — O. P. ALLEN of Palmer.

HAMPSHIRE.

President — D. A. HORTON of Hadley.
Secretary — FRANK E. PAIGE of Amherst.

HAMPSHIRE, FRANKLIN AND HAMPDEN.

President — EDGAR M. SMITH of Deerfield.
Secretary — L. C. FERRY of Northampton.

HIGHLAND.

President — AUSTIN STOWELL of Peru.
Secretary — JONATHAN McELWAIN of Middlefield.

HILLSIDE.

President — ALVAN BARRUS of Goshen.
Secretary — WM. G. ATKINS of West Cummington.

HINGHAM.

President — EBED L. RIPLEY of Hingham Centre.
Secretary — WM. H. THOMAS of Hingham.

HOOSAC VALLEY.

President — J. M. WATERMAN of Williamstown.
Secretary — H. CLAY BLISS of North Adams.

HOUSATONIC.

President — JOHN B. WALKER of New Marlborough.
Secretary — HENRY T. ROBBINS of Great Barrington.

MARSHFIELD.

President — JOHN H. PARKS of Duxbury.
Secretary — FRANCIS COLLAMORE of Pembroke.

MARTHA'S VINEYARD.

President — WM. J. ROTCH of Tisbury.
Secretary — B. T. HILLMAN of Chilmark.

MASSACHUSETTS.

President — THOS. MOTLEY of Jamaica Plain.
Secretary — E. F. BOWDITCH of Framingham.

MASSACHUSETTS HORTICULTURAL SOCIETY.

President — DR. HENRY P. WALCOTT of Cambridge.
Secretary — ROBERT MANNING of Boston.

MIDDLESEX.

President — JOHN CUMMINGS of Woburn.
Secretary — WM. H. HUNT of Concord.

MIDDLESEX NORTH.

President — N. B. CASE of North Reading.
Secretary — E. T. ROWELL of Lowell.

MIDDLESEX SOUTH.

President — S. B. BIRD of Framingham.
Secretary — F. M. ESTY of Framingham.

NANTUCKET.

President — GEORGE H. GARDNER of Nantucket.
Secretary — ALBERT EASTON of Nantucket.

PLYMOUTH.

President — JAMES C. SWAN of West Bridgewater.
Secretary — GEORGE W. R. HILL of Brockton.

UNION.

President — HENRY K. HERRICK of Blandford.
Secretary — ENOS W. BOISE of Blandford.

WORCESTER.

President — J. LEWIS ELLSWORTH of Worcester.
Secretary — L. F. HERRICK of Worcester.

WORCESTER NORTH.

President — F. C. CURRIER of Fitchburg.
Secretary — S. W. HUNTLEY of Fitchburg.

WORCESTER NORTH-WEST.

President — W. H. BOWKER of Boston.
Secretary — J. F. WHITCOMB of Athol.

WORCESTER WEST.

President — P. M. HARWOOD of Barre.
Secretary — SYLVESTER BOTHWELL of Barre.

WORCESTER SOUTH.

President — WALDO JOHNSON of Webster.
Secretary — C. V. COREY of Sturbridge.

AGRICULTURAL EXHIBITIONS, 1888.

AMESBURY AND SALISBURY at *Amesbury*, October 2 and 3.
BAY STATE (date not given).
BARNSTABLE at *Barnstable*, September 25 and 26.
BERKSHIRE at *Pittsfield*, September 11 and 12.
BLACKSTONE VALLEY at *Uxbridge*, September 25 and 26.
BRISTOL at *Taunton*, September 25, 26 and 27.
DEERFIELD VALLEY at *Charlemont*, September 13 and 14.
ESSEX at *Peabody*, September 25 and 26.
FRANKLIN at *Greenfield*, September 27 and 28.
HAMPDEN at *West Springfield*, September 19 and 20.
HAMPDEN EAST at *Palmer*, September 11 and 12.
HAMPSHIRE at *Amherst*, September 20 and 21.
HAMPSHIRE, FRANKLIN AND HAMPDEN at *Northampton*, October 3 and 4.
HIGHLAND at *Middlefield*, September 5 and 6.
HINGHAM at *Hingham*, September 25 and 26.
HOOSAC VALLEY at *North Adams*, September 18, 19 and 20.
HOUSATONIC at *Great Barrington*, September 26 and 27.
HILLSIDE at *Cummington*, September 25 and 26.
MASSACHUSETTS HORTICULTURAL, September 18, 19, 20 and 21.
MARSHFIELD at *Marshfield*, September 12, 13 and 14.
MARTHA'S VINEYARD at *West Tisbury*, October 2 and 3.
MIDDLESEX at *Concord*, September 25 and 26.
MIDDLESEX NORTH at *Lowell*, September 19 and 20.
MIDDLESEX SOUTH at *Framingham*, September 18 and 19.
NANTUCKET at *Nantucket*, September 5 and 6.
PLYMOUTH at *Bridgewater*, September 19 and 20.
UNION at *Blandford*, September 12 and 13.
WORCESTER at *Worcester*, September 20 and 21.
WORCESTER NORTH at *Fitchburg*, September 25 and 26.
WORCESTER NORTH-WEST at *Athol*, September 18 and 19.
WORCESTER SOUTH at *Sturbridge*, September 13 and 14.
WORCESTER WEST at *Barre*, September 27 and 28.

APPENDIX.

AGRICULTURAL EDUCATION.

BY HENRY H. GOODELL.

"HOW CAN HE GET WISDOM THAT HOLDETH THE PLOW, AND THAT GLORIETH IN THE GOAD, THAT DRIVETH OXEN, AND IS OCCUPIED IN THEIR LABORS, AND WHOSE TALK IS OF BULLOCKS."

An answer to the pertinent inquiry contained in the above quotation will form the subject-matter of the paper to-day. But *Agricultural Education*, the topic assigned me, is one so general in its nature that it has seemed necessary to limit its consideration to a discussion of the methods pursued in those three countries, France, Germany and Great Britain, where it has received the most careful attention. Each with a system of its own, — each differing widely from the others, yet each tending towards the same end, and so successful in its results, that the face of nature itself has been changed, and the barren lands and sodden wastes have been transformed into the very gardens of the world.

In looking at the system in Germany, we are struck in the first place with its completeness, — a Central Bureau presiding over the whole, — three or perhaps four intermediate stages, leading up to the rounded whole in the University,— each a link in the chain, complete in itself, and yet absolutely necessary to advance to a higher grade. It shows a persistent effort on the part of the various State governments to take advantage of every period in the development of the mind of those destined to agricultural pursuits.

For every stage of intellectual development, a school with open doors awaits the seeker after higher knowledge. But it is not merely to the *seeker* that these advantages are offered; for, by requirement of law, the children of the poorer classes are gathered into schools, conducted at night, at unusual hours or seasons of the year, at whatever times or under whatever circumstances may be best adapted to their peculiar needs.

It is to be particularly noted that while instruction in agriculture is offered at small expense to pupils of little or no preliminary discipline, the government always insists upon the longest possible drill in disciplinary studies of a general nature — consequently we find in the kindergarten an agricultural school for him who has had absolutely no previous training, and again in the agricultural institute, one for him who has mastered every stage in the long routine of classical and scientific training, up through the higher university study. At whatever grade in this system a person may close his training, he always finds himself fitted for his special work, by a schooling which has been acquired in logical sequence. No gaps have been left unbridged. No intermediate field left unexplored. He leaves school fitted for work.

There are, thus, essentially different schools of five different grades (in Bavaria seven), in which practical and scientific agriculture are taught, the method pursued in each having special reference to the mental maturity of the pupil. The more advanced the school, the more technical and scientific become the studies taught. The teacher in the kindergarten seeks to fix in memory the simplest generic name and a few general qualities of the plant which accidentally arrests the child's attention, while in the highest grade at the university, the latest developments in plant physiology are presented. More or less parallel with this graded system, is a system of special schools of a still more practical nature, which do not have in their courses purely disciplinary studies, but which turn their entire energy to practical work in some particular direction. Of these special schools, we would instance those of domestic economy, fruit culture, fish culture, the dairy, forest and veterinary academies, etc.

A second noteworthy fact in the German system of agricultural education, is the strong belief that except in the lowest class of schools, theory should not be united with practice, and that it can best be taught in colleges and universities.

It is true that in some few places the opposite view has been held, and either farms have been added by purchase or rental, or arrangements have been made with neighboring farmers to allow their estates to be used for illustrating the course of instruction. Still the fact remains, that as a class, the German system rests on the separation of theory and practice.

A third point worthy of observation is that while the lower agricultural education is obligatory, the higher is voluntary, and attendance is left to the option of the student. This, however, is secured through the great inducements offered by government to those taking courses in the two highest grades. A compulsory term of three years' service in the army is required of every citizen, but those students passing the examinations required in the institutes and higher agricultural schools, are allowed to take a one year's voluntary service. To young men just starting out in life, having to make their own way, this escape from two years of drudgery, while they are at the same time fitting themselves for the active duties of their profession, must be a strong inducement. Again, instead of serving as privates for three years, these one year volunteers serve as sub-officers at their own expense, and in time of war the additional officers are drawn from their ranks.

One more point should be noted, that with the exception of the institutes connected with the universities, none of these schools are purely agricultural. Leaving out the dead languages and the higher mathematics, their aim is to give a liberal education. Object teaching is especially resorted to, and even the schools of the lowest class are generously supplied with diagrams, charts, implements and the like.

Having now sketched the salient features of agricultural education in Germany, let us first endeavor to take a bird's-eye view of the whole, and then consider in detail separate grades or links in the common chain. Presiding over the whole is the Minister of Agriculture and Central Bureau, located at Berlin, with an Advisory Board, composed of those graduates from the universities who have studied to be overseers, renters, foresters, or who have paid particular attention to the relations of taxation to property. These lay out and prescribe the courses of study to be pursued in the government schools. Co-operating with these are the agricultural societies, whose ramifications spread into every part of the State. In Prussia alone they number seventeen hundred and ten. A parent society in each of its four Provinces, these subdividing into thirty-seven central ones, and these in turn branching into twelve hundred and seventy-one rural ones, all subordinated to the parent organization, all acknowledging its authority and obedient to its laws. In addition to these are three hundred and seventy-eight independent ones. These societies are of great practical value — encouraging fairs, granting premiums (the prize bull or stallion being required to stand for a certain length of time for the benefit of the district), and also turning the money of the State or Province, or their own money, to the support of schools or control stations. The government schools may be divided into four classes, to which a fifth may be added, supported by the agricultural societies, in which instruction is given by lecturers, who travel about from place to place, giving special local information on just such topics as would be of practical benefit to the farmer; namely, the character of the soil of that particular district, the crops best adapted to it, and the most effectual methods of securing them.

The first and highest of these schools are the Agricultural Institutes, *twenty-one* in number, all, with the exception of three or four, being departments of the universities. Here the highest instruction is given, the course varying from two to three years, according to the object of the pupil, whether to become a farmer, or fit himself to be a teacher. These are designed for gentlemen farmers, their sons or stewards.

Second. The agricultural schools for the sons of the more wealthy farmers. There are *twenty-six* of these schools, and they cover a four years' course, their object being, to quote the words of the privy councillor Dünkelberg, "to educate youth up to seventeen or eighteen years of age, in mathematics, natural sciences and two foreign languages, to such an extent that they can obtain the right to perform their military duties in one year. As these schools are preferentially established to procure this right for the sons of agriculturists, the pupils are at the same time also instructed in agriculture."

Third. The farming schools, over *forty* in number, designed for the sons of small farmers and peasant proprietors, in which the instruction is partly theoretical and partly practical.

Fourth. The supplemental schools, held in the evening during the winter months and covering two winter courses, their object being to enable young men who have left the primary schools to still further educate themselves in matters of science bearing upon agriculture, and in agriculture itself. These four classes form the graded links in the chain of agricultural education in Germany; but in addition to these are the large numbers of special schools, and experiment or control stations, to which a more extended reference will be made later on. In all, "the German empire contains not less than one hundred and eighty-four agricultural colleges and experiment stations, whose duty it is, not only to learn all that can be learned of the capacity of the soil and the methods of renewing and enriching it, but to bring the results of these experiments to the table of every farmer in the land." *

The two best examples of Agricultural Institutes † are the Agricultural High School at Berlin and the Royal Academy at Hohenheim, the former being purely theoretical, the latter combining theory with practice. To give some idea of the completeness of their equipment a few statistics respecting the school at Berlin may not be out of place. It forms simply a department of the university, having its own separate faculty, lecture rooms, apparatus, etc. Its staff consists of ten professors, twenty instructors and six assistants, besides clerks, modelers, and others. Thirteen rooms are devoted to the investigation and study of morphology and physiological botany alone. Animal physiology and histology receive a like generous treatment. The laboratories are supplied with the finest appliances and apparatus devised by science, and provision is made for the accommodation of

* Adams — "Plea for Scientific Agriculture."

† For the schedules of study and figures I am largely indebted to: Jenkins — "Report of Royal Commission on Technical Instruction"; Royer — "L'agriculture allemande, ses écoles, son organization," etc.; "Compte Rendu de l'exécution du décret du 3 Oct., 1848, relatif à l'enseignement professionnel de l'agriculture."

sixty students, simply in chemical studies. The collections are unsurpassed. A large hall is filled with agricultural implements, placed there by their makers, who replace them from time to time by later improvements. Steam-power and shafting admit of practical illustrations of power-driven machinery. The botanical collection embraces some two thousand specimens of wood, and over eighteen thousand of different kinds of corn, seeds and fibres, together with a valuable exhibit of artificial feeding stuffs, both in the raw and manufactured condition. The zoological collection, illustrating in the most complete manner the history of domestic animals, contains about three thousand specimens. The zootechnical, particularly that pertaining to wool, is of the highest interest and value; for not only does it furnish examples of fibre of the different breeds, but of different flocks of the same breed, and the gradual improvement in fibre by careful selection in breeding. The instruction, it is needless to say, is of the very highest order, and embraces every phase of technical, applied and economic agriculture. The fees for instruction, considering the advantages offered, are very moderate, being about $50 per annum.

Having spoken of the appliances for education at Berlin, let me briefly speak of the management of the farm at the famous Royal Agricultural Academy at Hohenheim. It consists of 760 acres. Of this, 480 is arable land, cropped under the three following rotations: —

ROUGH-FIELD.	SMOOTH-FIELD.	DAIRY-FIELD.
Vetches for fodder,	Rape for seed,	Beans and green maize, manured,
Rape for seed,	Rye with red clover,	Winter wheat,
Wheat,	Clover, mowed,	Green crops,
Green crops,	Clover, fed,	Spring corn and clover,
Barley with clover,	Oats,	Clover,
Clover,	Green crops and potatoes,	Clover,
Spelt.	Rye with hybrid and white clover and grass seeds,	Spelt,
	Grass, mown,	Lucerne,
	Grass, fed,	Lucerne.
	St. John's rye and fallow, manured and folded.	

The operations are carried on by twelve working horses and eight draft oxen; and it supports one hundred cattle (fifty being milch), and five hundred sheep, part natives, part Merinos and Southdowns, or crosses. On this farm, for practical instruction, are established sugar, vinegar and liqueur factories, and a distillery. The annual expense to the State is $25,600. The fees are only $45 for natives, and $125 for foreigners the first year and $85 the succeeding.

The Agricultural Schools, representing higher education, are distributed, one in each province of the Prussian empire, while in a few cases there are more than one. The course is a three years' one, and embraces the following studies, taken from the official schedule: Religion, languages (German and two foreign ones, either Latin, French or English), mathematics, natural sciences (embracing zoology and botany, physics, chemistry and mineralogy), agriculture (embracing production of crops, breeding of stock, farm management), book-keeping, drawing, gymnastics and singing. The greatest amount of time is devoted to the study of languages, and, next to that, to mathematics.

The Farm Schools are of two kinds, — those purely theoretical, where the students are prepared for the schools of the next higher grade, and those with a farm attached. In many of the latter class the director is a tenant farmer, running the school and the farm at his own risk, the students paying something, and the provincial government aiding in its support by a bounty of thirty to eighty dollars per annum for each student. The pupils do not assist in the cultivation of the farm, but the second year boys are taken in sets of fours and taught to perform every operation. In some of these schools plots of ground are given to the pupils to cultivate as they choose for their own profit. The course ranges from one and one-half to two years. There are some forty of these schools, supported partly by the State and partly by the provincial authorities at an annual expense of $85,000. The graduates obtain places as foremen of farm-yards, or go out as apprentices on large farms, paying a bonus of from twenty-five to seventy-five dollars the first year, besides throwing in their services for the privilege. In these schools no instruction in the languages is given, and the greatest amount of time seems to be devoted to the study of German, and to a consideration of the phenomena of plant growth. Two points are especially worthy of notice. One is the greater amount of time spent in the schoolroom than in this country, thirty-six hours per week being about the average; and the other, the great attention paid to book-keeping and the care with which the students are taught to balance their accounts and compare the results of each crop with the amount of capital and labor expended.

The Supplemental, or Winter Schools, embrace two winter courses, from November to March. This winter instruction is followed up in the summer by the travelling lecturer, who is frequently the director of one of these schools. The course embraces the following studies: —

FIRST WINTER.	SECOND WINTER.
Elementary chemistry (inorganic),	Elementary chemistry (organic),
Mineralogy and soils,	Botany and vegetable physiology,
Zoology,	Agricultural botany; plant diseases,
Cattle breeding,	Irrigation,
Dairying,	Physics and meteorology,
Physics, — mechanics, electricity,	Farm management, — capital, labor, organization.
Farm management,	
Book-keeping.	

GENERAL CULTURE.

German language, arithmetic, surveying, drawing.

The special schools of Germany are worthy of particular notice, for they cover ground briefly touched in the graded courses, and furnish a practical special education to be acquired in no other way. There were, in 1886, nine technical high schools and 994 industrial and trade schools. Among others there were eighteen dairy schools; six royal academies of forestry, besides many of lower grade; three veterinary schools; three shoeing schools, in connection with the veterinary; two drainage and irrigation; three bee-keeping; several of gardening and political economy, sugar making, brewery and distillery, fish culture; and a host of smaller farrier schools. In these last the instruction is given by lectures, and in one at least, on Sundays, after church, when the young men are at liberty.

The most celebrated of the dairy schools is at Raden. The course lasts six months. Only six pupils are received at a time and the fee is fifteen dollars per month. Instruction is given not merely in the different systems of cheese-making, as that of Tilsit, Gruyère and others, but also particular attention is paid to book-keeping and the principles of breeding and feeding. One of the best of the dairy schools for girls is at Heinrichtsthal in Saxony. It seems to be a sort of finishing-off school, where farmers' daughters, about to set up households of their own, can receive practical instruction in the daily duties of life. The fee is forty-five dollars for three months' lodging and instruction, and from ten to twelve pupils are received at a time. The course embraces: The technical management of a dairy, including book-keeping; feeding and management of cows; fattening calves and pigs; instruction in cooking; house-keeping in general; the management of poultry and of a kitchen-garden.

The subject of forestry is one to which great attention has been paid from the earliest times in Germany. As far back as 1795 we find a department of forestry in the university at Giessen, and schools devoted to its study, established in the early part of the century. Of the thoroughness and completeness of the instruction, we can form no idea till we have examined the course of study. At the royal Saxony Forest Academy the course is two and one-half years, and embraces the following studies, classified under the three heads of Fundamental Sciences, Professional and Complemental: —

Fundamental Sciences.—Chemistry, mineralogy, geognosy (with special reference to study of soils), botany (structural and physiological) and forest botany, zoology (with particular reference to animals injurious or the contrary to forest economy), entomology, physics and natural philosophy, meteorology, mathematics (commencing with arithmetic and leading up through geometry, plane and analytical, to integral and differential calculus), mensuration, mechanics, architecture, hydraulic engineering, road-making, general economy.

Professional Sciences. —History and literature of forestry, forest culture and conservation, forest mathematics, measurement of felled trees and standing timber, cubic increase of wood by annual growth, forest financial reckoning, forest economy and technology, forest management and administration, police, game laws.

Complemental Sciences. — Science of finance, law and jurisprudence, rural economy, meadow culture, fruit culture.*

Last in the system, but not least, come the control stations, of which there are, in Germany alone, seventy-two. The immediate outcome of the teachings of Liebig was to awaken a demand for the investigation of nature, and in 1852 the first experiment station was established at Möckern. The importance of its work was quickly recognized, and the establishment of others followed in such rapid succession that there are to-day in Europe one hundred and forty-eight in successful operation. In them, nature is carefully observed and studied in all the fields of agricultural inquiry. They are, then, in reality, the crowning schools of the German agricultural education. But there is another phase of their work, of the utmost importance to the farming community. They furnish the purchaser of artificial manures with a guarantee of their composition at the expense of the seller. Hence some of these stations are supported by associations of dealers, while others are under the direction of the agricultural societies.

The French system of agricultural education is, like the German, a graded one, and in like manner offers as a premium to the student in the higher departments a short voluntary service in the army instead of the usual compulsory five years. But it differs from the German in several important particulars. In the first place, it is based upon the union of theory with practice. In the second place, attendance in all grades is compulsory, while in the German, as we have seen, it is voluntary in the higher; and in the third place, it directly encourages its system of instruction by offering prizes, not to the pupils, but to those teachers whose scholars have passed the best examinations. In addition to this, the pupils themselves are stimulated to work by the offering of scholarships and rewards to those who successfully complete their course. Thus, at the Institut National Agronom-

* Brown — "Schools of Forestry in Germany."

ique at Paris, the two graduating with the highest honors hold for three years a scholarship enabling them to prosecute their studies at home or travel abroad. They are required, however, to send home to the director, at stated intervals, reports of what they have observed, and these reports are printed. At the great horticultural school at Versailles, we find, in like manner, scholarships worth $250, and held for a year, given as rewards to those passing the best examinations. At one of the farm or primary schools, $60 is given to every pupil receiving a certificate of having faithfully performed his duty and profited by the instruction. And no less than $34,000 a year is offered by the government in prizes for the best-managed farms in those departments where fairs are held. Again, the government recommends that, in the selection of teachers, preference should be given to those able to impart instruction in agricultural subjects, and in some of the departments it is made a requisite of the first importance. Can we wonder that with incentives such as these, appealing to instructor and pupil, and to the tiller of the soil himself, that agriculture and agricultural education in France should have received an impetus that has made it second to none in the whole world?

The different grades in the French system of agricultural education are four: *First*, the Institut National Agronomique at Paris, representing the highest form of education; *second*, the Regional schools, *three* in number (the 86 departments of France are divided according to location into three regions, and in each of these a school of higher education is established); *third*, the Practical Schools of Agriculture, *nine* in number, designed for the sons of those in moderate circumstances, who can afford to pay something for their education; *fourth*, the Farm Schools in the different departments, *twenty* in number, furnishing an education free to the sons of laborers and small farmers. In addition to this graded system are *forty* or more evening schools, the special schools, and the Departmental Professors of Agriculture, *fifty-five* in number, whose duty it is to deliver lectures on agriculture to the teachers and agriculturists of their district. A noticeable fact in the higher schools is the generous provision made for instruction. In the Institut National there is a teaching force of *forty-two*, while in each of the Regional schools the instructors number from *twenty* to *thirty*. Even in the elementary schools great care is taken to make the instruction as thorough and practical as possible. The following is the text of the ordinance of the 10th of October, 1887, decreeing the teaching of agriculture in the higher primary schools of Dourdan. The scholars, be it understood, are from ten to fourteen years of age. After first declaring that there shall be a special course in agriculture, it goes on: —

ART. II. This instruction shall include a course in agriculture and a course in the hygiene of domestic animals, embracing the following subjects: General agriculture, special crops, rural economy, horticulture and arboriculture, zootechny (general and special), diseases of plants, insects injurious and beneficial.

ART. III. The course in agriculture shall consist of about a hundred lectures, that of hygiene of twenty. The whole shall be supplemented by agricultural excursions and practical exercises in a garden or experimental plot.

ART. IV. The professor of agriculture shall give an adult course in the evening, in winter, but on Sunday afternoons in summer. *

A pleasant and very profitable feature of the Institut is the sending out of the students during vacation, for practical work and observation, to farms of known reputation, either in France or in foreign countries, the pupil paying from $15 to $20 a month to the proprietor for this privilege, and being required to make a carefully written report to the director of the result of his observations. Five thousand dollars are annually spent in this way. The amount of money expended by the government each year, over and above receipts, in aid of these schools, is something surprising, even in this State, noted for its generosity in educational matters. The sums are distributed as follows: —

Institut National,	$50,000 00
Regional schools,	80,760 00
Agricultural and Farm schools,	114,800 00
Evening schools,	30,000 00
Departmental professors,	35,000 00

* Ministère de l' agriculture. Bulletin, Vol. 6, No. 7, 1887.

Twenty-three Agronomic stations,	$17,000 00
Agricultural shows,	190,000 00
Fat-cattle shows,	40,000 00
Regional shows,	150,000 00
A total of	$707,560 00

But in addition to this are the special schools, all supported liberally, — as those of forestry, for example, at an annual expense of $43,000, or the three great veterinary academies at $87,760. In brief, if we should add to the sums appropriated by the general government, the help given by the departments, we should find the yearly amount expended in agricultural education to be considerably over a million dollars.

In Great Britain, agricultural education may be considered under the three heads of government aid, private enterprise and the agricultural societies. Government aid is very unevenly distributed. In England it is confined to the maintenance of a chair of agriculture at the Normal School of South Kensington, and to the payment to the masters of four shillings for every pupil passing in certain specified subjects; in Scotland, to the payment of $750 a year for the support of a chair of agriculture at the University of Edinburgh; while in Ireland it has established an institute for the training up of schoolmasters, and has organized and put in operation over a hundred schools in which agriculture is taught, besides some twenty model farm schools. Where, however, government aid seems to be deficient or withheld, there public societies and private enterprise have not been wanting to forward agricultural education. That there is a distinct call for education of this kind is evidenced by the numerous advertisements of private schools in which agricultural instruction is made the chief feature. The Albert Institute at Glasnevin furnishes the higher education in Ireland, and to it are brought yearly, at the expense of the government, the schoolmasters of the lower schools, fifty at a time, for a six weeks' course. A novel feature of agricultural education in Ireland is the "Travelling Educational Dairy," owned by the Royal Agricultural Society of Ireland, and let out by them at the rate of $35 per week and expenses. It consists of a huge box on wheels, the sides of which, parting in the centre, lift up and let down, forming the roof and flooring to a room some ten feet square. This is fitted up with the latest and best appliances for dairy use. It is surrounded by a gallery having accommodations for seventy or eighty spectators. A lecturer, dairy-maid and assistant constitute the working force. While the churning is going on, the lecturer explains the apparatus and the methods employed, or answers the questions put to him.

Higher agricultural education in England, as represented by the Royal Agricultural College at Cirencester, and the Downton College of Agriculture, owes its origin to the persistent efforts of private individuals. I have chosen the former as a type of this class. Its object* is to give a training suited to the needs of the following classes: — land owners, land occupiers, agents, stewards, factors, surveyors, intending colonists, employees in Indian agriculture, forestry, etc. It has a staff of eleven professors, five assistants and a manager of the farm. Its course extends over two years and one term, the last term being taken up with examinations for the diploma of the college. No entrance examination is required. The fees are $675 per annum for in-students, and $375 for out-students, furnished private rooms in the college being at an extra charge of $150 a year. These fees include board, and, in fact, all college charges, except laundry, books, fines and damage. It is evident from the charges that only the sons of those in easy circumstances can avail themselves of the benefits of this education. The farm, containing about four hundred and fifty acres of arable land, is divided into twenty fields, and the rotation followed is that known as the Norfolk four-course. Sheep are the chief stock (Cotswolds, of which a breeding flock of some five hundred is maintained), but special attention is also paid to Berkshire pigs. The following studies are pursued: —

Sessions 1 and 2. Practical Agriculture (soils, manures, implements, labor, buildings), Chemistry (inorganic), Book-keeping, Mensuration, Physics, Geology or Botany or

* Propectus Royal Agricultural College, Cirencester, 1885.

Zoology, Veterinary Anatomy and Physiology, Drawing (plans of farm buildings).

SESSIONS 3 and 4. Practical Agriculture (tillage, crops, etc.), Chemistry (organic), Book-keeping, Surveying, Physics, Geology or Botany or Zoology, Veterinary Pathology, Drawing (farm machinery).

SESSIONS 5 and 6. Practical Agriculture (stock, dairy, economics), Chemistry (agricultural), Book-keeping, Engineering, Mechanics, Geology or Botany or Zoology, Veterinary Therapeutics, Drawing (designs for farm buildings).

Agricultural law in the winter session; building materials and construction in the spring, and general estate management, with the principles of forestry, in the summer. Let it be observed here, that there are in Great Britain no schools of forestry for advanced pupils, and that candidates for government positions are sent by the government and the agricultural societies to acquire an education at the great forestry school of Nancy, in France. Connected with the college, for practical illustration, are forges, blacksmith and carpenter's workshops, a botanical garden and veterinary hospital. Established in 1845, the first class was graduated in 1847, and while some three thousand have enjoyed its benefits, only two hundred and eighty-six have received its diploma.

Of the agricultural societies, the most influential is the Royal Agricultural Society of England. With a membership of nearly ten thousand, it cannot but make itself felt most widely. One of its leading objects is declared to be "to take measures for the improvement of the education of those who depend upon the cultivation of the soil for their support."

This it has endeavored to do by establishing scholarships at the universities and colleges; by offering ten scholarships of $100 each and ten of $50 each to such students as would take a year's course of study at an agricultural college, or spend a year with some approved agriculturist; by offering prizes in certain of the veterinary colleges, and to tenant farmers for the best-managed farms. For eleven years it has conducted experiments at Woburn on the effects of different manures, and published the results in its journal. Through the same organ, the names of those dealers furnishing inferior articles of feeding stuffs or artificial manures have been given to the public; and it has even gone so far as to furnish an indemnity against prosecution for libel to those journals publishing literally their reports. But its greatest influence has been through its large consulting corps of experts, whom members may consult on a fixed scale of prices.* Thus, in chemistry, there are twenty-three different kinds of analyses, ranging in price from $1.50 for an estimate of value of sulphate and muriate of ammonia and of the nitrates of soda and potash, to $27 for an examination of the viscera complete for metals and alkaloids. For the eradication and prevention of diseases among the domestic animals, 54 veterinary surgeons are appointed, in as many agricultural centres, to whom members may go, at prices ranging from $1.50 for consultation by letter to $8 for attendance during an entire day; while sick cattle may be boarded and treated at the Infirmary of the Royal Veterinary College at Camden Town for about $3 a week, sheep and pigs being received for half that sum. So, too, in botany, a report can be obtained on the purity and germinating power of seeds sent for examination for $1.50, or the determination of a collection of grasses growing on the same kind of soil, and their pasture value, for $3. The consulting entomologist is a lady, and her annual reports have for ten years been a valuable feature of the journal. Insects are sent to her for determination, and questions are answered respecting their beneficial or injurious character. In short, in every question bearing upon the improvement of agriculture and agricultural education, we find the Royal Agricultural Society of England taking a prominent part and leading the way. Its 9,200 members, whether consciously or unconsciously, are a leaven, silently but powerfully leavening the whole lump.

The essential features of the English system we find, then, to be these: That until very recently this education has been confined exclusively to the upper and wealthy middle classes, no attempt having been made to improve the condition of the lower. Indeed, one of their ablest writers takes the ground "that elementary, general and so-called

* Journal of the Royal Agricultural Society, 1886.

middle-class education is scarcely an agricultural subject at all, ... and that it still is true, and probably always will be true, that the bulk of farmers have been bred by farmers, ... and that it is a fortunate thing that the education of farmers from their childhood upwards is almost entirely in the hands of farmers — that is, under their direction." * Second, that the purchaser pays for the analysis of his goods, while in France and Germany it is distinctly the reverse. Third, that the great agricultural societies are the pivots on which the whole system rests. To their generous encouragement is largely due the advance that has been made in British agriculture and agricultural education. It is true, it may be said

> "We've fallen on better times; men read and think.
> Our good forefathers used to fight and drink."

But the societies have furnished facts to read and think about. The investigations undertaken by them, the improved methods introduced by them, have been just so many object-lessons in the education of every farmer in the neighborhood.

We have now completed our survey of the system of agricultural education in the three leading countries of the world, and we find the following features especially worthy of consideration : —

First. The greatest improvement has been made in those countries where the graded system is most complete, — each step complete in itself, yet absolutely necessary in passing to the next higher. We are told that we have failed in our efforts to civilize the Indian simply from neglect of the intermediate steps, — that "man in passing from a savage to a civilized state passes through three stages: first, he is a hunter, living by the chase; second, he is a herdsman, living by pasturage of goats, sheep, camels and kine; third, he is a husbandman, living by cultivation of corn and maize and fruit and herbs," † and that it is utterly impossible for him to pass from the condition of the huntsman to that of a husbandman till he has first fulfilled the conditions of a nomadic

* Morton — "Agricultural Education."
† Hepworth-Dixon — "New America."

life, and learned a more peaceful existence in tending his flocks and herds. And, in like manner, this is perhaps one reason why the agricultural colleges of our own country have failed to accomplish all that was expected of them. They have aimed at a higher education when no provision had been made for the lower. They have tried to turn out men fitted to take the lead in agricultural pursuits, when these same men were incapable, from lack of previous training, to adequately profit by the instruction offered them.

Second. The weight of testimony seems, on the whole, to be in favor of divorcing theory from practice. Germany has maintained that idea, gradually giving up its farms, or retaining them simply for the sake of illustration. France, on the other hand, has held the opposite opinion strongly, and certainly its success would seem to warrant its belief. Perhaps a few quotations from leading educators will best show the grounds for this separation. Royer, in his "German Agriculture," says: "The laborer, worn out by fatigue and the stern demands of toil, cannot study, while the pupil has too many things to learn to be able to practice."

Mons. Risler, director of the Institut, defends its location at Paris, and consequent separation from practice, in these words: "In no other branch of industry, engineering, etc., have the schools the two-fold function of practice and theory. The schools are theoretical, and the practice is studied in the manufactories, the workshops, etc. Why do otherwise in agriculture? If you pursue both practice and theory, you will make bad practical men and bad scientific men."

Mons. de Miral, director of one of the Farm Schools, says: "It is difficult for the director to obtain any profit from the farm school as such, because the work done by the apprentices is so frequently defective. They break the implements, they lame the animals, they do so much damage that their labor costs more than that of paid workmen. The State ought, therefore, in justice, to augment its subvention for the maintenance of the apprentices." And, in this country, Hilgard utters the following golden truths: "It is not for the purpose of how to plow and hoe, but why they plow and hoe at all, and when and where to do it to the best advantage, that parents are willing to send their sons to the colleges. . . . And it follows that the time spent in merely mechanical and uninstructive labor in the agricultural colleges, detracts to that extent from the opportunities of the student and stints his education." *

Third. Numbers are not looked upon as the measure of success. It is the quality of the education and the standard of the men turned out. In Bavaria, for example, 1,096 supplemental schools are supported, with an average attendance of only 18 pupils; and in 7 winter schools we find only 157 pupils, but a teaching force of 53. At the practical school of agriculture at the Chateau of Tomblaine, in 1882, there were 18 students and 15 instructors. At Les Merchines, 20 pupils and 8 teachers. The little kingdom of Würtemberg, with an area of 7,675 square miles (a little less than Massachusetts), and a population of 1,971,118 (a little larger than Massachusetts), supports, at an annual expense of $51,370, the following schools: —

The Agricultural Institute at Hohenheim, with 21 teachers and 72 students.
The Veterinary School at Stuttgart, with 13 teachers and 60 students.
The Farm Schools at Ellwangen, Ochsenhausen, Kirchberg, each with 12 students.
The Viticultural School at Weinsberg, with 15 students.
Five Higher Agricultural Schools, with 89 students.
883 Evening and Winter Schools, with 20,100 students.

These statistics bring us to our last point; namely, the dependence of these schools upon government aid. Left to their own resources they would soon be given up; and it is only by the subsidy of the general government, by the appropriations of the provincial governments, and the support of the societies that they are enabled to carry on their work.

Perhaps now it may be asked, what are the results of this lavish outlay of money on the part of the government and individuals? What the direct results? France, with 37,-400,000 inhabitants, supports a population of 184 to the

* Hilgard — "Progress in Agriculture" (Atlantic Monthly, 1882).

square mile, and has 18,200,000 engaged in agricultural pursuits. Germany, with 45,200,000, supports a population of 213 to the square mile, and has 18,800,000 engaged in agricultural pursuits. Great Britain, with 35,200,000, supports a population of 291 to the square mile. In Germany the almost universal testimony of those in charge of the schools, is of the beneficial effects upon the peasants. Better rotations have been put in practice, hand-labor has given place to improved machinery, the number of acres under cultivation has been multiplied, the product per acre has increased two-fold, a great variety has been added to the list of products, and the adaptation of crops to soil has been more carefully studied.

France has become a vast garden, — "the best cultivated country," according to the Banker's Magazine of New York, "in the world; whose revenue from its land alone is estimated at $550,000,000," and whose exports in 1884, of articles of food and cereals, footed up to $165,302,200, and its wines to $47,450,000 more. Its agriculture certainly pays, for one-half of its population are engaged in its pursuit. Next to the United States and Russia it has become the greatest wheat-producing country in the world. Its forests, carefully superintended by pupils from the great school of Nancy, yield it an annual revenue of $50,000,000. The denuded slopes of the Alps and the Pyrenees, down which poured the mountain torrents, filling up and covering over the fertile plains with coarse debris, have been covered with smiling verdure to their very summits, and the waters have been led captive into the channels prepared for them. The sand dunes on the west coast, advancing at the rate of 14 feet per annum, and transplanting inland 90 cubic yards of sand per yard of coast line, annually, have been arrested in their course, and 224,154 acres have been reclaimed and covered with trees and shrubs.* The cultivation of the sugar beet, carried to the highest perfection, has twice saved the country from national bankruptcy.

In England, fifty years ago, the normal yield of wheat per acre was thirteen bushels, the latest returns make it 31.24 per acre. So, too, the hay crop. By a judicious use of

* Consular Report. Forestry of Europe, 1887.

fertilizers, Messrs. Lawes and Gilbert have raised the yield per acre from 2,300 pounds to 6,400. The barren plains of Norfolk, stretching for miles their sandy wastes, with here and there a stunted growth to mark the effort of nature to reclaim them, have been transformed into broad fields of life-sustaining crops; and the fens of Lincolnshire, reeking with malaria, have been changed into the granary of England. Thirty years ago and the Whitworth guns were the terror of the world, but the canny Scotchman, loading them with canister filled with seeds, aimed them at the beetling crags, which, lifting their towering heads far into the empyrean, defied ascent by man, and lo! the shells, bursting amid the clouds, scattered the seeds far and wide, and to-day his grace the duke of Athol looks with pride upon the wooded heights of Craigybarnes.

THE CHEMISTRY OF THE KITCHEN.

By James P. Lynde of Athol.

Besides . . . chemical elements, there is in the physical world one agent only, and this is called energy. It may appear, according to circumstances, as motion [heat], chemical affinity, cohesion, electricity, light, magnetism; and from any one of these forms it can be transformed into any of the others. — Dr. Mohr.

I have here a bundle of cotton, which I ignite; it burns and yields a definite amount of heat. Precisely that amount of heat was abstracted from the sun, in order to form that bit of cotton; . . . every tree, plant and flower grows and flourishes by the grace and bounty of the sun.

But we cannot stop at vegetable life, for this is the source of all animal life. In the animal body vegetable substances are brought again into contact with their beloved oxygen, and they burn within us as a fire burns in a grate. This is the source of all animal power, . . . all terrestrial power is drawn from the sun. — Prof. Tyndall.

These quotations present a clear statement of the modern idea of the conservation of energy.

Scientists explain how the energy derived from the sun is stored in fuel and transformed by oxidation or combustion into light and heat, and mechanical power by steam or hot air; or into electricity, which may be again transmuted into light and heat and power. The physiologist teaches us how the same latent energy stored in foods serves to warm our bodies and give us strength for every effort of body or mind. Many abstruse problems connected with these manifestations of energy remain to be solved through experimental investigation and research. We know but little about the brain and the generation of nervous energy.

Air and food are the two most important essentials of life. Animals speedily die when deprived of air, while a total deprivation of food is not fatal for a considerable time, varying with internal and external conditions and influences.

Man requires food to build up his organism, repair its waste, maintain its nutrition, generate heat and evolve its dynamic energies. The necessity or demand for food is manifested by sensations of hunger, discomfort and debility. Its supply is influenced and very largely controlled by the inexorable demands of the palate, an organ of sense, — the endowment of nerves distributed upon the tongue. Placed at the very gateway of life, it refuses to pass substances irritating, acrid and injurious without its protest, and impels the individual to select such food materials as are acceptable to its requirements, which, fortunately, are usually those essential to the necessities and integrity of the organization.

"Now good digestion wait on appetite and health on both." — MACBETH.

Man selects his food from animal and vegetable sources, influenced in his choice by peculiarities of race, climatic conditions and the refinements of civilization. The source of all our foods is in the vegetable kingdom. Vegetable products have the power of selecting and incorporating into their tissues such inorganic mineral elements as are needed for the growth and nutrition of animals, thus furnishing a complete food. Therefore animal tissues are but another form of vegetable tissues; and as vegetation is impossible without the influence of the light, heat and energy of the sun, therefore the sun is the source of the force or energy which we call life; and as matter is indestructible, so also is the life-force indestructible, however produced or manifested.

Food in its relation to the animal system, as a source of power, is the same as that of coal to the steam engine. The food must pass through the process of oxidation in the animal economy to be converted into actual energy, such as muscular and nervous power and animal heat; so likewise the coal must be oxidized in the locomotive, and converted or reconverted into potential energy through the expansive property of steam.

All species of animals, birds, fishes, reptiles, insects, worms and infusorial earths, together with the seeds of the grasses and many varieties of vegetables, fruits, roots and nuts, are used by mankind as food; and some tribes are cannibals, as were our English ancestors only a few hundred years ago.

Climatic influences modify food requirements. Hundreds of millions of people living in tropical countries subsist chiefly on rice and tropical fruits; those living in arctic regions consume enormous quantities of fats and fat meats, without fruits or starch foods. The diet of one region would be fatal to people living in the other. The food required in infancy, middle life, old age and disease, varies very widely, and its selection is influenced by many considerations.

The constituent elements of foods are the same as those of the tissues they are to nourish, — carbon, hydrogen, oxygen, nitrogen, sulphur, phosphorus, calcium, magnesium and iron are the essentials. We do not use these elements directly as foods, but in selecting our aliment we deal with their combinations as found in living organisms, plants and animals, or in organic products produced by the agency of life, having chemical combinations of inorganic materials in their substance, such as water, and the salts of lime, potash and iron. The organic structure of many foods contains compounds of which nitrogen is an important part, and such are called nitrogenous; others, composed of carbon, hydrogen and oxygen, variously combined, are non-nitrogenous. The nitrogenous foods are chiefly used in tissue building, and the non-nitrogenous in the generation of heat, — both are used in tissue building and the production of heat and force, but to an unequal degree. Physiologically considered, alimentary substances may be classed under four divisions of alimentary principles: —

I. Nitrogenized principles. Albumen, fibrine, casein and gluten. The proteids.

II. Fats and oils.

III. Carbo-hydrates. Starch and sugar.

IV. Inorganic materials. Mineral salts and water.

Nitrogen is an essential element in the structure of animal tissues, so that without it animal life in any form would be impossible; yet we do not receive and appropriate it directly from the atmosphere, the great storehouse of nitrogen, but from organic compounds containing it under various chemical relations, as found in the substance of our foods.

Milk and eggs present the most perfect type of all our alimentary materials. They contain all the elements necessary for the growth and nutrition of the body. Milk is essential to the young of all mammalia, including man, and should be administered to the human infant in a pure state, without sophistication of any kind, except a little salt.

Of foods rich in nitrogen, are meats of all kinds, — except fats, — fish, milk, eggs, cheese, beans, pease, cereal grains and nuts. These must be subjected to the digestive processes of the stomach and bowels, disintegrated and changed into a highly soluble material called albuminose or peptone, which, acted upon by chemical forces in contact with living tissues, and absorbed into the circulation, metabolized, and in some mysterious way, by many changes, made to contribute to the maintenance of life and energy.

The fats and oils are non-nitrogenous, composed of carbon, hydrogen and a small per cent. of oxygen; they are obtained from animal and vegetable sources.

Fats are not digested in the stomach. The pancreatic secretion converts them without chemical change in the intestine into a fine emulsion, which is absorbed into the circulation through the lacteals, and is partly saponified in the alkaline blood and partly oxidized in respiration, being one of the chief sources of animal heat, holding in this relation the highest place over all other alimentary materials.

It is also by selective cell action stored in the cellular tissues that envelop the body under the skin and surround the muscles, giving — when not in excess — a shapely form and rotundity to the person, and, as a non-conductor of heat, promoting warmth and comfort; and in diseased conditions affording a store of material to be absorbed for purposes of nutrition, when the consumption and digestion of food is insufficient for the needs of the body. It is found in brain, muscle, blood and bone, and is a very important — yes, indispensable — element in the animal economy.

The carbo-hydrates, starch and sugar, form another most interesting group of alimentary principles. Starch is the chief constituent of many of our most valuable foods, such as the seeds of the cereal grasses, tubers, roots, stems and fruits.

In the process of digestion starch is converted by the ptyalin (the diastase of the saliva) and trypsin (the diastase of the pancreatic secretion) into dextrine and grape sugar, which, absorbed into the blood, is arrested in the liver, where it is changed into animal starch — glycogen — and further transformed into fat, either in the liver or by the cells of the tissues; just how we do not certainly know.

The sweet taste of liver is due to the glycogen and sugar. Starch is not digested in the stomach, and is not found in the blood.

Sugar is a luxury and a necessity much used and highly prized by all civilized races. Its consumption is enormous. Fifty pounds per head in the United States, with 60,000,000 of people, amounts to 1,500,000 tons. Sugar was first made in Bengal, and its use was widely established in eastern countries as early as 766; but it was not until 1700 or 1750 that it came into general use. The sweet of ancient nations was honey gathered by the busy bee from flowers. Sugar is derived chiefly from vegetable sources, — from the sap and juices of the cane, grape, beet, maple, and several other trees and plants.

A sweet substance derived from coal tar has lately been discovered by Dr. Fahlburg, a German chemist residing in this country, called saccharine. It is the king of sweets, being 250 times sweeter than our best sugars. It is not a carbo-hydrate, is not decomposed in the body, and is not therefore a food. Its uses and value are yet to be determined.

Sugar is found in various combinations in brain, glands and muscles. It does not pass through any process of digestion, but is split up — metabolized — by chemical action into new compounds. A part is converted into grape sugar, is reconverted into animal starch or glycogen, and finally into fat, the uses of which have been considered.

The carbo-hydrates, therefore, are to the physical system the same as coal to the locomotive, — by oxidation, generators of heat and force.

The inorganic alimentary principles, water and saline compounds, are an indispensable part of the animal system. Water is everywhere abundant. It constitutes three-fourths of the weight of man and animals, and a much larger part of many articles of food. It undergoes no digestion or chemical change within the body, but is absolutely essential to every chemical and vital change, every manifestation of the life-force in any form. Its union with tissues is mechanical, not chemical. It is the great diluent in Nature's laboratory.

The skeleton must be built up from mineral matter, and this is supplied, in animal and vegetable foods, in the form of salts of lime, soda, potash, phosphorus, sulphur and iron. A part of these salts are found in the bones, others in the brain, muscles, blood, and other tissues.

Certain organic vegetable salts, such as the citric, tartaric, malic and peptic acids, with their compounds, are needed in healthy blood. Just how they act we do not certainly know; but when withheld for any considerable period, and a diet of salted food is used, scurvy with all its woes is the sure result.

Other accessory foods are condiments, such as mustard, radish, the peppers and spices. When prudently used, they are acceptable to the palate, cordial and stimulating to the digestive organs. These four classes of alimentary principles, — the nitrogenous, hydro-carbons, carbo-hydrates and inorganic, — are variously combined in the structure of our vegetable and animal foods. They come to us in forms that require important changes in texture to prepare them for comfortable use, and next in importance to their abundant supply comes the art of the cook, as exercised in the chemistry of the kitchen.

The art of cooking, as now developed, is a growth that has come down to us from most ancient times. It has attained its highest perfection among the French. The chief cook in large hotels can command a salary equal to those paid in other departments of skilled labor. He is a true artist, a real benefactor of mankind.

The kitchen is a very important department of the house and home. It should be a large room, well lighted and ventilated, supplied with a good range or stove, with all necessary furniture for the use of heat. Fuel and water must not be forgotten. The closets and pantry must be supplied with animal and vegetable foods, sugar, salt, soda, bitartrate of potassa, soap and condiments. Cooking cannot be skilfully performed without suitable materials and conveniences.

The cook should be a cheerful, happy person, of quick perception and good common-sense, active, patient, economical, very neat, and fairly good-looking.

Meats are cooked by boiling, baking, roasting, broiling or frying. Corned beef is boiled, salt pork is boiled or fried. Boiling of meat coagulates the albumen, dissolves the salts and extractives, softens and loosens the fibres, and prepares it for easy mastication and digestion.

If the object is to secure rich soups and broths, the meat should be cut into small pieces, put into cold water, soaked a short time, and cooked slowly — simmered, not boiled. By this process the meat loses about thirty per cent. of its weight, which is retained in the broth, the remaining meat is rich in albuminoids. Meats long boiled become shrivelled, shrunken, hard and indigestible. When the object of cooking is to retain in the meat all the flavor and nutritive properties, the piece should be large and the water boiling hot when the meat is put in, which immediately coagulates the surface albumen and prevents the escape of the internal juices. After boiling a few minutes the temperature should be reduced to 160° or 170°, and the cooking continued until the meat is tender. It is a wrong practice to give meat a long boiling; it should have a long stewing.

Roasting should commence with a high temperature, to quickly coagulate the surface albumen and retain the rich juices and soluble extractives. By this process the fats are cooked, fatty acids set free, and the meat rendered savory and palatable. Broiling over hot coals is similar in effect to roasting. Baking in a close oven retains in the meat the empyreumatic products arising from the cooked fats, rendering it richer and stronger for the stomach than by any other process of cooking, but it is not so digestible.

The frying-pan, the terror of the dyspeptic, but the dear, good friend of a lazy, incompetent cook, must be noticed. In the frying-pan the meat is cooked in boiling fat or oil, which penetrates its substance and is changed in its properties, making the meat more difficult to digest than by any other process of cooking. But the much abused frying-pan has its legitimate uses and must not be wholly condemned. Fresh fish, pork, bacon, veal and lamb can be well cooked in the frying-pan when the process is carefully conducted. It is of great use in warming food and preparing hashed meats for the table. The solid, indigestible doughnut and griddle-cake are among its contributions to the causes and miseries of dyspepsia. Fresh fish — except salmon, which is "the beef of the sea"—should be either fried, broiled or baked. Salmon may be boiled or baked; when boiled it should be put into the water when it is boiling hot, the same as beef, and for the same reason.

Other varieties of fish when boiled lose their nutritive soluble elements, leaving a soft, pasty mass, very indigestible and of little nutritive value. The popular notion that fish is a brain food, rich in phosphorus, is a myth,—a pleasant conception with no physiological basis to rest upon. There is less phosphorus in fish than in beef or wheat, and that food which is best for the body is best for the brain. The origin of the conception is attributed to a German scientist, Prof. Moleschott, who thirty years ago wrote this epigrammatic expression: "Without phosphorus, no thought." The great Agassiz, in an address in favor of a fish commission, with other considerations used the same idea, and urged that because of the intellectual activity of our people fish culture was demanded. When asked what gave him this idea, he replied: "Dumas, the French chemist, once suggested to me that fish contained considerable phosphorus, and might on that account be especially good for food; and you know the old saying — 'Without phosphorus, no thought' —I simply put the two together." Afterwards, Mark Twain, by his famous joke in the Galaxy, advised a method of its practical application that travelled around the world and burst the empty bubble: —

"Young Author. 'Yes, Agassiz does recommend authors to eat fish, because the phosphorus in it makes brains. So far you are correct. But I cannot help you to a decision about the amount you need to eat, at least with certainty.

If the specimen composition you send is about your fair, usual average, I should judge that perhaps a couple of whales would be all you would want for the present. Not the largest kind, but simply good middling-sized whales.' "

By far the largest part of our vegetable foods are obtained from farinaceous seeds of a tribe of the grasses,— the cerealia, —wheat, oats, barley, rye, corn and rice. Next in importance are the leguminosæ, — beans and pease; these are of very high nutritive value, but hard to digest. An old Scotch maxim — "Beans stick to the ribs" — expresses their staying qualities. Beans and pease are nearly alike in chemical composition. They contain, of nitrogenous matter, about twenty-five per cent., and this is chiefly legumine, or vegetable casein; of starch, fifty-five per cent.; of cellulose, fatty and mineral matter, from two to three per cent. of each; and water, ten per cent.; besides an important ferment called diastase. There are many varieties cultivated. They are eaten in a green, unripe state, cooked by boiling, and are highly prized for their succulent qualities. Baked beans and bean porridge are old English forms of cooking that will hold their high place in the chemistry of the kitchen so long as the old rhyme,

> "Bean porridge hot, bean porridge cold,
> Bean porridge best when nine days old,"

is remembered among men. By the action of the diastase on the starch, converting it into sugar, the porridge becomes sweeter and better just as expressed in the rhyme.

The cereals agree in their general character, but they differ widely in the relative amount of alimentary principles they contain. They all have nitrogenized protein compounds, — albumen, caseine and fibrine; and non-nitrogenized elements, — starch, dextrine, sugar, fatty material, mineral phosphates of lime and magnesia, and salts of potash, soda, and silica, and the ferment diastase; and several of them have gluten.

They have, of nitrogenous matter, from 7 per cent. in rice to 23 per cent. in wheat; from 61 per cent. of starch in oats to 89 in rice; from 1 per cent. of dextrine in rice to 15 in rye; from .80 per cent. of fat in rice to 6 in corn; from .90

per cent. of mineral matter in rice to 3 in corn. They are all rich in starch, but they vary widely in nitrogenous, dextrine, fatty and mineral matter. Starch is therefore the chief element affected by the process of cooking.

Starch is found in vegetable substances only. In grain it consists of minute granules, made up of concentric layers, insoluble at ordinary temperatures, and of no use as food until converted into dextrine and grape sugar. By cooking, the starch is prepared for the action of the digestive ferments, the ptyalin and mucin of the saliva, and the trypsin of the pancreatic secretion, by which this change is effected. The residue not acted upon, digested by these ferments, leaves the body in the feces.*

Of the cereal grains used for food, wheat is the most valuable and most extensively cultivated. It is rarely consumed whole, but is subjected to processes of milling and grinding, and is furnished for use in the form of flour. Besides sixty-six per cent. of starch, wheat flour contains, as a part of its nitrogenous material, a substance, composed of vegetable fibrine, mucine and glutine, called gluten, — about eleven per cent., — which gives to the moistened flour peculiar tenacious adhesive qualities. These two bodies, starch and gluten, undergo important changes in the chemistry of the kitchen. The presence of both is necessary in the preparation of one of the most valuable and most highly prized of all foods, — good bread.

Yeast is an agent capable of exciting alcoholic fermentation in mixtures when exposed to air and warmth, containing starch, sugar and nitrogenous matter. It will act at a temperature varying between 40° and 140°, but is most active at a temperature between 60° and 100°.

* It may be well in this connection to consider the action of a ferment. Ferments are substances, either organized, like the cells of yeast, — when living and functional, fermentation takes place; when they die, it ceases, — or the ferment may be unorganized, a substance like the ptyalin of the saliva and other digestive ferments. Ferments are known by their effects; they have never been completely isolated. The action of a ferment is not chemical; it has no chemical reactions or combinations, and is not consumed by its action, but will continue to exert its power while conditions remain favorable. Ferments act on the molecules of matter, splitting them up, disturbing their peace. They are formed in the bodies of man and animals, and are found in seeds. The venom of serpents, the poison of the tarantula and centipede, are ferments.

Bread is called unleavened when the flour is mixed with water, thoroughly kneaded and baked at a high temperature; of which corn bread is a sample, and, from wheat flour, biscuit, and hard-tack or sea-biscuit. Leavened bread is raised bread, — a moist, light, porous, spongy substance, easy to masticate and digest. A little butter or lard and salt (with sugar, if desired) is carefully mixed with the flour, and either milk or water, — lukewarm, — with yeast, is added, and made, by careful stirring, into a paste or dough, which is exposed to a temperature of from 50° to 80° until fermentation is fully established. Carbonic acid gas and alcohol is generated; the gas is absorbed or retained by the gluten, causing the dough to swell up into an elastic, spongy mass, when it is thoroughly kneaded with more flour, made into loaves and put in a warm place until fermentation is again actively established, when it is placed in an oven heated to a temperature of from 350° to 500°, where it remains until cooked.

The alcohol and some gaseous products are driven off by the high heat of the oven. The gluten and starch which is partially soluble is mixed with the fluids, which surround the particles with a thin film of moisture. The fine, invisible bubbles of carbonic acid gas generated in every part of the loaf overcome the adhesiveness of the gluten, and separate the myriads of particles from each other. The high temperature converts the moisture into steam, ruptures the starch granules, softens and renders the starch and gluten soluble and well prepared for the free action of the digestive ferments. Other interesting changes occur in the cooking of bread. Wheat, in common with all cereal grains, contains a ferment called diastase, which is chiefly found in the cortical part, but is diffused through all parts of the seed. Aided by warmth and moisture, this agent is the active principle in the process of germination. The seed, buried in the moist earth and warmed by the sun, absorbs water. The germinal cells are quickened from dormant into active life. The diastase changes the starch into dextrine and grape sugar, the food of the germinal cells; the tiny leaf shoots upward to the sunlight, the rootlets strike into the earth, and when the stored starch of the seed is consumed the plant can derive its nutriment from earth and air.

In the process of rising and baking of bread, the moisture and heat enable the diastase of the flour to convert a part of the starch into dextrine and sugar. The sugar, by the fermentation, is converted into alcohol and carbonic acid. When the temperature of the bread reaches 140° the yeast cells cease to act, and the high temperature of the oven converts the surface of the loaf into a dense crust, which prevents it from shrinking when the formation of the gas is checked, and this is long before the cooking is completed. The starch on the surface is changed by the high heat into dextrine and caramel, and is richer in nutriment and more easy to digest than the white part of the loaf.

Other materials beside yeast are used to generate carbonic acid gas in the cookery of flour, — such as bicarbonate of soda and potassa, carbonate of ammonia, reacting upon the lactic acid of sour milk, hydrochloric acid, tartaric acid, bitartrate of potassa and the acid phosphate of lime. The baking powders in the market are made from these chemicals. They are quick in their action and convenient for the housekeeper, but the yeast process makes the nicest bread. The cereals may be cooked by baking, steaming, boiling and frying. Oats, barley, rice and corn have no gluten and cannot be made into raised bread. Rye has gluten and can be raised in cooking. Other forms of starch foods are sago, tapioca, arrowroot, corn starch, and the familiar potato.

We must pay our respects to our friend, the potato. There are many varieties of this tuber, differing chiefly in color, form and the percentage of sugar and starch they contain.

A potato uncooked is a hard, disagreeable customer for the palate. The substance of the potato is made up of cellular tissue, penetrated and surrounded by a watery, albuminous juice, and filled with starch granules. The object of cooking is the rupture and softening of the starch granules and the albuminous cellular tissues. When well done, we have a changed potato, soft, floury, mealy, inviting to the eye, acceptable to the palate, and, next to the cereals, the most valuable of all our vegetable foods. They may be baked, boiled, steamed or fried. Except when fried, they should be cooked in their "jackets," to retain their potash salts. From 70 to 83 per cent. of the bulk of the potato is water; of starch, from 12 to 18 per cent.; sugar, from 3 to 10 per cent.; of mineral salts, chiefly potash, from 1 to 3 per cent.

Cellular tissue is the framework of plant growth, and forms, in many vegetables, very valuable food material. "Cellular tissue," says Miller, "constitutes the groundwork of every plant, and when obtained in a pure state its composition is the same, whatever may have been the nature of the plants which furnished it, though it may vary greatly in appearance and physical character. Thus, it is loose and spongy in succulent shoots of germinating seeds, and in the roots of plants, such as the turnip and the potato; it is porous and elastic in the pith of the rush and the elder; it is flexible and tenacious in the fibres of hemp and flax; it is compact in the branches and wood of growing trees; and becomes very hard and dense in the shells of the filbert, the peach, the cocoanut, and the phytelephas or vegetable ivory."

Roots furnish valuable foods, such as the carrot, parsnip, turnip and beet. They all have nitrogenous matter, cellular tissue, starch, sugar and mineral salts. They are cooked by boiling or steaming to soften the cellular tissue and cook the starch. They have about 83 per cent. of water and a varying amount of starch, sugar and salts.

The herbaceous foods, like the cabbage, spinach, rhubarb, onion, asparagus, lettuce and celery, are valued for their succulent character and the vegetable salts they contain. Some are eaten raw, like the lettuce and celery; others are boiled.

Fruits and berries are of great value as accessory foods. Our markets are supplied, in their season, with the common varieties grown in our climate, and those from warmer latitudes and the tropics. Green, unripe and over-ripe fruits are unhealthy, but when ripe and eaten in moderation they promote health and comfort and are a luxury. Fruit has in its composition from 87 per cent. of water in the strawberry to 74 per cent. in bananas; of vegetable acids, .07 per cent. in ripe pears to 2.5 per cent. in currants. They also contain tannin and insoluble pectose. As ripening proceeds the acids are oxidized or changed by physiological chemical action and partly disappear; the pectose is resolved into soluble pectin and other fruit products of the nature of gelatine, which, by the chemistry of the kitchen, in cooking, is converted into the many forms of fruit jellies; the starch is changed into glucose or grape sugar by the action of the nitrogenized diastase which they contain. Fruit is tender and perishable. The process of ripening, unless arrested, is soon followed by loss of flavor, deterioration, fermentation and decay, when it becomes very unhealthy and dangerous to eat. It would be in accordance with sound dietetic wisdom if ripe, wholesome fruit formed a part of every meal. Izaak Walton said, "Doubtless God could have made a better berry than the strawberry, but doubtless God never did," an opinion most people would assent to; others might prefer an apple, a pear, an orange or a banana. Most varieties of fruit are eaten without being cooked; others are made into sauces, jellies, pies and pickles. Some are preserved by drying; others by the modern process of canning, which has been developed into a great industry, and applied, in the chemistry of the kitchen and in large establishments, for the preservation of fruits, milk and meat of all kinds.

The demand for drink is manifested by sensations of thirst, and is more imperative than our desire for food. A man will live longer and suffer far less without food, than he will when deprived of drink. In relieving our thirst we are guided largely by the inexorable demand for gratification of the imperious palate, which has led to the use of infusions of vegetable substances, fermented and alcoholic drinks in many forms, and aerated waters combined with a great variety of fruit and vegetable syrups.

In the chemistry of the kitchen, water used for drink is partially purified by boiling, which drives off the gases and changes the organic matter it may contain, destroying its poisonous properties, and effectually kills the germs of specific diseases that may be present, like those of cholera, typhoid fever and intestinal entozoa.

The almost universally used infusions of tea and coffee are prepared in the kitchen. Their consumption is enormous. The active principle of tea—.48 per cent.—is called theine. It also contains tannin,—18 per cent.,—and an essential oil which gives it its aroma. It is cooked by infusion in a close vessel, and should not be boiled. It was introduced into Europe about the year 1600, but had been used by the Chinese from the earliest times.

Coffee is the berry of a small tropical tree. It was introduced into England in 1650, and its use has become common among almost all races and tribes of men who have commercial intercourse with each other. Its active principle, caffein, is identical in chemical composition with the theine of tea, but it differs in its physical properties and physiological action. It also contains tannin, legumine, a volatile oil on which its aroma depends, and other principles. To prepare the berry for use it must be roasted to a dark-brown color, — not charred, — which sets free the volatile oil and develops the aroma. It should then be ground and cooked in a close vessel by infusion, steaming or percolation, and not boiled, which saves the aroma and volatile principles. An excellent method and economical is to boil the grounds from which a previous supply has been made, and pour this, when hot, upon a fresh portion of coffee, which saves the aroma and all the principles that are of value.

Tea and coffee are innocent, pleasant beverages when used temperately, but if abused they are poisons. They are powerful nerve stimulants, producing, when used in moderation, a cheering sense of warmth, exhilaration, mental activity and wakefulness. They relieve hunger and fatigue, and are a protection from heat and cold. They dispel care, and contribute to the comfort and happiness of mankind; but if abused they wreck the nervous system, causing tremor, anxiety, palpitation, impairment of sight, disturbance of the brain, feverishness, indigestion and general weakness of body and mind.

Cocoa, from which chocolate is prepared, is derived from the seeds of a tree growing in tropical regions. It is rich in fat, starch and nitrogenous matter, and yields an active principle, theobromine, similar to caffein, and a volatile oil which gives it its delicate aroma. It is closely allied to tea and coffee in its effects, but is less stimulating and far more nutritious, and has been widely used for several hundred years.

It is prepared for use by infusion, and is a valuable, refreshing beverage in sickness and health.

The so-called domestic wines and small beers, containing a small per cent. of alcohol, are a product of the chemistry of the kitchen, prepared by fermentation of materials containing starch and sugar. They are agreeable drinks when well made, and the small beers are much used in the hot months of summer.

Milk, the most valuable and sensitive of all animal foods, is changed, by the chemistry of the kitchen, into sour milk, and, by fermentation, into koumiss, — a most valuable and refreshing drink for the sick. It is also separated into cream, butter, cheese, skim-milk, and buttermilk, and by incorporation with eggs in other food materials it furnishes many of our choicest and most delicate luxuries for the gratification of the palate and the pleasures of the table.

Another important department of kitchen chemistry is the preservation of food for future consumption by the use of ice in the refrigerator, by drying, by exclusion of air in canning, and the use of antiseptic and chemical agents, such as sugar, alcohol, vinegar, nitre and salt.

The importance of a wise choice of suitable food materials and their careful preparation for the table is so apparent as to need no discussion. With us the waste in the kitchen is enormous. With the French, everything is saved. They understand the art of cooking better than any other people.

Our meats are liable to contain the germs of trichinæ, tapeworm, tuberculosis and other diseases, and common prudence requires their careful and thorough cooking to destroy their power to harm. There is no physiological reason for eating animal food in a raw, half-cooked condition, and it is a very unsafe practice. Who can estimate the discomfort and ill-health caused by a daily diet of heavy, sour bread and badly cooked food? The legion of dyspeptic miseries so common among our people are a pestilent brood too often hatched from a monotonous sameness of diet and wretched cooking.

This discourse has discussed the nature and uses of foods, and the changes effected in their substance by processes of cooking. If our consideration of this subject may help any person to a more intelligent application of its well-ascertained facts and principles, it will not be in vain that we have considered the chemistry of the kitchen.

I have come to the conclusion that more than half the disease which embitters the middle and latter part of life is due to avoidable errors in diet, . . . and that more mischief, in the form of actual disease, of impaired vigor, and of shortened life, accrues to civilized man . . . in England and throughout central Europe from erroneous habits of eating than from the habitual use of alcoholic drink, considerable as I know that evil to be. — SIR HENRY THOMPSON.

If we will care for men's souls most effectively, we must care for their bodies also. — BISHOP R. S. FOSTER.

OUR HOMES: THEIR POWER AND INFLUENCE.

By J. W. Stockwell.

On June ninth of the year 1791, was born, in the city of New York, a poet known to fame by only one little poem; but that gem is known and loved in every country and every home.

In palace and cottage it is alike dear; in the abode of the rich or the humble dwelling of the poor it is alike cherished. Written in the loneliness of the hunger of the heart for the reality of the song he sings; written from remembrance of the past never to be regained, — a cherished memory, — he sings the song of "Home, Sweet Home."

Every one knows how swiftly it was wafted over the world. Prima donnas have sung it, to the delight of thousands and thousands; homesick wanderers have poured out their souls in its plaintive strains; mothers have crooned it over the cradle, until now it is the home melody of all nations.

Says one, "It is a jewel cut and set with perfect art, and on the forefinger of Time it sparkles forever."

Others strive and toil a lifetime for fame and an immortal name; he sings his little song, and the name of J. Howard Payne is green with everlasting fame.

A sentiment so dear in every country, — a sentiment touching so tenderly every heart, under any and every circumstance, — must have a potent influence, must exert a controlling power on the life and character of the individual, and on the moral, intellectual and Christian character of the world. Therefore, the question "What shall constitute the home, and what shall be its teaching?" is a deep, underlying question, on which the foundation of our institutions and the permanence of our moral and Christian virtues must depend; for, in the circle of life, the influence of the early home is ever a safeguard and a refuge, — an incitement and a power.

Welcome, — for a fine nature is always going back to its youth, won toward the innocence and simple life of those early days; thus assuring us that they are an eternal possession as well as a formative influence.

How suggestive the experience of the Shepherd King, when, shut in a hold near his birthplace by the Philistines, and held in weary inactivity, he yearns for the water of the well by the gate, where he had watered his flocks, and he himself had drank, in the sight of the Hebrew maidens.

Who has not felt the same? — longed, in a weary moment of heavy labor or anxious foreboding, for the quiet of his childhood's home; for the old quests for the arbutus, spring's earliest harbinger; for the shady nooks; for the rippling water-falls; for the many, many happy reminiscences that clothe with regretful pleasure these thoughts that hold us in willing bondage.

Do not call this "sentiment"; it is a part of the formative work in our minds, enlarging the heart, strengthening the character, and holding the nervous forces in control for the daily toil. Neither be afraid of sentiment *about* the home or *in* the home. Sentiment is nothing but *thought* blended with feeling, *thought* made sympathetic and kind. There can be be no true home without these. Here, surely, the head and heart should go together, — every work blended with love.

No mother counts the labor "*toil*" that is done for the child. Instead, the loving heart of the mother counts it all joy that she may do for love's sweet sake, the numberless acts of maternal care that make up the brightness of her day.

Therefore, with no *undue* sentiment, I desire to direct your thought to the rural home, and our duty to make it a power for good to us and to our children, holding them by all best thoughts to it, by making it what it should be, — loving, beautiful, bright and happy, — an inspiration to noble thought, a love of all things beautiful, and a pure life.

Ah! It was with deep intent "He set the solitary in families," and instituted the Christian home. Life centres there, and flows from it to every one who comes within the circle of its influence. Every task is ennobled, every duty glorified, in the mutual love and happiness that are found there.

Families are the unity of which society is composed,— they are the deep roots from which all our social, moral and Christian life is developed. Before true society can come, true homes must come; for these are the foundation on which it must rest. As the family is, so is the State.

Longfellow says: —

> "Each man's chimney is his golden mile-stone;
> Is the central point from which he measures every distance."

And Wordsworth, in one of the most beautiful, as well as suggestive, of all poems, draws his inspiration from his childhood's home: —

> "There was a time when meadow, grove and stream,
> The earth and every common sight did seem
> Apparelled in celestial light,
> The glory and the freshness of a dream.
> It is not now as it hath been of yore:
> Turn wheresoe'er I may,
> By night or day,
> The things which I have seen I now can see no more."

Then follows the power of its influence: —

> "The thought of our past years in me doth breed
> Perpetual benediction.
> I love the brooks that down their channels fret,
> Even more than when I tripped lightly as they;
> The innocent brightness of a new-born day
> Is lovely yet.
> Thanks to the human heart by which we live,
> Thanks to its tenderness, its joys and fears,
> To me the meanest flower that blows can give
> Thoughts that do often lie too deep for tears."

A distinguished speaker at one of our fairs last fall, suggested a sad thought, I fear too true, that the typical American home is now found, not in the rural districts, or on the old homestead of the country farm, but more nearly and more truly in the city home with its refinements and amenities. More sad to me, because I had chosen to speak on this subject that I might instil the lesson of the value of the country home, and the glorious inspiration caught from its surroundings.

In the same strain you remember Whittier's lines: —

> "I call to mind old homesteads where no flower
> Told that spring had come, but evil weeds,
> Nightshade and rough-leaved burdock, in the place
> Of the sweet door-way greeting of the rose
> And honeysuckle; where the house wall seemed
> Blistering in the sun, without a tree or vine
> To cast the tremulous shadow of its leaves
> Across the curtainless windows —
> Blind to the beauty everywhere revealed:
> Treading the mayflowers with regardless feet.
> In daily life
> Showing as little actual comprehension
> Of Christian charity and love and duty
> As if the Sermon on the Mount had been
> Out-dated like a last year's almanac.
> Rich in broad woodlands and half-tilled fields,
> And yet so bare and pinched and comfortless.
> Not such should be the homesteads of a land
> Where whoso wisely wills and acts may dwell
> As king and law-giver in broad-acred state,
> With beauty, art, taste, culture, books to make
> His hour of leisure rich.
> Our yeoman should be equal to his home
> Set in the fair, green valleys purple-walled.
> A man to match his mountains, not to creep.
> I would fain invite the eye to see and heart to feel
> The beauty and the joy within their reach,
> Home and home loves and the beatitudes
> Of nature free to all."

Again, in an editorial in a leading Boston daily, only a few days since, criticising a book recently published, we have the idea of that editor on the country home, and you will note the delicate compliment of its title, "The New Heathendom": —

"There is one fact that comes out plain in every discussion and must be removed before the country can be reclaimed. That is, that the very thing for which it is praised, the quiet, the freedom from worldly care, the promotion of meditation, is defeated by such a residence. The mere struggle for existence, getting food, keeping warm, for housing and transportation, is so great and exacting, that it is a dreadful dwarfing of powers. The burden of life falls directly on human shoulders, since the comforts of life and the machinery of the arts do not intervene to save the rough wear and tear. The escape from the world is impossible, when the bare material existence demands all one's energy. To bring this fact to light is the great service of this opportune book."

Of this same book a religious weekly, also of this city, says: "This book is a faithful and powerful study of life on the farm. It is possible for those only who have summered and wintered in the country to sufficiently appreciate the service Mr. Frederic has rendered in showing country life as it is."

This is not the time or place to criticise the sentiments that we are assured are so opportune in this American book that is dealing with country life, not in some secluded settlement, not among the ranchmen or the cow-boys, but in one of the most fertile, productive and enlightened States in our land, and one of the most populous, — the State of New York, — only to suggest its demoralizing teachings, by saying that the only prominent character in the book worthy of study or imitation, viewed from any decent standpoint of Christian morality, is jeered at by the author and is unnoticed by the critics.

In the kindly interest of the statesman, for it was such; in the lament of the poet; in the ill-concealed contempt of this writer; in the acceptance of these sentiments by a leading daily in this city, as also in this cultured religious weekly, we have before us a phase of this question very different from my intent or thought when, one year ago, I proposed, at your request, to write on this subject; and therefore it is the more unexpected and startling, when we find the rural home, — so long honored and esteemed for strength and nobility of character, purity of heart, equipoise of mind; the stronghold of virtue, enterprise and thrift; its young life sought after, and stepping to the front rank of success in all the varied growth of our cities, — now looked at askance, and the farmer's home as wanting in kindnesses, nobility and thrift. Nevertheless, we cannot ignore these criticisms, coming from such sources and from such varied motives. Is there truth in them? Is this the trend of the farm life of to-day? Let us seriously consider if there be any foundation for these criticisms. If so, where is its cause?

Is it in the political economy of our country?

The thriving industries and varied interests of the manufacturing village,—or yet more of the larger city,—stand out more prominently and demand more strongly recognition of their claims; but let us not forget that the strength of the hills has been our sure support in every emergency. In the late war the country towns were the first to defend the nation's life. And let the politician remember that the country home is the germinating power of a nation's prosperity; its decay is an infinite loss to the Commonwealth.

> "Ill fares the land, to hastening ills a prey,
> When wealth accumulates and men decay."

If it be in our educational and religious teachings, let the teacher and the preacher both remember that any teaching that leads to false standards of life is destructive to the national weal; that any teaching that takes from the unity of our life, in its work for God, is barren in producing character, — that plant of eternal growth. A divided life-service is a complete loss.

If it be in our calling — but that cannot be. In God's sweet sunshine, in the song of the birds, in the loveliness of Nature, in her ever-varying hues, in the promise of the harvest and its fruitions, is everything to enlarge the heart, and refine the instincts that teach the amenities of life and lead to them. No! No! Give God the praise; it was never intended that the first employment given to man should be a bondage or should dwarf and enslave his noblest faculties. In all past history *its* success has been the foundation of the nation's prosperity; its decadence the sure precursor of a nation's downfall.

Is it in our homes — our rural homes? Before the preacher or the teacher, and far above them in its formative power, is the early moulding influence of the home. The common school is a little thing compared with the influence, to the young, from the home life. Here must grow up the habits that form character. In it, kindliness, sympathy and love must be fostered, — from it, aspiration and desire must mount upward. We talk of the progress of the age, and are proud of it; but let us not forget its source, in those little springs dotted all over our country, in which it takes its rise. This is my subject; all before, both affirmative and negative, but impress more deeply its power and our responsibility.

And first we should make our home and its surroundings happy and pleasant to the young.

There was, at the Centennial Exhibition in Philadelphia, a beautiful statue called "Sunshine," so wondrously true, so wonderfully expressive, that you took in the artist's idea at a glance. It could not be mistaken for the more jolly "Mirth," nor for the coarser joys of "Bacchus." As plainly as words could speak, stood out, in every line and lineament of the solid marble, the idea — "Sunshine."

Time and again I was drawn to that statue, taking in its lesson of hope, of courage, of cheerfulness and of joy, to enrich the heart with its vital force. We should carry sunshine to our home and into our work. There is a bright side, a beautiful side, to our calling. Let us dwell in that.

Our surroundings are the most pleasant and beautiful. It is the most healthy, ennobling and independent employment on earth. We are brought into intimate communion with the God of Nature, and are daily in her temple.

Abounding wealth is not ours, but that happier possession, contentment, should be. And this will be found only in the pleasant home and attractive surroundings. Therefore make it such that this truth shall grow into our lives and hearts, "Be it ever so humble, there's no place like home."

Make sunshine a part of your daily life, and your religious life. There are, even now, too many Christian lives that are like the old-fashioned spare room that has been so mercilessly and justly satirized, — the sunshine is never allowed to enter there. Every cobweb of vanity is carefully swept down, every article of furniture is set rigidly by the catechism and the creed, but the sunshine is never allowed to come in. Not such should be the ideas of those who "Go forth under the open sky and list to Nature's teaching," with every bush aflame with God.

"There is an animal," said Charles Reade, "with an eye of a hawk to detect shams; it is called a boy." There is no use in telling this boy that farming is the pleasantest occupation in life, while he is at work twelve hours each day, with no books, no papers, no anything to meet his idea of pleasure or play. It is of no use to tell him that it is the easiest, the most delightful, the most independent calling, while he is at work before the mechanic's bell in the morning and after it at night, with no Saturday afternoon in which to straighten up and recreate somewhat for Sunday's chores and Church, which are carefully calculated to fill its hours and get the most out of it. You cannot make farmers of your sons in this way, but there is a way in which you can implant in their hearts a love of Nature that shall be so abounding that it shall hold them as with hooks of steel.

You can so intertwine your hearts with theirs in the appreciating of beautiful things in your occupation as shall bind them to your homes so strongly that no temptation can allure them from you or from purity. You can so enter into the healthy flow of their exuberant life as shall add grace and beauty to their characters, and longer and happier life to yourselves. You can so direct that their plays and their recreations, natural and right, and God-ordained, shall be educating, elevating and refining to their sensibilities, and a grace to their lives.

Throw out the sunshine and it shall bind your sons and daughters there, safe from temptation, to grow up to revere your memory. Have your cheeriest smile and kindest greeting for the home circle; the amenities of life cost nothing, but they are a storehouse of sunshine. Make your home attractive as you approach it; set out shade trees for beauty, and fruit trees to enjoy. Let the beauty of shrubs and the fragrance of flowers greet your coming.

Says Northrop, "The central duty of life is the creation of happy homes." And again, "The home should be illuminated by Nature's brightest hues without, and still more by winning smiles within, — cordial greetings, gentle words, sweet laughter, and nameless little kindnesses.

"If parents combine to make the circle of home life beautiful without and within, they will sow the seeds of truth, kindness, honesty and fidelity in the hearts of their children. The memory of a beautiful and happy home is one of the richest legacies parents can leave their children."

If taste and culture adorn our homes, and music adds its charm, our children will find the pleasures of rural homes more attractive than the glamour and whirl of city life.

Again, make the home the centre of a happy, social life, not entirely given up to the serious work or to the equally wearing mental toil.

Says Rev. James Q. Corning, "There is a law established by our Creator. It is the law of recreation — if you please, the law of play. It would be a physical error to regard either sleep or play as unworthy of our care, since God has ordained both. Those parents who restrain the recreative propensities of their children by forcing their intellects to precocious development do so in violation of God's laws, and it is devoutly to be wished that parents would regard it as a religious duty to care vastly more than they now do for the physical education of their children. And let me add that the chief way to do this is to obey the divine law which has made play and pastime the grand preliminaries to a long, active and useful life."

We cannot change the fact that underlies the old adage that "All work and no play makes Jack a dull boy"; and all play and no work makes Jack a wild boy.

The joy of living, the exuberance of animal life, the need and necessity of an overflow, in the good healthy boy, is as natural as breathing and just as right; but they belong largely to that period. We rise above them; the earnest work of life comes in and supplants them, and the physical nature is prepared to take it up with joyous strength.

Zachariah, in prophetic vision of the restored Jerusalem, gives us a pleasing picture of natural life when he says, "And the city shall be full of boys and girls playing in the streets thereof"; and the old prophet is dearer to us for the simile.

If mirthful recreation is essential to physical health, as it surely is, then it cannot conflict in any way with the health of the soul. It not only does not conflict with religion, but it is one of its great demands. I cannot help thinking that many Christian people have a wrong standard of judgment in reference to this great subject, else we should not see such egregious mistakes in moral measurement.

Dr. Hill aptly said, in a recent poem:—

> "The body is the servant of the soul;
> We want it strong, we want it in control:
> To both which ends these healthful plays will tend,
> What greater reason need their use defend."

Dr. Bellows said: "For my part (I say it with all solemnity), I have become sincerely suspicious of the piety of those who do not love pleasure in any form. I cannot trust the man who does not laugh." Let us who are older encourage the young to meet for social joys and mental growth,—combining pleasure with improvement, joy with growth; and to guide them, and to help them too, let us join them in their enjoyments, to give them right direction, a healthful impetus and an elevating result. All this not for amusement sake, but for recreation and strength, as secondary to some noble purpose in life, worthy of their best thought; they are free, but in a wise way, for we have other business on hand. "Life is real, life is earnest"; and only the earnest ones secure its prizes. Therefore, never allow them to dominate the life.

Again, the materialism of the age is drawing away from the quiet yet strong influence of home. Too many homes are now demoralized in their teachings; the lesson taught is that it is the main thing to get money, to improve our condition, and to get on in the world. This is called success—to be rich, to wear fine clothing, and to fare sumptuously every day, without manual labor and without toil. But parents who are educating their children in this way are leading them by a perilous path. Some few succeed, but the way is beset and full of pitfalls; and with so many it all ends in failure. To them, life loses its zest; enervating disappointment unmans them, and they plod along the remainder of the way with weary feet to the end.

Not such the object and end of life. What we call success in life (with too many the only conception of it), getting of money, may be an element of content and a source of happiness in life, but only when vitalized by true principles of life. The guiding star must not be money or material success; it must be something higher and nobler. The guiding star must not be reputation even, which is of to-day, but *character*, which is eternal; not from without, but ever from within, are the issues of life. Plant there peace and order, an honest conscience, a clear mind, a correct judgment, and a profound faith, and that life will be beyond the power of disappointment to disrobe of its beauty or discontentment to discharm; "So making life, death and the vast forever one grand, sweet song."

Ah! There is one lesson more essential for every young farmer to learn in these days, than how to be rich. It is how to do without riches and yet fill life with the joys of sweet and lasting content; how to stand in the lot of toil, happy in its law of compensations. Mind for mind's sake; learning for its reflective food; the nobler ideals of faith for their strength and support and joy; labor for labor's sake, and for the Divine ideal, "My Father worketh hitherto, and I work"; these, these are the elements of strength, contentment, personal peace, national prosperity, for they indicate the character of the individual and the character of the nation.

Plymouth Rock itself is insignificant to look upon, and yet it stands, and must ever stand, for all that is noblest and best in life; all that is truest and most permanent; for it is the synonym for all the independence, the strength, the virtues, and the faith, of the Pilgrim character, and who can portray its influence on the character of our people and the institutions of our land.

And now, in conclusion, let us not forget the dignity of our calling, and that it deserves our best work in the home circle and the farm life. No man can measure success who does not realize that his vocation is above his avocation, no matter what that may be. The man who works for God in his avocation and considers only self in his vocation, is not, and cannot be, a success, for he has not taken in the dignity of his work, and the continuity of the service. Especially is this true of the farmer, so near is he to the heart of Nature, and obedient to her laws and in unison with her work; her solitudes are vocal with a richness that is an inspiration; the varied forms of beauty and fragrance and utility minister benisons to their lives.

Ah! The old country home (now so flippantly named "The New Heathendom"), who can calculate its influence, or its power for good? Distinct, indeed, it is from the city home, yet its history is *there* written in living characters drawn from every hillside home in New England, and their withdrawal would mean weakness, decadence and loss in every department of its varied life. In every city how many pictures are lovingly drawn of the early home. It may have been a wood-colored, old farm-house with the well near the door, over which the well-sweep stands guard, and from which the bucket descends to bring the liquid nectar so grateful to the thirsty family, father and sons, at the noontide hour; or it may have been the large, square, white house with the green blinds, surrounded by the old and graceful elms, wherein the oriole builds her nest, and from whose pendant branches he swings and sings his welcome notes; or it may have been the one-story cottage, poor and bare in all its appointments but in children, who are in sufficient number to supply all deficiency in the other furnishings of its rooms, — bright and happy and rich as kings, — its belongings are no part of its happiness to the childish mind; and yet there has gone out from these homes an influence, the power of which is beyond all calculation, and it is never lost, hardly diminished by the on-rolling years, till in the quiet of old age the mind goes back with relief and delight to those early, formative days with their blessed associations, and we fully realize all that is sweet, restful and sacred in home love. The sterling character, the loving thoughts, the pure aspirations, all that man loves on earth or hopes for in Heaven, rise with reflective vision of the old home, for they were born there.

ANNUAL REPORT

OF THE

CATTLE COMMISSIONERS.

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

The undersigned Cattle Commissioners, as the statute requires, present their Annual Report.

Neat Stock

The neat-stock interest of the State, especially in the department of the dairy and fine thoroughbred cattle, grows more important year by year, and the protection of the herds from contagious diseases, both on account of the value of the animals and the influence of their products on the public health, is a matter of great concern. The action of the general government during the last two years, through the Bureau of Animal Industry, has materially lessened the prevalence of contagious pleuro-pneumonia, and perhaps "stamped it out" in certain sections of the country from which no inconsiderable proportion of our cattle supply is received. Since August last, the condition of New York, Ohio, Indiana, Illinois and other States west has been such, in this respect, that it has been considered safe for cattle from those States to mingle freely or be domiciled with ours, and we trust that this safety will continue. We have had occasion during the year to fear that the disease had made a lodgment with us, and that it might be disseminated far and wide. On the 26th of last January a car load of twenty milch cows were received by a commission dealer in Brighton from Smith Brothers of Buffalo, N. Y., were sold by him to different persons, and distributed to many towns in the eastern part of the State. One of the animals was bought by a Mr. Ford of South Boston, and taken to his premises, but was found to be quite sick on her arrival. She had veterinary attendance, and was treated for lung fever and pneumonia, but died on the 15th of February. A post-mortem was made at the veterinary hospital of Harvard University by Drs. Lyman and Harrison, and a microscopical examination by Professor Whitney; and, to their astonishment, it, in their opinion, revealed a case of contagious pleuro-pneumonia. Searching examinations were made of the lungs of the animal by veterinarians familiar with the disease, and this opinion fully confirmed. The Bureau of Animal Industry and this Board were informed of the case, and, our investigations leading to the same conclusion, prompt action was decided upon to hold the disease within the limits it might have reached. It was properly assumed that if one of the twenty animals, in the car load received the 26th of January, had died with this plague, the remaining nineteen must be infected with it, and effort was made to find and isolate or slaughter them, as circumstances might require. Twelve of them were found within three days, and they, together with the cattle with which they had been in contact, were placed in quarantine. Circulars were printed, and sent to the different towns, warning stock owners and town officers against the remaining seven cows, and offering a reward for their delivery to the commissioners. But they were so carefully secreted that we got no trace of them until late in the month of April, when three of them were found in health; and it was ascertained that four had died, but of what disease could not be learned. In the month of January many cows from Buffalo were received at Brighton, and they continued to arrive at intervals afterwards; and, as we had reason to fear the place of shipment was a centre of infection, an agent was sent there to ascertain the facts, as a guide to our action in relation to future importations from thence, as well as to give a history of the case already in hand.

His report gave us good reason to believe that the disease had been there during the winter; and that fact, with the added one of the seven hidden animals, led us to send a circular to the officers of all our towns and cities, directing them to forbid the movement of all cattle from place to place, except those on their way to market for immediate slaughter. So far as we know this order was universally obeyed except in the city of Boston. The circular was received by the Mayor and transmitted to the board of aldermen, where, by Brighton influence, it was laid on the table, and where it remains to this date. But Brighton, one of the wards of Boston, was the centre of infection, if there was one in the State. The disease, doubtless in an active form, had been there. Infected cattle had been driven about the lanes and yards, and sheltered in the sheds of its cattle markets, and had passed back and forth through the streets of the town. Under the circumstances the public safety appeared to make it the duty of this Board to do that which the law under severe penalties required the municipal officers of the city to perform. Therefore, on the 8th of March, an order was issued and posted, forbidding the driving about the streets and lanes, or to and from that market, of any milch cows, store cattle or working oxen. This order, though generally obeyed, was resisted in two or three instances. This resistance led to prosecutions, during the trial of which the constitutionality of our contagious cattle disease law was severely attacked at many points, but it was sustained by the courts in every instance, and convictions followed. It was soon found that objectionable cattle had been driven from Brighton to the Watertown market, which caused the closing of that also to this class of stock. March 30 information, was received from the agents of the Bureau of Animal Industry that a herd of twenty-eight young cattle, sent from western New York to New York market, had been shipped thence to Washington County in that State, and by sale had been scattered through that and the adjoining county of Bennington, Vt. Also, that several of the animals had died of contagious pleuro-pneumonia, and others were sick. As cattle had been shipped from this vicinity to our State during the winter, and more were expected, our safety seemed to require that Massachusetts should be quarantined against both New York and Vermont, which was accordingly done, with the exception of beef cattle for slaughter. Quarantine stations were established at points where the different railroads crossed our State line. The officers of the railroads were directed to unload all such store cattle found on their trains at the quarantine stations, and the town officers at the localities were directed to detain and care for them at their owner's expense for ninety days, unless previously released or slaughtered by order of the Commissioners. On the 20th of April a cow, owned by Patrick McMorrow of Jamaica Plain, and which had been sick and treated by a veterinarian two months for lung fever, was killed, and found by post-mortem to have had this disease. This animal, also, was found to have come from the West to Brighton, but further history of the animal, or the origin of her disease, could not be obtained. It should, perhaps, be stated in this connection that an animal affected by common lung fever, consumption or pneumonia presents appearances so nearly identical with those of the contagious form that it is impossible to distinguish them as different while the animal is living; but by post-mortem it at once becomes apparent. The history of an animal or herd, its travels and associations, therefore, becomes an important factor to aid in the intelligent control of the disease. From Feb. 24 to April 26 we had very frequent notices of supposed cases of the contagion, but examination and slaughter failed to reveal its presence; and it did not make its appearance in any of the herds with which the twenty cows received on the 26th of January came in contact. The extent of its period of incubation is assumed to be ninety days; therefore, at the expiration of that period from the time the twenty cows from Buffalo arrived, or on the 25th of April, all restrictions against the movement of the *cattle of the State* were removed. Early in August the proclamation of the Governor of Illinois was received, assuring us that the disease had been "stamped out" in that State; and, about the same time, word was received from the officers of the Bureau of Animal Industry that they had secured such control of it in New York that we were no longer endangered from that quarter; therefore, on the 15th of that month, all restrictions were removed from the transportation of cattle from any points west or north to Massachusetts.

In May, 1884, Congress passed an act establishing the Bureau of Animal Industry "to prevent the exportation of diseased cattle, and to provide means for the suppression and extirpation of pleuro-pneumonia and other contagious diseases among domestic animals," and to co-operate with any State which would, by its constituted authorities, engage in the same work for itself, and give the officers of the Bureau the same power and protection, when in the State and in the discharge of their duty, as it gives to its own sheriffs, constables and peace officers. Subsequently it made an appropriation of $500,000, to be used by the Bureau in the prosecution of the work. Knowing of this act of Congress, on the appearance of the disease at South Boston, Governor Ames at once notified Commissioner Coleman, the head of the Bureau, of its existence in the State, and asked for assistance in its extirpation. He then sent a message to the Legislature on the subject, which resulted in the passage of an act (chapter 250 of the Acts of 1887) complying with the act of Congress of 1884. Thus Massachusetts was one of the first, if not the first State in the Union, to accept, by legislative enactment, of the proffer of the United States to co-operate in this important enterprise. Immediately upon the notification of the governor, Dr. W. H. Rose and Dr. R. A. McLean, two of the most intelligent and experienced members of the Bureau, were dispatched to Boston and engaged in the work of investigation. They went from town to town and examined the suspected herds and animals, bought and paid for many affected cases as if in the ordinary course of trade, and caused their slaughter for post-mortem purposes. They made extensive journeys beyond our limits to trace out the history of the animals causing the trouble here, and to apprize us of those sources of cattle drift which were a danger to us; and in every way aided in the work to be performed as if it had been personal to themselves. Their skill and efficiency demonstrated the wisdom of our co-operation with the Bureau. The measures of the Board caused great disturbance in the general cattle trade, and, doubtless, some individual hardship. But the disease was here, and it was considered better to use the most vigorous and stringent measures immediately, than by delay and hesitation to repeat the costly and disastrous experience of 1860.

Hog Cholera.

Though not so prevalent as in 1886, this disease is not extinct in the State, and it will not be so long as our swine feeders continue to feed the refuse of Western pork, whether that refuse comes from their own kitchens, or from the markets of our large towns, or the kitchens of their boarding-houses and hotels. There were only occasional cases the first nine months of the year, but quite frequent the last three. Owing to the fact that our swine stock is comparatively small, and almost universally kept enclosed, there is little danger that it will be depleted by this disease as it is at the South and West where the animals run at large, even if the attacks are of the most virulent type. We rarely or never find a case of it among animals which have never been from the farm on which they were reared, and have been fed only on the products of the farm. It appears hardly equitable for an individual to engage in the business of gathering city swill to fatten swine, and when his feed has caused disease, to receive relief from his loss by having his stock killed and paid for, to protect his neighbors from the result of his business. And it will be our duty, if this practice continues, to compel strict quarantine, and, perhaps, slaughter without appraisal or payment for the animals.

Glanders.

In our last annual report it was stated that this disease has been more prevalent than in any previous year, and the same remark may now be repeated. We are quite frequently notified of supposed cases of it requiring our attention; and correspondence with similar Boards in adjoining States indicate that it is more than usually rife in their localities. Complaint is also made that it is more than usually prevalent in the horse-breeding sections of the West, from whence, doubtless, it comes to us, to some extent, in our large importation of their stock. In September, information was received of its supposed existence among the horses of the Cambridge Horse-railroad Company, and one or two positive cases were shown us. The company employed about 1,800 animals, and an examination disclosed the somewhat surprising fact of only one case of acute glanders or farcy, and 192, which, from some abnormal condition of the nasal epithelium or the submaxillary or lymphatic glands, were thought to have the disease in latent or chronic form, and capable of communicating it in the acute; they were, therefore, looked upon with suspicion, and taken from the road. On re-examination, as soon as was possible, 103 of them were put back to their work and 89 isolated. These were examined from time to time, but as there was no development of the disease in its acute form, as the stock generally, including the isolated animals, remained in most excellent condition, and as a most searching inquiry into the history of the horses of the stables and the stock of the vicinity failed to prove that acute, palpably apparent glanders, was other than a rare occurrence considering the large number of animals there congregated, they were gradually returned to their work, until the last were liberated on the 28th of December. All the animals which had been under suspicion were, however, stabled and worked by themselves, that they might be easily kept under watch and guard. On the 10th of December acute glanders was found to be prevalent among the horses of the South Boston division of the West End Land and Horse-railroad Company. The Commissioners were immediately informed of the fact, and an efficient and intelligent corps of veterinarians employed to eradicate the evil. When we arrived at the stables, we found that these gentlemen had already destroyed thirty-five animals, and were actively engaged in selecting and removing all suspicious cases, and disinfecting and renovating the stalls. Subsequent visits and examinations of the stables, of the horses, and the course of management in all its details, satisfied us that the officers of the company and their employees were thoroughly in earnest to eradicate the contagion and guard the public. The active work was, therefore, left in their hands, with only such supervision from us as might be necessary to keep informed of the success or failure of their operations. To the present time about 60 animals have been destroyed, and the trouble appears to be on the wane, though it will probably be many months before all danger will be passed.

Tuberculosis.

In our report for 1886, particular attention was called to the prevalence of this disease, its peculiarities described, and the difficulty of eradicating it by the force of our present statutes, or any appropriation the Legislature would make. The facts of a year ago are in the main the facts of to-day. The disease continues with no apparent abatement or increase, though, as the veterinary profession increases in number, and attention is called to it more and more, there is call for more active work. The disease could, doubtless, be eradicated by placing it in the same category with pleuro-pneumonia, and applying to it the same provisions of law; but it would, doubtless, necessitate the destruction of twenty animals to save one, and require the payment of many hundreds of thousands of dollars.

There are other diseases of our domestic animals recognized as contagious to a slight degree, — like footrot and scab in sheep, and fouls in cattle, — and we are occasionally notified of cases of the kind. But they occur so rarely, the public safety is so little endangered by them, that we have declined to consider them as within the intent of the law. As we understand the statute, its object is not to relieve individuals from their misfortunes and losses, but to protect the public from the dissemination of a contagion which might prove a great calamity; and payments should only be made when animals are destroyed which have been exposed to such contagion, and *may develop* and communicate it through the community, though there is uncertainty in each case. The changes and modifications made in the contagious-disease law by the Legislature of 1887, brought to our aid a class of intelligent officers for such duty, enabling us to act with more precision, and simplifying the work of the department through which the detailed operations and expenses of the commission are required to pass.

At present we know of no new disease, or new development of an old disease, to combat which, in its changed conditions, modifications of the law are necessary.

LEVI STOCKBRIDGE,
A. W. CHEEVER,
J. F. WINCHESTER, D. V. S.,
Cattle Commissioners of Massachusetts.

BOSTON, Jan. 6, 1888.

By assent of the majority of the Board, Dr. J. F. Winchester, its veterinarian, believing the portion of the above report in relation to glanders in the horses of the Cambridge Horse-railroad Company is not presented in that fulness of detail which the circumstances of the case and its importance demands, and having objected to the release of the isolated animals, hereby appends a review of the same.

LEVI STOCKBRIDGE.
A. W. CHEEVER.

DR. WINCHESTER'S REPORT.

Complaints were made to me by numerous veterinary surgeons of Boston, about the 1st of August, that they were finding numerous cases of glanders.

Knowing that glanders had existed amongst the horses of the Cambridge Railroad in April, 1886, the Board desired that I should write to the Board of Health of Cambridge, asking them to inspect the horses of the road.

The following letter was received in reply to my request: —

CITY OF CAMBRIDGE, OFFICE OF BOARD OF HEALTH,
CITY HALL, Aug. 17, 1887.

J. F. WINCHESTER, D. V. S., *Lawrence, Mass.*

DEAR SIR: —Your letter of the 9th inst., requesting us to have examined the horses of the Cambridge Railroad Company, for the purpose of determining whether any of them are suffering from glanders, was duly received. In answer I have to say I have personally examined the horses in the River Street stables, where some cases of glanders occurred a year or more ago, and can find no evidence or even suspicion that this disease exists there now, or that there have been any cases of it since that time.

This Board was notified about three weeks ago, by Col. Currier of the Society for the Prevention of Cruelty to Animals, that he had reason to believe that glanders existed among the horses of the Cambridge Railroad Company in the River Street stables. Since that information was received, I have examined this stable and the horses three times. At no time have I found any sick horses, although there are a number of very lame ones in an open lot at the rear of the stable. I have also seen the president, superintendent and veterinary surgeon of the company, and, after telling the object of my visit, asked each of them if any of their horses were suffering from glanders, and the answer by all of them was "No."

Respectfully yours,

ALFRED F. HOLT, M. D.,
Health Officer.

SEPT. 13. Full Board visited stables of Cambridge Horse-railroad. First examined horses in Riverside stable, where about 70 are kept; next, the Brookline Street stable, containing about 45;

and lastly, the Harvard Square stable, where we found over 150 animals. Glanders was found in each, and, by vote of Board, the following letter was written by the Secretary and forwarded by mail to the superintendent of the road: —

BOSTON, MASS., Sept. 13, 1887.

To the Superintendent of the Cambridge Horse-railroad.

SIR: —The undersigned Cattle Commissioners of Massachusetts, having this day examined a portion of the horses in the service of your railroad, and having found a contagious disease known as glanders existing among them, do hereby order and direct that the animals distinguished by the following numbers be strictly quarantined and kept from off the public streets, until further notice from this Board.

In the Riverside stable, Nos. 1292, 1268, 1250, 1271, 1155, 1121, 1256, 401, 1191, 257, 259, 2332, 492, 1652, 853, 1278, and a black gelding with his number lost, — 17 animals. In the Brookline Street stable one horse, No. 2250. In the Harvard Square stable, Nos. 2396, 325, 747, 2552, 2337, 1530, 133, and a black mare with her number lost, — 8 animals; and in the three stables, 26.

LEVI STOCKBRIDGE,
A. W. CHEEVER,
J. F. WINCHESTER, D. V. S.,
Cattle Commissioners of Massachusetts.
By A. W. CHEEVER, *Secretary.*

Voted, to visit other stables, and to go on Friday next, Sept. 16, and continue examination of horses therein.

SEPT. 16. Board visited the Port stable of the Cambridge Horse-railroad Company, and found 27 animals needing isolation or destruction.

Voted, that the Secretary send the following communication to the superintendent: —

BOSTON, MASS., Sept. 16, 1887.

To the Superintendent of the Cambridge Horse-railroad.

SIR: —The undersigned Cattle Commissioners of Massachusetts have this day examined 220 horses in the service of your railroad found in the so-called Port stables, and having found glanders existing among said horses, you are hereby ordered and directed to strictly quarantine and keep from off the public streets, until further notice from this Board, all the horses known by the following numbers, namely: 2525, 322, 263, 334, 2513, 1162, 1135, 460, 1845, 1225, 1846, 1186, 1817, 1185, 1187, 2540, 2405, 1356, 366, 1743, 1204, 278, 1884, 24, 25, 497 and 1581, — 27 animals.

LEVI STOCKBRIDGE,
A. W. CHEEVER,
J. F. WINCHESTER, D. V. S.,
Cattle Commissioners of Massachusetts.
By A. W. CHEEVER, *Secretary.*

SEPT. 22. Board visited Murray Street stable of railroad company, Cambridge, and examined 169 of the 184 horses kept there, the others being on the road.

Voted, to instruct the Secretary to send the following letter to the superintendent of the railroad: —

BOSTON, MASS, Sept. 22, 1887.

To the Superintendent of the Cambridge Horse-railroad.

SIR: —The undersigned Cattle Commissioners of Massachusetts have this day examined 169 of the horses in the service of your railroad, found in the so-called Murray Street stable, and having found glanders existing among said horses, you are hereby ordered and directed to strictly quarantine and keep off from the public streets, until further notice from this Board, all the horses known by the following numbers, namely: 2260, 1647, 271, 290, 1758, 1648, 269, 2275, 2271, 2255, 2279, 2535, 2273, 2308, 2510, 2312, 2300, 2261, 2297, 2307, 2284, 1764, 2271, 2267, 2255 and 1918, — 26 animals.

LEVI STOCKBRIDGE,
A. W. CHEEVER,
J. F. WINCHESTER, D. V. S.,
Cattle Commissioners of Massachusetts.
By A. W. CHEEVER, *Secretary.*

It was also voted to send the following letter to the superintendent by the Secretary: —

DEDHAM, MASS., Sept. 22, 1887.

COL. WM. A. BANCROFT.

DEAR SIR: — According to my promise in reply to yours of the 19th inst., I report the decision of the Board of Cattle Commissioners regarding your request for permission to remove a part or all of the horses recently ordered to quarantine to a vacant stable owned by the railroad company, where better facilities for exercising them will be afforded. The decision is that such removal is permitted, provided the vacant stable named is within the limits of the city of Cambridge, and that the animals shall be removed at such times and in such manner as shall in no way expose other horses to contagion, and that this Board shall receive notice forthwith of the location of said stable.

I am truly yours,
A. W. CHEEVER,
Secretary of the Massachusetts Cattle Commissioners.

SEPT. 23. Board examined Cambridge Railroad horses in the Beacon Street and Spring Street stables in Somerville, Mass., and voted to send the following letter to the superintendent: —

BOSTON, MASS., Sept. 23, 1887.

To the Superintendent of the Cambridge Railroad, Cambridge, Mass.

SIR: — The Cattle Commissioners have this day examined seventy-one of the seventy-five horses kept in your horse-car stable on Beacon

Street, Somerville, and fifty-two of the fifty-eight kept in the Spring Street stable in the same city, and found glanders existing in both. You are therefore hereby ordered and directed to strictly quarantine and keep off from the public streets, until further notice from this Board, all the horses in the Beacon Street stable bearing the following numbers: 2167, 2151, 2192, 2139; and in Spring Street stable the following: 1795, 1070, 823, 844, 825, 1483, 1547, 804, 851,—four in the Beacon Street stable and nine in the Spring Street stable.

LEVI STOCKBRIDGE,
A. W. CHEEVER,
J. F. WINCHESTER, D. V. S.,
Cattle Commissioners of Massachusetts.
By A. W. CHEEVER, *Secretary.*

The Secretary was also instructed by vote of the Board to notify as follows: —

DEDHAM, MASS., Sept 23, 1887.

Mr. J. R. TAYLOR, *Somerville, Mass.*

DEAR SIR: — As Secretary of the Massachusetts Cattle Commission I am instructed to notify you that a horse kept at the Beacon Street horse-car stable in Somerville and said to belong to you has this day been examined by the Commissioners, together with others kept in the same stable, and having found glanders existing therein you are hereby directed to quarantine and keep from off the public streets the horse owned by you and kept in said stable, until further notice from the Cattle Commissioners.

A. W. CHEEVER,
Secretary of the Board of Cattle Commissioners.

SEPT. 26. The Board met and examined more horses of the Cambridge Railroad Company, and voted to instruct the Secretary to send the following letter to the superintendent: —

BOSTON, MASS., Sept. 27, 1887.

To the Superintendent of the Cambridge Railroad.

SIR: — The Cattle Commissioners having made further examination of the horses in the service of your railroad, and finding glanders existing among them, hereby order and direct that the horses known by the following numbers be strictly quarantined and kept from off the public streets, namely: at the Brighton stable, Nos. 1669, 1329, 1686, 1358, 863, 1379 and 1405; at Oak Square stable, Nos. 1956, 1817, 2336 and 1412,—eleven animals.

LEVI STOCKBRIDGE,
A. W. CHEEVER,
J. F. WINCHESTER, D. V. S.,
Cattle Commissioners of Massachusetts.
By A. W. CHEEVER, *Secretary*

SEPT. 28. Board examined horses in two stables of Cambridge Railroad in West Somerville, and voted to send the superintendent the following communication: —

BOSTON, MASS., Sept. 28, 1887.

To the Superintendent of the Cambridge Railroad.

SIR: — The undersigned Cattle Commissioners of Massachusetts, having made further examination of horses in the service of your railroad, and finding contagious glanders existing among them, hereby order and direct that the horses known by the following numbers be strictly quarantined and kept from off the public streets, namely: at the West Somerville stables, Nos. 1763, 2416, 1110, 762, 1899, 757, 841's mate, — a black horse with white star in the forehead, white off-hind fetlock and white saddle mark (number lost), — 2590, 1856, 1996, 766, 743, 388, 1990, 736, 737, 775, 1912, 1397, 1697, 2613, 758, 1834 and 772, — 24 animals. In North Avenue stables, Nos. 789, 1673, 518, 205, 48, 601, 651, 704, 665, 1857, 2413, 698, 2601, 1658 and 1908, — 15 animals; and in both stables, 39 animals.

J. F. WINCHESTER, D. V. S.,
A. W. CHEEVER,
Cattle Commissioners of Massachusetts.
By A. W. CHEEVER, *Secretary.*

OCT. 3. Board met at Port stable, Cambridge, to review examination of the quarantined horses, and voted to write the superintendent of the road the following letter: —

BOSTON, MASS., Oct. 3, 1887.

To the Superintendent of the Cambridge Railroad.

SIR: — At a meeting of the Cattle Commissioners held this afternoon in this city, to consider the case of the horses now in quarantine in your stables, it was voted that the secretary notify you that the two horses bearing the numbers 2525 and 1185, respectively, and now kept in the Port stable, are hereby ordered to be destroyed at your earliest convenience, and when they may be examined by the Commissioners.

The Commissioners cannot be present at a post-mortem earlier than Wednesday afternoon of this week. All other quarantined horses, except Nos. 1857, 1356 and 1187, to be held in quarantine until further notice from this Board. These three last named are relieved from all restrictions.

For the Cattle Commissioners,
A. W. CHEEVER, *Secretary.*

OCT. 5. Board met to re-examine Cambridge quarantined car horses, and released two from quarantine.

OCT. 6. Commissioners reviewed their work at the West Somerville and North Avenue stables, and relieved from quarantine four horses, namely: 737 and 2416 at the West Somerville stable, and Nos. 1673 and 651 at North Avenue stable.

Oct. 7. Full Board examined horses in three car stables, and released four in Murray Street, one in Beacon Street and three in Spring Street.

Oct. 10. Full Board re-examined horses in the Brighton and Oak Square stables of the Cambridge Railroad, released No. 1405, and then went to the Mt. Auburn stable and examined 130 of the 135 kept there. Found 21 suspicious cases.

Voted, To postpone sending order for quarantine until the remaining horses of the company have been examined.

Oct. 12. Board re-examined suspected horses in Eighth Street stable, Stiles's stable and Baldwin Street stable, and voted to instruct the Secretary to write the following letter: —

Boston, Mass., Oct. 12, 1887.

To the Superintendent of the Cambridge Railroad, Cambridge.

Sir: — The undersigned Cattle Commissioners of Massachusetts, having made further examination of horses in the service of your road, and finding glanders existing among them, hereby order and direct that the horses known by the following numbers be strictly quarantined and kept from off the public streets, namely: at Mt. Auburn stable, Nos. 465, 1576, 1889, 573, 479, 340, 2579, 585, 2460, 460, 489, 1938, 1600, 540, and 539. At the Summer Street stable, Nos. 2071, 2087, 2360, 2028, 2038, 2064, 2097, 2107, 2099, 2034, 2062. At Eighth Street stable, Nos. 924, 41, 256, 1632, 982, 2656 and 1877. At Stiles's stable, Nos. 981, 1910, 149, 966, 2470, 867, 903, 929, 969, 2047 and 1643. At the Baldwin Street stable, Nos. 1095, 1073, 2010, 1807 and 1832, — 50 animals.

Levi Stockbridge,
A. W. Cheever,
J. F. Winchester, D. V. S.,
Cattle Commissioners of Massachusetts.
By A. W. Cheever, *Secretary.*

Oct. 20. Board met at Commonwealth Building at half-past nine, and remained in session until half-past five, discussing the question what to do with the quarantined horses. Dr. Winchester moved that a certain number of them be selected by him for immediate slaughter. Ayes, one; nays, two; motion lost. Dr. Winchester then moved that all the quarantined horses be gathered by themselves for more strict quarantine or thorough isolation. Motion lost. Dr. Winchester then moved that all the quarantined horses be held where they now are. Vote taken and motion not carried. It was then moved by A. W. Cheever that a certain number of the quarantined horses be selected by the commission to be relieved from quarantine. The motion was carried by a unanimous vote. Ex-President Stockbridge presented a list of 95 horses, which, from records kept of the examinations, he was ready to relieve from quarantine. A. W. Cheever moved that the list be accepted, and that the horses therein named be relieved from further restrictions. The vote was carried, Dr. Winchester voting in the negative. Dr. Winchester next moved that the quarantine be removed from all the other quarantined horses. The motion was lost, Ex-President Stockbridge and A. W. Cheever voting in the negative. A. W. Cheever moved that the Secretary be instructed to notify the railroad that the following list of quarantined horses are relieved from further restrictions, and the other quarantined horses must be held for further examination, which will be made forthwith. Motion carried, Dr. Winchester voting in the negative.

List of horses to be relieved from quarantine: at Baldwin Street stable, 1073, 2010, 1095, 1807, 1832; Summer Street, 2107, 2097, 2099, 2038, 2034, 2062, 2360, 2029, 2064, 2071, 2087; Mt. Auburn, 539, 340, 585, 1576, 1600, 489; Eighth Street, 2656, 41, 256, 1632, 982; Brighton, 1379, 1329, 1686; Oak Square, 1956, 1817, 1412; Stiles's, 1643, 149, 966, 903, 929, 969, 2074, 981; Beacon Street, 2157, 2167, 2192; Spring Street, 825, 854, 823, 1070; Harvard Square, 325, 2337; Murray Street, 1648, 1918, 2312, 2275, 2273, 2300, 2261, 2297, 2307, 1764; North Avenue, 2601, 665, 398, 704; West Somerville, 1899, 1996, 1990, 736, 775, 2613, 758, 1834, 772; Port stable, 322, 334, 1162, 1846; 1186, 499, 1581, 263, 1743, 366, 278, 1204, 2413, 1884; Riverside, 1292, 1250, 1271, 1155, 1121, 1191, 259. The meeting of the Board was then adjourned to to-morrow morning, at half-past nine, in the Commonwealth Building.

The following letter is the form of notice sent to the superintendent of the railroad: —

DEDHAM, Oct. 20, 1887.

At a meeting of the Cattle Commissioners held this day to take action concerning the disposition of horses in the service of your road, and recently quarantined by order of the Board because it was judged that a contagious disease known as glanders or farcy existed among them, it was voted that the Secretary notify you that the horses known by the above recorded numbers are relieved from quarantine restrictions. Quarantined horses not in this list you will hold subject to further examination by the Board, which examination will be made forthwith.

I am truly yours, A. W. CHEEVER,
Secretary of Massachusetts Cattle Commissioners.

A letter was also sent to J. R. Taylor, Somerville, notifying him that the Board had voted to remove quarantine restrictions from his horse kept at the Beacon Street stable.

OCT. 21. Board met at the Boston office at 9.30 A. M. On motion of Dr. Winchester, the Secretary was instructed to communicate with the superintendent of the Cambridge Railroad, notifying him that the said horses not relieved by yesterday's communication be collected and quarantined in a stable by themselves, and notification be sent to the Board where such horses can be seen by the Board on Monday next.

OCT. 25. Board met, and it was voted unanimously to remove the restrictions from Nos. 1268 and 540, and keep the remainder (67) where they now are. It was voted that Dr. Winchester be instructed to purchase two horses, to be inoculated from one or more quarantined horses, to be selected for the purpose from the Bay Street stable. The Secretary was instructed to communicate with the company as follows: —

MR. PRENTISS CUMMINGS, *President of the Cambridge Railroad Company.*

DEAR SIR: — I am instructed by the Cattle Commission to ask that no horses owned by your company, and which have been quarantined by order of the Commissioners and afterwards had the quarantine removed, be disposed of by trade or otherwise, without giving notice to the Commissioners. It is very desirable that the future history of these horses be known, how many, if any, it is found necessary to dispose of, on suspicion of glanders or for other ailments. Trusting this request will not be unkindly received, but will be fully granted,

I am very truly yours, A. W. CHEEVER,
Secretary Massachusetts Cattle Commissioners.

OCT. 27. Received reply to the above from Mr. Cummings, who writes that so long as the matter is within his control, the wishes of the Commission as expressed shall be complied with.

OCT. 30. With Mr. Cheever visited Bay Street stable, where we met Drs. Liautard and Huidekoper and several Boston veterinarians. The doctors examined the horses, and will report later.

OCT. 31. Board met in Boston office, to determine what should be done with the quarantined horses. A. W. Cheever moved that ten more horses be released, namely, the ten which President Stockbridge had selected on Tuesday last as being in his judgment not dangerous to the public welfare. The motion was lost.

NOV. 7. Board met in Boston office, to dispose of Cambridge horses. Dr. Winchester presented reports of Drs. Liautard and Huidekoper upon the horses examined on Oct. 30. President Stockbridge moved that the Board accept the reports and place them on file, and withhold from publication or public use. The motion was carried, Mr. Cheever voting against its passage. President Stockbridge moved that the horses be divided into two classes: those known by Nos. 1135, 1225, 867, 924, 1483, 133, 743, 757, 762, 460, 2260, 1658, 227, 789, 205, 518, 1938, 290, 2552 and 1185 to be in one class, and to be kept where they are until further examination can be made by the Board; all the others to be placed in another class, and permission given to work them as before the quarantine, except that they must be worked in pairs by themselves, and not with horses which have not been held in quarantine. The motion was carried, Dr. Winchester voting against it.

Nov. 10. Board met at Bay Street stable, and re-examined the quarantined horses, 19 in number. Mr. Cheever moved that the seven, namely, Nos. 518, 789, 1658, 867, 757, 762 and 1185, be relieved on same conditions as those liberated on Monday, Nov. 7. The motion was carried, and the Secretary directed to notify the railroad accordingly, Dr. Winchester voting in the negative. It was moved by Dr. Winchester that all the horses set at liberty which were in quarantine Oct. 20 be ordered collected in stables by themselves, and not to be worked or kept with other horses. Mr. Cheever moved to lay the motion on the table till the next meeting of the Board. Motion carried to lay on table.

Nov. 17. Board met at Bay Street stable. Dr. Winchester moved that seven of the twelve remaining in quarantine be ordered destroyed. Motion lost, Dr. Winchester only voting in favor. Mr. Stockbridge then moved that the owners be advised to destroy seven, but be permitted to keep them, instead, in close quarantine, at the expense of the company, if deemed desirable. Motion carried, Dr. Winchester voting against it. Dr. Winchester then moved to strictly isolate the remaining five horses. Motion lost. Mr. Cheever moved to release the five on the same conditions on which the others had been released. Motion carried, Dr. Winchester voting in the negative.

Dec. 7. Board met in Springfield. Dr. Winchester moved that the Board buy some horses and inoculate the same from some of the horses that have been in quarantine. Motion carried.

Dec. 28. Board went to Cambridge, and Mr. Stockbridge moved that the seven now in quarantine be released. Carried, Dr. Winchester voting against it, and the following letter was sent to the president of the road: —

DEDHAM, MASS., Dec. 28, 1887.

Mr. H. M. WHITNEY, *President West End Street Railway Company.*

DEAR SIR: — At a meeting of the Cattle Commissioners held this day I was instructed to notify you that the seven horses numbered 460, 1483, 1225, 924, 743, 1938 and 133, now in quarantine, may be released on same conditions as previous horses were released.

I am yours truly,

A. W. CHEEVER, *Secretary.*

The first official notice was received from Alfred F. Holt, M. D., health officer of Cambridge, who said, "I have personally examined the horses in the River Street stable, where some cases of glanders occurred a year or more ago, and can find no evidence or even suspicion that this disease exists there now." It is not to be expected that Dr. Holt should recognize the disease in its chronic form, and he fully appreciated his position, when he asked the president, superintendent and veterinary surgeon of the road if any of their horses were suffering from glanders. The answer to his question was "No," which was, undoubtedly, honest so far as their knowledge went; but when the veterinary surgeon employed is a student in his second year, and, as I am told, "being educated by the corporation," what more could be expected?

Knowing these facts, and that it was an improbability, where such a large number of horses were owned, and that glanders had existed among them, it was decided to inspect the horses.

After the Board had made a partial examination of the horses, and found glanders among them, the railroad employed a number of veterinary surgeons of Boston to review the work of the Commission, at the same time apparently ignoring the opinion of the student.

The first interview with any of the officials of the road took place in Boston, September 29, when President Cummings and M. F. Dickinson, Jr., counsel for the road, were present.

Mr. Cummings stated that since last year, when the Commission ordered eight horses killed, the company had had very few cases of glanders in their stables. Some half-dozen had been killed on *suspicion* rather than *knowledge* of the disease. He also said that the road had employed C. P. Lyman, F. R. C. V. S., W. Bryden, V. S., and R. H. Harrison, D. V. S., to review the work of the Commission; and their report, according to Mr. Cummings, in relation to the first fifty-six horses examined, was, fifteen suspicious, four disagreed on, and the other thirty-seven — agreed that they had not, in their opinions, the disease, although they would not declare positively.

Mr. Cummings *failed* to mention that Austin Peters, D. V. S., M. R. C. V. S., was called to the Harvard Square stable as the first veterinarian to review the work of the Commission; also, that he stopped where he began, for his report was not, in the opinion of the officials, as their future movements proved, favorable to the road, but sustained the opinion of the Cattle Commissioners.

The first consultation of the Board with the veterinarians employed by the railroad took place October 3, at the Port stable.

The first question that presented itself was, "What will produce a scar or cicatrix on the septum of a horse's nose, other than accidents, purpura hæmorrhagica and glanders?" Dr. Bryden said they were frequently the result of horse ail, or the feeding of cut feed might cause them, while Drs. Lyman and Harrison did not mention any other cause. Of the horses quarantined at this stable Dr. Bryden saw two or three he would order off the street, while Dr. Lyman said he would not condemn to death any of the quarantined horses without close observation for at least one year, and he further stated it was with that understanding he was induced to review the work of the Commissioners.

The next day the consultation was continued at the River Street stable with about the same result, excepting that the veterinarians employed by the railroad acknowledged that they never heard of or saw *pin-hole ulceration* in connection with glanders. Duprey, who has well described this species of glanders, characterizes these "little ulcerations" as the result of the degeneration of miliary tubercles, and represents them truly as having "thin edges unevenly excavated, like *pin holes*, with this difference, however: that the hole made by the pin would be deep and pointed, whereas these ulcerations are shallow and have thin edges."

On the 17th of October the Board met the directors of the road at their office in Cambridge. Mr. Cummings gave an abstract of Dr. Lyman's letter, containing conclusions he had arrived at by the examination of the quarantined horses. He found different shaped scars, — long, T-shaped, V-shaped and star-shaped, the latter very suggestive of glanders, the others not so. The classification of the shape of scars as indicative of glanders is *self-assumed* and *without precedent.*

Dr. Lyman stated that the officials did not deny the existence of glanders in their stables. Dr. Lyman further stated that he would require three lesions — gland, ulcer and discharge — to satisfy him that a horse was diseased with glanders. He also said that the chancre could not exist without swollen glands, and in chronic glanders the sub-maxillary glands must show an abnormal condition.

Bouley says: "In fact, in some horses which were at work, and which had neither glandage nor discharge, glander pustules were found in the nostrils. Generally few in number and isolated, these pustules had not given rise to any notable irritation of the mucous membrane supporting them, nor to increased secretion, no abnormal amount of discharge issuing from the nostrils. There was no apparent derangement of health or condition. Though benignant in the subjects it affected, it was yet sometimes powerfully malignant when transmitted, giving rise to the fully developed disease with regard to the intensity of all the symptoms and the gravity of the nasal and visceral lesions."

On the 18th of October an agreement was made to select four horses to be killed, in order that there might be an agreement at post-mortem as to what evidence would be accepted as glanders before death. The first horse chosen, No. 2634, was one that had developed the disease in the acute form since the examinations had been begun, the horse having been, for the last four months, at the Harvard Square stable, where *glanders* was said to be "never known." The second, No. 2396, accepted as a very suspicious case by the veterinarians and the Commission. The third, No. 2332, one in which the veterinarians of the road could detect no evidence of disease, but was selected by the Commission. The fourth, No. 2405, a suspicious one to the Commission, and was selected by the veterinarians of the road.

The post-mortem examination of the horses chosen took place on the 19th of October, and there were present, besides the officials directly interested, Drs. Peters, Very, Howard, Blackwood and Marshall.

No. 2634, which was accepted by all as being diseased, presented satisfactory lesions of acute glanders and farcy.

No. 2396, which both agreed was very suspicious, presented chronic glander cicatrices on both sides of the septum, an active ulcer on the superior part of the septum about half way its length, and pin-hole ulcerations and tubercles on both sides of the septum.

No. 2332, the case in which the veterinarians employed by the road failed to find any evidence of disease. Pock-marked indentations very numerous on both sides of the septum. As Bouley says, "The pituitary of these animals was grêlée, as it were like the skin of pock-marked man."

No. 2405, one chronic glander cicatrix on the right with epithelial erosions.

The veterinarians employed by the road would not admit that any, except No. 2634, showed any lesion of glanders, neither would they state the cause of the pathological changes seen on the septum.

On the 20th of October the Board released ninety-five horses from further quarantine restrictions, without regard to the facts that they had been quarantined as diseased and suspicious of glanders, and that an acute case had made its appearance.

The next day Mr. L. Stockbridge gave me the following communication as the reason of his action in the matter: —

BOSTON, Oct 21, 1887.

I am decidedly of the opinion that Dr. Winchester has, both by ante-mortem and post-mortem examination, demonstrated the correctness of his opinion that the disease with which the isolated horses of the Cambridge Horse-railroad are infected, has, in most of its essential particulars, lesions like those described by standard veterinary authors on the subject as chronic glanders; but that by neither of these forms of examination has he demonstrated that the disease, as developed in this case, or at this stage of its exhibit, is as destructive to the membranes and tissues of the nasal passages, the bronchial tubes and the lungs of the infected animal, or that, in consequence of its contagiousness is as dangerous to the equine stock of the community as is claimed by him and them. So I believe,

LEVI STOCKBRIDGE.

Mr. Stockbridge does not appreciate this form of glanders, as his experience has been entirely confined to other forms, more acute than the dry form of the disease.

The remaining sixty-nine were collected and quarantined at the Bay Street stable, permission having been given the officials Sept. 22, to collect the quarantined animals together, provided they should do so at such a time and in such a manner as should in no way expose other horses to the contagion. They were examined on the 24th inst., and on the 25th two were released by a unanimous vote, their condition being such as to warrant their release. It was then suggested by me that Drs. A. F. Liautard of New York, a graduate at Alfort, France, and the Dean of the American Veterinary College, University of New York, and Rush S. Huidekoper of Philadelphia, a graduate at Alfort, France, and Dean of Veterinary Department of University of Pennsylvania, be called to examine the remaining sixty-seven, the examination to take place the following Sunday. Mr. Stockbridge presented a list of ten horses that he was willing should be released the Monday following the examination by Liautard and Huidekoper, while Mr. Cheever wanted to wait until he had heard their reports, as he might change his mind as to what course to pursue.

The order of the 20th was modified in that all horses that had been quarantined be not disposed of without notice to the Commissioners; but on the 10th of November information was gained that one of the *quarantined horses* had been *sold to go to New Hampshire*.

Sunday, the 30th, Drs. Liautard and Huidekoper examined the sixty-seven horses in quarantine at Bay Street stable, and some of the officials of the road, numerous veterinary surgeons and Mr. Cheever, with myself, were present.

The next day, at a meeting of the Board, Mr. Cheever was willing that the ten horses Mr. Stockbridge had proposed on the 25th to release on this day should be relieved; but now Mr. Stockbridge is willing to wait until after the reports of Drs. Liautard and Huidekoper are at hand; and the meeting was adjourned subject to the call of the veterinarian.

The reports of Drs. Liautard and Huidekoper were presented to the Board Nov. 7, and they were accepted and placed on file, Mr. Cheever voting against it that day, but subsequently approving Dr. Liautard's bill, thereby making it a unanimous vote.

New York, Oct. 31, 1887.

To the Cattle Commissioners of Massachusetts.

Gentlemen: — Having been requested by you, through Dr. J. F. Winchester, to visit in Cambridge, Mass., a number of horses belonging to the Cambridge and Boston Railroad Company, and give my opinion as to the prevalence of glanders among them, and to what extent the disease, if any, prevailed, I went to Boston on Oct. 30, and in company with Dr. R. Huidekoper of Philadelphia, was brought by Dr. Winchester to the stables of the company, where we met a number of gentlemen, officers of the road, Mr. Cheever of your Board, with several veterinarians of Boston, and there I successfully examined the sixty-seven animals which were quarantined by your order, and carefully noted their condition as they were brought to my consideration, one after the other.

Though the history of this outbreak is not very familiar to me, I must say that I have been given to understand that the stables of the Cambridge and Boston Railroad Company have not been free from that disease for some years back, — according to one of the gentlemen present at the time of the examination, an officer of the road, I believe, for some two years, according to Dr. Winchester, for some twenty, — and that recently several cases of chronic and acute glanders had been detected amongst the horses, and they were destroyed on that account. I was, besides, informed that most all of the quarantined animals belong to various stables of the company, and that, if I remember right, with one or two exceptions, in which horses were mates, all the others were single horses taken out of teams, in which the mate was left apparently free from disease, and now at work.

The first fact, establishing the existence of the disease for some time back, is not without importance; and, though I have been principally guided in my decision by the symptoms observed, the weight brought to bear by this history cannot be entirely overlooked, when deciding the question of the suspicious condition of a number of the horses.

I now beg to present you with my report of the condition in which I found the horses, and the conclusions the same has brought me.

Before doing this, however, I hope you will allow me to make a few remarks on the disease known as glanders, and its symptomatology, as then a better appreciation will be obtained of the various reasons that have suggested my conclusions.

There are such differences in the manifestations of the two forms of disease known as acute and chronic glanders, the symptoms are so easily recognized, the duration of the disease so different, that a distinction between them is an easy and simple task for the veterinarian, and on that account, and as far as these horses, now in dispute, were concerned, there was no doubt. The question was not, Have they acute or chronic glanders? it is the chronic form.

In chronic glanders, sub-division is commonly admitted, of an *ordinary* or *confirmed*, of a *dry* and of a *latent* form.

In the *ordinary* form, the three essential symptoms, with their peculiarities of gland, discharge, and ulcers or chancres, are met with.

In the *dry* form the symptoms given by the glands and by the discharge are missing, and the surgeon is left to decide only on the characters presented by the *septum nasi* and its covering.

In the *latent* form there is, so to speak, nothing positively indicative of the existence of the disease, so far as given by the gland, the discharge, or the *septum nasi*.

These two last forms are very insidious, and may exist for a number of years in stables, remain undiscovered, and yet keep on spreading until a large outbreak takes place, and careful examination reveals the extent of the ravages committed. Bouley, in his article on glanders, in the "Dictionnaires des Sciences Medicales," reports a case very interesting, and which I may ask to present, as having much importance and bearing much weight with the horses of the Cambridge road.

He says, speaking of *dry glanders:* "It is one of the insidious forms of glanders, and so much so that nothing apparently abnormal calls the attention of the surgeon, when condition of the glands and presence and character of the discharge only are taken into consideration. An outbreak had taken place in a large horse establishment in Paris, the horses had been submitted to the ordinary examination for condition of glands and the discharge, and every other ordinary sanitary precaution being taken, the disease was thought to be under control; but, instead of that, it seemed to continue in spreading more and more. Then a careful examination of the *septum nasi* was made on every horse, and then *ulcerations*, recent or old *cicatrices*, *tubercles*, *epithelial abrasions*, *etc.*, *etc.*, were discovered, diseased animals were destroyed, and for two years after the establishment was free from the disease."

Into this form of glanders (dry form) the condition of the horses at Cambridge can be classified; for, out of the sixty-seven animals brought to my examination, I can almost say that in none of them did I find a diseased condition of the glands, or a sufficient amount of discharge to assist me in the diagnosis. A few of them (2579, 479, 460, 1938, 465, 2460, 1110, 1185, 2525) presented a slight soreness and fulness of the glands of the intermaxillary space, or a slight discharge of one or both nostrils, but scarcely sufficient to be taken then into consideration, except as what little value they might have in relation to the suspected presence of the disease and the history alluded to.

Without, therefore, going into the consideration of the characteristic condition of glanderous glands of the maxillary space, or the specific appearance of this discharge, we must stop a moment as to the symptoms to be obtained by examination of the septum nasi.

Chronic glanders has for characteristic lesions of the nasal cavities three forms of ulceration,— *chancre consecutive* to the granular pustule, the *tubercular chancre* proper, or the *simple epithelial* erosion. They probably have not the same diagnostic value, and while the epithelial erosions *alone* may only suggest the presumption of the disease, the others, according to some authors, have such special signification that their presence is positive evidence of the disease, no matter to what extent they may exist, should it be but the smallest tubercle or the largest radiated cicatrix.

According to the extent and dimensions that some of the ulcers may assume, and also, according to their agglomeration at the time of their ulcerating process, variations may take place in the appearance of the septum, while at times it may be but one or several little tubercular pustules (the tuberculous chancre of Bouley) which may ulcerate and give rise to the formation of those peculiar pin ulcers of the false nostrils, or the ordinary chancre of the septum, or of the turbinated bones; then again, we may find large, irregular radiated cicatrix in various parts of the septum cord, more or less prominent over the mucous membrane, and not uncommonly surrounded by an inflammatory ring on its edges. With those also, or without them, are often seen nothing but simple epthelial abrasions, which are but simply a disappearance of the epithelium, upon a more or less extensive surface, and varying in their depth.

Besides these, the peculiar appearance of the septum and of the mucous membrane is very suggestive. The coloration has assumed a leaden or slate hue, due to the venous congestion, the lymphatics have become more or less prominent, and the whole mucous membrane seems to be thicker on account of the infiltrated condition that it assumes; while again, the finger passed over the surface of the septum will get a feeling of roughness, due to the granular changes which take place in the mucous structure.

There is one point to be taken in consideration with the existence of this form of disease of solipeds, and specially so in the dry or latent form. It is the fact that apparently a perfect condition of health exists, and that, different from what we meet in almost all other contagious diseases, it may last for years, with the absence of almost any indication of sickness. For many, all the functions of the body do remain at their normal standard, the pulse is normal, the respiration but slightly altered, except in its rhythm (if the lungs be extensively diseased), and the temperature remains at the normal degree, varying from 99° to 101°.

In conclusion, and after careful consideration, not only of the symptoms observed, but also of the general history of this outbreak, of the condition of the animals examined, and the various general public and private interests engaged, and taking into consideration the acknowledged symptoms and characteristics of dry glanders, as we find them recognized as such by veterinary authorities, I have seen proper to divide the sixty-seven horses that I have examined into four classes: —

1st. Those which presented characters positive in their nature, as far as ulcers, cicatrices, granular tubercles, epithelial lesions, and which, in consequence, I would pronounce as affected with chronic glanders (dry form).

2d. Those which I consider *Suspicious*, as having presented to me, principally, lesions of the mucous membrane in the shape of epithelial erosions, or perhaps now and then a cicatrix, or other character of a suspicious nature. In this class, Nos. 479, 2284, 269 and 766 have not been classified amongst those of the first, only on account of the diminutive size of the lesions they presented.

3d. Those which I named *Doubtful*, as having presented lesions whose nature might be interpreted differently.

4th. Those in which I have failed to detect any signs of disease which would justify me in placing them in either of the two preceding classes.

601. Left side two small tubercular cic. granular septum, leady septum.

518. Right side radiated cic. tubercular granular septum, slate.

205. Epithelial erosions over the whole right side, ulcerations on the left, lead color septum.

789. Epithelial erosions over the whole left side, cic. on the left, lead septum, lymphatic swelling on groin.

1658. Small ulcerations and tubercles on both sides.

2250. Granular cic. on right. Large epithelial erosions.

2260. Old and recent cic. on the right side. Small epithelial ulcer on left.

2579. Slight epithelial erosions and ulcerations on both sides, more marked on left. Slight discharge, sticky on left.

573. Small ulcer on left. Epithelial on right, slate.

1758. Large radiated cic. on right. Small epithelial erosion, septum inflated.

2252. Ulceration on turbinated bone on left side.

1358. Cic. on right, lead color. Lymphingitis off hind leg. Temp. 100°.

1110. Max. glands swollen. Slight discharge on the left; extensive epithelial and ulceration on same side.

853. Small ulcer and granular tubercles on left side.

1483. Well developed chancre on left side.

924. Radiated chronic cic. on both sides, slate color.

2470. Cic. on left side. Tubercles and abrasions on the mucous membrane.

867. Cic. and ulcerations on right side near the turbinated bone.

460. Max. glands tender and swollen. Injection and ulceration of the septum on right side; left side lead.
1763. Slight discharge on right. Cic. on both, granular, that of right side under false nostril.
2535. Cic. on left, also small ulcer. Infiltrated septum.
762. Characteristic tubercle on right side.
290. Same as above.
743. Cic. on both sides septum, ulceration on left.
133. Cic. radiated on right side. Epithelial abrasions, lead septum.
1669. Gland swollen and painful. Several cic. on left side, lead septum.
Black gelding, River Street stable. Elongated, radiated cic. on right side; dark-colored septum.
1185. Glands swollen and painful. Slight discharge on left, ulcerations on same; lead.
2525. Pale granular cic. on right side. Epithelial abrasions; glands.
1225. Cic. on right side. Granular septum both sides.
1135. Characteristic ulcer on left side.

Suspicious.

1908. Slight leaden colorations of septum on both sides. Epithelial abrasions, excessive tenderness on cervical vertebræ.
479. Cic. on left side, very small; slight discharge.
2284. Cic. at bottom of left side, œdematous septum.
1938. Lymph. glands and max. space somewhat swollen and painful. Small epithelial erosions on left side.
465. Glands painful, septum dark and leady, mucous membrane rough.
269. Small cic. on left side, some abrasions on septum.
2460. Slight discharge on right side, some epithelial abrasions.
1647. Cic. on left; doubtful.
2255. Epithelial abrasions all over septum.
1256. Glands sore and swollen, peculiar growth on near side.
1912. Staring coat, glands, epithelial erosions.
766. Small abrasions and cic. of doubtful appearance. Swelling of both hind legs.
388. Small cic. on left, marked slate color, perhaps granular.
2590. On left side a small granular or ulcerated spot.
1530. Very small cic. on left side, slight slate color.
401. Infiltrated and lead color.
863. Slight swollen glands. Epithelial on left.
1278. Radiated cic. on the right side.
1795. Same condition, somewhat slate color of septum.
2336. Cic. on left, eroded on right side.
1877. Suspicious swelling of sinuses; slate septum.
2540. Granular cic. Some abrasions on mucous membrane, right side.
1856. Same condition.

Doubtful.

48. Straight cic. on right.
2279. Small cic. on right, perhaps infiltrated septum.
757. Cic. on right, well forward.
1910. Small cic. in front, suspicious mucous membrane.
24. Large granuloma on right.

Free.

1839, 1397, 1697, 2510, 1652, 804, 25 and 1845.

A. Liautard, M. D., V. S.

New York, Nov. 15, 1887.

My Dear Doctor: — When I sent you the report to the Cattle Commission I did not make any suggestions as to the sanitary measures that presented themselves, as I thought they were sufficiently explained by the conclusions of the report.

You will, however, excuse me, if, on second consideration, I take this opportunity to specify what line of conduct I believe the proper to follow.

Relating to the animals that are recognized as *diseased*, there is but one indication, — that is, to destroy them. Those which are called *suspicious* ought to be submitted to a daily observation and inspection by a veterinarian in good standing and competent, for several months, and to be treated accordingly. The others, *doubtful* and healthy, ought to return to work, though careful watching of those called doubtful would certainly not be improper.

And last, but certainly not least, I would suggest and strongly recommend a weekly inspection of all the horses of the company until sufficient time had elapsed to satisfy a competent veterinarian that there is no more danger of another outbreak.

In the experience I had of a large horse establishment in this city some years ago, in which no less than 250 horses were killed, it took over six months of weekly, semi-monthly and monthly inspection, before the stock was considered out of danger.

Yours truly,

A. Liautard, M. D., V. S.

Philadelphia, Penn.

Dr. J. F. Winchester.

Dear Sir: — I herewith append an itemized report of my examination of the sixty-seven horses in the stables at Cambridge, Mass., on Oct. 30, as requested by you.

I found twenty horses, as numbered in report, with tubercles, indurated cicatrices and glands sufficient to establish the diagnosis of glanders. Twenty-eight animals (column 2) presented the same symptoms in a less marked degree. These cases are extremely suspicious, but, as individuals, I am not warranted in pronouncing them glandered. The remaining nineteen cases in their general appearance and condition are not in the shape that they should be, but in them I find no lesion to make a diagnosis.

Considered collectively, and taking into account that these horses have done no work for several weeks, during which time they have had good care and feed, there are, in both those horses which I find diseased and suspicious, and also in those in which I find no specific lesion, many evidences of constitutional disturbances, — dry, rough coats, glairy mucous membranes, dullness not accounted for by the lymphatism of the subjects, — which add greatly to confirming the suspicion of those which are not distinctly glandered. This recent rest of the animals also explains the absence of any more acute cases.

I consider the twenty diseased cases and the twenty-eight suspicious cases as absolutely unsafe to handle by the attendants, and dangerous to horses that may come in contact with them, or their belongings. The remaining nineteen, if worked, should be placed in teams by themselves, allowed no communication with other horses, and should be examined at least once a week, by a veterinarian competent to detect the first symptom of the disease.

RUSH S. HUIDEKOPER.

Notes on Examination of Cambridge Horse Car Stables, Oct. 30, 1887.

601.	Indurated cords, max. space,	Suspicious.
48.	Varnished mucous membrane,	Suspicious
518.	Tubercles right side,	Diseased.
205.	Ulcer and indurated glands,	Diseased.
789.	Cicatrices and indurated cords, etc. hind legs,	Diseased.
227.	Tubercles and indurated inguinal glands,	Diseased.
1938.	Nothing,	None.
1839.	Nothing,	None.
1658.	Tubercles,	Diseased.
2256.	Nothing,	None.
2260.	Cicatrices and indurated cords,	Diseased.
2579.	Glands, indurated oily discharge,	Suspicious.
573.	Indurated glands,	Suspicious.
479.	Nothing,	None.
2284.	Ulcers,	Suspicious.
1758.	Nothing,	None.
460.	Cicatrices off nostril,	Diseased.
1938.	Tubercle near nostril and septum, glands,	Diseased.
1763.	Nothing,	None.
465.	Indurated glands,	Suspicious.
2535.	Glands,	Suspicious.
269.	Indurated cords off side,	Suspicious.
2460.	Varnished mucous membrane,	Suspicious.
762.	Tubercle off side,	Diseased.
290.	Tubercles off side, varnished membrane,	Diseased.
1647.	Tubercles, prolonged expiration,	Suspicious.
2255.	Nothing,	None.
1256.	Indurated glands off side,	Suspicious.
1397.	Cicatrix near side,	Suspicious.
1697.	Nothing,	None.
1912.	Nothing, epithelioma, greasy heels,	None.

766.	Nothing,	None.
757.	Cicatrices, tubercles,	Diseased.
743.	Tubercles and glands,	Diseased.
388.	Indurated glands, discharge,	Suspicious.
2590.	Ulcer near nostril,	Suspicious.
133.	Cicatrices and glands,	Diseased.
1669.	Cicatrix near nostril, glands,	Suspicious.
Black gelding, River Street stable.	Tubercles,	Suspicious.
2552.	Cicatrix left nostrils, glands,	Diseased.
1358.	Cicatrices,	Suspicious.
1110.	Glands indurated,	Suspicious.
1530.	Tubercles, glands; cic. hind legs,	Suspicious.
401.	Tubercles off nostril,	Suspicious.
863.	Tubercles near nostril,	Suspicious.
1278.	Tubercles off nostril,	Suspicious.
853.	Nothing,	None.
2510.	Nothing,	None.
1652.	Nothing,	Doubtful.
1795.	Cicatrices, prolonged expiration,	Suspicious.
804.	Cicatrices off nostril,	Suspicious.
1483.	Tubercle near side, glands,	Diseased.
2336.	Varnished membrane, glands indurated,	Suspicious.
924.	Tubercles, indurated glands,	Diseased.
2470.	Nothing,	None.
867.	Tubercles, indurated glands of,	Diseased.
1910.	Nothing,	None.
1877.	Nothing,	None.
25.	Glands, indurated varnished mucous membrane,	Suspicious
2546.	Nothing.	None.
1185.	Discharge and glands indurated near side,	Diseased.
1845.	Discharge, nothing,	None.
2525.	Cicatrices, indurated glands,	Suspicious.
1225.	Tubercles, cicatrices,	Diseased.
1135.	Cicatrices, glands indurated,	Diseased.
24.	Nothing,	None.
1856.	Cicatrices,	Suspicious.

RUSH S. HUIDEKOPER.

Diseased, 518, 205, 789, 227, 1658, 2260, 460, 1938, 762, 290, 757, 743, 133 2552. 1483, 924, 867, 1185, 1225, 1135 = 20.

Suspicious, 601, 48, 2579, 573, 2284, 465, 2535, 269, 2460, 1674, 1256, 1397, 338, 2590, 1669, Black Gelding, River Street, 1358, 1110, 1530, 401, 863, 1278, 1795, 804, 2336, 25, 2525, 1856 = 28.

No Lesion, 1938, 1839, 2256, 479, 1758, 1763, 2255, 1697, 1912, 766, 853, 2510, 1652, 2470, 1910, 1877, 2546, 1845, 24 = 19.

Without regard to the opinions of the experts employed, forty-seven more horses were released that day, and subsequently all the rest, including the two that had been ordered killed Oct. 3, and the seven that the road were advised to kill Nov. 17, with the order that they be worked in pairs by themselves.

Mr. Cheever said that the reports had not worked a change in his mind. His opinion was that all the horses quarantined ought to be returned to work, and he would not vote to have one killed or kept any longer in quarantine. Mr. Stockbridge argued that the horses released were not dangerous to the public.

A motion made to have all the horses that were in quarantine Oct. 20, and afterwards released, collected together, was laid on the table, by request of Mr. Cheever, until the next meeting, for the reason that was afterwards made known, by his acknowledgement, that he wanted to consult with the officials of the road, to see if it would inconvenience them to have such an order passed.

On the 17th of November, a motion made that the horses in quarantine and released on Nov. 7 be collected together, was carried. When the road changed hands, all the horses that had at any time been in quarantine were ordered by the West End Railroad Company to a stable by themselves.

Desiring a copy of the records of and reports to the Cattle Commission, I asked Mr. Cheever on the 12th of November to bring the same to Boston. His reply follows: —

SATURDAY, NOV. 12, 1887.

DEAR DOCTOR: — The more I think of your request the more I dislike it. My records are much in the nature of running narrative, the official mixed with the personal; have always been in doubt as to whether they were sufficiently official. You know what the law requires, — that the Board keep records, — and you know that very little of the work of the other members is incorporated in my record. I have aimed to record all important acts of the Board, and it has been in the same book with my record of my personal work. I consider my book is open to inspection by any authority having right to demand it. It is open to the Board at any and all times when requested. At the next meeting I will bring it, and, if the Board sanctions your request for copy, I will give it in full, or so much as you may wish. I do not see why I should give you a copy now in personal request and to use as you may personally desire, without assuring me that it will not be misused, than I should give you a copy of those reports for you to use without restriction which the Board has voted to keep from public use till after our annual report has been prepared. I cannot see it right for me to grant your request, so do not come to Boston for that purpose.

I am truly yours,

A. W. CHEEVER.

At the meeting held on the 17th of November, the motion made by me that each member have access to the records, was carried, but at the appointed time Mr. Cheever failed to bring the reports of Liautard and Huidekoper, and it required another vote of the Commission before I got them.

In accordance with the vote of the Board, three horses were inoculated on the 10th of December, from three that had been released from quarantine by the Commission; and in all of the animals inoculated, glanders was produced.

Number of horses examined, about,	1,700
Number of horses quarantined by vote of full Board after first examination,	192
Number of horses released by vote of full Board on second examination,	20
Number of horses released by Board, Winchester against,	162
Number killed,	4
Number of horses released after being condemned, Winchester against,	2
Number released after leaving them to the option of the road to kill or to keep, Winchester against,	7
Number of horses examined by experts,	67
Liautard's report condemns, 31 diseased, 23 suspicious, 5 doubtful, 8 free.	
Huidekoper's report condemns, 20 diseased, 28 suspicious, 19 no evidence.	

J. F. WINCHESTER, D. V. S.

THE

ORTHOPTERA OF NEW ENGLAND.

Designed for the use of the Students in the Massachusetts Agricultural College, and the Farmers of the State.

C. H. FERNALD, A.M., Ph.D.

THE

ORTHOPTERA OF NEW ENGLAND.

INTRODUCTION.

The insects belonging to the order Orthoptera are almost without exception injurious to our cultivated crops, our forest and shade trees, or become a nuisance in our houses, and therefore demand the careful attention of the student of agriculture and the practical farmer.

It has been our aim to present the subject in as simple a manner as possible, and as free from difficult terms as is consistent with scientific accuracy, so that any intelligent farmer may be able to determine any orthopterous insects he may find destroying his crops, and learn what means have been suggested for their destruction or for holding them in check. To give completeness to the work, all the New England species are here described, the greater part of them having already been found within the limits of the State of Massachusetts.

In the preparation of this work I have made free use of the writings of others, especially the works of Stäl, Saussure and Scudder. In fact, any work on the North American Orthoptera must be based more or less on the writings of Mr. Scudder, our highest authority on this order, whether recent or fossil, and to this gentleman I am indebted more than I can well express for personal assistance in this work. All errors and erroneous conclusions must be laid to my charge, and not to any advice from him. I am also under obligations to Profs. A. S. Packard and C. V. Riley for illustrations, as well as to Mrs. Tenney for illustrations from Tenney's Natural History.

CHARACTERS OF THE ORDER.

If we omit the Earwigs (*Forficulidæ*), as has been urged by Dr. Packard and some others, the Orthoptera form quite a compact and natural order, which may be briefly defined as follows. The fore wings are somewhat thickened (not as much as in the beetles), and are not used in flight, but as wing covers. The hind wings are thin and membranous, and are the true organs of flight.

They are folded up lengthwise like a fan, and concealed beneath the wing covers when at rest. A few of the species have the wings or wing covers, one or both, much shortened or entirely wanting. The mouth has jaws which move laterally against each other, and they are used for biting or chewing.

The Orthoptera have an incomplete transformation from the egg to the adult state; that is, they have no period of inactivity, but closely resemble the adult from the time they leave the egg, except in size and the absence of wings and wing covers.

This order is represented in New England by the following families: —

Gryllidæ, . . .	which include the Crickets.
Locustidæ, . . .	which include the Katydids.
Acrididæ, . . .	which include the Grasshoppers.
Phasmidæ, . . .	which include the Walking-sticks.
Blattidæ, . . .	which include the Cockroaches.

EXTERNAL ANATOMY.

To enable one to determine the species of the Orthoptera, it is necessary to gain some acquaintance with the external parts and their names. For this purpose we have introduced a brief description of the anatomy of a grasshopper, with illustrations, which will serve for the whole order.

An insect may be divided into three parts: *head*, *thorax* and *abdomen*. The thorax may be subdivided into *prothorax*, *mesothorax* and *metathorax*. See Fig. 1. The head bears a pair of jointed *antennæ*, two large compound *eyes*, three *ocelli* or simple eyes (sometimes wanting) and the mouth parts. Fig. 1. The mouth parts consist of an upper lip or *labrum*, a broad flap which closes over the mouth in front, a pair of jaws or *mandibles*, one on each side, which move laterally, and by means of which they chew their food. Behind the mandibles are a pair of smaller jaws, called the *maxillæ*, which also move laterally, and to these are attached a pair of small jointed appendages, called the *maxillary palpi*. The maxillæ are accessory jaws, used to hold and arrange the food while it is being ground by the mandibles. Behind the maxillæ is the lower lip or *labium*, which forms the lower side of the mouth, and attached to this are a pair of jointed appendages, called the *labial palpi*. See Fig. 2, where the mouth parts are shown separated from each other.

The prothorax has the fore legs attached to its under side, and the part between the base of these legs is the *prosternum*, which is sometimes a smooth piece extending from one leg to the other, and

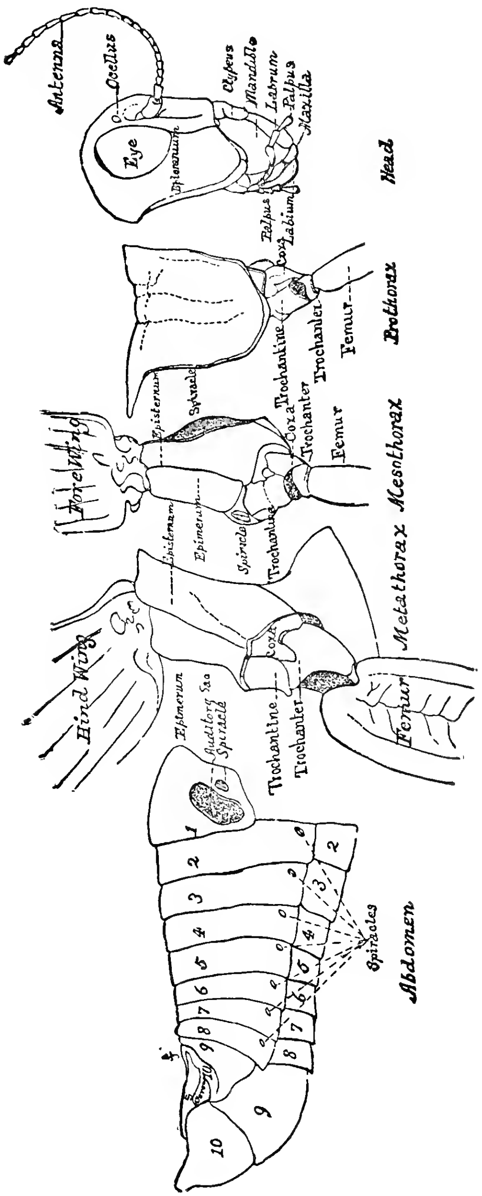

FIG. 1.

sometimes it has a prominent spine arising from the middle. In some families more than one spine arises from the prosternum. The top and sides of the prothorax are covered by one continuous saddle-shaped piece, called the *pronotum*. The ridge along the middle of the pronotum is called the *median carina*. The form and structure of this piece are of great importance in classification.

The mesothorax, or middle thorax, has the second pair of legs attached to its under side, and the first pair of wings, or fore wings,

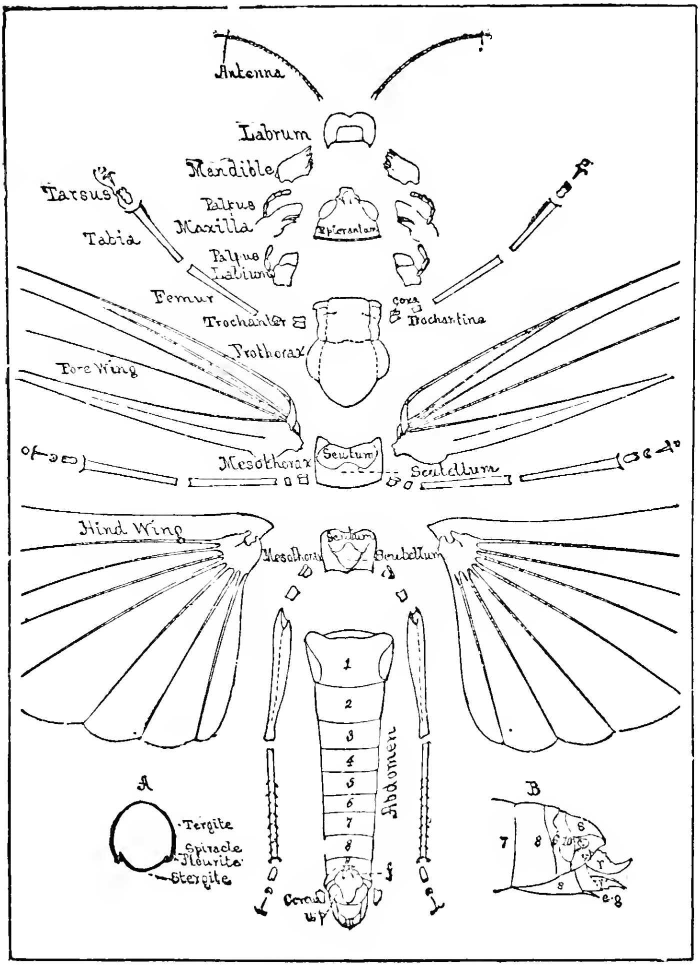

FIG. 2.

attached to its upper side. These fore wings are of a denser texture than the hind wings, and are often called *wing covers, elytra* or *tegmina*.

The metathorax has the hind legs attached to its under side, and the hind wings, or true organs of flight, attached to its upper side.

These wings fold lengthwise like a fan, and are concealed beneath the fore wings when the insect is at rest.

The abdomen consists of a series of rings, or segments, more or less movable on each other, and has the external organs of reproduction at the end. On each side of the first segment is a large auditory sac, and near it a *spiracle*, and there is a row of similar spiracles along each side of the abdomen, as shown in Fig. 1. These spiracles are holes which allow the air to pass into the respiratory system within the body. A cross section of the abdomen is shown in Fig. 2, A.

The legs are attached to the body by three pieces, called *trochanter*, *trochantin* and *coxa*. Each leg consists of three parts: the *femur*, the *tibia* and the *tarsus*, but the tarsus has several joints, the last one ending with a pair of diverging *claws*. There is sometimes a small cushion, or pad, between these claws, called the *pulvillus*. See Fig. 2.

In the female, Fig. 2, B, the abdomen tapers somewhat towards the end, to which are appended the two pairs of stout, somewhat curved spines, called *valves*, which form the ovipositor. Fig 2, B, *r*, *r'*. The anus is situated above the larger and upper pair, the external opening of the oviduct being between the lower pair of spines, and bounded beneath by a triangular, acute flap, which serves as an egg guide. Fig. 2, B, *e-g*, and Fig. 3. At the time of egg-laying, the abdomen may be lengthened to nearly twice its usual proportions. The ovipositor varies considerably from the above description, in some families.

The end of the male abdomen is usually blunt and more or less turned up, the space above being more or less covered with the supra-anal plate, Fig. 1, *s*, upon which rest the marginal *apophyses*, Figs. 1 and 2, *f*, which arise from the middle of the hinder edge of the last dorsal segment. On each side of the supra-anal plate is a more or less flattened and pointed appendage; these are the anal *cerci*. Figs. 1 and 2. In some families they are developed into long, tapering, jointed appendages.

INTERNAL ANATOMY.

The internal anatomy of a grasshopper (*Melanoplus femur-rubrum*) is shown in part in Fig. 3, where the œsophagus arises from the mouth *m*, and curves backward into the crop, which is very large, and occupies a central position in the thorax. It is in the crop that the "molasses," thrown out by the insect when captured, is produced, and which consists of partially digested food. The stomach is much smaller in diameter than the crop, and lies

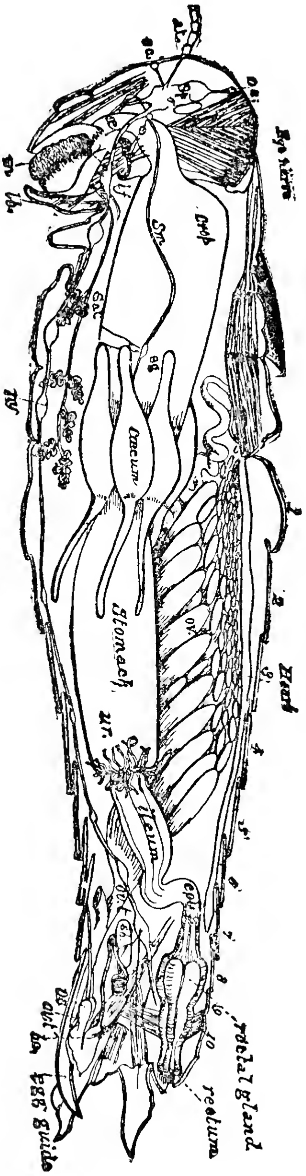

FIG. 3.

below the middle line in the forward half of the abdomen. From the forward end of the stomach arise six large appendages, called *gastric cœca;* and from the hinder end, where the stomach connects with the *ileum*, arise a large number of fine tubes, much convoluted, and wound around the intestine. These are called the urinary tubes, Fig. 3, *ur.*, and are supposed to correspond to the kidneys of higher animals. The ileum is much smaller than the stomach, and has numerous longitudinal ridges on its surface. The next division of the digestive system is the *colon*, which is smaller than the ileum, has a smooth surface, is somewhat twisted, and ends in the much enlarged rectum, which ends in the anus, at the extremity of the abdomen. The rectum has six large rectal glands on the outside, the nature of which is unknown. The salivary glands are shown in Fig. 3, *sal.*, extending from beneath the gastric cœca forward to the mouth, where they empty their secretions.

The ovaries, Fig. 3, *ov.*, form a large mass before the eggs are laid, and crowd the intestine somewhat out of place. The heart, Figs. 3 and 4, consists of a long tube lying along the abdomen just beneath the upper side, and has six enlarged places along its course, probably where valves are situated within. The blood flows through this tubular heart toward the head, and flows back again among the viscera, bathing the surface of all the organs of the body.

All insects breathe by means of a complicated system of air tubes distributed throughout the body, the air entering through the spiracles or breathing holes which are arranged in a row along each side of the body. From these spiracles air tubes pass in, a short distance, connecting with tubes on each side which extend through the abdomen into the thorax. Fig. 4, S.

Branches extend from these tubes to a similar pair near the back, Fig. 4, D, and another pair along the under side, Fig. 4, V. The tubes send out numerous branches which divide and subdivide, the ultimate ends of which are closed. The blood, as it flows from the head, bathes these tubes (called *tracheæ*), and is purified, as in the human lungs. In addition to the above system of air tubes, those species which take long flights have a series of air sacs connected with the air tubes. See Fig. 4, 1–7, and I, II, III.

The nervous system consists of a series of nerve centers (ganglia), which are double, though quite fully fused together. These are connected by two cords, which are united in some parts of the body, but distinct in others.

The first ganglion, Figs. 3, *sp.*, and 5, is situated near the central part of the head, and sends nerves to the ocelli, antennæ and eyes; and the nervous cord which connects this ganglion with the second separates, allowing the œsophagus to pass through the opening. The second ganglion sends nerves to the mouth parts, the third to the fore legs, the fourth to the middle legs and fore

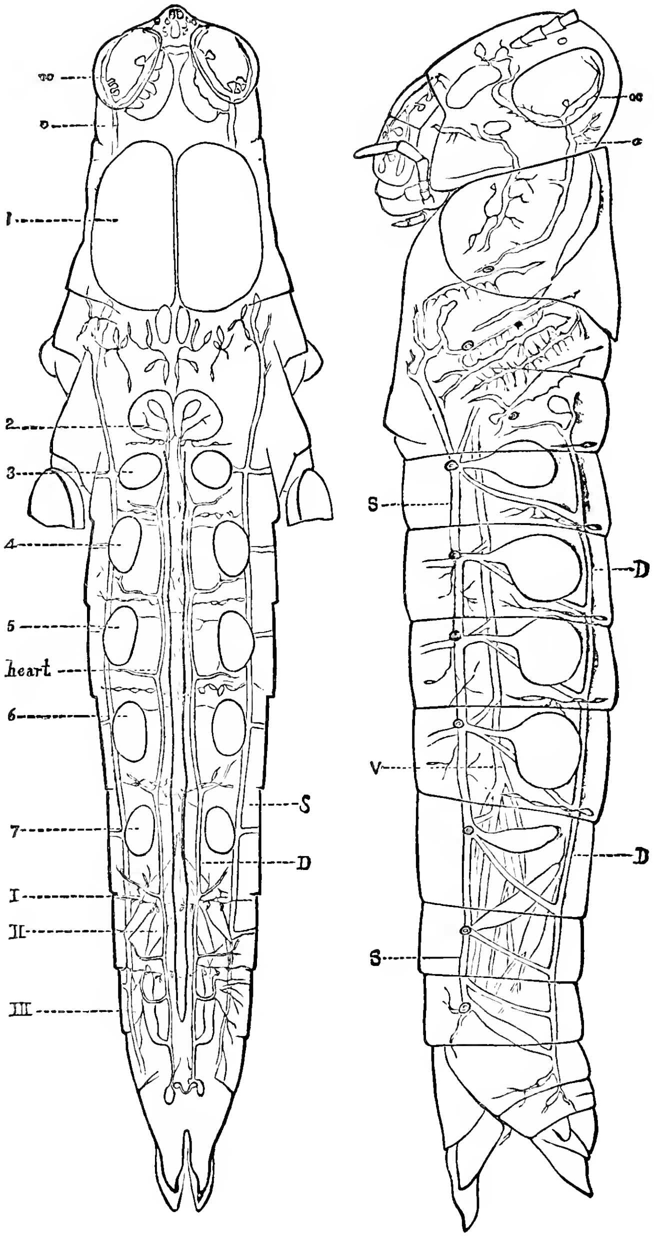

Fig. 4.

wings, the fifth to the hind legs and hind wings, and the remaining ganglia send nerves to the various parts of the abdomen.

The sense of sight is undoubtedly well developed in those

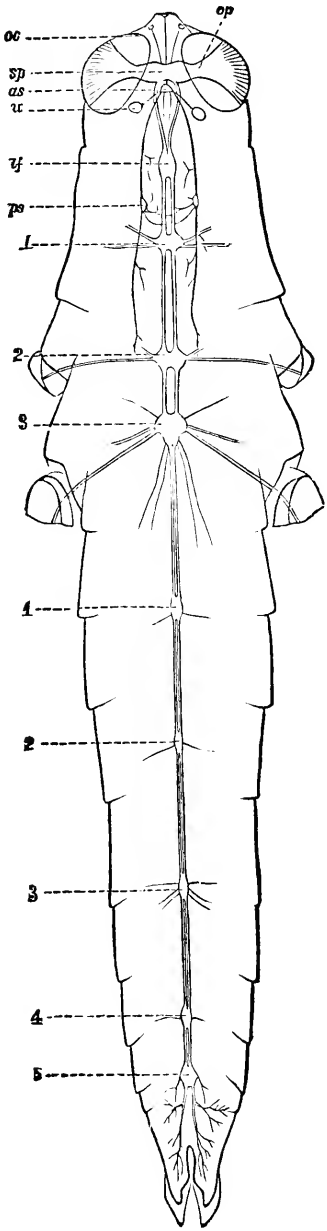

FIG. 5.

Orthoptera which have eyes. The sense of feeling probably exists over the surface of the body to a slight degree, but to a very great degree in the palpi and antennæ.

The sense of hearing is possessed by nearly if not all the Orthoptera. The ears or auditory sacs in grasshoppers are situated on the sides of the first segment of the abdomen. Fig. 1.

SYNOPSIS OF THE FAMILIES.

The New England Orthoptera may be separated into families by means of the following table, in which each figure on the right leads to the same one on the left: —

1.	Hind legs longest; hind femora thickened; (jumpers)	4.
	Legs of nearly equal length; hind femora not thickened (runners),	2.
2.	Abdomen with a forceps-like appendage at the end,	FORFICULIDÆ.
	Abdomen without a forceps at the end	3.
3.	Body oval and flattened	BLATTIDÆ.
	Body long and slender	PHASMIDÆ.
4.	Antennæ shorter than the body	ACRIDIDÆ.
	Antennæ longer than the body	5.
5.	Wing covers flat above, but bent abruptly down at the sides,	GRYLLIDÆ.
	Wing covers sloping down on the sides	LOCUSTIDÆ.

FAMILY GRYLLIDÆ.

Crickets.

Body somewhat cylindrical. Head large and free. Antennæ long, slender, tapering and many jointed. Eyes elliptical, and ocelli present. Labrum nearly circular, and maxillary palpi with the last joint enlarged at the end (except in *Nemobius*). Wing covers in the male with a stridulating organ. Wings folded lengthwise, their pointed ends sometimes extending beyond the wing covers. Wings and wing covers often shortened, or wholly wanting. Organs of hearing, when present, situated on the fore tibiæ. Tarsi three-jointed, without pads between the claws. They stridulate or make their chirping noise by rubbing the wing covers together.

The Genera of the Gryllidæ may be separated by the following table: —

1.	Fore tibiæ broad	2.
	Fore tibiæ slender	3.
2.	Length more than one-third of an inch	*Gryllotalpa.*
	Length less than one-third of an inch	*Tridactylus.*
3.	Hind thighs slender	*Œcanthus.*
	Hind thighs stout	4.
4.	Last joint of maxillary palpi nearly the same length as the one preceding	*Gryllus.*
	Last joint of maxillary palpi twice as long as the one preceding	*Nemobius.*

Genus TRIDACTYLUS. Olivier (1789).

Body somewhat depressed, the surface punctured and glassy. Head and pronotum convex and slightly depressed. Antennæ inserted beneath the eyes, and in a very lateral position. Eyes oval, very distant from each other, and slightly projecting. Ocelli placed in a line between the eyes, the two lateral ones against the eyes, and the third (sometimes obsolete) between them. Second joint of labial palpi and third joint of maxillary palpi not dilated.

Elytra horny and opaque, not reaching to the end of the abdomen. Wings much longer, and folded lengthwise like a fan. In the colder latitudes the wings are sometimes imperfect. Anterior tibiæ dilated, and armed at the end with four slightly curved spurs; the inside of the tibiæ with a groove in which the tarsus may be lodged. Middle tibiæ with their edges ciliated, and their four apical spurs very short. Fore and middle tarsi with the first joint much shorter than the third, and the second joint very short. End of hind tibiæ with four spurs finely hooked at the end. Hind edges of these tibiæ often dentate. There are four pairs of movable paddle-shaped organs near the outer end. Upper cerci (anal appendages) composed of two joints, the lower ones entire and blunt.

TRIDACTYLUS TERMINALIS. Scudder.

Length, from one-third to one-fourth of an inch.

Head and thorax pitchy black, sometimes with reddish-brown spots. Hind femora with two broad transverse white bands, and a white spot near the end. The wings reach to the end of the abdomen. — *Cambridge, Mass., Harris Collection.*

Genus GRYLLOTALPA. Latreille (1807).

Mole-Crickets.

Posterior margin of the sternum of the eighth abdominal segment, in the males, entire. Fore tibiæ broad and flattened, with four spurs at the end, the upper two movable, the lower two immovable. Hind femora shorter than the prothorax. First joint of hind tarsi unarmed or obscurely spined at the tip. The fore legs, being very stout and strong, are admirably adapted for digging. Wing covers seldom reach beyond the middle of the abdomen. Anal cerci longer than pronotum.

Fig. 6.
Gryllotalpa
borealis.

GRYLLOTALPA BOREALIS. Burmeister.

The Common Mole-Cricket. (Fig. 6.)

Length, one inch and one-fourth.

Color, dark cinnamon brown, and covered with very fine short hairs. Wing covers less than half the length of the abdomen, the wings, when folded, extending only about an eighth of an inch beyond them.

"Sides of ponds, burrowing in moist earth." This species occurs very generally east of the Rocky Mountains.

GRYLLOTALPA COLUMBIA. Scudder.

This species does not differ in any respect from *G. borealis*, as stated by Mr. Scudder, save in the larger size, and comparatively greater breadth of the wing covers, which cover rather more than half of the abdomen, and in the much greater length of the wings, which extend considerably beyond the extremity of the abdomen.

This species has been taken in Massachusetts, Maryland and Washington, D. C.

The mole-crickets have often done great damage in Europe, where they burrow under the turf in moist gardens and meadows, and feed on the tender roots of many kinds of plants. They are also said to feed on other insects and worms, so that they are undoubtedly omnivorous in their habits.

Genus GRYLLUS. Linneus (1758).

Crickets.

Stout-bodied insects. Head large and globose; eyes large and rounded; three ocelli present, the middle one between the antennæ, and elongated transversely. Antennæ as long or longer than the body, and gradually tapering towards the end. Last joint of maxillary palpi but little, if any, longer than the one before it. Pronotum of the same width as the head.

Feet stout, and slightly lengthened. Femora compressed; hind femora much enlarged, even to the end. Fore tibiæ with a large oval drum on the outside, and a smaller, round drum on the opposite side (auditory sacs). Hind tibiæ with a double row of from four to seven spines. Tarsi slender and elongated; a groove along the middle of the upper side of hind tarsi, with a row of short spines along each side of it. Anal cerci tapering, jointed, nearly as long as the abdomen, and present in both sexes. Ovipositor often longer than the abdomen.

Wing covers usually well developed, flattened above and strongly bent down at the sides. In the females they are generally reticulated in the dorsal field by more or less regular, lozenge-shaped spaces. Wing covers of the males provided with a well-developed stridulating organ, with two to six quite transverse undulated or arched veins. "Mirror" rounded behind, and divided by a broken or arcuate vein. The wings vary much in length, and are sometimes wanting.

The New England species may be separated as follows: —

1. { Ovipositor as long as the body . . . . . . *abbreviatus.*
   { Ovipositor as long as the femur and half the tibia . . *luctuosus.*

GRYLLUS ABBREVIATUS. Serville.

Black; elytra fusco-testaceous; veins testaceous; wings wanting; ovipositor as long as the body.

GRYLLUS LUCTUOSUS. Serville.

The Common Black Cricket.

Black or brownish; elytra fusco-testaceous or black; wings extending to the end of the abdomen, or wanting. Ovipositor as long as the femur and half of the tibia.

Saussure considers *G. pennsylvanicus*, Burm., a wingless variety of this species; and he also considers *niger*, Har., and *neglectus*, Scudd , varieties of the same species.

The species are so variable that it is exceedingly difficult to separate them; and it is necessary to have a long series for examination.

Packard states that crickets lay in the fall three hundred eggs glued together in a common mass. In July the larvæ appear, and by the last of August the grass is alive with them. They are quite omnivorous in their habits, feeding on grass, garden vegetables and fruit, to which they do much injury.

Genus NEMOBIUS. Serville (1839).

The insects which belong to this genus are rather small, their bodies and legs covered more or less with hairs. Head orbicular, and scarcely wider than the pronotum; front of head obliquely flattened. Ocelli present, but the one in the middle of the face is often obliterated. Last joint of maxillary palpi twice as long as the one before it, and enlarged at the outer end, which is obliquely truncate.

Pronotum square, somewhat narrowed in front, the forward and hinder edges parallel.

Elytra with but few veins; wings present or absent in variations of the same species.

Feet nearly as stout as in *Gryllus*. Anterior tibiæ with a small oval drum (auditory sac) on the outside, near the upper end. Hind femora short and stout. Hind tibiæ somewhat compressed, and armed with spines, and elongated, movable, pubescent spurs. Three or four pairs of spines inserted near the middle line of the tibiæ. All the tarsi elongated, but the hind tarsi without a longitudinal groove above, and the first joint with two spurs at the end, the inner one twice as long as the outer, and reaching nearly to the claws. Anal cerci of medium length, and very hairy.

Nemobius fasciatus. De Geer.

The Striped Cricket.

Brown, with the head fuscous, and with four dull, yellowish-brown lines on the vertex. Palpi reddish brown, lighter at the end. A dull, yellowish-brown, longitudinal stripe, more or less distinct, on each side of pronotum. Elytra pale brown, a little shorter than the abdomen, with the humeral bands pale, and the lateral ones fuscous.

Legs dark brownish yellow; hind femora as long as the tibiæ and two-thirds of the tarsi. Hind tibiæ with four pairs of spines before the terminal spines.

Ovipositor as long as the femur; valves crenulated on the upper side near the end.

Saussure makes three varieties under this species, as follows: —

a. Elytra but little shorter than the abdomen, wings long and caudate . . . . *N. fasciatus.*
b. Wings wanting; elytra covering about half of the abdomen . . . . *N. vittatus.*
c. Smaller than the last, otherwise the same . . *N. exiguus.*

Very common in the fall, in company with the larger species.

Genus Œcanthus. Serville (1831).

Body very slender, smooth or slightly pubescent, and, when alive, of a whitish or greenish-white color.

Head elongated and directed forward; the vertex horizontally flattened; eyes ovoid, slightly projecting; ocelli wanting.

Palpi filiform, slightly elongated, the last joint not dilated.

Antennæ very long and tapering. Pronotum elongated, very narrow, contracted in front, with the hinder border nearly straight.

Wing covers large, reaching beyond the end of the abdomen. Wings often prolonged. Legs slender, and moderately long. Tibiæ all longer than the femora, those of the first two pairs without spurs at the end; the first pair somewhat dilated above the middle, where they are provided with a little "drum" or auditory sac on each side. Hind femora slightly swollen; tibiæ more or less spiny; tarsi with a pair of unequal spurs at the end of the first joint.

Abdomen comparatively slim, armed at the end with a pair of tapering, jointed, and hairy cerci, which are of about the same length as the abdomen.

Œcanthus niveus. Serville.

Tree Cricket. (Fig. 7, male; Fig. 8, female.)

Length, about three-fourths of an inch to the ends of the closed wings. Color, pale whitish green, often changing to a lighter or darker brown, frequently with brownish stripes on the head. Two short black lines, one beyond the other, on the under side of the base of the antennæ.

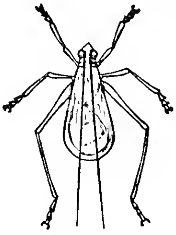

Fig. 7.
Œcanthus niveus.
Male.

These insects arrive at maturity in the autumn, when the singing or shrilling of the males may be heard. After pairing, the female forces her ovipositor into the tender canes or branches of the raspberry, grape, plum, peach and other trees, depositing her eggs in a series, as shown in Fig. 9. The canes are weakened in this way, and break down easily. The eggs hatch in the early part of the next summer, and the young feed at first on plant lice, and later in the season on the ripe fruits.

Fig. 8.
Œcanthus niveus.
Female, side view.

The infested canes may be cut off and burned late in the fall or early in the spring; and the mature insects may be killed in the fall by jarring the bushes on which they collect, causing them to fall to the ground, where they may be crushed under the feet.

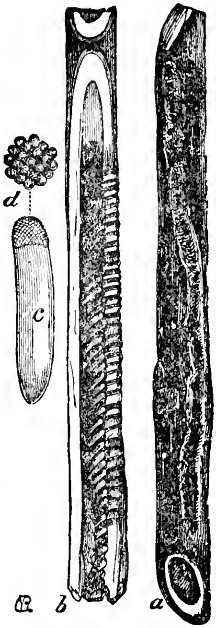

Fig. 9.
Eggs of Œcanthus.
a. Irregular row of punctures.
b. The same laid open.
c. An egg enlarged.
d. The end of the same.

Family LOCUSTIDÆ.

Katydids.

Head placed perpendicularly; antennæ longer than the body, slim, tapering and many jointed. Eyes hemispherical, elliptical or ovoid; ocelli nearly always wanting; labrum circular.

Wings and wing covers generally well developed, though sometimes shortened or wholly wanting. The chirping or stridulating organs consist of a transparent membrane, in a more or less rounded, thick ring, situated in the anal field of the wing covers of the male. The stridulation is made by rubbing the bases of the wing covers together. Near the upper end of the fore tibiæ there is an oval cavity covered with a membrane (auditory sac). Tarsi four-jointed, without pulvilli or pads between the claws.

The New England Genera may be separated by means of the following table: —

1.	Wingless, or with rudimentary wings and wing covers	2.
	Winged	3.
2.	Wingless; pronotum not covering the whole top of the thorax	*Ceuthophilus.*
	Pronotum covering the whole top of the thorax	*Thyreonotus.*
3.	Wing covers expanded in the middle	4.
	Wing covers not expanded in the middle	6.
4.	Wing covers much broader in the middle, concave	*Cyrtophyllus.*
	Wing covers somewhat broadened in the middle, not concave	5.
5.	Ovipositor very small	*Microcentrum.*
	Ovipositor of medium size	*Amblycorypha.*
6.	Vertex of the head with a conical projection forward	*Conocephalus.*
	Vertex of the head without a conical projection	7.
7.	Ovipositor straight, or nearly so; insect small	*Xiphidium.*
	Ovipositor curved; insect large	*Scudderia.*

Genus Ceuthophilus. Scudder (1862).

"Head rather large, oval; antennæ long, slender, cylindrical; first joint as broad as long, larger and stouter than the rest, which are about equal in thickness, gradually tapering to the extremity; second, quite short; third, longest; the remainder unequal. Eyes sub-pyriform, sub-globose, crowded against the first swollen joint of antennæ. Maxillary palpi long and slender; first two joints equal; third fully equal in length to first and second together; fourth, three-fourths as long as the third; fifth, nearly as long as third and fourth together, somewhat curved, swollen towards extremity, split on the under side almost its entire length. Sides of the thoracic nota broad, mostly concealing the epimera; wings wanting; legs rather long; coxæ carinated externally, the third pair but slightly, the first pair having the carina elevated into a sharp, the second into a dull, point at the middle; first two pairs of femora mostly wanting spines; hind femora thick and heavy, turned inward at the base, channelled beneath. Ovipositor generally rather long, nearly straight, but a little concave above, rounded off somewhat abruptly at the extremity to the sharp upturned point."

Ceuthophilus maculatus. Harris.

The Spotted, Wingless Grasshopper.

Length, when mature, nearly three-fourths of an inch; entirely without wings and wing covers. Pale yellowish brown, somewhat darker above, and covered with light-colored spots. Hind femora marked on the outside with short, parallel, oblique lines. Hind tibiæ in the mature male curved at the base.

Everywhere common under stones, old logs, etc.

Ceuthophilus brevipes. Scudder.

"A species very closely allied to the preceding, but of a smaller size, and differing from it in its markings and proportions. It is of a pale, dull, brown color, very profusely spotted with dirty white spots, not so large or so frequently confluent as in *C. maculatus*, except near the extremity of the hind femora, where they nearly form an annulation. The mottling of the pronotum is somewhat different than in *C. maculatus;* the hind legs are proportionably shorter, as is also the ovipositor, the spines of whose inner valves are duller.

"Length scarcely more than half an inch; average length of hind femora, .44 inch; average length of ovipositor, .25 inch." —*Scudder*.

Genus Cyrtophyllus. Burmeister (1838).

Antennæ very long and slim, eyes small, globular and prominent, vertex with a small spine projecting forward between the antennæ. Pronotum truncate in front, rounded behind, with two transverse grooves. Prosternum with two spines; fore coxæ with one spine on the outside. Middle tibiæ spinose on the outer and inner sides. Wing covers much wider in the middle, concave, obtuse and rounded at the end.

CYRTOPHYLLUS CONCAVUS. Harris.

Broad-winged Katydid. (Fig. 10.)

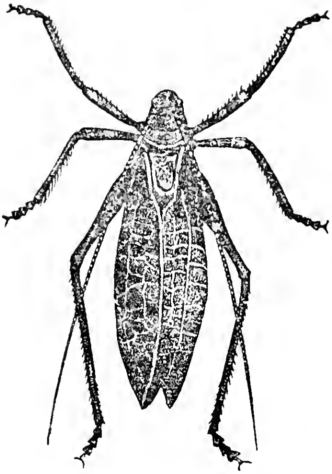

Fig 10.
Cyrtophyllus concavus.

Length about one inch and a half to the end of closed wing covers; body, one inch. Color of body, pale green, wings and wing covers somewhat darker green. The wing covers curve around the body so that their edges touch above and beneath, enclosing the body. Wing covers with a prominent vein running through the middle, and on each side of this the veins form a network, so that the wing cover strongly resembles a leaf.

Their eggs are of a dark slate-color, about one-eighth of an inch in length, and one third as wide. They are laid in two rows along a twig, the eggs overlapping each other a little. They hatch the next spring, and the young feed on the tender leaves of almost any plant.

These insects have never been reported as injurious, but, where abundant, their noise may become an intolerable nuisance. I cannot imagine what ingenious person first discovered that their song resembled the words "katy did," instead of some other words; for many persons besides myself fail, upon hearing them for the first time, to recognize them by their sound.

Genus AMBLYCORYPHA. Stäl (1873).

Vertex smooth, without spines or projections of any kind, but with a slight groove along the middle, between the antennæ; eyes elliptical; pronotum rounded behind, narrower in front. Prosternum without spines. Fore coxæ with a spine on the outside. Wing covers as long or but little longer than the hind femora. Hind tibiæ with a row of spines on each edge behind, and a row, more remote, on the opposite side. Wings longer than the wing covers.

The species may be separated as follows: —

{ Wing covers extending beyond the end of the hind femora, ***oblongifolia.***
{ Wing covers reaching only to the end of the hind femora . ***rotundifolia.***

AMBLYCORYPHA OBLONGIFOLIA. De Geer.

Oblong Leaf-winged Katydid.

Length, one inch and three-fourths to the end of the wing covers, the wings extending one-fourth of an inch beyond.

Wings and wing covers, grass green; body, dull clay yellow, tinged with green in places.

AMBLYCORYPHA ROTUNDIFOLIA. Scudder.

Round-winged Katydid.

Length, one inch and one-fourth to the end of the wing covers, the wings extending about one-eighth of an inch beyond. Color, grass green, sometimes tinged more or less with clay yellow.

Genus MICROCENTRUM. Scudder (1862).

"Head oval, broader and stouter than in *Amblycorypha;* tubercle of the vertex somewhat prominent, scarcely broader than first joint of antennæ, slightly furrowed; eyes broadly oval, very prominent; first joint of antennæ as broad as long; second, one-third as large, but also stout; remainder long and slender, cylindrical. Prothorax flat or very slightly concave, posterior quite convex; the sides nearly parallel, the length but little surpassing the breadth; lateral carinæ quite sharp; lobes of the side straight in front, well rounded and curving forward behind, rounded beneath, deeper than broad; wing covers with the triangular superior surface extending backward farther than in *Amblycorypha*, and the wing covers themselves not regularly rounded as there, but with the inner border straighter till near the tip, the outer border sloped off towards the tip, and the tip itself more pointed; legs slender, much shorter than in *Amblycorypha*, especially the hind legs; ovipositor very short, strongly curved, and bluntly pointed.

"This genus differs from *Amblycorypha*, to which it is most nearly allied, especially by the cut of the wing covers and the shortness of the hind legs and ovipositor." — *Scudder.*

MICROCENTRUM LAURIFOLIUM. Linneus.

Length of wing covers, one inch and three-fourths; of hind femora, nine-tenths of an inch. Wings and wing covers, grass green; body, yellowish green, lighter beneath. Front of prothorax with a very small central tooth.

Scudder described this species under the name of *Microcentrum affiliatum*, but Stäl pronounces it identical with the Linnean species, after a comparison with the type. Is it distinct from *M. retinervis*, Burm.?

Genus Scudderia. Stäl (1873).

Top of the head, between the antennæ, compressed into a short, blunt spine, which curves upward sharply. Eyes nearly hemispherical. Pronotum slightly narrowed in front, rounded behind, deeply notched on the side behind, the sides of the notch forming a right angle. Fore coxæ with a sharp spine on the outside. Ovipositor large, curving upward. Supra-anal plate of the male sending out a stout spine, which curves down, and is widened and notched at the end. Sub-anal plate sends out a much longer spine, notched at the end, and curving upward.

Scudderia curvicauda. De Geer.

Narrow-winged Katydid.

Length of body, about one inch; from the face to the end of the wing covers, an inch and a half; the wings extending about one-fourth of an inch farther. Body and wings, grass green; face and under side of the body, sometimes lighter, and sometimes tinged with dull yellow. It feeds principally on oak leaves.

The male does not make as loud a "shrill" as the broad-winged katydid, and the sound he makes at night and in cloudy weather is different from the one he makes in the sunshine.

Genus Conocephalus. Thunberg (1815).

Face, very oblique; vertex, prolonged forwards into a cone. Eyes, elliptical; pronotum, truncate in front, rounded behind, narrowed in front, obtusely notched on the side behind. Prosternum, with two long, slim spines. Fore coxæ with a spine on the outside.

Conocephalus ensiger. Harris.

Cone-headed Katydid.

Length of body, one inch; to the end of the wing covers, two inches and one-fourth; length of ovipositor, one inch. Color, pale green, lighter in the face and beneath. A small tooth is situated on the under side of the conical part of the head, between the antennæ; and a U-shaped black mark on the under side of the cone near the end.

CONOCEPHALUS ROBUSTUS. Scudder.

"Either pea-green or dirty brown; tubercle of the vertex tipped with black, not extending, or but very faintly and narrowly, down the sides; lateral carinæ of prothorax, pale yellowish; wing covers dotted with irregularly distributed black dots, most conspicuous in the brownish individuals. In form, as in coloration, this species is much like *C. ensiger*. The shape of the conical projection of the vertex is the same, or a little stouter; it is a larger species, much broader and stouter than it, the wings broader, and, when compared with the hind femora, a little longer than they are in *C. ensiger;* the spines upon the under side of the hind femora are larger than there, being noticed easily with the unassisted eye; the ovipositor of the female is much shorter than in *C. ensiger;* and, finally, the insect is much broader across the mesothorax, with a heavier sonorous apparatus in the male; wing covers fully as long as the wings, in the male: slightly longer than the wings, in the female. The only difference between this species and *C. ensiger* in coloration is the usual lacking of the spots on the wing covers in the latter, and in the same the presence of a broad black band on either side of the tubercle of the vertex, which exists in the former but seldom, and then it is very narrow.

"Male, length of wings, 1.7 inch; breadth in middle, .32 inch; of hind femora, .9 inch. Female, length of wing covers, 1.9 inch; extent of wing covers beyond wings, .1 inch; breadth of wing covers in middle, .22 inch; length of hind femora, 1 inch; of ovipositor, 1 inch." — *Scudder*.

Genus XIPHIDIUM. Serville (1831).

Face, rounded, somewhat oblique; a blunt projection between the antennæ, somewhat excavated on the sides, for the reception of the protuberance on the inner side of the first joint of the antennæ. Eyes, hemispherical; pronotum truncate in front, rounded behind, lateral edges rounded, slightly excavated on the side, behind. Prosternum, with two spines; front coxæ, with a spine on the outside. Anterior tibiæ armed beneath with a row of six spines on each side.

This genus includes those small and medium-sized green grasshoppers, with long, tapering antennæ, which are so common during the summer in grass fields.

The species may be separated by the following table: —

1.	Wing covers abruptly narrowed in the middle	3.
	Wing covers not narrowed in the middle	2.
2.	Wings a little longer than the wing covers . . .	*fasciatum.*
	Wings a little shorter than the wing covers . .	*brevipenne.*
3.	Brown stripe on the pronotum, bordered with black,	*glaberrimum.*
	Brown stripe not bordered with black	4.
4.	Wing covers as long as the wings	*vulgare.*
	Wing covers a little shorter than the wings . .	*concinnum.*

XIPHIDIUM FASCIATUM. De Geer.

The Slender Meadow Grasshopper.

Length of body, about half an inch; to the end of wing covers, about four-fifths of an inch. Wings a little longer than the wing covers. Upper side of abdomen, brown. A brown stripe extends from the projection between the antennæ, back across the middle of the pronotum, being widest behind. Legs, sprinkled with brown. Ovipositor, as long as the abdomen.

XIPHIDIUM BREVIPENNE. Scudder.

"Size of X. *fasciatum*, with which it agrees in coloration throughout, except that the wings are a little darker. The dorsal band is a little broader, and the ovipositor is reddish brown throughout, while in X. *fasciatum* it is green at the base; wings, .08 inch shorter than the wing covers; both shorter than the body; ovipositor nearly equalling the hind femora in length. In these respects it differs very much from X. *fasciatum*.

"Length of body, .5 inch; of wing covers, .33 inch; of hind femora, .43 inch; of ovipositor, .4 inch."

XIPHIDIUM VULGARE. Harris.

The Common Meadow Grasshopper.

Length of body, three-fourths of an inch; to the end of the wing covers, about one inch. Wing covers abruptly narrowed in the middle; green, faintly tinged with brown. The males have two black dashes, one behind the other, on each wing, on the outside of the transparent spot. Body green, or greenish brown, with a dorsal brown stripe extending from the tubercle of the vertex across the prothorax, being widest behind. Ovipositor gradually curved, and pointed at the end; about three-tenths of an inch in length.

XIPHIDIUM CONCINNUM. Scudder.

"Male, brownish green; a dark reddish-brown dorsal streak upon the head and prothorax, becoming faint towards the hind border of the prothorax, and narrowing anteriorly to the width of the tubercle of the vertex, passing over this down the front to the labrum, expanding broadly in the middle of the face; legs brownish green, tarsi dark brown, spines of tibiæ tipped with black; abdominal appendages reddish brown; wing covers pellucid, veins grass green, except the heavy transverse vein of the sonorous apparatus, which is brown; wings pale brownish green, extending a little beyond wing covers; female having the same markings as the male, except that all the nervures of the wing covers are brown, and the wings are more dusky and are shorter than the wing covers; ovipositor reddish brown, a little curved, and very pointed; a much slenderer and more graceful form than *X. vulgare*.

"Length of body, .7 inch; of wing covers, .84 inch; of wings beyond wing covers, .08 inch; of hind femora, .6 inch; of ovipositor, .32 inch."

XIPHIDIUM GLABERRIMUM. Burmeister.

"The dorsal band here is bordered with black, as is also the outer edge of the sonorous apparatus of the male; antennæ very long; ovipositor slightly expanded in the middle." — *Scudder*.

Genus THYREONOTUS. Serville.

Face rounded, slightly oblique. Eyes small and nearly globose. Vertex with a blunt projection between the antennae, somewhat excavated on the sides, and grooved above. Basal joint of the antennæ flattened. Pronotum truncate in front, more or less rounded behind, and extending back over the first joint of the abdomen, concealing the rudimentary wings and wing covers; flattened above and bent sharply down on the sides, forming an abrupt, curved edge on each side of the back. Prosternum with two short spines; fore coxa with a long sharp spine on the outside.

The fore and middle tibiæ have two rows of six spines each on the inside, and a row of three or four equidistant spines along the outside. Hind femora and tibiæ very long, and of equal length. Ovipositor as long as the body, and straight.

Thyreonotus dorsalis. Burmeister.

Length of body, nearly one inch; of ovipositor, one inch. Color, yellowish brown, more or less mottled, darker above.

Thyreonotus pachymerus. Burmeister.

"Among other distinctions between these two species, it may be seen that this species has the pronotum well rounded behind, while the hind margin of the other is nearly square; and the ovipositor is longer in *T. dorsalis* than in *T. pachymerus*, as are also the hind legs." — *Scudder*.

Family ACRIDIDÆ.

Grasshoppers.

Anterior and middle legs equal, or nearly equal, in length, much shorter than the posterior pair; posterior legs elongate, fitted for leaping; the femora enlarged near the base. The tarsi three-jointed; the first joint, which is usually the longest of the three, and much longer than the second, has the under side marked by two cross-impressions, which give it the appearance, when seen on this side, of being composed of three pieces; the terminal or third joint is furnished with two strong claws. Wing covers and wings, when in repose, rest partly horizontal on the back of the abdomen, and partly deflexed against the sides. The antennæ are shorter than the body, seldom exceeding half its length, and composed of from six to twenty-four joints; they are either filiform, flattened, or ensiform, rarely clavate. Most of the species possess wings, but in a few these organs are wanting.

This family contains a much larger number of species than either of the other families of the Orthoptera, and includes those which have proved the most destructive to our cultivated crops. The entire life-history of but few of our species has been carefully studied; yet, in a general way, they are so nearly alike that the history of one will answer for that of all.

When the female is ready to deposit her eggs, she digs a hole in the ground, with the valves of her ovipositor, as deep as the length of her abdomen will permit, and at this time she is able to lengthen the abdomen to nearly twice its ordinary length. She then deposits her eggs in this hole, one at a time, placing them in regular order, so as to form an elongated oval mass. During the process a glairy fluid is deposited about the mass, which hardens and binds them together somewhat in the form of a bean. The hole is then filled with dirt mixed with this fluid, which forms a mass nearly impervious to water, after it hardens. See Fig. 11. The number of eggs deposited by the different species varies considerably, some laying only twenty-five or thirty in one mass, but depositing several masses, while others, as the red-winged grasshopper (*Hippiscus tuberculatus*), deposit all, to the number of 125 or 130, in one mass.

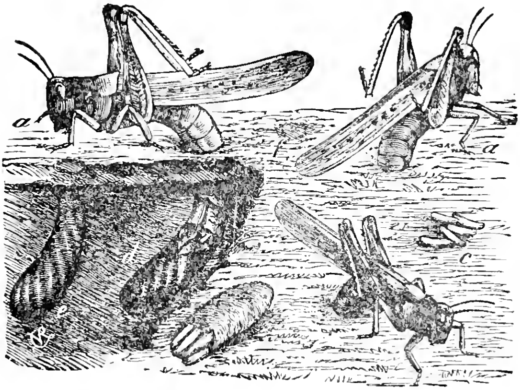

FIG. 11.

Grasshoppers laying eggs.

a, *a*, *a*, female in different positions.
b, egg pod.
c, separate eggs.
d, *e*, earth removed to expose the pods.

The different species vary also in the selection of places for depositing their eggs; some species may frequently be seen, in the fall, digging holes and laying their eggs in the hard gravel of a well-travelled road.

The young grasshoppers are very large eaters; and, in the process of growth, they molt or shed their skins from three to five times. At the second or third molt, rudimentary wing covers appear, and the insect is called a pupa; but previous to this time it is called a larva. At the last molt the wings and wing covers appear fully developed, and then the insect is called an imago, — perfect or mature insect. See Fig. 12.

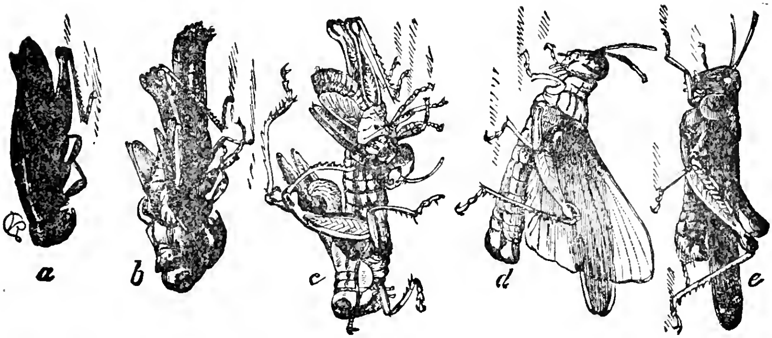

FIG. 12.

Grasshopper molting its skin. *a* to *e*, showing the successive stages.

A pupa may be distinguished from a short-winged imago, by having the wing covers twisted around so that the faces and margins are the reverse of what they are in the perfect insect.

Warm, dry weather is favorable to the increase of grasshoppers, and it is in excessively dry seasons that they are most injurious. Dampness is undoubtedly the most efficient natural agent for keeping them in check. Although they may hatch in great numbers, yet, if a rainy season follow soon after, they will to a large extent be destroyed. Extreme changes during the winter appear to destroy the vitality of the eggs.

Grasshoppers are preyed upon in their various stages by quite a number of different species of insects, and especially by a reddish-colored mite, which adheres to them in large numbers, and, by sucking their blood, weakens and finally destroys them. Very many of our native birds feed on them, and domestic fowls are great aids in their destruction. It is doubtful if any artificial remedies can be used profitably, except when a great invasion is threatened, as sometimes occurs; and then it may prove safe and profitable to sprinkle the crops, ahead of the invading hosts, with Paris green or other poisonous insecticides.

The sub-families represented in New England may be separated by the following table: —

1.	Pronotum extending back to the tip of the abdomen .	*Tettiginæ.*
	Pronotum not extending back to the tip of the abdomen .	2.
2.	Prosternum with a prominent spine	*Acridinæ.*
	Prosternum not spined, or with only an oblique tubercle .	3.
3.	Face very oblique	*Truxalinæ.*
	Face not oblique, or but slightly so	*Œdipodinæ.*

Synopsis of the Acridinæ.

1.	Wings abortive or wanting	*Pezotettix.*
	Wings well developed	2.
2.	Median carina of the pronotum somewhat prominent .	*Acridium.*
	Median carina of the pronotum not prominent	3.
3.	Hind femora not reaching the end of the wing covers .	*Melanoplus.*
	Hind femora reaching or surpassing the end of the wing covers,	*Paroxya.*

Genus Pezotettix. Burmeister (1840).

Body medium size; female narrow posteriorly. Head large; face perpendicular, or nearly so; vertex between the eyes narrow, in front of these, short, somewhat deflexed, concave, no foveolæ; frontal costa, lateral carinæ, and cheek carinæ, distinct; frontal costa generally convex above the ocellus; eyes sub-ovate or sub-globose; antennæ cylindrical, reaching the tip of the pronotum;

joints somewhat distinct. Pronotum sub-cylindrical; disk sub-convex; median carina generally obliterated on the anterior lobes, more or less distinct on the posterior lobe, sub-truncate in front, truncate or rounded behind, sometimes obtusely angled, but in the latter instances the posterior lateral margin ascends from the lateral angle to the apex without any entering angle at the humerus: the three transverse impressions distinct, cutting the median carina; the intermediate one sub-bisinuate; posterior lobe punctured. Prosternal spine rather short, obtuse; pectus broad as the head. Elytra and wings wanting or abbreviated. Four anterior legs short; in the male the middle femora much swollen; posterior femora moderately dilated at the base. Extremity of the male abdomen somewhat swollen and turned up; cerci generally slender.

The species may be separated by the following table: —

1.	Without wings or wing covers	*glacialis.*
	Wing covers present	2.
2.	Wing covers more than half the length of the abdomen,	*borealis.*
	Wing covers not more than half the length of the abdomen,	*manca.*

PEZOTETTIX GLACIALIS. Scudder.

The Wingless Mountain Grasshopper.

Head not large; vertex furrowed; frontal costa with a deep furrow and depression at the ocellus; eyes not prominent, not elongate, docked anteriorly, and very slightly above. Pronotum a little widest posteriorly; anterior and posterior margins truncate; lateral carinæ almost obliterated, obtusely rounded; median very slight. Prosternal spine rather short and blunt, compressed laterally. With neither wings nor elytra. Color, female: vertex, disk of the pronotum, and abdomen, olivaceous green; a broad black band behind the eye, crossing the sides of the pronotum to the tip, extending upon the abdomen in the form of transverse streaks; pronotum below this, greenish yellow, with a medial black spot. Vertex and pectus, greenish yellow; prosternum, dusky. Front and sides of the head yellowish green, with a greenish stripe down the middle of the frontal ridge. Furrow and interior carina of the under side of the hind femora, coral red; remainder yellowish green, with two broad bands of dark green across the outside; apex, black; tibiæ, green.

Male differs as follows: mesonotum and metanotum, bright green; whole dorsal surface black, with a dorsal row of yellowish green spots, and a triangular spot of the same color between the middle and posterior coxæ; a lateral row of greenish-yellow spots on the first eight abdominal segments.

Length, about three-fourths of an inch.

Mr. Scudder states that this species frequents the branches of the small birch trees among the White Mountains of New Hampshire. It has also been taken on Speckled Mountain in Maine, and on Graylock in Massachusetts.

Pezotettix manca. Smith.

Top of the head, disk of pronotum, and elytra, brown. Sides of the pronotum smooth and shining in front of the last transverse impression; behind it thickly punctate; a broad black band extending from the eyes over the upper half of the pronotum, and continued upon the other thoracic segments and along the side of the abdomen, inclosing on the thorax an oblique whitish spot, which extends from the base of the elytra to the posterior coxæ. Hind femora brown, yellow below, banded with black above; tibiæ, bright red.

Length, about three-fourths of an inch; length of elytra, from one-sixth to one-seventh of an inch; posterior femora, about four-tenths of an inch.

Pezotettix borealis. Scudder.

Dark brown, darkest above; a broad black band behind the eye, extending over the upper portion of the sides of pronotum to the hind border; front, dark yellowish brown; mouth parts, dirty yellowish; legs, yellowish brown; hind femora streaked with black, with the tip black; hind tibiæ reddish, with a faint, paler annulation near the base, the spines tipped with black; wing-covers, dirty, yellowish brown, spotted irregularly with darker brown; wings colorless, a little dusky on costal border.

Length of body, about two-thirds of an inch; of wing covers, nearly half an inch; of hind femora, nearly half an inch.

This northern species has been taken on Speckled Mountain in Maine, and on the White Mountains, New Hampshire. It is thought by some to be identical with *P. frigida* of Northern Europe.

Genus Acridium. Burmeister (1838).

Prosternum armed with a prominent, blunt spine; median carina of the pronotum somewhat prominent; wings and wing covers well developed, as long or longer than the abdomen; abdomen of the male not swollen at the tip; eyes, elongate, oval.

The species may be separated as follows: —

Wing covers longer than the abdomen	***alutaceum.***
Wing covers about as long as the abdomen . . .	***rubiginosum.***

Acridium alutaceum. Harris.

Leather-colored Grasshopper.

Dirty brownish yellow, a paler yellow stripe on the top of the head and thorax; a slightly elevated, longitudinal line on the top of the thorax; wing covers semi-transparent, with irregular brownish spots; wings transparent, uncolored, netted with dirty yellow; abdomen, with transverse rows of minute blackish dots; hind femora, whitish within and without, the white portion bounded by a row of minute distinct black dots, and crossed, herring-bone fashion, by numerous brown lines; hind tibiæ reddish, with yellowish-white spines, which are tipped with black.

Length to the end of abdomen, one and three-fourths inches.

Acridium rubiginosum. Harris.

Light rust red, somewhat uniform. Wing covers opaque, rather paler on the overlapping position, without spots, or sprinkled over with dim, small, dusky spots. Wings transparent, slightly reddish towards the tip; veins blackish; posterior femora reddish; the flat disk whitish, with a row of black dots above and below; apex with a lunate black spot on the side. Spines of the tibiæ whitish, tipped with black.

Length of female about one inch and a half, — male much smaller.

Genus Melanoplus. Stäl (1873).

Eyes nearly equal in the sexes, never broader than the length of the cheek; no distinct lateral carinæ; mesosternum and metasternum together longer than wide; upper margin of the hind femora smooth; first joint of hind tarsi of the same length as the last joint, and a little stouter; pulvilli between the claws, large; last joint of the abdomen of the male much swollen.

The species may be separated as follows: —

1.	Wing covers shorter than the abdomen, or of the same length .	2.
	Wing covers much longer than the abdomen	5.
2.	Median carina distinct on the front lobe of the pronotum . .	3.
	Median carina indistinct or wanting on front lobe of the pronotum,	4.
3.	With a yellow stripe along the sides	*femoratus.*
	With no yellow stripe along the sides	*punctulatus.*
4.	Wing covers as long as the abdomen	*collinus.*
	Wing covers much shorter than the abdomen	*rectus.*
5.	Anal cerci pointed at the tip	*femur-rubrum.*
	Anal cerci broadly rounded at the tip	*atlanis.*

MELANOPLUS FEMORATUS. Burmeister.

The Yellow-striped Grasshopper. (Fig. 13.)

Dull or olive green, with a yellowish line on each side, extending from the front of the head to the tips of the wing covers; hind tibiæ and tarsi blood red, the spines tipped with black; wings transparent, faintly tinged with pale green, and netted with greenish-brown lines. Abdomen of the male very obtuse, curving upward at the end; anal cerci expanded at the base; female with the upper valves of the ovipositor tapering, finely pointed.

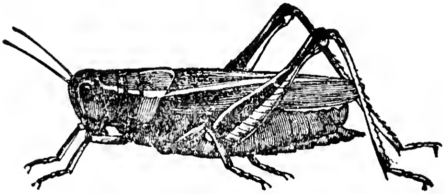

Fig. 13.
Melanoplus femoratus.

Length to tip of the abdomen, from one to one and one-fourth inches.

MELANOPLUS PUNCTULATUS. Uhler.

"Antennæ dark colored; eyes prominent; no lateral stripe. Wing covers spotted irregularly with dusky blotches; posterior lobe of pronotum rather coarsely punctate; hind tibiæ parti-colored. Male with the basal half of the anal cerci equal. Female with the upper valves of the ovipositor scarcely tapering, finely pointed."—*Scudder.*

Length, one inch. This species is very rare, but has been taken in Maine and Massachusetts.

MELANOPLUS COLLINUS. Scudder.

"Transverse furrows of anterior lobe of pronotum, distinct; upper half of divergent lobes but little darker than the lower half; wing covers as long as the abdomen. Male with the anal cerci forked at the tip. Female, stout."—*Scudder.*

MELANOPLUS RECTUS. Scudder.

"Transverse furrows of anterior lobe of pronotum indistinct; upper half of divergent lobes strikingly darker than the pale lower half; wing covers much shorter than the abdomen. Male with the anal cerci equal or nearly equal throughout; long, slender, and nearly straight. Female rather slender."—*Scudder.*

This species is quite rare. It has been taken in Massachusetts, in the valleys of the White Mountains, New Hampshire, and at Norway, Maine.

Melanoplus femur-rubrum. De Geer.

The Red-legged Grasshopper.

Dull olive-green, with a black spot extending from the eyes along the side of the pronotum; an oblique yellow line on each side of the body, beneath the wings; a row of dusky brown spots along the middle of the wing covers; hind tibiæ and tarsi red, with black spines. Marginal apophyses of the last dorsal segment in the male, stout and parallel, reaching half-way over the supra-anal plate. Anal cerci tapering, pointed at the tip, and not half as broad on the apical as on the basal half. Apex of the last abdominal segment entire. Median carina of the pronotum of the female generally distinct on the anterior lobe; prosternal spine nearly cylindrical, scarcely tapering, except at the extreme tip, which is generally bluntly rounded.

Length, about one inch.

The eggs are deposited in the ground in the fall, and hatch the following May or June; but the insects do not reach maturity until July or August.

This is one of the most common grasshoppers in New England, and at times becomes so abundant as to destroy not only garden and field crops, but even attack shrubs and small trees. Prof. S. I. Smith states that he has seen small hackmatack trees, in Maine, almost covered with them, and entirely stripped of their leaves. When they are so abundant, they rise in the air and are carried long distances by the wind, when it is blowing strongly.

Melanoplus atlanis. Riley.

Length, about one inch.

This species strongly resembles *M. femur-rubrum*, but may be distinguished by the following characters given by Mr. Scudder:—

Male, with the marginal apophyses of the last dorsal segment slender, divergent, reaching scarcely one-third way over the supra-anal plate; anal cerci broad, equal, broadly rounded at tip, scarcely twice as long as broad; apex of last abdominal segment notched. *Female*, with the median carina of the pronotum generally indistinct or wholly wanting on the anterior lobe; prosternal spine tapering, generally bluntly pointed at tip.

This is a common species throughout New England.

Genus Paroxya. Scudder (1876).

Body straight, sub-cylindrical. Head moderately large; eyes large, prominent, separated from each other above by fully (male) or very much more than (female) the width of the basal joint of antennæ; antennæ long, equal, of similar length in both sexes. Pronotum simple, smooth (the posterior lobe punctulate); the median carina slight, equal; the anterior scarcely longer than the posterior lobe, the hind border of latter obtusely and bluntly angled; lower border of deflected lobes very obtusely angled in the middle; tubercle of prosternum prominent, sub-cylindrical, bluntly pointed, at the base laterally compressed, at least in the male. Wings and wing covers about reaching the tip of the abdomen, slender. Hind femora reaching (male) or surpassing (female) the tip of the wing covers, moderately stout, but tapering very regularly, unarmed above. Edges of inferior valve of ovipositor smooth; anal cerci of male having the general structure of those of *Melanoplus*.

PAROXYA ATLANTICA. Scudder.

Dull, olivaceous, excepting the top of the head, thorax and wing covers, which vary from light to dark brown. Head olivaceous, yellow on face and sides, in the female more or less infuscated; above the antennæ brownish, fuscous, more or less tinged with chestnut color; behind the eye a broad, straight, horizontal black band, edged more or less distinctly, above and below, with yellowish; antennæ not half so long as the body, in the male; pale yellow at base, at least in male; beyond, testaceous, deepening into fuscous toward the tip. Upper surface of pronotum of the color of the top of the head, the upper half of the deflected lobes with a very broad black band, in continuation of that on the head, anteriorly edged more or less distinctly, both above and below, with yellowish, and fading out before, or abruptly terminating at, the posterior lobe. Wing covers nearly uniform brownish fuscous, with a faint line of small fleckings down the middle, in the female. Legs of the color of the body, the middle and hind femora generally more or less infuscated on their outer face; hind tibiæ glaucous, with black or blackish spines.

Length, one inch.

Synopsis of the Truxalinæ.

1.	Prosternum obtusely tuberculated	2.
	Prosternum not tuberculated	3.
2.	Antennæ somewhat enlarged towards the base . .	*Opomala.*
	Antennæ not enlarged towards the base . .	*Stetheophyma.*
3.	Posterior margin of the pronotum truncate . . .	*Chloëaltis.*
	Posterior margin of the pronotum rounded or angular	*Stenobothrus.*

Genus OPOMALA. Serville (1831).

Head pyramidal; face very oblique. Antennæ reaching the apex of the pronotum, more or less enlarged near the base; the joints prismatic. Eyes somewhat prominent, oblique, placed near the front and close to the antennæ. Pronotum usually tricarinate, sometimes sub-cylindrical, and the carinæ sub-obliterated; sides straight, parallel or nearly so, truncate in front, truncate or obtusely rounded behind; transverse impressions generally indistinct. Wing covers straight, lanceolate, sometimes reaching to the tip of the abdomen, sometimes abbreviated. Prosternum with a short, blunt protuberance. Anterior and middle legs short; posterior generally long and slender.

OPOMALA BRACHYPTERA. Scudder.

Brown, dotted faintly above with black. A faint, dark stripe extending from the lower border of each eye along the side of the pronotum. Hind femora with a row of black dots on the upper edge; terminal lobe dark. Spines tipped with black. The female is more uniformly brown than the male, with numerous minute dusky dots; wings and wing covers shorter than the male.

Length, a little more than an inch.

Genus CHLOËALTIS. Harris (1841).

Eyes rather short, somewhat acuminate at the apex, placed near the vertex, oblique, and rather distant from each other. Back of the pronotum and head in one plane, horizontal. Head produced in front between the antennæ, in the form of a short, blunt pyramid. Antennæ short, filiform, sub-depressed, and joints sub-distinct. Face oblique and straight. Pronotum short, compressed at the sides, which are flat, straight and parallel, or very nearly so; tricarinate, the three carinæ distinct but not elevated; transverse incisions slight; truncate in front, and truncate or sub-truncate behind. Wing covers abbreviated, shorter than the abdomen, except in *Ch. punctulata*, when they are about equal to it in length; ovate-lanceolate. Prosternum unarmed, but slightly swollen.

The species may be separated as follows: —

1.	Female, green, or pale brown; male, green above	*viridis.*
	Brown, without any green	2.
2.	Wing covers about as long as the abdomen	*punctulata.*
	Wing covers shorter than the abdomen	*conspersa.*

CHLOËALTIS VIRIDIS. Scudder.

Wing covers shorter than the body, a little longer than the wings. Top of head and prothorax, green; sides of head and prothorax, dirty brown, with a horizontal black band behind the eye, extending over the prothorax; front of head, yellowish brown; fore and hind legs, reddish brown; mesothoracic legs, green; spines of tibiæ tipped with black; wing covers above, green; upon the sides, brown; body beneath, yellowish. The female varies from olivaceous green to dark brown, with a dark band behind the eye, as in the male; upon the top of the head a dark band extends from either side of the vertex, curving inwards and then outwards to midway between the median and lateral carinæ; hind tibiæ, reddish brown.

Length, about three-fourths of an inch.

CHLOËALTIS PUNCTULATA. Scudder.

Wings and wing covers extending to tip of abdomen. Vertex edged with reddish brown; a narrow, reddish-brown band extends along the lateral carinæ of pronotum to the eye, edged below with black; it extends also slightly upon the base of the wing covers; abdomen, sternum, fore legs and mouth parts (except the black mandibles), reddish brown; hind tibiæ, yellowish brown, the spines tipped with black; all the tarsi darker; wing covers green, with scattered, small, brownish spots.

Length of body, about one inch.

CHLOËALTIS CONSPERSA. Harris.

The Sprinkled Grasshopper.

Light reddish brown, sprinkled with black spots; a black line running behind each eye, on the head, and extending on each side of the thorax on the elevated lateral line; wing covers oblong-oval, pale yellowish brown, with many small, darker brown spots; wings about one-seventh of an inch long, transparent, with dusky lines at the tip; hind .tibiæ pale red, the spines at the end, black.

Length, nearly nine-tenths of an inch.

Genus STENOBOTHRUS. Fischer (1853).

Body medium size or small, elongate. Face more or less sloped obliquely backward and under toward the breast; vertex in front of the eyes, somewhat prominent, horizontal; eyes sub-rotund or sub-angulate. The antennæ generally exceed the head and pronotum in length, and are sub-compressed or sub-cylindrical.

Pronotum with a more or less flattened disk, the sides somewhat compressed, the front margin truncate, the hind margin obtuse angled or obtusely rounded; the three carinæ usually distinct, but not elevated; the median straight, entire; the lateral straight or curved inward at or in advance of the middle. Wings and wing covers sometimes abbreviated, sometimes as long or longer than the abdomen, generally narrow. Prosternum unarmed, narrow.

The species may be separated as follows: —

Wing covers unspotted	*curtipennis.*
Wing covers spotted	*maculipennis.*

STENOBOTHRUS CURTIPENNIS. Harris.

The Short-winged Grasshopper.

Olive gray above, variegated with dark gray and black; legs and body beneath, yellow; a broad black line extending from behind each eye on the sides of the thorax; wing covers, in the male, as long as the abdomen; in the female, covering two-thirds of the abdomen; wings rather shorter than the wing covers, transparent, faintly tinged with yellow; spines on hind tibiæ tipped with black. Length, about seven-eighths of an inch.

STENOBOTHRUS MACULIPENNIS. Scudder.

The Spotted-winged Grasshopper. (Fig. 14.)

Head and top of pronotum, green (in some individuals, brown); a broad, reddish-brown band extending from the eyes to the hinder side of the pronotum, limited above by the lateral carinæ, which are white. Sides of the pronotum below the band, brownish or dull yellowish. Wing covers extending beyond the end of the abdomen, green, with a row of square, black spots along the middle, and a few irregularly scattered, smaller black spots. Length, three-fourths of an inch.

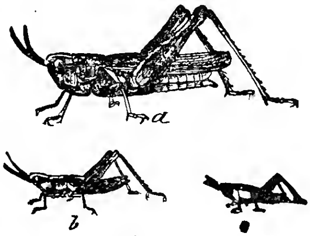

Fig. 14.
Stenobothrus maculipennis.
a. Mature insect.
b. Pupa.
c. Larva.

This is a very variable species, and contains several well-marked varieties.

Genus STETHEOPHYMA. Fischer (1854).

Head large; face somewhat oblique; eyes sub-depressed; antennæ filiform, of medium length. Pronotum flattened above, tricarinate; the median carina somewhat acute, and the lateral rather obtuse, sub-parallel, or slightly divergent posteriorly; the three transverse furrows undulate, the posterior only cutting the median carina; the sides marked more or less with impressed lines. Prosternum with an obtuse tubercle. Wings and wing covers perfect in both sexes, or slightly abbreviated in the female.

STETHEOPHYMA LINEATA. Scudder.

Dark brown. A narrow, curved, dark line extends from the upper border of the eyes to the lateral carinæ of the pronotum, and is the upper limit of a broad, brownish-yellow band extending from the eye to the lateral carinæ, whence it continues backward along the carinæ; below this, upon the upper border of the side, extends another broad black band from the eye to the hind edge of the pronotum; median carina, black. Costal edge of wing covers dark, with a yellow streak beneath extending from the base to the costal border at about two-thirds the distance to the apex; beneath this is a band, narrow and black at the base, broadening till it occupies the whole width of the wing covers, becoming brown toward the tip, while the inner border is yellowish brown. Wings dusky, the internal half with a yellowish tinge. Legs dark brown; hind femora black on the outer and inner surfaces, reddish brown above, coral red below, with a white spot near the apex; tip black. Hind tibiæ yellow, with black spines; the base and tips black, and a dusky annulation below the knee. Length, from one inch to one and one-fourth.

Mr. Scudder has described two other species, — *gracilis* and *platyptera;* but they are thought to be varieties of *lineata.*

Synopsis of the Œdipodinæ.

1.	Median carina of the pronotum with a single notch	2.
	Median carina of the pronotum with two notches	7.
2.	Mesosternal lobes of the female twice as distant as the metasternal lobes	3.
	Mesosternal lobes of the female not more distant than the metasternal lobes	5.
3.	Wings brightly colored	*Arphia.*
	Wings transparent, faintly colored	4.
4.	Pronotum wrinkled	*Encoptolophus.*
	Head and pronotum smooth or granulated	*Chortophaga.*
5.	Median carina of the pronotum even throughout	*Camnula.*
	Median carina of the pronotum irregular	6.
6.	Median carina of pronotum nearly obsolete on hind lobe,	*Hippiscus.*
	Median carina of pronotum high and arched on hind lobe,	*Dissosteira.*

7. The two inner longitudinal veins of the wing covers run separately to the inner border . . . . 8.
The two inner longitudinal veins of the wing covers unite before reaching the inner border . . . . *Psinidia.*

8. Veins of the hind part of the hind wings thickened . *Circotettix.*
Veins of the hind part of the hind wings not thickened, *Trimerotropis.*

Genus Arphia. Stäl (1873).

Body compressed; pronotum granulated; median carina either notched or entire. Wing covers of one color, but sprinkled with minute black dots; wings margined externally with black.

The species may be separated as follows: —

Pronotum right angled behind . . . . *sulphurea.*
Pronotum acute angled behind . . . . *xanthoptera.*

Arphia sulphurea. Fabricius.

Dusky brown, varying from an ashen to a dark hue. Wing covers paler than the head and thorax, more or less distinctly spotted with brown. Wings deep yellow at the base and on the basal half of the front margin, bounded externally by a dusky brown band beyond the middle, which curves and is prolonged on the hind margin, but does not reach the anal angle; a sub-marginal ray of the dark, extending two-thirds the distance to the base, separates the yellow of the margin from that of the disk; apex translucent, dusky. Posterior femora black inside, with two white bands; posterior tibiæ dusky, with a pale ring near the base; middle sometimes bluish. Length, a little over an inch.

Arphia xanthoptera. Burmeister.

Thorax generally, though not always, darker than in the former species; sometimes with two yellow dots on the middle of the sides of the pronotum, one above the other, and the front and hind margins dotted with olive; but these markings are not uniform. The dark ray of the wings near the front margin, not more than half as long as in the former species, extending but one-third the distance to the base; this is remarkably uniform. Posterior femora generally with two oblique dull yellowish bands on the exterior face, and also a paler and more distinct ring near the apex.

Length, from one to one and one-fourth inches.

Genus Chortophaga. Saussure (1884).

Body compressed, somewhat slim, punctate or fine wrinkled, green, sub-glabrous, slightly pubescent. Legs remote, with scattered hairs on their surface. Antennæ rather short, and slightly flattened. Pronotum acute angled behind. Wing covers narrow; costal half, green; the sutural half, brownish.

CHORTOPHAGA VIRIDIFASCIATA. De Geer.

The Goat-Headed Grasshopper. (Fig. 15.)

Fig. 15.
Chortophaga viridifasciata.
a. Larva.
b. Mature insect.

This exceedingly variable insect has received numerous names, but all the different shades of variation may be reduced to two forms, which are known by the names *virginiana*, Fabricius, the green form; and *infuscata*, Harris, the brown form.

The form VIRGINIANA is described as follows: —

Green; wing covers with a broad green stripe on the outer margin, extending from the base beyond the middle, and including two small dusky spots on the edge, the remainder dusky, but semi-transparent at the end; wings transparent, very pale greenish yellow next to the body, with a large dusky cloud near the middle of the hind margin, and a black line on the front margin; antennæ, fore and middle legs reddish; hind femora green, with two black spots in the furrow beneath. Length, about one inch.

Form INFUSCATA. Harris.

Dusky brown; wing covers faintly spotted with brown; wings transparent, pale greenish yellow next to the body, with a large dusky cloud near the middle of the hind margin, and a black line on the front margin; hind femora pale, with two large black spots on the inside; hind tibiæ brown, with darker spines, and a broad whitish ring below the knees.

Genus ENCOPTOLOPHUS. Scudder (1875).

Head but little swollen above, front vertical above, roundly sloping below, a little constricted above the antennæ; eyes separated by about their own width, moderately large, somewhat elliptical; antennæ rather short and flattened; top of the pronotum nearly flat, the median carina abrupt, but not greatly elevated, cut into halves by a distinct though slight notch; lateral carinæ distinct but broken, very slightly curved; hind margin of pronotum forming a right angle; wing covers reaching but little beyond the end of the abdomen.

Encoptolophus sordidus. Burmeister.

The Clouded Grasshopper. (Fig. 16.)

Dusky brown; wing covers pale, clouded, and spotted with brown; wings transparent, dusky at tip, with a dark brown line on the front margin; hind tibiæ brown, with darker spines, and a broad whitish ring below the knees. Length, about one inch.

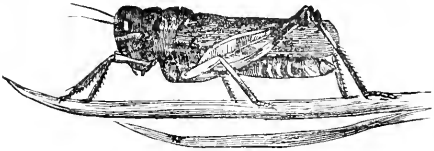

Fig. 16.
Encoptolophus sordidus.

Genus Camnula. Stäl (1873).

Head compressed; antennæ medium, a little stouter in the male; hind femora with an acute margin slightly crested; eyes small, rather prominent, rounded kidney-shaped. Pronotum nearly level above with median and lateral carinæ.

Camnula pellucida. Scudder.

Ash brown; face reddish brown; antennæ yellowish at base, dark brown toward tip; a triangular black spot behind the eye, the apex touching it; a quadrate transverse black spot on the anterior upper portion of the sides of the pronotum; pronotum above sometimes with a dark band down the middle; wing covers with the basal half dark brown, with small yellowish spots and transverse streaks, especially on front border; apical half clear, with dark brown rounded spots prevalent along the middle, decreasing in size toward the tip; when closed, the upper surface is dark brown, with a rather broad yellowish line along each angle on the upper surface; wings pellucid, with black nervules; legs dark brown, the hind femora yellowish or reddish brown, with two or three rather broad, diagonal, dark brown streaks, dark

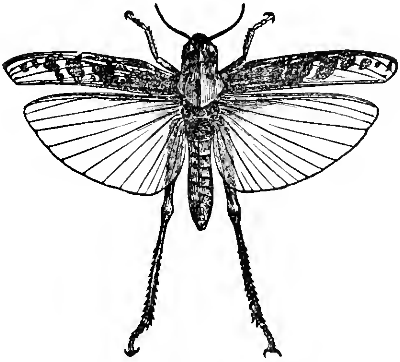

Fig. 17.
Camnula pellucida.

brown at the apex; hind tibiæ yellowish brown, reddish toward the tip, with a very narrow, generally faint, annulation of dark brown at the base; spines tipped with black. Length of body, three-fourths of an inch.

Genus Hippiscus. Saussure (1861).

Large, or medium-sized, glabrous. Top of the head with a small central ridge. Pronotum with a granular surface, truncate in front, acute angled behind, compressed centrally on the sides, and above on each side of median carina; this last with one notch; lateral carinæ prominent only in the middle. Wing covers extending considerably beyond the end of the abdomen.

The species may be separated as follows: —

Base of the wings, pale yellowish	*rugosus.*
Base of the wings, red	*tuberculatus.*

Hippiscus rugosus. Scudder.

Head and thorax, dark brown; two yellowish bands run from behind the eye backwards and inwards, nearly or quite meeting one another a little in advance of the middle of the pronotum, where they diverge and strike the hinder edge of the pronotum at the outer angles; there are two yellowish spots, one below the other, on the sides of the pronotum; wing covers marked with large dark blotches, generally occupying the larger portion of the wing; the tip of the wing cover pellucid, nearly free from spots; wings with the basal color, pale yellowish, and the apical portion dusky. Length of body, from one inch to one and one-fourth.

Hippiscus tuberculatus. Palisot de Beauvois.

The Red-winged Grasshopper.

Antennæ of female rather short and stout; pronotum granulated, scarcely spotted, plain above; median carina of uniform height throughout. Wing covers spotted with brown; base of wings red, costa and outer margin fuscous.

This species has been generally called *phœnicopterus;* but Saussure has shown that they are distinct species.

Genus Dissosteira. Scudder (1876).

Head prominent, vertex elevated and tumid; antennæ of the male not thickened before, nor tapering at, the tip; posterior lobe of the pronotum somewhat enlarged, median carina much elevated, deeply notched near the middle, the posterior lobe much arched. Insects of large size.

Saussure unites the genus *Spharagemon*, Scudder, established in 1875, with *Dissosteira*, and adopts the latter name because of the gender of the former!

The species may be separated as follows: —

1.	Base of the wings black	*carolina.*
	Base of the wings light yellow	2.
2.	Apex of the wings with dusky spots at the tip . .	*marmorata.*
	Apex of the wings without dusky spots at the tip . . .	3.
3.	Body pale, sparingly punctured	*bollii.*
	Body deeply punctured, and irrorate with black .	*æqualis.*

Dissosteira carolina. Linneus.

Pale yellowish brown, with small dusky spots; wings black, with a broad yellow hind margin, which is covered with dusky spots at the tip. Length, from one to one and one-half inches.

Dissosteira æqualis. Say.

Ashy gray, mottled with dusky brown and white; wing covers semi-transparent at tip, with numerous dusky spots, so run together as to form three tranverse bands; basal half of wings light yellow, transparent, with dusky veins and a few spots at the tip, and an intermediate broad black band, which reaches the inner angle of wing, curving and growing narrower on the hind margin; hind tibiæ coral red, spines tipped with black, and a wide white annulation below the knees. Length, one and one-fourth inches.

Dissosteira bollii. Scudder.

Brownish fuscous, the face with a grayish cinereous (in the male) or yellowish cinereous (in the female) tinge, distinctly punctate, the pits dusky or blackish; antennæ brownish yellow on the basal half, infuscated beyond, the whole more or less annulate with dusky yellow and blackish in the male. Wing covers flecked throughout with minute blackish spots. Wings light greenish yellow at the base, with a broad median arcuate band, blackish in color, sending out a broad short shoot toward the base next the upper border. Beyond, the wing is at first hyaline, with broad blackish, fuliginous veins, while the extreme tip is black, as the median band. Hind femora dull brownish; the basal two-fifths of the hind tibiæ blackish, with a broad whitish annulus beyond, coral red. Crest of pronotum very high, that of the posterior lobe independently arched, much more elevated in front than behind. Length of body, about one and one-fourth inches.

Mr. Scudder has described a species under the name of *D. balteatum;* but Saussure considers it only a variety of the above species.

DISSOSTEIRA MARMORATA. Harris.

The Marbled Grasshopper.

Ash-colored, variegated with pale yellow and black; thorax suddenly narrowed before the middle, the slightly raised longitudinal line on the top cut through in the middle by a transverse fissure; wing covers marbled with large whitish and black spots, and semi-transparent at the end; wings light yellow on the half next the body, transparent near the end, with two black spots on the tip, and a broad intermediate black band, which, narrowed and curving inwards on the hind margin, nearly reaches the inner angle; hind femora pale yellow, black at the extremity, and nearly surrounded by two broad black bands; hind tibiæ coral red, with a black ring below the knee, and followed by a white ring, black at the lower extremity also, with tips of the spines black. In some individuals, an additional black ring below the white one on the tibiæ. Length, from three-fourths to one inch.

Genus PSINIDIA. Stäl (1873).

Antennæ of the male elongated, somewhat stout and flattened; pronotum with a granulated or tuberculated surface, rounded in front, acute angled behind; median carina with two notches, lateral carinæ distinct on the posterior lobe.

PSINIDIA FENISTRALIS. Serville.

The Long-horned Grasshopper.

Ash-colored, variegated with gray and dark brown; antennæ nearly as long as the body, and with flattened joints; thorax very much compressed laterally before the middle; wing covers and wings long and narrow; the former variegated with dusky spots, and semi-transparent at the tip; wings next to the body vermillion red, yellow, sometimes pale, sometimes deep and almost orange-colored, at other times uncolored and semi-transparent; with a broad black band across the middle, which is narrowed and prolonged on the hinder margin, and extends quite to the inner angle; beyond the band, the wings are transparent, with the tips black or covered with blackish spots; hind tibiæ whitish, with a black ring at each end, a broad one of the same color just above the middle, and the spines tipped with black. Length, three-fourths of an inch. The wings of this species are very variable in color at the base.

Genus Trimerotropis. Stäl (1873).

Body slightly wrinkled, and covered with fine hairs; pronotum slightly angled in front and acutely angled behind, and slightly wrinkled; median carina broken by two wide notches; wing covers long and narrow.

Trimerotropis maritima. Harris.

Ash gray; face variegated with white; wing covers sprinkled with minute brownish spots, and semi-transparent at tip; wings transparent, faintly tinged with yellow next the body, uncolored at tip, with a series of irregular blackish spots forming a curved band across the middle; hind tibiæ and feet pale yellow, with the extreme points of the spines black. Length, from three-fourths to one and one-fourth inches.

Genus Circotettix. Scudder (1876).

Body pubescent and punctured. Eyes somewhat prominent, separated above by a space about equal to their width; antennæ but little longer than the head and prothorax combined; pronotum with the front lobe slightly narrower than the head; median carina on the anterior portion of the front lobe, obsolete on the posterior portion, and inconspicuous on the hind lobe; front margin scarcely angulated, hind margin rectangular; lateral carinæ distinct on posterior lobe, but not prominent; surface slightly wrinkled. Wings and wing covers much longer than the body.

Circotettix verruculatus. Kirby.

Ash-colored, mottled with black and gray; wing covers semi-transparent beyond the middle, with numerous blackish spots which run together at the base, and form a band across the middle; wings broad, light yellow on the basal half, the remainder dusky but transparent, with black net-work, and deep black at tip, and an intermediate, irregular band, formed by a contiguous series of black spots, reaching only to the hind margin, but not continued toward the inner angle; hind tibiæ pale yellow, with a black ring below the knees, a broader one at the extremity, and a blackish spot behind the upper part of the tibia. Length, nearly one inch.

Synopsis of the Tettiginæ.

1.	Pronotum arched roundly	*Batrachidea.*
	Pronotum nearly or quite horizontal	2.
2.	Antennæ with thirteen or fourteen joints . . .	*Tettix.*
	Antennæ with twenty-two joints	*Tettigidea.*

Genus Tettix. Fischer (1853).

Head generally small; eyes globular, somewhat prominent; antennæ composed of thirteen or fourteen joints, filiform; pronotum extending back over the abdomen to or beyond its extremity; the lower anterior angle of the sides angulated and bent inward; the lateral carinæ somewhat prominent, convergent near the front border. Wing covers short, in the form of oval scales. Wings well developed, usually as long or longer than the abdomen, and slightly curving upward at the end. Pronotum without any spine or tubercle. Species small.

The species may be separated as follows: —

1.	Length about half an inch	2.
	Length about one-fifth of an inch . . .	*triangularis.*
2.	Length to tip of wings, .55 to .60 of an inch .	*granulatus.*
	Length to tip of wings half an inch or less	3.
3.	Pronotum advanced to the eyes	*cucullatus.*
	Pronotum not advanced to the eyes	*ornatus.*

Tettix granulatus. Kirby.

Cinereous, obscurely clouded with black, the whole body granulated with very minute, elevated, whitish points. Pronotum longer than the abdomen, tricarinate. Tibiæ reddish, obscurely banded with white. Body black, sprinkled with numberless very minute elevated points or granules. Pronotum cinereous, clouded obscurely with black; the middle carina straight, and the lateral ones curved at the base. The rudiments of wing covers cinereous, ridged, with excavated punctures; nerves of the wings black, those of the costal area white. The fore anterior tibiæ reddish, obscurely annulated with white. Length, nearly half an inch.

Fig. 18. Tettix granulatus.

Tettix ornatus. Say.

Smaller than *T. granulatus;* vertex but little in advance of the eyes, and front border nearly straight, instead of angulated. Pronotum shorter than in the preceding; wings smaller. Both this and the preceding species have almost every conceivable variation of ornamentation; but, as has been remarked, color and ornamentation have but little value in separating the species of *Tettix*.

TETTIX CUCULLATUS. Scudder.

Vertex at the front border smaller than across the middle of the prominent eyes. Testaceous-fuscous, granulose. Pronotum dilated in front, advanced upon the head to the eyes. Length, nearly half an inch.

It differs from *T. granulatus*, which it most resembles, in having the vertex very narrow, slightly less than the diameter of the much-inflated eyes, the front cut off square, and slightly hollowed, not projecting outward so far as the eyes. The pronotum is broader and more compact over the thorax, more suddenly sloped off behind, and extending backward nearly twice the length of the abdomen, the wings overreaching slightly. The punctures on the wing covers not so deep.

TETTIX TRIANGULARIS. Scudder.

Allied to *T. ornatus*, and agreeing with it in ornamentation, in the character of the vertex and prominence of the eyes, but differing in the length of the pronotum and wings. As in both of the preceding species, the pronotum and wings are of equal length, but in this species the pronotum is scarcely longer than the body, and is not produced backward into such a slender point, the sides being straighter. Length, three times the breadth; length of pronotum, .17 of an inch.

Genus TETTIGIDEA. Scudder (1862).

More robust and clumsy than *Tettix*, head larger, more swollen upon the top, and less sloping down the front; antennæ consisting of twenty-two joints, which are cylindrical and not flattened. The lower anterior angle of the sides of the pronotum, which is angulated and bent inwards in *Tettix*, is here rounded and straighter; the lateral carinæ are not so prominent as there, or so strongly bent inwards in advance of the broader portion; the front border is thrust forward at an angle partially concealing the head. Wing covers considerably longer and narrower than in *Tettix*. This genus further differs from *Tettix*, in having a small circular space, without facets, set off from the upper, inner border of the eye.

The species may be separated as follows: —

Pronotum extending beyond the end of the abdomen . .	*lateralis.*
Pronotum not extending beyond the end of the abdomen .	*polymorpha.*

TETTIGIDEA LATERALIS. Say.

Pale brownish-testaceous, with a lateral, broad fuscous line. Pronotum shorter than the wings. Antennæ reddish brown, blackish at tip. Pronotum flattened, with small longitudinal lines or wrinkles, and a more obvious, continuous, elevated central line extending the whole length. Wings brown on the anterior margin toward the tip, and extending at least one-twentieth of an inch beyond the pronotum; sides with a dilated blackish-brown line or vitta, beginning at the eye, and including the abdomen above, and each side. Legs brown, more or less annulated with pale; under side of abdomen pale yellowish or testaceous. Length, to tips of wings, nearly half an inch.

TETTIGIDEA POLYMORPHA. Burmeister.

Dark brown; sides blackish; pronotum clay-colored or pale brown, and about as long as the body. Wing covers with a small white spot at the tips; wings much shorter than the pronotum. Male with the face and edges of the lateral margins of the pronotum yellow. This species is much shorter and thicker than *T. lateralis.*

Length, two-fifths of an inch.

Genus BATRACHIDEA. Serville (1839).

Head larger than in *Tettix;* eyes more distant; front less sloping; antennæ with twelve joints; median carina very high and arched; lateral carinæ indicated only in front.

The species may be separated as follows: —

Pronotum reaching to the end of the abdomen . . .	*cristata.*
Pronotum not reaching to the end of the abdomen . . .	*carinata.*

BATRACHIDEA CRISTATA. Harris.

Vertex projecting beyond the eyes, front border well rounded, a little angulated, the median carina sharp, prominent, sloping downwards posteriorly, the front deeply notched immediately in front of the eyes; eyes rather prominent, scarcely more than half as broad as the vertex; the pronotum with sides neither swollen nor hollowed, of the length of the body; the median carina high, regularly arched; the lateral border with two shallow grooves, one anterior, the other posterior, overlapping one another in the middle; the whole pronotum is minutely scabrous, and there is generally a dark quadrate or triangular spot on either side, above the terminal half of the wing covers; wings reaching the tip of the pronotum. Length of pronotum, one-third of an inch.

Batrachidea carinata. Scudder.

The head much as in *B. cristata*, with the eyes slightly larger and more prominent; the median carina of the pronotum sharp, regularly arched, the pronotum extending backward quite a distance behind the tip of the abdomen, a little upturned towards the tip, with slightly longer wings; the lateral grooves are narrower and less distinct than in *B. cristata*, and the upper surface is more coarsely scabrous than in that species; markings the same as in *B. cristata*. Length of body, one-third of an inch; of pronotum, .43 of an inch.

Family PHASMIDÆ.

The Walking-sticks.

But a single member of this family is known to occur in New England, and it has been placed in the genus *Diapheromera.*

Genus Diapheromera. Gray (1835).

Body long, slender and cylindrical. Head oval and slightly inclined. Antennæ long, slender, and composed of numerous joints, and are inserted in front of the eyes. Palpi short, cylindrical. Legs simple, the anterior pair similar to the others. Tarsi five-jointed. Elytra very short, or wanting.

Diapheromera femorata. Say.

The Common Walking-stick. (Fig. 19.)

Length of body, from two and one-half to three inches. Color, green or greenish brown, but varying much, becoming quite brown towards the end of the season.

Head of the male with three brown stripes, the female with only two, one on each side, extending backward from the base of the antennæ.

Fore and middle femora armed with a short acute spine on the under side, near the outer end. Elytra entirely wanting.

This insect feeds on the foliage of oak, hickory, locust, and has been known to attack the peach and rose bushes.

The eggs, which are black, and oval in outline, are dropped loosely on the ground in the fall, and do not hatch till the succeeding year, and sometimes not till the second year. They change but little except in size and color during their early life, and molt but twice.

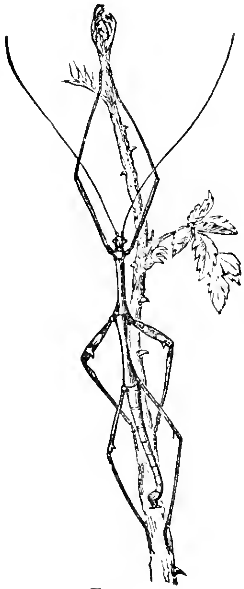

Fig. 19.
Diapheromera femorata.

Family BLATTIDÆ.

Cockroaches.

Body usually depressed and oval. Pronotum shield-like. Legs adapted for running only. Wing covers usually leathery, opaque, overlapping (if well developed) when at rest. Head bent down, face sloping backwards. Eyes large; ocelli rudimentary, usually two. Antennæ long and slender.

Synopsis of the Genera.

1.	Sub-anal styles wanting in the males; last joint of the abdomen of the female not divided beneath	*Blatta.*
	Sub-anal styles present in the males; last joint of the abdomen of the female divided	2.
2.	Supra-anal plate fissured	*Periplaneta.*
	Supra-anal plate not fissured	*Platamodes.*

Genus Blatta. Linneus (1758).

The insects placed in this genus have a pad (pulvillus) between the claws of the feet; the seventh sternum of the abdomen entire in both sexes; and the sub-anal styles rudimentary in the males.

Blatta germanica. Fabricius.

Water Bug. Croton Bug. (Fig. 20.)

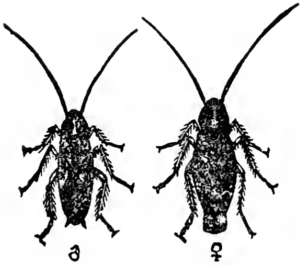

Fig. 20.
Blatta germanica. Male and female.

Length, about half an inch. Color, dull yellowish, with a yellowish-brown head and yellowish antennæ. Pronotum with a reddish-brown longitudinal band on each side. Wing covers and wings somewhat longer than the abdomen.

The eggs, thirty-six in number, are laid in two rows in a capsule which the female carries around attached to the end of her abdomen; and, when the young hatch, she assists them in escaping from the capsule. The young molt or shed their skins six times before they reach maturity, which takes from four to five months. They do not avoid the light as much as the other species of this family, but still are nocturnal to a certain degree.

This species is common in houses in and about all the large cities in New England, where it is called the "croton bug." It feeds on almost everything, but prefers wheat bread to all other articles of diet. It sometimes injures libraries by gnawing the bindings of books bound in cloth. The use of Ryrethrum powder on the shelves is the best remedy. It has been recommended to mix a teaspoonful of powdered arsenic with a tablespoonful of mashed potato, and scatter about their lurking-places; but, when poison is used, the greatest caution is necessary to prevent accidents.

Borax is also said to be useful in destroying the croton bug.

BLATTA? FLAVOCINCTA. Scudder.

"Prothoracic shield rather dark brown, slightly paler along the median line, bordered throughout with a pale yellowish band, forming only a very narrow edge posteriorly; broader in front, and quite broad at the sides, covering all the deflexed border; the edge at the sides and front is slightly raised; wing covers scarcely reaching the tip of the abdomen, reddish brown, with the anterior half of the outer margin paler, with a yellowish tinge; wings not half the length of the wing covers; abdomen above very dark brown; below, dark brown, the terminal segment being darkest; legs yellowish brown, with spines as in *B? lithophila;* head reddish brown; sides below antennæ yellowish; eyes black; antennæ dark brown, paler toward tip; third joint rather larger than the two succeeding joints, and equal in size to the second. Length of body, fifty-six hundredths of an inch."

Mr. Scudder placed this species and *germanica* under the genus ECTOBIA, and it may not be properly placed here. He also described a species under ECTOBIA as *lithophila* (a manuscript name of Harris); but he informs me that it is very likely to be the larva of *Platamodes pennsylvanica.*

Genus PERIPLANETA. Burmeister (1838).

Last abdominal sternum of the female divided; sub-anal styles of the male well developed. Antennæ slim and tapering, longer than the body. Legs long and very spiny.

Wing covers and wings extending beyond the end of the abdomen in both sexes	*americana.*
Wing covers and wings not reaching to the end of the abdomen in the males, rudimentary in the females. .	*orientalis.*

PERIPLANETA AMERICANA. Fabricius.

Length, one inch and one-fourth. Color, reddish brown, with paler indistinct bands on the pronotum. Wings and wing covers well developed in both sexes, and extending beyond the end of the abdomen. Legs much lighter in color than the body.

PERIPLANETA ORIENTALIS. Linneus.

Length, about four-fifths of an inch. Color, dark brown. Pronotum not banded; legs of a lighter color than the body. Wings and wing covers of the male well developed, reaching nearly to the end of the abdomen. Wings wanting in the female, and wing covers very small, not more than one-fifth of an inch long.

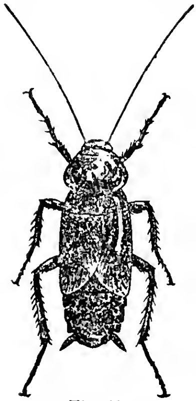

Fig. 21.
Periplaneta orientalis.

The female lays sixteen eggs in two rows in a large horny capsule, which she carries with her for seven or eight days, when she drops it in a warm and sheltered place. When the young hatch, they discharge a fluid which softens the cement along the edge of the capsule, and enables them to escape without assistance. The young larvæ are white at first, differing from the adult only in size, color and the absence of wings. They run about with great activity, feeding upon any starchy food they can find.

This species is nocturnal in its habits, and flees at the first appearance of light. It is a great pest, for it devours almost anything that comes in its way, as flour, bread, meat, cheese, woolen clothes, and even old leather. Various methods have been suggested for their destruction, but one of the best is to use a small wooden box, having a circular hole at the top, with a glass rim, out of which they cannot escape. It should be baited at night, and the contents thrown into hot water in the morning.

Genus PLATAMODES. Scudder (1862).

" A genus more closely allied to *Periplaneta* than to any other, but readily distinguishable from it by its much narrower and more elongated body, — the sides being sub-parallel to one another throughout their whole extent, while in *Periplaneta* the abdomen is much swollen. The wings and wing covers extend beyond the abdomen, the latter being well rounded at the tip. The supra-anal plate is regularly rounded, but lacks altogether the fissuration seen in *Periplaneta;* but at the same time it is not squarely docked, as in *Stylopyga*. The anal cerci are somewhat shorter and not so flattened as in *Periplaneta*, while the anal styles are very short, and turned abruptly downwards. In *Periplaneta* the sub-genital plate does not extend so far backward as the supra-anal. In *Platamodes* it extends backward farther. A further distinction between the two genera may be seen at the inner borders of the eyes, which in *Platamodes* are nearly parallel, while in *Periplaneta* they approach one another anteriorly. I have only seen males."

Platamodes unicolor. Scudder.

"Wings and wing covers, uniform pale, shining reddish brown; head and prothoracic shield nearly the same, but slightly darker, particularly in the middle of the latter; abdomen a little darker above, especially on the borders; cerci dark brown; legs, especially the tibiæ, darker than the body; eyes black; antennæ and palpi brown; antennæ reaching backward to tip of wing covers. Length of body, .25 inch; length to tip of wings, .35."

Family FORFICULIDÆ. Stephens (1829).

Earwigs. (Fig. 22.)

Dr. Packard has followed Leach and some others in separating the earwigs from the Orthoptera, and has established the Order Dermatoptera for their reception.

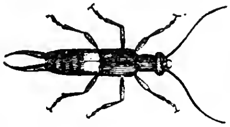

Fig. 22.
Earwig. Forficula.

We have but a single species in New England, common also in Europe, and placed in the genus Labia.

Genus Labia. Leach (1817).

Body small and convex; head moderately large; antennæ composed of from ten to fifteen joints. Pronotum somewhat smaller than the head; wing covers always present, though the wings are sometimes wanting. Abdomen somewhat widened in the middle, the last segment much larger than the others, and armed with a pair of forceps separated at the base in the males, but not separated in the females. Legs comparatively short; the first joint of the tarsi as long as the other two, and the second is the shortest.

Labia minor. Linneus.

The Little Earwig.

Length of body, including forceps, one-fourth of an inch. Head and sides of abdomen nearly black. Mouth parts, antennæ, thorax, wing covers, exposed portion of the wings, and the middle of the upper side of the abdomen, yellowish brown; the last segment of the abdomen and the forceps reddish brown. Legs and last two joints of antennæ honey yellow. Entire surface of the body covered with fine, short hairs.

This species remains concealed during the day, but flies about at night, and is sometimes attracted into houses by the light. It was taken in this way at Amherst, Mass., at 8 P. M., Aug. 25, 1887. It is probably not abundant enough to do any considerable damage, but in Europe they are at times very injurious to flowers and fruits; and they are caught in traps, consisting of hollow tubes closed at one end, which are set up in the gardens, and in which they conceal themselves. The hollow stems of the sunflowers are used for this purpose, as the earwigs are fond of the remains of the sweet pith.

Curtis states that the female earwig lays her cluster of little oval, opaque, yellowish eggs under a fallen leaf or other sheltered place, then nestles upon them as a hen does on her eggs, and then probably protects and feeds her young.

The term earwigs, which has been applied to these insects in Europe, and very generally in this country, has sometimes been incorrectly given to one of the Myriopods.

DEFINITION OF TERMS.

Antennæ. Two jointed, thread-like appendages on the front of the head.
Carina (plural *Carinæ*). A keel or ridge.
Cerci. The small appendages issuing from the sides of the last abdominal segment.
Cinereous. An ash-gray color.
Clavate. Having a thickened, club-like extremity.
Costa. It is usually applied to the median carina of the face; but is also applied to the front margin of the wings and elytra.
Dentate. Furnished with a tooth.
Disk. The middle surface.
Dorsum. The upper surface or back of the thorax, abdomen, etc.
Dorsal. Pertaining to the upper surface.
Elongate. Signifies that the part is longer than it is wide.
Elytra. The wing covers. The anterior or upper wings.
Femora. The thighs.
Filiform. Slender, or thread-like.
Foveola. A cavity or cellular depression.
Fulvous. Tawny, or light yellowish brown.
Fuscous. Dark brown, or sooty color.
Ganglion (plural *Ganglia*). A nervous mass or enlargement.
Glabrous. Smooth or polished.
Hyaline. Transparent, with a greenish tinge.
Lateral lobes of the pronotum. The deflexed portions that cover the sides of the thorax.
Medial or *Median.* Occupying the middle.
Mesonotum. The upper or dorsal surface of the mesothorax.
Mesosternum. The under surface of the mesothorax.
Mesothorax. The middle part of the thorax, to which the wing covers and middle pair of legs are attached.
Metanotum. The upper or dorsal surface of the metathorax.
Metasternum. The under surface of the metathorax.
Metathorax. The posterior part of the thorax, to which the wings and hind pair of legs are attached.
Nerves. The larger ribs or veins of the wings and wing covers, extending from the base toward the apex.
Nervules. The smaller connecting veins of the wings and wing covers.
Ocelli (singular *Ocellus*). The three simple or little eyes.
Pectus. The breast or under surface of the thorax.
Pronotum. The shield which covers the front part of the thorax.

Prosternum. The under surface of the prothorax.

Prothorax. The anterior division of the thorax, to which the head is joined.

Pulvilli (singular *Pulvillus*). The little pads between the claws.

Punctate or *Punctured.* Containing numerous small, point-like depressions or punctures.

Reticulated. Furnished with veining or markings like net-work.

Scabrous. Covered with small, slight elevations.

Spurs. The strong spines at the apex of the tibiæ.

Sulcus. A linear groove or channel.

Suture. A seam or impressed line; generally used in reference to the junction of two pieces or plates.

Tarsus (piural *Tarsi*). The jointed foot.

Tibia (plural *Tibiæ*). The part of the leg between the thigh and the foot.

Tricarinate. Having three keels or *carinæ*.

Tuberculate. Covered with tubercles.

Unarmed. Without a spine; unspined.

Vertex. The front portion of the upper surface of the head, between and in front of the eyes.

A LIST OF THE NEW ENGLAND ORTHOPTERA,

With the Principal Synonyms.

GRYLLIDÆ.

Tridactylus terminalis, Uhler, Mss. (Scudder.)
Gryllotalpa borealis, Burmeister.
  Gr. brevipennis, Serville.
Gryllotalpa columbia, Scudder.
  G. longipennis, Scudd.
Gryllus abbreviatus, Serv.
  Gr. angustus, Scudd.
Gryllus luctuosus, Serv.
  Gr. pennsylvanicus, Burm.
  Gr. neglectus, Scudd.
  Gr. niger, Harris.
Nemobius fasciatus, De Geer.
  N. vittatus, Harr.
Œcanthus niveus, Serv.
  Œ. fasciatus, Fitch.

LOCUSTIDÆ.

Ceuthophilus maculatus, Harr.
  Phal. lapidicola, Burm.
Ceuthophilus brevipes, Scudd.
Cyrtophyllus concavus, Harr.
  Platy. perspicillatum, Serv.
Amblycorypha oblongifolia, De Geer.
Amblycorypha rotundifolia, Scudd.
Microcentrum laurifolium, Linneus.
  Micro. affiliatum, Scudd.
Scudderia curvicauda, De Geer.
  Gryl. myrtifolius, Drury.
  Phan. angustifolia, Harr.
Conocephalus ensiger, Harr.
Conocephalus robustus, Scudd.
Xiphidium fasciatum, De Geer.
  Orch. gracile, Harr.
Xiphidium brevipenne, Scudd.
Xiphidium vulgare, Harr.
Xiphidium concinnum, Scudd.
Xiphidium glaberrimum, Burm.
Thyreonotus dorsalis, Burm.
Thyreonotus pachymerus, Burm.

ACRIDIDÆ.

Pezotettix glacialis, Scudd.
Pezotettix manca, Smith.
Pezotettix borealis, Scudd.
Acridium alutaceum, Harr.
Acridium rubiginosum, Harr.
Melanoplus femoratus, Burm.
  C. bivittatus, Uhl.
  L. leucostoma, Kirby.
  A. flavivittatum, Harr.
Melanoplus punctulatus, Scudd.
Melanoplus collinus, Scudd.
Melanoplus rectus, Scudd.
Melanoplus femur-rubrum, De Geer.
Melanoplus atlanis, Riley.
  M. atlantis, Scudd.
Paroxya atlantica, Scudd.
Opomala brachyptera, Scudd.

Chloëaltis viridis, Scudd.
Chloëaltis punctulata, Scudd.
Chloëaltis conspersa, Harr.
Stenobothrus curtipennis, Harr.
Sten. longipennis, Scudd.
Stenobothrus maculipennis, Scudd.
Sten. æqualis, Scudd.
Sten. bilineatus, Scudd.
Stethophyma lineata, Scudd.
Arphia sulphurea, Fab.
Arphia xanthoptera, Burm.
Chortophaga viridifasciata, De Geer.
T. infuscata, Harr.
T. radiata, Harr.
Encoptolophus sordidus, Burm.
Œ. nebulosa, Harr.
Camnula pellucida, Scudd.
Œ. atrax, Scudd.
Hippiscus rugosus, Scudd.
Hippiscus tuberculatus, Pal. de Beau.
Œd. obliterata, Burm.
Œd. phœnicoptera, Thos.
Dissosteira carolina, Linn.
Dissosteira æqualis, Say.
Dissosteira bollii, Scudd.
Dissosteira marmorata, Harr.
Psinidia fenistralis, Serv.
Œ. eucerata, Harr.
Trimerotropis maritima, Harr.
Circotettix verruculatus, Kirby.
Loc. latipennis, Harr.
Tettix granulatus, Kirby.
T. ornata, Harr.
Tettix ornatus, Say.
T. arenosa, Burm.
T. dorsalis, Harr.
T. quadrimaculata, Harr.
T. bilineata, Harr.
T. sordida, Harr.
Tettix cucullatus, Scudd.
Tettix triangularis, Scudd.
Tettigidea lateralis, Say.
Tettigidea polymorpha, Burm.
T. parvipennis, Harr.
Batrachidea cristata, Harr.
Batrachidea carinata, Scudd.

PHASMIDÆ.

Diapheromera femorata, Say.

BLATTIDÆ.

Blatta germanica, Fab.
Blatta ? flavocincta, Scudd.
Periplaneta americana, Fab.
Periplaneta orientalis, Linn.
Platamodes unicolor, Scudd.

FORFICULIDÆ.

Labia minor, Linn.
L. minuta, Scudd.

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FIFTEENTH ANNUAL REPORT

ON

COMMERCIAL FERTILIZERS.

By C. A. Goessmann, *State Inspector*.

REPORT

The demand for Commercial Fertilizers has been, as usual, quite active during the past year. About the same number of manufacturers as in the preceding year (33 to 34), have sent their goods into our market. Some dealers from more remote localities have not renewed their licenses on account of changes in the charges of freight; new parties have taken their places.

The general character of the articles offered for sale has been, on the whole, fairly within the guaranty stated.

The cost of the different brands of fertilizer has varied but little from that of the previous year, whenever the composition has been the same. The lower cost of nitrogen in form of ammoniates and nitrates, as compared with that of the preceding year, has been more than equalized by the higher valuation of nitrogen in first-class organic nitrogenous matter.

Judging from present indications, no material changes can be expected in the cost of fertilizers at the opening of the coming season.

A few subsequent pages contain a tabulated statement of the market prices of nitrogen, phosphoric acid and potash in their various commercial forms, which have been adopted during the past year (1887), in the commercial valuation of compound fertilizers collected within the State, as prescribed by our laws for the regulation of the trade in fertilizers, and described farther on in this report.

Some explanations concerning the rules which guide agricultural chemists in the valuation of compound commercial fertilizers have been added for the purpose of assisting those not yet familiar with the current mode of ascertaining the commercial value of the essential articles of plant-food as specified by chemical analysis.

One hundred and eight analyses are reported within the subsequent pages.

The valuation which accompanies the analysis of a fertilizer should inform the consumer, as far as practicable, regarding the cash retail price at which the several specified elements of plant-food, in an efficient form, have been offered for sale in our principal markets at the beginning of the season.

The market value of manurial substances, as bones, salt, ashes, various compounds of lime, barnyard manure, factory refuse and waste materials of different description, quite frequently does not stand in a close relation to their chemical composition. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for a speedy action, exert, as a rule, a decided influence on their selling price.

The market reports of centres of trade in New England, New York and New Jersey, aside from consultations with leading manufacturers of fertilizers, have furnished us the necessary information regarding the current trade value of fertilizing ingredients.

The subsequent statement of cash values in the retail trade is obtained by taking the average of the wholesale quotations in New York and Boston during the six months preceding March 1, 1887, and increasing them 20 per cent., to cover expenses for sales, credits, etc.

These trade values, except those for phosphoric acid soluble in ammonium citrate, were agreed upon by the Experiment Stations of Massachusetts, Connecticut and New Jersey, for use in their several States for the last season.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals.

	1887. Cts. per pound.
Nitrogen in nitrates,	16
Nitrogen in ammoniates,	17½
Organic nitrogen in dried and fine ground fish,	17½
Organic nitrogen in Peruvian guano, blood, meat, azotin ammonite and castor pomace,	17½
Organic nitrogen in fine ground bone and tankage,	16
Organic nitrogen in fine medium bone and tankage,	14
Organic nitrogen in medium bone and tankage,	12
Organic nitrogen in coarse medium bone and tankage,	10
Organic nitrogen in coarse bone, horn shavings, hair and fish scraps,	8
Phosphoric acid, soluble in water,	8
Phosphoric acid, soluble in ammonium citrate,*	7½
Phosphoric acid, insoluble in dry fine ground fish, in fine bone, tankage,	7
Phosphoric acid, insoluble in fine medium bone and tankage,	6
Phosphoric acid, insoluble in medium bone,	5
Phosphoric acid, insoluble in coarse medium bone,	4
Phosphoric acid, insoluble in coarse bone,	3
Phosphoric acid, insoluble in fine ground rock phosphate,	2
Potash as sulphate in compounds free from chlorine,	5½
Potash as kainite,	4¼
Potash as muriate,	4¼

The above trade values are the figures at which, on March 1st, the respective ingredients could be bought at retail for cash per pound in our leading markets in the raw materials, which are the regular source of supply.

They also correspond to the average wholesale prices for the six months ending March 1st, plus 20 per cent. in case of goods for which we have wholesale quotations.

The calculated values obtained by the use of the above figures will be found to agree fairly with the reasonable retail price in case of standard raw material such as, —

Sulphate of Ammonia,	Dry Ground Fish,
Nitrate of Soda,	Azotin,
Muriate of Potash,	Ammonite,
Sulphate of Potash,	Castor Pomace,
Dried Blood,	Bone,
Dried Ground Meat,	Plain Superphosphates.

*Dissolved from two grams of Phosphate, unground, by 100 C. C. neutral solution of ammonium citrate, sp. gr. 1.09, in 30 minutes at 65 deg. C., with agitation

Trade Values in Superphosphates, Special Manures and Mixed Fertilizers of High Grade.

The organic nitrogen in these classes of goods will be valued at the highest figures laid down in the Trade Values of Fertilizing Ingredients in Raw Materials, namely, 17.5 cents per pound; it being assumed that the organic nitrogen is derived from the best sources, viz., animal matter, as meat, blood, bones or other equally good forms, and not from leather, shoddy, hair, or any low-priced inferior form of vegetable matter, unless the contrary is ascertained.

Insoluble phosphoric acid will be valued at three cents, it being assumed, unless found otherwise, that it is from bone or similar source and not from rock phosphate. In this latter form the insoluble phosphoric acid is worth but two cents per pound. Potash is rated at four and one-fourth cents, if sufficient chlorine is present in the fertilizer to combine with it and make muriate. If there is more potash present than will combine with the chlorine, then this excess of potash will be counted as sulphate.

To introduce large quantities of chlorides, common salt, etc., into a fertilizer, claiming sulphate of potash as a constituent, is a practice which in our present state of information will be considered of doubtful merit. The use of the highest trade values is based on the opinion that these articles ought to contain the most efficient forms of fertilizing ingredients.

In most cases the valuation of the ingredients in Superphosphates and Specials falls below the retail price of these goods. The difference between the figures represents the manufacturer's charges for converting raw materials into manufactured articles. These charges are for grinding and mixing, bagging or barrelling, storage and transportation, commission to agents and dealers, long credits, interest on investment, bad debts, and finally profits.

Local disadvantages for transportation exert not unfrequently a serious influence on the cost of one and the same brand of fertilizers. Binding rules cannot be laid down regarding these points. Farmers must judge for themselves

once in five minutes; commonly called "reverted" or "backgone" phosphoric acid.

whether the difference between our valuation and the prices asked for is a fair one, considering local conditions of supply.

The prices stated in these bulletins in connection with analyses of commercial fertilizers refer to their cost per ton of 2,000 pounds, on board of car or boat near the factory or place of general distribution. To obtain the valuation of a fertilizer (*i. e.*, the money worth of its fertilizing ingredients), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound. We thus get the values per ton of the several ingredients, and adding them together we obtain the total valuation per ton.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant-food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value, in case of one and the same kind of substance. Two samples of fish fertilizer, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse material of various descriptions, sent to the Station for examination, are valued with reference to the market prices of their principal constituents, taking into consideration at the same time their general fitness for speedy action.

A large percentage of commercial fertilizing material consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industry is liable to affect at any time, more or less seriously, the composition of the refuse. A constant inquiry into the character of the agricultural chemicals, and of commercial manurial refuse substances offered for sale, cannot fail to secure confidence in their composition, and to diminish financial disappointment in consequence of their application. This work is carried on for the purpose of aiding the farming community in a clear and intelligent appreciation of the substances for manurial purposes.

Consumers of commercial manurial substances do well to buy, whenever practicable, on guaranty of composition with reference to their essential constituents; and to see to it that the bill of sale recognizes that point of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest stated quantity of each specified essential constituent.

Brightman's Dry Fish.

(Collected of F. G. Arnold, Swansea, Mass.)

Guaranteed composition: Total phosphoric acid, 7 to 9 per cent. (bone phosphate of lime, 15 to 20 per cent.); ammonia, 10 to 12 per cent. (equivalent to nitrogen, 8.2 to 9.9 per cent.).

	Per cent.
Moisture at 100° C.,	9.17
Total phosphoric acid,	7.92
Soluble phosphoric acid,	.64
Reverted phosphoric acid,	4.36
Insoluble phosphoric acid,	2.92
Nitrogen,	8.73
Insoluble matter,	2.69

Valuation per two thousand pounds: —

12.8 pounds of soluble phosphoric acid,	$1 02
87.2 pounds of reverted phosphoric acid,	6 54
58.4 pounds of insoluble phosphoric acid,	1 75
174.6 pounds of nitrogen,	30 56
	$39 87

Cleveland's Superphosphate.

(Cleveland Dryer Company, Cleveland, O.; collected of E. W. Foster, Tewksbury, Mass.)

Guaranteed composition: Total phosphoric acid, 10 to 13 per cent.; soluble phosphoric acid, 6 to 7 per cent.; reverted phosphoric acid, 2 to 3 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 3 to 4 per cent. (equivalent to potassium sulphate, 5.55 to 7.40 per cent.); nitrogen, 2.05 to 2.85 per cent. (equivalent to ammonia, 2½ to 3½ per cent.).

	Per cent.
Moisture at 100° C.,	14.15
Total phosphoric acid,	13.69
Soluble phosphoric acid.	7.00
Reverted phosphoric acid,	4.83
Insoluble phosphoric acid,	1.86
Potassium oxide,	2.96
Nitrogen,	2.40
Insoluble matter,	5.52

Valuation per two thousand pounds: —

140. pounds of soluble phosphoric acid,	$11 20
96.6 pounds of reverted phosphoric acid,	7 25
37.2 pounds of insoluble phosphoric acid,	1 12
59.2 pounds of potassium oxide,	3 26
48. pounds of nitrogen,	8 40
	$31 23

Economic Fertilizer, No. 1, for Grass.

(Economic Fertilizer Company, Butler, Breed & Co., Agents, Boston, Mass.; collected of H. P. Rogers, Allston, Mass.)

Guaranteed composition: Total phosphoric acid, 4½ per cent.; alkalies, 14½ per cent.; nitrogen, 2 per cent.

	Per cent.
Moisture at 100° C.,	1.27
Total phosphoric acid,	8.37
Soluble phosphoric acid,	none.
Reverted phosphoric acid,	2.12
Insoluble phosphoric acid,	6.25
Potassium oxide,	none.
Nitrogen,	1.86
Insoluble matter,	5.16

Valuation per two thousand pounds: —

42.4 pounds of reverted phosphoric acid,	$3 18
125. pounds of insoluble phosphoric acid,	3 75
37.2 pounds of nitrogen (in nitrates),	5 95
	$12 88

Stockbridge's Manure: Potatoes and Vegetables.

(Collected of Wilder & Puffer, Springfield, Mass.)

Guaranteed composition: Soluble and reverted phosphoric acid, 8 to 10 per cent.; potassium oxide, 5 to 6 per cent.; nitrogen, 3¼ to 4¼ per cent. (equivalent to ammonia, 4 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	12.84
Total phosphoric acid,	10.49
Soluble phosphoric acid,	7.60
Reverted phosphoric acid,	1.87
Insoluble phosphoric acid,	1.02
Potassium oxide,	3.82
Nitrogen,	3.82
Insoluble matter,	3.02

Valuation per two thousand pounds: —

152. pounds of soluble phosphoric acid,	$12 16
37.4 pounds of reverted phosphoric acid,	2 81
20.4 pounds of insoluble phosphoric acid,	61
76.4 pounds of potassium oxide,	3 25
76.4 pounds of nitrogen,	13 37
	$32 20

Stockbridge's Manure: Corn and Grain.

(Collected of Wilder & Puffer, Springfield, Mass.)

Guaranteed composition: Total phosphoric acid, 7 to 9 per cent.; available phosphoric acid, 6 to 7 per cent.; potassium oxide, 4 to 5 per cent.; ammonia, 4 to 5 per cent. (equivalent to nitrogen, 3.25 to 4.25 per cent.).

	Per cent.
Moisture at 100° C.,	14.66
Total phosphoric acid,	11.34
Soluble phosphoric acid,	6.72
Reverted phosphoric acid,	3.08
Insoluble phosphoric acid,	1.54
Potassium oxide,	4.18
Nitrogen,	2.83
Insoluble matter,	2.57

Valuation per two thousand pounds: —

134.4 pounds of soluble phosphoric acid,	$10 75
61.6 pounds of reverted phosphoric acid,	4 62
30.8 pounds of insoluble phosphoric acid,	92
83.6 pounds of potassium oxide,	3 55
56.6 pounds of nitrogen,	9 91
	$29 75

Church's "Fish and Potash."

(Collected of Wilder & Pufler, Springfield, Mass.)

Guaranteed composition: Total phosphoric acid, 5 to 6 per cent.; potassium sulphate, 5 to 6 per cent.; ammonia, 4 to 5 per cent. (equivalent to nitrogen, 3.3 to 4.1 per cent.).

	Per cent.
Moisture at 100° C.,	26.75
Total phosphoric acid,	6.58
Soluble phosphoric acid,	2.45
Reverted phosphoric acid,	2.71
Insoluble phosphoric acid,	1.42
Potassium oxide,	3.33
Nitrogen,	4.23
Insoluble matter,	3.02

Valuation per two thousand pounds: —

49. pounds of soluble phosphoric acid,	$3 92
54.2 pounds of reverted phosphoric acid,	4 07
28.4 pounds of insoluble phosphoric acid,	85
66.6 pounds of potassium oxide,	3 66
84.6 pounds of nitrogen,	14 81
	$27 31

H L. Phelps' "Complete Manure for Grass."

(Collected of Prentiss, Brooks & Co., Holyoke, Mass.)

Guaranteed composition: Available phosphoric acid, 4 to 6 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 8 to 10 per cent.; ammonia, 5 to 6 per cent. (equivalent to nitrogen, 4.1 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	11.63
Total phosphoric acid,	8.60
Soluble phosphoric acid,	3.29
Reverted phosphoric acid,	3.59
Insoluble phosphoric acid,	1.77
Potassium oxide,	8.10
Nitrogen,	4.02
Insoluble matter,	.92

Valuation per two thousand pounds: —

65.8 pounds of soluble phosphoric acid,	$5 26
71.8 pounds of reverted phosphoric acid,	5 39
35.4 pounds of insoluble phosphoric acid,	1 06
162. pounds of potassium oxide,	6 88
80.4 pounds of nitrogen,	14 07
	$32 66

H. L. Phelps' Complete Manure for Potatoes.

(Collected of Prentiss, Brooks & Co., Holyoke, Mass.)

Guaranteed composition: Available phosphoric acid, 5 to 6 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 8 to 10 per cent.; ammonia, 5 to 6 per cent. (equivalent to nitrogen, 4.1 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	7.89
Total phosphoric acid,	8.29
Soluble phosphoric acid,	2.19
Reverted phosphoric acid,	3.43
Insoluble phosphoric acid,	2.67
Potassium oxide,	9.33
Nitrogen,	3.85
Insoluble matter,	1.18

Valuation per two thousand pounds: —

43.8 pounds of soluble phosphoric acid,	$3 50
68.6 pounds of reverted phosphoric acid,	5 15
53.4 pounds of insoluble phosphoric acid,	1 60
186.6 pounds of potassium oxide,	7 93
77. pounds of nitrogen,	3 48
	$31 66

Quinnipiac Phosphate.

(Quinnipiac Company, New Haven, Conn.; collected of B. L. Bragg & Co., Springfield, Mass.)

Guaranteed composition: Available phosphoric acid, 9 to 12 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium sulphate, $3\frac{1}{2}$ to $5\frac{1}{2}$ per cent. (equivalent to potassium oxide, 2 to 3 per cent.); nitrogen, $2\frac{1}{4}$ to $3\frac{1}{4}$ per cent. (equivalent to ammonia, $3\frac{1}{4}$ to $4\frac{1}{4}$ per cent.).

	Per cent.
Moisture at 100° C.,	11.33
Total phosphoric acid,	14.78
Soluble phosphoric acid,	4.70
Reverted phosphoric acid,	6.14
Insoluble phosphoric acid,	3.94
Potassium oxide,	2.44
Nitrogen,	3.09
Insoluble matter,	6.33

Valuation per two thousand pounds:—

94. pounds of soluble phosphoric acid,	$7 52
122.8 pounds of reverted phosphoric acid,	9 21
78.8 pounds of insoluble phosphoric acid,	2 36
48.8 pounds of potassium oxide,	2 68
61.8 pounds of nitrogen,	10 82
	$32 59

H. J. Baker & Bro.'s "A. A. Ammoniated Superphosphate."

(Collected of Wilder & Puffer, Springfield, Mass.)

Guaranteed composition: Soluble phosphoric acid, $9\frac{1}{4}$ to $11\frac{1}{4}$ per cent.; reverted phosphoric acid, 10 to 12 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium oxide, 2 to 3 per cent.; ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	13.43
Total phosphoric acid,	12.19
Soluble phosphoric acid,	11.39
Reverted phosphoric acid,	.61
Insoluble phosphoric acid,	.19
Potassium oxide,	2.57
Nitrogen,	3.45
Insoluble matter,	61

Valuation per two thousand pounds: —

227.8 pounds of soluble phosphoric acid,	$18 22
12.2 pounds of reverted phosphoric acid,	92
3.8 pounds of insoluble phosphoric acid,	11
51.4 pounds of potassium oxide,	2 18
69. pounds of nitrogen,	12 08
	$33 51

H. J. Baker & Bro.'s "Complete Potato Manure."

(Collected of Wilder & Puffer, Springfield, Mass.)

Guaranteed composition: Available phosphoric acid, 5¾ per cent.; potassium oxide, 10 per cent.; ammonia, 4 per cent. (equivalent to nitrogen, 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	10.15
Total phosphoric acid,	7.82
Soluble phosphoric acid,	5.49
Reverted phosphoric acid,	1.65
Insoluble phosphoric acid,	.68
Potassium oxide,	9.40
Nitrogen,	5.04
Insoluble matter,	1.17

Valuation per two thousand pounds: —

109.8 pounds of soluble phosphoric acid,	$8 78
33. pounds of reverted phosphoric acid,	2 48
13.6 pounds of insoluble phosphoric acid,	41
188. pounds of potassium oxide,	7 99
100.8 pounds of nitrogen,	17 64
	$37 30

Quinnipiac Company's "Fish and Potash." ("Cross Fish" Brand.)

(Collected of B. L. Bragg & Co., Springfield, Mass.)

Guaranteed composition: Total phosphoric acid, 5 to 7 per cent.; available phosphoric acid, 3 to 5 per cent.; potassium sulphate, 6 to 10 per cent. (equivalent to nitrogen, 3 to 5 per cent.); nitrogen, 3¼ to 4¼ per cent. (equivalent to ammonia, 4 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	19.17
Total phosphoric acid,	9.08
Soluble phosphoric acid,	.51
Reverted phosphoric acid,	4.91
Insoluble phosphoric acid,	3.66
Potassium oxide,	5.79
Nitrogen,	4.52
Insoluble matter,	6.34

Valuation per two thousand pounds: —

10.2 pounds of soluble phosphoric acid,	$0 82
98.2 pounds of reverted phosphoric acid,	7 37
73.2 pounds of insoluble phosphoric acid,	2 20
115.8 pounds of potassium oxide,	6 37
90.4 pounds of nitrogen,	15 82
	$32 58

Quinnipiac Potato Manure.

(Collected of B. L. Bragg & Co., Springfield, Mass.)

Guaranteed composition: Available phosphoric acid, 5 to 7 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium oxide, 6 to 8 per cent. (equivalent to potassium sulphate, 11 to 15 per cent.); nitrogen, 3.25 to 4.25 per cent. (equivalent to ammonia, 4 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	9.39
Total phosphoric acid,	9.82
Soluble phosphoric acid,	2.90
Reverted phosphoric acid,	4.61
Insoluble phosphoric acid,	2.31
Potassium oxide,	5.38
Nitrogen,	3.62
Insoluble matter,	5.01

Valuation per two thousand pounds: —

58. pounds of soluble phosphoric acid,	$4 64
92.2 pounds of reverted phosphoric acid,	6 92
46.2 pounds of insoluble phosphoric acid,	1 39
107.6 pounds of potassium oxide,	5 92
72.4 pounds of nitrogen,	12 67
	$31 54

"Americus" Ammoniated Bone Superphosphate.

(Williams, Clark & Co., New York; collected of B. L. Bragg & Co., Springfield Mass.)

Guaranteed composition: Total phosphoric acid, 11 to 16 per cent.; soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 3 to 4 per cent.; potassium sulphate, 4 to 6 per cent,; nitrogen, 2½ to 3½ per cent.; (equivalent to ammonia, 3 to 4 per cent.).

	Per cent.
Moisture at 100° C.,	11.90
Total phosphoric acid,	11.16
Soluble phosphoric acid,	8.48
Reverted phosphoric acid,	2.41
Insoluble phosphoric acid,	.27
Potassium oxide,	2.48
Nitrogen,	2.73
Insoluble matter,	6.00

Valuation per two thousand pounds:—

169.6 pounds of soluble phosphoric acid,	$13 57
48.2 pounds of reverted phosphoric acid,	3 62
5.4 pounds of insoluble phosphoric acid,	16
49.6 pounds of potassium oxide,	2 73
54.6 pounds of nitrogen,	9 56
	$29 64

H. L. Phelps' Guano and Potash.

(Collected of Prentiss, Brooks & Co., Holyoke, Mass.)

Guaranteed composition: Available phosphoric acid, 4 to 5 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 6 to 7 per cent.; ammonia, 4 to 5 per cent. (equivalent to nitrogen, 3.3 to 4.1 per cent.).

	Per cent.
Moisture at 100° C.,	13.33
Total phosphoric acid,	11.03
Soluble phosphoric acid,	3.04
Reverted phosphoric acid,	6.43
Insoluble phosphoric acid,	1.56
Potassium oxide,	7.76
Nitrogen,	3.79
Insoluble matter,	.86

Valuation per two thousand pounds: —

60.8 pounds of soluble phosphoric acid,	$4 86
128.6 pounds of reverted phosphoric acid,	9 65
31.2 pounds of insoluble phosphoric acid,	94
155.2 pounds of potassium oxide,	6 60
75.8 pounds of nitrogen,	13 27
	$35 32

Bradley's XL Superphosphate of Lime.

(Collected of B. L. Bragg & Co., Springfield, Mass.)

Guaranteed composition: Total phosphoric acid, 11 to 14 per cent.; soluble phosphoric acid, 7 to 8 per cent.; reverted phosphoric acid, 2 to 3 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide (sulphate), 2 to 3 per cent.; nitrogen, $2\frac{1}{2}$ to $3\frac{3}{4}$ per cent. (equivalent to ammonia, 3 to 4 per cent.).

	Per cent.
Moisture at 100° C.,	15.89
Total phosphoric acid,	12.42
Soluble phosphoric acid,	8.21
Reverted phosphoric acid,	1.97
Insoluble phosphoric acid,	2.24
Potassium oxide,	2.26
Nitrogen,	2.85
Insoluble matter,	1.12

Valuation per two thousand pounds: —

164.2 pounds of soluble phosphoric acid,	$13 14
39.4 pounds of reverted phosphoric acid,	2 96
44.8 pounds of insoluble phosphoric acid,	1 34
45.2 pounds of potassium oxide,	2 49
57. pounds of nitrogen,	9 98
	$29 91

Crocker's Potato, Tobacco and Hop Phosphate.

(L. L. Crocker's Buffalo Fertilizer Company, Buffalo, N. Y.; collected of E. N. Smith, Sunderland, Mass.)

Guaranteed composition: Soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 2 to 4 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium sulphate, 6 to 8 per cent.; ammonia, $2\frac{1}{2}$ to $3\frac{1}{2}$ per cent. (equivalent to nitrogen, 2 to 2.9 per cent.).

	Per cent.
Moisture at 100° C.,	13.25
Total phosphoric acid,	11.98
Soluble phosphoric acid,	8.18
Reverted phosphoric acid,	2.47
Insoluble phosphoric acid,	1.33
Potassium oxide,	3.91
Nitrogen,	2.65
Insoluble matter,	4.48

Valuation per two thousand pounds: —

163.6 pounds of soluble phosphoric acid,	$13 09
49.4 pounds of reverted phosphoric acid,	3 91
26.6 pounds of insoluble phosphoric acid,	80
78.2 pounds of potassium oxide,	4 30
53. pounds of nitrogen,	9 28
	$31 38

Crocker's Ammoniated Bone Superphosphate.

(Crocker's Buffalo Fertilizer Company, Buffalo, N. Y; collected of E. N. Smith, Sunderland, Mass.)

Guaranteed composition: Soluble phosphoric acid, 6 to 8 per cent.; precipitated phosphoric acid, 2 to 4 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium sulphate, 1 to 3 per cent.; ammonia, 3½ to 4½ per cent. (equivalent to nitrogen, 2.9 to 3.7 per cent.).

	Per cent.
Moisture at 100° C.,	12.07
Total phosphoric acid,	11.61
Soluble phosphoric acid,	7.80
Reverted phosphoric acid,	2.24
Insoluble phosphoric acid,	1.57
Potassium oxide,	1.58
Nitrogen,	3.60
Insoluble matter,	4.61

Valuation per two thousand pounds: —

156. pounds of soluble phosphoric acid,	$12 48
44.8 pounds of reverted phosphoric acid,	3 36
31.4 pounds of insoluble phosphoric acid,	94
31.6 pounds of potassium oxide,	1 74
72. pounds of nitrogen,	12 60
	$31 12

Chittenden's "Complete Fertilizer for Potatoes, Roots and Vegetables."

(National Fertilizer Company, Bridgeport, Conn.; collected of L. W. Fairchild Sunderland, Mass.)

Guaranteed composition: Total phosphoric acid, 8 to 10 per cent.; available phosphoric acid, 6 to 8 per cent.; potassium oxide, 6 to 8 per cent.; ammonia, 4 to 5 per cent. (equivalent to nitrogen, 3.3 to 4.1 per cent.).

	Per cent.
Moisture at 100° C.,	9.81
Total phosphoric acid,	14.74
Soluble phosphoric acid,	6.40
Reverted phosphoric acid,	4.47
Insoluble phosphoric acid,	3.87
Potassium oxide,	6.05
Nitrogen,	4.53
Insoluble matter,	2.24

Valuation per two thousand pounds: —

128. pounds of soluble phosphoric acid,	$10 24
89.4 pounds of reverted phosphoric acid,	6 71
77.4 pounds of insoluble phosphoric acid,	2 32
121. pounds of potassium oxide,	5 14
90.6 pounds of nitrogen,	15 86
	$40 27

Chittenden's Complete Fertilizer for Grass.

(Collected of L. W. Fairchild, Sunderland, Mass.)

Guaranteed composition: Total phosphoric acid, 6 to 8 per cent.; available phosphoric acid, 4 to 6 per cent.; potassium oxide, 5 to 7 per cent.; ammonia, 5 to 6 per cent. (equivalent to nitrogen, 4 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	12.47
Total phosphoric acid,	13.72
Soluble phosphoric acid,	4.86
Reverted phosphoric acid,	4.16
Insoluble phosphoric acid,	4.70
Potassium oxide,	5.12
Nitrogen,	3.60
Insoluble matter,	3.05

Valuation per two thousand pounds: —

97.2 pounds of soluble phosphoric acid,	$7 78
83.2 pounds of reverted phosphoric acid,	6 24
94. pounds of insoluble phosphoric acid,	2 82
102.4 pounds of potassium oxide,	4 35
72. pounds of nitrogen,	12 60
	$33 79

Cumberland Superphosphate.

(Cumberland Bone Company, Portland, Me.; collected of B. F. Bridges Jr., South Deerfield, Mass.)

Guaranteed composition: Total phosphoric acid, 11 to 14 per cent.; soluble phosphoric acid, 5 to 7 per cent.; reverted phosphoric acid, 1 to 3 per cent.; insoluble phosphoric acid, 2 to 4 per cent.; potassium oxide, 2 to 3 per cent.; ammonia, 2.42 to 3.63 per cent. (equivalent to nitrogen, 2 to 3 per cent.).

	Per cent.
Moisture at 100° C.,	18.22
Total phosphoric acid,	13.06
Soluble phosphoric acid,	6.76
Reverted phosphoric acid,	3.39
Insoluble phosphoric acid,	2.91
Potassium oxide,	3.54
Nitrogen,	2.86
Insoluble matter,	4.40

Valuation per two thousand pounds: —

135.2 pounds of soluble phosphoric acid,	$10 82
67.8 pounds of reverted phosphoric acid,	5 09
58.2 pounds of insoluble phosphoric acid,	1 75
70.8 pounds of potassium oxide,	3 01
57.2 pounds of nitrogen,	10 01
	$30 68

Dole's "Special Fertilizer for Onions and Root Crops."

(Dole Fertilizer Company, Boston, Mass.; collected of B. F. Bridges, Jr., South Deerfield, Mass.)

Guaranteed composition: Total phosphoric acid, 6 to 8 per cent.; potassium sulphate, 6 to 8 per cent.; ammonia, 4 to 6 per cent. (equivalent to nitrogen, 3.3 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	10.60
Total phosphoric acid,	8.55
Soluble phosphoric acid,	3.53
Reverted phosphoric acid,	2.88
Insoluble phosphoric acid,	2.14
Potassium oxide,	4.61
Nitrogen,	4.06
Insoluble matter,	4.58

Valuation per two thousand pounds: —

70.6 pounds of soluble phosphoric acid,	$5 65
57.6 pounds of reverted phosphoric acid,	4 32
42.8 pounds of insoluble phosphoric acid,	1 28
92.2 pounds of potassium oxide,	5 07
81.2 pounds of nitrogen,	14 21
	$30 53

George W. Miles' Fish and Potash.

(Collected of B. F. Bridges, South Deerfield, Mass.)

Guaranteed composition: Soluble and reverted phosphoric acid, 5 to 8 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium sulphate, 4 to 6 per cent.; ammonia, 3 to 6 per cent. (equivalent to nitrogen, 2.5 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	14.80
Total phosphoric acid,	9.50
Soluble phosphoric acid,	5.73
Reverted phosphoric acid,	1.78
Insoluble phosphoric acid,	1.99
Potassium oxide,	3.03
Nitrogen,	3.31
Insoluble matter,	5.60

Valuation per two thousand pounds: —

114.6 pounds of soluble phosphoric acid,	$9 17
35.6 pounds of reverted phosphoric acid,	2 67
39.8 pounds of insoluble phosphoric acid,	1 19
60.6 pounds of potassium oxide,	3 33
66.2 pounds of nitrogen,	11 59
	$27 95

Soluble Pacific Guano.

(Glidden & Curtis, Boston; collected of Peckham & Ross, Worcester, Mass.)

Guaranteed composition: Soluble phosphoric acid, 6½ to 8 per cent.; reverted phosphoric acid, 1½ to 3 per cent.; insoluble phosphoric acid, 2 to 4 per cent.; potassium oxide, 2 to 3½ per cent.; nitrogen, 2 to 3 per cent. (equivalent to ammonia, 2½ to 3½ per cent.).

	Per cent.
Moisture at 100° C.,	15.14
Total phosphoric acid,	11.93
Soluble phosphoric acid,	6.30
Reverted phosphoric acid,	1.79
Insoluble phosphoric acid,	3.84
Potassium oxide,	2.76
Nitrogen,	2.69
Insoluble matter,	6.54

Valuation per two thousand pounds: —

126. pounds of soluble phosphoric acid,	$10 08
35.8 pounds of reverted phosphoric acid,	2 69
76.8 pounds of insoluble phosphoric acid,	2 30
55.2 pounds of potassium oxide,	2 35
53.8 pounds of nitrogen,	9 42
	$26 84

Bowker's Lawn Dressing.

(Collected of Peckham & Ross, Worcester, Mass.)

Guaranteed composition: Soluble and reverted phosphoric acid, 5 to 6 per cent.; potassium sulphate, 5 to 6 per cent.; ammonia, 5 to 6 per cent. (equivalent to nitrogen, 4.1 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	9.06
Total phosphoric acid,	8.34
Soluble phosphoric acid,	5.60
Reverted phosphoric acid,	1.64
Insoluble phosphoric acid,	1.10
Potassium oxide,	2.59
Nitrogen,	6.18
Insoluble matter,	3.01

Valuation per two thousand pounds: —

112. pounds of soluble phosphoric acid,	$8 96
32.8 pounds of reverted phosphoric acid,	2 46
22. pounds of insoluble phosphoric acid,	66
51.8 pounds of potassium oxide,	2 85
123.6 pounds of nitrogen,	21 63
	$36 56

Stockbridge's Manure: Seeding Down.

(Collected of Peckham & Ross, Worcester, Mass.)

Guaranteed composition: Soluble phosphoric acid, 2.5 to 3 per cent.; available phosphoric acid, 14 to 15 per cent.; potassium oxide, 4 to 5 per cent.; ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	13.52
Total phosphoric acid,	12.74
Soluble phosphoric acid,	5.31
Reverted phosphoric acid,	4.32
Insoluble phosphoric acid,	3.11
Potassium oxide,	3.97
Nitrogen,	4.02
Insoluble matter,	1.87

Valuation per two thousand pounds: —

106.2 pounds of soluble phosphoric acid,	$8 50
86.4 pounds of reverted phosphoric acid,	6 48
62.2 pounds of insoluble phosphoric acid,	1 87
79.4 pounds of potassium oxide,	3 36
80.4 pounds of nitrogen,	14 07
	$34 28

George E. Holmes' Bones.

(Collected of Peckham & Ross, Worcester, Mass.)

No guaranty obtained.

	Per cent.
Moisture at 100° C.,	4.78
Total phosphoric acid,	21.19
Soluble phosphoric acid,	.38
Reverted phosphoric acid,	4.96
Insoluble phosphoric acid,	15.85
Nitrogen,	4.22
Insoluble matter,	.23

Valuation per two thousand pounds: —

7.6 pounds of soluble phosphoric acid,	$0 61
99.2 pounds of reverted phosphoric acid,	7 44
317. pounds of insoluble phosphoric acid,	12 68
84.4 pounds of nitrogen,	11 82
	$32 57

Bradley's Complete Fertilizer for Top-Dressing Grass and Grain.

(Collected of Peckham & Ross, Worcester, Mass.)

Guaranteed composition: Total phosphoric acid, 7 to 9 per cent.; soluble phosphoric acid, 5 to 6 per cent.; reverted phosphoric acid, 1 to 2 per cent; insoluble phosphoric acid, 1 to 2 per cent.; potassium oxide, 5 to 6 per cent. (equivalent to potassium sulphate, 9.25 to 11.1 per cent.); nitrogen, 4.11 to 5 per cent. (equivalent to ammonia, 5 to 6 per cent.).

	Per cent.
Moisture at 100° C.,	11.96
Total phosphoric acid,	9.21
Soluble phosphoric acid,	4.30
Reverted phosphoric acid,	2.64
Insoluble phosphoric acid,	2.27
Potassium oxide,	7.99
Nitrogen,	4.00
Insoluble matter,	3.15

Valuation per two thousand pounds: —

86. pounds of soluble phosphoric acid,	$6 88
52.8 pounds of reverted phosphoric acid,	3 96
45.4 pounds of insoluble phosphoric acid,	1 36
159.8 pounds of potassium oxide,	8 79
80. pounds of nitrogen,	14 00
	$34 99

Mapes' Potato Manure.

(Collected of Peckham & Ross, Worcester, Mass.)

Guaranteed composition: Total phosphoric acid, 8 to 10 per cent.; potassium oxide (sulphate), 6 to 8 per cent.; ammonia, 4½ to 5 per cent. (equivalent to nitrogen, 3.7 to 4.1 per cent.).

	Per cent.
Moisture at 100° C.,	10.45
Total phosphoric acid,	13.38
Soluble phosphoric acid,	5.57
Reverted phosphoric acid,	3.47
Insoluble phosphoric acid,	4.34
Potassium oxide,	7.07
Nitrogen,	3.77
Insoluble matter,	.95

Valuation per two thousand pounds: —

111.4 pounds of soluble phosphoric acid,	$8 91
69.4 pounds of reverted phosphoric acid,	5 21
86.8 pounds of insoluble phosphoric acid,	2 60
141.4 pounds of potassium oxide,	7 78
75.4 pounds of nitrogen,	13 20
	$37 70

Mapes' Corn Manure.

(Collected of Peckham & Ross, Worcester, Mass.)

Guaranteed composition: Total phosphoric acid, 10 to 12 per cent. (nearly all soluble and available); potassium oxide (sulphate), 6 to 8 per cent.; ammonia, 4.5 to 5 per cent. (equivalent to nitrogen, 3.7 to 4.1 per cent.).

	Per cent.
Moisture at 100° C.,	11.05
Total phosphoric acid,	12.47
Soluble phosphoric acid,	2.98
Reverted phosphoric acid,	5.73
Insoluble phosphoric acid,	3.76
Potassium oxide,	6.92
Nitrogen,	3.83
Insoluble matter,	1.10

Valuation per two thousand pounds: —

59.6 pounds of soluble phosphoric acid,	$4 77
114.6 pounds of reverted phosphoric acid,	8 60
75.2 pounds of insoluble phosphoric acid,	2 26
138.4 pounds of potassium oxide,	7 61
76.6 pounds of nitrogen,	13 41
	$36 65

Mapes' Complete Manure, "A Brand."

(Collected of Peckham & Ross, Worcester, Mass.)

Guaranteed composition: Available phosphoric acid, 10 to 12 per cent.; insoluble phosphoric acid, 2 to 4 per cent.; potassium oxide, 2.5 to 3.5 per cent. (equivalent to potassium sulphate, 4.62 to 6.47 per cent.); ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	18.40
Total phosphoric acid,	12.79
Soluble phosphoric acid,	4.77
Reverted phosphoric acid,	5.08
Insoluble phosphoric acid,	2.94
Potassium oxide,	3.09
Nitrogen,	2.66
Insoluble matter,	2.44

Valuation per two thousand pounds:—

95.4 pounds of soluble phosphoric acid,	$7 63
101.6 pounds of reverted phosphoric acid,	7 62
58.8 pounds of insoluble phosphoric acid,	1 76
61.8 pounds of potassium oxide,	3 40
53.2 pounds of nitrogen,	9 31
	$29 72

E. Frank Coe's Ammoniated Bone Superphosphate.

(Collected of J. Clark & Son, Worcester, Mass.)

Guaranteed composition: Total phosphoric acid, 11 to 13 per cent.; soluble phosphoric acid, 7 to 9 per cent.; available phosphoric acid, 10 to 12 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium sulphate, 3 to 4 per cent.; nitrogen, 2 to 2½ per cent. (equivalent to ammonia, 2½ to 3½ per cent.).

	Per cent.
Moisture at 100° C.,	9.06
Total phosphoric acid,	12.06
Soluble phosphoric acid,	7.93
Reverted phosphoric acid,	1.59
Insoluble phosphoric acid,	2.54
Potassium oxide,	1.83
Nitrogen,	2.32
Insoluble matter,	6.60

Valuation per two thousand pounds : —

158.6 pounds of soluble phosphoric acid,	$12 69
31.8 pounds of reverted phosphoric acid,	2 39
50.8 pounds of insoluble phosphoric acid,	1 52
36.6 pounds of potassium oxide,	2 01
46.4 pounds of nitrogen,	8 12
	$26 73

Darling's Ground Bone.

(Collected of J. H. Fairbanks, Fitchburg, Mass.)

Guaranteed composition : Total phosphoric acid, 22 to 25 per cent. ; nitrogen, 3.5 to 4.5 per cent. (equivalent to ammonia, 4 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	7.61
Total phosphoric acid,	21.50
Soluble phosphoric acid,	.37
Reverted phosphoric acid,	7.25
Insoluble phosphoric acid,	13.88
Nitrogen,	3.64
Insoluble matter,	1.60

Valuation per two thousand pounds : —

7.4 pounds of soluble phosphoric acid,	$0 59
145.0 pounds of reverted phosphoric acid,	10 88
277.6 pounds of insoluble phosphoric acid,	13 88
72.8 pounds of nitrogen,	11 65
	$37 00

N. Ward & Co.'s High Grade Animal Fertilizer.

(Collected of N. Ward & Co., Boston, Mass.)

Guaranteed composition : Available phosphoric acid, 12 to 14 per cent. ; nitrogen, 2.88 to 3.70 per cent. (equivalent to ammonia, 3.5 to 4.5 per cent.) ; potassium oxide, 4 to 5 per cent.

	Per cent.
Moisture at 100° C.,	15.43
Total phosphoric acid,	12.63
Soluble phosphoric acid,	5.82
Reverted phosphoric acid,	5.60
Insoluble phosphoric acid,	1.21
Potassium oxide,	4.46
Nitrogen,	3.58
Insoluble matter,	.89

Valuation per two thousand pounds: —

116.4 pounds of soluble phosphoric acid,	$9 31
112.0 pounds of reverted phosphoric acid,	8 40
24.2 pounds of insoluble phosphoric acid,	73
89.2 pounds of potassium oxide,	3 79
71.6 pounds of nitrogen,	12 53
	$34 76

Breck's Lawn Dressing.

(Collected of Joseph Breck & Sons, Boston, Mass.)

Guaranteed composition: Soluble and reverted phosphoric acid, 8 to 9 per cent.; potassium oxide, 4 to 6 per cent.; ammonia, 5 to 6 per cent. (equivalent to nitrogen, 4.1 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	9.20
Total phosphoric acid,	10.62
Soluble phosphoric acid,	7.38
Reverted phosphoric acid,	1.39
Insoluble phosphoric acid,	1.85
Potassium oxide,	5.38
Nitrogen,	5.31
Insoluble matter,	2.98

Valuation per two thousand pounds: —

147.6 pounds of soluble phosphoric acid,	$11 81
27.8 pounds of reverted phosphoric acid,	2 09
37.0 pounds of insoluble phosphoric acid,	1 11
107.6 pounds of potassium oxide,	4 57
106.2 pounds of nitrogen,	18 59
	$38 17

Cumberland Superphosphate.

(Cumberland Bone Company, Portland, Me.; collected of Joseph Breck & Sons, Boston, Mass.)

Guaranteed composition: Total phosphoric acid, 11 to 14 per cent.: soluble phosphoric acid, 5 to 7 per cent.; reverted phosphoric acid, 1 to 2 per cent.; insoluble phosphoric acid, 3 to 4 per cent.; potassium sulphate, 2 to 3 per cent.; nitrogen, 2 to 3 per cent. (equivalent to ammonia, 2.43 to 3.08 per cent.).

	Per cent.
Moisture at 100° C.,	17.93
Total phosphoric acid,	12.75
Soluble phosphoric acid,	6.17
Reverted phosphoric acid,	3.09
Insoluble phosphoric acid,	3.49
Potassium oxide,	3.08
Nitrogen,	2.08
Insoluble matter,	4.08

Valuation per two thousand pounds: —

123.4 pounds of soluble phosphoric acid,	$9 87
61.8 pounds of reverted phosphoric acid,	4 64
69.8 pounds of insoluble phosphoric acid,	2 09
61.6 pounds of potassium oxide,	3 39
41.6 pounds of nitrogen,	7 28
	$27 27

Standard Superphosphate.

(Collected of Joseph Breck & Sons, Boston, Mass.)

Guaranteed composition: Total phosphoric acid, 11 to 16 per cent.; available phosphoric acid, 9 to 13 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 4 per cent.; nitrogen, 2½ to 3½ per cent. (equivalent to ammonia, 3 to 4 per cent.).

	Per cent.
Moisture at 100° C.,	11.82
Total phosphoric acid,	12.41
Soluble phosphoric acid,	7.32
Reverted phosphoric acid,	2.81
Insoluble phosphoric acid,	2.28
Potassium oxide,	1.55
Nitrogen,	3.04
Insoluble matter,	1.88

Valuation per two thousand pounds: —

146.4 pounds of soluble phosphoric acid,	$11 71
56.2 pounds of reverted phosphoric acid,	4 22
45.6 pounds of insoluble phosphoric acid,	1 37
31.0 pounds of potassium oxide,	1 32
60.8 pounds of nitrogen,	10 64
	$29 26

Church's "Fish and Potash."

(Collected of Gould & Co., Medfield, Mass.)

Guaranteed composition: Total phosphoric acid, 5 to 6 per cent.; potassium sulphate, 5 to 6 per cent.; ammonia, 4 to 5 per cent. (equivalent to nitrogen, 3.3 to 4.1 per cent.).

	Per cent.
Moisture at 100° C.,	26.75
Total phosphoric acid,	5.44
Soluble phosphoric acid,	2.00
Reverted phosphoric acid,	2.57
Insoluble phosphoric acid,	1.08
Potassium oxide,	2.95
Nitrogen,	3.90
Insoluble matter,	1.59

Valuation per two thousand pounds: —

40.0 pounds of soluble phosphoric acid,	$3 20
51.4 pounds of reverted phosphoric acid,	3 86
21.6 pounds of insoluble phosphoric acid,	65
59.0 pounds of potassium oxide,	3 25
78.0 pounds of nitrogen,	13 65
	$24 61

Cleveland Superphosphate.

(Cleveland Dryer Co., Cleveland, O.; collected of Sheldon & Newcomb, Greenfield, Mass.)

Guaranteed composition: Soluble phosphoric acid, 6 to 7 per cent.; reverted phosphoric acid, 2 to 3 per cent.; insoluble phosphoric acid, 2 to 3 per cent.; potassium oxide, 3 to 4 per cent. (equivalent to potassium sulphate, 5.55 to 7.40 per cent.); nitrogen, 2.05 to 2.85 per cent. (equivalent to ammonia, 2.5 to 3.5 per cent.).

	Per cent.
Moisture at 100° C.,	14.29
Total phosphoric acid,	11.96
Soluble phosphoric acid,	7.32
Reverted phosphoric acid,	1.63
Insoluble phosphoric acid,	3.01
Potassium oxide,	3.23
Nitrogen,	3.04
Insoluble matter,	5.44

Valuation per two thousand pounds: —

146.4 pounds of soluble phosphoric acid,	$11 71
32.6 pounds of reverted phosphoric acid,	2 45
60.2 pounds of insoluble phosphoric acid,	1 81
64.6 pounds of potassium oxide.	3 55
60.8 pounds of nitrogen,	10 64
	$30 16

Quinnipiac Potato Manure.

(Collected of D. A. Horton, Northampton, Mass.)

Guaranteed composition: Available phosphoric acid, 5 to 7 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium oxide, 6 to 8 per cent. (equivalent to potassium sulphate, 11 to 15 per cent.); nitrogen, 3.25 to 4.25 per cent. (equivalent to ammonia, 4 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	14.55
Total phosphoric acid,	10.53
Soluble phosphoric acid,	1.28
Reverted phosphoric acid,	5.41
Insoluble phosphoric acid,	3.84
Potassium oxide,	5.82
Nitrogen,	4.55
Insoluble matter,	5.44

Valuation per two thousand pounds: —

25.6 pounds of soluble phosphoric acid,	$2 05
108.2 pounds of reverted phosphoric acid,	8 12
76.8 pounds of insoluble phosphoric acid,	2 30
116.4 pounds of potassium oxide,	6 40
91.0 pounds of nitrogen,	15 93
	$34 80

Quinnipiac Dry Ground Fish.

(Collected of D. A. Horton, Northampton, Mass.)

Guaranteed composition: Available phosphoric acid, 4 to 6 per cent.; insoluble phosphoric acid, 2 to 4 per cent.; nitrogen, 7.5 to 10 per cent. (equivalent to ammonia, 9 to 12 per cent.).

	Per cent.
Moisture at 100° C.,	10.42
Total phosphoric acid,	7.86
Soluble phosphoric acid,	.37
Reverted phosphoric acid,	3.66
Insoluble phosphoric acid,	3.83
Nitrogen,	8.56
Insoluble matter,	1.13

Valuation per two thousand pounds: —

7.4 pounds of soluble phosphoric acid,	$0 59
73.2 pounds of reverted phosphoric acid,	5 49
76.6 pounds of insoluble phosphoric acid,	2 30
171.2 pounds of nitrogen,	29 96
	$38 34

The "Lawrence Fertilizer."

(Lee, Blackburn & Co., Lawrence, Mass.; collected of F. M. Victor, Lawrence, Mass.)

Guaranteed composition: Total phosphoric acid, 12 to 14 per cent.; potassium oxide, 2 to 3 per cent.; nitrogen, 2 to 3 per cent.

	Per cent.
Moisture at 100° C.,	16.12
Total phosphoric acid,	12.24
Soluble phosphoric acid,	9.76
Reverted phosphoric acid,	2.26
Insoluble phosphoric acid,	.22
Potassium oxide,	1.68
Nitrogen,	3.00
Insoluble matter,	1.05

Valuation per two thousand pounds: —

195.2 pounds of soluble phosphoric acid,	$15 62
45.2 pounds of reverted phosphoric acid,	3 39
4.40 pounds of insoluble phosphoric acid,	13
33.6 pounds of potassium oxide,	1 43
60.0 pounds of nitrogen,	10 50
	$31 07

Ground Bone.

(Lee, Blackburn & Co., Lawrence, Mass.; collected of F. M. Victor, Lawrence, Mass.)

No guaranty obtained.

	Per cent.
Moisture at 100° C,	8.22
Total phosphoric acid,	24.31
Soluble phosphoric acid,	.47
Reverted phosphoric acid,	7.41
Insoluble phosphoric acid,	16.90
Nitrogen,	3.13
Insoluble matter,	1.95

Valuation per two thousand pounds: —

9.4 pounds of soluble phosphoric acid,	$0 75
148.2 pounds of reverted phosphoric acid,	11 12
338.0 pounds of insoluble phosphoric acid,	16 90
62.6 pounds of nitrogen,	10 02
	$38 79

Baugh's Double Eagle Phosphate.

(Collected of J. C. Stanley, Newburyport, Mass.)

Guaranteed composition: Available phosphoric acid, 7 to 8 per cent.; ammonia, 2½ to 3 per cent. (equivalent to nitrogen, 2 to 2½ per cent.).

	Per cent.
Moisture at 100° C,	13.82
Total phosphoric acid,	12.55
Soluble phosphoric acid,	5.80
Reverted phosphoric acid,	1.76
Insoluble phosphoric acid,	4.99
Potassium oxide,	none.
Nitrogen,	2.22
Insoluble matter,	5.34

Valuation per two thousand pounds: —

116.0 pounds of soluble phosphoric acid,	$9 28
35.2 pounds of reverted phosphoric acid,	2 64
99.8 pounds of insoluble phosphoric acid,	2 99
44.4 pounds of nitrogen,	7 77
	$22 68

Dow's Nitrogenous Superphosphate.

(Collected of J. Stackpole & Sons, Ipswich, Mass.)

Guaranteed composition: Available phosphoric acid, 8 to 10 per cent.; potassium chloride, 3 to 4 per cent.;

ammonia, 2½ to 3½ per cent. (equivalent to nitrogen, 2 to 2.9 per cent.).

	Per cent.
Moisture at 100° C,	15.97
Total phosphoric acid,	9.99
Soluble phosphoric acid,	4.19
Reverted phosphoric acid,	3.78
Insoluble phosphoric acid,	2.02
Potassium oxide,	2.62
Nitrogen,	3.00
Insoluble matter,	.63

Valuation per two thousand pounds: —

83.8 pounds of soluble phosphoric acid,	$6 70
75.6 pounds of reverted phosphoric acid,	5 67
40.4 pounds of insoluble phosphoric acid,	1 21
52.4 pounds of potassium oxide,	2 23
60.0 pounds of nitrogen,	10 50
	$26 31

Maynard's Perfect Mineral Fertilizer.

(Maynard Fertilizer Company, Lawrence, Mass.; collected at works.)

Guaranteed composition: Moisture, 19.4 per cent.; total phosphoric acid, 1.37 per cent.; potassium oxide, .44 per cent.; insoluble matter, 5.15 per cent.; chlorine, 7.69 per cent.; sulphuric acid, 2.61 per cent.; carbonic acid, 22.25 per cent.; sodium oxide, 7.55 per cent.; calcium oxide, 33.39 per cent.; ferric oxide, 1.03 per cent.

	Per cent.
Moisture at 100° C.,	16.76
Total phosphoric acid,	1.10
Potassium oxide,	1.12
Calcium oxide,	29.82
Sodium oxide,	8.25
Ferric oxide,	.82
Magnesium oxide,	3.33
Chlorine,	7.20
Sulphuric acid,	5.19
Carbonic acid,	–
Insoluble matter,	15.51

Consists of a mixture of common salt, wood ashes and gypsum: valuation depends on local conditions.

Sparrow's High Grade Grass Fertilizer.

(Collected of G. W. Atkinson, Reading, Mass.)

Guaranteed composition: Total phosphoric acid, 8 to 10 per cent.; soluble and reverted phosphoric acid, 4 to 6 per cent.; potassium oxide, 4 to 5 per cent.; ammonia, 4½ to 5½ per cent. (equivalent to nitrogen, 3.70 to 4.52 per cent.).

	Per cent.
Moisture at 100° C.,	15.65
Total phosphoric acid,	11.46
Soluble phosphoric acid,	2.91
Reverted phosphoric acid,	4.12
Insoluble phosphoric acid,	4.43
Potassium oxide,	4.31
Nitrogen,	5.02
Insoluble matter,	2.52

Valuation per two thousand pounds: —

58.2 pounds of soluble phosphoric acid,	$4 66
82.4 pounds of reverted phosphoric acid,	6 18
88.6 pounds of insoluble phosphoric acid,	2 66
86.2 pounds of potassium oxide,	3 66
100.4 pounds of nitrogen,	17 57
	$34 73

Dole's Perfect Lawn Dressing.

(Collected of M. A. Stone, Reading, Mass.)

Guaranteed composition: Total phosphoric acid, 10 to 12 per cent.; soluble and reverted phosphoric acid, 8 to 10 per cent.; potassium oxide, 4 to 5 per cent.; nitrogen, 4 to 5 per cent.

	Per cent.
Moisture at 100° C.,	11.85
Total phosphoric acid,	9.06
Soluble phosphoric acid,	2.64
Reverted phosphoric acid,	3.04
Insoluble phosphoric acid,	3.38
Potassium oxide,	3.60
Nitrogen,	3.81
Insoluble matter,	3.57

Valuation per two thousand pounds: —

52.8 pounds of soluble phosphoric acid,	$4 22
60.8 pounds of reverted phosphoric acid,	4 56
67.6 pounds of insoluble phosphoric acid,	2 03
72.0 pounds of potassium oxide,	3 06
76.2 pounds of nitrogen,	13 34
	$27 21

J. A. Tucker & Co.'s Original Bay State Bone Superphosphate.

(Collected of Hanscom Bros., Haverhill, Mass.)

Guaranteed composition: Total phosphoric acid, 10 to 12 per cent.; soluble and reverted phosphoric acid, 9 to 9½ per cent.; potassium oxide, 2 to 3 per cent.; ammonia, 3 to 3½ per cent. (equivalent to nitrogen, 2½ to 2.9 per cent.).

	Per cent.
Moisture at 100° C.,	21.17
Total phosphoric acid,	11.51
Soluble phosphoric acid,	8.41
Reverted phosphoric acid,	.42
Insoluble phosphoric acid,	2.68
Potassium oxide,	2.10
Nitrogen,	3.40
Insoluble matter,	.47

Valuation per two thousand pounds: —

168.2 pounds of soluble phosphoric acid,	$13 46
8.4 pounds of reverted phosphoric acid,	63
53.6 pounds of insoluble phosphoric acid,	1 61
42.0 pounds of potassium oxide,	1 79
68.0 pounds of nitrogen,	11 90
	$29 39

Pure Raw Bone Fertilizer.

(Manufactured by A. L. Ames, Peabody, Mass.; collected of J. M. Caldwell, Ipswich, Mass.)

Guaranteed composition: Available phosphoric acid, 8 to 11 per cent.; potassium oxide, 2 to 3 per cent. (equivalent to potassium chloride, 4 to 6 per cent.); ammonia, 2½ to 3½ per cent. (equivalent to nitrogen, 2 to 2.9 per cent.).

	Per cent.
Moisture at 100° C.,	10.34
Total phosphoric acid,	9.36
Soluble phosphoric acid,	7.23
Reverted phosphoric acid,	1.85
Insoluble phosphoric acid,	.28
Potassium oxide,	.10
Nitrogen,	3.60
Insoluble matter,	1.60

Valuation per two thousand pounds: —

144.6 pounds of soluble phosphoric acid,	$11 57
37.0 pounds of reverted phosphoric acid,	2 78
5.6 pounds of insoluble phosphoric acid,	17
2.0 pounds of potassium oxide,	09
72.0 pounds of nitrogen,	12 60
	$27 21

Randall's Field and Farm.

(Collected of W. E. Livingston, Lowell, Mass.)

Guaranteed composition: Total phosphoric acid, 10 to 11 per cent.; soluble phosphoric acid, 7 to 9 per cent.; reverted phosphoric acid, 1 to 2 per cent.; potassium oxide, 2 to 4 per cent.; ammonia, 2 to 3 per cent. (equivalent to nitrogen, 1.7 to 2.5 per cent.).

	Per cent.
Moisture at 100° C.,	18.48
Total phosphoric acid,	10.88
Soluble phosphoric acid,	3.82
Reverted phosphoric acid,	1.97
Insoluble phosphoric acid,	5.09
Potassium oxide,	2.73
Nitrogen,	3.03
Insoluble matter,	2.39

Valuation per two thousand pounds: —

76.4 pounds of soluble phosphoric acid,	$6 11
39.4 pounds of reverted phosphoric acid,	2 96
101.8 pounds of insoluble phosphoric acid,	3 04
54.6 pounds of potassium oxide,	2 32
60.6 pounds of nitrogen,	10 61
	$25 04

Soluble Pacific Guano.

(Glidden & Curtis, Boston, Mass.; collected of Hanscom Bros., Haverhill, Mass.)

Guaranteed composition: Soluble phosphoric acid, $6\frac{1}{2}$ to 8 per cent.; reverted phosphoric acid, $1\frac{1}{2}$ to 3 per cent.; insoluble phosphoric acid, 2 to 4 per cent.; potassium oxide, 2 to $3\frac{1}{2}$ per cent.; nitrogen, $2\frac{1}{2}$ to $3\frac{1}{2}$ per cent.

	Per cent.
Moisture at 100° C.,	13.38
Total phosphoric acid,	12.86
Soluble phosphoric acid,	6.02
Reverted phosphoric acid,	1.80
Insoluble phosphoric acid,	5.04
Potassium oxide,	2.99
Nitrogen,	2.81
Insoluble matter,	8.00

Valuation per two thousand pounds: —

120.4 pounds of soluble phosphoric acid,	$9 63
36.0 pounds of reverted phosphoric acid,	2 70
100.8 pounds of insoluble phosphoric acid,	3 02
59.8 pounds of potassium oxide,	2 53
56.2 pounds of nitrogen,	9 84
	$27 72

Sparrow's B. B. High Grade Superphosphate.

(Collected of G. W. Atkinson, Reading, Mass.)

Guaranteed composition: Total phosphoric acid, 10 to 12 per cent.; available phosphoric acid, 8 to 10 per cent.; potassium oxide, 2 to 3 per cent.; nitrogen, $2\frac{1}{2}$ to $3\frac{1}{2}$ per cent.; (equivalent to ammonia, 3 to 4 per cent.).

	Per cent.
Moisture at 100° C.,	14.59
Total phosphoric acid,	10.81
Soluble phosphoric acid,	9.24
Reverted phosphoric acid,	1.32
Insoluble phosphoric acid,	.25
Potassium oxide,	2.08
Nitrogen,	4.00
Insoluble matter,	3.24

Valuation per two thousand pounds : —

184.8 pounds of soluble phosphoric acid,	$14 78
26.4 pounds of reverted phosphoric acid,	1 98
5.0 pounds of insoluble phosphoric acid,	15
41.6 pounds of potassium oxide,	1 78
80.0 pounds of nitrogen,	14 00
	$32 69

Bradley's Potato Manure.

(Collected of G. W. Atkinson, Reading, Mass.)

Guaranteed composition : Soluble phosphoric acid, 5 to 6 per cent. ; reverted phosphoric acid, 1 to 2 per cent. ; insoluble phosphoric acid, 2 to 3 per cent. ; potassium oxide, 6 to 8 per cent. (equivalent to potassium sulphate, 11 to 13 per cent.) ; nitrogen, 2.68 to 3.50 per cent. (equivalent to ammonia, $3\frac{1}{4}$ to $4\frac{1}{4}$ per cent.).

	Per cent.
Moisture at 100° C.,	12.25
Total phosphoric acid,	9.99
Soluble phosphoric acid,	5.53
Reverted phosphoric acid,	1.38
Insoluble phosphoric acid,	3.08
Potassium oxide,	6.30
Nitrogen,	3.26
Insoluble matter,	4.60

Valuation per two thousand pounds : —

110.6 pounds of soluble phosphoric acid,	$8 85
27.6 pounds of reverted phosphoric acid,	2 07
61.6 pounds of insoluble phosphoric acid,	1 85
126.0 pounds of potassium oxide,	6 93
65.2 pounds of nitrogen,	11 41
	$31 11

Dole's Fertilizer, No. 203.

(Collected of M. A. Stone, Reading, Mass.)

Guaranteed composition : Total phosphoric acid, 10 to 12 per cent. ; available phosphoric acid, 8 to 10 per cent. ; potassium oxide, 3 to 4 per cent. ; nitrogen, 3 to 4 per cent. (equivalent to ammonia, 3.5 to 4.5 per cent.).

	Per cent.
Moisture at 100° C.,	17.61
Total phosphoric acid,	9.00
Soluble phosphoric acid,	4.96
Reverted phosphoric acid,	2.56
Insoluble phosphoric acid,	1.48
Potassium oxide,	2.84
Nitrogen,	2.87
Insoluble matter,	7.00

Valuation per two thousand pounds: —

99.2 pounds of soluble phosphoric acid,	$7 94
51.2 pounds of reverted phosphoric acid,	3 84
29.6 pounds of insoluble phosphoric acid,	89
56.8 pounds of potassium oxide,	2 41
57.4 pounds of nitrogen,	10 05
	$25 13

Bay State Fertilizer.

(Clark's Cove Guano Company, New Bedford, Mass.; collected of M. A. Stone, Reading, Mass.)

Guaranteed composition: Total phosphoric acid, 9½ to 14 per cent.; soluble phosphoric acid, 7 to 8½ per cent.; reverted phosphoric acid, 1 to 2½ per cent.; insoluble phosphoric acid, 1½ to 3 per cent.; potassium oxide, 2 to 3 per cent.; nitrogen, 2.1 to 2.8 per cent. (equivalent to ammonia, 2½ to 3½ per cent.).

	Per cent.
Moisture at 100° C.,	12.18
Total phosphoric acid,	12.56
Soluble phosphoric acid,	8.12
Reverted phosphoric acid,	1.70
Insoluble phosphoric acid,	2.74
Potassium oxide,	2.72
Nitrogen,	3.24
Insoluble matter,	5.29

Valuation per two thousand pounds: —

162.4 pounds of soluble phosphoric acid,	$12 99
34.0 pounds of reverted phosphoric acid,	2 55
54.8 pounds of insoluble phosphoric acid,	1 64
54.4 pounds of potassium oxide,	2 31
64.8 pounds of nitrogen,	11 34
	$30 83

Lowell Bone Fertilizer.

(Collected of O. G. Coburn, Lowell, Mass.)

Guaranteed composition: Total phosphoric acid, 10 to 12 per cent.; soluble phosphoric acid, 8 to 10 per cent.; insoluble phosphoric acid, 3 to 5 per cent.; nitrogen, 2.5 to 4 per cent.

	Per cent.
Moisture at 100° C.,	16.59
Total phosphoric acid,	12.57
Soluble phosphoric acid,	5.42
Reverted phosphoric acid,	6.33
Insoluble phosphoric acid,	.82
Potassium oxide,	3.57
Nitrogen,	2.30
Insoluble matter,	.73

Valuation per two thousand pounds:—

108.4 pounds of soluble phosphoric acid,	$8 67
126.6 pounds of reverted phosphoric acid,	9 50
16.4 pounds of insoluble phosphoric acid,	49
71.4 pounds of potassium oxide,	3 03
46.0 pounds of nitrogen,	8 05
	$29 74

Dow, Davis & Co.'s Pure Ground Bone.

(Collected of J. Stackpole & Sons, Ipswich, Mass.)

No guaranty obtained.

	Per cent.
Moisture at 100° C.,	9.03
Total phosphoric acid,	26.59
Soluble phosphoric acid,	none.
Reverted phosphoric acid,	6.63
Insoluble phosphoric acid,	19.96
Nitrogen,	2.88
Insoluble matter,	.19

Valuation per two thousand pounds:—

132.6 pounds of reverted phosphoric acid,	$9 95
399.2 pounds of insoluble phosphoric acid,	19 96
57.6 pounds of nitrogen,	9 22
	$39 13

Dole's Perfect Food for Fruit Trees and Vines.

(Collected of M. A. Stone, Reading, Mass.)

Guaranteed composition: Total phosphoric acid, 9 to 12 per cent.; available phosphoric acid, 8 to 10 per cent.; potassium oxide, 8 to 10 per cent.; nitrogen, 3 to 5 per cent. (equivalent to ammonia, 4 to 6.5 per cent.).

	Per cent.
Moisture at 100° C.,	9.04
Total phosphoric acid,	9.74
Soluble phosphoric acid,	2.37
Reverted phosphoric acid,	2.81
Insoluble phosphoric acid,	4.56
Potassium oxide,	5.24
Nitrogen,	2.44
Insoluble matter,	6.66

Valuation per two thousand pounds: —

47.4 pounds of soluble phosphoric acid,	$3 79
56.2 pounds of reverted phosphoric acid,	4 22
912. pounds of insoluble phosphoric acid,	2 74
104.8 pounds of potassium oxide,	4 45
48.8 pounds of nitrogen,	8 54
	$23 74

Bowker's Dissolved Boneblack.

(Collected at Amherst, Mass.)

Guaranteed composition: Total phosphoric acid, 15 to 18 per cent.

	Per cent.
Moisture at 100° C.,	16.05
Total phosphoric acid,	17.47
Soluble phosphoric acid,	14.77
Reverted phosphoric acid,	2.00
Insoluble phosphoric acid,	.71
Insoluble matter,	4.82

Valuation per two thousand pounds: —

295.4 pounds of soluble phosphoric acid,	$23 63
40.0 pounds of reverted phosphoric acid,	3 00
14.2 pounds of insoluble phosphoric acid,	43
	$27 06

Adams' Fine Ground Bone.

(Adams & Thomas, Springfield, Mass.; collected of C. W. Shaw, Springfield, Mass.)

No guaranty obtained.

	Per cent.
Moisture at 100° C.,	5.09
Total phosphoric acid,	16.10
Soluble phosphoric acid,	none.
Reverted phosphoric acid,	3.51
Insoluble phosphoric acid,	12.59
Nitrogen,	4.45
Insoluble matter,	2.16

Valuation per two thousand pounds: —

70.2 pounds of reverted phosphoric acid,	$5 27
251.8 pounds of insoluble phosphoric acid,	12 59
89.0 pounds of nitrogen,	12 46
	$30 32

Williams, Clark & Co.'s "Americus" Pure Bone Meal.

(Collected of Benjamin Mercer, Stockbridge, Mass.)

Guaranteed composition; Total phosphoric acid, 18 to 24 per cent.; nitrogen, 3 to 4 per cent. (equivalent to ammonia, 4 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	3.66
Total phosphoric acid,	19.02
Soluble phosphoric acid,	none.
Reverted phosphoric acid,	6.85
Insoluble phosphoric acid,	12.17
Nitrogen,	4.22
Insoluble matter,	.50

Valuation per two thousand pounds: —

137.0 pounds of reverted phosphoric acid,	$10 28
243.4 pounds of insoluble phosphoric acid,	12 17
84.4 pounds of nitrogen,	11 82
	$34 27

H. J. Baker & Bro.'s Pelican Bone Fertilizer.

(Collected of T. E. Hall & Co., Pittsfield, Mass.)

Guaranteed composition: Soluble phosphoric acid, 7½ to 9½ per cent.; reverted phosphoric acid, 8 to 10 per cent.; potassium oxide, 2.25 to 3 per cent.; ammonia, 2.25 to 3.75 per cent. (equivalent to nitrogen, 1.85 to 3.09 per cent.).

	Per cent.
Moisture at 100° C.,	17.40
Total phosphoric acid,	10.62
Soluble phosphoric acid,	9.47
Reverted phosphoric acid,	1.15
Insoluble phosphoric acid,	none.
Potassium oxide,	2.45
Nitrogen,	3.06
Insoluble matter,	1.08

Valuation per two thousand pounds: —

149.4 pounds of soluble phosphoric acid,	$11 95
23.0 pounds of reverted phosphoric acid,	1 73
49.0 pounds of potassium oxide,	2 08
61.2 pounds of nitrogen,	10 71
	$26 47

Chittenden's Universal Phosphate.

(Collected of T. E. Hall & Co., Pittsfield, Mass.)

Guaranteed composition: Total phosphoric acid, 11 to 12 per cent.; available phosphoric acid, 9 to 11 per cent.; potassium oxide, 2 to 3 per cent.; ammonia, 2.5 to 3.5 per cent. (equivalent to nitrogen, 2.1 to 2.9 per cent.).

	Per cent.
Moisture at 100° C.,	12.46
Total phosphoric acid,	13.82
Soluble phosphoric acid,	5.79
Reverted phosphoric acid,	3.65
Insoluble phosphoric acid,	4.38
Potassium oxide,	2.34
Nitrogen,	3.35
Insoluble matter,	5.20

Valuation per two thousand pounds: —

115.8 pounds of soluble phosphoric acid,	$9 26
73.0 pounds of reverted phosphoric acid,	5 48
87.6 pounds of insoluble phosphoric acid,	2 63
46.8 pounds of potassium oxide,	1 99
67.0 pounds of nitrogen,	11 73
	$31 09

Farmers' Fertilizer: "Reaper Brand."

(Farmers' Fertilizer Company, Syracuse, N. Y.; collected of H. P. Lucas, Pittsfield, Mass.)

Guaranteed composition: Available phosphoric acid, 5.5 to 7 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium oxide (sulphate), 8 to 10 per cent.; ammonia, 2 to 3 per cent. (equivalent to nitrogen, 1.7 to 2.5 per cent.).

	Per cent.
Moisture at 100° C.,	14.35
Total phosphoric acid,	7.51
Soluble phosphoric acid,	5.25
Reverted phosphoric acid,	2.08
Insoluble phosphoric acid,	0.18
Potassium oxide,	3.60
Nitrogen,	2.50
Insoluble matter,	4.53

Valuation per two thousand pounds: —

105.0 pounds of soluble phosphoric acid,	$8 40
41.6 pounds of reverted phosphoric acid,	3 12
3.6 pounds of insoluble phosphoric acid,	11
72.0 pounds of potassium oxide,	3 96
50.0 pounds of nitrogen,	8 75
	$24 34

Great Eastern Potato Phosphate.

(Great Eastern Fertilizer Company, New York; collected of F. W. Bechtel, Glendale, Mass.)

Guaranteed composition: Soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 2 to 4 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium oxide, 6 to 8 per cent.; ammonia, 2.5 to 3.5 per cent. (equivalent to nitrogen, 2.1 to 2.9 per cent.).

	Per cent.
Moisture at 100° C.,	14.38
Total phosphoric acid,	9.62
Soluble phosphoric acid,	6.46
Reverted phosphoric acid,	2.02
Insoluble phosphoric acid,	1.14
Potassium oxide,	5.04
Nitrogen,	2.18
Insoluble matter,	6.62

Valuation per two thousand pounds: —

129.2 pounds of soluble phosphoric acid,	$10 34
40.4 pounds of reverted phosphoric acid,	3 03
22.8 pounds of insoluble phosphoric acid,	68
100.8 pounds of potassium oxide,	4 28
43.6 pounds of nitrogen,	7 63
	$25 96

Bowker's Hill and Drill Phosphate.

(Collected of H. P. Lucas, Pittsfield, Mass.)

Guaranteed composition: Total phosphoric acid, 11 to 14 per cent.; soluble phosphoric acid, 8 to 9 per cent.; reverted phosphoric acid, 2 to 3 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium oxide, 2 to 3 per cent. (equivalent to potassium sulphate, 3.7 to 5.5 per cent.); nitrogen, 2.5 to 3.25 per cent. (equivalent to ammonia, 3 to 4 per cent.).

	Per cent.
Moisture at 100° C.,	14.36
Total phosphoric acid,	10.87
Soluble phosphoric acid,	6.94
Reverted phosphoric acid,	2.55
Insoluble phosphoric acid,	1.38
Potassium oxide,	1.51
Nitrogen,	3.34
Insoluble matter,	3.50

Valuation per two thousand pounds: —

138.8 pounds of soluble phosphoric acid,	$11 10
51.0 pounds of reverted phosphoric acid,	3 83
27.6 pounds of insoluble phosphoric acid,	83
30.2 pounds of potassium oxide,	1 66
66.8 pounds of nitrogen,	11 69
	$29 11

Great Eastern General Fertilizer.

(Great Eastern Fertilizer Company, New York; collected of S. H. Prindle, Williamstown, Mass.)

Guaranteed composition: Soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 2 to 4 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium oxide, 2 to 4 per cent.; ammonia, 3.5 to 4.5 per cent. (equivalent to nitrogen, 2.9 to 3.7 per cent.).

	Per cent.
Moisture at 100° C.,	12.53
Total phosphoric acid,	9.66
Soluble phosphoric acid,	6.62
Reverted phosphoric acid,	1.65
Insoluble phosphoric acid,	1.39
Potassium oxide,	2.17
Nitrogen,	3.33
Insoluble matter,	6.25

Valuation per two thousand pounds: —

132.4 pounds of soluble phosphoric acid,	$10 59
33.0 pounds of reverted phosphoric acid,	2 48
27.8 pounds of insoluble phosphoric acid,	83
43.4 pounds of potassium oxide,	1 84
66.6 pounds of nitrogen,	11 66
	$27 40

Adams' Market Bone Fertilizer.

(Collected of C. W. Shaw, Springfield, Mass.)

Guaranteed composition: Total phosphoric acid, 9 to 11 per cent.; available phosphoric acid, 8 to 10 per cent.; potassium oxide, 3 to 5 per cent.; nitrogen, 3.15 to 4 per cent. (equivalent to ammonia, 4 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	13.78
Total phosphoric acid,	9.33
Soluble phosphoric acid,	3.14
Reverted phosphoric acid,	3.62
Insoluble phosphoric acid,	2.57
Potassium oxide,	5.30
Nitrogen,	2.54
Insoluble matter,	2.93

Valuation per two thousand pounds: —

62.8 pounds of soluble phosphoric acid,	$5 02
72.4 pounds of reverted phosphoric acid,	5 43
51.4 pounds of insoluble phosphoric acid,	1 54
106.0 pounds of potassium oxide,	4 51
50.8 pounds of nitrogen,	8 89
	$25 39

Chittenden's Ammoniated Bone Superphosphate.

(Collected of T. E. Hall & Co., Pittsfield, Mass.)

Guaranteed composition: Total phosphoric acid, 9 to 11 per cent.; available phosphoric acid, 7 to 9 per cent.; potassium oxide, 2 to 4 per cent.; ammonia, 2 to 3 per cent. (equivalent to nitrogen, 1.65 to 2.5 per cent).

	Per cent.
Moisture at 100° C.,	13.48
Total phosphoric acid,	12.73
Soluble phosphoric acid,	6.79
Reverted phosphoric acid,	2.39
Insoluble phosphoric acid,	3.55
Potassium oxide,	4.79
Nitrogen,	3.40
Insoluble matter,	3.73

Valuation per two thousand pounds: —

135.8 pounds of soluble phosphoric acid,	$10 86
47.8 pounds of reverted phosphoric acid,	3 59
71.0 pounds of insoluble phosphoric acid,	2 13
95.8 pounds of potassium oxide,	4 07
68.0 pounds of nitrogen,	11 90
	$32 55

Standard Ammoniated Bone Phosphate.

(Manufactured by Farmers' Fertilizer Company, Syracuse, N. Y.; collected of H. P. Lucas, Pittsfield, Mass.)

Guaranteed composition: Total phosphoric acid, 11 to 15 per cent.; available phosphoric acid, 9 to 11 per cent.; insoluble phosphoric acid, 2 to 4 per cent.; potassium sulphate, 8 to 9 per cent.; ammonia, 1 to 2 per cent. (equivalent to nitrogen, .82 to 1.65 per cent.).

	Per cent.
Moisture at 100° C,	11.70
Total phosphoric acid,	9.62
Soluble phosphoric acid,	6.02
Reverted phosphoric acid,	3.22
Insoluble phosphoric acid,	.38
Potassium oxide,	3.56
Nitrogen,	2.08
Insoluble matter,	5.69

Valuation per two thousand pounds: —

120.4 pounds of soluble phosphoric acid,	$9 63
64.4 pounds of reverted phosphoric acid,	4 83
7.6 pounds of insoluble phosphoric acid,	23
71.2 pounds of potassium oxide,	3 92
41.6 pounds of nitrogen,	7 28
	$25 89

Adams' Market Bone Fertilizer for Potatoes.

(Collected of C. W. Shaw, Springfield, Mass.)

Guaranteed composition: Total phosphoric acid, 9 to 11 per cent.; available phosphoric acid, 8 to 10 per cent.; potassium oxide, 4 to 5 per cent.; nitrogen, 3 to 4 per cent.

	Per cent.
Moisture at 100° C.,	11.16
Total phosphoric acid,	8.48
Soluble phosphoric acid,	2.23
Reverted phosphoric acid,	2.43
Insoluble phosphoric acid,	3.82
Potassium oxide,	4.09
Nitrogen,	3.78
Insoluble matter,	1.56

Valuation per two thousand pounds: —

44.6 pounds of soluble phosphoric acid,	$3 57
48.6 pounds of reverted phosphoric acid,	3 65
76.4 pounds of insoluble phosphoric acid,	2 29
81.8 pounds of potassium oxide,	3 48
75.6 pounds of nitrogen,	13 23
	$26 22

Williams, Clark & Co.'s "Americus" Ammoniated Bone Superphosphate.

(Collected of J. A. Brewer, Great Barrington, Mass.)

Guaranteed composition: Total phosphoric acid, 11 to 16 per cent.; soluble phosphoric acid, 8 to 9 per cent.; reverted phosphoric acid, 2 to 3 per cent.; potassium oxide, 2 to 3 per cent. (equivalent to potassium sulphate, 4 to 6 per cent.); nitrogen, 2 to 3 per cent. (equivalent to ammonia, 3 to 4 per cent.); magnesium sulphate, 3 to 4 per cent.

	Per cent.
Moisture at 100° C.,	14.11
Total phosphoric acid,	10.60
Soluble phosphoric acid,	8.60
Reverted phosphoric acid,	2.00
Insoluble phosphoric acid,	none.
Potassium oxide,	2.32
Nitrogen,	3.20
Insoluble matter,	3.48

Valuation per two thousand pounds: —

172.0 pounds of soluble phosphoric acid,	$13 76
40.0 pounds of reverted phosphoric acid,	3 00
46.4 pounds of potassium oxide,	2 55
64.0 pounds of nitrogen,	11 20
	$30 51

H. Preston & Son's Ammoniated Bone Superphosphate.

(Collected of W. M. Wood, Pittsfield, Mass.)

Guaranteed composition: Available phosphoric acid, 9 to 10 per cent.; potassium oxide, 2 to 3 per cent.; ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	14.28
Total phosphoric acid,	10.88
Soluble phosphoric acid,	6.86
Reverted phosphoric acid,	1.75
Insoluble phosphoric acid,	2.27
Potassium oxide,	3.31
Nitrogen,	2.62
Insoluble matter,	3.26

Valuation per two thousand pounds: —

137.2 pounds of soluble phosphoric acid,	$10 98
35.0 pounds of reverted phosphoric acid,	2 63
45.4 pounds of insoluble phosphoric acid,	1 36
66.2 pounds of potassium oxide,	2 81
52.4 pounds of nitrogen,	9 17
	$26 95

Adams & Thomas' New England Lawn Dressing.

(Collected of C. W. Shaw, Springfield, Mass.)

No guaranty obtained.

	Per cent.
Moisture at 100° C.,	9.20
Total phosphoric acid,	9.99
Soluble phosphoric acid,	.40
Reverted phosphoric acid,	4.35
Insoluble phosphoric acid,	5.24
Potassium oxide,	6.92
Nitrogen,	2.44
Insoluble matter,	2.13

Valuation per two thousand pounds: —

8.0 pounds of soluble phosphoric acid,	$0 64
87.0 pounds of reverted phosphoric acid,	6 53
104.8 pounds of insoluble phosphoric acid,	3 14
138.4 pounds of potassium oxide,	5 88
48.8 pounds of nitrogen,	8 54
	$24 73

Great Eastern General Fertilizer.

(Manufactured by Great Eastern Fertilizer Company, New York; collected of F. W. Bechtel, Glendale, Mass.)

Guaranteed composition: Soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 2 to 4 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium oxide, 2 to 4 per cent.; ammonia, 2.5 to 3.5 per cent. (equivalent to nitrogen, 2 to 2.9 per cent.).

	Per cent.
Moisture at 100° C.,	12.77
Total phosphoric acid,	10.39
Soluble phosphoric acid,	5.70
Reverted phosphoric acid,	2.43

	Per cent.
Insoluble phosphoric acid,	2.26
Potassium oxide,	2.69
Nitrogen,	2.91
Insoluble matter,	5.99

Valuation per two thousand pounds: —

114.0 pounds of soluble phosphoric acid,	$9 12
48.6 pounds of reverted phosphoric acid,	3 65
45.2 pounds of insoluble phosphoric acid,	1 36
53.8 pounds of potassium oxide,	2 29
58.2 pounds of nitrogen,	10 19
	$26 61

Cotton Seed Hull Ashes.

(American Oil Company, New York; collected of George D. Howe, North Hadley, Mass.)

No guaranty obtained.

	Per cent.
Moisture at 100° C,	8.08
Total phosphoric acid,	11.50
Potassium oxide,	26.62
Magnesium oxide,	17.15
Calcium oxide,	11.37
Insoluble matter,	5.38

Valuation per two thousand pounds: —

230.0 pounds of phosphoric acid (6c.),	$13 80
532.4 pounds of potassium oxide (5½c.),	29 28
	$43 08

Cotton Seed Hull Ashes.

(American Oil Company, New York; collected of D. A. Horton, Northampton, Mass.)

No guaranty obtained.

	Per cent.
Moisture at 100° C,	7.30
Total phosphoric acid,	9.59
Potassium oxide,	19.15
Magnesium oxide,	14.81
Calcium oxide,	12.23
Insoluble matter,	8.86

Valuation per two thousand pounds: —

191.8 pounds of phosphoric acid (6c.),	$11 51
383.0 pounds of potassium oxide (5½c.),	21 07
	$32 58

Lister Bro.'s Ground Bone.

(Collected of Cyrus Hamlin, Westford, Mass.)

No guaranty obtained.

	Per cent.
Moisture at 100° C.,	9.74
Total phosphoric acid,	12.85
Soluble phosphoric acid,	none.
Reverted phosphoric acid,	4.72
Insoluble phosphoric acid,	8.13
Nitrogen,	2.93
Insoluble matter,	2.63

Valuation per two thousand pounds: —

94.4 pounds of reverted phosphoric acid,	$7 08
162.6 pounds of insoluble phosphoric acid,	8 13
58.6 pounds of nitrogen,	8 79
	$24 00

Bowker's Dissolved Boneblack.

(Collected of Pearse and Easterbrook, Fall River, Mass.)

Guaranteed composition: Soluble phosphoric acid, 16 to 18 per cent.; total bone phosphate, 33 to 38 per cent.

	Per cent.
Moisture at 100° C.,	17.60
Total phosphoric acid,	15.20
Soluble phosphoric acid,	14.75
Reverted phosphoric acid,	.28
Insoluble phosphoric acid,	.17
Insoluble matter,	2.17

Valuation per two thousand pounds: —

295.0 pounds of soluble phosphoric acid,	$23 60
5.6 pounds of reverted phosphoric acid,	42
3.4 pounds of insoluble phosphoric acid,	10
	$24 12

Economic Fertilizer, No. 1, for Grass.

(Collected of W. S. Butler & Co., Boston, Mass.)

Label lost; no guaranty obtained.

	Per cent.
Moisture at 100° C.,	11.66
Total phosphoric acid,	6.64
Soluble phosphoric acid,	.15
Reverted phosphoric acid,	1.06
Insoluble phosphoric acid,	5.43
Potassium oxide,	33
Nitrogen,	1.34
Insoluble matter,	5.38

Valuation per two thousand pounds:—

3.0 pounds of soluble phosphoric acid,	$0 24
21.2 pounds of reverted phosphoric acid,	1 59
108.6 pounds of insoluble phosphoric acid,	3 26
6.6 pounds of potassium oxide,	28
26.8 pounds of nitrogen (in nitrates),	4 29
	$9 66

Economic Fertilizer, No. 7, for General Purposes.

(Butler, Breed & Co., Boston; collected of Butler & Co., Boston, Mass.)

Guaranteed composition: Total phosphoric acid, 8 to 12.5 per cent.; nitrogen, 2.5 per cent.; alkalies, 8 to 12.5 per cent.

	Per cent.
Moisture at 100° C.,	7.00
Total phosphoric acid,	13.37
Soluble phosphoric acid,	none.
Reverted phosphoric acid,	.27
Insoluble phosphoric acid,	13.10
Potassium oxide,	none.
Nitrogen,	1.84
Insoluble matter,	8.20

Valuation per two thousand pounds:—

5.4 pounds of reverted phosphoric acid,	$0 41
262.0 pounds of insoluble phosphoric acid,	7 86
36.8 pounds of nitrogen,	6 44
	$14 71

Brightman & Co.'s Ground Bone.

(Collected of Pearse & Easterbrook, Fall River, Mass.)

No guaranty obtained.

	Per cent.
Moisture at 100° C.,	6.34
Total phosphoric acid,	23.21
Soluble phosphoric acid,	none.
Reverted phosphoric acid,	2.77
Insoluble phosphoric acid,	20.44
Nitrogen,	3.69
Insoluble matter,	1.33

Valuation per two thousand pounds: —

55.4 pounds of reverted phosphoric acid,	$4 16
408.8 pounds of insoluble phosphoric acid,	22 48
73.8 pounds of nitrogen,	11 07
	$37 71

Hargrave's Ground Bone.

(Hargrave's Manufacturing Company, Fall River, Mass.; collected at mill.)

Guaranteed composition: Total phosphoric acid, 18.80 per cent.; soluble phosphoric acid, .51 per cent.; reverted phosphoric acid, 3.61 per cent.; insoluble phosphoric acid, 14.67 per cent.; nitrogen, 3.93 per cent. (equivalent to ammonia, 4.77 per cent.).

	Per cent.
Moisture at 100° C.,	20.71
Total phosphoric acid,	23.39
Soluble phosphoric acid,	.09
Reverted phosphoric acid,	4.94
Insoluble phosphoric acid,	18.36
Nitrogen,	2.76
Insoluble matter,	1.11

Valuation per two thousand pounds: —

1.8 pounds of soluble phosphoric acid,	$0 14
98.8 pounds of reverted phosphoric acid,	7 41
367.2 pounds of insoluble phosphoric acid,	18 36
55.2 pounds of nitrogen,	8 28
	$34 19

Lister's Celebrated Ground Bone.

(Collected of W. P. Wilson, New Bedford, Mass.)

Guaranteed composition: Total phosphoric acid, 11 to 13 per cent.; ammonia, 3 to 3.1 per cent. (equivalent to nitrogen, 2.5 per cent.).

	Per cent.
Moisture at 100° C.,	11.04
Total phosphoric acid,	12.06
Soluble phosphoric acid,	.12
Reverted phosphoric acid,	4.30
Insoluble phosphoric acid,	8.64
Nitrogen,	3.05
Insoluble matter,	2.80

Valuation per two thousand pounds: —

2.4 pounds of soluble phosphoric acid,	$0 19
86.0 pounds of reverted phosphoric acid,	6 45
172.8 pounds of insoluble phosphoric acid,	8 64
61.0 pounds of nitrogen,	9 15
	$24 43

Church's Menhaden Fish and Potash, D.

(Collected of S. S. Paine & Bros., New Bedford, Mass.)

Guaranteed composition: Total phosphoric acid, 6 to 7 per cent.; potassium oxide, 3 to 4 per cent. (equivalent to potassium sulphate, 6 to 7 per cent.); nitrogen, 4 to 5 per cent. (equivalent to ammonia, 5 to 6 per cent.).

	Per cent.
Moisture at 100° C.,	26.25
Total phosphoric acid,	5.80
Soluble phosphoric acid,	1.69
Reverted phosphoric acid,	3.12
Insoluble phosphoric acid,	.99
Potassium oxide,	3.28
Nitrogen,	4.28
Insoluble matter,	1.62

Valuation per two thousand pounds: —

33.8 pounds of soluble phosphoric acid,	$2 70
62.4 pounds of reverted phosphoric acid,	4 68
19.8 pounds of insoluble phosphoric acid,	59
65.6 pounds of potassium oxide,	3 61
85.6 pounds of nitrogen,	14 98
	$26 56

Brightman & Co.'s Ammoniated Bone Superphosphate.

(Collected of P R. Atwood, Plymouth, Mass.)

Guaranteed composition: Available phosphoric acid, 8 to 10 per cent.; potassium oxide, 3 to 5 per cent.; ammonia, 3 to 5 per cent. (equivalent to nitrogen, 2.5 to 4 per cent.).

	Per cent.
Moisture at 100° C.,	16.17
Total phosphoric acid,	9.72
Soluble phosphoric acid,	5.21
Reverted phosphoric acid,	2.78
Insoluble phosphoric acid,	1.72
Potassium oxide,	3.31
Nitrogen,	2.60
Insoluble matter,	6.81

Valuation per two thousand pounds: —

104.2 pounds of soluble phosphoric acid,	$8 34
55.6 pounds of reverted phosphoric acid,	4 17
34.4 pounds of insoluble phosphoric acid,	1 03
66.2 pounds of potassium oxide,	2 81
52.0 pounds of nitrogen,	9 10
	$25 45

Bay State Fertilizer.

(Clark's Cove Guano Company, New Bedford, Mass.; collected of P. R. Atwood, Plymouth, Mass.)

Guaranteed composition: Total phosphoric acid, 9.5 to 14 per cent.; soluble phosphoric acid, 7 to 8.5 per cent.; reverted phosphoric acid, 1 to 2.5 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium oxide, 2 to 3 per cent.; nitrogen, 2.1 to 2.8 per cent. (equivalent to ammonia, 2.5 to 3.5 per cent.); moisture, 8 to 10 per cent.

	Per cent.
Moisture at 100° C.,	14.32
Total phosphoric acid,	11.78
Soluble phosphoric acid,	8.43
Reverted phosphoric acid,	2.77
Insoluble phosphoric acid,	.58
Potassium oxide,	1.83
Nitrogen,	2.72
Insoluble matter,	5.04

Valuation per two thousand pounds: —

168.6 pounds of soluble phosphoric acid,	$13 49
55.4 pounds of reverted phosphoric acid,	4 16
11.6 pounds of insoluble phosphoric acid,	35
36.6 pounds of potassium oxide,	1 56
54.4 pounds of nitrogen,	9 52
	$29 08

Allen Fertilizer.

(American Manufacturing Company, Boston, Mass.; collected of Parker & Wood, Boston, Mass.)

Guaranteed composition: Total phosphoric acid, 6 to 10 per cent.; soluble phosphoric acid, 4 to 6 per cent.; reverted phosphoric acid, 1 to 2 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium oxide, 4 to 6 per cent.; ammonia, 2.25 to 3 per cent. (equivalent to nitrogen, 1.85 to 2.5 per cent.).

	Per cent.
Moisture at 100° C.,	22.89
Total phosphoric acid,	8.73
Soluble phosphoric acid,	5.11
Reverted phosphoric acid,	2.08
Insoluble phosphoric acid,	1.54
Potassium oxide,	5.07
Nitrogen,	2.34
Insoluble matter,	4.53

Valuation per two thousand pounds: —

102.2 pounds of soluble phosphoric acid,	$8 18
41.6 pounds of reverted phosphoric acid,	3 12
30.8 pounds of insoluble phosphoric acid,	92
101.4 pounds of potassium oxide,	4 31
47.8 pounds of nitrogen,	8 37
	$24 90

Baker's A. A. Ammoniated Bone Superphosphate.

(Collected of W. P. Wilson, New Bedford, Mass.)

Guaranteed composition: Available phosphoric acid, 10 to 12 per cent.; potassium oxide, 2 to 3 per cent.; ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	16.36
Total phosphoric acid,	12.72
Soluble phosphoric acid,	10.91
Reverted phosphoric acid,	1.69
Insoluble phosphoric acid,	.12
Potassium oxide,	2.87
Nitrogen,	3.15
Insoluble matter,	1.09

Valuation per two thousand pounds: —

218.2 pounds of soluble phosphoric acid,	$17 46
33.8 pounds of reverted phosphoric acid,	2 54
2.4 pounds of insoluble phosphoric acid,	07
57.4 pounds of potassium oxide,	2 44
63.0 pounds of nitrogen,	11 03
	$33 54

Brightman & Co.'s Dry Ground Menhaden Fish Guano.

(Collected of Pearse & Easterbrook, Fall River, Mass.)

Guaranteed composition: Total bone phosphate of lime, 15 to 20 per cent.; ammonia, 10 to 12 per cent. (equivalent to nitrogen, 7.88 to 8.24 per cent.).

	Per cent.
Moisture at 100° C.,	10.72
Total phosphoric acid,	7.95
Soluble phosphoric acid,	.46
Reverted phosphoric acid,	3.53
Insoluble phosphoric acid,	3.96
Nitrogen,	8.41
Insoluble matter,	2.72

Valuation per two thousand pounds: —

9.2 pounds of soluble phosphoric acid,	$0 74
70.6 pounds of reverted phosphoric acid,	5 30
79.2 pounds of insoluble phosphoric acid,	3 96
168.2 pounds of nitrogen,	29 44
	$39 44

Mayo's Superphosphate.

(Collected of P. Williams & Co., Taunton, Mass.)

Guaranteed composition: Soluble phosphoric acid, 9 to 11 per cent.; available phosphoric acid, 10.5 to 11.5 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium oxide, 2 to 4 per cent.; nitrogen, 2.5 to 3 per cent. (equivalent to ammonia, 3 to 3.5 per cent.).

	Per cent.
Moisture at 100° C,	19.27
Total phosphoric acid,	11.61
Soluble phosphoric acid,	8.71
Reverted phosphoric acid,	2.30
Insoluble phosphoric acid,	.60
Potassium oxide,	3.70
Nitrogen,	2.80
Insoluble matter,	5.02

Valuation per two thousand pounds: —

174.2 pounds of soluble phosphoric acid,	$13 94
46.0 pounds of reverted phosphoric acid,	3 45
12.0 pounds of insoluble phosphoric acid,	36
74.0 pounds of potassium oxide,	3 15
56.0 pounds of nitrogen,	9 80
	$30 70

Adams' Bone Superphosphate.

(Stearns Fertilizer Co., New York; collected of Wilson & Holden, Worcester, Mass.)

Guaranteed composition: Available phosphoric acid, 8 to 11 per cent.; insoluble phosphoric acid, 1 to 3 per cent.; potassium oxide, 2 to 3 per cent. (equivalent to potassium sulphate, 4 to 8 per cent.); ammonia, 2.5 to 3.5 per cent. (equivalent to nitrogen, 2.1 to 2.9 per cent.).

	Per cent.
Moisture at 100° C,	19.69
Total phosphoric acid,	10.93
Soluble phosphoric acid,	6.56
Reverted phosphoric acid,	3.34
Insoluble phosphoric acid,	1.03
Potassium oxide,	4.23
Nitrogen,	3.54
Insoluble matter,	3.74

Valuation per two thousand pounds: —

131.2 pounds of soluble phosphoric acid,	$10 50
66.8 pounds of reverted phosphoric acid,	5 01
20.6 pounds of insoluble phosphoric acid,	62
84.6 pounds of potassium oxide,	4 65
70.8 pounds of nitrogen,	12 39
	$33 17

Crocker's Ammoniated Bone Superphosphate.

(Collected of S. P. Bliss, Taunton, Mass.)

Guaranteed composition: Soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 2 to 4 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium sulphate, 1 to 3 per cent.; ammonia, 2.5 to 4.5 per cent. (equivalent to nitrogen, 2.9 to 3.7 per cent.).

	Per cent.
Moisture at 100° C.,	11.04
Total phosphoric acid,	11.22
Soluble phosphoric acid,	7.69
Reverted phosphoric acid,	2.13
Insoluble phosphoric acid,	1.40
Potassium oxide,	1.77
Nitrogen,	2.92
Insoluble matter,	4.66

Valuation per two thousand pounds: —

153.8 pounds of soluble phosphoric acid,	$12 30
42.6 pounds of reverted phosphoric acid,	3 20
28.0 pounds of insoluble phosphoric acid,	84
35.4 pounds of potassium oxide,	1 95
58.4 pounds of nitrogen,	10 22
	$28 51

Brightman & Co.'s Fish and Potash.

(Collected of P. R. Atwood, Plymouth, Mass.)

Guaranteed composition: Total bone phosphate of lime, 15 to 18 per cent.; soluble phosphoric acid, 2 to 3 per cent.; insoluble phosphoric acid, .40 per cent.; potassium oxide, 2 to 3 per cent.; ammonia, 3 to 5 per cent. (equivalent to nitrogen, 2.5 to 4.1 per cent.).

	Per cent.
Moisture at 100° C.,	25.84
Total phosphoric acid,	5.33
Soluble phosphoric acid,	1.34
Reverted phosphoric acid,	2.13
Insoluble phosphoric acid,	1.86
Potassium oxide,	3.13
Nitrogen,	2.88
Insoluble matter,	10.60

Valuation per two thousand pounds: —

26.8 pounds of soluble phosphoric acid,	$2 14
42.6 pounds of reverted phosphoric acid,	3 20
37.2 pounds of insoluble phosphoric acid,	1 12
62.6 pounds of potassium oxide,	2 66
57.6 pounds of nitrogen,	10 08
	$19 20

Standard Peruvian Guano, 1. — Guaranteed.

(Collected of P. Williams & Co., Taunton, Mass.)

Guaranteed composition: Total phosphoric acid, 13 to 17 per cent.; potassium oxide, 2 to 3 per cent.; ammonia, 9 to 10 per cent. (equivalent to nitrogen, 7.4 to 8.2 per cent.).

	Per cent.
Moisture at 100° C.,	10.43
Total phosphoric acid,	14.65
Soluble phosphoric acid,	.94
Reverted phosphoric acid,	7.63
Insoluble phosphoric acid,	6.08
Potassium oxide,	2.93
Nitrogen,	7.93
Insoluble matter,	8.42

Valuation per two thousand pounds: —

18.8 pounds of soluble phosphoric acid,	$1 50
152.6 pounds of reverted phosphoric acid,	11 45
121.6 pounds of insoluble phosphoric acid,	3 65
58.6 pounds of potassium oxide,	2 49
158.6 pounds of nitrogen,	27 76
	$46 85

Red Beach Bone Superphosphate.

(Collected of S. S. Paine & Bros., New Bedford, Mass.)

Guaranteed composition: Total phosphoric acid, 10 to 15 per cent.; potassium oxide, 2.26 per cent.; ammonia, 3.11 per cent. (equivalent to nitrogen, 2.56 per cent.).

	Per cent.
Moisture at 100° C.,	17.29
Total phosphoric acid,	9.83
Soluble phosphoric acid,	8.33

	Per cent.
Reverted phosphoric acid,	1.30
Insoluble phosphoric acid,	.20
Potassium oxide,	1.95
Nitrogen,	1.69
Insoluble matter,	2.42

Valuation per two thousand pounds: —

166.6 pounds of soluble phosphoric acid,	$13 33
26.0 pounds of reverted phosphoric acid,	1 95
4.0 pounds of insoluble phosphoric acid,	12
39.0 pounds of potassium oxide,	1 66
33.8 pounds of nitrogen,	5 92
	$22 98

Seeding-Down Fertilizer.

(Manufactured by Cumberland Bone Company, Portland, Me.; collected of J. Q. Evans, Salisbury, Mass.)

Guaranteed composition: Total phosphoric acid, 23.40 per cent.; soluble phosphoric acid, 3.20 per cent.; reverted phosphoric acid, 4.43 per cent.; insoluble phosphoric acid, 15.77 per cent.; potassium oxide, .97 per cent.; nitrogen, 1.45 per cent. (equivalent to ammonia, 1.76 per cent.).

	Per cent.
Moisture at 100° C.,	12.17
Total phosphoric acid,	22.38
Soluble phosphoric acid,	2.72
Reverted phosphoric acid,	3.04
Insoluble phosphoric acid,	16.62
Potassium oxide,	1.13
Nitrogen,	1.69
Insoluble matter,	5.80

Valuation per two thousand pounds: —

54.4 pounds of soluble phosphoric acid,	$4 35
60.8 pounds of reverted phosphoric acid,	4 56
332.4 pounds of insoluble phosphoric acid,	9 97
22.6 pounds of potassium oxide,	96
33.8 pounds of nitrogen,	5 92
	$25 76

Darling's Animal Fertilizer.

(Collected of C. H. Thompson & Co., Boston, Mass.)

Guaranteed composition: Total phosphoric acid, 10 to 12 per cent.; potassium oxide, 4 to 6 per cent.; nitrogen, 3.3 to 5 per cent. (equivalent to ammonia, 4 to 6 per cent.).

	Per cent.
Moisture at 100° C.,	13.47
Total phosphoric acid,	13.51
Soluble phosphoric acid,	2.02
Reverted phosphoric acid,	5.23
Insoluble phosphoric acid,	8.28
Potassium oxide,	4.97
Nitrogen,	3.29
Insoluble matter,	3.53

Valuation per two thousand pounds: —

40.4 pounds of soluble phosphoric acid,	$3 23
104.6 pounds of reverted phosphoric acid,	7 85
165.6 pounds of insoluble phosphoric acid,	4 97
99.4 pounds of potassium oxide,	4 22
65.8 pounds of nitrogen,	11 52
	$31 79

C. A. Bartlett's Bone.

(Collected of C. A. Bartlett, at works, Worcester, Mass.)

No guaranty obtained.

	Per cent.
Moisture at 100° C.,	5.13
Total phosphoric acid,	24.67
Soluble phosphoric acid,	.28
Reverted phosphoric acid,	5.48
Insoluble phosphoric acid,	18.91
Nitrogen,	3.43
Insoluble matter,	.56

Valuation per two thousand pounds: —

5.6 pounds of soluble phosphoric acid,	$0 45
109.6 pounds of reverted phosphoric acid,	8 22
378.2 pounds of insoluble phosphoric acid,	18 91
68.6 pounds of nitrogen,	10 29
	$37 87

Jefferds' Fine Ground Bone.

(Collected of J. G. Jefferds, at works, Worcester, Mass.)

Guaranteed composition: Total phosphoric acid, 25 to 30 per cent.; ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.).

	Per cent.
Moisture at 100° C.,	4.50
Total phosphoric acid,	28.83
Soluble phosphoric acid,	.36
Reverted phosphoric acid,	7.54
Insoluble phosphoric acid,	20.93
Nitrogen,	2.01
Insoluble matter,	.36

Valuation per two thousand pounds: —

7.2 pounds of soluble phosphoric acid,	$0 58
150.8 pounds of reverted phosphoric acid,	11 31
418.6 pounds of insoluble phosphoric acid,	20 93
40.2 pounds of nitrogen,	6 03
	$38 85

Soluble Pacific Guano.

(Collected of Heart & Akin, New Bedford, Mass.)

Guaranteed composition: Soluble phosphoric acid, 6½ to 8 per cent.; reverted phosphoric acid, 1.5 to 3 per cent.; insoluble phosphoric acid, 2 to 4 per cent.; potassium oxide, 2.5 to 3.5 per cent.; nitrogen, 2 to 3 per cent. (equivalent to ammonia, 2.5 to 3.5 per cent.).

	Per cent.
Moisture at 100° C.,	21.49
Total phosphoric acid,	12.11
Soluble phosphoric acid,	6.59
Reverted phosphoric acid,	2.41
Insoluble phosphoric acid,	3.11
Potassium oxide,	1.80
Nitrogen,	2.16
Insoluble matter,	5.45

Valuation per two thousand pounds: —

131.8 pounds of soluble phosphoric acid,	$10 54
48.2 pounds of reverted phosphoric acid,	3 62
62.2 pounds of insoluble phosphoric acid,	1 87
36.0 pounds of potassium oxide,	1 53
43.2 pounds of nitrogen,	7 56
	$25 12

Darling's Animal Fertilizer.

(Collected of Parker & Wood, Boston, Mass.)

Guaranteed composition: Total phosphoric acid, 10 to 12 per cent.; potassium oxide, 4 to 6 per cent.; ammonia, 4 to 6 per cent. (equivalent to nitrogen, 3.3 to 5 per cent.).

	Per cent.
Moisture at 100° C.,	14.92
Total phosphoric acid,	10.70
Soluble phosphoric acid,	4.57
Reverted phosphoric acid,	2.30
Insoluble phosphoric acid,	3.83
Potassium oxide,	4.14
Nitrogen,	3.64
Insoluble matter,	1.36

Valuation per two thousand pounds: —

91.4 pounds of soluble phosphoric acid,	$7 31
46.0 pounds of reverted phosphoric acid,	3 45
76.6 pounds of insoluble phosphoric acid,	2 30
82.8 pounds of potassium oxide,	3 52
72.8 pounds of nitrogen,	12 74
	$29 32

Darling's Lawn Dressing.

(Collected of Parker & Wood, Boston, Mass.)

Guaranteed composition: Total phosphoric acid, 10 to 12 per cent.; potassium oxide, 5 to 6 per cent.; ammonia, 5 to 7 per cent. (equivalent to nitrogen, 4.1 to 5.6 per cent.).

	Per cent.
Moisture at 100° C,	12.60
Total phosphoric acid,	12.82
Soluble phosphoric acid,	3.54
Reverted phosphoric acid,	3.47
Insoluble phosphoric acid,	5.81
Potassium oxide,	5.11
Nitrogen,	4.46
Insoluble matter,	2.12

Valuation per two thousand pounds: —

70.8 pounds of soluble phosphoric acid,	$5 66
69.4 pounds of reverted phosphoric acid,	5 21
116.2 pounds of insoluble phosphoric acid,	3 49
102.2 pounds of potassium oxide,	4 34
89.2 pounds of nitrogen,	15 61
	$34 31

Williams & Clark Co.'s Americus Ammoniated Bone Superphosphate.

(Collected of C. A. Bartlett, Worcester, Mass.)

Guaranteed composition: Total phosphoric acid, 11 to 16 per cent.; soluble phosphoric acid, 8 to 9 per cent.; reverted phosphoric acid, 2 to 3 per cent; potassium oxide, 2 to 3 per cent. (equivalent to potassium sulphate, 4 to 6 per cent.); nitrogen, 2 to 3 per cent. (equivalent to ammonia, 3 to 4 per cent.).

	Per cent.
Moisture at 100° C,	15.04
Total phosphoric acid,	10.94
Soluble phosphoric acid,	9.14
Reverted phosphoric acid,	1.38
Insoluble phosphoric acid,	.42
Potassium oxide,	2.25
Nitrogen,	2.83
Insoluble matter,	3.43

Valuation per two thousand pounds: —

182.8 pounds of soluble phosphoric acid,	$14 62
27.6 pounds of reverted phosphoric acid,	2 07
8.4 pounds of insoluble phosphoric acid,	25
45.0 pounds of potassium oxide,	2 48
56.6 pounds of nitrogen,	9 91
	$29 33

Bay State Fertilizer.

(Manufactured by Clark's Cove Guano Company, New Bedford, Mass.; collected of Heart & Akin, New Bedford, Mass.)

Guaranteed composition: Total phosphoric acid, 10 to 13 per cent.; soluble phosphoric acid, 6 to 9 per cent.; reverted phosphoric acid, 2 to 2½ per cent.; available phosphoric acid, 8 to 11 per cent.; potassium oxide, 2 to 3.5 per cent.; nitrogen, 2.1 to 2.8 per cent. (equivalent to ammonia, 2.55 to 3.5 per cent.).

	Per cent.
Moisture at 100° C,	13.10
Total phosphoric acid,	13.16
Soluble phosphoric acid,	7.84
Reverted phosphoric acid,	2.33
Insoluble phosphoric acid,	2.89
Potassium oxide,	1.80
Nitrogen,	2.93
Insoluble matter,	4.82

Valuation per two thousand pounds : —

156.8 pounds of soluble phosphoric acid,	$12 54
46.6 pounds of reverted phosphoric acid,	3 50
57.8 pounds of insoluble phosphoric acid,	1 73
36.0 pounds of potassium oxide,	1 53
58.6 pounds of nitrogen,	10 26
	$29 56

Randall's Flour of Bone.

(Collected of Benjamin Randall, at works, Boston, Mass.)

Guaranteed composition : Total phosphoric acid, 20 to 25 per cent. ; ammonia, 3 to 4 per cent. (equivalent to nitrogen, 2.5 to 3.3 per cent.) ; sodium chloride (common salt), 5 to 8 per cent.

	Per cent.
Moisture at 100° C,	9.82
Total phosphoric acid,	13.49
Soluble phosphoric acid,	.47
Reverted phosphoric acid,	4.23
Insoluble phosphoric acid,	8.79
Nitrogen,	6.64
Insoluble matter,	.84

Valuation per two thousand pounds : —

9.4 pounds of soluble phosphoric acid,	$0 75
84.6 pounds of reverted phosphoric acid,	6 35
175.8 pounds of insoluble phosphoric acid,	8 79
132.8 pounds of nitrogen,	19 92
	$35 81

Jefferds' Animal Fertilizer.

(Collected of J. G. Jefferds, at works, Worcester, Mass.)

Guaranteed composition : Total phosphoric acid, 14 to 16 per cent. ; potassium oxide, 5 to 7 per cent. ; ammonia, 5 to 7 per cent. (equivalent to nitrogen, 4.1 to 5.76 per cent.).

	Per cent.
Moisture at 100° C,	6.15
Total phosphoric acid,	15.09
Soluble phosphoric acid,	.37
Reverted phosphoric acid,	5.71
Insoluble phosphoric acid,	9.01
Potassium oxide,	5.36
Nitrogen,	5.53
Insoluble matter,	1.32

Valuation per two thousand pounds: —

7.4 pounds of soluble phosphoric acid,	$0 59
114.2 pounds of reverted phosphoric acid,	8 57
180.2 pounds of insoluble phosphoric acid,	5 41
107.2 pounds of potassium oxide,	4 56
110.6 pounds of nitrogen,	19 36
	$38 49

Crocker's Ammoniated Bone Superphosphate.

(Collected of C. W. Sears, Worcester, Mass.)

Guaranteed composition: Soluble phosphoric acid, 6 to 8 per cent.; reverted phosphoric acid, 2 to 4 per cent.; insoluble phosphoric acid, 1 to 2 per cent.; potassium sulphate, 1 to 3 per cent.; ammonia, 3.5 to 4.5 per cent. (equivalent to nitrogen, 2.9 to 3.7 per cent.).

	Per cent.
Moisture at 100° C,	11.66
Total phosphoric acid,	11.99
Soluble phosphoric acid,	8.37
Reverted phosphoric acid,	2.23
Insoluble phosphoric acid,	1.39
Potassium oxide,	1.39
Nitrogen,	3.43
Insoluble matter,	4.70

Valuation per two thousand pounds: —

167.4 pounds of soluble phosphoric acid,	$13 39
44.6 pounds of reverted phosphoric acid,	3 35
27.8 pounds of insoluble phosphoric acid,	83
27.8 pounds of potassium oxide,	1 53
68.3 pounds of nitrogen,	12 01
	$31 11

C. A. GOESSMANN,

State Inspector.

FIFTH ANNUAL REPORT

OF THE

DIRECTOR OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

FIFTH ANNUAL REPORT

OF THE

DIRECTOR OF THE STATE AGRICULTURAL EXPERIMENT STATION AT AMHERST, MASS.

To the Honorable Board of Control.

GENTLEMEN: — The advantages expected from a better outfit in the chemical laboratory, the feeding department and the field have been fairly realized during the past year. The examinations carried on in the laboratory have been more varied and more numerous; the feeding experiments have received deservedly an increased attention; and the assignment of fields for definite lines of investigation has been advanced wherever circumstances have advised that course.

The laboratory building is in a good state of repair. The supply of new apparatus has been regulated by the means at our disposal for that purpose. Much has been accomplished in that way; more still remains to be done to meet the constant demands, arising partly from an unavoidable destruction of apparatus and partly from new inquiries into more intricate subjects of animal and vegetable economy.

The stalls lately built for a better accommodation of horses, cattle and swine have been completed according to designs. Ample provisions have been made to supply them with hot and cold water when needed. A new milk-setting room and an ice-house have just been finished to complete the outfit for observations concerning the products of the dairy. Some additional plain structures will be needed before long, to provide rooms for experiments with sheep and growing cattle.

The barn and adjoining sheds are well preserved. Some parts of them have been transformed into a balance room, a feed room, a seed room, a tool room and workshop, and an office, aside from some root pits and silos.

The dwelling-house of the farmer is, as far as circumstances permit, in a satisfactory condition. The building will soon need, however, in common with some of the older farm buildings, a new coat of paint.

The work in the field has been greatly increased, in consequence of the recent addition of an area of thirty acres of land. These lands are located on the east side of the highway, and consist of ten acres of wood land and of twenty acres of worn-out grass land. Twelve acres of the latter, which had been underdrained, graded and ploughed during the preceding year, were utilized during the past season for the raising of potatoes, corn, horse bean, squashes, oats and barley. Most of the crops succeeded fairly, while others suffered seriously from frequent and heavy rainfalls during the months of July and August. The lower part of this portion of the lands, about four acres in size, has been seeded down into a permanent meadow. The upper part will be again planted with some general farm crop, to renovate it, by drill cultivation, for future experiments. The remaining eight acres of old grass land have been extensively underdrained during the latter part of the autumn and subsequently ploughed. These lands are designed to serve ultimately in part for the cultivation of general farm crops and for a fruit orchard for experimental purposes.

The lands located on the west side of the high road have been resurveyed, and the outlines of each experimental field marked by painted gas pipes; the latter are buried four feet in the soil, to prevent the shifting of the markers and to serve the farmer as future guides in ploughing, etc. The entire area of ploughed land is divided into four distinct fields, named A, B, C, D, of which there is a complete record of their past history.

The experimental work carried on in the barn, the fields and the laboratory of the Station during the past years is described in the subsequent pages under the following headings:—

1. Experiments with milch cows; English hay, corn fodder, fodder corn, ensilage, roots, etc.

2. Experiments with milch cows; with green fodder, vetch and oats, Southern cow pea, serradella, etc.

3. Experiments with pigs; with skim-milk, corn meal, gluten meal, and wheat bran.

4. On fodder supply and analyses of fodder articles.

5. Fodder corn raised with single articles of plant food.

6. Fodder crops raised with and without complete manure.

7. Experiments with wheat, vetch and oats, serradella, and Southern cow pea.

8. Experiments with potatoes, roots, and miscellaneous crops.

9. Suggestions upon planting trees and small fruits, by Prof. S. T Maynard.

10. Fertilizer and fertilizer analyses; miscellaneous analyses.

11. Well-water analyses.

12. Compilation of analyses of fodder articles with reference to food value.

13. Compilation of analyses of fodder articles with reference to fertilizing ingredients.

14. Compilation of analyses of agricultural chemicals and refuse materials used for fertilizing purposes.

15. Meteorological observations.

From the previous enumeration of subjects reported on, it will be noticed that some of them are reports of progress, regarding questions for one or two years already under investigation; while others are new additions to the work assigned.

This feature in the communications on experimental work is but natural when remembering that one year's observation in field work does only in exceptional cases entitle to a final conclusion.

Some compilations of our previous analyses of fodder articles, agricultural chemicals and refuse material from various branches of industry have been added for the purpose of placing permanently on record for reference certain facts concerning these materials. These abstracts cannot otherwise but prove acceptable to the farmers of the State.

The tabular statement of the extremes of temperature at Amherst, Mass., from the year 1836 to 1888, has been prepared at the special request of the U. S. Forestry department.

The periodical publications of the Station have been as numerous as in previous years. The interest in the bulletins and annual reports has been steadily growing during the past year. The number of bulletins printed has been raised from 5,000 in 1886 to 6,000 in 1887, and will be increased to 7,000 early in the coming season.

It gives me particular pleasure to bear testimony to the satisfactory support I have had from all parties engaged with me in the work of the Station.

In conclusion permit me to thank you very sincerely for the liberal support I have enjoyed in performing the duties assigned to me.

Yours very respectfully,

C. A. GOESSMANN,

Director of the State Agricultural Experiment Station.

ON FEEDING EXPERIMENTS.

I. Feeding Experiments with Milch Cows; English Hay, Corn Fodder, Fodder Corn, Ensilage, Roots, etc.

II. Feeding Experiments with Milch Cows; with Green Fodder, Vetch and Oats, Southern Cow Pea, Serradella, etc.

III. Feeding Experiments with Pigs; Skim-milk, Corn Meal, Gluten Meal and Wheat Bran.

I. Feeding Experiments with Milch Cows.

The feeding experiments with milch cows reported within a few subsequent pages are essentially a continuation of those described in the fourth annual report of the Station (1886–1887). To compare the feeding effect of dried fodder corn, corn fodder (stover), and corn ensilage as a substitute, in whole or in part, for English hay, and that of corn ensilage as compared with that of roots, under otherwise corresponding circumstances, has been the principal object of our work on both occasions.

The same fodder articles have been used in both trials, with the exception that in the experiments discussed below carrots have been taken instead of sugar beets, which were used in the preceding year. Aside from this temporary modification in the diet, a comparatively new fodder article, the gluten meal, has been added as a temporary ingredient of the daily fodder ration. This particular change in the composition of the feed used was made for the purpose of securing, whenever desired, a closer numerical relation between the digestible nitrogenous and non-nitrogenous organic constituents of the food consumed as compared with that which served in our previous experiments. The gluten meal was chosen from among the various concentrated commercial feed-stuffs on account of its close relation to corn, of which it constitutes a part, and its higher nitrogenous character when compared with that of the corn meal and the wheat bran (shorts).

Three cows, mixed breed, from five to six years old, were selected for our work. They were practically in the same milking period, from three to six weeks after calving, at the beginning of the trial. The observation extended over a period of seven months, — October 1, 1886, to April 24, 1887.

The temporary changes in the diet, wherever decided upon, were carried out gradually, as it is customary in all carefully conducted feeding experiments. At least five days are allowed in every instance to pass by, in case of a change in the character of the feed, before the daily observations of the results appear in our published records. The dates which accompany all detailed reports of our feeding experiments, past and present, furnish exact figures in that direction. This is, in particular, the case whenever such statements are of a special interest, for an intelligent appreciation of the final conclusions presented.

As our feeding experiments with milch cows were originally undertaken with the intention of carrying out a systematic course of inquiry into the economical relations of the production of milk with reference to the dairy industry, as well as to a practical general farm management, it was thought best, for various reasons, to begin our work with cows of moderate milking qualities. The effect of different diets on the quantity and quality of the milk produced, as well as their bearing on the net cost of production, promised to be of particular interest under the stated circumstances. A beginning of our work at the lower end of the scale of the production of milk offered besides, the particular advantage that the results obtained, by a careful mode of observation, might find a direct application to a still quite numerous class of cows on our farms, which are not infrequently assumed to be of but little merit from an economical standpoint. It is our intention to publish, as soon as practicable, a statement concerning the annual yield of milk of some of our cows at present on trial, and also the net cost of its production, as far as the feed is concerned, to show more plainly the annual profits of keeping cows of moderate milking qualities.

The daily diet of the cows consisted, at the beginning of the experiments, of three and one-quarter pounds of corn meal, an equal weight of wheat bran, and all the hay they could eat. The actual amount of hay consumed in each case was ascertained by daily weighing out a liberal supply of it, and deducting subsequently the hay left over.

The statement in our records below refers to the average consumption of hay per day during the feeding period.

The above stated combination of fodder articles was adopted as the basis of our investigation mainly for the reason that it had been used with satisfactory results in some of our earlier feeding experiments, and not on the assumption of its being the best possible combination of fodder articles for milch cows. The weights of the animals were taken on the same day of each week before milking and feeding.

The valuation of the various fodder articles consumed is based on the local market price per ton in Amherst when used.

Good English hay, .	$15.00.	Rye middlings, . .	$24.00.
Corn meal, ...	23.00.	Dry corn fodder (stover),	5.00.
Wheat bran, . . .	20.00.	Corn ensilage, . .	2.75.
Gluten meal, . . .	23.00.	Carrots, ...	7.00.

The *value* of a fodder for dairy purposes may be stated from *two distinctly different standpoints;* namely, with reference to its *influence on the temporary yield of milk* and *the general condition of the animals* which consume it, and in regard to its *first cost,* — i. e., its *physiological* and *commercial value.*

The market value and the actual feeding effect of one and the same article do not necessarily correspond with each other; in fact, they rarely coincide.

The market value may be stated for each locality by one definite number. The feeding effect of one and the same substance, simple or compound, *varies* under *different circumstances*, and depends in a controlling degree on its *judicious use in compounding diets.*

As no single plant or part of plant has been found to supply economically and efficiently, to any considerable extent, the wants of our various kinds of farm stock, it becomes a matter of first importance to learn how to supplement our leading farm crops to meet the divers wants of each kind. To secure the highest feeding value of each article of fodder is most desirable in the interest of good economy. The judicious selection of ingredients for a suitable and remunerative diet for our dairy stock obliges us, therefore, to study the value of the fodder articles at our disposal from both standpoints.

The chemical analyses of the various articles used in the combination of fodder in our case are stated in some succeeding pages to show their character and their respective quality. To ascertain the chemical composition of a fodder ration, in connection with an otherwise carefully managed feeding experiment, enables us to recognize with more certainty the causes of the varying feeding effects of one and the same fodder article when fed in different combinations. It furnishes, also, a most valuable guide in the selection of suitable *commercial feed stuffs* from *known sources* to supplement economically our home-raised fodder crops. Practical experience in feeding stock has so far advanced that it seems to need no further argument to accept it as a matter of fact that the efficiency of a fodder ration in the dairy does not depend, aside from its general or special adaptation, on the mere presence of more or less of certain prominent fodder articles, but on the presence of a proper quantity and a certain relative proportion of certain prominent constituents of plants, which are known to be essential for a successful support of life and of the special functions of the dairy cow.

Investigations into the relations which the various prominent constituents of plants bear to the support of animal life have rendered it advisable to classify them, in this connection, into *three* groups, — *mineral constituents*, and *nitrogenous* and *non-nitrogenous organic constituents*. For details regarding this matter I have to refer to previous publications of the Station. (See Fourth Annual Report, pages 31–37.) Numerous and extensive practical feeding experiments with most of our prominent fodder articles in various conditions, and with all kinds of farm live stock, have introduced the practice of reporting, in connection with the analysis of the chemist, also, the result of careful feeding experiments, as far as the various fodder articles have proved digestible, and were thus qualified for the support of the life and the functions of the particular kind of animal on trial. In stating the amount of the digestible portion of the fodder consumed in a feeding experiment, it has proved useful, for comparing different fodder rations, etc., to make known by a distinct record the relative proportion which has been noticed to exist between the amount of its digestible nitrogenous and non-nitrogenous organic constituents. This relation is expressed by the name of "Nutritive Ratio." An examination of the subsequent short description of our feeding experiments will show, for instance, that the corn meal fed contained one part of digestible nitrogenous to 8.76 parts of digestible non-nitrogenous organic matter, making the customary allowance for the higher physiological value of the fat as compared with that of starch, sugar, etc. (2.5 times higher). The "Nutritive Ratios" of the articles of feed consumed are subsequently stated, as follows: —

Corn meal, . . .	1 : 8.76.	English hay, . .	1 : 9.5.
Wheat bran, . .	1 : 3.47.	Dry corn fodder, . .	1 : 9.3.
Gluten meal, . .	1 : 2.67.	Corn ensilage, . .	1 : 11.9.
Rye middlings, . .	1 : 7.23.	Carrots, . . .	1 : 9.24.

The results of our own analyses of these fodder articles are here turned to account for the calculation of the above stated "Nutritive Ratios."

It has been noticed that, as a general rule, growing animals and milch cows require a richer food, i. e., a closer relation of digestible nitrogenous and non-nitrogenous organic constituents in their feed, to do their best, than full-grown animals and moderately worked horses or oxen. German investigators recommend a combination of fodder articles, in other respects suitable, which contains one part of digestible nitrogenous organic constituents to 5.4 parts of digestible non-nitrogenous constituents.

From the description of our earlier feeding experiments with milch cows (see Fourth Annual Report, page 11), it may be observed, that the relations of the digestible nitrogenous and non-nitrogenous organic constituents in the different combinations of fodder articles which constituted, during the various feeding periods, the daily diet of the cows, varied on that occasion from 1 : 6.7 to 1 : 10.17. The closer relation was obtained by feeding on an average, daily, —

3¼ lbs. of wheat bran, 15 lbs. of hay, 40 lbs. of Lane's sugar beet,	Nutritive ratio, 1 : 6.7.

And the wider ratio by feeding daily on an average, —

3¼ lbs. of corn meal, 5 lbs. of hay, 41¾ lbs. of corn ensilage,	Nutritive ratio, 1 : 10.17.

(See Daisy.) During our more recent feeding experiments described below, on the whole, closer relations are adopted than before. The relations between the two above stated important groups of fodder constituents vary from 1 : 5.9 to 1 : 7.9; they are also more uniform during the various feeding periods. The closer relation is obtained by feeding daily on an average, —

3¼ lbs. of corn meal,* 3¼ lbs. of wheat bran,* 3¼ lbs. of gluten meal, 10 lbs. of hay, 35 lbs. of carrots,	Nutritive ratio, 1 : 5.9.

and the wider ratio by feeding daily on an average, —

3¼ lbs. of corn meal, 3¼ lbs. of wheat bran, 25 lbs. of hay,	Nutritive ratio, 1 : 7.9.

(See Dora.) The entire recent feeding experiment (I.) is subdivided into eight distinctly different feeding periods; the same number as on the preceding occasion, for the same length of time, — seven months.

The dry corn fodder, the ensilage and the roots were cut, before being offered as feed. The exact amount consumed of each fodder article was ascertained by taking their weights before feeding and deducting the amount left, if any. Grain and roots were usually fed during milking, and the coarse fodder between times.

* 3¼ lbs. of wheat bran is equal to four quarts; and 3¼ lbs. of corn meal is equal to two quarts.

A careful examination of our subsequently tabulated feeding records of each cow (Susie, Meg and Dora), leads apparently with much propriety, among others, to the following conclusions: —

The *nutritive* value of our dry corn fodder compares well with that of an average quality of English hay; the same may be said of good corn ensilage in place of from one-half to two-thirds of the customary amount of hay.

The *nutritive* value of our dry corn fodder (stover) and of a good corn ensilage, taking into consideration pound for pound of the dry vegetable matter they contain, has proved in our case fully equal, if not superior, to that of the average English hay.

The *nutritive* feeding value of carrots, taking into consideration pound for pound of the dry matter they contain, exceeds that of the corn ensilage as an ingredient of the daily diet, in place of a part (one-half) of the hay fed. The conclusions thus far stated are in full agreement with those pointed out in our earlier experiments.

The influence of the *various diets* used, on the *quality* of the milk, seems to depend in a controlling degree on the constitutional characteristics of the animal on trial. The effect is not unfrequently in our case the reverse in different animals depending on the same diet.

The yield of the milk decreased, although at a different rate, in the case of different animals as time advanced. The shrinkage in the daily yield of milk amounted, at the end of the entire experiment, to from 3.2 quarts to 4.9 quarts in case of different cows. The gradual decline in the entire milk record of every cow is only once broken; namely, during the sixth feeding period, Feb. 7th to Feb. 21st, when the yield of milk shows an increase of from .7 to 1.9 quarts per day, as compared with that of the preceding period. This change for the better was noticed when ten pounds of hay and thirty-four pounds of carrots were used, under otherwise corresponding circumstances, as a substitute for five pounds of hay and twenty-nine pounds of corn ensilage; the amount of dry vegetable matter contained in the hay fed with roots and in the hay fed with corn ensilage was practically the same in both instances. The feed of the sixth feeding period, containing carrots as an ingredient, is thus the most nutritive and also the most expensive.

The total cost of the feed consumed for the production of milk is lowest wherever corn fodder or corn ensilage have replaced, in the whole or in part, English hay, under otherwise corresponding circumstances.

The net cost of feed consumed for the production of one quart of milk, during the various feeding periods, varies as widely as from .34 cents to 1.6 cents in case of the same cow. The net cost of the feed is obtained by deducting 80 per cent. of the value of the fertilizing constituents it contains.

The manurial value of the feed consumed during the entire feeding experiment, deducting 20 per cent. for the amount of fertilizing constituents lost in the production of milk, is, at current market rates, in every instance, more than equal to one-third of the original cost of the feed.

Two cows gained from 60 to 66 pounds in live weight during the trial; and one—the best milker, Dora—held practically her own from beginning to end.

For further details see the following pages. To avoid misconstruction regarding the statement of net cost of milk used in our description, I state once more that it does not include expenses for labor, housing, interest on investment, etc., but means merely net cost of feed after deducting 80 per cent. of its manurial value.

SUSIE: Age, Five Years; Grade, Ayrshire; Last Calf, July 14, 1886.

Feeding Periods.	Feed Consumed (pounds) per day. Wheat Bran.	Corn Meal.	Gluten Meal.	Rye Middlings.	Hay.	Ensilage.	Corn Fodder.	Roots (Carrots).	Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
1886.													
1. Oct. 1 to 25,	3.25	3.25	-	-	21.92	-	-	-	28.59	13.5	2.11	1:7.9	855
2. Nov. 1 to 16,	3.25	3.25	3.25	-	19.03	-	-	-	26.15	13.2	1.98	1:6.1	877
3. Dec. 6 to 13,	-	3.25	3.25	3.25	20.00	-	-	-	27.65	11.8	2.35	1:6.8	883
4. Dec. 21 to 31,	3.25	3.25	-	-	-	-	21.36	-	23.81	11.9	2.00	1:7.7	883
1887.													
5. Jan. 18 to 31,	3.25	3.25	3.25	-	5.00	32.79	-	-	22.60	11.0	2.06	1:6.4	897
6. Feb. 7 to 21,	3.25	3.25	3.25	-	10.00	-	-	35.00	21.36	12.9	1.66	1:5.9	914
7. Mar. 9 to 25,	3.25	3.25	3.25	-	20.00	-	-	-	27.00	11.1	2.42	1:6.2	951
8. Apr. 6 to 24,	3.25	3.25	3.25	-	18.95	-	-	-	26.07	9.4	2.76	1:6.1	1,019

MEG: AGE, SIX YEARS; GRADE, DEVON; LAST CALF, AUG. 2, 1886.

FEEDING PERIODS.	Feed Consumed (pounds) per day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Wheat Bran.	Corn Meal.	Gluten Meal.	Rye Middlings.	Hay.	Ensilage.	Corn Fodder.	Roots (Carrots).					
1886.													
1. Oct. 1 to 25,	3.25	3.25	–	–	25.00	-	–	–	28.66	13.9	2.06	1:7.9	1,023
2. Nov. 1 to 16,	3.25	3.25	3.25	–	19.34	–	–	–	26.44	13.2	2.00	1:6.1	1,049
3. Dec. 6 to 13,	–	3.25	3.25	3.25	20.00	–	–	-	27.65	12.9	2.15	1:6.8	1,078
4. Dec. 21 to 31,	3.25	3.25	–	–	–	–	17.59	–	20.62	12.0	1.72	1:7.5	1,023
1887.													
5. Jan. 18 to 31,	3.25	3.25	3.25	–	5.00	25.25	–	–	20.46	10.3	1.98	1:6.1	1,055
6. Feb. 7 to 21,	3.25	3.25	3.25	–	10.00	–	–	35.00	21.36	11.0	1.94	1:5.9	1,083
7. Mar. 9 to 25,	3.25	3.25	3.25	-	20.00	–	–	–	27.00	10.9	2.50	1:6.2	1,087
8. Apr. 6 to 24,	3.25	3.25	3.25	–	18.95	–	–	–	26.07	10.7	2.43	1:6.1	1,149

DORA: AGE, SIX YEARS; GRADE, DEVON; LAST CALF, SEPT. 6, 1886.

FEEDING PERIODS.	Feed Consumed (pounds) per day.								Amount of dry vegetable matter contained in the daily fodder consumed (in pounds).	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Wheat Bran.	Corn Meal.	Gluten Meal.	Rye Middlings.	Hay.	Ensilage.	Corn Fodder.	Roots (Carrots).					
1886.													
1. Oct. 1 to 25,	3.25	3.25	–	–	23.00	–	–	–	26.86	16.3	1.65	1:7.8	882
2. Nov. 1 to 16,	3.25	3.25	3.25	–	17.70	–	–	–	21.92	15.7	1.59	1:6.0	859
3. Dec. 6 to 13,	–	3.25	3.25	3.25	20.00	–	–	–	26.98	14.6	1.85	1:6.8	889
4. Dec. 21 to 31,	3.25	3.25	–	–	–	–	19.77	–	22.46	14.0	1.60	1:7.7	851
1887.													
5. Jan 18 to 31,	3.25	3.25	3.25	–	5.00	28.64	–	–	21.42	12.8	1.68	1:6.2	856
6. Feb. 7 to 21,	3.25	3.25	3.25	–	10.00	–	–	35.00	21.36	13.5	1.58	1:5.9	855
7. Mar. 9 to 25,	3.25	3.25	3.25	–	20.00	–	–	–	27.00	12.2	2.21	1:6.2	836
8. Apr. 6 to 24,	3.25	3.25	3.25	–	18.95	–	–	–	26.07	11.7	2.23	1:6.1	877

Total Cost of Feed per Quart of Milk.

(SUSIE.)

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Wheat Bran consumed during period.	Total amount of Corn Meal consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Rye Middlings consumed during period.	Total amount of Hay consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Fodder consumed during period.	Total amount of Roots (Carrots) consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1886.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
1. Oct. 1 to 25,	338.6	13.5	81.25	81.25	–	–	623.0	–	–	–	$6 41	1.89
2. Nov. 1 to 16,	211.3	13.2	52.00	52.00	52.00	–	304.5	–	–	–	4 00	1.89
3. Dec. 6 to 13,	94.0	11.8	–	28.00	28.00	28.00	160.0	–	–	–	2 18	2.31
4. Dec. 21 to 31,	130.5	11.9	35.75	35.75	–	–	–	–	235.0	–	1 36	1.04
1887.												
5. Jan. 18 to 31,	153.3	11.0	45.50	45.50	45.50	–	70.0	459.0	–	–	2 66	1.74
6. Feb. 17 to 21,	193.5	12.9	48.75	48.75	48.75	–	150.0	–	–	525.0	4 58	2.37
7. Mar. 9 to 25,	189.8	11.1	55.25	55.25	55.25	–	340.0	–	–	–	4 38	2.31
8. Apr. 6 to 24,	179.0	9.4	61.75	61.75	61.75	–	360.0	–	–	–	3 84	2.15

Total Cost of Feed per Quart of Milk.

(Meg.)

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Wheat Bran consumed during period.	Total amount of Corn Meal consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Rye Middlings consumed during period.	Total amount of Hay consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Fodder consumed during period.	Total amount of Roots (Carrots) consumed during period.	Total cost of Feed consumed during period.	Average cost of feed for production of one qt. of Milk for period.
1886.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
1. Oct. 1 to 25,	347.8	13.9	81.25	81.25	–	–	625.0	–	–	–	$6 43	1.85
2. Nov. 1 to 16,	211.0	13.2	52.00	52.00	52.00	–	309.5	–	–	–	4 04	1.91
3. Dec. 6 to 13,	103.0	12.9	–	28.00	28.00	28.00	160.0	–	–	–	2 18	2.12
4. Dec. 21 to 31,	132.0	12.0	35.75	35.75	–	–	–	–	193.5	–	1 25	.95
1887.												
5. Jan. 18 to 31,	144.5	10.3	45.50	45.50	45.50	–	70.0	353.5	–	–	2 51	1.74
6. Feb. 7 to 21,	165.5	11.0	48.75	48.75	48.75	–	150.0	–	–	525.0	4 57	2.76
7. Mar. 9 to 25,	184.0	10.9	55.25	55.25	55.25	–	340.0	–	–	–	4 38	2.38
8. Apr. 6 to 24,	203.3	10.7	61.75	61.75	61.75	–	360.0	–	–	–	3 84	1.90

Total Cost of Feed per Quart of Milk.

(DORA.)

FEEDING PERIODS.	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Wheat Bran consumed during period.	Total amount of Corn Meal consumed during period.	Total amount of Gluten Meal consumed during period.	Total amount of Rye Middlings consumed during period.	Total amount of Hay consumed during period.	Total amount of Ensilage consumed during period.	Total amount of Corn Fodder consumed during period.	Total amount of Roots (Carrots) consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one qt. of Milk for period.
1886.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
1. Oct. 1 to 25,	408.0	16.3	81.25	81.25	–	–	576.0	–	–	–	$6 05	1.48
2. Nov. 1 to 16,	251.5	15.7	52.00	52.00	52.00	–	283.0	–	–	–	3 84	1.53
3. Dec. 6 to 13,	116.5	14.6	–	28.00	28.00	28.00	160.0	–	–	–	2 18	1.87
4. Dec. 21 to 31,	154.0	14.0	35.75	35.75	–	–	–	–	217.5	–	1 31	.85
1887.												
5. Jan. 18 to 31,	179.0	12.8	45.50	45.50	45.50	–	70.0	401.0	–	–	2 58	1.44
6. Feb. 7 to 21,	203.0	13.5	48.75	48.75	48.75	–	150.0	–	–	525.0	4 58	2.26
7. Mar. 9 to 25,	208.0	12.2	55.25	55.25	55.25	–	340.0	–	–	–	4 38	2.11
8. Apr. 6 to 24,	222.3	11.7	61.75	61.75	61.75	–	360.0	–	–	–	3 84	1.73

Summary of Net Cost of Feed for each Cow during succeeding Periods.

PERIODS.	Total Cost of Feed Consumed during Period.	Value of Fertilizing Constituents contained in the Feed	Manurial Value of the Feed after deducting the 20 per cent taken by the Milk.	Net Cost of Feed for the Production of Milk during the Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
					Cents.	Lbs.
1. Susie, . .	$6 41	$2 72	$2 18	$4 23	1.21	861
Meg, . .	6 43	2 72	2 18	4 25	1.22	1,030
Dora, . .	6 05	2 58	2 06	3 99	.98	860
2. Susie, . .	4 00	1 92	1 54	2 46	1.16	896
Meg, . .	4 04	1 92	1 54	2 50	1.18	1,055
Dora, . .	3 84	1 85	1 48	2 36	.94	876
3. Susie, . .	2 18	92	74	1 44	1.53	883
Meg, . .	2 18	92	74	1 44	1.40	1,056
Dora, . .	2 18	92	74	1 44	1.24	884
4. Susie, . .	1 36	1 00	80	56	.43	876
Meg, . .	1 25	89	71	54	.41	1,020
Dora, . .	1 31	96	78	53	.34	844
5. Susie, . .	2 66	1 48	1 18	1 48	.97	905
Meg, . .	2 51	1 39	1 11	1 41	.98	1,070
Dora, . .	2 58	1 43	1 14	1 44	.89	860
6. Susie, . .	4 58	1 67	1 34	3 24	1.67	921
Meg, . .	4 58	1 67	1 34	3 24	1.96	1,096
Dora, . .	4 58	1 67	1 34	3 24	1.60	852
7. Susie, . .	4 38	2 09	1 67	2 71	1.43	967
Meg, . .	4 38	2 09	1 67	2 71	1.47	1,101
Dora, . .	4 38	2 09	1 67	2 71	1.30	831
8. Susie, . .	3 84	2 27	1 82	2 02	1.13	1,060
Meg, . .	3 84	2 27	1 82	2 02	.99	1,170
Dora, . .	3 84	2 27	1 82	2 02	.91	885

Summary.

Susie.

Total amount of milk produced during above records, .	1,490 qts.
Total cost of feed per quart of milk produced, . . .	1.97 cts.
Manurial value left behind per quart of milk produced, .	.75 cts.
Net cost per quart of milk produced, ...	1.22 cts.

Meg.

Total amount of milk produced during above records, . .	1,491.1 qts.
Total cost of feed per quart of milk produced, . . .	1.96 cts.
Manurial value left behind per quart of milk produced, .	.75 cts.
Net cost per quart of milk produced, ...	1.21 cts.

Dora.

Total amount of milk produced during above records, . .	1,742.3 qts.
Total cost of feed per quart of milk produced, . . .	1.65 cts.
Manurial value left behind per quart of milk produced, .	.64 cts.
Net cost per quart of milk produced, ...	1.01 cts.

Manurial Value of Feed.

Susie.

FEEDING PERIODS.	Total Cost of Feed Consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
1886.					Cents.	Lbs.
1. Oct. 1 to 25, .	$6 41	$2 72	$2 18	$4 23	1.24	861
2. Nov. 1 to 16, .	4 00	1 92	1 54	2 46	1.16	896
3. Dec. 6 to 13, .	2 18	92	74	1 44	1.53	883
4. Dec. 21 to 31, .	1 36	1 00	80	56	.43	876
1887.						
5. Jan. 18 to 31, .	2 66	1 48	1 18	1 48	.97	905
6. Feb. 7 to 21, .	4 58	1 67	1 34	3 24	1.67	921
7. Mar. 9 to 25, .	4 38	2 09	1 67	2 71	1.43	967
8. Apr. 6 to 24, .	3 84	2 27	1 82	2 02	1.13	1,060
Total, . .	$29 41	$14 07	$11 27	$18 14	-	-

MEG.

FEEDING PERIODS.	Total Cost of Feed Consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
1886.					Cents.	Lbs.
1. Oct. 1 to 25, .	$6 43	$2 72	$2 18	$4 25	1.22	1,030
2. Nov. 1 to 16, .	4 04	1 92	1 51	2 50	1.18	1,055
3. Dec. 6 to 13, .	2 18	92	74	1 44	1.40	1,056
4. Dec. 21 to 31, .	1 25	89	71	54	.41	1,020
1887.						
5. Jan. 18 to 31, .	2 51	1 39	1 11	1 41	.98	1,070
6. Feb. 7 to 21, .	4 58	1 67	1 34	3 24	1.96	1,096
7. Mar. 9 to 25, .	4 38	2 09	1 67	2 71	1.47	1,101
8. Apr. 6 to 24, .	3 84	2 27	1 82	2 02	.99	1,170
Total, . .	$29 21	$13 87	$11 11	$18 11	–	–

DORA.

FEEDING PERIODS.	Total Cost of Feed Consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting the 20 per cent. taken by the Milk.	Net Cost of Feed for the Production of Milk during Period.	Net Cost of Feed for the Production of one quart of Milk.	Weight of Animal at close of Period.
1886.					Cents.	Lbs.
1. Oct. 1 to 25, .	$6 05	$2 58	$2 06	$3 99	.98	860
2. Nov. 1 to 16, .	3 84	1 85	1 48	2 36	.94	876
3. Dec. 6 to 13, .	2 18	92	74	1 44	1.24	884
4. Dec. 21 to 31, .	1 31	96	78	53	.34	844
1887.						
5. Jan. 18 to 31, .	2 58	1 43	1 14	1 44	.80	860
6. Feb. 7 to 21, .	4 58	1 67	1 34	3 24	1.60	852
7. Mar. 9 to 25, .	4 38	2 09	1 67	2 71	1.30	831
8. Apr. 6 to 24, .	3 84	2 27	1 82	2 02	.91	885
Total, . .	$28 76	$13 77	$11 03	$17 73	–	–

Valuation of Essential Fertilizing Constituents contained in the various Articles of Fodder Used.

Nitrogen, 17 cents per pound; Phosphoric acid, 6 cents; Potassium oxide, 4¼ cents.

(*Per cent.*)

	Wheat Bran.	Corn Meal.	Gluten Meal.	Rye Middlings.	Hay.	Ensilage.	Corn Fodder.	Roots (Carrots).
Nitrogen,	2.80	1.96	5.03	1.84	1.21	0.36	1.17	0.14
Phosphoric acid,	2.36	0.77	0.30	1.26	0.36	0.14	0.37	0.10
Potassium oxide,	1.36	0.45	0.03	0.81	1.63	0.33	1.02	0.54
Valuation per 2,000 lbs.,	$13 51	$7 97	$17 49	$8 46	$5 93	$1 68	$5 26	$1 06

Analyses of Milk.

SUSIE.

(*Per cent.*)

	1886. Oct. 22.	Nov. 3.	Nov. 30.	Dec. 14.	Dec. 31.	1887. Jan. 19.	Jan. 31.	Mar. 1.	Mar. 22.	April 21.
Water,	88.10	87.65	87.21	87.16	88.23	87.75	87.27	87.50	87.68	88.26
Solids,	11.90	12.34	12.79	12.83	11.77	12.24	12.72	12.50	12.32	11.74
Fat (in solids),	3.79	3.47	4.29	3.92	3.34	3.47	4.08	3.63	3.66	3.45

MEG.

Water,	87.71	87.80	87.80	87.62	88.37	88.29	88.43	87.84	87.49	87.88
Solids,	12.29	12.20	12.20	12.38	11.63	11.71	11.57	12.16	12.51	12.12
Fat (in solids),	3.69	3.36	3.30	3.61	3.16	2.98	3.11	3.45	3.55	3.64

DORA.

Water,	87.75	87.14	87.18	87.45	87.00	86.84	87.10	87.47	86.68	86.70
Solids,	12.25	12.86	12.82	12.55	13.00	13.16	12.90	12.53	13.32	13.30
Fat (in solids),	3.60	3.96	3.89	3.73	3.77	3.77	3.27	3.71	3.91	3.85

HAY.

[From Experiment Station.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.30	166.00	–	–	1 : 9.5
Dry Matter,	91.70	1,834.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.12	122.40	–	–	
" Cellulose,	30.19	603.80	350.20	58	
" Fat,	2.55	51.00	23.46	46	
" Protein (Nitrogenous Matter),	9.75	195.00	111.15	57	
Non-nitrogenous Extract Matter,	51.39	102.78	647.51	63	
	100.00	2,000.00	1,132.32	–	

DRY CORN FODDER (STOVER).

[From Experiment Station.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	15.40	308.00	–	–	1 : 9.3
Dry Matter,	84.60	1,692.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	4.22	84.40	–	–	
" Cellulose,	20.93	418.60	301.39	72	
" Fat,	2.63	52.60	39.45	75	
" Protein (Nitrogenous Matter),	9.17	183.40	133.88	73	
Non-nitrogenous Extract Matter,	63.05	1,261.00	844.87	67	
	100.00	2,000.00	1,319.59	–	

CORN ENSILAGE.

[From the Silos of the Experiment Station.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	71.60	1,432.00	-	-	1 : 11.9
Dry Matter,	28.40	568.00	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude Ash,	3.32	66.40	-	-	
" Cellulose,	18.52	370.40	266.69	72	
" Fat,	6.07	121.40	91.05	75	
" Protein (Nitrogenous Matter),	7.78	155.60	113.59	73	
Non-nitrogenous Extract Matter,	64.31	1,286.20	861.75	67	
	100.00	2,000.00	1,333.08	-	

CARROTS.

[Raised at the Experiment Station, 1886.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	90.02	1,800.40	-	100	1 : 9.24
Dry Matter,	9.98	199.60	-		
	100.00	2,000.00	-		
Analysis of Dry Matter.					
Crude Ash,	11.21	224.20	-		
" Cellulose,	10.76	215.20	215.20		
" Fat,	1.89	37.80	37.80		
" Protein (Nitrogenous Matter),	8.90	178.00	178.00		
Non-nitrogenous Extract Matter,	67.24	1,344.80	1,344.80		
	100.00	2,000.00	1,775.80		

The average amount of dry matter in well grown carrots is usually stated (E. Wolff) to be 15 per cent. of the weight of the fresh root; in *our* case it varied from *9 to 12* per cent., according to the size of the root tested. Large specimens of roots contain frequently a smaller amount of dry vegetable matter than smaller ones equally matured. Cultivation, manuring, season and time of seeding, aside from fitness of the soil, affect seriously the general character of the root crops. In our case, soil and state of fertilization were favorable, — frequent rains towards the close of the summer season had favored apparently in an exceptional degree the growth of the leaves at the expense of a timely maturing of the roots.

Analysis of Carrots with reference to Fertilizing Constituents.

	Per cent.
Moisture at 100° C.,	90.02
Ferric oxide,	0.01
Phosphoric acid (6 cents per pound),	0.10
Magnesium oxide,	0.02
Calcium oxide,	0.07
Potassium oxide (4¼ cents per pound),	0.54
Sodium oxide,	0.11
Nitrogen (17 cents per pound),	0.14
Insoluble matter,	0.01

Valuation per 2,000 pounds,	$1 06

CORN MEAL.

[Amherst, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.62	252.40	–	–	1 : 8.76
Dry Matter,	87.38	1,747.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	1.56	31.20	–	–	
" Cellulose,	2.66	53.20	18.09	34	
" Fat,	4.27	85.40	64.90	76	
" Protein (Nitrogenous Matter,	11.43	228.60	194.31	85	
Non-nitrogenous Extract Matter,	80.08	1,601.60	1,505.50	94	
	100.00	2,000.00	1,782.80	–	

WHEAT BRAN.

[Amherst, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.87	217.40	–	–	1 : 3.47
Dry Matter,	89.13	1,782.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	5.90	118.00	–	–	
" Cellulose,	8.27	165.40	33.08	20	
" Fat,	4.40	88.00	70.40	80	
" Protein (Nitrogenous Matter,	19.63	392.60	345.53	88	
Non-nitrogenous Extract Matter,	61.80	1,236.00	988.80	80	
	100.00	2,000.00	1,437.81	–	

RYE BRAN (Middlings).

[Amherst Mills.]

74.63 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.)	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.54	250.80	–	–	1 : 7.28
Dry Matter,	87.46	1,749.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	4.02	80.40	–	–	
" Cellulose,	3.70	74.00	6.66	9.0	
" Fat,	5.61	112.20	64.52	57.5	
" Protein (Nitrogenous Matter),	13.15	263.00	173.58	66.0	
Non-nitrogenous Extract Matter,	73.52	1,470.40	1,095.45	74.5	
	100.00	2,000.00	1,340.21	–	

Analysis of Rye Bran with Reference to Fertilizing Constituents.

One hundred parts of air-dried Bran contained: —

	Per cent.
Moisture at 100° C.,	12.54
Phosphoric acid (6 cents per pound),	1.26
Magnesium oxide,	0.32
Calcium oxide,	0.09
Ferric oxide,	0.02
Potassium oxide, (4¼ cents per pound),	0.81
Sodium oxide,	0.03
Nitrogen (17 cents per pound),	1.84
Insoluble matter,	0.17
Valuation per 2,000 pounds,	$8 46

CHICAGO GLUTEN MEAL.

96.81 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.83	176.60	–	–	1 : 2.67
Dry Matter,	91.17	1,823,40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	0.73	14.60	–	–	
" Cellulose,	0.79	15.80	5.37	34	
" Fat,	8.46	169.20	128.59	76	
" Protein (Nitrogenous Matter),	31.43	628.60	534.31	85	
Non-nitrogenous Extract Matter,	58.59	1,171.80	1,101.49	94	
	100.00	2,000.00	1,769.76	–	

The material is sold at Springfield, Mass., at $23.20 per ton.

Analysis of Gluten Meal with reference to Fertilizing Constituents.

	Per cent.
Moisture at 100° C.,	8.83
Phosphoric acid (6 cents per pound),	0.30
Ferric oxide,	0.05
Magnesium oxide,	0.03
Calcium oxide,	0.03
Potassium oxide ($4\frac{1}{4}$ cents per pound),	0.03
Sodium oxide,	0.02
Nitrogen (17 cents per pound),	4.62
Valuation per 2,000 pounds,	$16 15

2. Feeding Experiments with Milch Cows.

The experiments were chiefly instituted for the purpose of comparing the feeding effect of a good English hay with that of some reputed green fodders. The green crops used in this connection consisted of a mixed crop of oats and vetch, of southern cow-pea and of serradella. Some details regarding the mode of cultivation and the general character of these fodder plants will be found farther on in this report, under the heading "Field Experiments."

The feeding of the various green fodders began at the time of their blooming; they were fed in succession as stated above, for they began to bloom in the order mentioned. The feeding of vetch and oats ceased when the oats turned yellow; that of the cow-pea and serradella terminated with the exhaustion of the supply from the first cut.

The customary rules for the management of feeding experiments, regarding the changes in feed, etc., were followed in the same manner as pointed out on previous occasions.

Five cows served in the experiment. Two cows, Ida and Lizzie, were fed during the entire trial with a daily ration, consisting of

Corn Meal, ...	3¼ pounds (2 quarts.)
Wheat Bran, ...	3¼ pounds (4 quarts.)
English Hay, ...	from 20 to 25 pounds.

The amount of hay left over was each day weighed back; the printed detailed record below gives the average daily consumption for each feeding period. Three cows, Eva, Minnie and May, received periodically the same diet as the first mentioned two. This daily diet was however replaced at stated times by the following one:

Corn Meal, ...	3¼ pounds.
Wheat Bran, ...	3¼ pounds.
English Hay, ...	5 pounds.

and as much of either green vetch and oats or green southern cow-pea or green serradella as the animals on trial would consume.

The average of the daily consumption in each feeding period is stated in the subsequent record of the experiment. One-fourth (five pounds) of the adopted full daily hay ration has been retained in our green fodder diet for the purpose of preventing disorders in the digestion of a liberal quantity of green fodder.

The green fodder diet has produced in two cases, cow pea and serradella, a decided temporary increase in the quantity of milk when compared with the English hay diet. The substitution of three-fourths of the full hay ration by cow pea and serradella has given also satisfactory results as far as the quality of the milk, the net cost of feed and the general condition of the animals on trial are concerned. The serradella leads as a rule.

The substitution of hay by the mixed crop of vetch and oats has not shown in some directions as decisive advantages. This circumstance may find its explanation in the future by the fact that our mixed crop, vetch and oats, consisted of one-tenth in dry weight of vetch to nine-tenths of that of oats; it ought to contain from one to two or equal weights. The vetches rank among the better class of fodder crops furnished by the great and important family of leguminous plants. Green vetch when fed with green oats is more relished by cattle than when fed alone.

The cost of green fodder is based on that of hay, $15.00 per ton, allowing two tons of hay, with 15 per cent. of moisture, as the average produce of English hay per acre. This mode of valuation has been adopted on account of the entire absence of market prices as far as green vetch, cow pea and serradella are concerned. These crops, as a rule, rank higher in the scale of an agricultural valuation than the meadow grass.

Produce Per Acre of Green Crops raised on the Station Grounds.

6.80 tons of grass at 75 per cent. moisture, equals 2 tons at 15 per cent. moisture.

10.89 tons of vetch and oats at 73.36 per cent. moisture, equals 1.8 tons at 15 per cent. moisture.

9.56 tons of cow pea at 80.62 per cent. moisture, equals 2.4 tons at 15 per cent. moisture.

9.50 tons of serradella at 80.14 per cent. moisture, equals 2.2 tons at 15 per cent. moisture.

Valuation Per Ton of the Articles of Fodder used.

Wheat Bran,	$21.00	Green Cow Pea,	$3.14
Corn Meal,	21.00	Green Serradella,	3.16
Hay,	15.00	Green Grass,	4.41
Green Vetch and Oats,	2.75		

A few subsequent pages contain a more detailed statement of our actual observations.

FEEDING RECORD.

LIZZIE: Five Years; Native; Last Calf, Feb. 1, 1887.

FEEDING PERIODS.	Feed Consumed (pounds) per day.			Amount of dry vegetable matter contained in the daily fodder consumed (in pounds.)	Quarts of milk produced per day.	Pounds of dry matter per quart of milk.	Nutritive Ratio.	Average weight of animal during each feeding period.
	Wheat Bran.	Corn Meal.	Hay.					
1887.								
1. June 2 to Aug. 23, ...	3.25	3.25	19.89	23.46	12.73	1.84	1:8.54	986.45
2. Sept. 1 to Oct. 25, ...	3.25	3.25	24.44	27.52	9.59	2.86	1:8.72	1,011.56

IDA: Seven Years; Grade, Durham; Last Calf, Feb. 3, 1887.

1887.								
1. June 2 to Aug. 23, ...	3.25	3.25	19.87	23.44	7.54	3.10	1:8.53	984.58
2. Sept. 1 to Oct. 25, ...	3.25	3.25	23.77	26.92	4.89	5.50	1:9.27	1,009.06

Total Cost of Feed per Quart of Milk.

(LIZZIE.)

	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Wheat Bran consumed during period.	Total amount of Corn Meal consumed during period.	Total amount of Hay consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of Milk for period.
1887.	Qts.	Qts.	Lbs.	Lbs.	Lbs.		Cents.
1. June 2 to Aug. 23,	1,056.50	12.73	269.75	269.75	1,651.25	$18 04	1.70
2. Sept. 1 to Oct. 25,	527 75	9.59	178.75	178.75	1,344.00	13 84	2.62

(IDA.)

	Total quantity of Milk produced during entire period.	Average daily yield of Milk for period.	Total amount of Wheat Bran consumed during period.	Total amount of Corn Meal consumed during period.	Total amount of Hay consumed during period.	Total cost of Feed consumed during period.	Average cost of Feed for production of one quart of Milk for period.
1887.	Qts.	Qts.	Lbs.	Lbs.	Lbs.		Cents.
1. June 2 to Aug. 23,	625.75	7.54	269.75	269.75	1,650.30	$18 04	2.88
2. Sept. 1 to Oct. 25,	269.25	4.89	178.75	178.75	1,307 75	13 57	5.04

Manurial Value of Feed.

(LIZZIE.)

FEEDING PERIODS.	Total cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting 20 per cent. taken by the Milk.	Net cost of Feed for the production of Milk during period.	Net cost of Feed for the production of one quart of Milk.	Weight of animal at close of period.
1887.					Cents.	Lbs.
1. June 2 to Aug. 23,	$18 04	$8 40	$6 72	$11 32	1.07	980.00
2. Sept. 1 to Oct. 25,	13 84	6 42	5 14	8 70	1.64	1,015.00
Total,	$31 88	$14 82	$11 86	$20 02	–	–

(IDA.)

FEEDING PERIODS.	Total cost of Feed consumed during period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting 20 per cent. taken by the Milk.	Net cost of Feed for the production of Milk during period.	Net cost of Feed for the production of one quart of Milk.	Weight of animal at close of period.
1887.					Cents.	Lbs.
1. June 2 to Aug. 23,	$18 04	$8 40	$6 72	$11 32	1.80	980.00
2. Sept. 1 to Oct. 25,	13 57	6 30	5 04	8 53	3.17	1,030.00
Total,	$31 61	$14 70	$11 76	$19 85	–	–

FEEDING RECORD.

EVA: Age Seven Years; Grade, Jersey, Last Calf, Jan. 20, 1887.

Feeding Periods.	Feed Consumed (pounds) per day.						Amount of dry vegetable matter contained in the daily fodder consumed (in pounds.)	Quarts of Milk produced per day.	Pounds of dry matter per quart of Milk.	Nutritive Ratio.	Average weight of animal during each Feeding Period.
	Wheat Bran.	Corn Meal.	Hay.	Vetch and Oats.	Cow Pea.	Serradella.					
1887.											
1. June 2 to July 7,	3.25	3.25	19.88	-	-	-	23.45	11.64	2.01	1 : 8.54	937.70
2. July 12 to 26,	3.25	3.25	5.00	59.15	-	-	25.93	10.20	2.54	1 : 6.94	902.50
3. Aug. 1 to 7,	3.25	3.25	19.82	-	-	-	23.39	9.10	2.57	1 : 8.51	917.50
4. Aug. 14 to Sept. 1,	3.25	3.25	5.00	-	97.37	-	28.94	10.71	2.70	1 : 9.01	875.83
5. Sept. 6 to 27,	3.25	3.25	5.22	-	-	97.12	29.52	9.57	3.08	1 : 5.38	933.12
6. Oct. 3 to 25,	3.25	3.25	23.52	-	-	-	26.69	7.73	3.45	1 : 8.67	938.12

FEEDING RECORD — Continued.

MINNIE: AGE, SEVEN YEARS; GRADE, AYRSHIRE; LAST CALF, MAY 3, 1887.

FEEDING PERIODS.	FEED CONSUMED (POUNDS) PER DAY.						Amount of dry vegetable matter contained in the daily fodder consumed (in pounds.)	Quarts of Milk produced per day.	Pounds of dry matter per quart of Milk.	Nutritive Ratio.	Average weight of animal during each Feeding Period.
	Wheat Bran.	Corn Meal.	Hay.	Vetch and Oats.	Cow Pea.	Serradella.					
1887.											
1. June 2 to July 7,	3.25	3.25	19.97	-	-	-	23.53	15.73	1.49	1:8.51	905.00
2. July 12 to 26,	3.25	3.25	5.00	67.80	-	-	28.24	14.53	1.94	1:6.94	895.83
3. Aug. 1 to 7,	3.25	3.25	20.14	-	-	-	23.64	12.60	1.87	1:8.57	990.00
4. Aug. 14 to Sept. 1,	3.25	3.25	5.00	-	97.37	-	28.94	15.09	1.92	1:9.01	896.66
5. Sept. 6 to 27,	3.25	3.25	5.22	-	-	98.20	29.74	14.81	2.01	1:5.36	947.50
6. Oct. 3 to 25,	3.25	3.25	24.42	-	-	-	27.50	11.60	2.57	1:8.72	958.12

FEEDING RECORD — Concluded.

MAY: Age, Six Years; Grade, Jersey; Last Calf, June 6, 1887.

Feeding Periods.	Feed Consumed (pounds) per day.						Amount of dry vegetable matter contained in the daily fodder consumed (in pounds.)	Quarts of Milk produced per day.	Pounds of dry matter per quart of Milk.	Nutritive Ratio.	Average weight of animal during each Feeding Period.
	Wheat Bran.	Corn Meal.	Hay.	Vetch and Oats.	Cow Pea.	Serradella.					
1887.											
1. June 19 to July 7,	3.25	3.25	19.82	–	–	–	23.39	13.90	1.68	1 : 8.51	815.50
2. July 12 to 26,	3.25	3.25	5.00	64.23	–	–	27.28	12.90	2.11	1 : 6.94	801.25
3. Aug. 1 to 7,	3.25	3.25	20.04	–	–	–	23.58	11.78	2.00	1 : 8.53	795.00
4. Aug. 14 to Sept. 1,	3.25	3.25	5.00	-	97.37	–	28.94	12.10	2.39	1 : 9.01	777.50
5. Sept. 6, to 27,	3.25	3.25	5.22	–	–	97.71	29.64	11.85	2.50	1 : 5.45	822.50
6. Oct. 3, to 25,	3.25	3.25	24.18	–	–	–	27.28	9.93	2.75	1 : 8.70	849.37

Total Cost of Feed per Quart of Milk.

(EVA.)

	Total quantity of Milk Produced during entire Period.	Average daily yield of Milk for Period.	Total amount of Wheat Bran Consumed during Period.	Total amount of Corn Meal Consumed during Period.	Total amount of Hay Consumed during Period.	Total amount of Vetch and Oats Consumed during period.	Total amount of Cow Pea consumed during Period.	Total amount of Serradella Consumed during Period.	Total cost of Feed Consumed during Period.	Average cost of Feed for Production of one Quart of Milk for Period.
1887.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
1. June 2 to July 7,	419.00	11.64	117.00	117.00	716.00	–	–	–	$7 83	1.39
2. July 12 to 26,	153.00	10.20	48.75	48.75	75.00	887.25	–	–	2 81	1.84
3. Aug. 1 to 7,	63.75	9.10	22.75	22.75	138.75	-	-	-	1 52	2.38
4. Aug. 14 to Sept. 1,	203.50	10.71	61.75	61.75	95.00	-	1,850.00	-	4 91	2.41
5. Sept. 6 to 27,	210.50	9.57	71.50	71.50	115.00	–	–	2,136.75	5 74	2.25
6. Oct. 3 to 25,	178.25	7.73	74.75	74.75	521.00	–	–	–	5 46	3.06

Total Cost of Feed per Quart of Milk — Continued.

(Minnie.)

	Total quantity of Milk Produced during entire Period.	Average daily yield of Milk for Period.	Total amount of Wheat Bran Consumed during Period.	Total amount of Corn Meal Consumed during Period.	Total amount of Hay Consumed during Period.	Total amount of Vetch and Oats Consumed during Period.	Total amount of Cow Pea Consumed during Period.	Total amount of Serradella Consumed during Period.	Total cost of Feed Consumed during Period.	Average cost of Feed for Production of one Quart of Milk for period.
1887.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
1. June 2 to July 7, ...	566.25	15.73	117.00	117.00	719.00	-	-	-	$7 85	1.38
2. July 12 to 26, ...	218.00	14.53	48.75	48.75	75.00	1,017.00	-	-	2 99	1.37
3. Aug. 1 to 7, ...	88.25	12.60	22.75	22.75	141.00	-	-	-	1 54	1.74
4. Aug. 14 to Sept. 1, ...	286.70	15.09	61.75	61.75	95.00	-	1,850.00	-	4 91	1.72
5. Sept. 6 to 27, ...	326.00	14.81	71.50	71.50	115.00	-	-	2,160.50	5 78	1.77
6. Oct. 3 to 25, ...	267.00	11.60	74.75	74.75	561.75	-	-	-	5 77	2.16

Total Cost of Feed per Quart of Milk — Concluded.

(May.)

	Total quantity of Milk Produced during entire Period.	Average daily yield of Milk for Period.	Total amount of Wheat Bran Consumed during Period.	Total amount of Corn Meal Consumed during Period.	Total amount of Hay Consumed during Period.	Total amount of Vetch and Oats Consumed during Period.	Total amount of Cow Pea Consumed during Period.	Total amount of Serradella Consumed during Period.	Total cost of Feed Consumed during Period.	Average cost of Feed for Production of one Quart of Milk for Period.
1887.	Qts.	Qts.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.		Cents.
1. June 19 to July 7,	264.25	13.90	61.75	61.75	376.50	-	-	-	$4 12	1.55
2. July 12 to 26,	193.50	12.90	48.75	48.75	75.00	963.50	-		2 92	1.51
3. Aug. 1 to 7,	78.25	11.78	22.75	22.75	140.25	-	-	-	1 54	1.96
4. Aug. 14 to Sept 1,	230.00	12.10	61.75	61.75	95.00	-	1,850.00	-	4 91	2.13
5. Sept. 6 to 27,	260.75	11.85	71.50	71.50	115.00	-	-	2,149.50	5 76	2.21
6. Oct. 3 to 25,	267.00	9.93	74.75	74.75	556.25	-	-	-	5 73	2.15

Valuation of Essential Fertilizing Constituents contained in the various Articles of Fodder Used.

Nitrogen, 17 cents per pound; Phosphoric acid, 6 cents; Potassium oxide, 4¼ cents.

(*Per cent.*)

	Wheat Bran.	Corn Meal.	Hay	Green Vetch and Oats.	Green Cow Pea.	Green Serradella.
Nitrogen,	2.80	1.66	1.41	0.451	0.274	0.379
Phosphoric acid,	2.36	0.77	0.41	0.100	0.098	0.124
Potassium oxide,	1.36	0.45	1.84	0.838	0.306	0.398
Valuation per 2,000 pounds,	$13 51	$6 94	$6 84	$2 36	$1 31	$1 77

Manurial Value of Feed.

(Eva.)

FEEDING PERIODS.	Total Cost of Feed Consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting 20 per cent. taken by the Milk.	Net Cost of Feed for the production of Milk during Period.	Net Cost of Feed for the production of one Quart of Milk.	Weight of animal at close of Period.
1887.					Cents.	Lbs.
1. June 2 to July 7,	$7 83	$3 64	$2 91	$4 92	1.17	956.00
2. July 12 to 26,	2 81	1 80	1 44	1 37	0.89	922.50
3. Aug. 1 to 7,	1 52	71	57	95	1.49	917.50
4. Aug. 14 to Sept. 1,	4 91	2 16	1 73	3 18	1.56	887.50
5. Sept. 6 to 27,	5 74	3 03	2 42	3 32	1.57	995.00
6. Oct. 3 to 25,	5 46	2 55	2 04	3 42	1.91	957.50
Total,	$28 27	$13 89	$11 11	$17 16	–	–

Manurial Value of Feed — Continued.

(Minnie.)

FEEDING PERIODS.	Total Cost of Feed Consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting 20 per cent. taken by the Milk.	Net Cost of Feed for the production of Milk during Period.	Net Cost of Feed for the production of one Quart of Milk.	Weight of animal at close of Period.
1887.					Cents.	Lbs.
1. June 2 to July 7,	$7 85	$3 65	$2 92	$4 93	0.87	935.00
2. July 12 to 26, .	2 99	1 96	1 57	1 42	0.66	930.00
3. Aug. 1 to 7, .	1 54	71	57	97	1.09	990.00
4. Aug. 14 to Sept. 1,	4 91	2 16	1 73	3 18	1.19	915.00
5. Sept. 6 to 27, .	5 78	3 05	2 44	3 34	1.02	965.00
6. Oct. 3 to 25, .	5 77	2 68	2 15	3 62	1.35	992.50
Total, . . .	$28 84	$14 21	$11 38	$17 46	-	-

(May.)

FEEDING PERIODS.	Total Cost of Feed Consumed during Period.	Value of Fertilizing Constituents contained in the Feed.	Manurial Value of the Feed after deducting 20 per cent. taken by the Milk.	Net Cost of Feed for the production of Milk during Period.	Net Cost of Feed for the production of one Quart of Milk.	Weight of animal at close of Period.
1887.					Cents.	Lbs.
1. June 19 to July 7,	$4 12	$1 92	$1 54	$2 58	0.98	831.50
2. July 12 to 26, .	2 92	1 89	1 51	1 41	0.73	822.50
3. Aug. 1 to 7, .	1 54	71	57	97	1.24	795.00
4. Aug. 14 to Sept. 1,	4 91	2 16	1 73	3 18	1.38	800.00
5. Sept. 6 to 27, .	5 76	3 05	2 44	3 32	1.28	857.50
6. Oct. 3 to 25, .	5 73	2 66	2 13	3 60	1.34	832.50
Total, . .	$23 98	$12 39	$9 92	$14 06	-	-

Analyses of Milk.

LIZZIE.

(Per cent.)

	June 23.	July 6.	July 27.	Aug. 8.	Sept. 28.	Oct. 11.	Oct. 25.
Water,	–	87.38	–	–	86.84	–	85.91
Solids,	–	12.62	–	–	13.16	–	14.09
Fat (in solids),	–	4.12	–	–	4.20	–	5.25

IDA.

	June 23.	July 6.	July 27.	Aug. 8.	Sept. 28.	Oct. 11.	Oct. 25.
Water,	–	86.87	–		86.82	–	87.18
Solids,	–	13.13	–	–	13.18	–	12.82
Fat (in solids),	–	4.75	–	–	4.25	–	4.70

EVA.

	June 23.	July 6.	July 27.	Aug. 8.	Sept. 28.	Oct. 11.	Oct. 25.
Water,	–	85.05	85.59	85.50	85.77	84.73	83.99
Solids,	–	14.95	14.41	14.50	14.23	15.27	16.01
Fat (in solids),	–	5.53	5.39	5.08	4.76	5.46	5.93

MINNIE.

	June 23.	July 6.	July 27.	Aug. 8.	Sept. 28.	Oct. 11.	Oct. 25.
Water,	–	87.25	89.06	87.97	87.23	87.40	87.15
Solids,	–	12.75	10.94	12.03	12.77	12.60	12.85
Fat (in solids),	–	4.09	2.75	3.35	4.09	3.74	4.04

MAY.

	June 23.	July 6.	July 27.	Aug. 8.	Sept. 28.	Oct. 11.	Oct. 25.
Water,	86.46	87.00	87.30	88.23	87.13	87.35	86.52
Solids,	13.54	13.00	12.70	11.77	12.87	12.65	13.48
Fat (in solids),	3.82	3.76	3.46	3.13	3.76	3.71	4.34

Analyses of Fodder Articles used in Experiment 2.

VETCH AND OATS.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	73.36	1,467.20	–	–	1 : 6.85
Dry Matter,	26.64	532.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	12.37	247.40	–	–	
" Cellulose,	34.20	684.00	–	–	
" Fat,	2.74	54.80	27.40	50	
" Protein (Nitrogenous Matter),	10.59	211.80	127.08	60	
Non-nitrogenous Extract Matter,	40.10	802.00	802.00	100	
	100.00	2,000.00	956.18	–	

COW PEA.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	80.62	1,612.40	–	–	1 : 11.71
Dry Matter,	19.38	387.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	5.97	119.40	–	–	
" Cellulose,	23.02	60.40	216.39	47	
" Fat,	1.81	36.20	21.36	59	
" Protein (Nitrogenous Matter),	8.58	171.60	102.96	60	
Non-nitrogenous Extract Matter,	60.62	1,212.40	936.56	69	
	100.00	2,000.00	1,277.27	–	

SERRADELLA.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture, at 100° C.,	80.14	1,602.80	–	–	1:5.03
Dry Matter,	19.86	397.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	11.53	230.60	–	–	
" Cellulose,	38.76	775.20	–	–	
" Fat,	2.09	41.80	25.08	60	
" Protein (Nitrogenous Matter),	12.17	243.40	153.34	63	
Non-nitrogenous Extract Matter,	35.45	709.00	709.00	100	
	100.00	2,000.00	887.42	–	

Analyses of Green Crops with reference to Fertilizing Constituents.

	Per Cent.		
	Vetch and Oats.	Cow Pea.	Serradella.
Moisture at 100° C.,	73.36	80.62	80.140
Phosphoric acid,	.100	.098	.124
Potassium oxide,	.838	.306	.398
Sodium oxide,	.033	.063	.098
Calcium oxide,	.092	.300	.472
Magnesium oxide,	.031	.099	.067
Ferric oxide,	.012	.016	.021
Nitrogen,	.451	.274	.379
Insoluble matter,	.352	.077	.157

WHEAT BRAN.

73.36 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.14	222.80	-	-	1 : 3.85
Dry Matter,	88.86	1,777.20	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude Ash,	6.59	131.80	-	-	
" Cellulose,	12.80	256.00	51.20	20	
" Fat,	6.00	120.00	96.00	80	
" Protein (Nitrogenous Matter),	17.72	354.40	311.87	88	
Non-nitrogenous Extract Matter,	56.89	1,137.80	910.24	80	
	100.00	2,000.00	1,369.31	-	

CORN MEAL.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.08	261.60	-	-	1 : 9.66
Dry Matter,	86.92	1,738.40	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude Ash,	1.66	33.20	-	-	
" Cellulose,	3.49	69.80	23.73	34	
" Fat,	4.97	99.40	75.54	76	
" Protein (Nitrogenous Matter),	10.39	207.80	176.63	85	
Non-nitrogenous Extract Matter,	79.49	1,589.80	1,494.41	94	
	100.00	2,000.00	1,770.41	-	

HAY.

[From Experiment Station, 1887.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.78	215.60	–	–	1:10.54
Dry Matter,	89.22	1,784.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.11	142.20	–	–	
" Cellulose,	35.55	711.00	412.38	58	
" Fat,	2.63	52.60	24.19	46	
" Protein (Nitrogenous Matter),	8.75	175.00	99.75	57	
Non-nitrogenous Extract Matter,	45.96	919.20	579.10	63	
	100.00	2,000.00	1,115.42	–	

Milk and Creamery Record from November 1, 1886, to October 31, 1887.

	Quarts of Milk Produced.	Spaces of Cream from Milk.	Price allowed per Space.	Amount Received from Creamery.
1886.				
November 1 to 30,	1,178¼	380	4 cents.	$15 20
December 1 to 31,	1,153¼	414	4 "	16 56
1887.				
January 1 to 31,	1,002	416	3⅞ "	16 12
February 1 to 28,	2,191	1,007	3¾ "	37 76
March 1 to 31,	2,525¼	1,044	3¾ "	39 15
April 1 to 30,	2,296½	834	3⅝ "	30 23
May 1 to 31,	1,735¾	928	3⅜ "	31 32
June 1 to 30,	1,931	968	3 "	29 04
July 1 to 31,	1,852¾	855	3⅛ "	26 72
August 1 to 31,	1,869	990	3½ "	34 65
September 1 to 30,	1,920¼	1,002	3½ "	35 07
October 1 to 31,	1,662½	930	3¾ "	34 87
	21,317½	9,768	–	$346 69

November, 1886.	6.60 spaces of cream make 1 lb. butter, equal to 26.40 cents per pound.
December, 1887.	6.60 spaces of cream make 1 lb. butter, equal to 26.40 cents per pound.
January, "	6.60 spaces of cream make 1 lb. butter, equal to 25.57 cents per pound.
February, "	6.55 spaces of cream make 1 lb. butter, equal to 24.56 cents per pound.
March, "	6.33 spaces of cream make 1 lb. butter, equal to 23.76 cents per pound.
April, "	6.37 spaces of cream make 1 lb. butter, equal to 23.09 cents per pound.
May, "	6.30 spaces of cream make 1 lb. butter, equal to 21.30 cents per pound.
June, "	6.47 spaces of cream make 1 lb. butter, equal to 19.47 cents per pound.
July, "	6.31 spaces of cream make 1 lb. butter, equal to 19.73 cents per pound.
August, "	6.44 spaces of cream make 1 lb butter, equal to 22.55 cents per pound.
September, "	6.55 spaces of cream make 1 lb butter, equal to 22.98 cents per pound.
October, "	6.55 spaces of cream make 1 lb. butter, equal to 24.58 cents per pound.

During the first three months — November, December and January — the milk was furnished by three cows; and during the remainder of the time by six cows.

The total amount of milk set was 21,317½ quarts; the total receipts for cream produced were $346.69, or, on an average, 1.63 cents per quart of milk produced.

3. Feeding Experiments with Pigs.

The observations recorded below are a continuation of feeding experiments with pigs, described in our Second and Third Annual Reports. The first of these experiments (see, for details, Second Annual Report, page 68) was instituted for the purpose of comparing the feeding effects of *equal measures* of creamery buttermilk — Amherst creamery — and of skim-milk from the Station, adding in both instances to the daily diet a corresponding amount of corn meal. The daily ration of corn meal was from time to time increased, independent of the amount of milk fed at the time, during the progress of the growth of the animals on trial. The results of this experiment showed practically no difference in regard to the amount of dressed pork produced in either case.

Repeated examinations of the two kinds of milk used in the trial had proved that the skim-milk contained on an average one-fifth, or twenty per cent., more solid matter of a similar character than the creamery buttermilk at our disposal.

This excess of solids in the skim-milk, judging from our results, seemed to be wasted in our mode of feeding; for 714 pounds of corn meal and 982 gallons of skim-mik (with 10 per cent. of solids) had produced 510 pounds of dressed pork, whilst 718 pounds of corn meal and 985 gallons of creamery buttermilk (with 8 per cent. of solids) had yielded, under otherwise corresponding circumstances, 515 pounds of dressed pork, as the total amount from three pigs on each side.

To account, if possible, for the less satisfactory returns of the skim-milk diet, as compared with that of the creamery buttermilk, the second feeding experiment was planned (see, for details, Third Annual Report, page 23). It was decided to calculate the amount of corn meal to be fed in the new experiment with reference *to an equal amount* of *solids* in *both kinds of milk* and *not* with reference to *any equal measure* of both kinds.

The average result of this trial seemed to account quite satisfactorily for the above-stated difference in solids of both kinds of milk; for 2,250 pounds of corn meal fed with 1,533 gallons of skim-milk had produced 990½ pounds of dressed pork, whilst 2,211 pounds of corn meal fed with 1,899 gallons of creamery buttermilk had yielded, under otherwise corresponding circumstances, 889½ pounds of dressed pork, as the total returns from six pigs on each side. It was stated on that occasion, that, in our opinion, *a more judicious distribution* of an *increased proportion* of *corn meal*, in case of the skim-milk diet had evidently rendered the latter, pound for pound, more efficient during the second experiment, as compared with the first.

Having adopted the same local market prices of the three articles, which served in the daily diet during both experiments,—corn meal per ton, $22.50; skim-milk, 1.8 cents per gallon; buttermilk, 1.37 cents per gallon,—it was found that the cost of feed consumed, per pound of dressed pork produced, in the first experiment, amounted in case of the creamery buttermilk diet to 4.6 cents, in case of the skim-milk diet to 5.8 cents; whilst in the second experiment it amounted, in case of the former to 4.2 cents, and in case of the latter to 4.85 cents. In calculating the cost of the food consumed in each case on the *above-stated market prices*, the creamery buttermilk had proved the cheaper article; the *higher nutritive value* of the more concentrated *skim-milk* from our dairy had been more than offset by the *lower market price* of the *creamery buttermilk*. The adoption of *an equal market price per gallon* of *skim-milk and of creamery buttermilk*, 1.37 cents per gallon, would have caused a reduction in the above-stated cost of feed, per pound of dressed pork, of from .65 to .75 cents in favor of the skim-milk.

Before proceeding with the description of the five succeeding experiments, it seems advisable to offer a few explanatory remarks regarding the standpoint assumed in the planning and management of the work here under discussion. In the published detailed record of the second feeding experiment (see Third Annual Report), it may be noticed that the character of the daily diet was changed from time to time by adding a larger proportion of corn meal to a given amount of skim-milk, or buttermilk. The quantity of feed offered daily to the animals on trial was controlled by their individual appetite,—beginning with eight and twelve ounces of meal to four quarts of milk and closing with a daily ration consisting, in case of one lot of animals, of ninety-one ounces of corn meal and twelve quarts of buttermilk per head, and in case of tho other, of one hundred and eight ounces of corn meal to seven quarts of skim-milk. The changes regarding the quantity of the daily supply of feed were, for obvious reasons, gradual and depending on the appetite of each animal. The alterations regarding the character of the daily feed—i. e., the changes in the relative proportion of meal and milk—were made with reference to the stage of growth of the animals on trial. The proportions between meal and milk were changed from four to five times. These changes consisted in a periodical increase of meal for a given amount of milk; they were made for the purpose of increasing the amount of non-nitrogenous fodder constituents in the daily diet during the later stages of growth. This course of preparing the daily feed was adopted to secure, whenever desired, a definite change in the relative proportion of its digestible nitrogenous and non-nitrogenous food constituents. As both kinds of milk used in the experiment contained the nitrogenous food constituents in a much larger proportion (1 :1.8,—1 :1.9) than the corn meal (1 :8.76), an increase in the quantity of the latter rendered it possible to regulate, within certain limits, the character (nutritive ratio) of the daily diet, with reference to a desired proportion of both groups of essential food constituents. The experiment (II.) began with a daily diet, consisting of skim-milk and corn meal, which contained one part of digestible nitrogenous food constituents to 2 :7 parts of digestible non-nitrogenous food constituents; this proportion was subsequently altered by an increase in corn meal to 1 :3.1, later on to 1 :3.9, and closed with 1 :5. The animals which served in this particular case varied in weight from 17 to 19 pounds at the beginning of the experiment. The first stated ration was fed until the animals had reached a weight of from 45 to 50 pounds; the second until they had reached from 90 to 100 pounds, the third until 135 to 145 pounds, and the fourth subsequently to the end of the trial. The final summing up of the results of that experiment showed, when including the entire number of pigs on trial (twelve), that 3.39 pounds of dry matter contained in the feed consumed had yielded one pound of dressed pork. In two instances (of the buttermilk diet) from 3.47 to 3.48 pounds of dry matter of the feed had been consumed for one pound of dressed pork obtained; while in two other instances (of the skim-milk diet) from 2.97 to 3.27 pounds of dry matter of the feed had sufficed for the production of the same weight of dressed pork (one pound).

As it seemed of interest to learn whether the particular course pursued in the previously described experiments of feeding skim-milk from the home dairy with corn meal could be improved on, and, if so, in what direction, the three subsequently described new feeding experiments were instituted. *The principal aim of these new experiments was to ascertain whether a daily diet for pigs, of which skim-milk and corn meal formed a material portion, would secure better pecuniary returns, in case an exceptionally large proportion of digestible nitrogenous food constituents was fed during the entire experiment.* Gluten meal and wheat bran were chosen for various reasons to serve in making up the feed to meet this requirement as soon as our milk supply became exhausted. A short abstract of the results obtained in this connection may be found upon a few succeeding pages. Although not less than four animals have served in each of these five new experiments, our present communication will be confined to a *detailed* record of but two animals in each case, with the exception of the last experiment (VII.).

Third Feeding Experiment (A, B).

Four animals of a mixed breed were selected for the work; their respective weights varied from 40 to 59 pounds. The daily diet during the first three months consisted exclusively of skim-milk from the Station and of corn meal; during the remainder of the time (three and a half months) a mixture of equal weights of wheat bran and gluten meal was added, to assist in maintaining the desired close relation between the proportion of digestible nitrogenous and non-nitrogenous food constituents in the daily food. The relation between these two important groups of food constituents was materially the same during the entire experiment. It consisted of one part of nitrogenous food constituents to from 3.27 to 3.76 parts of non-nitrogenous constituents. From four and one-half to five ounces of corn meal were added to every quart of skim-milk needed, to meet the wants of the animal. This composition of the feed was retained until the quantity called for per head had reached eight quarts of skim-milk and forty ounces of corn meal per day. At this stage of the experiment the mixture of equal weights of wheat bran and gluten meal was added to the daily fodder ration; beginning with sixteen ounces per head, and closing up with twenty-five ounces. The exact amount required per day was governed by the appetite of the animal; the mixture served to meet the increasing demand of the various animals on trial. It is a good rule to increase the daily fodder rations only when called for, and always gradually.

The subsequent detailed record of our results shows that the cost of feed consumed per pound of dressed weight produced varied from 6.2 cents to 6.6 cents, while from 4.10 to 4.18 pounds of dry matter contained in the feed consumed had yielded one pound of dressed pork. The live weights gained during the experiment amounted to 246.5 and 206.5 pounds.

[A.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at close of Period.	Gain in Weight per day during Period.
1885.								lb. oz.
April 1 to May 11,	73.5	257.0	-	-	1:3.29	40.0	84.8	1 1
May 12 to June 3,	57.5	184.0	-	-	1:3.39	84.8	110.5	1 2
June 4 to June 29,	49.0	208.0	8.0	8.0	1:3.04	110.5	150.5	1 9
June 30 to Aug. 12,	121.0	352.0	25.0	25.0	1:3.35	150.5	212.0	1 6
Aug. 13 to Sept. 16,	105.0	210.0	22.0	22.0	1:3.67	212.0	246.5	1 0

Total Amount of Feed Consumed from April 1 to Sept. 16.

406 lbs. Corn Meal, equal to dry matter, ...	357.4 lbs
1,211 qts. Skim-Milk, equal to dry matter, ...	274.7 "
55 lbs. Wheat Bran, equal to dry matter, ...	48.3 "
55 lbs. Gluten Meal, equal to dry matter, . . .	50.3 "
Total amount of dry matter, ...	730.7 lbs.

Live weight of animal at beginning of experiment, . .	40.0 lbs.
Live weight at time of killing, ...	246.5 "
Live weight gained during experiment, ...	206.5 "
Dressed weight at time of killing, ...	210.0 "
Loss in weight by dressing, ...	36.5 lbs., or 14.8 per cent.
Dressed weight gained during experiment, ...	174.9 lbs.

Cost of Feed Consumed during Experiment.

406 lbs. of Corn Meal, at $24.00 per ton, ...	$4 87
303 gals. Skim-Milk, at 1.8 cents per gallon, ...	5 46
55 lbs. Wheat Bran, at $22.50 per ton, ...	0 62
55 lbs. Gluten Meal, at $22.50 per ton, ...	0 62
	$11 57

3.54 lbs. of dry matter fed yielded 1 lb. of live weight; and 4.18 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.6 cents.

[B.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at close of Period.	Gain in Weight per day during Period.
1885.								lb. oz.
April 1 to May 11,	73.5	257.0	-	-	1:3.29	59.5	109.3	1 3
May 12 to June 3,	57.5	184.0	-	-	1:3.39	109.3	133.3	1 1
June 4 to June 29,	65.0	208.0	13.0	13.0	1:3.27	133.3	188.5	2 2
June 30 to July 22,	69.0	184.0	17.0	17.0	1:3.39	188.5	223.0	1 8
July 23 to Sept. 16,	210.0	378.0	44.0	44.0	1:3.76	223.0	306.0	1 8

Total Amount of Feed Consumed from April 1 to Sept. 16.

475 lbs. Corn Meal, equal to dry matter, ...	418.2 lbs.
1,211 qts. Skim-Milk, equal to dry matter, ...	274.7 "
74 lbs. Wheat Bran, equal to dry matter, ...	65.1 "
74 lbs. Gluten Meal, equal to dry matter, ...	67.8 "
Total amount of dry matter, ...	825.8 lbs.

Live weight of animal at beginning of experiment,	59.5 lbs.
Live weight at time of killing,	306.0 "
Live weight gained during experiment,	246.5 "
Dressed weight at time of killing,	258.0 "
Loss in weight by dressing,	48 lbs., or 12.4 per cent.
Dressed weight gained during experiment,	205.9 lbs.

Cost of Feed Consumed during Experiment.

475 lbs. Corn Meal, at $24.00 per ton,	$5 70
303 gals. Skim-Milk, at 1.8 cents per gallon,	5 45
74 lbs. Wheat Bran at $22.50 per ton,	0 83
74 lbs. Gluten Meal, at $22.50 per ton,	0 83
	$12 81

3.35 lbs. of dry matter fed yielded 1 lb. of live weight, and 4.01 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.2 cents.

Fourth Feeding Experiment (C, D).

Five animals served in the experiment; their live weights varied from 30 to 38 pounds when entering upon the trial; they were of a similar mixed breed as those selected for the third experiment. The daily diet of the entire lot consisted, from December 8 to February 15, of four quarts of skim-milk and eight ounces of corn meal, besides a mixture consisting of two weight parts of gluten meal and one weight part of wheat bran; the increase demand for feed was supplied by this mixture, which was moistened with water before being fed. The daily quantity needed per head amounted in the beginning of the trial to three ounces and rose towards the close of that period to 12 ounces. Subsequently — until the 11th of May — another mixture, consisting of equal weights of corn meal, gluten meal and wheat bran, was substituted in its place. After May 11 until the close of the experiment, May 31, a larger proportion of corn meal was fed. The daily diet consisted, during that period, of four quarts of skim-milk and a mixture of dry feed, consisting of seven parts of corn meal, one part of gluten meal and one part of wheat bran. On the 12th of May the daily diet consisted, on an average per head, of four quarts of skim-milk, twenty-eight ounces of corn meal, four ounces of gluten meal and four ounces of wheat bran. The consumption of the solid constituents of the daily fodder ration had reached, at the close of the experiment, in some instances, fifty-six ounces of corn meal, eight ounces of gluten meal and eight ounces of wheat bran. The daily quantity of milk fed remained the same during the entire experiment, — four quarts per head. Water was used to assist in moistening the dry portion of the feed.

A comparison of the subsequent statement of our results with those in the preceding experiment (III.) shows no marked differences; the results are, if anything, inferior, — considering the weight of the animals in both cases when killed. The cost of the feed consumed, per pound of dressed weight produced, varied from 6.1 to 6.6 cents; while from 3.77 to 4.08 pounds of dry matter contained in the feed consumed had yielded one pound of dressed pork.

The live weights gained during the experiment amounted to 128 and 111 pounds. The cost of feed consumed for the production of a given quantity of dressed pork *increases materially* with the *advancing growth* of the animal. For details concerning this important point see statement in our Third Annual Report. The financial success of feeding pigs for home market *depends*, in a *controlling degree*, on a *timely closing up of the operation*. To go beyond 160 — 175 pounds of live weight is only, in exceptional cases, a remunerative practice with our average market prices for dressed pork.

The beneficial effects of a more liberal supply of non-nitrogenous feed constituents, as starch and fats (in corn meal) during the last period of this feeding experiment, deserves particular attention.

[C.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at close of Period.	Gain in Weight per day during Period.
1885 and 1886.								lb. oz.
Dec. 8 to Jan. 25,	24.5	196.0	5.6	11.2	1:2.63	31.8	66.5	0 11
Jan. 26 to Feb. 15,	10.5	84.0	4.8	9.6	1:2.81	66.5	82.0	0 12
Feb. 16 to Mar. 23,	26.8	144.0	8.8	8.8	1:3.01	82.0	92.5	0 5
Mar. 24 to May 10,	28.6	232.0	5.6	5.6	1:2.66	92.5	119.0	0 9
May 11 to May 31,	55.4	84.0	8.2	8.2	1:4.33	119.0	142.8	1 2

Total Amount of Feed Consumed from Dec. 8 to May 31.

145.8 lbs. Corn Meal, equal to dry matter,	127.4 lbs.
740.0 qts. Skim-Milk, equal to dry matter,	167.8 "
33.0 lbs. Wheat Bran, equal to dry matter,	28.6 "
43.4 lbs. Gluten Meal, equal to dry matter,	40.5 "
Total amount of dry matter,	364.3 lbs.

Live weight of animal at beginning of experiment,	31.8 lbs.
Live weight at time of killing,	142.8 "
Live weight gained during experiment,	111.0 "
Dressed weight at time of killing,	115.0 "
Loss in weight by dressing,	27.8 lbs., or 19.3 per cent.
Dressed weight gained during experiment,	89.3 lbs.

Cost of Feed Consumed during Experiment.

145.8 lbs. Corn Meal, at $24.00 per ton,	$1 75
185.0 gals. Skim-Milk, at 1.8 cents per gallon,	3 30
33.1 lbs. Wheat Bran at $22.50 per ton,	0 37
43.4 lbs. Gluten Meal at $22.50 per ton,	0 49
	$5 91

3.28 lbs. of dry matter fed yielded 1 lb. of live weight, and 4.08 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.6 cents.

[D.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at close of Period.	Gain in Weight per day during Period.
1885 and 1886.								lb. oz.
Dec. 8 to Jan. 25,	24.5	196.0	4.4	8.8	1:2.64	34.0	70.0	0 12
Jan. 26 to Feb. 15,	10.5	84.0	5.2	10 4	1:2.78	70.0	90.5	1 0
Feb. 16 to April 3,	38.7	188.0	15.2	15.2	1:3.06	90.5	118.0	0 9
April 4 to May 10,	25.8	188.0	7.3	7.3	1:2.86	118.0	137.5	0 8
May 11 to May 31,	60.0	81.0	8.4	8.4	1:4.48	137.5	162.0	1 2

Total Amount of Feed Consumed from Dec. 8 to May 31.

159.5 lbs. Corn Meal, equal to dry matter,	138.4 lbs.
737.0 qts. Skim-Milk, equal to dry matter,	167.2 "
40.5 lbs. Wheat Bran, equal to dry matter,	35.7 "
50.1 lbs. Gluten Meal, equal to dry matter,	46.0 "
Total amount of dry matter,	387.3 lbs.

Live weight of animal at beginning of experiment,	34.0 lbs.
Live weight at time of killing,	162.0 "
Live weight gained during experiment,	128.0 "
Dressed weight at time of killing,	130.0 "
Loss in weight by dressing,	32 lbs., or 19.7 per cent.
Dressed weight gained during experiment,	102.7 lbs.

Cost of Feed Consumed during Experiment.

159.5 lbs. Corn Meal, at $24.00 per ton,	$1 91
184.0 gals. Skim Milk, at 1.8 cents per gallon,	3 31
40.5 lbs. Wheat Bran, at $22.50 per ton,	0 46
50.1 lbs. Gluten Meal, at $22.50 per ton,	0 56
	$6 24

3.02 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.77 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.1 cents.

Fifth Feeding Experiment (E, F, G, H).

Six pigs of a mixed breed were secured for the observation; their live weights varied at the beginning of the experiment from 25 to 30 pounds. The course of feeding was similar to that adopted in the two previous experiments. Skim-milk and corn meal furnished, as in the previous trials, a liberal proportion of the daily diet; gluten meal and wheat bran were used in a somewhat different proportion than before as food ingredients to compound the desired temporary fodder ration. The feeding began with four quarts of skim-milk and eight ounces of corn meal; the increasing daily demand for feed was supplied by a mixture of equal weights of gluten meal and wheat bran until October 31, when a mixture of equal weights of gluten meal, corn meal and wheat bran took its place in providing the desired daily fodder ration, until the close of the experiment, January 15, 1887. At that time from forty-two to forty-eight ounces of this mixture were required per head.

The results of this experiment, judging from subsequent more detailed statements, are in some instances more favorable than those previously described; yet they fall behind those obtained in our earlier experiments (I. and II.). The cost of feed consumed per pound of dressed pork varied, in three cases, from 5.2 to 5.8 cents, and reached in one case 6.32 cents. The amount of dry matter in the food consumed for the production of one pound of dressed pork varied, in three cases, from 3.56 to 3.99 pounds, and rose, in one case, to 4.31 pounds. The live weight gained during the entire experiment varied from 132 to 158 pounds. Two animals were sick for some weeks and appear not in the record below.

[E.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.)	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1886 and 1887.								lb. oz.
Sept. 15 to Oct. 4,	10.0	80.0	6.3	6.3	1:2.75	30.8	51.5	1 1
Oct. 5 to Oct. 31,	13.5	108.0	35.3	35.3	1:2.90	51.5	89.0	1 6
Nov. 1 to Dec. 10,	66.0	160.0	46.0	46.0	1:3.52	89.0	133.0	1 2
Dec. 11 to Jan. 15,	47.8	144.0	29.8	29.8	1:3.39	133.0	164.3	0 14

Total Amount of Feed Consumed from Sept. 15 to Jan. 15.

137.3 lbs. Corn Meal, equal to dry matter,	119.58 lbs.
492.0 qts. Skim-milk, equal to dry matter,	111.58 "
117.4 lbs. Wheat Bran, equal to dry matter,	102.99 "
117.4 lbs. Gluten Meal, equal to dry matter,	106.89 "
Total amount of dry matter,	441.04 lbs.

Live weight of animal at beginning of experiment,	30.8 lbs.
Live weight at the time of killing,	164.3 "
Live weight gained during experiment,	133.5 "
Dressed weight at time of killing,	136.0 "
Loss in weight by dressing,	28.5 lbs., or 17.3 per cent.
Dressed weight gained during experiment,	110.5 lbs.

Cost of Feed Consumed during Experiment.

137.3 lbs. Corn Meal, at $24.00 per ton,	$1 64
123.0 gals. of Skim-milk, at 1.8 cents per gallon,	2 21
117.4 lbs. Wheat Bran, at $22.50 per ton,	1 32
117.4 lbs. Gluten Meal, at $22.50 per ton,	1 32
	$6.49

3.30 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.99 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.8 cents.

[F.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.)	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period
1886 and **1887.**								lb. oz.
Sept. 15 to Oct. 4,	10.0	80.0	6.3	6.3	1:2.75	34.5	56.3	1 1
Oct. 5 to Oct. 31,	13.5	108.0	35.0	35.0	1:2.90	56.3	99.5	1 10
Nov. 1 to Dec. 10,	69.3	160.0	49.3	49.3	1:3.57	99.5	156.3	1 7
Dec. 11 to Jan. 19,	58.0	160.0	38.0	38.0	1:3.45	156.3	193.3	0 15

Total Amount of Feed Consumed from Sept. 15 to Jan. 19.

150.8 lbs. Corn Meal, equal to dry matter,	131.77 lbs.
508.0 qts. Skim-milk, equal to dry matter,	115.21 "
128.6 lbs. Wheat Bran, equal to dry matter,	113.10 "
128.6 lbs. Gluten Meal, equal to dry matter,	117.10 "
Total amount of dry matter,	477.18 lbs.

Live weight of animal at beginning of experiment,	34.5 lbs.
Live weight at time of killing,	193.3 "
Live weight gained during experiment,	158.8 "
Dressed weight at time of killing,	163.0 "
Loss in weight by dressing,	30.3 lbs., or 15.7 per cent.
Dressed weight gained during experiment,	133.9 lbs.

Cost of Feed Consumed during Experiment.

150.8 lbs. Corn Meal, at $24.00 per ton,	$1 81
127.0 gals. Skim-milk at 1.8 cents per gallon,	2 29
128.6 lbs. Wheat Bran, at $22.50 per ton,	1 45
128.6 lbs. Gluten Meal, at $22.50 per ton,	1 45
	$7 00

3.04 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.56 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.2 cents.

[G.]

Total Amount of Feed Consumed from Sept. 15 to Jan. 19.

150.0 lbs. Corn Meal, equal to dry matter,	131.07 lbs.
508.0 qts. Skim-milk, equal to dry matter,	115.21 "
128.0 lbs. Wheat Bran, equal to dry matter,	112.58 "
128.0 lbs. Gluten Meal, equal to dry matter,	116.54 "
Total amount of dry matter,	475.40 lbs.

Live weight of animal at beginning of experiment,	32.0 lbs.
Live weight at time of killing,	164.0 "
Live weight gained during experiment,	132.0 "
Dressed weight at time of killing,	137.0 "
Loss in weight by dressing,	27.0 lbs., or 16.4 per cent.
Dressed weight gained during experiment,	110.2 lbs.

Cost of Feed Consumed during Experiment.

150.0 lbs. Corn Meal, at $24.00 per ton,	$1 80
127.0 gals. Skim-milk, at 1.8 cents per gallon,	2 29
128.0 lbs. Wheat Bran, at $22.50 per ton	1 44
128.0 lbs. Gluten Meal, at $22.50 per ton,	1 44
	$6 97

3.60 lbs. of dry matter fed yielded 1 lb. of live weight, and 4.31 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.3 cents.

[H.]

Total Amount of Feed Consumed, from Sept. 15 to Jan. 19.

149.5 lbs. Corn Meal, equal to dry matter,	130.63 lbs
508.0 qts. Skim-milk, equal to dry matter,	115.21 "
127.4 lbs. Wheat Bran, equal to dry matter,	112.05 "
127.4 lbs. Gluten Meal, equal to dry matter,	116.00 "
Total amount of dry matter,	473.89 lbs.

Live weight of animal at beginning of experiment,	33.0 lbs.
Live weight at time of killing,	178.3 "
Live weight gained during experiment,	145.3 "
Dressed weight at time of killing,	153.0 "
Loss in weight by dressing,	25.3 lbs., or 14.2 per cent.
Dressed weight gained during experiment,	124.7 lbs.

Cost of Feed Consumed during Experiment.

149.5 lbs. Corn meal, at $24.00 per ton,	$1 79
127.0 gals. Skim-milk, at 1.8 cents per gallon,	2 29
127.4 lbs. Wheat Bran, at $22.50 per ton,	1 43
127.4 lbs. Gluten Meal, at $22.50 per ton,	1 43
	$6 94

3.26 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.80 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.6 cents.

SUMMARY OF EXPERIMENTS III., IV., V.

		Corn Meal (in lbs.).	Skim-milk (in gals.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Live Weight gained during Experiment.	Dressed Weight gained during Experiment.	Cost per Pound of Dressed Pork (cents)
III.	A,	406.0	303.0	55.0	55.0	206.5	174.9	6.6
	B,	475.0	303.0	74.0	74.0	246.5	205.9	6.2
IV.	C,	145.8	185.0	33.0	43.4	111.0	89.3	6.6
	D,	159.5	184.0	40 5	50.1	128.0	102.7	6.1
V.	E,	137.3	123.0	117.4	117.4	133.5	110.5	5.8
	F,	150.8	127 0	128.6	128.6	158 8	133.9	5.2
	G,	150.0	127.0	128.0	128.0	132.0	110.2	6.3
	H,	149.5	127.0	127.4	127.4	145.3	153.0	5.6
		1,773.9	1,479.0	703 9	703 9	1,261.6	1,080.4	-

Total Cost of Feed Consumed during the above-stated Experiments.

1,773.9 lbs. Corn Meal,	$21 28
1,479.0 gals. Skim-milk,	26 62
703.9 lbs. Wheat Bran,	7 92
723.9 lbs. Gluten Meal,	8 14
	$63 96

Average cost of feed for production of 1 lb. of dressed pork, 5.92 cents.

Manurial Value of the Feed Consumed during the above Experiments.

Corn Meal.	Skim Milk.	Wheat Bran.	Gluten Meal.	Total.
$7 07	$13 31	$4 75	$6 33	$31 46

Total manurial value of feed for production of 1 lb. of dressed pork 2.91 cents.

SIXTH FEEDING EXPERIMENT (I, J, K, L, M).

Seven animals of a mixed breed were selected for the trial; their live weight varied from 40 to 60 pounds; five of them remained well; two became sick and dropped out of the experiment.

The feeding began Feb. 17th, with a daily ration of seven quarts of milk, twenty-one ounces of corn meal and seven ounces each of wheat bran and gluten meal. The amount of skim-milk and corn meal remained the same during the entire trial, and a mixture of equal weight parts of gluten meal and wheat bran supplied subsequently the increasing demand for feed. Seven quarts of skim-milk, twenty-one ounces of corn meal and twenty-one ounces of the stated mixture were fed daily to each animal, at the close of the trial, May 2, 1887. The cost of feed consumed, per pound of dressed pork produced, varied from 6.72 to 4.32 cents. Taking the entire amount of dressed pork produced, during the experiment, into consideration, the cost of feed per pound of dressed pork amounts to 5.69 cents. The amount of dry matter contained in the feed required to produce one pound of dressed pork varied from 2.70 to 4.15 pounds.

[I.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1887.								lb. oz.
Feb. 17 to Mar. 3,	19.7	105.0	6.6	6.6	1:2.99	42.0	62.5	1 6
Mar. 4 to Mar. 28,	32.8	175.0	16.4	16.4	1:3.13	62.5	98.5	1 7
Mar. 29 to May 2,	61.3	245.0	16.6	16.6	1:3.23	98.5	126.5	0 13

Total Amount of Feed Consumed from Feb. 17 to May 2.

113.8 lbs. Corn Meal, equal to dry matter,	99.43 lbs.
525.0 qts. Skim-milk, equal to dry matter,	119.07 "
39.6 lbs. Wheat Bran, equal to dry matter,	34.83 "
39.6 lbs. Gluten Meal, equal to dry matter,	36.05 "
Total amount of dry matter,	289.38 lbs.

Live weight of animal at beginning of experiment,	42.0 lbs.
Live weight of animal at time of killing,	126.5 "
Live weight gained during experiment,	84.5 "
Dressed weight at time of killing,	104.4 "
Loss in weight by dressing,	22.1 lbs. or 17.5 per cent.
Dressed weight gained during experiment,	69.7 lbs.

Cost of Feed Consumed during Experiment.

113.8 lbs. Corn Meal, at $24.00 per ton,	$1 37
131.0 gals. Skim-milk, at 1.8 cents per gallon,	2 36
39.6 lbs. Wheat Bran, at $22.50 per ton,	45
39.6 lbs. Gluten Meal, at $22.50 per ton,	45
	$4 63

3.42 lbs. of dry matter fed yielded 1 lb. of live weight, and 4.15 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.6 cents.

[J.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1887.								lb. oz.
Feb. 17 to Mar. 3,	19.7	105.0	6.6	6 6	1:2.99	63.5	87.0	1 9
Mar. 4 to Mar. 28,	32.8	175.0	16.4	16.4	1:3.13	87.0	123.0	1 7
Mar. 29 to May 2,	61.3	245.0	16 6	16.6	1:3.23	123.0	173.0	1 7

Total Amount of Feed Consumed from Feb. 17 to May 2.

113.8 lbs. Corn Meal, equal to dry matter, ...	99.43 lbs
525.0 qts. Skim-milk, equal to dry matter, ...	119.07 "
39.6 lbs. Wheat Bran, equal to dry matter, . . .	34.83 "
39.6 lbs. Gluten Meal, equal to dry matter, . . .	36.05 "
Total amount of dry matter, ...	289.38 lbs.

Live weight of animal at beginning of experiment, . .	63.5 lbs.
Live weight of animal at time of killing, ...	173.0 "
Live weight gained during experiment, ...	109.5 "
Dressed weight at time of killing, ...	142.7 "
Loss in weight by dressing, ...	30.3 lbs., or 17.5 per cent.
Dressed weight gained during experiment, . . .	90.3 lbs.

Cost of Feed Consumed during Experiment.

113.8 lbs. Corn Meal, at $24.00 per ton, ...	$1 37
131.0 gals. Skim-milk, at 1.8 cents per gallon, ...	2 36
39.6 lbs. Wheat Bran at $22.50 per ton, ...	45
39.6 lbs. Gluten Meal at $22.50 per ton, ...	45
	$4 63

2.64 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.20 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.1 cents.

[K.]

Total Amount of Feed Consumed from Feb. 17 to May 2.

113.8 lbs. Corn Meal, equal to dry matter, ...	99.43 lbs.
525.0 qts. Skim-milk, equal to dry matter, ...	119.07 "
39.6 lbs. Wheat Bran, equal to dry matter, . . .	34.83 "
39.6 lbs. Gluten Meal, equal to dry matter, . . .	36.05 "
Total amount of dry matter, . .	289.38 lbs.

Live weight of animal at beginning of experiment,	61.5 lbs.
Live weight of animal at time of killing,	145.0 "
Live weight gained during experiment,	83.5 "
Dressed weight at time of killing,	119.6 "
Loss in weight by dressing	2.54 lbs., or 17.5 per cent.
Dressed weight gained during experiment,	68.9 lbs.

Cost of Feed Consumed during Experiment.

113.8 lbs. Corn Meal, at $24.00 per ton,	$1 37
131.0 gals. Skim-milk, at 1.8 cents per gallon,	2 36
39.6 lbs. Wheat Bran, at $22.50 per ton,	45
39.6 lbs. Gluten Meal, at $22.50 per ton,	45
	$4 63

3.47 lbs. of dry matter fed yielded 1 lb. of live weight, and 4.20 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.72 cents.

[L.]

Total Amount of Feed Consumed from Feb. 17 to May 2.

113.8 lbs. Corn Meal, equal to dry matter,	99.43 lbs.
525.0 qts. Skim-milk, equal to dry matter,	119.07 "
39.6 lbs. Wheat Bran, equal to dry matter,	34.83 "
39.6 lbs. Gluten Meal, equal to dry matter,	36.05 "
Total amount of dry matter,	289.36 lbs.

Live weight of animal at beginning of experiment,	59.0 lbs.
Live weight of animal at time of killing,	143.5 "
Live weight gained during experiment,	84.5 "
Dressed weight at time of killing,	118.4 "
Loss in weight by dressing,	25.1, or 17.5 per cent.
Dressed weight gained during experiment,	69.7 lbs.

Cost of Feed Consumed during Experiment.

113.8 lbs. Corn Meal, at $24.00 per ton,	$1 37
131.0 gals. of Skim-milk, at 1.8 cents per gallon,	2 36
39.6 lbs. Wheat Bran, at $22.50 per ton,	45
39.6 lbs. Gluten Meal, at $22.50 per ton,	45
	$4 63

3.42 lbs. of dry matter fed yielded 1 lb. of live weight, and 4.15 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 6.64 cents.

[M.]

Total Amount of Feed Consumed from Feb. 17 to May 2.

113.8 lbs. Corn Meal, equal to dry matter,	99.43 lbs.
525.0 qts. Skim-milk, equal to dry matter,	119.07 "
39.6 lbs. Wheat Bran, equal to dry matter,	34.83 "
39.6 lbs. Gluten Meal, equal to dry matter,	36.05 "
Total amount of dry matter,	289.38 lbs.

Live weight of animal at beginning of experiment, . .	46.0 lbs.
Live weight of animal at time of killing, ...	176.0 "
Live weight gained during experiment, . . .	130.0 "
Dressed weight at time of killing, . . .	145.2 "
Loss in weight by dressing, ...	30.8 lbs., or 17.5 per cent.
Dressed weight gained during experiment, . . .	107.2 lbs.

Cost of Feed Consumed during Experiment.

113.8 lbs. Corn Meal, at $24.00 per ton, ...	$1 37
131.0 gals. Skim-milk, 1.8 cents per gallon, ...	2 36
39.6 lbs. Wheat Bran, at $22.50 per ton, ...	45
39.6 lbs. Gluten Meal, at $22.50 per ton, ...	45
	$4 63

2.23 lbs. of dry matter fed yielded 1 lb. of live weight, and 2.70 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.32 cents.

SUMMARY OF EXPERIMENT VI.

	Corn Meal (in lbs.).	Skim-milk (in gallons).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Live Weight gained during Experiment.	Dressed Weight gained during Experiment.	Cost per Pound of Dressed Pork (cents).
I, ...	113.8	131.0	39.6	39.6	84.5	69.7	6.6
J, ...	113.8	131.0	39.6	39.6	109.5	90.3	5.1
K, ...	113.8	131.0	39.6	39.6	83.5	68.9	6.72
L, ...	113.8	131.0	39.6	39.6	84.5	69.7	6.64
M, ...	113.8	131.0	39.6	39.6	130.0	107.2	4.32
	569.0	655.0	198.0	198.0	492.0	405.8	-

Total Cost of Feed Consumed during the above-stated Experiment.

569.0 lbs. Corn Meal, ...	$6 83
655.0 gals. Skim-milk, ...	11 79
198.0 lbs. Wheat Bran, ...	2 23
198.0 lbs. Gluten Meal, ...	2 23
	$23.08

Average cost of feed for production of 1 lb. of dressed pork, 5.69 cents.

Manurial Value of the Feed Consumed during the above Experiment.

Corn Meal.	Skim-milk.	Wheat Bran.	Gluten Meal.	Total.
$2 27	$5 94	$1 33	$1 73	$11 27

Manurial value of feed for production of 1 lb. of dressed pork, 2.78 cents.

Seventh Feeding Experiment.

Seven animals, crosses between White Chester and Black Berkshire, served in this experiment. Their live weights were from twenty-two to twenty-six pounds in case of different animals. The same fodder articles were used as in the third, fourth, fifth and sixth experiments; they were, however, fed in different proportions. The daily ration of corn meal was gradually increased during the progress of the experiment, for the purpose of altering the relative proportion between the nitrogenous and non-nitrogenous matter in the feed. The relative proportion of one part of digestible nitrogenous matter to two and nine-tenth parts of non-nitrogenous matter was changed at stated periods until it reached 1 : 4.28.

Average of Daily Rations.

	Corn Meal (ounces).	Skim-milk (quarts).	Wheat Bran (ounces).	Gluten Meal (ounces).
June 28 to July 11, ...	8.00	4	-	-
July 12 to July 25, ...	12.00	6	-	-
July 26 to July 28, ...	12.00	6	1.34	2.66
July 29 to Aug. 8, ...	12.00	6	2.00	4.00
Aug. 9 to Aug. 15, ...	14.67	6	2.66	2.66
Aug. 16 to Aug. 23, ...	17.34	6	5.33	5.33
Aug. 24 to Aug. 29, ...	20.00	6	8.00	8.00
Aug. 30 to Sept. 12, ...	23.34	6	11.35	11.35
Sept. 13 to Sept. 26, ...	29.00	6	17.00	17.00
Sept. 27 to Oct. 11, ...	47.00	6	12.00	12.00
Oct. 12 to Oct. 27, ...	62.66	6	15.66	15.66

The cost of feed consumed varied, in case of different animals, from 4.80 to 5.49 cents per pound of dressed pork produced.

Taking the entire lot of animals into consideration it amounts to 5.15 cents per pound of dressed pork obtained. The amount of dry matter contained in the feed required for the production of one pound of dressed pork varied from 2.83 to 3.24 lbs.

[N.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1887.								lb. oz.
June 28 to July 25,	17.50	140.0	-	-	1:2.91	25.75	47.00	0 12
July 26 to Aug. 8,	10 50	84.0	1.63	3.25	1:2.85	47.00	63.50	1 1
Aug. 9 to Sept. 26,	68.59	294.0	31.83	31.83	1:3.39	63.50	130.50	1 6
Sept. 27 to Oct. 27,	106.34	186.0	26.58	26.58	1:4.30	130.50	189.50	1 14

Total Amount of Feed Consumed from June 28 to Oct. 27.

202.93 lbs. Corn Meal, equal to dry matter, ...	176.39 lbs.
704 qts. Skim-milk, equal to dry matter, ...	126.72 "
60.04 lbs. Wheat Bran, equal to dry matter, ...	53.35 "
61.66 lbs. Gluten Meal, equal to dry matter, ...	55.46 "
Total amount of dry matter, ...	441.92 lbs.

Live weight of animal at beginning of experiment, . .	25.75 lbs.
Live weight at time of killing, ...	189.50 "
Live weight gained during experiment, ...	163.75 "
Dressed weight at time of killing, ...	148.00 "
Loss in weight by dressing, ...	41 lbs., or 21 per cent.
Dressed weight gained during experiment, ...	129.36 lbs.

Cost of Feed Consumed during Experiment.

202.93 lbs. Corn Meal, at $24.00 per ton, ...	$2 44
176 gals. Skim-milk, at 1.8 cents per gallon, ...	3 17
60.04 lbs. Wheat Bran, at $22.50 per ton, ...	68
61.66 lbs. Gluten Meal, at $22.50 per ton, ...	69
	$6 98

2.51 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.18 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.39 cents.

[O.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1887.								lb. oz.
June 28 to July 25,	17.50	140.0	-	-	1:2.91	23.50	44.00	0 11
July 26 to Aug. 8,	10.50	84.0	1.63	3.25	1:2.85	44.00	61.00	1 3
Aug. 9 to Sept. 26,	68.75	294.0	32.00	32.00	1:3.34	61.00	125.00	1 5
Sept. 27 to Oct. 27,	106.34	186.0	26.58	26.58	1:4.30	125.00	184.50	1 14

Total Amount of Feed Consumed from June 28 to Oct. 27.

203.09 lbs. Corn Meal, equal to dry matter, ...	176.53 lbs.
704 qts. Skim-milk, equal to dry matter, ...	126.72 "
60.21 lbs. Wheat Bran, equal to dry matter, . . .	53.51 "
61.83 lbs. Gluten Meal, equal to dry matter, . . .	55.62 "
Total amount of dry matter, ...	412.38 lbs.

Live weight of animal at beginning of experiment, . .	23.50 lbs.
Live weight at time of killing, ...	184.50 "
Live weight gained during experiment, ...	161.00 "
Dressed weight at time of killing, ...	144.00 "
Loss in weight by dressing, ...	40.5 lbs., or 21 per cent.
Dressed weight gained during experiment, ...	127.19 lbs.

Cost of Feed Consumed during Experiment.

203.09 lbs. Corn Meal, at $24.00 per ton, ...	$2 44
176 gals. Skim-milk, at 1.8 cents per gallon, ...	3 17
60.21 lbs. Wheat Bran, at $22.50 per ton, ...	68
61.83 lbs. Gluten Meal, at $22.50 per ton, ...	70
	$6 99

2.56 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.24 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.49 cents.

[P.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1887.								lb. oz.
June 28 to July 25,	17.50	140.0	-	-	1:2.91	23.00	45.00	0 12
July 26 to Aug. 8,	10.50	84.0	1.63	3.25	1:2.85	45.00	61.50	1 2
Aug. 9 to Sept. 26,	68.75	294.0	32.00	32.00	1:3.34	61.50	138.50	1 9
Sept. 27 to Oct. 27,	106.34	186.0	26.58	26.58	1:4.30	138.50	197.00	1 14

Total Amount of Feed Consumed from June 28 to Oct. 27.

203.09 lbs. Corn Meal, equal to dry matter,	176.53 lbs.
704 qts. Skim-milk, equal to dry matter,	126.72 "
60.21 lbs. Wheat Bran, equal to dry matter,	53.51 "
61.83 lbs. Gluten Meal, equal to dry matter,	55.62 "
Total amount of dry matter,	412.38 lbs.

Live weight of animal at beginning of experiment,	23.00 lbs.
Live weight at time of killing,	197.00 "
Live weight gained during experiment,	174.00 "
Dressed weight at time of killing,	156.00 "
Loss in weight by dressing,	41 lbs., or 20 per cent.
Dressed weight gained during experiment,	139.20 lbs.

Cost of Feed Consumed during Experiment.

203.9 lbs. Corn Meal, at $24.00 per ton,	$2 44
176 gals. Skim-milk, at 1.8 cents per gallon,	3 17
60.21 lbs. Wheat Bran, at $22.50 per ton,	68
61.83 lbs. Gluten Meal, at $22.50 per ton,	70
	$6 99

2.37 lbs. of dry matter fed yielded 1 lb. of live weight, and 2.96 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.02 cents.

[Q.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in weight per day during period.
1887.								lb. oz.
June 28 to July 25,	17.50	140.0	-	-	1:2.91	28.50	54.75	0 15
July 26 to Aug. 8,	10.50	84.0	1.63	3.25	1·2.85	54.75	70.75	1 2
Aug. 9 to Sept. 26,	68.41	294.0	31.67	31.67	1:3.34	70.75	143.00	1 8
Sept. 27 to Oct. 25,	97.68	174.00	24.41	24.41	1:4.28	143.00	193.00	1 9

Total Amount of Feed Consumed from June 28 to Oct. 25.

194.09 lbs. Corn Meal, equal to dry matter,	168.70 lbs.
692 qts. Skim-milk, equal to dry matter,	124.56 "
57.71 lbs. Wheat Bran, equal to dry matter,	51.28 "
59.33 lbs. Gluten Meal, equal to dry matter,	53.37 "
Total amount of dry matter,	397.91 lbs.

Live weight of animal at beginning of experiment,	28.50 lbs.
Live weight at time of killing,	193.00 "
Live weight gained during experiment,	164.50 "
Dressed weight at time of killing,	158.00 "
Loss in weight by dressing,	35 lbs., or 22 per cent.
Dressed weight gained during experiment,	128.31 lbs.

Cost of Feed Consumed during Experiment.

194.09 lbs. Corn Meal, at $24.00 per ton,	$2 32
173 gals. Skim-milk, at 1.8 cents per gallon,	3 11
57.71 lbs. Wheat Bran, at $22.50 per ton,	65
59.93 lbs. Gluten Meal at $22.50 per ton,	68
	$6 76

2.41 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.10 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.27 cents.

[R.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period
1887.								lb. oz.
June 28 to July 25,	17.50	140.0	-	-	1:2.91	23.50	50.00	0 15
July 26 to Aug. 8,	10.50	84.0	1.63	3.25	1:2.85	50.00	65.25	1 1
Aug. 9 to Sept. 26,	63.75	294.0	32.00	32.00	1:3.34	65.25	144.25	1 9
Sept. 27 to Oct. 25,	97.68	174.0	24.41	24.41	1:4.28	144.25	201.00	1 13

Total Amount of Feed Consumed from June 28 to Oct. 25.

194.43 lbs. Corn Meal, equal to dry matter, ...	169.00 lbs.
692 qts. Skim-milk, equal to dry matter, ...	124.56 "
58.01 lbs. Wheat Bran, equal to dry matter, ...	51.58 "
59.66 lbs. Gluten Meal, equal to dry matter, ...	53.67 "
Total amount of dry matter, ...	398.81 lbs.

Live weight of animal at beginning of experiment, . . .	23.50 lbs.
Live weight at time of killing, ...	201.00 "
Live weight gained during experiment, ...	177.50 "
Dressed weight at time of killing, ...	156.00 "
Loss in weight by dressing, ...	45 lbs., or 22 per cent.
Dressed weight gained during experiment, ...	138.45 lbs.

Cost of Feed Consumed during Experiment.

194.43 lbs. Corn Meal, at $24.00 per ton, ...	$2 33
173 gals. Skim-milk, at 1.8 cents per gallon, ...	3 11
58.01 lbs. Wheat Bran, at $22.50 per ton, ...	65
59.66 lbs. Gluten Meal, at $22.50 per ton, ...	67
	$6 76

2.24 lbs. of dry matter fed yielded 1 lb. of live weight, and 2.88 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.89 cents.

[S.]

PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1887.								lb. oz.
June 28 to July 25,	17.50	140.0	-	-	1:2.91	21.50	48.00	0 15
July 26 to Aug. 8,	10.50	84.0	1.63	3.25	1:2.85	48.00	63.00	1 1
Aug. 9 to Sept. 26,	68.75	294.0	32.00	32.00	1:3.34	63.00	135.00	1 7
Sept. 27 to Oct. 25,	97.68	174.0	24.41	24.41	1:4.28	135.00	184.00	1 9

Total Amount of Feed Consumed from June 28 to Oct. 25.

194.43 lbs. Corn Meal, equal to dry matter,	169.00 lbs.
692 qts. Skim-milk equal to dry matter,	124.56 "
58.04 lbs. Wheat Bran, equal to dry matter,	51.58 "
59.66 lbs. Gluten Meal, equal to dry matter,	53.67 "
Total amount of dry matter,	398.81 lbs.

Live weight of animal at beginning of experiment,	21.50 lbs.
Live weight at time of killing,	184.00 "
Live weight gained during experiment,	162.50 "
Dressed weight at time of killing,	145.00 "
Loss in weight by dressing,	39 lbs. or 21 per cent.
Dressed weight gained during experiment,	128.38 lbs.

Cost of Feed Consumed during Experiment.

194.43 lbs. Corn Meal, at $24.00 per ton,	$2 33
173 gals. Skim-milk, at 1.8 cents per gallon,	3 11
58.04 lbs. Wheat Bran, at $22.50 per ton,	65
59.66 lbs. Gluten Meal, at $22.50 per ton,	67
	$6 76

2.45 lbs. of dry matter fed yielded 1 lb. of live weight, and 3.10 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 5.26 cents.

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PERIODS.	Total amount of Corn Meal Consumed during Period (in lbs.).	Total amount of Skim-milk Consumed during Period (in qts.).	Total amount of Wheat Bran Consumed during Period (in lbs.).	Total amount of Gluten Meal Consumed during Period (in lbs.).	Nutritive Ratio of Food.	Weight of Animal at beginning of Period.	Weight of Animal at end of Period.	Gain in Weight per day during Period.
1887.								lb. oz.
June 28 to July 25,	17.50	140.0	-	-	1:2.91	25.75	53.50	0 15
July 26 to Aug. 8,	10.50	84.0	1.63	3.25	1:2.85	53.50	70.00	1 2
Aug. 9 to Sept. 26,	68.75	294.0	32.00	32.00	1:3.34	70.00	147.00	1 9
Sept. 27 to Oct. 25,	97.68	174.0	24.41	24.41	1:4.28	147.00	204.00	1 13

Total Amount of Feed Consumed from June 28 to Oct. 25.

194.43 lbs. Corn Meal, equal to dry matter,	169.00 lbs.
692 qts. Skim-milk, equal to dry matter,	124.56 "
58 04 lbs. Wheat Bran, equal to dry matter,	51.58 "
59.66 lbs. Gluten Meal, equal to dry matter,	53.67 "
Total amount of dry matter,	398.81 lbs.

Live weight of animal at beginning of experiment,	25.75 lbs.
Live weight at time of killing,	204.00 "
Live weight gained during experiment,	178.25 "
Dressed weight at time of killing,	162.00 "
Loss in weight by dressing,	42 lbs., or 21 per cent.
Dressed weight gained during experiment,	140.85 lbs.

Cost of Feed Consumed during Experiment.

194.43 lbs. Corn Meal, at $24.00 per ton,	$2 33
173 gals. Skim-milk, at 1.8 cents per gallon,	3 11
58.04 lbs. Wheat Bran, at $22.50 per ton,	65
59.66 lbs. Gluten Meal, at $22.50 per ton,	67
	$6 76

2.23 lbs. of dry matter fed yielded 1 lb. of live weight; and 2.83 lbs. of dry matter yielded 1 lb. of dressed weight.

Cost of feed for production of 1 lb. of dressed pork, 4.80 cents.

SUMMARY OF EXPERIMENT VII.

	Corn Meal (in lbs.).	Skim-milk (in gals.).	Wheat Bran (in lbs.).	Gluten Meal (in lbs.).	Live Weight gained during Experiment.	Dressed Weight gained during Experiment.	Cost per pound of Dressed Pork (cents)
N,	202.93	176.0	60.04	61.66	163.75	129.36	5.39
O,	203.09	176.0	60.21	61.83	161.00	127.19	5.49
P,	203.00	176.0	60.21	61.83	174.00	139.20	5.02
Q,	194.09	173.0	57.71	59.93	164.50	128.31	5.27
R,	194.43	173.0	58.04	59.66	177.50	138.45	4.89
S,	194.43	173.0	58.04	59.66	162.50	128.38	5.26
T,	194.43	173.0	58.04	59 66	178.25	140.85	4.80
	1,386 40	1,220.0	412.29	424.23	1,181.50	931.74	-

Total Cost of Feed consumed during the above-stated Experiment.

1,386.40 lbs. Corn Meal,	$16 64
1,220.0 gals. Skim-milk,	21 96
412.29 lbs. Wheat Bran,	4 64
424.23 lbs. Gluten Meal,	4 77
	$48 01

Average cost of feed for production of 1 lb. of dressed pork, 5.15 cents.

Manurial Value of the Feed consumed during the above Experiment.

Corn Meal.	Skim-milk.	Wheat Bran.	Gluten Meal.	Total.
$5 52	$11 32	$2 97	$3 71	$23 52

Manurial value of feed for production of 1 lb. of dressed pork, 2.52 cents.

Taking for granted that in raising one and the same kind of animals to corresponding weights, practically the same amount of nitrogen, phosphoric acid, potassa, etc., will be retained in the animal system, it follows that the excess of any one of these constituents of one diet as compared with another one must count in favor of the higher commercial value of the manurial residue of that particular diet.

Accepting this view regarding the final determination of net cost of feed as correct, it will be noticed, in the subsequent summary of our previously described six feeding experiments, that an addition of gluten meal and wheat bran to a diet consisting of skim-milk and corn meal, reduces the cost of dressed pork, in consequence of the higher value of the manurial refuse obtained. As we sold our dressed pork for from 5½ to 7½ cents per pound, we received from 1.5 to 3.5 cents for labor, housing, etc.

Our seventh feeding experiment has given us the most satisfactory pecuniary results; for the net cost of feed consumed amounted to 3.39 cents per pound of dressed pork produced, after allowing a loss of thirty per cent. of the manurial value of the feed, in consequence of the growth of the animal.

SUMMARY OF EXPERIMENTS II., III., IV., V., VI., VII.

EXPERIMENTS.	Average amount of Dry Matter for production of one pound of Dressed Pork (lbs.).	Cost of Feed per pound of Dressed Pork (cents).	Manurial Value of Feed per pound of Dressed Pork (cents).	Net Cost of Feed per pound of Dressed Pork after deducting 30 per cent. from Manurial Value (cents).
II.,	3.31	5.51	2.30	3.90
III., IV., V.,	3.86	5.92	2.91	3.88
VI.,	3.56	5.69	2.78	3.74
VII.,	3.07	5.15	2.52	3.39

Valuation of Essential Fertilizing Constituents contained in the Various Articles of Fodder used.

	PER CENT.			
	Corn Meal.	Skim-milk.	Wheat Bran.	Gluten Meal.
Moisture,	10.00	90.00	10.80	8.80
Nitrogen (17 cents per pound),	1.96	0.55	2.80	5.03
Phosphoric acid (6 cents per pound),	0.77	0.17	2.36	0.30
Potassium oxide (4¼ cents per pound),	0.45	0.20	1.36	0.03
Valuation per 2,000 pounds,	$7 97	$2 25	$13 51	$17 49

Average Analysis of Skim-milk.

	Per cent.
Moisture at 100° C.,	89.78
Dry Matter,	10.22
	100.00

Analysis of Dry Matter.

Ash (Mineral Matter),	7.82
Fat,	3.23
Protein (Nitrogenous Matter),	34.54
Non-nitrogenous Extract Matter,	54.40
	100.00

Nutritive Ratio, 1 : 1.8.

The skim-milk contained 10.22 per cent. of solids; one quart of it weighed 35.5 ounces, and contained 3.63 ounces of solids; one gallon contained 14.52 ounces of dry organic matter.

Used in the second, third, fourth, fifth and sixth experiments.

SKIM-MILK.

[Average of two Analyses.]

	Per cent.
Moisture at 100° C.,	91.00
Dry Matter,	9.00
	100.00

Analysis of Dry Matter.

Ash (Mineral Matter),	6.67
Fat,	2.78
Protein (Nitrogenous Matter),	34.00
Non-nitrogenous Extract Matter,	56.55
	100.00

Nutritive Ratio, 1 :1.86.

Used in the seventh feeding experiment.

GLUTEN MEAL.

99.82 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.45	169.00	-	-	1 : 2.27
Dry Matter,	91.55	1,831.00	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude Ash,	0.76	15.20	-	-	
" Cellulose,	1.73	34.60	11.76	34	
" Fat,	9.34	186.80	141.97	76	
" Protein (Nitrogenous Matter),	35.31	706.20	600.27	85	
Non-nitrogenous Extract Matter,	52.86	1,057.20	993.76	94	
	100.00	2,000.00	1,747.76	-	

Used in the third experiment.

GLUTEN MEAL.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.95	179.00	-	-	1 : 3.00
Dry Matter,	91.05	1,821.00	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude Ash,	0.76	15.20	-	-	
" Cellulose,	1.58	31.60	10.74	34	
" Fat,	7.51	150.20	114.15	76	
" Protein (Nitrogenous Matter),	30.81	616.20	523.77	85	
Non-nitrogenous Extract Matter,	59.34	1,186.80	1,115.59	94	
	100.00	2,000.00	1,764.25	-	

Used in the fourth, fifth and sixth experiments.

GLUTEN MEAL.

91.44 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.04	200.80	–	–	1 : 2.27
Dry Matter,	89.96	1,799.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	0.78	15.60	–	–	
" Cellulose,	4.45	89.00	30.26	34	
" Fat,	9.34	186.80	141.96	76	
" Protein (Nitrogenous Matter),	34.67	693.40	589.59	85	
Non-nitrogenous Extract Matter,	50.76	1,015.20	954.29	94	
	100.00	2,000.00	1,716.10	–	

Used in the seventh feeding experiment.

CORN MEAL.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.62	252.40	–	–	1 : 8.76
Dry Matter,	87.38	1,747.60	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	1.56	31.20	–	–	
" Cellulose,	2.66	53.20	18.09	34	
" Fat,	4.27	85.40	64.90	76	
" Protein (Nitrogenous Matter),	11.43	228.60	194.31	85	
Non-nitrogenous Extract Matter,	80.08	1,601.60	1,505.50	94	
	100.00	2,000.00	1,782.80	–	

Used in the second, fourth, fifth and sixth experiments.

CORN MEAL.

93.28 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.95	239.00	-	-	1 : 7.42
Dry Matter,	88.05	1,761.00	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude Ash,	1.59	31.80	-	-	
" Cellulose,	2.59	51.80	17.61	34	
" Fat,	4.43	88.60	67.34	76	
" Protein (Nitrogenous Matter),	13.13	262.60	223.21	85	
Non-nitrogenous Extract Matter,	78.26	1,565.20	1,471.29	-	
	100.00	2,000.00	1,779.45	-	

Used in the third feeding experiment.

CORN MEAL.

[Average of two Analyses.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.08	261.60	-	-	1 : 9.66
Dry Matter,	86.92	1,738.40	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude Ash,	1.66	33.20	-	-	
" Cellulose,	3.49	69.80	23.73	34	
" Fat,	4.97	99.40	75.54	76	
" Protein (Nitrogenous Matter),	10.39	207.80	176.63	85	
Non-nitrogenous Extract Matter,	79.49	1,589.80	1,494.41	94	
	100.00	2,000.00	1,770.41	-	

Used in the seventh feeding experiment.

WHEAT BRAN.

81.93 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.05	241.00	–	–	1 : 3.77
Dry Matter,	87.95	1,759.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.64	132.80	–	–	
" Cellulose,	11.49	229.80	45.96	20	
" Fat,	4.75	95.00	76.00	80	
" Protein (Nitrogenous Matter),	17.86	357.20	314.34	88	
Non-nitrogenous Extract Matter,	59.26	1,185.20	948.16	80	
	100.00	2,000.00	1,384.46	–	

Used in the third, fourth, fifth and sixth experiments.

WHEAT BRAN.

73.36 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.14	222.80	–	–	1 : 3.85
Dry Matter,	88.86	1,777.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.59	131.80	–	–	
" Cellulose,	12.80	256.00	51.20	20	
" Fat,	6.00	120.00	96.00	80	
" Protein (Nitrogenous Matter),	17.72	354.40	311.87	88	
Non-nitrogenous Extract Matter,	56.89	1,137.80	910.04	80	
	100.00	2,000.00	1,369.11	–	

Used in the seventh feeding experiment.

ON FODDER SUPPLY, AND ANALYSES OF FODDER ARTICLES.

On Fodder Supply.

The practice of raising a greater variety of valuable crops for green fodder deserves the serious consideration of farmers engaged in the dairy business, for it secures a liberal supply of healthy, nutritious fodder, at a time when hay becomes scarce and costly, and when it would be still a wasteful practice to feed an imperfectly matured green fodder corn. The frequently limited area of land fit for a remunerative production of grasses, and the not less recognized exhausted condition of a large proportion of natural pastures, makes it but judicious to consider seriously the means which promise, not only to increase, but also to cheapen, the products of the dairy.

A liberal introduction of reputed forage crops into farm operations has, everywhere in various directions, promoted the success of agricultural industry. The desirability of introducing a greater variety of fodder plants into our farm management is generally conceded. In choosing plants for that purpose, it seems advisable to select crops which would advantageously supplement our leading fodder crop (aside from the products of pastures and meadows), — the fodder corn and corn stover.

Taking this view of the question, the great and valuable family of leguminous plants, as clovers, vetches, lucerne, serradella, peas, beans, lupines, etc., is, in a particular degree, well qualified for that purpose. They deserve also a decided recommendation in the interest of a wider range for the introduction of economical systems of rotations, under various conditions of soil, and different requirements of markets. Most of these fodder plants have an extensive root system, and, for this reason, largely draw their plant-food from the lower portion of the soil. The amount of stubble and roots they leave behind after the crop has been harvested is exceptionally large, and decidedly improves both the physical and chemical condition of the soil. The lands are consequently better fitted for the production of shallow-growing crops, as grains, etc. Large productions of fodder crops assist in the economical raising of general farm crops; although the area devoted to the cultivation of the latter is reduced, the total yield of the land is usually more satisfactory.

One of the foremost experts in stock-feeding, Julius Kühn of Halle, Germany, expressed the whole question in the following terse manner: "Much fodder, — much manure, large crops and more money in the end."

Each farmer ought to make his selection, from among the various fodder plants, to suit his individual resources and wants; yet, adopting this rule as his guide, he ought to make his selection on the basis that the crop which is capable of producing, for the same area, the largest quantity of nitrogen — containing food constituents, at the least cost, is, as a rule, the most valuable one for him.

Our prominent fodder plants may be classified, in regard to the relative proportion of their *nitrogenous* organic food constituents to their *non-nitrogenous* organic food constituents (nutritive ratio), in the following order: —

1.	Leguminous plants, clover, vetch, etc.,	1 :2.2 to 1 :4.5
2.	Grasses,	1 :5.0 to 1 :8.0
3.	Green corn, roots and tubers,	1 :6.0 to 1 :15.0

The value of an article of fodder may be stated from two different stand-points,— that is, with reference to its cost in the local market, and with reference to its nutritive feeding value.* The market price may be expressed by a definite sum for each locality; it depends on demand and supply in the market, and it is beyond the control of the individual farmer. The nutritive value, or, commonly called, food

* For details regarding estimation of nutritive ratio, see article on "Fodder and Fodder Analysis," Page 31-37, Fourth Annual Report.

value, of the article cannot be expressed by a definite sum; it varies with a more or less judicious application, and depends also, to a considerable degree, on its adaptation under varying circumstances.

To secure the most satisfactory returns from feeding our home-raised fodder crops, is as important a question as that of raising them in an economical manner. The question whether one or the other fodder mixture will prove, ultimately, under otherwise corresponding circumstances, the cheapest one, can only be answered intelligently when both the original cost of the feed consumed, and the value of the manurial residue subsequently obtained, are duly considered.

The composition of the various articles of food used in farm practice exerts a decided influence on the manurial value of the animal excretions, resulting from their use in the diet of different kinds of farm live-stock. The more potash, phosphoric acid, and, in particular, nitrogen, a fodder contains, the more valuable will be, under otherwise corresponding circumstances, the manurial residue left behind, after it has served its purpose as a constituent of the food consumed.

As the financial success in most farm management depends, in a considerable degree, on the amount, the character and the cost of the manurial refuse material secured in connection with the special farm industry carried on, it needs no further argument to prove that the relations which exist between the composition of the fodder and the value of the manure resulting deserves the careful consideration of the farmer, when devising an efficient and at the same time an economical diet for his live-stock.

Fodder Corn and Corn Ensilage.

In the fourth annual report on the work of the Experiment Station, it was stated that a series of tests carried out with plants taken from our fields had demonstrated the fact that the vegetable matter in the variety of corn on trial (Clark) had increased from fifty to one hundred per cent. in actual weight between the time of the first appearance of the tassel and the beginning of the kernels to glaze. It was found that the same variety of corn, raised under fairly corresponding circumstances, as far as the general character of the soil and the mode of cultivation are concerned, contained, in one hundred weight parts, at the time of the *first appearance of the tassel*, from *twelve to fifteen* weight parts of dry vegetable matter, and from *eighty-five* to *eighty-eight* parts of water; while at the time of the *beginning of the glazing of the kernels*, the former was noticed to vary from *twenty-three* to *twenty-eight* weight parts, and the water from *seventy-seven* to *seventy-two*. These results of our investigation left no doubt concerning the fact that our green fodder corn, at the time of the beginning of the glazing of the kernels, contained nearly twice as much vegetable matter per ton weight of corn as at the time of the appearance of the tassels.

This feature in the change of the composition of the fodder corn during its growth is not an exceptional one; similar changes are noticed in all our farm plants. Our observations in this direction were reported for the purpose of furnishing some more definite numerical values for the consideration of our practical farmers. As long as the vital energy of an annual plant is still essentially spent in the increase of its size, as a rule, but a comparatively small amount of valuable organic compounds, as starch, sugar, etc., accumulate within its cellular tissue. The comparative feeding value of the same kind of fodder plants, or any particular part of such plants, is not to be measured by its size, but by the quantity of valuable organic nitrogenous and non-nitrogenous constituents stored up in its cellular system. The larger or smaller amount of dry vegetable matter left behind from a given weight of samples of the same kind, of a fodder plant of a corresponding stage of growth, indicates, in the majority of cases, their respective higher or lower economical value for feeding purposes. Agricultural chemists, for this reason, usually begin their examination of a fodder plant with a test for the determination of the amount of dry vegetable matter left behind when carefully brought to a constant weight at a temperature not exceeding 110° C.

The amount of vegetable matter in a given weight of green fodder corn, cut at the *beginning of the glazing of the kernels*, is known to be not only nearly *twice* as large, as compared with that contained in an *equal weight of green fodder corn* when just showing the *tassels*, but it is also known to be, pound for pound, more nutritious; for it contains more starch, more sugar, more of valuable nitrogenous matter, etc.

Accepting these views as correct, our silos have been filled, for several years past, with fodder corn which had just reached the stage of growth when the kernels begin to glaze over. The condition of the plants along the outside of the corn-field served as guides. These plants are, as a rule, more advanced in growth than those in the more protected parts of the field.

The fodder corn, when cut for the silo, Sept. 9, began to acquire a slightly yellowish tint along the outside of the field, yet was still green and succulent in the interior parts; the kernels were soft, their contents somewhat milky, and their outside just beginning to glaze.

A silo, five by fourteen feet, inside measure, and eleven feet deep, was filled to a depth of from eight to nine feet, as fast as the cut corn, 1¼ to 1½ inches long, could be supplied and tramped down. As soon as the amount of corn assigned for that silo (9 tons) was filled in, the surface was carefully covered with tarred paper and tight-fitting boards, in the same manner as in the case of the first silo, and at once pressed down with twenty-five barrels of sand. A maximum registering thermometer was safely buried at a depth of about three feet in the mass, to record the highest temperature which the latter would reach during the time of keeping the silo closed.

The silo was re-opened for feeding, Jan. 4, 1887. The record of the maximum thermometer buried in the centre of the silo showed 97° F., indicating but a slight increase in temperature, as compared with the temperature on the day when filled. The ensilage was of a good quality. A comparison with the composition of the green fodder corn which served for its manufacture, shows the usual changes noticed in a silo which has been filled at once and closed carefully without any material delay, to prevent a more serious heating up of its contents; namely, a decrease in nitrogenous matter and crude cellulose, and an increase in fatty acids and soluble non-nitrogenous extract matter. The nutritive ratio of the fodder corn was but slightly altered.

A sample of the corn ensilage, taken from two feet below the surface, near the centre of the silo, contained 32.46 parts of dry matter, 0.0185 parts of actual ammonia, and required 0.659 milligrams of sodium oxide for the neutralization of its acids (acetic and lactic acids). An average sample of the ensilage served for the analysis below reported.

I. Green Fodder Corn, used for Ensilage in 1886 (Clark variety).
II. Corn Ensilage, obtained from the above-described Fodder Corn.

	Pounds per Hundred.	
	I.	II.
Moisture at 100° C.,	70.27	71.60
Dry Matter,	29.73	28.40
	100.00	100.00
Analysis of Dry Matter.		
Crude Ash,	5.24	3.32
" Cellulose,	24.50	18.52
" Fat,	3.38	6.07
" Protein (Nitrogenous Matter).	8.36	7.78
Non-nitrogenous Extract Matter,	58.52	64.31
	100.00	100.00

Analysis of Green Fodder Corn and Corn Ensilage, with Reference to Fertilizing Constituents.

	Pounds per Hundred.	
	Green Fodder Corn.	Corn Ensilage.
Moisture at 100° C.,	70.27	71.60
Phosphoric acid (6 cents per pound),	0.13	0.14
Ferric oxide,	–	0.02
Magnesium oxide,	0.05	0.09
Calcium oxide,	0.18	0.10
Potassium oxide (4¼ cents per pound),	0.36	0.33
Sodium oxide,	0.05	0.05
Nitrogen (17 cents per pound),	0.41	0.36
Insoluble matter,	0.45	0.04
Valuation per 2,000 pounds,	$1 86	$1 68

The corn was raised upon land which had been for several years fertilized with ground bone and muriate of potash, 600 pounds of ground bone and 200 pounds of muriate of potash being applied.

The ensilage has been used with satisfactory results in the feeding experiments with milch cows, I., which are described in the beginning of this report.

The silo was filled again with fodder corn for ensilage, Sept. 5, 1887. The same rules were carried out on that occasion as in the preceding year. A maximum and a minimum recording thermometer has been buried several feet below the surface of the cut corn, to study changes in temperature, etc. The ensilage will be used for a repetition of our feeding experiments, under some modified circumstances.

1. FODDER OATS.

[Grown at the Experiment Station on well-manured land. Collected July 5, 1886 (in bloom).]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture when collected,	78.61	1,572.00	–	–	1 : 13.02
Dry Matter when collected,	21.39	427.80	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.38	147.60	–	–	
" Cellulose,	33.12	662.40	–	–	
" Fat,	2.02	40.40	18.58	46	
" Protein (Nitrogenous Matter),	7.10	142.00	80.94	57	
Non-nitrogenous Extract Matter,	50.38	1,007.60	1,007.60	100	
	100.00	2,000.00	1,107.12	–	

2. FODDER OATS.

[Grown at the Experiment Station on well-manured land. Collected July 13, 1886.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture when collected,	71.18	1,423.60	–	–	1 : 13.32
Dry Matter when collected,	28.82	576.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.99	139.80	–	–	
" Cellulose,	32.83	656.60	–	–	
" Fat,	2.44	48.80	22.45	46	
" Protein (Nitrogenous Matter),	7.05	141.00	80.38	57	
Non-nitrogenous Extract Matter,	50.69	1,013.80	1,013.80	100	
	100.00	2,000.00	1,116.63	–	

ROWEN (HAY).

[Raised on Station Grounds, 1887. Contained a liberal admixture of Red Clover.]

	Per cent.
Moisture at 100° C.,	8.84
Dry Matter,	91.16
	100.00

Analysis of Dry Matter.

Crude Ash,	10.50
" Cellulose,	29.46
" Fat,	3.05
" Protein (Nitrogenous Matter),	13.20
Non-nitrogenous Extract Matter,	43.79
	100.00

Fertilizing Ingredients of Rowen.

	Per cent.
Moisture at 100° C.,	8.840
Phosphoric acid,	.364
Potassium oxide,	2.860
Nitrogen,	1.930
Sodium oxide,	.122
Calcium oxide,	.853
Magnesium oxide,	.197
Ferric oxide,	.057
Insoluble Matter,	2.178

SERRADELLA.

[Grown at the Experiment Station. Collected when in bloom, Aug. 4, 1886.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture when collected,	84.60	1,692.00	-	-	1 : 4.07
Dry Matter when collected,	15.40	308.00	-	-	
	100.00	2,000.00	-	-	
Analysis of Dry Matter.					
Crude Ash,	11.85	237.00	-	-	
" Cellulose,	26.21	524.20	-	-	
" Fat,	2.65	53.00	31.80	60	
" Protein (Nitrogenous Matter),	17.75	355.00	223.65	63	
Non-nitrogenous Extract Matter,	41.54	830.80	830.80	100	
	100.00	2,000.00	1,086.25	-	

Analysis of Serradella, with Reference to Fertilizing Constituents.

	Per cent.
Moisture at 100° C.,	10.54
Phosphoric acid (6 cents per pound),	.90
Potassium oxide (4¼ cents per pound),	2.60
Magnesium oxide,	.39
Calcium oxide,	2.63
Sodium oxide,	.55
Nitrogen (17 cents per pound),	2.54
Insoluble Matter,	.21
Valuation per 2,000 pounds,	$11 93

This plant has been described in previous reports as a valuable fodder plant, adapted to moist, sandy lands. Its feeding value has been tested at the Station during the past year.

WHITE DAISY (LEUCANTHEMUM VULGARE).

(Dried.)

	Per cent.
Moisture at 100° C.,	9.65
Dry Matter,	90.35
	100.00

Analysis of Dry Matter.

Crude Ash,	7.05
" Cellulose,	36.09
" Fat,	2.32
" Protein (Nitrogenous Matter),	7.68
Non-nitrogenous Extract Matter,	46.86
	100.00

Fertilizing Ingredients of White Daisy.

Moisture at 100° C.,	9.65
Phosphoric acid,	.435
Potassium oxide,	1.253
Nitrogen,	1.110
Sodium oxide,	1.636
Calcium oxide,	1.302
Magnesium oxide,	.198
Insoluble Matter,	.279
Valuation per 2,000 lbs.,	\$5 36

"PRIDE OF THE NORTH" CORN.

[Raised at the Experiment Station, 1886.]

Average length of ear, seven inches, containing fourteen rows of kernels. The ear was well filled-out at the butt. Average weight of the corn and cob was six ounces, consisting of 84 per cent. of kernels and 16 per cent, of cob. Average weight of kernels, .24 gramme.

	Per cent.
Moisture at 100° C.,	8.75
Dry Matter,	91.25
	100.00

Analysis of Dry Matter.

Crude Ash,	1.59
" Cellulose,	2.54
" Fat,	4.34
" Protein (Nitrogenous Matter),	12.05
Non-nitrogenous Extract Matter,	79.48
	100.00

The seed corn came from the Department of Agriculture at Washington, D. C.; it had been obtained from Minnesota. The corn was raised at the Station lands in good cultivation, with 600 pounds of ground bones and 200 pounds of muriate of potash per acre, as fertilizer. The plant belongs to the "Dent" variety, and deserves recommendation for trial in our section of the State. The composition of the kernels is above the average. The stalks are, however, somewhat harder than many of our local varieties.

"WESTERN DENT" CORN.

[Sent on from Sunderland, Mass.]

	Per Cent	
	Ears.	Stover.
Moisture at 100° C.,	10.20	6.67
Dry Matter,	89.80	93.33
	100.00	100.00
Analysis of Dry Matter.		
Crude Ash,	1.47	4.17
" Cellulose,	1.86	35.44
" Fat,	4.72	1.71
" Protein (Nitrogenous Matter),	9.31	6.63
Non-nitrogenous Extract Matter,	82.64	52.05
	100.00	100.00

The above-stated corn was raised, according to reports received, on excellent soil in "Sunderland Meadows;" four cords of barnyard manure and 150 pounds of a phosphatic fertilizer per acre had been applied.

6 stalks, well air-dried, weighed	2 lbs., 0 oz.
6 ears, well air-dried, weighed	2 " 8 "

The average length of the ear was seven and one-half inches. It contained twelve rows of kernels, and its average weight amounted to six and one-half ounces; 85.6 per cent. kernels, and 14.4 per cent. cob.

"CANADA" CORN (KERNELS).

[Sent on from North Amherst, Mass.]

	Per cent.
Moisture at 100° C.,	9.76
Dry Matter,	90.24
	100.00

Analysis of Dry Matter.

Crude Ash,	1.77
" Cellulose,	2.18
" Fat,	6.39
" Protein (Nitrogenous Matter),	11.50
Non-nitrogenous Extract Matter,	78.16
	100.00

The above-stated corn was grown on heavy, dry loam, fertilized with nine cords of barnyard manure and hog manure to the acre.

8 ears, well air-dried, weighed	1 lb., 13 oz.
5 stalks, well air-dried, weighed	1 " 4 "

The average length of the ear was six and one-third inches. It contained eight rows of kernels, and its average weight amounted to three and three-fourths ounces; 85.07 per cent. kernels, and 14.93 per cent. cob. The average weight of a kernel was .34 gramme. The yield per acre at harvest time was 5,063.5 pounds of ears.

ADAM'S WHITE CORN.

[Sent on from North Amherst, Mass.]

	Per cent.
Moisture at 100° C.,	10.96
Dry Matter,	89.04
	100.00

Analysis of Dry Matter.

Crude Ash,	1.56
" Cellulose,	2.22
" Fat,	5.37
" Protein (Nitrogenous Matter),	8.88
Non-nitrogenous Extract Matter,	81.97
	100.00

The above-stated corn was grown on light, sandy loam, fertilized with four cords of barnyard manure and thirty-five bushels of unleached ashes per acre.

6 ears, well air-dried, weighed	2 lbs., 2 oz.
6 stalks, well air-dried, weighed	1 " 6 "

The average length of ear was eight and one-quarter inches. It contained twelve rows of kernels, and its average weight amounted to six ounces; 72.2 per cent. kernels, and 27.8 per cent. cob. The average weight of a kernel was .25 gramme. The yield per acre at harvest time was 4,050 pounds of ears.

BROOM-CORN SEED (UNGROUND).

[Sent on from North Hadley, Mass.]

	Per cent.
Moisture at 100° C.,	14.10
Dry Matter,	85.90
	100.00

Analysis of Dry Matter.

Crude Ash,	2.35
" Cellulose,	8.34
" Fat,	4.05
" Protein (Nitrogenous Matter),	11.21
Non-nitrogenous Extract Matter,	74.05
	100.00

BROOM-CORN SEED MEAL.

70.26 per cent. passed screen 144 mesh to square inch.

[Sent on from North Hadley, Mass.]

	Per cent.
Moisture at 100° C.,	13.54
Dry Matter,	86.46
	100.00

Analysis of Dry Matter.

Crude Ash,	2.43
" Cellulose,	8.00
" Fat,	4.13
" Protein (Nitrogenous Matter),	11.14
Non-nitrogenous Extract Matter,	74.30
	100.00

BROOM-CORN WASTE (STALKS)

[Sent on from North Hadley, Mass.]

	Per cent.
Moisture at 100° C.,	8.70
Dry Matter,	91.30
	100.00

Analysis of Dry Matter.

Crude Ash,	4.88
" Cellulose,	39.25
" Fat,	1.00
" Protein (Nitrogenous Matter),	6.78
Non-nitrogenous Extract Matter,	48.09
	100.00

Fertilizing Ingredients of Broom-Corn Waste.

Moisture at 100° C.,	10.374
Phosphoric acid (6 cents),	.460
Potassium oxide (4¼ cents),	1.858
Nitrogen (12 cents),	.870
Calcium oxide,	.242
Magnesium oxide,	.170
Insoluble Matter,	.997
Valuation per ton of 2,000 pounds,	$4 13

PEA MEAL.

[Sent on from Springfield, Mass.]

63.88 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	8.85	177.00	-	–	1 : 2.98
Dry Matter,	91.15	1,823.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	2.94	58.80	–	–	
" Cellulose,	19.42	388.40	–	–	
" Fat,	1.67	33.40	26.72	80	
" Protein (Nitrogenous Matter),	20.95	419.00	368.72	88	
Non-nitrogenous Extract Matter,	55.02	1,100.40	1,034.38	94	
	100.00	2,000.00	1,429.82	–	

The above material comes from parties engaged in the manufacture of split peas. It is evidently a mixture of ground peas with a liberal admixture of ground skins of peas. The article is offered in Springfield at twenty dollars per ton. The well-known highly nutritious quality of the peas renders a trial advisable.

Analysis of Pea Meal, with Reference to its Fertilizing Constituents.

	Per cent
Moisture at 100° C.,	8.85
Ferric oxide,	0.03
Phosphoric acid (6 cents per pound),	0.82
Magnesium oxide,	0.30
Calcium oxide,	0.30
Potassium oxide (4¼ cents per pound),	0.99
Sodium oxide,	0.62
Nitrogen (17 cents per pound),	3.08
Insoluble matter,	0.12
Valuation per 2,000 pounds,	$12 31

GLUTEN MEAL (Chicago).

[Bought at Springfield, Mass.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.04	200.80	–	–	1 : 2.27
Dry Matter,	89.96	1,799.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	.78	15.60	–	–	
" Cellulose,	4.45	89.00	30.26	34	
" Fat,	9.34	186.80	141.97	76	
" Protein (Nitrogenous Matter),	34.67	693.40	589.39	85	
Non-nitrogenous Extract Matter,	50.76	1,015.20	954.29	94	
	100.00	2,000.00	1,715.91	–	

WHEAT BRAN.

[Amherst Mill.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	10.38	207.60	–	–	1 : 4.17
Dry Matter,	89.62	1,792.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	6.92	138.40	–	–	
" Cellulose,	14.26	285.20	57.04	20	
" Fat,	4.81	96.20	76.96	80	
" Protein (Nitrogenous Matter),	16.25	325.00	286.00	88	
Non-nitrogenous Extract Mattter,	57.76	1,155.20	924.16	80	
	100.00	2,000.00	1,344.16		

WHEAT BRAN (1886).

[Fine Ground.]

94.95 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.20	244.00	–	–	1 : 3.16
Dry Matter,	87.80	1,756.00	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	7.33	146.60	–	–	
" Cellulose,	10.92	218.40	43.68	20	
" Fat,	2.80	56.00	44.80	80	
" Protein (Nitrogenous Matter),	19.79	395.80	348.30	88	
Non-nitrogenous Extract Matter,	59.16	1,183.20	946.56	80	
	100.00	2,000.00	1,383.34	–	

Analysis of Wheat Bran, with reference to Fertilizing Constituents.

	Per cent.
Moisture at 100° C.,	9.54
Phosphoric acid (6 cents per pound),	1.89
Magnesium oxide,	0.54
Calcium oxide,	0.14
Potassium oxide, (4¼ cents per pound),	1.09
Sodium oxide,	0.06
Nitrogen (17 cents per pound),	2.83
Insoluble matter,	0.64
Valuation per 2,000 pounds,	$12 82

WHEAT MIDDLINGS.

[Amherst Mill.]

99.51 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	9.54	190.80	–	–	1 : 4.07
Dry Matter,	90.46	1,809.20	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	4.47	89.40	–	–	
" Cellulose,	5.64	112.80	22.56	20	
" Fat,	6.00	120.00	96.00	80	
" Protein (Nitrogenous Matter),	19.45	389.00	342.32	88	
Non-nitrogenous Extract Matter,	64.44	1,288.80	1,031.04	80	
	100.00	2,000.00	1,491.92	–	

Analysis of Wheat Middlings, with reference to Fertilizing Constituents.

	Per cent.
Moisture at 100° C.,	12.20
Phosphoric acid (6 cents per pound),	2.84
Ferric oxide,	.02
Magnesium oxide,	.91
Calcium oxide,	.14
Potassium oxide (4¼ cents per pound),	1.62
Sodium oxide,	.09
Nitrogen (17 cents per pound),	2.78
Insoluble matter,	.13
Valuation per 2,000 pounds,	$14 24

CORN MEAL.

92.93 per cent. passed through Mesh 144 to square inch.

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	11.68	233.60	–	–	1 : 7.50
Dry Matter,	88.32	1,766.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	1.56	31.20	–	–	
" Cellulose,	2.44	48.80	16.59	34	
" Fat,	4.73	94.60	71.89	76	
" Protein (Nitrogenous Matter),	10.34	206.80	175.78	85	
Non-nitrogenous Extract Matter,	80.93	1,618.60	1,121.48	94	
	100.00	2,000.00	1,385.74	–	

CORN MEAL.

[Amherst Mill.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	12.98	259.60	–	–	1 : 10.01
Dry Matter,	87.02	1,740.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	1.75	35.00	–	–	
" Cellulose,	3.42	68.40	23.26	34	
" Fat,	5.08	101.60	77.22	76	
" Protein (Nitrogenous Matter),	10.07	201.40	171.19	85	
Non-nitrogenous Extract Matter,	79.68	1,593.60	1,497.98	94	
	100.00	2,000.00	1,769.65	–	

CORN MEAL.

[Amherst Mill.]

	Percentage Composition.	Constituents (in lbs.) in a ton of 2,000 lbs.	Pounds Digestible in a ton of 2,000 lbs.	Per cent. of Digestibility of Constituents.	Nutritive Ratio.
Moisture at 100° C.,	13.18	263.60	–	–	1 : 9.33
Dry Matter,	86.82	1,736.40	–	–	
	100.00	2,000.00	–	–	
Analysis of Dry Matter.					
Crude Ash,	1.57	31.40	–	–	
" Cellulose,	3.56	71.20	24.21	34	
" Fat,	4.86	97.20	73.87	76	
" Protein (Nitrogenous Matter),	10.72	214.40	182.24	85	
Non-nitrogenous Extract Matter,	79.29	1,585.80	1,490.65	94	
	100.00	2,000.00	1,770.97	–	

CRACKED CORN (CHITS REMOVED).

[Sent on from North Hadley, Mass.]

	Per cent.
Moisture at 100° C.,	13.58
Dry Matter,	86.42
	100.00
Analysis of Dry Matter.	
Crude Ash,	2.64
" Cellulose,	3.15
" Fat,	4.06
" Protein (Nitrogenous Matter),	10.99
Non-nitrogenous Extract Matter,	79.16
	100.00

CHIT CORN MEAL.

80.65 per cent. passed screen 144 Mesh to square inch.

[Sent on from North Hadley, Mass.]

	Per cent.
Moisture at 100° C.,	12.32
Dry Matter,	87.68
	100.00

Analysis of Dry Matter.

	Per cent.
Crude Ash,	2.08
" Cellulose,	3.92
" Fat,	5.74
" Protein (Nitrogenous Matter),	10.26
Non-nitrogenous Extract Matter,	78.00
	100.00

ENSILAGE OF SWEET CORN.

[Sent on from Marblehead, Mass]

Analysis of Dry Matter.

	Per cent.
Crude Ash,	5.66
" Cellulose,	24.21
" Fat,	5.19
" Protein (Nitrogenous Matter),	10.10
Non-nitrogenous Extract Matter,	54.84
	100.00

The general appearance of the ensilage was good. The small amount of soluble non-nitrogenous matter, in presence of a comparatively large amount of crude nitrogenous matter and of crude cellulose, seems to indicate a considerable destruction of non-nitrogenous matter (sugar, starch, etc.) during the keeping of the corn in the silo. The composition of this sample of ensilage of sweet corn resembles that obtained from corn in the tassel. A comparison of the above analysis with some of the analyses of the dry vegetable matter of corn ensilage, produced at the Experiment Station during previous years, suggests that conclusion.

ANALYSES OF FINE SALT.

[I. and II. sent on from Florida, Berkshire County, Mass. III. sent on from Springfield, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	3.280	4.591	4.616
Sodium chloride,	95.091	94.012	94.236
Calcium sulphate,	1.487	1.177	0.999
Calcium chloride,	0.032	0.143	0.071
Magnesium chloride,	0.075	0.049	0.026
Matter insoluble in water (largely carbonates of lime and magnesia),	0.035	0.028	0.052
Salicylic acid,	0.	0.	trace.
	100.000	100.000	100.000

The above-described samples of salt have been offered of late in our markets as "dairy salt," judging from communications received. As the recent introduction into our markets of various brands of salt from new salt works in western New York imparts a particular interest to the question of what constitutes a good dairy salt, a short discussion of that question may not be without interest in connection with the above analyses.

There are three sources of supply for the manufacture of salt; namely, sea water, brines and rock salts. None of them yield by any current mode of manufacture a chemically pure article of sodium chloride; all three may be successfully turned to account for the manufacture of the various brands of salt in our market.

Local circumstances control the selection of the particular source of supply; and, as the particular fitness of salt for different domestic applications, as meat-packing, family use and dairy, depends not only on a fairly good chemical composition, but also to a considerable degree on a suitable mechanical condition, it is quite obvious that the selection of the mode of manufacture has to be made with reference to the general character and the quality of the source on hand, and to the kind of salt desired.

Our home-manufactured salt — "coarse," "fine" and "dairy salt" — has been produced, until of late, almost entirely from natural brines, sea-water excluded. All natural brines contain more or less of foreign saline admixtures. Most prominent among these are the sulphates of lime and magnesia, and the chlorides of calcium and magnesium.

The general character and the industrial value of different brines, considering concentration equally favorable, depend as a rule not so much on the total amount of foreign saline substances present, as on the relative proportion of the above-stated foreign admixtures.

The same circumstances apply with equal force to the salt produced. The less chlorides of calcium and magnesium a salt contains, the better will be considered its quality, from a commercial stand-point. The presence of sulphate of lime, within certain limits, is far less objectionable.

A salt which contains but one-fourth of one per cent. of the chlorides of magnesium and of calcium, might prove highly objectionable to the dairyman, on account of its unpleasantly bitter saline taste; while the sulphate of lime rarely amounts to less than one and one-quarter per cent. in the best-reputed brands of dairy salts, home and foreign.

A detailed statement of the exact amount of each of the above-mentioned foreign saline admixtures is for this reason needed, to render a decision possible regarding the relative merits of the various brands of salt offered for sale, as far as a desirable composition is concerned.

The most common cause of injuring the composition of salt, for dairy purposes in particular, is a too liberal use of lime during its manufacture, to secure a desirable white color and a fine granulation of the salt produced.

The natural consequence of that course of operation is an alkaline reaction of the salt, — a most objectionable quality of a dairy salt, for it hastens on the decomposition of the butter.

The peculiar nature of the products of the dairy, — butter and cheese, — as well as the unusual pecuniary risks involved in their successful manufacture, renders it necessary that only first-class articles of salt should be applied for dairy purposes. The fitness of any of the various brands of salt in our markets. for dairy use is not restricted to those obtained from any particular natural source or locality, but depends entirely upon a suitable good chemical composition, and a suitable mechanical condition.

A good dairy salt ought to be of a neutral reaction, and of a pure saline taste; free from offensive odor, and without any stain of color; of a properly reduced size to favor a speedy solution; and, what is scarcely of less importance, free from colored specks. As the application of dairy salt in form of saturated solutions enables, with but little trouble, the removal of insoluble foreign admixtures, this mode of using salt in the dairy industries, whenever admissable, deserves commendation.

To produce an article of the above description requires an extra exertion on the part of the manufacturer, and necessitates thus additional expenses, as compared with the average brands of "common fine" and the ordinary "coarse or solar salts," neither of which, as a general rule, answers to the previous description.

A dairy salt, originally good, may become objectionable in consequence of a subsequent careless storing amidst strong-smelling articles of merchandise, etc., or in barns.

Judging the above samples of "dairy salt" by the customary commercial standard of composition previously explained, it will be noticed that sample I. is preferable to sample II., although its total amount of foreign saline admixture is larger than in samples II. and III. The last-named sample would rank next, if it did not contain some salicylic acid.

None of the above three samples can claim to rank with the better brands of "dairy salt" in our markets.

The presence of an exceptional amount of carbonate of lime in all of them impairs greatly their fitness for dairy purposes A good salt may not improve materially an otherwise carelessly manufactured butter or cheese, yet a lower grade of fine salt will invariably destroy the keeping quality of a good butter and cheese.

The addition of salicylic acid as a preservative is strongly condemned by good authorities in sanitary matters.

DAIRY SALT.

[Sent on from Amherst, Mass.]

	Per cent.
Moisture at 100° C.,	.145
Sodium chloride,	98.520
Calcium sulphate,	1.009
Calcium chloride,	.189
Magnesium chloride,	.065
Insoluble matter (chiefly carbonate of magnesia and sand),	.072

ROCK SALT.

[From the Retsof Salt Mines at Pifford, Livingston County, New York. Sent on from Springfield, Mass.]

	Per cent.
Moisture at 100° C.	2.60
Calcium sulphate,	0.42
Calcium chloride,	0.33
Magnesium chloride,	0.01
Sodium chloride,	95.94
Insoluble matter,	0.70
	100.00

This article has been, of late, introduced into our market in lump form, to take the place of the English lump salt for stock feeding. The sample sent on for examination was of a very fair quality, and compared very favorably with the former. Its selling price at Springfield, Mass., is stated: from 5 to 10 pounds, at $1\frac{1}{2}$ cents per pound; 100 pounds, at 75 cents; wholesale, per ton of 2,000 pounds, at $8.50; and in car-loads, one dollar less per ton.

SALT.

KIND AND SOURCE.	Moisture 100° C.	Sodium Chloride.	Calcium Sulphate.	Calcium Chloride.	Magnesium Chloride.	Sodium Sulphate.	Magnesium Sulphate.	Insoluble Matter.	Remarks.
Rock Salt of Pettite Anse, La.,	.330	98.882	.782	.004	.003	–	–	–	Sent on for Examination.
Rock Salt of Neyba, St. Domingo, W. I.,	.300	98.330	1.480	–	.090	.070	.070	–	
Solar Salt, Onondaga, N.Y.,	2.500	96.004	1.315	.092	.089	–	–	–	
Solar Salt, Hocking Valley, Ohio,	2.130	97.512	None.	.234	.089	–	–	–	
Solar Salt, Saginaw Valley, Mich.,	3.344	95 813	.316	.356	.140	–	–	–	
Solar Salt from Kansas,	4.950	93.060	1 220	–	.240	.350	.180	–	
Solar Salt, Lincoln County, Nebraska,	1.200	98.130	.250	–	.080	.390	None.	–	
Common Fine and Boiled Salt, Onondaga, N. Y.,	3.000	95.353	1.355	.155	.136	–	–	–	
Common Fine and Boiled Salt, Portsmouth, Mich.,	6.752	90.682	.805	.974	.781	–	–	–	
Common Fine and Boiled Salt, Mason City, Ohio,	3.470	95.789	–	.614	.041	–	–	–	
Dairy and Table Salt, Ashton's (English),	0.760	97.652	1.430	–	.060	–	.048	.050	
Onondaga Dairy Salt,	0.700	97.832	1.263	–	.037	.026	.023	.120	
Fine Salt, Bulletin 26, I.,	3.280	95.091	1.487	.032	.075	–	–	.035	
Fine Salt, Bulletin 26, II.,	4.591	94.012	1.177	.143	.049	–	–	.028	
Fine Salt, Bulletin 26, III.,	4.616	94.236	.999	.071	.026	–	–	.052	Salicylic Acid: Trace.
Dairy Salt, sent on from Amherst, Mass.,	0.145	98.520	1.009	.189	.065	–	–	.072	

FIELD EXPERIMENTS.

I. Field A. Fodder Corn Raised with Single Articles of Plant Food.

II. Field B. Fodder Crops Raised with and without Complete Manure.

III. Field C. Experiments with Wheat, Vetch and Oats, Serradella and Southern Cow Pea.

IV. Field D. Experiments with Potatoes, Roots and Miscellaneous Crops.

FIELD EXPERIMENTS.

[Field A.]

1. Fodder Corn raised upon Underdrained Lands, partly fertilized with Single Articles of Plant Food, partly without the use of any Manurial Matter.

The field utilized for this experiment consists of ten adjoining plats, one-tenth of one acre each in size. The plats are five feet apart; the grounds between them are kept free from any growth, and receive no fertilizing ingredients of any description.

The entire field is surrounded by a tile drain, and each plat has a separate one through its centre. This terminates at its east end in a well which is connected with the surrounding drain.

The land was used, for several years previous to the establishment of the Experiment Station, in 1882, as a meadow for the production of hay. During the spring of 1883 it was planted with corn, for fodder corn, without the use of any fertilizer.

The same course of planting and cultivation was carried out during 1884, for the purpose of exhausting the soil, as far as practicable, for a remunerative cultivation of corn.

The crop raised in 1884 upon these plats of unmanured land left no doubt concerning their exhausted condition, as far as further successful cultivation of corn was concerned; for the entire yield of corn fodder amounted to 5,040 pounds, with a moisture of thirty per cent.

This condition of the soil encouraged the beginning of a special inquiry into the chemical and physical condition of our soil, as far as *its relation to the production of the corn crop is concerned.* With that end in view, the following course was decided upon and carried out during the succeeding season (1885).

The entire field (A) was prepared, May 12, in a similar manner as in preceding years for the planting of corn (see Second Annual Report, page 81). All except Plat 6 were planted with (Clark) corn.

Plat No. 0, ...	Thrown out of the experiment.
Plat No. 1, ...	Twenty-five pounds of sodium nitrate (= to 4 lbs. of nitrogen).
Plat No. 2, ...	Nothing.
Plat No. 3, ...	Thirty pounds of dried blood (= to 4 lbs. of nitrogen).
Plat No. 4, ...	Nothing.
Plat No. 5, ...	Twenty-five pounds of ammonium sulphate (= to 5 lbs. of nitrogen).
Plat No. 6, ...	Nothing. (Black Fallow.)
Plat No. 7, ...	Fifty pounds of dissolved bone-black (= to 85 lbs. of available phosphoric acid).
Plat No. 8, ...	Nothing.
Plat No. 9, ...	Twenty-five pounds of muriate of potash (= to from 12 to 13 lbs. of potassium oxide).
Plat No. 10, ...	48½ pounds of potash-magnesia sulphate (= to from 12 to 13 lbs. of potassium oxide).

The growth on the entire field was cut Sept. 5, and the product of each plat stooked by itself in the field for drying; it was housed Oct. 10, with the following results:—

1885.

PLAT.	Amount of Dry Corn Fodder obtained.	Fertilizer Applied.
No. 1, . .	480 lbs.	25 lbs. of sodium nitrate (= to 4 lbs. of nitrogen).
2, . .	310 "	Nothing.
3, . .	350 "	30 lbs. of dried blood (= to 4 lbs. of nitrogen).
4, . .	300 "	Nothing.
5, . .	360 "	25 lbs. of ammonium sulphate (= to 5 lbs. of nitrogen).
6, . .	–	Fallow.
7, . .	280 "	50 lbs. of dissolved bone-black (= to 8.5 lbs. of available phosphoric acid).
8, . .	250 "	Nothing.
9, . .	945 "	25 lbs. of muriate of potash (= to from 12 to 13 lbs. of potassium oxide).
10, . .	845 "	48½ lbs. of potash-magnesia sulphate (= to from 12 to 13 lbs. of potassium oxide).

Comparing these results with those obtained in the previous year, where the products of the various plats were practically of a corresponding weight (458 lbs. each), it was noticed that *the application of potash compounds alone, muriate of potash leading* (see Plats No. 9 and 10), *had exerted a marked effect* on the *quantity* and the *quality* of the corn fodder raised, increasing the previous annual yield not less than one hundred per cent. above that of the preceding year (1884).

The amount of corn fodder raised on Plat No. 1, which received nitrate of soda, had exceeded but slightly (22 lbs.) that of the previous season; while the application of blood, ammonium sulphate and phosphoric acid, had not prevented a considerable falling off. The yield of corn fodder of fertilized and unfertilized plats was practically the same in Plats 1 to 8.

In sight of these facts, it seemed but justifiable to conclude that a *deficiency of the soil in available potash had controlled, in our case, more than that of any other essential article of plant food, the final yield of the crop.*

As the cultivation of grasses and fodder corn affects the manurial resources of the soil in a similar direction, by abstracting approximately one part of phosphoric acid to four parts of potash, it is but a natural result that a soil which originally did not contain much more of available potash than of available phosphoric acid, must become unproductive before the latter is exhausted. In case circumstances necessitate a direct succession of these two crops, it is well to remember that fact, and to provide against a failure by applying to the soil liberally, in particular, potash compounds in some form or other. Muriate of potash deserves recommendation.

To verify the above conclusion, the experiment was continued during the year 1886, with the *sole modification of increasing on each fertilized plat the particular fertilizing ingredients to twice the amount used in the preceding year.*

The plats were thoroughly ploughed and harrowed May 15, 1886. The fertilizers were sown broadcast in each case, and slightly harrowed in before planting the corn, in rows, May 21 and 22 (Clark's variety). The rows were three feet three inches apart. The seeds were dropped from twelve to fourteen inches apart, and six to eight kernels in a place. The mode of planting and the subsequent treatment of the crop was in every way corresponding to the course adopted in the two preceding years. The young plants appeared uniform and healthy looking, in all plats, June 1. They turned, however, to a pale green color by June 28, with the exception of those on Plats 9 and 10. The latter were still of a dark green color Sept. 11, when the entire crop was cut and stooked in the field. The corn growing on Plats 1 to 8, inclusive, had reached, at the end of the season, a height of from two to four feet, and showed only here and there a partially filled ear; it was badly dried up and unhealthy looking when cut. The plants grown upon Plats 9 and 10 had reached a height of from five to eight feet; the stalks and leaves were still succulent when cut, and the ears pretty well formed throughout the plats, but small, and the kernels scarcely beginning to glaze.

The weight of the corn fodder raised upon each plat was ascertained Oct. 23, when the crop was housed. The subsequent statement contains the results of the experiment. The weights of the corn fodder are stated with reference to the same state of moisture (from 45 to 50 per cent.) as in the preceding year, to allow a comparison of the results.

1886.

PLAT.	Amount of Dry Corn Fodder obtained.	Fertilizer Applied.
No. 1, . .	430 lbs.	50 lbs. of sodium nitrate (= to 7 to 8 lbs. of nitrogen).
2, . .	250 "	Nothing.
3, . .	310 "	60 lbs. of dried blood (= to 7 to 8 lbs. of nitrogen).
4, . .	250 "	Nothing.

1886.

PLAT.	Amount of Dry Corn Fodder obtained.	Fertilizer Applied.
No. 5, . .	280 lbs.	50 lbs. of ammonium sulphate (= to 10 lbs. of nitrogen).
6, . .	–	Fallow.
7, . .	255 "	100 lbs. of dissolved bone-black (= to 17 lbs. available phosphoric acid).
8, . .	195 "	Nothing.
9, . .	840 "	50 lbs. of muriate of potash (= to 25 lbs. of potassium oxide).
10, . .	895 "	97 lbs. of potash-magnesia sulphate (= to 25 lbs. of potassium oxide).

These results, compared with those of the previous year, show still a falling off in yield in all plats, notwithstanding a decided increase in the various single manurial substances applied on Plats 1, 3, 5, 7, 9 and 10. The yield of the fertilized Plats 1, 3, 5 and 7 during 1886 was less than that of the unfertilized plats in 1885. The good service of *potash compounds* as the *sole fertilizer was still as striking as in the two preceding years.*

1887.

The examination into the condition of "Field A," as far as its store of available plant food is concerned, was continued during the past year, with a view to showing, if possible, still more decidedly, that a serious exhaustion of the soil in available potassa, in particular, was the leading cause of a reduced production of corn fodder. To secure that end the following course has been pursued: —

The various plats were ploughed and harrowed during the second week of May. Plats 2, 4 and 8, which in previous years had been planted with corn without receiving any fertilizing ingredients, were used again for the raising of corn fodder, and left unfertilized as before. Plats 1, 3, 5, 7, 9 and 10 were fertilized broadcast before planting the corn. The mode of planting and the subsequent treatment of the crop was the same as in preceding years. No. 1, which for several years in succession had received as a fertilizer but from 4 to 8 pounds of nitrogen in form of nitrate of soda, was fertilized with a mixture of 50 pounds of nitrate of soda (= 7 to 8 pounds of nitrogen) and 50 pounds of muriate of potash (= 25 pounds of potassium oxide).

No. 3, for several years in succession fertilized with from 4 to 8 pounds of nitrogen in form of dried blood, was treated with a mixture of 60 pounds of dried blood (=7 to 8 pounds of nitrogen) and 100 pounds of dissolved bone-black (= 16 to 17 pounds of available phosphoric acid).

No. 5, for several years in succession fertilized with 4 to 10 pounds of nitrogen in form of sulphate of ammonia, received as fertilizer a mixture of 50 pounds of ammonium sulphate (= 10 pounds of nitrogen) and 97 pounds of potash-magnesia sulphate (= 25 pounds of potassium oxide).

No. 7, for two succeeding years fertilized with from 8 to 16 pounds of available phosphoric acid, was treated with a mixture of 100 pounds of dissolved bone-black (= 16 to 17 pounds available phosphoric acid) and 50 pounds of muriate of potash (= 25 pounds potassium oxide).

No. 9 was fertilized, as in preceding years, with nothing but muriate of potash, of which 50 pounds were applied (=25 pounds potassium oxide), the same quantity previously used (1886).

No. 10, in preceding years fertilized with from 12 to 25 pounds of potassium oxide in form of potash-magnesia sulphate, received a mixture of 97 pounds of potash-magnesia sulphate (= 25 pounds potassium oxide) and 60 pounds of dried blood (= 7 to 8 pounds nitrogen).

The corn (Clark) was planted, in the same manner as in the preceding years, May 23. The crop upon the entire field looked uniform and healthy until the middle of July. Subsequently a gradual change in appearance became noticeable. The growth upon the plats which had either received no fertilizer, or one which did not contain potash, turned yellowish, ceased to grow, and produced a few imperfect ears; while, upon those plats which had been fertilized with a material containing potash, it retained its healthy appearance, reached its normal height and produced a liberal number of perfect ears. The entire crop was cut and stooked in the field Sept. 15; it was housed, after being weighed, Oct. 17.

The following tabular statement of our field results for three succeeding years needs scarcely any further explanation. The beneficial influence of a potash supply on the yield of fodder, upon our experimental plats, is in every instance unmistakable ; while the application of a liberal supply of phosphoric acid and nitrogen, either separately or combined, on the whole, does not materially affect the annual yield, when compared with the unfertilized plats.

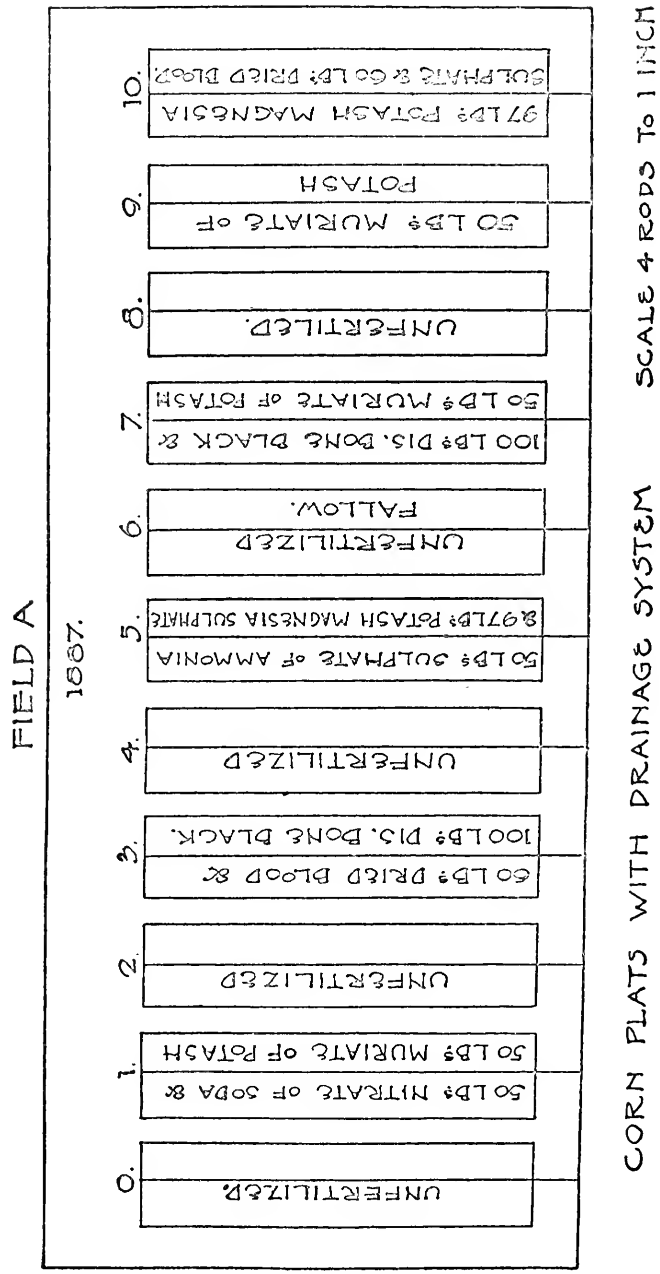
The investigation will be continued, with some modifications, to serve as an illustration concerning the effect of a one-sided exhaustion of farm lands, and to assist in pointing out some practical lessons for an economical management of the latter.

FIELD "A."

[1882, a meadow; 1883, planted with "Longfellow" corn; 1884, 1885, 1886 and 1887, planted with "Clark" corn.]

NUMBER OF PLAT.	Fertilizers Applied.			Yield of Dry Fodder Corn.		
	1885.	1886.	1887.	1885.	1886.	1887.
				Lbs.	Lbs.	Lbs.
Plat 1,	25 lbs. sodium nitrate (=4 lbs. nitrogen).	50 lbs. sodium nitrate (=7 to 8 lbs. nitrogen).	50 lbs. sodium nitrate (=7 to 8 lbs. nitrogen), and 50 lbs. muriate of potash (=25 lbs. potassium oxide),	480	430	720
Plat 2,	Nothing,	Nothing,	Nothing,	310	250	165
Plat 3,	30 lbs. dried blood (=4 lbs. nitrogen).	60 lbs. dried blood (=7 to 8 lbs. nitrogen).	60 lbs. dried blood (=7 to 8 lbs. nitrogen), 100 lbs. dissolved bone-black (=17 lbs. available phosphoric acid),	350	310	240
Plat 4,	Nothing,	Nothing,	Nothing,	300	250	130
Plat 5,	25 lbs. ammonium sulphate (=5 lbs. nitrogen).	50 lbs. ammonium sulphate (=10 lbs. nitrogen).	50 lbs. ammonium sulphate (=10 lbs. nitrogen), and 97 lbs. potash-magnesia sulphate (=25 lbs. potassium oxide),	360	280	635
Plat 6,	Fallow,	Fallow,	Fallow,	-	-	-
Plat 7,	50 lbs. dissolved bone-black (=8.5 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (=17 lbs. available phosphoric acid).	100 lbs. dissolved bone-black (=17 lbs. available phosphoric acid), and 50 lbs. muriate of potash (=25 lbs. potassium oxide),	280	255	730
Plat 8,	Nothing,	Nothing,	Nothing,	250	195	165
Plat 9,	25 lbs. muriate of potash (=12 to 13 lbs. potassium oxide).	50 lbs. muriate of potash (=25 lbs. potassium oxide).	50 lbs. muriate of potash (=25 lbs. potassium oxide),	945	840	655
Plat 10,	48½ lbs. of potash-magnesia sulphate (=to 12 to 13 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (=to 25 lbs. potassium oxide).	97 lbs. potash-magnesia sulphate (=25 lbs. potassium oxide), and 60 lbs. dried blood (=7 to 8 lbs. nitrogen),	845	895	940

Plat 0 was thrown out of the experiment.


FIELD A
1887.
0.
UNFERTILIZED.
1.
50 LBS NITRATE OF SODA &
50 LBS MURIATE OF POTASH
2.
UNFERTILIZED
3.
60 LBS DRIED BLOOD &
100 LBS DIS. BONE BLACK.
4.
UNFERTILIZED
5.
50 LBS SULPHATE OF AMMONIA
&97 LBS POTASH MAGNESIA SULPHATE
6.
UNFERTILIZED
FALLOW.
7.
100 LBS DIS. BONE BLACK &
50 LBS MURIATE OF POTASH
8.
UNFERTILIZED.
9.
50 LBS MURIATE OF
POTASH
10.
97 LBS POTASH MAGNESIA
SULPHATE & 60 LBS DRIED BLOOD
CORN PLATS WITH DRAINAGE SYSTEM
SCALE 4 RODS TO 1 INCH

2. Influence of Fertilizers on the Quantity and the Quality of some Prominent Fodder Crops.

(Field B.)

The land selected for the experiment had been used for several years for the production of hay. At the beginning of the season of 1883 it had been ploughed and planted with corn, *without the addition of any fertilizer*. The soil consisted of a good, sandy loam, and was, in consequence of its previous treatment, in a *suitably impoverished condition* to respond to the application of fertilizers.

The entire field, consisting at that time of one and one-tenth acres, was sub-divided into plats, each one-tenth of an acre in size. Every alternate plat was fertilized at the rate of six hundred pounds of ground, rendered bones, and two hundred pounds of muriate of potash, per acre. The fertilizer was applied a few days before seeding, and slightly harrowed under.

1884.—The experiment in this year comprised four standard grasses; i. e., Orchard grass (*Dactylis glomerata*), Meadow Fescue (*Festuca pratense*), Timothy (*Phleum pratense*) and Redtop (*Agrostis vulgaris*), besides two Millets, Hungarian grass (*Panicum Germanicum*) and Pearl Millet (*Penicillaria spicata*), and one variety of corn, Clark.

Plats No. 11, 13, 15, 19 and 21 were fertilized; and Nos. 12, 14, 16, 18 and 20 received no manurial matter of any description. In the case of the grasses and millets, each plat was again sub-divided into two, and each half seeded down with one distinct kind of grass seed, as follows: —

Plat No. 11 (fertilized), . . .	Orchard Grass (north side). Meadow Fescue (south side).
Plat No. 12 (unfertilized), . .	Orchard Grass (north side). Meadow Fescue (south side).
Plat No. 13 (fertilized), . . .	Hungarian Grass (north side). Pearl Millet (south side).
Plat No. 14 (unfertilized), . . .	Hungarian Grass (north side). Pearl Millet (south side).
Plat No. 15 (fertilized), . . .	Timothy (north side). Redtop (south side).

Plat No. 16 (unfertilized), . . . { Timothy (north side). Redtop (south side).

Plats No. 17, 18, 19, 20 and 21 were planted with corn (Clark).

1885. — During the year 1885, Plats No. 17, 18, 19, 20 and 21 served again, as in previous years, for the cultivation of corn. The entire crop upon all plats was cut Sept. 4, 1885. The dry corn fodder secured from the fertilized plats averaged $5\frac{1}{6}$ tons per acre, and that from the unfertilized plats yielded $3\frac{1}{10}$ tons for the same area. The fertilized Plat No. 13 produced 1,870 pounds of dried millet, or 18,700 pounds ($9\frac{1}{3}$ tons) per acre; and the unfertilized Plat No. 14 (for three succeeding years without manure) produced 1,050 pounds of air-dried crops, or 10,500 pounds ($5\frac{1}{4}$ tons) for a corresponding area.

The Plats 11, 12, 15 and 16 (Field B), which had been seeded down broadcast during the month of September, 1884, with several varieties of grasses, for the purpose of studying their individual nutritive character at different successive stages of growth, soon became infested with all kinds of plants. As this circumstance could not otherwise than quite seriously interfere with our object, it was thought best to re-plough these plats, and *to seed down again each variety of grass, in drills.* The cultivation of grasses in drills, two feet apart, was adopted with much success, June 22, 1885. A frequent use of the cultivator, aided by the hoe and hand-weeding, has enabled us to secure, as far as practicable, a clean growth.

1886. — No material change was made in the general arrangement and mode of treatment of the plats in Field B, beyond the addition, on the west end of each plat, of an area forty-three feet in length, and a width corresponding to that of the existing plats. This addition makes the present length of these plats 175 feet; they are each 33 feet wide.

The same varieties of grasses and of corn (Clark) were cultivated. The latter was also planted, in place of two varieties of millets, cultivated during the preceding year, in Plats 13 and 14. The corn was planted, as in previous years, in drills three feet three inches apart; the seed was dropped, from six to eight in a place, at a distance of from twelve to fourteen inches apart, May 17, 1886. Plats 13, 17, 19 and 21 were fertilized with ground bone and potash, as in preceding years; while Plats 14, 18 and 20 received no manurial matter of any description. The growth of the corn on fertilized and unfertilized plats presented throughout the season a similar appearance, as has been noticed and described on previous occasions, with the exception of the fertilized Plat 13 and the unfertilized Plat 14, which yielded a larger return than any other of the plats under a corresponding treatment. These two plats had been changed from the cultivation of corn, in 1883, to that of millet, in 1884 and 1885.

For further details regarding yield, etc., we have to refer to pages 71 and 72 of our fourth annual report.

The entire field was ploughed during fall, to prepare it for experiments with other crops in the succeeding year. The samples of the various grasses on trial had been collected at successive stages of growth, to ascertain their composition. The results of these analyses are contained in the following tabular statement.

ORCHARD GRASS (HAY).

	Collected June 7, 1886, while in Bloom.		Collected June 30, 1886, in Seed.	
	Fertilized.	Unfertilized.	Fertilized.	Unfertilized.
Moisture at 100° C.,	9.09	9.16	8.38	8.72
Dry Matter,	90.91	90.84	91.62	91.28
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude Ash,	7.90	8.67	6.17	5.46
" Cellulose,	34.12	34.15	35.48	35.79
" Fat,	2.41	2.40	3.56	3.26
" Protein (Nitrogenous Matter),	8.94	11.24	7.57	8.15
Non-nitrogenous Extract Matter,	46.63	43.50	47.22	47.34
	100.00	100.00	100.00	100.00

REDTOP (HAY).

	Collected July 5, 1886, while in Bloom.		Collected July 22, 1886, in Seed.	
	Fertilized.	Unfertilized.	Fertilized.	Unfertilized.
Moisture at 100° C.,	6.81	7.75	8.24	8.02
Dry Matter,	93.19	92.25	91 76	91.98
	100.00	100.00	100.00	100.00
Analysis of Dry Matter.				
Crude Ash,	5.69	5.17	4.84	4.17
" Cellulose,	34.11	32.95	33.49	31.12
" Fat,	1.56	1.64	1.50	1.69
" Protein (Nitrogenous Matter),	8.32	8.40	6.41	8.28
Non-nitrogenous Extract Matter,	50.32	51.84	53.76	54.74
	100.00	100.00	100.00	100.00

MEADOW FESCUE (HAY).

	Collected June 28, 1886, in Seed.	
	Fertilized.	Unfertilized.
Moisture at 100° C.,	7.40	8.03
Dry Matter,	92.60	91.97
	100.00	100.00
Analysis of Dry Matter.		
Crude Ash,	7.17	8.18
" Cellulose,	34.46	34.61
" Fat,	2.17	1.78
" Protein (Nitrogenous Matter),	7.02	7.27
Non-nitrogenous Extract Matter,	49.18	48.16
	100.00	100.00

TIMOTHY (HERDS' GRASS).

	Collected June 28, 1886, while in Bloom.	
	Fertilized.	Unfertilized.
Moisture at 100° C.,	65.74	65.00
Dry Matter,	34.26	35.00
	100.00	100.00
Analysis of Dry Matter.		
Crude Ash,	5.29	5.37
" Cellulose,	33.23	32.50
" Fat,	1.95	2.07
" Protein (Nitrogenous Matter),	8.20	8.83
Non-nitrogenous Extract Matter,	51.33	51.23
	100.00	100.00

Fertilizing Ingredients of Timothy.

	Fertilized.	Unfertilized.
Moisture at 100° C.,	7.80	7.24
Phosphoric acid (6 cents per pound),	0.36	0.56
Potassium oxide (4¼ cents per pound),	1.63	1.44
Nitrogen, (17 cents per pound),	1.21	1.31
Sodium oxide,	0.08	0.37
Calcium oxide,	0.44	0.99
Magnesium oxide,	0.12	0.09
Insoluble matter,	1.01	1.33
Valuation per 2,000 pounds.	$5 93	$6 35

Fertilizing Ingredients of Orchard Grass.

[I. Fertilized. Collected in bloom, June 7, 1886. II. Unfertilized. Collected in bloom, June 7, 1886. III. Fertilized. Collected in seed, June 30, 1886. IV. Unfertilized. Collected in seed, June 30, 1886.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	9.09	9.16	8.38	8.72
Phosphoric acid,	0.483	0.399	0.329	0.444
Potassium oxide,	2.339	2.114	1.758	1.303
Nitrogen,	1.300	1.640	1.109	1.190
Sodium oxide,	0.211	0.233	0.246	0.211
Calcium oxide,	0.401	0.457	0.496	0.470
Magnesium oxide,	0.255	0.236	0.192	0.305
Ferric oxide,	0.014	0.021	0.063	0.034
Insoluble matter,	1.867	1.976	2.280	2.116
Valuation per 2,000 pounds,	$6 99	$7 86	$5 66	$5 69

Fertilizing Ingredients of Redtop Hay.

[I. Fertilized. Collected in bloom, July 5, 1886. II. Unfertilized. Collected in bloom, July 5, 1886. III. Fertilized. Collected in seed, July 22, 1886. IV. Unfertilized. Collected in seed, July 22, 1886.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	6.81	7.75	8.24	8.02
Phosphoric acid,	0.377	0.391	0.352	0.326
Potassium oxide,	1.206	1.054	1.160	0.659
Nitrogen .	1.240	1.248	0.940	1.219
Sodium oxide,	0.180	0.425	0.829	0.317
Calcium oxide,	0.614	0.645	0.451	0.575
Magnesium oxide,	0.125	0.149	0.149	0.111
Ferric oxide,	0.024	0.033	0.038	0.060
Insoluble matter,	1.716	1.683	1.710	1.836
Valuation per 2,000 pounds,	$5 53	$5 59	$4 61	$5 07

Fertilizing Ingredients of Meadow Fescue.

[I. Fertilized. Collected in seed, June 28, 1886. II. Unfertilized. Collected in seed, June 28, 1886.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	7.40	8.03
Phosphoric acid,	0.230	0.229
Potassium oxide,	1.815	2.183
Nitrogen,	1.04	1.07
Sodium oxide,	0.080	0.139
Calcium oxide,	0.540	0 466
Magnesium oxide,	0.140	0.136
Ferric oxide,	0.027	0.025
Insoluble matter,	1.403	1.961
Valuation per 2,000 pounds,	$5 36	$5 87

The higher percentage of *nitrogenous matter* in the crop from the *unfertilized* plats, over that from the *fertilized* plats, finds its explanation in the fact that, owing to the scanty supply of plant-food in the former, the plants matured at an earlier date. The advantages of fertilization are, therefore, not shown in the percentage of nitrogenous matter, but in an increased total yield of a healthy, vigorous growth.

1887. — The lands were ploughed and harrowed during the second week of May. The original lines of sub-division were retained. Plats 12, 14, 16, 18 and 20 remained unfertilized, as in previous years. Plats 11, 13, 15, 17, 19 and 21 were fertilized, as before, with a mixture of 600 pounds of fine-ground bones, and 200 pounds of muriate of potash, per acre. The fertilizer was applied broadcast, and slightly harrowed under before seeding. The different plats were planted May 18, and the seeds, in every case, laid in drills, from two feet to three feet three inches apart, as circumstances advised, — grasses and clovers, two feet, and corn and peas, three feet three inches, apart.

Plat No. 11 (fertilized), . .	Corn (Clark variety).
Plat No. 12 (unfertilized), .	Corn (Clark variety).
Plat No. 13 (fertilized), . .	Italian Rye Grass (Lolium Italicum). English Rye Grass (Lolium perenne).
Plat No. 14 (unfertilized), . .	Italian Rye Grass (Lolium). English Rye Grass (Lolium).
Plat No. 15 (fertilized), . .	5 varieties Southern Cow Pea.
Plat No. 16 (unfertilized), . .	5 varieties Southern Cow Pea.
Plat No. 17 (fertilized), . .	Meadow Fescue *(Festuca pratensis).*
Plat No. 18 (unfertilized), . .	Alsyke Clover. Medium Red Clover.
Plat No. 19 (fertilized), . .	Alsyke Clover. Medium Red Clover.
Plat No. 20 (unfertilized), . .	Mammoth Red Clover. Alfalfa (Luzerne).
Plat No. 21 (fertilized), . .	Mammoth Red Clover. Alfalfa (Luzerne).

The results regarding the yield of the annual plants — corn and cow peas — are stated below; while the record of the comparative yield of the perennial plants — grasses and clovers — are reserved for another year. The majority of these plants show their respective values as fodder plants better in the second year, when seeded somewhat late in the spring. Our present communication is, for this reason, confined to some analyses of the first cut of Alfalfa, and Alsyke clover.

Plat 11 (fertilized) yielded 3,910 pounds of green fodder corn; Plat 12 (unfertilized) yielded 2,890 pounds of green fodder corn, — a difference of thirty per cent. in favor of the fertilized plat. The plant-food coming from the disintegration of the sod of the preceding grass crop has evidently favored an increased production upon the unfertilized plat.

Plats 15 and 16 were each planted May 18, with five different varieties of Southern peas, the seeds of which were secured of J. J. Wolfenden, provision dealer in Newberne, N. C.

1. Sugar Crowder.
2. Black (Pallack).
3. Whippoorwill Cow Pea.
4. Clay Cow Pea.
5. Crowder.

The entire lot grew slowly at first until the season turned warmer. The vines of No. 5 became diseased, and dried up prematurely. Nos. 2, 3 and 4 produced a voluminous growth, from 28 to 30 inches high. None but No. 2 produced, to any extent, matured pods.

The entire yield on Plat 15 (fertilized) amounted to 2,400 pounds of green crop, containing from 18 to 19 per cent. of dry vegetable matter.

Plat 16 (unfertilized) produced 1,300 pounds of green fodder, — a difference of 54 per cent. in favor of the fertilized plat. An analysis of No. 4, Clay variety of Southern cow pea (*Dolichos*) will be found in a later chapter, on new fodder crops. The crop was cut for fodder, Aug. 29 to Sept. 3.

ALFALFA (LUZERNE; HAY).

[Collected from Experiment Station Plats, Aug. 16, 1887, while in bloom. First Cut.]

	Fertilized.	Unfertilized.
Moisture at 100° C.,	8.33	8.41
Dry Matter,	91.67	91.59
	100.00	100.00
Analysis of Dry Matter.		
Crude Ash,	7.18	7.83
" Cellulose,	28.54	27.86
" Fat,	1.54	2.04
" Protein (Nitrogenous Matter),	11.12	12.96
Non-nitrogenous Extract Matter,	51.62	49.31
	100.00	100.00

ALSYKE CLOVER (HAY; TRIFOLIUM HYBRIDUM).

[Collected from the Experiment Station Plats, Aug. 16, 1887, while in bloom.]

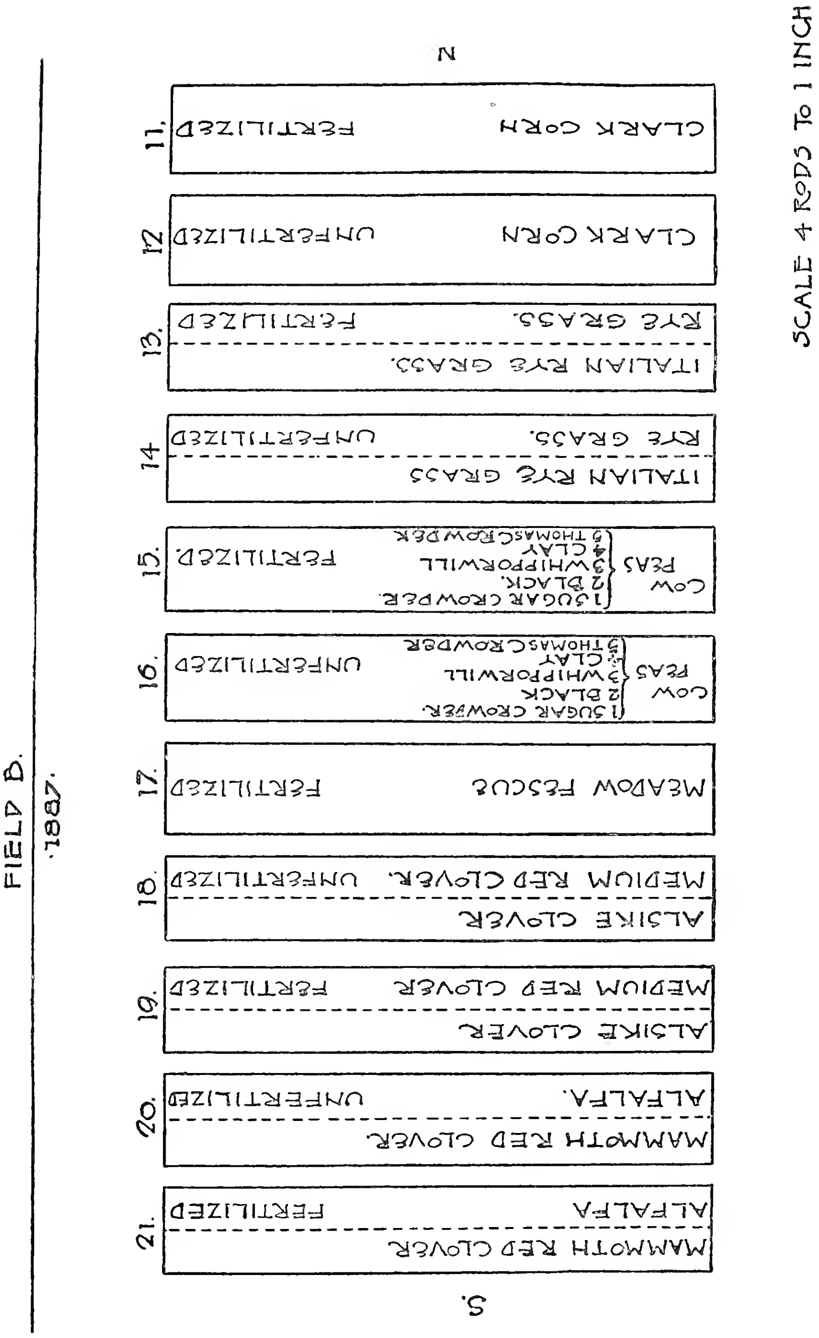
	Fertilized.	Unfertilized.
Moisture at 100° C.,	8.64	8.30
Dry Matter,	91.36	91.70
	100.00	100.00
Analysis of Dry Matter.		
Crude Ash,	10.92	13.35
" Cellulose,	26.28	21.44
" Fat,	2.89	3.26
" Protein (Nitrogenous Matter),	14.97	17.32
Non-nitrogenous Extract Matter,	44.94	44.63
	100.00	100.00

Fertilizing Ingredients of (1) Alfalfa, (2) Alsyke Clover.

[I. Alfalfa. Fertilized. II. Alfalfa. Unfertilized. III. Alsyke Clover. Fertilized. IV. Alsyke Clover. Unfertilized.

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	8.33	8.41	8.64	8.30
Phosphoric acid,	0.444	0.458	1.016	0.584
Potassium oxide,	2.043	0.872	2.740	1.605
Nitrogen,	1.630	1.900	2.190	2.540
Sodium oxide,.	0.668	1.354	0.236	0.570
Calcium oxide,	1.486	2.558	1.644	1.836
Magnesium oxide,	0.249	0.582	0.735	0.610
Ferric oxide,	0.105	0.085	0.417	0.246
Insoluble matter,	0.716	0.687	3.226	3.241
Valuation per 2,000 pounds,	$7 81	$7 65	$11 00	$10 70

The higher per cent. of nitrogenous matter in the crop from the *unfertilized* plats, over that from the *fertilized* plats, finds its explanation in the fact that, owing to the scanty supply of plant-food in the former, the plants matured at an earlier date. The advantages of fertilization are, therefore, not shown in the percentage of nitrogenous matter, but in an increase of total yield of a healthy, vigorous growth.


FIELD D.
1887.
SCALE 4 RODS TO 1 INCH
N
S.
11. CLARK CORN FERTILIZED
12. CLARK CORN UNFERTILIZED
13. RYE GRASS. ITALIAN RYE GRASS. FERTILIZED
14. RYE GRASS. ITALIAN RYE GRASS UNFERTILIZED
15. COW PEAS 1 SUGAR CROWDER. 2 BLACK. 3 WHIPPORWILL 4 CLAY 5 THOMAS CROWDER FERTILIZED.
16. COW PEAS 1 SUGAR CROWDER. 2 BLACK 3 WHIPPORWILL 4 CLAY 5 THOMAS CROWDER UNFERTILIZED
17. MEADOW FESCUE FERTILIZED
18. MEDIUM RED CLOVER. ALSIKE CLOVER UNFERTILIZED
19. MEDIUM RED CLOVER ALSIKE CLOVER FERTILIZED
20. ALFALFA. MAMMOTH RED CLOVER UNFERTILIZED
21. ALFALFA MAMMOTH RED CLOVER FERTILIZED

3. Experiments with Wheat.
(Fourteen Varieties.)
[Field C.]

Fourteen varieties of winter wheat were sown on the south half of Field C, in drills, eighty feet in length and three feet three inches apart, during the first week of October, 1886. The rows, eight in number, ran north and south.

The soil consisted of a good loam; the fertilizers used were 600 pounds of ground bone, and 200 pounds of muriate of potash, per acre. Eight rows of the following fourteen varieties were sown: (1) Genoese, (2) Egyptian, (3) Indian, (4) White Crimean, (5) Fulcaster, (6) Genoese, (7) German Emperor, (8) Raub's Black Prolific, (9) McGehee (white), (10) Diehl — Mediterranean, (11) Four-rowed Sheriff, (12) Martin's Amber, (13) Extra Early Oakley, (14) Amber (Mass.). The seed for the first thirteen varieties named was sent on by the U. S. Department of Agriculture; that of the fourteenth was obtained from Joseph Breck & Sons, Boston, Mass., for the purpose of comparing one of our reputed home varieties with those sent on.

The first four varieties (Genoese, Egyptian, Indian and White Crimean) were on the eastern portion of the field, which was low and moist; they were entirely winter-killed, and serradella was planted in their places. Numbers 6 and 11 (Genoese and Four-rowed Sheriff) were also largely winter-killed, — so much so, that at time of harvest they were left as worthless on the field. The Extra Early Oakley (13) was the first variety to head, — the 3d of June. On June 7 it was followed by number 14, — our native Amber Wheat. June 13, all save number 11 (Four-rowed Sheriff) had headed. July 19, each variety was stooked by itself, with the exception of Genoese (6) and Four-rowed Sheriff (11), which were not far enough advanced, and of poor growth. July 29, they were taken to the barn and threshed. Every variety was more or less affected by the rust.

The following table shows growth, height, color and yield of the eight rows of the different varieties that matured: —

VARIETY.	Growth.	Height in Inches.	Color.	Bearded or Unbearded.	Yield of the 8 Rows. Weight of Straw.	Weight of Grain.	Weight of Chaff.	Remarks.
5. Fulcaster,	Compact, strong,	48	Light,	Bearded,	130	67	21	
7. German Emperor,	Compact, strong,	48	Light,	Bearded, Unbearded,	115	54	15	Evidently a mixture of two different varieties.
8. Raub's Black Prolific,	Not very compact,	36	Dark,	Bearded,	75	40	20	
9. McGehee (White),	Not very compact,	39	Dark,	Unbearded,	60	36	9	
10. Diehl — Mediterranean,	Compact,	39	Dark,	Bearded,	80	52	18	
12. Martin's Amber,	Compact,	42	Light,	Unbearded,	90	38	10	
13. Extra Early Oakley,	Not very compact,	33	Light,	Bearded,	60	36	9	
14. Amber (Mass.),	Compact,	39	Dark,	Bearded,	160	74	24	

None of the imported varieties exceeded our home Amber wheat in any essential point.

Vetch (Vicia sativa) *and Oats.* — An area of a small fraction over one-fifth of an acre was sown broadcast, May 16, with vetch and oat seed, — one part of vetch to three parts of oats.

The soil was prepared for the crop in the same way as in the case of wheat.

On the 25th of May the young plants appeared above ground. The first cutting was made July 8, the crop then standing three and one-half feet high, and the vetch being in bloom; the cutting was stopped July 26. Two hundred pounds per day were cut, on the average, to serve in our second feeding experiment with milch cows. It was relished by them much more than during the previous year, when the vetch was sown alone.

The yield of the area was fully two tons of green crop, which would give an estimated yield of 10.89 tons of green fodder per acre.

Composition of Green Vetch and Oats.

	July 7.	July 20.	July 26.	Average.
Moisture at 100° C.,	86.11	73.66	73.05	76.61
Dry Matter,	13.89	23.34	23.95	23.39
	100.00	100.00	100.00	100.00

The feeding ceased when the oats turned yellow.

Analysis of Green Vetch and Oats.

[Collected from Experiment Station Field, July 8, 1887.]

	Per cent.
Moisture at 100° C.,	86.11
Dry Matter,	13.89
	100.00

Analysis of Dry Matter.

Crude Ash,	12.37
" Cellulose,	34.20
" Fat,	2.74
" Protein (Nitrogenous Matter),	10.59
Non-nitrogenous Extract Matter,	40.10
	100.00

The vetch has already received considerable attention in various sections of our country; reports, thus far, speak with much satisfaction of the results. The plant resembles, in many respects, the common garden pea; there are early and late varieties in cultivation. Its period of vegetation is from 18 to 22 weeks, and the time of seeding corresponds to that of the pea. The common vetch is a hardier plant than the latter, and grows well upon an inferior soil. Its reputation as a valuable green fodder, either single or when grown in common with rye, oats or barley, is well established.

An equal number of both plants gives a richer green fodder than the proportion we tried.

Serradella (Ornithopus sativus, Brot.). — The area occupied by this plant was 206 feet long by 80 feet wide, and belonged to a piece of land prepared in common with that used for the cultivation of the varieties of wheat.

The seed was sown in drills, three feet three inches apart, May 25. The plants began to bloom July 12. The cutting of the crop for green fodder commenced Sept. 2; from 200 to 300 pounds were used per day, as part of the feed for three cows. The supply lasted until Sept. 26. The yield on our field amounted to 7,300 pounds of green fodder, or 9½ tons per acre, with an average of from 18 to 20 per cent. of dry vegetable matter.

The serradella, like the vetch, is an annual leguminous plant, which found its way from Portugal into Central Europe some fifty years ago. It grows from one to one and one-half feet high, and prefers a moist, deep, sandy soil. Time of seeding and mode of cultivation correspond with that customary in the cultivation of peas. The growth of the plant is slow until the time of blooming, when it rapidly increases in size and nutritive constituents.

The close of the blooming period, at the end of August or beginning of September, is with us the best time for cutting the crop. Leading agriculturists speak very highly of this fodder plant.

Our results in the field and in our feeding experiments (see "Feeding Experiment with Milch Cows, II.," in this report) have been for several years very satisfactory. The cows relish the serradella highly.

Analysis of Green Serradella.

[Collected from the Experiment Station Fields, Sept. 20, 1887.]

	Per cent.
Moisture at 100° C.,	80.58
Dry Matter,	19.42
	100.00

Analysis of Dry Matter.

Crude Ash,	11.53
" Cellulose,	38.76
" Fat,	2.09
" Protein (Nitrogenous Matter),	12.01
Non-nitrogenous Extract Matter,	35.61
	100.00

Southern Cow Pea (Dolichos?); variety, Clay. — This valuable variety of Southern cow pea has been raised for several years past, with very satisfactory results, upon the grounds of the Experiment Station. Its exceptionally high value for green manuring and for renovating the soil, has been pointed out in previous annual reports. During the past summer season we have studied its comparative value as green fodder for milch cows. The results of these experiments are stated in this report under the head of "Feeding Experiments with Milch Cows, II." The cow pea is much liked by cows and horses, and its effect as an essential part of the daily diet for milch cows is very satisfactory, judging from our own results.

The fact that the seeds of the Clay or Whippoorwill varieties cannot be matured in our section of the country, cannot be considered a serious impediment to its more general use, for the seeds may be had in unlimited quantity at a very reasonable cost. J. J. Wolfenden, provision dealer in Newberne, N. C., among others, has offered his services for the purchase of genuine seeds, at reasonable terms.

The ground which served during the past summer season for the cultivation of Southern cow pea for feeding, adjoined that used for the raising of serradella and of wheat. The soil was prepared, as far as ploughing and fertilizing were concerned, in the same manner as that upon which wheat was raised. The seeds were planted May 25, in drills three feet three inches apart. The entire area occupied by the crop, in this part of our experimental field, was 101.5 feet long and 80 feet wide; it yielded 3,765 pounds of green fodder, with an average of from 12 to 18 per cent. of dry vegetable matter. The rate of production per acre, calculated on the basis of our own observation, would be 9½ tons of green fodder. A few weeks more of growth would have materially increased the yield. The course adopted in our feeding experiment obliged us to use the Southern cow pea, as the serradella was not yet far enough advanced in growth. Southern observers obtain from 20 to 25 tons of green crop per acre. The cutting of the pea vines for fodder began as early as Aug. 1, and lasted until Aug. 23. A new growth had started from the roots again Aug. 25; it proved, however, of but little value for feeding purposes, on account of the lateness of the season.

Analysis of Southern Cow Pea.

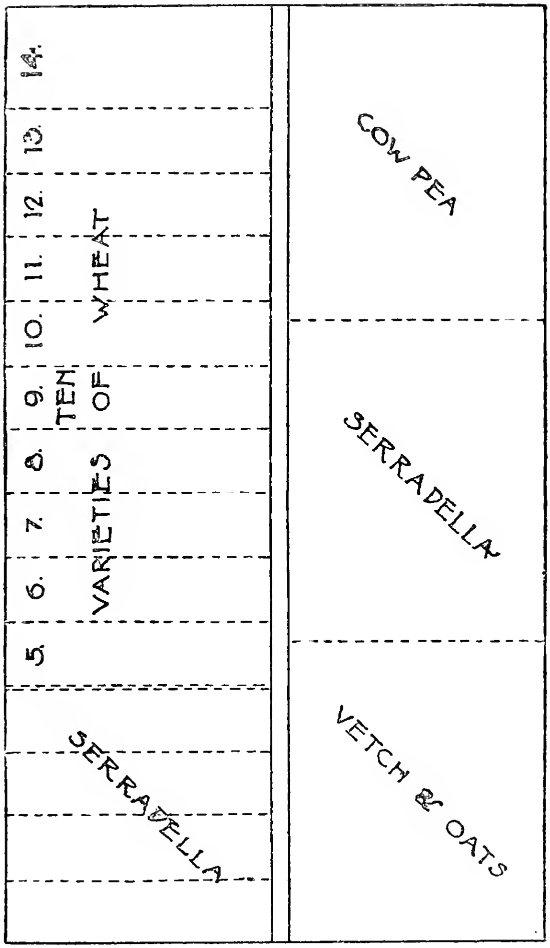
[Collected from Experiment Station Fields, Sept. 2, 1887.]

	Per cent
Moisture at 100° C.,	78.81
Dry Matter,	21.19
	100.00

Analysis of Dry Matter.

Crude Ash,	5.97
" Cellulose,	23.02
" Fat,	1.81
" Protein,	8.28
Non-nitrogenous Extract Matter,	61.92
	100.00

FIELD C



SCALE 4 RODS TO THE INCH.

4. Experiments with Potatoes.

(Var.: Beauty of Hebron.)

[Field D.]

A. — *Experiments with High-grade German Potash Salts and Ground Bones, as Fertilizers.*

The experiments were originally instituted (1884) for the purpose of studying the effects of muriate of potash and sulphate of potash on the yield of potatoes, as far as quantity and quality are concerned.

Three plats, each one-fifth of an acre in size, were chosen for the experiment. The land had been for several years in grass, and contained quite a number of old apple-trees. The majority of the latter were removed, and the turf thoroughly broken up before manuring.

Plat 1 (west end) received 120 pounds of ground rendered bones, and 30 pounds of muriate of potash (equal to from 26 to 27 pounds of phosphoric acid, 4 to 4½ pounds of nitrogen, and 15 to 16 pounds of potassium oxide).

Plat 2 received no manure.

Plat 3 (east end) received 120 pounds of ground rendered bones, and 58 pounds of double sulphate of potash and magnesia (equal to from 26 to 27 pounds of phosphoric acid, 4 to 4½ pounds of nitrogen, 15 to 16 pounds of potassium oxide, and 5 to 6 pounds of magnesium oxide).

The fertilizers were applied broadcast, and harrowed under before planting. The potatoes were planted in rows three feet apart, and fourteen inches distant in the rows, during the first week in May, 1884. The crop was kept clean from weeds by a timely use of the cultivator.

As an additional feature of the experiment, one-half of each plant was planted with medium-sized whole potatoes, the other with half potatoes obtained from similar sized tubers.

The crop obtained from Plats 2 and 3 were seriously disfigured by scab, while that from Plat 1 had suffered less.

1885. — The arrangement of the field, the mode of manuring, and the variety of potatoes raised, were the same as in the preceding season. The seed potatoes used had been carefully selected from our own crop, raised during the preceding season, on the same plats.

The young crop was hoed June 9. The difference in the plats was quite marked July 24: Plat No. 1, fertilized with muriate of potash, had the largest foliage and looked darker green than the remainder; No. 3, fertilized with sulphate of potash, looked next best. A *blight on the leaves*, which showed itself during the first week of August, prematurely terminated the experiment; the vines upon all plats died soon after. The crop was harvested Aug. 26. *The potatoes from all the plats suffered severely from scab.*

The exceptionally large proportion of small potatoes obtained, in particular, from Plats No. 2 and 3, as well as the low percentage of solids in the potatoes tested, proved the premature termination of a healthful condition of the entire crop. The normal growth of the tubers came apparently to a standstill soon after the first examination for solids had been made (July 24). The results seemed to indicate a connection between "blight" and "scab," and left scarcely any doubt about the circumstance, that either the one or the other, or both jointly, had contributed directly or indirectly towards the partial failure of the crop for the two succeeding seasons.

It was decided, in sight of these facts, to continue the experiments in 1886 upon the same field, with some modifications, to ascertain, if possible, whether the main influence regarding the results in our past observation had to be ascribed to atmospheric agencies, or to the condition of the soil and the fertilizer applied, or to the quality of the seed potato used.

1886. — The same field was used as in 1885. The land was well prepared by ploughing and harrowing, April 27, and subsequently fertilized, the same as in previous years. *The change regarding the character of the fertilizer applied, consisted in using nearly twice the amount of potash salts, muriate and sulphate of potash, for the same area, in case of Plats 1 and 3.* A second important change from our previous practice consisted in securing first quality seed potatoes, — in particular, *free* from scab. The same variety —

Beauty of Hebron — was obtained for that purpose from Vermont; it was as fair an article as could be desired The system of planting and cultivating was the same as in previous years. The potatoes were planted upon all plats May 5, 1886. All the vines were in full blossom July 6; they began to turn yellowish and dry up July 30 The crop on the entire field was dried up Aug. 8. This change seemed to appear most marked, and first, on the vines raised from whole potatoes. The crop was harvested Aug. 28.

Neither a liberal use of our own mixture of commercial manurial substances, rich in potash compounds, nor the selection of a fair quality of seed potatoes from another locality, had affected our results, as compared with those of the previous season; for the entire crop, with scarcely any exception, was badly disfigured by scab. The potatoes were unfit for family use, and had to be sold at a low price for stock-feeding.

For further details in regard to our observations in 1884, 1885 and 1886, see annual reports.

A due consideration of all the circumstances which accompanied our course of observation thus far, induced us to draw the following conclusions: —

1. Medium-sized *whole potatoes* give better results than half potatoes obtained from tubers of a corresponding size.

2. Disregarding the results of the first year, when previously existing resources of plant food in liberal quantities must have rendered the influences of an additional supply of manurial substances less marked, it appears that *sulphate of potash* produced *better* results in our case than muriate of potash.

3. The *premature dying out of the vines*, accompanied by *blight* or *scab*, or both, must be considered a *controlling cause* of the *exceptionally large proportion of small potatoes.*

4. Some peculiar condition of the soil upon the lands used for this experiment is to be considered the real seat of our trouble.

To test the correctness of conclusion 4 still further, the experiment has been continued for another year.

1887. — The same plats as in previous years were utilized for the experiment. The subdivision remained unchanged. The fertilizers applied were the same as in 1886.

The lands were ploughed and harrowed during the first week of May, and the potatoes planted in all the plats May 11. First quality potatoes, "Beauty of Hebron," raised in Vermont, were used as seed. The growth looked well upon all the plats until July 28, when the vines on Plats 2 and 3 began to turn yellow. They commenced drying up Aug. 9, and by Aug. 12 were dry on all plats. An examination of the little potatoes, July 1, showed already, in every case, the marks of scab.

The *entire crop*, when harvested, *was so seriously affected by scab* that it proved worthless in the general market.

The months of July and August were exceptionally wet and warm in our part of the State, — a circumstance which has, most likely, aggravated our trouble. The potato crop this year has been extensively a failure, in our vicinity, wherever low lands have been used for its cultivation.

B. — *Observations with Scabby Potatoes.*

These experiments were inaugurated in 1886, for the purpose of inquiring into the circumstances which control the development and the propagation of the scab on potatoes.

1886. — The first year's work in this connection has been confined to the task of observing the behavior of scabby potatoes as *seed* potatoes, under some definite previous treatment. To prevent a possible propagation of scab in the new crop by infected seed potatoes, the following course was adopted: Thoroughly scabby potatoes, obtained from the previously described experimental plats, were treated with some substances known to be destructive to various forms of parasitic growth. This operation was carried out with the intention of destroying the propagating power of adherent germs of an objectionable character, before planting the seed.

The field for the observation was distinctly separate from other experimental plats for the cultivation of potatoes. It had been used for many years previous for the raising of grass, and had since been planted but once, — the preceding year (1885), with corn. The land was prepared by ploughing and harrowing in the same way as other potato fields.

It was fertilized broadcast, at the rate of 600 pounds of ground rendered bones and 290 pounds of potash magnesia sulphate.

The field was subdivided into five plats of equal size, eighty feet long and fifty feet wide, and the potatoes subsequently planted in rows, three feet three inches apart, with hills three feet from each other in the rows. Three feet of space was left between the plats unoccupied. The scabby seed potatoes selected for the trial were, as far as practicable, of a uniformly medium size. Each lot was immersed in the particular solution prepared for the different plats; after being kept there for twenty-four hours they were removed and directly planted.

Plat 1 was planted with *healthy* and *smooth potatoes*, without any previous treatment. This course was adopted to learn whether soil, fertilizer, or atmospheric agencies of the season would favor the appearance of the scab in the crop.

Plat 2. The scabby seed potatoes were allowed to remain for twenty-four hours in a saturated solution of muriate of potash before being planted.

Plat 3. A strong solution of hypochlorite of lime (bleaching lime) was applied in a similar way, for the preparation of the scabby seed, as in the case of Plat 2.

Plat 4. A saturated solution of carbolic acid in water, served, in this instance, for the treatment of the scabby potatoes.

The potatoes were planted in all plats on the same day, May 7. The vines did not appear evenly, at first; they were, however, equally vigorous upon all plats at the close of June.

The tops on all plats were pretty generally dried up Aug. 18. The potatoes were harvested on the entire field Aug. 30. The yield on all the plats was fair, and the quality of the potatoes, almost without exception, excellent; this seemed to be more striking in regard to those on Plats 2, 3 and 4, which had been, in the beginning of the season, somewhat behind in growth. Here and there could be seen a potato with a small mark of scab; a large proportion were perfectly smooth and without any sign of it.

The results were recorded as those of a first experiment.

The fact that a *scabby potato* may produce, under certain circumstances, a smooth and otherwise excellent potato, was confirmed. Good potatoes have been raised before from seed potatoes suffering from scab, without any previous treatment similar to ours. Without any intention of anticipating the results of future observations, or to point out with certainty the exact cause of our results, we expressed the opinion that a *difference in the condition of the soil in our old and new experimental potato plats* might have proved to be the principal cause of our trouble: for the former yielded, from healthy potatoes, most inferior scabby potatoes; whilst the latter produced, from scabby potatoes, a most superior, smooth potato, under otherwise almost identical conditions, as far as soil, mode of cultivation and kind of fertilizer were concerned, upon land in close proximity, during the same season.

1887.—The experiment has been repeated during the past season upon the same lands, with but a slight modification. The soil was ploughed and fertilized as in the preceding year. Ten plats, each fifty feet long, were planted with four rows of potatoes, three feet three inches apart, and with nineteen hills in the row. Medium-sized, whole scabby potatoes (Beauty of Hebron), selected from the crop raised upon our own fields during the previous year, and which is described in some preceding pages, under the heading "Potato Experiment," "A," served as seed potatoes. One-half the plats were planted with scabby potatoes, all from the same lot, after being immersed for eighteen hours in some solution prepared for that purpose; and the other half were planted without any previous treatment of the seed,—Plats 2, 6 and 10 with our scabby potatoes, Beauty of Hebron, and Plats 4 and 8 with healthy, smooth tubers, of the same variety.

Plat 1, ...	Scabby potatoes, soaked in a solution of potassium sulphide
Plat 2, ...	Scabby potatoes, without any particular treatment.
Plat 3, ...	Scabby potatoes, treated with a solution of hypochlorite of lime (bleaching lime).
Plat 4, ...	Smooth, healthy potatoes, without previous treatment.

Plat 5, ...	Scabby potatoes, treated with a solution of potassium chloride (muriate of potash).
Plat 6, ...	Scabby potatoes, without previous treatment.
Plat 7, ...	Scabby potatoes, treated with a solution of carbolic acid.
Plat 8, ...	Smooth, healthy potatoes, not treated.
Plat 9, ...	Scabby potatoes, treated with copper sulphate (blue copperas).
Plat 10, ...	Scabby potatoes, not treated.

The young plants made their appearance on all the plats, except No. 9, June 1; those on No. 9 appeared eight or ten days later. The entire crop looked uniformly well. The vines dried up on all plats at about the same time. The crop was harvested with the following results: –

BEAUTY OF HEBRON.

PLAT.	Date of Planting.	Condition of Seed.	Solutions Used.	Results. (Sept. 12, 1887.)
No. 1,	May 12 to 14, 1887.	Scabby.	Potassium sulphide.	Good; not scabby.
2,		Scabby.	None.	Good; not scabby.
3,		Scabby.	Hypochlorite of lime (bleaching lime).	Especially good.
4,		Good.	None.	Somewhat scabby.
5,		Scabby.	Potassium chloride (muriate of potash).	Especially good.
6,		Scabby.	None.	Good; not scabby.
7,		Scabby.	Carbolic acid.	Especially good.
8,		Good.	None.	Especially good.
9,		Scabby.	Copper sulphide (blue copperas).	Only 7 hills left. More or less scabby.
10,		Scabby.	None.	Somewhat scabby.

A careful consideration of these results seems to show that a certain condition of the soil has been the leading cause for the origin and propagation of the scab; for scabby seed potatoes have produced healthy, smooth tubers, both with and without any special previous treatment, — see Plats 1, 2, 7 and 8. On the other hand, it is not without interest to notice that Plats 1, 3 and 7 have furnished us with some of the best potatoes we have raised during the past season.

The investigation will be continued, with some modifications, another year.

P. S. — One of the best results with the cultivation of various kinds of potatoes during the past season was noticed with some seed potatoes sent on by the United States Department of Agriculture, called "Polaris," and stated as being imported directly from Ireland.

Roots. — The seeds used in this trial were sent on by the United States Department of Agriculture, with the exception of No. 7, Saxony sugar beet, which was taken from our own collection of seeds. The supply of seeds was small.

The land consisted of a good loam in a fair condition of fertilization. It had been manured for several years past, annually, with a mixture consisting of 600 pounds of fine-ground bone, and 200 pounds of muriate of potash, per acre. The seeds, ten varieties in all, were sown May 25. Each variety occupied two rows across the field, of equal length (80 feet).

No. 1, ...	Beet, Mangel Wurzel, "Giant Long Red."
2, ...	Beet, Mangel Wurzel, "Yellow Ovoid."
3, ...	Beet, "Eclipse."
4, ...	Beet, "Red Globe."
5, ...	Beet, "Egyptian Turnip."
6, ...	Beet, "Long Smooth Red."
7, ...	Beet, Sugar Beet, "Saxony."
8, ...	Turnip, Ruta Baga, "White Sweet German."
9, ...	Turnip, "Early Yellow" or "Golden Stone."
10, ...	Turnip, Ruta Baga, "Skirving's Purple Top."

The rows were three feet three inches apart. The young plants were, in every case, thinned out or transplanted, as circumstances advised, to about eight inches distant from each other in the rows.

The transplanting and thinning out took place between July 5 and 11; the weather during this time was favorable for transplanting. The seeds of Nos. 6 and 9 did not prove as good as the others; the young plants of Nos. 5 and 9, in particular, did not do as well after transplanting as the remainder.

The crop was harvested partly Oct. 31 and partly Nov. 2. The first lot of roots, Nos. 1, 2, 3, 4 and 5, after being removed from the ground, was topped at once, and three of each kind were taken to the laboratory for a chemical examination; three of an approximately corresponding size were photographed.

The second lot, Nos. 6, 7, 8, 9 and 10, was treated in a similar manner. The three sample roots selected in each case, represent, as far as practicable, the smallest, medium and largest of each variety raised.

The photographs were taken with all the roots at an equal distance from the camera.

STATEMENT OF RESULTS.

NAME OF VARIETY.	Number of Rows.	Number of Roots.	Weight of Roots.	Weight of three Samples Photographed.
			lbs.	lbs.
1. Mangel Wurzel, "Giant Long Red,"	2	150	365	11.75
2. Mangel Wurzel, "Yellow Ovoid,"	2	177	350	9.75
3. Beet, "Eclipse,"	2	163	285	4.
4. Beet, "Red Globe,"	2	173	335	7.5
5. Beet, "Egyptian Turnip,"	2	146	170	8.75
6. Beet, "Long Smooth Red,"	2	145	185	5.
7. Sugar Beet, "Saxony,"	3	216	470	8.75
8. Ruta Baga, "White Sweet German,"	2	176	445	4.
9. Turnip, "Early Yellow" or "Golden Stone,"	2	43	50	5.5
10. Ruta Baga, "Skirving's Purple Top,"	2	140	295	12.75

The analyses of the different varieties of roots will be reported as soon as finished.

MISCELLANEOUS FIELD EXPERIMENTS WITH FARM AND GARDEN CROPS.

The field notes under the above heading are made for no other purpose than to enter on record a series of experiments, for various reasons, not yet fit for a general report. In some instances the supply of seeds was too small to entitle us to draw any particular conclusion; in others, the selections of seeds were made merely for the purpose of preparing the lands for a future special field experiment.

The small supply of seeds was furnished, in the majority of cases, by the U. S. Department of Agriculture.

The work carried on in this connection has had, for obvious reasons, no other aim than to study the adaptation of some new field crop to our climate, or to compare some new variety of a prominent garden crop with those frequently raised in our section of the State. The field set aside for these experiments was in a good state of cultivation. Barnyard manure, supplemented by commercial phosphates and potash compounds, had been used in the past as manure; no alteration was made in this respect during the past season.

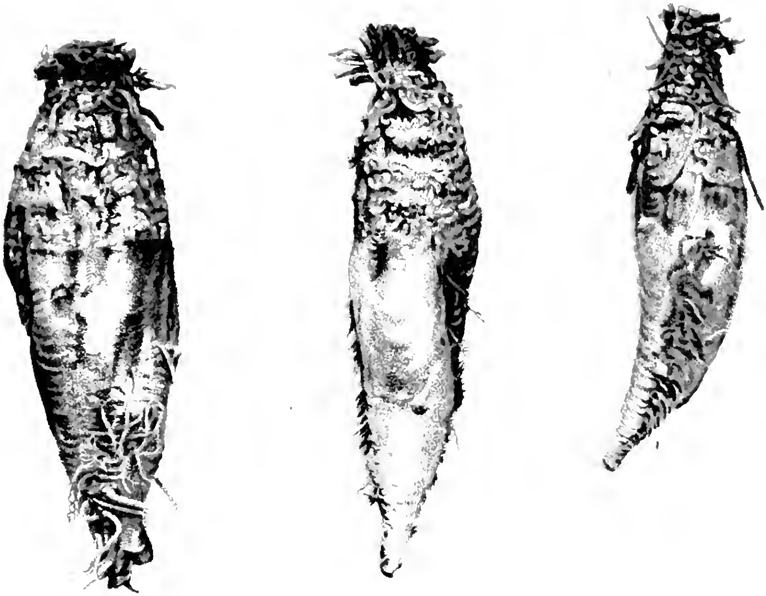
The list of seeds sown embraces, aside from those already mentioned in previous pages, one variety of mustard, "Southern Giant Curled;" three of pepper, "Cayenne," "Sweet Mountain," and "Golden Dawn;" two of tomato, "Paragon" and "Improved Mayflower;" one of cabbage, "Early Summer;" two of cauliflower, "Early Snow Ball" and "Giant Cauliflower," "Pyrethrum roseum"; and one variety of potato, "Polaris," in the form of seeds and seed potatoes (two tubers).

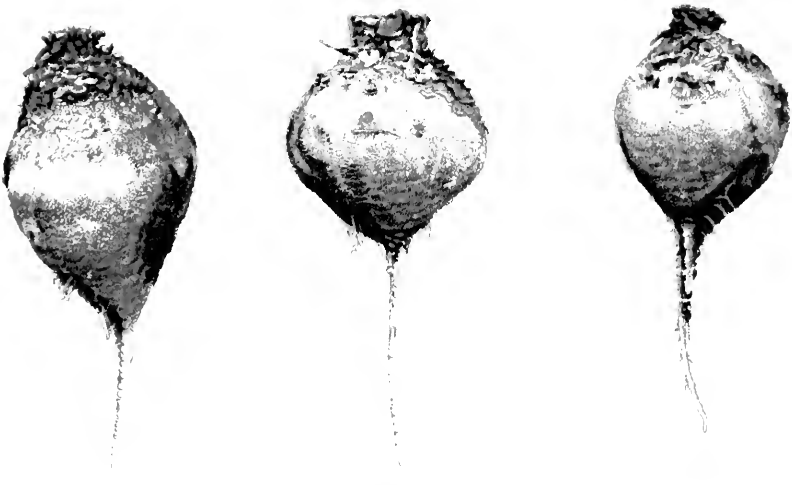
The seeds were, in every instance, sown in a hot-bed and subsequently transplanted in the field. All matured well, with the exception of *Pyrethrum roseum*, which is a perennial plant.

Aside from these plants, there have also been cultivated, on a small scale, Asiatic Rhubarb, Sago Bean (*Sago hispida*), wild potato from Colorado, and several reputed new varieties of potatoes, to secure material for future experiments.

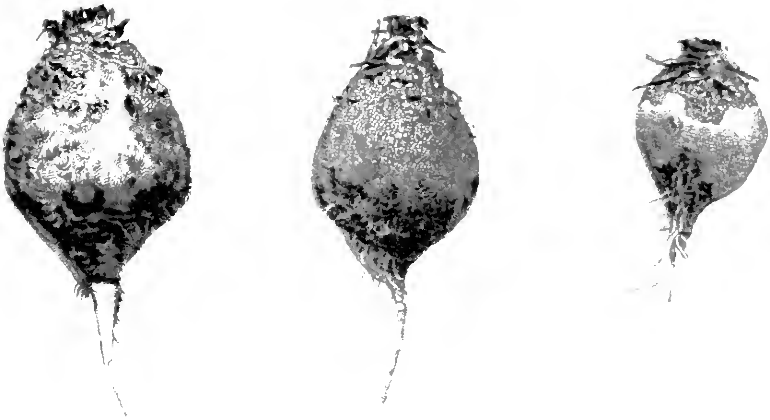
The recently ploughed old grass lands, on the east side of the highway, were planted with potatoes, corn and horse beans, squashes, several varieties of oats, and barley. The lower portion, from five to six acres, has been laid down during the fall into a permanent meadow; while the remainder of worn-out grass land in that locality — from six to eight acres — has been underdrained and ploughed at the close of the season.

The details of the past year's work upon this part of the land of the Station will be related hereafter, in connection with a description of a more matured system of cultivation.





[illegible] "Eclipse"

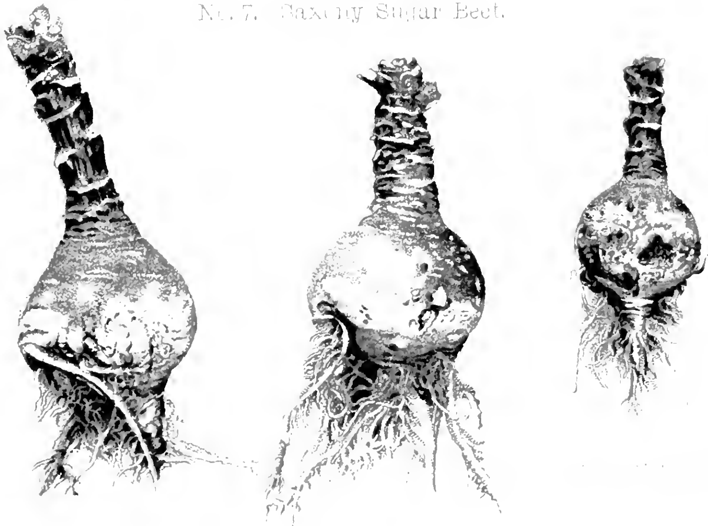


[illegible] "Red Glob[illegible]"

[illegible]

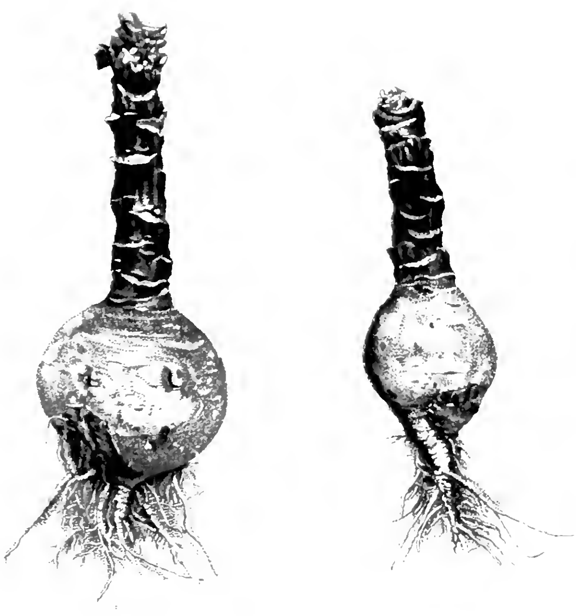
No. 6. Beet, "Long Smooth Red".

No. 7. Saxony Sugar Beet.



No. 8. Turnip, Ruta Baga, "White Sweet German".

No. 9. [illegible] "Early Yellow" or "Golden Stone."



No. 10. Turnip, [illegible] Baga, "Skirvings [illegible]".

SUGGESTIONS UPON PLANTING TREES AND SMALL FRUITS.

[By S. T. Maynard, Professor of Botany and Horticulture, Massachusetts Agricultural College.]

The most important points to be considered in successful planting of trees and small fruits are : —

1. Selection of trees and plants.
2. Preparation of the trees and plants.
3. Soil and its preparation.
4. Methods of planting.
5. After-care and cultivation.

Selection of Trees and Planting.

Successful planting depends very largely upon the condition of the trees or plants at the time of planting The best results are generally obtained, *other things being equal*, when the trees or plants are obtained from local nurseries, and planted with little or no exposure to the drying influence of the sun and air. The merits of the Massachusetts-grown trees, as compared with those grown in the extensive nurseries of distant States, are often discussed, and the latter condemned for New England planting. While, in many of the above-mentioned nurseries, owing to long experience, especial skill and a soil naturally suited to the best growth, very fine trees are grown, perhaps better than are generally grown in small local nurseries, yet the danger from injury in transporting, should they go a great distance, and the length of time from digging to transplanting, will make it generally safer to depend upon home-grown trees where they can be obtained.

Great care must be exercised in digging, and, if large quantities are to be dug at once, as soon as a few are dug the roots should be protected by mats or blankets, or have soil thrown over them until all are to be packed for transporting or taken to the field for planting. In packing for shipping, no material is so good to keep the roots moist and prevent their heating as clean sphagnum moss; for short distances, moist straw or hay may answer very well for this purpose.

Vigorous young plants are much better than those that have been a very long time in growing to suitable size. The average age for fruit trees and plants in the best condition for transplanting is about as follows: Apple, three years from bud; pear, 3 years from bud; peach, 1 year from bud; plum, 2 years from bud; cherry, 2 years from bud; quince, 3 years from cutting or root graft; grape, 1 year No. 1, or 2 years No. 2, from cuttings or layers; currant, 2 years from cuttings; gooseberries, 2 years from cuttings; raspberries and blackberries, 1 year from suckers or root cuttings; strawberries, only new runners of last season's growth should be used, the old plants having black roots, with the feeding surfaces so far from the crown that when they are dug nearly all of them are destroyed.

Preparation of Trees and Plants for Planting.

It is impossible to remove a tree from the nursery to the orchard without injuring some of the larger roots, while nearly all the rootlets and all the root hairs will be destroyed by only a slight exposure to the air. As there are no feeding roots on the newly transplanted trees until new ones are formed, if none of the buds or shoots are removed, the supply of moisture being insufficient, all make a very feeble growth, or fail to develop at all, especially if a drought comes on early in the summer. To prevent this injury and ensure a vigorous starting of a few buds, the top should be cut back in proportion to the amount of injury to the roots, which will generally be from one-half to two-thirds of the entire top. In this pruning all shoots should be cut entirely away that are not needed for the formation of a perfect head, and the others cut back one-half or two-thirds of their length.

If the head is not formed high enough upon the trunk, it may often be carried higher by cutting off all lateral shoots, leaving the most central one for a leader, upon which will be formed the new head, several inches higher than the first. This may be still carried up by pinching the ends of the lowest laterals, to force the growth into the higher ones. Thus, in a single season, the head may be carried from one to two feet higher than it was when received from the nursery. All injured roots should have the ends cut smooth with a sharp knife; and with small fruits, like the grape, currant and strawberry, it is often desirable to cut back some of the longer ones.

Soil and its Preparation.

Unless suitable soil is selected, very poor results will often be obtained. The apple thrives upon a greater variety of soils than any other fruit, but that best suited to its growth is a rich, moist, well-drained loam. The pear, plum and quince require a heavier soil, but it should be free from standing water. The cherry delights in a light, sandy loam. The peach can only be successfully grown in New England upon high and well-drained land. Upon the tops of our high hills the trees are hardier, live longer and bear more fruit, although, even here, they are not safe from injury, and annual crops cannot be expected until some method of protection has been discovered that can be easily and cheaply applied. Grape vines give the best fruit in quality when planted upon high, gravelly soil; but, to insure a vigorous growth of vine to enable a large crop of fruit to mature, some nitrogenous manure must be used, but only early in the season, as a late application would induce a late growth of wood, that is very liable to injury by severe cold.

The raspberry and blackberry mature their wood much better upon light land than upon heavy, moist soil, but, like the grape, require an addition of nitrogenous manure to secure a growth of canes sufficient to mature a large crop of fruit. Spreading mulch upon the surface, or constant cultivation, will generally prevent the escape of moisture at the time of the ripening of the fruit, when it is most needed.

The currant and gooseberry require a moist, heavy soil for the best results, but are liable to be thrown out by frosts if the soil is not well underdrained.

The best soil for the strawberry is a moist, sandy loam. Upon light, sandy soils there is a tendency to a large number of berries, but, there not being moisture enough in the soil, very few will mature.

Before planting it is necessary that the soil be made rich enough to ensure a good growth, if it is not already in that condition. For small fruits it is generally best to apply the manure or fertilizers broadcast and harrow in, as it may also be done for the large fruits, if the land is to be cultivated with some other crop for a few years.

If the trees are to be planted in land not cultivated for other crops, the manure or fertilizer would be more economically applied only about the trees, increasing the area covered as they increase in size. Unfermented manure should never be placed in contact with the roots of any tree or plant, but if decomposed and well mixed with the soil, no injury will result from the use of a limited quantity. The best way to use coarse manure is to apply it to the surface about the trees slightly covered with soil. The quantity to be used must be varied with the condition of the soil, but should be used sparingly upon the peach until they begin bearing.

Perhaps the best material to use, where the soil is not sufficiently rich for the production of fruit, is fine-ground bone and potash, four parts of the former to one part of muriate of potash. This, at the rate of one pound to a tree, mixed in the fine soil used around the roots, and one pound applied near the surface, will insure a good growth, unless the soil is unusually poor. The holes should be dug a little larger than the roots will extend, and loosened a little deeper than they are to be planted. For convenience and beauty, trees should be set at regular distances.

Methods of Planting.

Generally the best time for planting is in the early spring, although it may be successfully done in the fall, when the leaves drop early and the shoots mature by Nov. 1.

In the spring, trees should not be planted until the ground will work up fine, and not compact when pressed about the roots. If the soil is light, the roots should be planted a little deeper than they grew in the nursery, but if moist, the same depth as they stood in the nursery is sufficient. Grape vines should be planted with the crown, or collar, within a few inches of the surface, and the roots extending six to ten inches deep, according to the soil. Raspberry, blackberry and strawberry plants should be planted as early in the spring as the land will work. Black-cap raspberries must be planted with the large central bud near the surface, as deep covering often destroys it; the roots, however, must be put, obliquely, as deep as they will go. It is important that the soil be pressed *very finely* about the roots before all is filled in, and that upon the surface be left light.

It often happens that trees are received from the nursery in a dry, shrivelled condition, which, if planted in that state, would certainly fail to grow. They may be improved, and sometimes saved, by burying top and root in moist soil for a few days or a week; then, by severe pruning at planting, they will be much more certain to grow.

After Care.

It often happens that trees received in good condition, and very carefully planted, fail to grow from want of after care. This, for the first season, consists in seeing that a sufficient supply of moisture is present about the roots.

In time of drought, watering may be avoided by covering the ground, for several feet about the tree, with mulch, five or six inches deep, or by stirring the surface soil once or twice each week. Trees planted in turf are especially liable from the moisture being taken up by the surrounding grass roots. This can only be prevented by covering the ground with a mulch of any waste material, like corn stover, old hay, straw, shavings, sawdust, fine brush, cider pomace, meadow mud or peat.

The same result may be obtained by packing the loose stones often found about the trees. Mulching material of any kind should not be in contact with the trunk of the trees from Nov. 1 to May 1, unless they are protected by banking up, or by a tin or tar-paper band about them to protect from injury by mice.

VALUATION OF FERTILIZERS, AND FERTILIZER ANALYSES.

To assist the farmers, not yet familiar with the current mode of determining the commercial value of manurial substances offered for sale in our markets, some of the essential considerations, which serve as a basis for our valuation, are once more stated within a few subsequent pages.

The valuation of a fertilizer is based on the average trade value of fertilizing elements, specified by analysis. The money value of the higher grades of agricultural chemicals, and of the higher-priced compound fertilizers, depends, in the majority of cases, on the amount and the particular form of two or three essential articles of plant food; i. e., phosphoric acid, nitrogen and potash, which they contain. The valuation which usually accompanies the analyses of these goods shall inform the consumer, as far as practicable, regarding the cash retail price at which the several specified essential elements of plant food, in an efficient form, have been offered of late for sale, in our large markets.

The market value of low-priced materials used for manurial purposes, as salt, wood ashes, various kinds of lime, barnyard manure, factory refuse and waste materials of different descriptions, does not, quite frequently, stand in a close relation to their chemical composition. Their cost varies in different localities. Local facilities for cheap transportation, and more or less advantageous mechanical condition for speedy action, exert, as a rule, a decided influence on their selling price.

The wholesale market price of manurial substances is liable to serious fluctuations; for supply and demand exert here, as well as in other branches of commercial industry, a controlling influence on their temporary money value. As farmers have only in exceptional instances a desirable chance to inform themselves regarding conditions which control the market price, the assistance rendered in this connection by agricultural chemists charged with the examination of commercial fertilizers, cannot otherwise but benefit, ultimately, both farmers and manufacturers.

The market reports of centres of trade in New England, New York and New Jersey, aside from consultations with leading manufacturers of fertilizers, furnish the necessary information regarding the current trade value of fertilizing ingredients. The subsequent statement of cash values in the retail trade is obtained by taking the average of the wholesale quotations in New York and Boston, during the six months preceding March 1, 1887, and increasing them by twenty per cent., to cover expense for sales, credits, etc.

These trade values, except those for phosphoric acid, soluble in ammonium-citrate, were agreed upon by the Experiment Stations of Massachusetts, Connecticut and New Jersey, for use in their several States for the present season.

Trade Values of Fertilizing Ingredients in Raw Materials and Chemicals.

	1887. Cents per Pound.
Nitrogen in nitrates,	16
Nitrogen in ammoniates,	17½
Organic nitrogen in dried and fine-ground fish,	17½
Organic nitrogen in Peruvian guano, blood, meat, azotin, ammonite, and castor pomace,	17½
Organic nitrogen in fine-ground bone and tankage,	16
Organic nitrogen in fine medium bone and tankage,	14
Organic nitrogen in medium bone and tankage,	12
Organic nitrogen in coarse medium bone and tankage,	10
Organic matter in coarse bone, horn shavings, hair and fish scraps,	8
Phosphoric acid, soluble in water,	8
Phosphoric acid, soluble in ammonia citrate,*	7½
Phosphoric acid, insoluble, in dry, fine-ground fish, in fish bone and tankage,	7
Phosphoric acid, insoluble, in fine, medium bone and tankage,	6
Phosphoric acid in medium bone and tankage,	5
Phosphoric acid in coarse medium bone and tankage,	4
Phosphoric acid in coarse bone and tankage,	3
Phosphoric acid in fine-ground rock phosphate,	2
Potash as sulphate, in compounds free from chlorine,	5½
Potash as kainite,	4¼
Potash as muriate,	4¼

* Dissolved from two grams of phosphate, unground, by 100 c.c. neutral solution of ammonium citrate, sp gr. 1.09, in 30 minutes, at 65 deg. C., with agitation once in five minutes, commonly called "reverted" or "backgone" phosphoric acid.

The above trade values are the figures at which, on March 1, the respective ingredients could be bought at retail *for cash* per pound in our leading markets in the raw materials, which are the regular source of supply.

They also correspond to the average wholesale prices for the six months, ending March 1, plus 20 per cent. in case of goods for which we have wholesale quotations. The calculated values obtained by the use of the above figures will be found to agree fairly with the reasonable retail price in case of standard raw materials, such as:—

Sulphate of Ammonia,	Dried Ground Fish,
Nitrate of Soda,	Azotin,
Muriate of Potash,	Ammonite,
Sulphate of Potash,	Castor Pomace,
Dried Blood,	Bone,
Dried Ground Meat,	Plain Superphosphates.

Trade Values in Superphosphates, Special Manures and Mixed Fertilizers of High Grade.

The organic nitrogen in these classes of goods will be valued at the highest figures laid down in the "Trade Values of Fertilizing Ingredients in Raw Materials;" namely, 17.5 cents per pound, it being assumed that the organic nitrogen is derived from the best sources, namely, animal matter, as meat, blood, bones or other equally good forms, and not from leather, shoddy, hair, or any low-priced inferior form of vegetable matter, unless the contrary is ascertained.

Insoluble phosphoric acid will be valued at three cents, it being assumed, unless found otherwise, that it is from bone or similar sources, and not from rock phosphate. In this latter form the insoluble phosphoric acid is worth but two cents per pound. Potash is rated at $4\frac{1}{4}$ cents, if sufficient chlorine is present in the fertilizer to combine with it to make muriate. If there is no more potash present than will combine with the chlorine, then the excess of potash will be counted as sulphate. To introduce large quantities of chlorides, common salt, etc., into a fertilizer, claiming sulphate of potash as a constituent, is a practice which, in our present state of information, will be considered of doubtful merit. The use of the highest trade values is based on the opinion that these articles ought to contain the most efficient forms of fertilizing ingredients. In most cases the valuation of the ingredients in superphosphates and specials falls below the retail price of these goods. The difference between the two figures represents the manufacturers' charges for converting raw materials into manufactured articles. These charges are for grinding and mixing, bagging or barreling, storage and transportation, commission to agents and dealers, long credits, interest on investment, bad debts, and, finally, profits.

Local disadvantages for transportation exert, not infrequently, a serious influence on the cost of one and the same brand of fertilizers. Binding rules cannot be laid down regarding these points. Farmers must judge for themselves whether the difference between our valuation and the prices asked for is a fair one, considering local conditions of supply.

The prices stated in these bulletins, in connection with analyses of commercial fertilizers, refer to their cost per ton of 2,000 pounds on board of car or boat near the factory, or place of general distribution. To obtain the valuation of a fertilizer (*i. e.*, the money worth of its fertilizing constituents), we multiply the pounds per ton of nitrogen, etc., by the trade value per pound. We thus get the values per ton of the several ingredients, and, adding them together, we get the total valuation per ton.

The mechanical condition of any fertilizing material, simple or compound, deserves the most serious consideration of farmers, when articles of a similar chemical character are offered for their choice. The degree of pulverization controls, almost without exception, under similar conditions, the rate of solubility, and the more or less rapid diffusion of the different articles of plant food throughout the soil.

The state of moisture exerts a no less important influence on the pecuniary value, in case of one and the same kind of substance. Two samples of fish fertilizer, although equally pure, may differ from fifty to one hundred per cent. in commercial value, on account of mere difference in moisture.

Crude stock for the manufacture of fertilizers, and refuse material of various descriptions, sent to the Station for examination, are valued with reference to the market prices of their principal constituents, taking into consideration, at the same time, their general fitness for speedy action.

A large percentage of commercial fertilizing material consists of refuse matter from various industries. The composition of these substances depends on the mode of manufacture carried on. The rapid progress in our manufacturing industry is liable to affect, at any time, more or less seriously, the composition of the refuse. A constant inquiry into the character of the agricultural chemicals, and of commercial manurial refuse substances offered for sale, cannot fail to secure confidence in their composition, and to diminish financial disappointment in consequence of their application. This work is carried on for the purpose of aiding the farming community in a clear and intelligent appreciation of the substances for manurial purposes.

Consumers of commercial manurial substances do well to buy, whenever practical, on guaranty of composition with reference to their essential constituents, and see to it that the bill of sale recognizes that part of the bargain. Any mistake or misunderstanding in the transaction may be readily adjusted, in that case, between the contending parties. The responsibility of the dealer ends with furnishing an article corresponding in its composition with the lowest-stated quantity of each specified essential constituent.

Sulphate of Ammonia.

[Sent on from Amherst, Mass. Two samples.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	1.63	.29
Nitrogen (17½ cents per pound),	21.68	20.97
Sulphuric acid,	59.64	59.20
Valuation per 2,000 pounds,	$75 88	$73 43

Nitrate of Soda.

[Sent on from Ashby, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	.96	1.35
Nitrogen (16 cents per pound),	14.66	16.14
Sulphuric acid,	Trace.	–
Chlorine,	Trace.	–
Valuation per 2,000 pounds,	$47 01	$51 65

Sulphate of Magnesia.

[Sent on from Amherst, Mass.]

	Per cent.
Moisture at 100° C.,	29.01
Magnesium oxide,	15.87
Sulphuric acid,	30.35
Insoluble matter,	6.29

Ammonite.

[Sent on from Southampton, Mass.]

	Per cent.
Moisture at 100° C.,	6.17
Ash,	9.56
Nitrogen (17½ cents per pound),	12.20
Phosphoric acid (6 cents per pound),	3.40
Insoluble matter,	0.22
Valuation per 2,000 pounds,	$17 50

The material was in a fine mechanical condition, and thus in a favorable form for speedy disintegration.

Saltpetre Waste.

[Sent on from South Acton, Mass.]

	Per cent.
Moisture at 100° C.,	2.71
Sodium oxide,	45.92
Potassium oxide (4¼ cents per pound),	6.11
Calcium oxide,	0.71
Sulphuric acid,	0.84
Nitrogen in nitric acid (16 cents per pound),	0.80
Chlorine,	56.00
Valuation per 2,000 pounds,	$7 75

The sample contained less nitric acid and more potash than previous samples.

Felt Factory Waste.

[Sent on from Lowell, Mass.]

	Per cent.
Moisture at 100° C.,	39.24
Organic and volatile matter,	66.47
Ash,	33.53
Nitrogen (eight cents per pound),	5.26
Insoluble matter,	8.44
Valuation per 2,000 pounds,	$8 42

The principal part of the ash consisted of carbonate of lime. The material ought to be composted before being incorporated into the soil. For use in stables as an absorbent it deserves commendation.

Cotton-seed Meal.

[I. Sent on from Boston, Mass. II. Sent on from Ashby, Mass.]

	Per Cent. I.	Per Cent. II.
Moisture at 100° C.,	10.200	7.71
Ash,	5.480	7.29
Phosphoric acid (6 cents per pound),	2.278	2.01
Magnesium oxide,	.478	1.13
Potassium oxide ($4\frac{1}{4}$ cents per pound),	1.620	2.09
Sodium oxide,	.170	–
Ferric oxide,	.019	–
Calcium oxide,	.403	0.27
Nitrogen (17 cents per pound),	4.193	4.02
Insoluble matter,	.240	0.06
Valuation per 2,000 pounds,	$18 37	$17 86

Sea-weed Ashes.

[Sent on from Duxbury, Mass.]

	Per cent.
Moisture at 100° C.,	1.47
Calcium oxide,	6.06
Magnesium oxide,	4.37
Potassium oxide,	0.92
Sodium oxide,	8.72
Phosphoric acid,	0.30
Sulphuric acid,	2.98
Chlorine,	6.60
Sulphur,	0.14
Insoluble matter (before calcination),	63.65
Insoluble matter (after calcination),	56.28

The analysis of the above ash showed it to contain .14 per cent. of magnesium chloride.

Mussel and Mud.

[Sent on from Eastham, Mass.]

	Per cent.
Moisture at 100° C.,	2.24
Phosphoric acid (5 cents per pound),	0.35
Calcium oxide,	23.39
Iron and alumina,	8.26
Nitrogen (15 cents per pound),	0.72
Insoluble matter,	37.60
Valuation per 2,000 lbs.,	$2 50

Sea-weed.

[Sent on from Eastham, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	12.05	14.96
Ferric oxide,	0.25	0.09
Calcium oxide,	2.73	3.86
Phosphoric acid,	0.44	0.17
Magnesium oxide,	1.48	1.30
Sodium oxide,	11.75	8.40
Potassium oxide,	3.81	0.36
Chlorine,	6.40	5.28
Nitrogen,	1.66	1.28
Insoluble matter,	7.73	0.78

Muck.

[Sent on from Peabody, Mass.]

	Per cent.
Moisture at 100° C.,	89.89
Dry matter,	10.11
Ash in fresh muck,	3.05
Nitrogen in fresh muck,	.26

The ash contained a considerable portion of lime and magnesia compounds. The material is a fair specimen of its kind.

German Peat.

[Sent on from Millbury, Mass.]

	Per cent.
Moisture at 100° C.,	11.29
Nitrogen in organic matter (8 cents per pound),	1.23
Ash constituents,	1.23
Insoluble matter (in ash),	0.38
Valuation per 2,000 pounds,	$1 97

The material was well dried, and evidently designed to serve as an absorbent in some branch of manufacture.

Muriate of Potash.

[Sent on from Ashby, Mass. Four samples.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	0.15	1.16	0.75	0.57
Potassium oxide ($4\frac{1}{4}$ cents per pound),	51.87	53.33	52.11	52.11
Sodium oxide,	–	–	–	10.13
Chlorine,	–	–	–	54.00
Valuation per 2,000 pounds,	$44 09	$45 33	$44 30	$44 30

Muriate of Potash.

[I. Sent on from Fitchburg, Mass. II. Sent on from North Hadley, Mass. III. Sent on from Amherst, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	0.15	1.05	1.86
Potassium oxide (4¼ cents per pound),	51.87	48.60	49.98
Sodium oxide,	–	5.70	–
Chlorine,	–	43.20	–
Valuation per 2,000 pounds,	$44 09	$41 31	$42 48

Sulphate of Potash and Magnesia.

[I. Sent on from Amherst, Mass. II. Sent on from Ashby, Mass. III. Sent on from Ashby, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	3.85	7.73	0.34
Magnesium oxide,	13.66	12.90	–
Potassium oxide (5½ cents per pound),	22.63	22.70	51.28
Sodium oxide,	6.34	4.22	–
Sulphuric acid,	47.28	45.61	46.41
Chlorine,	2.64	1.46	–
Insoluble matter,	0.80	0.46	0.93
Valuation per 2,000 pounds,	$24 89	$24 97	$56 41

Wood Ashes.

[I. and II. Sent on from Sunderland, Mass. III. Sent on from Northampton, Mass. IV. Sent on from Boston, Mass. V. Sent on from Amesbury, Mass.]

	Per Cent.				
	I.	II.	III.	IV.	V.
Moisture at 100° C., . . .	11.39	10.97	9.70	17.38	7.47
Phosphoric acid, ...	1.71	1.19	0.89	1.17	1.86
Magnesium oxide, ...	3.32	3.20	3.64	3.77	3.98
Calcium oxide, ...	37.25	36.46	37.23	31.50	39.05
Potassium oxide, ...	6.14	6.28	7.55	6.21	4.69
Insoluble matter (before calcination),	10.83	17.45	23.80	18.05	15.68
Insoluble matter (after calcination),	7.71	12.01	12.62	13.49	13.98

These samples are of good quality, with the exception of No. V. Unleached wood ash sells in our vicinity at from 24 to 25 cents per bushel of from 42 to 44 pounds.

Wood Ashes.

[I. Sent on from New York City, N. Y. II. Sent on from North Hatfield, Mass. III. Sent on from Methuen, Mass. IV. Sent on from Eastham, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C., ...	4.73	14.19	17.33	13.59
Phosphoric acid, ...	–	0.81	–	1.46
Calcium oxide, ...	–	36.86	–	35.90
Magnesium oxide, ...	–	2.64	–	3.16
Potassium oxide, ...	3.40	7.23	7.22	5.74
Insoluble matter (before calcination), .	22.49	6.48	7.05	10.64
Insoluble matter (after calcination), .	15.12	5.81	–	7.55

Wood Ashes.

[Sent on from South Deerfield. Four samples.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	14.09	13.31	14.71	12.37
Phosphoric acid,	1.38	1.38	1.17	.98
Magnesium oxide,	3.35	3.48	3.57	3.58
Calcium oxide,	36.90	37.74	36.32	36.26
Potassium oxide,	6.72	4.86	6.85	6.77
Insoluble matter (before calcination),	8.20	7.46	14.65	17.78
Insoluble matter (after calcination),	6.42	5.80	9.14	10.45

Canada Wood Ashes.

[I. Hard-wood ashes. Sent on from Stockbridge, Mass. II. Sent on from Granby, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	19.16	13.53
Phosphoric acid,	1.32	1.31
Calcium oxide,	34.80	36.63
Magnesium oxide,	3.04	3.12
Potassium oxide,	5.65	6.22
Insoluble matter (before calcination),	7.48	9.22
Insoluble matter (after calcination),	5.64	6.95

Wood Ashes.

[Sent on from Amherst, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	17.22	10.87	9.52
Calcium oxide,	34.28	36.28	54.48
Magnesium oxide,	3.96	3.94	4.35
Potassium oxide,	4.42	5.37	5.23
Phosphoric acid,	1.54	1.14	1.65
Insoluble matter (before calcination),	16.82	11.76	11.14
Insoluble matter (after calcination),	12.46	10.11	9.97

Lime-kiln Ashes.

[Sent on from South Deerfield, Mass.]

	Per cent.
Moisture at 100° C.,	18.90
Phosphoric acid,	.36
Calcium oxide,	44.89
Magnesium oxide,	1.26
Potassium oxide,	.99
Insoluble matter (before calcination),	7.19
Insoluble matter (after calcination),	2.58

Wood Ashes (Canada).

[I. and II. Sent on from Boston, Mass. III. Sent on from Sunderland, Mass. IV. Sent on from Concord, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	11.12	8.67	1.10	15.98
Phosphoric acid,	2.05	1.59	1.08	1.34
Magnesium oxide,	3.30	3.18	2.93	4.45
Calcium oxide,	39.15	39.75	50.09	30.49
Potassium oxide,	5.30	5.58	2.93	4.76
Insoluble matter (before calcination),	9.80	10.10	9.59	16.91
Insoluble matter (after calcination),	8.67	9.17	7.38	14.14

Nos. 1, 2 and 4 are unleached Canada ashes; the large amount of moisture and of insoluble matter in No. 4 explains its lower percentage of potash. Sample No. 3 is a partially leached ash.

Cotton-seed Hull Ashes.

[Sent on from North Hadley, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	7.40	8.08
Potassium oxide (5½ cents per pound),	28.55	26.62
Magnesium oxide,	16.14	17.15
Phosphoric acid (6 cents per pound),	8.97	11.50
Calcium oxide,	10.58	11.37
Insoluble matter,	11.71	5.38
Valuation per 2,000 pounds,	$42 17	$43 08

These samples contain an exceptionally high percentage of potassium oxide and of phosphoric acid.

Cotton-seed Hull Ashes.

[Sent on from North Hadley, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	12.34	22.30
Potassium oxide (5½ cents per pound),	22.08	31.72
Magnesium oxide,	10.78	4.67
Phosphoric acid (6 cents per pound),	10.32	2.89
Calcium oxide,	6.64	3.35
Insoluble matter (before calcination),	20.08	7.59
Insoluble matter (after calcination),	17.06	7.30
Valuation per 2,000 pounds,	$36 67	$38 36

Soap-grease Residue.

[Sent on from South Lincoln, Mass.]

	Per cent.
Moisture at 100° C.,	38.79
Total phosphoric acid (5 cents per pound),	11.04
Insoluble phosphoric acid,	8.93
Reverted phosphoric acid,	2.11
Potassium oxide (4¼ cents per pound),	0.14
Nitrogen (12 cents per pound),	2.21
Insoluble matter,	1.20
Valuation per 2,000 pounds,	$16 24

Soup from Horse-rendering Establishment.

[Sent on from Arlington, Mass.]

	Per cent.
Moisture at 100° C.,	92.14
Total phosphoric acid (6 cents per pound),	0.14
Nitrogen (15 cents per pound),	1.12
Valuation per 2,000 pounds,	$3 53

Fish.

[I. Dried Fish; sent on by Swanzey Farmers' Club, Swanzey, Mass. II. Fish and Potash; sent on from Medfield, Mass. III. Fish Bone and Potash; sent on from Concord, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	9.17	26.75	16.93
Total phosphoric acid,	7.92	5.44	4.19
Soluble phosphoric acid,	0.64	2.00	0.39
Reverted phosphoric acid,	4.36	2.57	2.00
Insoluble phosphoric acid,	2.92	1.08	1.82
Potassium oxide,	None.	2.95	1.24
Nitrogen,	8.73	3.90	1.66
Insoluble matter,	2.69	1.59	30.80
Valuation per 2,000 pounds,	$39 87	$23 87	$11 54

Ground Bones.

[Sent on from Westford, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	3.94	9.74
Total phosphoric acid,	27.73	12.85
Soluble and reverted phosphoric acid (7½ cents per pound),	6.10	4.72
Insoluble phosphoric acid (5 cents per pound),	21.63	8.13
Nitrogen (15 cents per pound),	1.83	2.93
Insoluble matter,	0.10	2.61
Valuation per 2,000 pounds,	$36 27	$23 90

The mechanical condition of both samples was much the same; the valuation above given has been for this reason the same. The desirability of having ground bones sold only by a guaranteed composition finds an additional strong illustration in this case.

Ground Bone.

[Sent on from Concord, Mass.]

	Per cent.
Moisture at 100° C.,	3.05
Total phosphoric acid,	17.72
Reverted phosphoric acid (7½ cents per pound),	5.55
Insoluble phosphoric acid (4 cents per pound),	12.17
Nitrogen (15 cents per pound),	5.15
Insoluble matter,	1.19
Valuation per 2,000 pounds,	$33 52

Steamed Bone and Meat.

[Sent on from Fitchburg, Mass.]

	Per cent.
Moisture at 100° C.,	4.71
Total phosphoric acid (5 cents per pound),	20.28
Soluble phosphoric acid,	0.56
Reverted phosphoric acid,	4.54
Insoluble phosphoric acid,	14.18
Nitrogen (15 cents per pound),	5.37
Insoluble matter,	1.19
Valuation per 2,000 pounds,	$35 25

Ground Rock Phosphate.

[Sent on from West Springfield, Mass.]

	Per cent.
Moisture at 100° C.,	0.10
Total phosphoric acid,	30.51
Soluble phosphoric acid,	None.
Reverted phosphoric acid,	0.19
Insoluble phosphoric acid (2 cents per pound),	30.31
Magnesium oxide,	3.03
Calcium oxide,	41.87
Ferric and aluminum oxides,	4.26
Insoluble siliceous matter,	13.74

The material is of but little value for manurial purposes, without a previous treatment with sulphuric acid, to render its phosphoric acid available.

South Carolina Rock Phosphate.

[Sent on from Ashby, Mass.]

	Per cent.
Moisture at 100° C.,	1.68
Total phosphoric acid,	25.81
Soluble phosphoric acid,	0.27
Reverted phosphoric acid,	0.47
Insoluble phosphoric acid,	25.07
Insoluble matter,	11.64

The material is of fair composition, and ought to be manufactured into superphosphate before used.

Natural Phosphate.

[Sent on from New York.]

	Per cent.
Moisture at 100° C.,	3.26
Total phosphoric acid,	28.95
Reverted phosphoric acid,	1.50
Insoluble phosphoric acid,	27.45
Alumina and ferric oxides,	11.76
Calcium oxide,	35.40

The article is characterized by the presence of a liberal amount of sesquioxide of iron and alumina. Actual field experiments have to decide its agricultural value.

Carib Guano.

[Sent on from Baltimore, Md. I. Rock; coarse. II. Fine-ground. III. Soil.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	2.12	2.16	15.80
Total phosphoric acid,	35.43	33.09	21.72
Soluble phosphoric acid,	–	–	0.12
Reverted phosphoric acid,	3.78	3.49	0.44
Insoluble phosphoric acid,	31.65	29.60	21.16
Total nitrogen,	–	–	0.56
Nitrogen as ammoniates,	–	–	0.28
Nitrogen as nitrates,	–	–	0.26
Calcium oxide,	44.74	43.26	–
Insoluble matter,	0.60	1.59	7.15

The valuation of this material depends in a controlling degree on its mechanical condition.

Superphosphates.

[Sent on from Ashby, Mass. I. and II. Dissolved Bone-black. III. and IV. Acid Phosphate.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	13.83	13.86	16.39	13.93
Total phosphoric acid,	18.21	16.37	14.68	13.84
Soluble phosphoric acid (8 cents per pound),	14.59	14.60	10.50	10.91
Reverted phosphoric acid (7½ cents per pound),	3.41	1.53	3.82	0.69
Insoluble phosphoric acid (3 cents per pound),	0.21	0.24	0.36	2.24
Insoluble matter,	3.52	2.09	7.89	9.54
Valuation per 2,000 pounds,	$28 59	$25 80	$22 75	$19 84

These articles are of fair quality.

Marl.

[I. and II. Sent on from Baltimore, Md. III. Sent on from South Framingham, Mass.]

	Per Cent.		
	I.	II.	III.
Moisture at 100° C.,	16.70	15.26	12.12
Phosphoric acid,	0.09	0.08	0.35
Sulphuric acid,	1.00	0.31	Trace.
Carbonic acid,	4.23	1.76	–
Calcium oxide,	9.21	5.29	47.11
Magnesium oxide,	0.25	0.16	0.65
Potassium oxide,	0.61	0.37	–
Insoluble matter (before calcination),	59.59	68.86	7.73
Insoluble matter (after calcination),	–	–	7.51

I. and II. Are samples of "green marl;" they belong to a valuable class of marls.

III. This material, sent on "as a sample of marl," is essentially a carbonate of lime of fine aggregation and of a soft texture; and for this reason it deserves recommendation for agricultural purposes, wherever an addition of lime will benefit the soil in the interest of the crops raised upon it.

Peruvian Guano.

[Sent on from Taunton, Mass.]

	Per cent.
Moisture at 100° C.,	12.17
Total phosphoric acid,	18.45
Soluble phosphoric acid (8 cents per pound),	1.54
Reverted phosphoric acid ($7\frac{1}{2}$ cents per pound),	5.92
Insoluble phosphoric acid (3 cents per pound),	10.99
Potassium oxide ($4\frac{1}{4}$ cents per pound),	3.46
Total nitrogen,	5.13
Actual ammonia ($17\frac{1}{2}$ cents per pound),	3.94
Organic nitrogen ($17\frac{1}{2}$ cents per pound),	0.86
Nitrogen as nitric acid (16 cents per pound),	0.33
Insoluble matter,	13.64
Valuation per 2,000 pounds,	$38 74

Compound Fertilizers.

[I. Sent on from Millbury, Mass. II. Sent on by Swanzey Farmers' Club, Swanzey, Mass.]

	Per Cent.	
	I.	II.
Moisture at 100° C.,	11.83	7.69
Total phosphoric acid,	13.95	9.91
Soluble phosphoric acid,	6.62	2.81
Reverted phosphoric acid,	2.69	3.57
Insoluble phosphoric acid,	4.64	3.53
Potassium oxide,	3.28	10.64
Nitrogen,	2.88	4.62
Insoluble matter,	3.82	1.81
Valuation per 2,000 pounds,	$30 28	$37 19

Compound Fertilizers.

[I. Animal fertilizer; sent on from Boston. II. Sent on from Eastham, Mass. III. Sent on from Tewksbury, Mass. IV. Peruvian guano; sent on from Taunton, Mass.]

	Per Cent.			
	I.	II.	III.	IV.
Moisture at 100° C.,	7.20	8.81	14.15	12.17
Total phosphoric acid,	14.51	3.97	13.69	18.45
Soluble phosphoric acid,	6.34	0.25	7.00	1.54
Reverted phosphoric acid,	6.74	2.96	4.83	5.92
Insoluble phosphoric acid,	1.43	0.76	1.86	10.99
Potassium oxide,	5.11	2.97	2.96	3.46
Calcium oxide,	–	–	16.65	–
Total nitrogen,	3.44	1.39	2.40	5.13
Nitrogen in ammoniates,	–	–	–	3.94
Nitrogen in nitrates,	–	–	–	0.33
Nitrogen in organic matter,	–	–	–	0.86
Insoluble matter,	1.23	65.16	5.52	13.64
Valuation per 2,000 pounds,	$37 49	$12 69	$30 49	$38 73

Miscellaneous Analyses.

Vinegars.

[Sent on from Prescott, Mass. I. Made Oct. 5, 1885, from unripe Baldwin apples; shrinkage, 1¼ gals. on 10, or 12½ per cent. II. Made Oct. 28, 1885, from ripe Baldwin apples; shrinkage not determined. III. Made Oct. 28, 1885, from sweet apples; shrinkage, 1 gal. on 7, or 14 2-7 per cent.]

	Per Cent.		
	I.	II.	III.
Temperature, C.,	11.1	11.1	11.1
Specific gravity,	1.016	1.019	1.024
Acetic acid,	6.67	8.41	8.66
Sulphuric acid and chlorine,	Trace.	Trace.	Trace.
Solids at 100° C.,	1.44	1.94	3.02

The tests were made Jan. 24, 1887.

[Two samples, sent on from Montague, Mass.]

	I.	II.
Total acids,	4.90 per cent.	4.55 per cent.

Milk.

[Seven samples; sent on from Hardwick, Mass.]

	Specific Gravity.	Temperature, C.	Per Cent.		
			Solids.	Fat.	Solids not Fat.
No. 1,	1.0338	17°	10.27	1.47	8.80
2,	1.0329	17°	10.02	1.44	8.58
3,	1.0323	17°	9.67	1.31	8.36
4,	1.0323	17°	13.74	4.68	9.06
5,	1.0335	17°	9.19	0.74	8.45
6,	1.0320	17°	11.47	3.01	8.46
7,	1.0311	17°	15.62	7.27	8.35

Analysis of Water sent on for Examination.

[Parts per Million.]

Number.	Actual Ammonia.	Albuminoid Ammonia.	Chlorine.	Solids at 100° C.	Solids at red heat.	Hardness (Clarks' degree).	Lead.	Locality.
I., . . .	14.80	2.20	148.00	0.682	0.258	19.76	-	Millis.
II., . .	-	-	-	-	-	-	None.	No. Amherst.
III., . .	0.03	0.14	16.00	130.00	73.2	26.70	-	Westford.
IV., . .	2.460	1.620	5.00	0.0396	0.0220	-	-	Millis.
V., . .	Contain	ed free	acid, la	rge amou	nts of SO_3.	Traces	of Fe.	Amherst.
VI., . .	0.10	0.18	23.30	178.00	112.80	31.20	-	Athol.
VII., . .	0.03	0.09	6.00	56.00	45.60	13.50	-	So. Amherst.
VIII., . .	0.05	0.16	92.80	462.00	360.00	8.86	-	Rutland.
IX., . .	0.69	0.09	55.60	392.00	216.00	7.43	-	Amherst.
X., . .	0.15	0.11	10.00	36.00	18.80	1.27	-	Westford.
XI., . .	-	-	-	-	-	-	None.	Amherst.
XII., . .	0.18	0.36	72.50	584.00	231.00	-	-	Marblehead.
XIII., . .	0.04	0.02	21.00	194.00	-	3.66	-	Amherst.
XIV., . .	0.34	0.47	18.00	139.00	91 00	3.77	-	Amherst.
XV., . .	SO_3—	42.20	7.20	90.00	33.00	CaO —	46.00	Bellows Falls.
XVI., . .	0.05	0.10	9.10	164 00	86.00	6.57	-	No. Hadley.
XVII., . .	0.10	0.09	6.00	120 00	66.00	6.00	-	No. Hadley.
XVIII., .	0.03	0 08	48.00	186.00	84.00	6.29	-	No. Hadley.
XIX., . .	4.75	0.20	74.00	706.00	252.00	5.43	-	Amherst.
XX., . .	4.72	0.28	56.00	386.00	234.00	5.14	-	Hadley.
XXI., . .	0.07	0.04	18.00	214.00	48.00	2.86	-	So. Amherst.
XXII., . .	-	0.04	2.00	52.00	20.00	0.48	-	So. Amherst.
XXIII., .	0.08	0.15	8.00	132.00	104.00	-	-	Pawtucket, R.I.
XXIV., .	1 225	0.70	11.00	202.00	140.00	-	-	Amherst.
XXV., . .	0.07	0.32	9.00	258.00	194.00	-	-	Amherst.
XXVI., .	0.02	0.21	3.50	79.00	37.00	-	-	Amherst.
XXVII., .	-	-	-	-	-	-	Present.	Amherst.
XXVIII., .	0.22	0.18	9.00	66.00	40.00	1.11	-	Attleboro'.
XXIX., .	3.45	0.90	5.40	110.00	70.00	3.90	-	No. Amherst.
XXX., . .	0.14	0.08	150.00	652.00	126.00	11.05	-	Amherst.
XXXI., .	-	-	-	-	-	-	Present.	East Amherst.
XXXII., .	-	-	-	-	-	-	Present.	Amherst.
XXXIII., .	-	-	-	-	-	-	None.	East Amherst.
XXXIV., .	-	-	-	-	-	-	None.	Amherst.
XXXV., .	3.50	0.50	73.00	692.00	258.00	11.20	None.	Amherst.
XXXVI., .	0.26	0.26	36.00	344 00	130.00	7.43	-	Springfield.
XXXVII., .	0.48	0.13	13.50	64.00	44.00	-	-	So. Amherst.
XXXVIII., .	0.044	0.098	6.00	50.00	32.00	1.11	None.	Amherst.
XXXIX, .	0.12	0.15	None.	22.00	20.00	1.27	-	Westhampton.
XL., . .	0.13	0.20	18.00	150.00	86.00	1.95	None.	Athol.

The above-stated results of analyses of drinking waters were obtained from samples sent on, for that purpose, from various parts of the State. In most instances these requests are accompanied by a specified instruction, regarding the object of the party interested, — a circumstance which renders the task of the chemist, comparatively speaking, an easy one.

The analyses have been made according to Wanklyn's process, familiar to chemists; and are directed towards the indications of the presence of chlorine, free and albuminoid ammonia, and the poisonous metals, lead in particular. (For a more detailed description of this method, see "Water Analyses," by J. A. Wanklyn and E. T. Chapman.)

Mr. Wanklyn's interpretation of the results of his mode of investigation is as follows: —

1. Chlorine alone does not necessarily indicate the presence of filthy water.

2. Free and albuminoid ammonia in water, without chlorine, indicates a vegetable source of contamination.

3. More than five grains per gallon* of chlorine (= 71.4 parts per million), accompanied by more than .08 parts per million of free ammonia and more than .10 parts per million of albuminoid ammonia, is a clear indication that the water is contaminated with sewage, decaying animal matter, urine, etc., and should be condemned.

4. Eight-hundredths parts per million of free ammonia and one-tenth part per million of albuminoid ammonia render a water very suspicious, even without much chlorine.

5. Albuminoid ammonia over .15 parts per million ought to absolutely condemn the water which contains it.

6. The total solids found in the water should not exceed forty grains per gallon (571.4 parts per million).

An examination of the above results of analyses shows that Nos. 3, 7, 8, 16, 17, 21, 23 and 25 are of a suspicious character, and that Nos. 1, 4, 6, 9, 10, 12, 14, 19, 20, 24, 28, 30, 35 and 36 ought to be condemned, on account of a large amount of free and albuminoid ammonia, due most likely to access of sewage waters. Of eight samples of

* One gallon equals 70,000 grains.

water tested for lead, three were found to be poisoned by that metal, in consequence of the use of lead pipes.

A satisfactory supply of good drinking water on a farm, depends, in a controlling degree, on a judicious selection of the location of the well designed for the use of the family and for the live-stock, and on the personal attention bestowed, from time to time, on the condition of the well and its surroundings. Good wells are liable to change for the worse at any time, on account of circumstances too numerous to state in this connection. To ascertain, from time to time, the exact condition of the well which supplies the wants of the family and of the live-stock, is a task which no farmer can, for any length of time, discard, without incurring a serious risk to health and prosperity.

The subject receives, quite frequently, but little attention, on account of the fact that the harmful qualities which an apparently good water may contain, are disguised beyond recognition by the unaided senses. Certain delicate chemical tests, aided at times by microscopic observations, are, in the majority of cases, the only reliable means, in our present state of scientific inquiry, by which desirable information regarding the true character of a drinking water can be obtained.

Parties sending on water for an analysis ought to be very careful to use clean vessels, clean stoppers, etc. The sample should be sent on without delay after collecting. One gallon is desirable for the analysis.

COMPILATION OF ANALYSES,

MADE AT THE

AGRICULTURAL INSTITUTIONS AT AMHERST, MASS.,

OF FODDER ARTICLES.

1868–1888.

A. Analyses of Fodder Articles.

B. Analyses of Fodder Articles, with Reference to Fertilizing Ingredients.

"A."

CORN (ZEA MAIZE).

Fodder Analyses of Kernels.

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Analysis of Dry Matter, 100 Parts.					Per Cent of Digestibility.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Wheeler's Prolific,	B'd of Agricul. '79–80,	10.00	90.00	1.60	2.10	5.24	13.81	77.25	34.	76.	85.	94.	1:7.10
Clark Corn,	" "	10.00	90.00	1.84	2.78	5.40	13.80	76.18	34.	76.	85.	94.	1:7.07
Tip Corn,	" "	10.00	90.00	1.71	2.78	5.77	14.11	75.63	34.	76.	85.	94.	1:7.13
Southern Corn,	" "	10.00	90.00	1.52	2.24	4.98	13.84	77.42	34.	76.	85.	94.	1:7.06
Canada Corn,	" "	10.00	90.00	1.49	2.78	5.28	13.88	76.57	34.	76.	85.	94.	1:7.03
Canada Dutton,	" "	10.00	90.00	1.59	2.78	5.83	12.06	77.74	34.	76.	85.	94.	1:8.30
Early Southern,	" "	10.00	90.00	1.89	2.78	5.53	13.26	76.54	34.	76.	85.	94.	1:7.40
Western (White) Dent,	" "	10.00	90.00	1.53	2.78	4.74	12.81	78 14	34.	76.	85.	94.	1:7.66
Western (Yellow) Dent,	" "	10.00	90.00	1.67	3.38	5.06	12.36	77.53	34.	76.	85.	94.	1:8.91
Crosby Sweet Corn,	" "	10.00	90.00	1.97	2.78	7.72	12.97	74.56	34.	76.	85.	94.	1:7.77
Blue Texas Sweet Corn,	" "	10.00	90.00	1.71	2.78	9.43	15.02	71.06	34.	76.	85.	94.	1:6.71
Nebraska Red Corn,	Report I.,	10.74	89.26	1.44	3.36	6.05	14.16	74.99	34.	76.	85.	94.	1:6.97

Hampden Prolific,	Report II.,	11.43	88.57	1.72	2.17	4 52	11.36	80.23	34.	76.	85.	94.	1: 8.77
Hampden Prolific,	" II.,	8.02	91.98	1.69	1.98	5.29	13.73	77.31	34.	76.	85.	94.	1: 7.15
Topover Corn,	" III.,	11.55	88.45	1.47	1.96	6.61	14.01	75.95	34.	76.	85.	94.	1: 7.11
Yellow Sweet Corn,	" IV.,	10.90	89.10	2.16	2.58	4.25	12.61	78.40	34.	76.	85.	94.	1: 7.74
Self-Husking Corn,	" IV.,	12.10	87.90	1.74	2.52	5.44	12.47	77.83	34.	76.	85.	94.	1: 7.96
Pride of the North,	Bulletin 24,	8.75	91.25	1.59	2.54	4.34	12.05	79.48	34.	76.	85.	94.	1: 8.18
Western Dent,	Bulletin 26,	10.20	89.80	1.47	1.86	4.72	9.31	82.64	34.	76.	85.	94.	1:11.03
Corn Meal,	Report I.,	17.04	82.96	1.58	3.60	4.82	16.08	73.20	34.	76.	85.	94.	1: 5.54
" "	" I.,	13.55	86.45	1.42	2.64	4.24	10.40	81.30	34.	76.	85.	94.	1: 9.66
" "	" II.,	13.85	86.15	1.42	2.64	4.24	10.40	81.30	34.	76.	85.	94.	1: 9.66
" "	" II.,	12.62	87.38	1.56	2.65	4.27	11.43	80.09	34.	76.	85.	94.	1: 8.68
" "	" II.,	11.95	88.05	1.59	2.59	4.43	13.13	78.26	34.	76.	85.	94.	1: 7.42
" "	" II.,	12.40	87.60	1.66	2.71	4.14	10.77	80.72	34.	76.	85.	94.	1: 9.25
" "	" III.,	12.62	87.38	1.56	2.66	4.27	11.43	80.08	34.	76.	85.	94.	1: 8.76
" "	" III.,	11.95	88.05	1.59	2.59	4.43	13.13	78.26	34.	76.	85.	94.	1: 7.42
" "	" IV.,	12.62	87.38	1.56	2.66	4.27	11.43	80.88	34.	76.	85.	94.	1: 8.76
" "	" V.,	13.18	86.82	1.57	3.56	4.86	10.72	79.29	34.	76.	85.	94.	1: 9.33
" "	" V.,	12.98	87.02	1.75	3.42	5.08	10.07	79.68	34.	76.	85.	94.	1:10.17

Fodder Analysis of Corn and Cob (Whole Ear).

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Analysis of Dry Matter, 100 Parts.					Per Cent. of Digestibility.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogeuous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Wheeler's Prolific, ...	B'd of Agricul. '79-80,	10.00	90.00	1.57	7.39	4.47	12.17	74.40	-	-	-	-	-
Southern Corn, ...	" "	10.00	90.00	1.37	8.47	4.06	11.78	74.32	-	-	-	-	-
Western (Yellow) Dent, . .	" "	10.00	90.00	1.57	7.30	4.47	11.13	75.53	-	-	-	-	-
Corn Meal and Cob, . . .	Report I., . . .	19.07	80.93	1.61	9.77	3.43	15.06	70.13	-	-	-	-	-
Corn-cob Meal, ...	" IV., . . .	9.45	90.55	1.64	6.32	5.19	9.85	77.00	-	-	-	-	-
Corn and Cob, ...	" IV., . . .	10.71	89.29	2.16	5.39	5.27	12.18	75.00	-	-	-	-	-

Fodder Analysis of Corn Cobs.

Wheeler's Prolific, ...	B'd of Agricul. '79-80,	10.00	90.00	1.41	33.19	0.67	4.15	60.58	-	-	-	-	-
Southern Corn, ...	" "	10.00	90.00	0.75	33.39	0.38	3.49	61.99	-	-	-	-	-
Western (Yellow) Dent, . .	" "	10.00	90.00	0.94	31.36	0.46	3.62	63.62	-	-	-	-	-

Fodder Analysis of Fodder Corn.

Dried Fodder Corn in tassel (frost-bitten),	Report I.,	8.83	91.17	4.86	29.05	2.06	8.63	55.40	72.	75.	73.	67.	1: 9.82
Fodder Corn,	" II.,	6.65	93.35	4.68	31.39	1.42	6.83	55.68	72.	75.	73.	67.	1:12.54
Fodder Corn (frost-bitten),	" II.,	6.67	93.33	5.11	33.75	1.11	6.17	53.86	72.	75.	73.	67.	1:13.88
From unfertilized plats,	" III.,	78.50	21.50	3.91	25.74	2.92	13.75	53.68	72.	75.	73.	67.	1: 5.97
Fodder Corn,													
Collected July 22,	" III.,	88.61	11.39	8.54	26.01	3.24	17.19	42.02	72.	75.	73.	67.	1: 4.22
" July 29,	" III.,	85.76	14.24	8.00	27.29	2.65	14.42	47.64	72.	75.	73.	67.	1: 5.37
" Aug. 5,	" III.,	84.64	15.36	5.95	26.40	2.26	11.86	53.53	72.	75.	73.	67.	1: 6.83
" Aug. 13,	" III.,	82.08	17.92	5.69	24.11	2.13	11.23	56.84	72.	75.	73.	67.	1: 7.25
" Aug. 27,	" III.,	81.15	18.85	4.70	24.30	1.81	8.87	60.32	72.	75.	73.	67.	1: 9.46
" Sept. 3,	" III.,	76.81	23.19	4.22	20.93	2.63	9.17	63.05	72.	75.	73.	67.	1: 9.30
Collected Sept. 1,	" V.,	72.27	27.73	3.16	24.32	2.89	9.64	59.99	72.	75.	73.	67.	1: 8.97
Kernels glazed,													
Fodder Corn for Ensilage,	" V.,	70.27	29.73	5.24	24.50	3.38	8.36	58.52	72.	75.	73.	67.	1:10.36

Fodder Analysis of Corn Fodder (Stover).

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	ANALYSIS OF DRY MATTER, 100 PARTS.					PER CENT. OF DIGESTIBILITY.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Corn Stover,	Report II.,	8.73	91.27	3.12	34.28	1.27	6.58	54.75	-	30.	40.	100.	1:21.16
Shredded Stover,	" III.,	6.95	93.05	5.16	33.46	1.71	12.15	47.52	72.	75.	73.	67.	1: 7.23
Corn Fodder,	" IV.,	15.40	84.60	4.22	20.93	2.63	9.17	63.05	72.	75.	73.	67.	1: 9.3
Western Dent Stover,	Bulletin 26,	16.67	83.33	4.17	35.44	1.71	6.63	52.05	72.	75.	73.	67.	1:13.14
"Topover Corn" Stover,	Report III.,	25.00	75.00	6.12	36.10	2.49	6.47	48.82	72.	75.	73.	67.	1:13.43

Fodder Analysis of Ensilage (from Fodder Corn).

Corn Ensilage,	Board of Agricul. '80,	80.70	19.30	9.17	33.32	3.21	8.08	46.22	72.	75.	73.	67.	1:10.34
Ensilage of Corn in Tassel,	Report II.,	86.88	13.12	6.89	33.66	3.88	12.58	42.99	72.	75.	73.	67.	1: 6.57
Ensilage of Cut Corn,	" III.,	81.88	18.12	5.07	26.23	3.49	7.83	57.38	72.	75.	73.	67.	1:11.8
Ensilage of Whole Corn,	" III.,	83.18	16.82	4.23	29.44	3.69	9.03	53.61	72.	75.	73.	67.	1: 9.71
Corn Ensilage,	" IV.,	77.48	22.52	4.19	19.08	3.49	7.82	65.42	72.	75.	73.	67.	1:11.3

Corn Ensilage,	" IV.,	78.05	21.95	3.16	20.48	3.84	7.37	65.15	72.	75.	73.	67.	1:12.2
Corn Ensilage,	" IV.,	76.90	23.10	5.22	17.67	3.15	8.27	65.69	72.	75.	73.	67.	1:10.4
Corn Ensilage,	Bulletin 26,	71.69	28.40	3.32	18.52	6.07	7.78	64.31	72.	75.	73.	67.	1:11.9

Fodder Analysis of Gluten Meal.

Gluten Meal,	Report I.,	8.43	91.57	0.64	3.55	8.75	38.22	48.84	34.	76.	85.	94.	1:1.96
" "	" I.,	10.23	89.77	0.65	1.20	5.06	33.56	59.53	34.	76.	85.	94.	1:2.31
" "	" II.,	11.68	88.32	0.79	.77	3.94	28.24	66.26	34.	76.	85.	94.	1:2.92
" "	" III.,	8.45	91.55	0.76	1.73	9.34	35.31	52.86	34.	76.	85.	94.	1:2.27
" "	" IV.,	8.95	91.05	0.76	1.58	7.51	30.81	59.34	34.	76.	85.	94.	1:3.00
" "	" V.,	8.83	91.17	0.73	.79	8.46	31.43	58.59	34.	76.	85.	94.	1:2.67
" "	" V.,	10.04	89.96	0.78	4.45	9.34	34.67	50.76	34.	76.	85.	94.	1:2.27

Fodder Analysis of Corn Refuse from Factories.

Hominy Feed, Chit and soft parts of Kernels of Corn,	Report I.,	8.93	91.07	2.07	3.77	4.89	11.20	78.07	-	-	-	-	-
Hominy Meal,	" III.,	8.11	91.89	3.24	4.78	12.22	11.76	68.00	34.	76.	85.	94.	1:9.28
Hominy Meal,	" IV.,	10.70	89.30	2.82	3.69	10.88	11.88	70.73	34.	76.	85.	94.	1:8.75
Corn Refuse from Starch Factory,	" IV.,	57.04	42.96	0.90	7.54	10.17	22.41	58.98	-	-	-	-	-
Chit Corn Meal,	" V.,	12.32	87.68	2.08	3.92	5.74	10.26	78.00	-	-	-	-	-
Cracked Corn, Chits removed,	" V.,	13.58	86.42	2.64	3.15	4.06	10.99	79.16	-	-	-	-	-

WHEAT.

Fodder Analysis of Wheat Grain.

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Analysis of Dry Matter, 100 Parts. Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Per Cent. of Digestibility. Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	Nutritive Ratio.
Wheat Grain, ...	Report II., ...	10.58	89.42	2.18	2.42	1.79	13.35	80.26	-	80.	90.	92.5	1:6.42

Fodder Analysis of Wheat Straw.

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	Dig. Crude Cellulose.	Dig. Crude Fat.	Dig. Crude Protein.	Dig. Non-nitrogenous Extract Matter.	Nutritive Ratio.
Wheat Straw, ...	Report II., ...	6.20	93.80	4.80	35.91	1.63	7.20	50.46	-	42.	60.	65.	1:8.

Fodder Analysis of Wheat Bran.

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	Dig. Crude Cellulose.	Dig. Crude Fat.	Dig. Crude Protein.	Dig. Non-nitrogenous Extract Matter.	Nutritive Ratio.
Wheat Bran, ...	Report I., ...	13.70	86.30	6.76	9.33	2.91	19.56	61.44	20.	80.	88.	80.	1:3.30
" "	" I., ...	12.08	87.92	7.92	13.72	3.81	15.67	58.88	20.	80.	88.	80.	1:4.16
" "	" II., ...	10.48	89.52	6.98	10.20	4.77	20.24	57.81	20.	80.	88.	80.	1:3.25
" "	" III., ...	12.05	87.95	6.64	11.49	4.75	17.86	59.26	20.	80.	88.	80.	1:3.77
" "	" IV., ...	10.00	90.00	6.11	7.60	6.08	18.63	61.58	20.	80.	88.	80.	1:3.84
" "	" V., ...	12.20	87.80	7.33	10.92	2.80	19.79	59.16	20.	80.	88.	80.	1:3.16
" "	" V., ...	11.14	88.86	6.59	12.80	6.00	17.72	56.89	20.	80.	88.	80.	1:3.85
" "	" V., ...	10.38	89.62	6.92	14.26	4.81	16.25	57.76	20.	80.	88.	80.	1:4.10

Fodder Analysis of Wheat Middlings.

Wheat Middlings,	Report III.,	9.25	90.75	5.34	8.40	6.46	18.18	61.62	20.	80.	88.	80.	1:3.99
" "	" IV.,	10.55	89.45	2.49	1.40	4.26	19.21	72.64	20.	80.	88.	80.	1:3.07
" "	" IV.,	9.85	90.15	2.53	2.75	3.19	17.23	74.30	20.	80.	88.	80.	1:4.38

Fodder Analysis of Rye Bran and Middlings.

Rye Bran,	Report I.,	13.70	86.30	5.17	4.54	2.07	18.98	69.24	9.	57.5	66.	74.5	1:4.39
Rye Bran,	" IV.,	8.18	91.82	3.43	3.46	3.03	16.52	73.56	9.	57.5	66.	74.5	1:5.45
Rye Middlings,	Bulletin 27,	12.54	87.46	4.02	3.70	5.61	13.15	73.52	9.	57.5	66.	74.5	1:7.28

Fodder Analysis of Various Fodder Stuffs.

Broom Corn Seed Meal,	Report V.,	13.54	86.46	2.43	8.00	4.13	11.14	74.30	-	-	-	-	-
Broom Corn Seed,	" V.,	14.10	85.90	2.35	8.34	4.05	11.21	74.05	-	-	-	-	-
Broom Corn Waste,	" V.,	8.70	91.30	4.88	39.25	1.00	6.78	48.09	-	-	-	-	-
Linseed Cake,	" I.,	8.35	91.65	7.52	8.69	5.69	37.25	40.85	26.	91.	87.	91.	1:1.62
Cocoa Dust, Refuse from Cocoa Manufactories,	" I.,	7.10	92.90	6.83	5.86	25.85	15.47	45.99	-	-	-	-	-
Pea Meal, Refuse from Pea-splitting Manufactories,	" V.,	8.85	91.15	2.94	19.42	1.67	20.95	55.02	-	-	-	-	-

Fodder Analysis of Cotton-seed Meal.

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	ANALYSIS OF DRY MATTER, 100 PARTS.					PER CENT. OF DIGESTIBILITY.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Cotton-seed Meal,	Report I.,	9.13	90.87	7.61	6.28	12.83	47.01	26.24	23.	91.	74.	46.	1:1.23
" " "	" I.,	8.38	91.62	8.51	6.73	12.94	42.47	29.35	23.	91.	74.	46.	1:1.41
" " "	" I.,	7.10	92 90	9.34	7.53	13.75	42.50	26.80	23.	91.	74.	46.	1:1.44
" " "	" I.,	8.15	91.85	7.46	7.41	14.72	36.54	33.87	23.	91.	74.	46.	1:1.88
" " "	" I.,	7.09	92.91	9.15	10.53	13.65	41.64	25.03	23.	91.	74.	46.	1:1.46

Fodder Analysis of Ensilage from Various Materials.

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	Nutritive Ratio.
Corn and Cob before entering silo,	Report IV.,	10.71	89.29	2.16	5.39	5.27	12.18	75.00	-	-	-	-	-
Same, ensilaged whole,	" IV.,	25.50	74.50	1.43	8.32	8.66	10.56	71.03	-	-	-	-	-
Same, cut and ensilaged,	" IV.,	50.27	49.73	1.35	8.50	7.84	6.63	75.68	-	-	-	-	-
Rowen, dried in field,	" IV.,	19.71	80.29	8.99	29.43	4.96	14.70	41.92	-	-	-	-	-
Rowen, after being in silo eleven months,	" IV.,	18.44	81.56	8.76	27.93	6.98	12.34	43.99	-	-	-	-	-
Sweet Corn,	Bulletin 26,	-	-	5.66	24.21	5.19	10.10	54.84	-	-	-	-	-

Fodder Analysis of Grasses.

English Hay, cut June 20. Last stage of blooming,	Report III.,	10.55	89.45	4.69	29.21	2.65	9.02	54.43	58.	46.	57.	63.	1:10.6
Hay from Station,	" III.,	8.30	91.70	6.12	30.19	2.55	9.75	51.39	58.	46.	57.	63.	1: 9.5
Hay from Station, '87,	" V.,	10.78	89.22	7.11	35.55	2.63	8.75	45.96	58.	46.	57.	63.	1:10.55
Rowen,	Report IV.,	19.71	80.29	8.99	29.43	4.96	14.70	41.92	58.	46.	57.	63.	1: 5.87
Rowen, Station, '87,	" V.,	8.84	91.16	10.50	29.46	3.05	13.20	43.79	58.	46.	57.	63.	1: 6.41
Herd's Grass or Timothy, fertilized,	Bulletin 24,	65.74	34.26	5.29	33.23	1.95	8.20	51.33	58.	46.	57.	63.	1:11.52
Herd's Grass or Timothy, unfertilized, collected in bloom,	Bulletin 26,	65.00	35.00	5.37	32.50	2.07	8.83	51.23	58.	46.	57.	63.	1:11.86
Timothy, after blooming,	Report I.,	8.70	91.30	4.04	36.59	2.12	7.24	50.01	58.	46.	57.	63.	1:14.83
Timothy, after blooming,	" II.,	10.55	89.45	4.69	29.21	2.65	9.02	54.43	58.	46.	57.	63.	1:10.6
Red Top.													
Collected July 22. Fertilized,	Report V.,	8.24	91.76	4.84	33.49	1.50	6.41	53.76	58.	46.	57.	63.	1:15.07
" July 22. Unfertilized,	" V.,	8.02	91.98	4.17	31.12	1.69	8.28	54.74	58.	46.	57.	63.	1:11.54
" July 5. Fertilized,	" V.,	6.81	93.19	5.69	34.11	1.56	8.32	50.32	58.	46.	57.	63.	1:11.24
" July 5. Unfertilized,	" V.,	7.75	92.25	5.17	32.95	1.64	8.40	51.84	58.	46.	57.	63.	1:11.20

Fodder Analysis of Grasses — Continued.

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	ANALYSIS OF DRY MATTER, 100 PARTS.					PER CENT. OF DIGESTIBILITY.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Orchard Grass.													
Collected June 7, in bloom, unfertilized,	Report V.,	9.16	90.86	8.67	34.15	2.40	11.29	43.50	58.	46.	57.	63.	1: 7.77
Same, fertilized,	" V.,	9.09	90.91	7.90	34.12	2.41	8.94	46.63	58.	46.	57.	63.	1:10.18
Collected June 30, in seed, unfertilized,	" V.,	8.72	91.28	5.46	35.79	3.26	8.15	47.34	58.	46.	57.	63.	1:11.67
Same, fertilized,	" V.,	8.38	91.62	6.17	35.48	3.56	7.57	47.22	58.	46.	57.	63.	1:12.63
Barnyard Grass.													
Collected, in bloom, Aug. 14,	Report II.,	6.65	93.35	10.82	33.72	1.95	15.27	38.24	-	42.	60.	65.	1: 2.94
Meadow Fescue.													
Collected June 28, fertilized,	Report V.,	7.40	92.60	7.17	34.46	2.17	7.02	49.18	58.	46.	57.	63.	1:13.49
Collected June 28, unfertilized,	" V.,	8.03	91.97	8.18	34.61	1.78	7.27	48.16	58.	46.	57.	63.	1:12.67
Common Millet, in bloom,	Report II.,	6.15	93.85	4.67	29.80	2.04	7.69	55.80	-	42.	60.	65.	1: 8.32
Common Millet, matured,	" II.,	6.73	93.27	4.23	33.39	2.67	7.09	52.62	-	42.	60.	60.	1: 8.5
Pearl Millet, in bloom,	" II.,	6.20	93.80	4.80	35.91	1.63	7.20	50.46	-	42.	60.	65.	1: 8.

Pearl Millet, fertilized, collected Sept. 10,	Report III.,	7.80	92.20	6.68	34.31	1.47	7.88	49.66	-	42.	60.	65.	1: 7.15
Pearl Millet, unfertilized, collected Sept. 10,	" III.,	8.10	91.90	7.08	34.30	0.89	8.11	49.62	-	42.	60.	65.	1: 6.8
Hungarian Grass,	" II.,	7.45	92.55	5.73	31.96	2.22	9.45	50.64	-	42.	60.	65.	1: 6.22
Hungarian Grass, in bloom,	" III.,	74.07	25.93	7.15	24.66	1.01	9.38	57.80	-	42.	60.	65.	1: 6.86
Hay of Ripe Oats,	" I.,	8.70	91.30	6 11	36.31	2.61	6.05	48.92	-	46.	57.	100.	1:15.03
Hay of Oats, in blossom,	" I.,	6.43	93.57	6.41	34.06	2.92	6.58	50.03	-	46.	57.	100.	1:14.23
Hay of Oats, Seeds in milk,	" III.,	9.55	90.45	6.08	34.32	2.69	10.89	40.02	-	46.	57.	100.	1: 7.9
Green Oats, in blossom, collected July 5,	Bulletin 24,	78.61	21.39	7 38	33.12	2.02	7.10	50.38	-	46.	57.	100.	1:13.02
Green Oats, collected July 13,	" 24,	71.18	28.82	6.99	32.83	2.44	7.05	50.69	-	46.	57.	100.	1:13.32
Hay of Winter Rye, in full bloom, May 25,	Report I.,	8.55	91.45	6.40	32.97	2.57	10.66	47.40	-	46.	57.	100.	1: 8.28
Hay of Barley, Seeds in milk,	" III.,	10.25	89.75	4.95	29.12	2.76	10.26	52.91	-	46.	57.	100.	1: 9.59

Fodder Analyses of Leguminous Plants.

Alsyke Clover, unfertilized, collected Aug. 16,	Report V.,	8.30	91.70	13.35	21.44	3.26	17.32	44.63	-	-	-	-	-
Alsyke Clover, fertilized, collected Aug. 16,	" V.,	8.64	91.36	10.92	26.28	2.89	14.97	44.94	-	-	-	-	-
Luzerne (Alfalfa), beginning to bloom,	" III.,	16.00	84.00	10.45	25.42	2.50	16.34	45.29	40.	39.	77.	65.	1: 4.71
Sand Luzerne, in bloom,	" III.,	8.80	91.20	9.57	21.27	2.59	16.26	50.31	40.	39.	77.	65.	1: 3.5
Luzerne (Alfalfa); unfertilized, collected Aug. 16,	" V.,	8.41	91.59	7.83	27.86	2.04	12.96	49.31	40.	39.	77.	65.	1: 4.55

Fodder Analysis of Leguminous Plants—Concluded

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	Analysis of Dry Matter, 100 Parts.					Per Cent. of Digestibility.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Luzerne (Alfalfa); fertilized, collected Aug. 16,	Report V.,	8.33	91.67	7.18	28.54	1.54	11.12	51 62	40.	39.	77.	65.	1: 5.43
Vetch, collected in bloom,	" III.,	8.35	91.65	7.97	30.63	2.30	15.76	43.29	54.	60.	76.	65.	1: 4.02
Vetch, collected fully matured,	" III.,	9.45	90.55	8.50	30.05	2.69	14.42	44.34	45.	60.	71.	55.	1: 4.09
Vetch and Oats by weight; 90 per cent. Oats and 10 per cent. Vetch,	" V.,	86.11	13.89	12.37	34.20	2.74	10.59	40.10	-	50.	60.	100.	1: 6.85
Cow Pea, variety, Clay; collected Aug. 1,	" II.,	9.30	90.70	9.53	23.58	3.81	17.02	46.06	47.	59.	60.	69.	1: 4.75
Cow Pea, variety, Whippoorwill; collected Aug. 1,	" II.,	9.65	90.35	10.46	22.36	3.87	16.95	46.36	47.	59.	60.	69.	1: 4.74
Cow Pea, same as previous, mixed with Oats,	" II.,	9.75	90.25	7.87	19.06	4.49	17.17	51.41	47.	59.	60.	69.	1: 4.95
Cow pea, collected Sept. 2,	" V.,	78.81	21.19	5.97	23.02	1.81	8.58	60.62	47.	59.	60.	69.	1:11.71
Serradella, cut in bloom,	" II.,	7.20	92.80	5.87	24.37	2.37	17.85	49.54	-	60.	63.	100	1: 4.72
Serradella, fully matured,	" II,	8.70	91.30	6.46	25.14	2.91	15.26	50.23	47.	50.	69.	69.	1: 5.47
Serradella, collected when in bloom,	Bulletin 24,	84.60	15.40	11.85	26.21	2.65	17.75	41.54	-	60.	63.	100.	1: 4.07

Serradella, collected Sept. 20, matured,	Report V.,	80.58	19.42	11.53	38.76	2.09	12.17	35.45	47.	50.	60.	69.	1: 6.20
White Lupine, in bloom,	" III.,	85.35	14.65	5.03	31.18	2.41	18.71	42.67	-	-	-	-	-
Horse-bean Straw, collected Sept. 15,	" II.,	9.15	90.85	9.59	41.44	1.51	9.69	37.77	36.	55.	51.	61.	1: 8.55
									(Ratio	of Beans	to	Straw,	40:54.)
Horse-bean Straw (Beans), collected Sept. 15,	" II.,	10.28	89.72	4.27	8.11	1.11	30.03	56.48	63.	97.	90.	94.	1: 2.24
Whole Plant, Horse-bean, collected in bloom,	" III.,	84.83	15.17	5.75	23.17	2.31	16.68	47.09	-	67.	71.	60.	1: 2.71

Fodder Analyses of Roots.

Vilmorin Sugar Beet,	Report III.,	84.25	15.75	4.65	6.98	0.64	12.98	74.75	100.	100.	75.	95.	1: 8.17
" " "	" III.,	83.55	16.45	4.53	6.75	0.68	10.14	77.90	100.	100.	75.	95.	1:10.84
" " "	" III.,	80.47	19.53	3.85	6.45	0.53	16.13	72.79	100.	100.	75.	95.	1: 6.37
" " "	" III.,	85.99	14.01	4.27	5.77	0.61	15.75	73.60	100.	100.	75.	95.	1: 6.49
Lane's Improved Sugar Beet,	" III.,	83.57	16.43	3.57	5.27	0.83	17.44	72.89	100.	100.	75.	95.	1: 5.86
Sugar-beet Pulp, refuse from diffusion method,	" II.,	89.68	10.32	1.04	23.74	0.95	12.41	61.86	100.	100.	100.	100.	1: 7.1
Carrots (Danvers),	" III.,	87.48	12.52	4.92	7.55	3.94	9.63	73.96	100.	100.	100.	100.	1: 9.49
Carrots,	Bulletin 26,	90.02	9.98	11.21	10.76	1.89	8.90	67.24	100.	100.	100.	100.	1: 9.24
Southern Prize Turnip,	Report III.,	91.77	8.23	7.85	10.12	1.74	9.67	70.62	100.	100.	57.	88.7	1: 8.8
Yellow Globe Mangold,	" III.,	88.27	11.73	7.83	7.08	0.73	12.84	71.52	100.	100.	75.	95.	1: 6.26

Fodder Analyses — Concluded.

VARIETY.	Source of Analysis.	Moisture.	Dry Matter.	ANALYSIS OF DRY MATTER, 100 PARTS.					PER CENT. OF DIGESTIBILITY.				Nutritive Ratio.
				Crude Ash.	Crude Cellulose.	Crude Fat.	Crude Protein (Nitrogenous Matter).	Non-nitrogenous Extract Matter.	Crude Cellulose.	Crude Fat.	Crude Protein.	Non-nitrogenous Extract Matter.	
Potato, fertilized, not matured fully, ...	Report III., . . .	78.05	21.95	4.63	1.98	0.83	13.56	79.00	100.	100.	65.	93.	1: 6.13
R. I. Greening Apples, . . .	" III., . . .	80.32	19.68	2.13	7.05	2.81	4.57	83.44	-	-	75.	100.	1:24.3
Sweet Apples, ...	" III., . . .	75.17	24.83	2.02	6.14	1.71	3.92	86.21	-	-	-	-	-
Apple Pomace, R. I. Greening, .	" III., . . .	78.22	21.78	1.09	16.58	3.19	6.94	70.20	-	-	-	-	-
Apple Pomace of Baldwin, . .	" III., . . .	82.78	17.22	1.82	13.15	4.37	7.73	72.93	-	-	-	-	-
Apple Pomace, Ensilage, . .	" IV., . . .	85.33	14.67	4.21	22.18	7.36	8.22	58.03	-	-	-	-	-

"B."

Fertilizing Ingredients in Corn (Zea Maize; Kernels).

VARIETY.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Potassium Oxide.	Calcium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Silica.	Nitrogen.	Valuation per Ton.*
Wheeler's Prolific,	Mass. Board of Agricul. '79–80,	10.00	-	.773	.369	.015	.210	.031	.013	.018	1.99	$7 91
Southern Corn,	" " "	10.00	-	.719	.383	.014	.212	.026	.011	.005	1.99	7 86
Canada Corn,	" " "	10.00	-	.743	.309	.024	.175	.057	.013	.004	2.00	7 95
Canada Dutton,	" " "	10.00	-	.738	.421	.015	.208	-	.030	.011	1.74	7 16
Western (Yellow) Dent,	" " "	10.00	-	.679	.466	.024	.237	.049	.005	.039	1.78	7 27
Crosby Sweet Corn,	" " "	10.00	-	.742	.712	.032	.222	.021	.003	.027	1.87	7 86
Corn Meal,	Report II.,	17.04	-	.644	.419	.040	.176	-	-	-	2.23	8 71
Corn Meal,	" IV.,	10.00	-	.770	.450	.027	.197	.064	.015	.005	1.86	7 62

Fertilizing Ingredients in Corn and Cob.

VARIETY.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Potassium Oxide.	Calcium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Silica.	Nitrogen.	Valuation per Ton.*
Wheeler's Prolific,	Board of Agricul. '79–80,	10.00	1.4116	.676	.433	.017	.198	.038	Trace.	.050	1.752	$7 18
Southern Corn,	" "	10.00	1.2317	.575	.390	.015	.173	.033	.010	.035	1.696	6 79
Western (Yellow) Dent,	" "	10.00	1.4087	.575	.474	.024	.203	.054	.005	.073	1.602	6 54

* On basis of valuation for 1887, nitrogen 17 cents, phosphoric acid 6 cents, potassium oxide 4¼ cents, per pound.

Fertilizing Ingredients in Corn Cobs.

VARIETY.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Potassium Oxide.	Calcium Oxide.	Magnesium Oxide	Sodium Oxide.	Ferric Oxide.	Silica.	Nitrogen.	Valuation per Ton.
Wheeler's Prolific,	B'd of Agricul. '79-80.	10.00	1.2729	.117	.765	.028	.068	.073	Trace.	.220	.597	$2 82
Southern Corn,	" "	10.00	0.6783	.054	.406	.021	.031	.016	.008	.141	.503	2 23
Canada Corn,	" "	10.00	0.1629	.017	.102	.004	.008	.005	.011	.017	-	-
Canada Dutton Corn,	" "	10.00	1.1485	.054	.906	.057	.110	-	.020	-	-	-
Western (Yellow) Dent,	" "	10.00	0.8494	.043	.461	.019	.034	.071	.005	.216	.521	2 21
Longfellow,	Report II.,	12.00	1.3800	.075	.909	.036	.044	.031	.016	.269	-	-
Corn Cobs,	" IV.,	10.00	1.0300	.080	.680	.030	.060	.040	.010	.200	.540	2 52

Fertilizing Ingredients in Fodder Corn.

CONDITIONS.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Calcium Oxide.	Potassium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Insoluble Matter.	Nitrogen.	Valuation per Ton.
Unfertilized,	Report III.,	None.	3.49	.526	.455	.507	.544	.268	.058	1.123	1.96	$7 72
Fertilized with muriate of potash,	" III.,	"	6.26	.397	.545	1.259	.488	.157	.071	1.614	1.77	7 57
" " dissolved bone-black,	" III.,	"	4.92	.630	.780	.470	.770	.070	.090	1.990	1.99	7 93

Fertilized with sulphate ammonia.	Report III.,	None.	5.080	.600	.600	.520	.810	.060	.050	1.190	2.01	$7 99
Fodder Corn, kernels glazed,	" V.,	72.27	-	.40	.54	1.09	.16	.15	-	1.35	1.25	1 69
" " green,	" V.,	70.27	-	.13	.18	.36	.05	.05	-	.45	.41	1 86

Fertilizing Ingredients in Ensilage (from Fodder Corn).

CONDITIONS AND STAGE OF GROWTH.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Calcium Oxide.	Potassium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Insoluble Matter.	Nitrogen.	Valuation per Ton.
Ensilage from Corn, kernels glazed,	Bulletin 26,	71.60	-	.14	.10	.33	.09	.05	.02	.04	.36	$1 68

Fertilizing Ingredients in Gluten Meal.

VARIETY.	Source of Analysis.	Sulphuric Acid.	Moisture.	Ash.	Phosphoric Acid.	Calcium Oxide.	Potassium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Nitrogen.	Valuation per Ton.
Gluten Meal,	Report I.,	.0215	8.43	.586	.4512	.0582	.0564	.0346	-	-	5.5997	$19 63
" "	" IV.,	.021	9.00	.700	.45	.058	.06	.034	-	-	5.44	19 05
" "	" V.,	-	8.83	.666	.295	.036	.034	.026	.018	.048	4.62	16 09

Fertilizing Ingredients in Hominy Feed

VARIETY.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Calcium Oxide.	Potassium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Insoluble Matter.	Nitrogen.	Valuation per Ton.
Hominy Feed,	Report I.,	8.93	1.89	.98	.18	.49	.28	-	-	-	1.63	$6 14

Fertilizing Ingredients in Wheat (Wheat Meal).

VARIETY.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Calcium Oxide.	Potassium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Insoluble Matter.	Nitrogen.	Valuation per Ton.
Wheat Meal,	Report IV.,	9.83	1.22	.57	.17	.54	.05	1.06	-	-	2.21	$8 65

Fertilizing Ingredients in Wheat Bran.

VARIETY.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Calcium Oxide.	Potassium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Insoluble Matter.	Nitrogen.	Valuation per Ton.
Wheat Bran,	Report III.,	-	-	2.46	.26	1.95	.89	.37	-	.14	2.86	$14 91
" "	" IV.,	11.45	-	3.05	-	1.49	.90	.09	-	.11	2.82	14 52
" "	" IV.,	9.40	-	3.12	-	1.42	.91	.16	-	.15	3.03	15 42
" "	" V.,	12.20	6.44	2.84	.14	1.62	.91	.09	.02	.13	2.78	14 24

Fertilizing Ingredients in Wheat Middlings.

VARIETY.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Calcium Oxide.	Potassium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Insoluble Matter.	Nitrogen.	Valuation per Ton.
Wheat Middlings,	Report IV.,	9.18	2.30	.95	.20	.63	.21	.11	-	-	2.63	$10 63

Fertilizing Ingredients in Rye Middlings.

Rye Middlings,	Report V.,	12.54	3.52	1.26	.09	.81	.32	.03	.02	.17	1.84	$8 46

Fertilizing Ingredients of Various Fodder Stuffs.

Linseed Cake,	Report I.,	8.35	6.89	1.86	0.64	1.43	0.77	-	-	-	5.462	$22 01
Cocoa Dust,	" I.,	7.10	6.35	1.34	0.63	2.11	Traces.	-	-	-	2.299	11 22
Pea Meal,	" V.,	8.85	-	0.82	0.302	0.993	0.302	0.618	0.027	0.122	3.08	11 31
Broom Corn Waste, stalks,	" V.,	10.37	4.70	0.460	0.242	1.858	0.170	-	-	1.000	0.87	5 09

Fertilizing Ingredients of Cotton-seed Meal.

VARIETY.	Source of Analysis.	Moisture.	Organic and Volatile Matter.	Ash.	Phosphoric Acid.	Calcium Oxide.	Potassium Oxide.	Magnesium Oxide.	Sodium Oxide.	Insoluble Matter.	Nitrogen.	Valuation per Ton.
Cotton-seed Meal, coarse portion,	Report I.,	7.09	93.465	6.535	2.341	2.63	1.797	2.23	-	1.784	5.90	$24 40
" " " " "	" III.,	6.80	94.230	5.77	1.45	0.39	0.89	0.99	-	0.600	6.10	24 46
" " " (damaged),	" IV.,	9.90	-	-	1.26	0.22	1.21	0.56	-	0.200	3.73	14 97
" " "	" V.,	7.71	92.71	7.29	2.01	0.27	2.09	1.13	-	0.06	4.02	17 86

Fertilizing Ingredients in Various Grasses and Leguminous Plants.

VARIETY.	Source of Analysis.	Moisture.	Ash.	Phosphoric Acid.	Calcium Oxide.	Potassium Oxide.	Magnesium Oxide.	Sodium Oxide.	Ferric Oxide.	Insoluble Matter.	Nitrogen.	Valuation per Ton.
Hay from Station, 1887,	Report V.,	10.78	6.34	.464	.521	2.085	.284	.064	.032	1.37	1.25	$6 58
Rowen from Station, 1887,	" V.,	8.84	9.57	.364	.853	2.860	.197	.122	.057	2.18	1.93	9 50
Herd's Grass, fertilized, collected in bloom,	Bulletin 24,	7.80	4.88	.36	.44	1.63	.12	.08	-	1.01	1.21	5 93
Same, unfertilized,	" 26,	7.24	4.98	.56	.99	1.44	.09	.37	-	1.33	1.31	6 35
Redtop, fertilized, collected July 22,	Report V.,	8.24	4.44	3.52	.451	1.160	.149	.829	.038	1.710	.94	4 61
" unfertilized, collected July 22,	" V.,	8.02	3 84	3.26	.575	.659	.111	.317	.060	1.836	1.21	5 07
" collected July 5, fertilized,	" V.,	6.81	5.30	.377	.614	1.206	.125	.180	.024	1.716	1 19	5 53
" collected July 5, unfertilized,	" V.,	7.75	4.77	.391	.645	1.054	.149	.425	.033	1.683	1.24	5 59
Orchard Grass, in bloom, unfertilized,	" V.,	9.16	7.88	.399	.457	2.114	.236	.233	.021	1.976	1.64	7 86
" " in bloom, fertilized,	" V.,	9.09	7.18	.483	.401	2.339	.255	.211	.014	1.867	1.30	6 99
" " in seed, unfertilized,	" V.,	8.72	4.98	.444	.470	1.303	.505	.211	.034	2.116	1.19	5 69
" " in seed, fertilized,	" V.,	8.38	5.65	.329	.496	1.758	.192	.246	.063	2.28	1.11	5 66
Meadow Fescue, collected June 28,	" V.,	7.40	6.64	.230	.540	1.815	.140	.080	.027	1.403	1.04	5 36
" " collected June 28,	" V.,	8.03	7.52	.229	.466	2.183	.136	.139	.025	1.961	1.07	5 87
Vetch and Oats,	" V.,	86.11	1.72	0.094	0.087	0.789	.030	0.031	.012	0.331	2.25	1 58
Cow Pea, collected Sept. 2,	" V	78.81	-	0.098	0.300	0.306	.099	0.063	.016	0.077	0.29	1 51

Serradella, in bloom (Hay),	Bulletin 24, Green,	81.60	1.82	0.155	0.453	0.448	.067	0.095	-	0.036	0.437	2 06
	Bulletin 24, Hay,	10.54	10.60	0.90	2.63	0.260	.39	0.55	-	0.21	2.54	11 93
Serradella, collected Sept. 20 (Green),	Report V.,	80.58	-	0.124	0.472	0.398	.067	0.098	.021	0 157	0.385	1 80
White Lupine, in bloom,	" III.,	85.35	0.74	0.35	3.07	1.73	.73	0.68	.17	0.90	0.44	3 39
Horse Bean, whole plant, collected in bloom,	" III.,	74.71	-	0.33	1.37	1.37	.62	0.09	.20	2.04	0.675	3 87
Alsyke Clover, unfertilized, collected Aug. 16,	" V.,	8.30	12.24	0.584	1.836	1.605	.610	0.570	.246	3.241	2.54	10 70
Alsyke Clover, fertilized, collected Aug. 16,	" V.,	8.64	9.98	1.016	1.644	2.740	.735	0.236	.417	3.226	2.19	11 00
Luzerne (Alfalfa), unfertilized, collected Aug. 26,	" V.,	8.41	7.17	0.458	2.558	0.872	.582	1.354	.085	0.687	1.90	7 65
Luzerne (Alfalfa), fertilized, collected Aug. 26,	" V.,	8.33	6.58	0.444	1.486	2.043	.249	0.668	.105	0.716	1.63	7 81

Fertilizing Ingredients in Roots and Fruits.

Vilmorin Sugar Beet,	Report IV.,	85.99	.62	.03	.06	.18	.04	.18	.01	.10	.29	$1 18
Carrots,	Bulletin 26,	90.02	-	.10	.07	.54	.02	.11	.01	.01	.14	1 06
R. I. Greening Apples,	Report IV.,	84.65	.327	.008	.023	.122	.025	.013	.001	.002	.113	0 49
Sweet Apples,	" IV.,	75.17	.501	.011	.044	.269	.029	.042	.005	.004	.156	0 60
Apple Pomace, Baldwin,	" IV.,	82.78	.306	.018	.032	.150	.028	.020	.008	.008	.213	0 87
" " R. I. Greening,	" IV.,	78.22	.237	.017	.042	.119	.027	.032	.008	.009	.241	0 92

Compilation of Analyses made at Amherst, Mass., of Agricultural Chemicals and Refuse Materials used for Fertilizing Purposes.*

As the basis of Valuation changes from year to year, no Valuation is stated.

1868 to 1888.

Muriate of Potash (43 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	4.05	0.05	2.05	
Potassium oxide, . .	58.98	45.94	52.46	
Sodium oxide, . . .	11.26	2.13	6.69	
Magnesium oxide, . .	0.90	0.30	0.55	
Chlorine, ...	54.00	43.20	48.60	
Insoluble matter, . .	2.00	0.15	0.75	

Sulphate of Potash (14 Analyses).

	Highest.	Lowest.	Average.	Remarks.
Moisture at 100° C., .	5.00	0.19	1.00	
Potassium oxide, . .	51.28	20.44	35.86	
Sodium oxide, . . .	8.59	0.34	4.46	
Magnesium oxide, . .	2.63	0.24	1.50	
Sulphuric acid, . .	59.30	10.86	45.00	
Insoluble matter, . .	31.55	0.14	0.75	

* This compilation does not include the analyses made of licensed fertilizers. They are to be found in the Reports of the State Inspector of Fertilizers from 1873 to 1888, contained in the Reports of the Secretary of the Massachusetts State Board of Agriculture for those years. C. A. G.

Sulphate of Potash and Magnesia (12 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	11.58	1.95	5.50	
Potassium oxide, . .	27.77	11.70	22.50	
Sodium oxide, . . .	18.97	2.09	6.50	
Magnesium oxide, . .	13.66	10.86	12.25	
Calcium oxide, . .	3.38	0.82	2.50	
Sulphuric acid, . .	47.90	31.91	43.00	
Chlorine, ...	7.80	0.14	2.50	
Insoluble matter, . .	2.36	0.26	1.41	

German Potash Salts (11 Analyses).

	Highest.	Lowest.	Average.	Remarks.
Moisture at 100° C., . .	25.83	.45	13.14	
Potassium oxide, . .	50.40	7.56	21.63	
Sodium oxide, . . .	26.23	1.30	13.76	
Calcium oxide, . .	1.26	0.06	.85	
Magnesium oxide, . .	9.83	Trace.	9.25	
Sulphuric acid, . .	21.53	.17	10.85	
Chlorine, ...	49.11	22.27	35.63	
Insoluble matter, . .	3.76	.90	2.08	

Kainite (3 Analyses).

	Highest.	Lowest.	Average.	Remarks.
Moisture at 100° C., . .	13.57	2.15	9.26	
Potassium oxide, . .	16.48	12.51	14.04	
Sodium oxide, . . .	–	–	*21.38	* The only estimation made.
Calcium oxide, . . .	1.41	.82	1.12	
Magnesium oxide, . .	11.30	6.65	8.97	
Sulphuric acid, . .	23.71	17.53	21.05	
Chlorine, ...	–	–	*32.38	* The only estimation made.
Insoluble matter, . .	1.56	.17	.86	

Carnallite (1 Analysis).

	Per cent.
Potassium oxide,	13.68
Sodium oxide,	7.66
Magnesium oxide,	13.19
Sulphuric acid,	.56
Chlorine,	41.56

Krugite (1 Analysis).

	Per cent.
Moisture at 100° C.,	4.82
Calcium oxide,	12.45
Magnesium oxide,	8.79
Potassium oxide,	8.42
Sodium oxide,	5.57
Sulphuric acid,	31.94
Chlorine,	6.63
Insoluble matter,	14.96

Sulphate of Magnesia (9 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C.,	31.90	7.50	22.50	
Calcium oxide,	3.89	1.15	2.52	
Magnesium oxide,	*25.29	13.50	18.25	* Kieserite, natural and calcined.
Sulphuric acid,	*52.23	31.91	37.00	
Insoluble matter,	11.06	.40	5.73	

Nova Scotia Plaster (9 Analyses).

Moisture at 100° C.,	15.79	.52	6.50	
Calcium oxide,	37.59	30.60	33.50	
Magnesium oxide,	1.40	.36	.75	
Sulphuric acid,	54.10	33.56	44.00	
Carbonic acid,	–	–	–	
Insoluble matter,	7.95	.45	2.00	

Onondaga Plaster (7 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C.,	22.25	8.95	13.27	
Calcium oxide,	31.46	29.15	30.00	Contains 1 sample of Cayuga Plaster.
Magnesium oxide,	6.06	3.89	4.66	
Sulphuric acid,	36.00	31.58	33.00	
Carbonic acid,	8.80	7.20	8.20	
Insoluble matter,	12.00	8.28	9.83	

Gypseous Shale (1 Analysis).

	Per cent.
Calcium sulphate,	38.55
Calcium carbonate,	11.05
Magnesium carbonate,	2.65
Insoluble matter,	37.15

Gas-house Lime (4 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C.,	33.55	11.01	22.28	
Calcium oxide,	45.80	40.00	42.66	
Magnesium oxide,	8.30	8.30	8.30	
Sulphuric acid,	20.73	20.73	20.73	Sulphuric acid includes all forms of sulphur present.
Insoluble matter,	15.00	0.40	6.05	

Lime Waste.

	Per Cent.			Remarks.
	Liquid from Lime-vats (Evaporated).	Mass from bottom of Lime-vats.	Lime Waste from Sugar Factory.	
Moisture at 100° C., . .	11.50	17.54	36.30	
Ash, ...	41.00	65.24	–	
Calcium oxide, . . .	23.40	47.80	27.51	
Magnesium oxide, . .	–	–	Trace.	
Potassium oxide, . .	–	-	.22	
Phosphoric acid, . .	.77	.81	2.25	
Nitrogen, ...	6.87	1.06	–	
Insoluble matter, . .	.10	5.50	.32	

Lime-kiln Ashes (7 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	30.70	.20	15.45	
Calcium oxide, . . .	50.16	36.00	43.08	
Magnesium oxide, . .	4.45	1.26	2.60	
Potassium oxide, . .	1.70	.02	.86	
Phosphoric acid, . .	3.16	Trace.	1.18	
Carbonic acid, . . .	39.36	9.66	16.66	
Insoluble matter, . .	53.77	3.30	14.54	

Marls (4 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C.,	55.80	0.60	18.18	
Calcium oxide,	50.61	20.72	40.07	
Magnesium oxide,	1.03	0.22	0.64	Massachusetts.
Iron and alumina,	1.00	0.36	0.69	
Phosphoric acid,	2.72	0.07	1.05	
Carbonic acid,	40.38	16.63	28.51	
Insoluble matter,	3.44	3.44	3.44	

Virginia Marl.

	Per Cent.		Remarks.
	2 feet below Surface.	4 feet below Surface.	
Moisture at 100° C.,	16.70	15.26	
Calcium oxide,	9.21	5.29	No. 1 contained a large amount of shells.
Magnesium oxide,	0.25	0.16	
Potassium oxide,	0.61	0.37	
Phosphoric acid,	0.09	0.08	No. 2 was largely sand.
Sulphuric acid,	1.00	0.31	
Carbonic acid,	4.23	1.76	
Insoluble matter,	59.59	68.86	

Wood Ashes. (Canada.) (71 Analyses.)

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	28.57	0.70	12.00	
Calcium oxide,. . .	50.89	18.00	34.44	
Magnesium oxide, . .	7.47	2.28	3.50	
Iron oxide, . . .	–	–	0.83	
Potassium oxide, . .	8.51	2.49	5.50	
Phosphoric acid, . .	3.34	0.29	1.81	
Insoluble matter, . .	24.10	2.10	12.50	

Cotton-seed Hull Ashes (16 Analyses).

Moisture at 100° C., . .	26.81	2.30	7.33	
Calcium oxide,. . .	39.75	3.35	10.00	
Magnesium oxide, . .	17.15	2.02	9.50	
Iron oxide, . . .	–	–	1.50	
Potassium oxide, . .	42.12	5.00	20.95	
Phosphoric acid, . .	13.67	0.76	7 52	
Insoluble matter, . .	32.48	5.38	11.79	

Ashes of Spent Tan-bark (3 Analyses).

Moisture at 100° C., . .	7.45	4.87	6.31	
Calcium oxide,. . .	37.26	31.35	33.46	
Magnesium oxide, . .	5.10	2.57	3.55	
Potassium oxide, . .	2.87	1.14	2.04	
Phosphoric acid, . .	2.77	0.13	1.61	
Insoluble matter, . .	24.33	24.33	24.33	

Ashes of Waste Products.

	Per Cent.			Remarks.
	Chestnut R. R. Ties.	Logwood.	Mill.	
Moisture at 100° C., . .	6.15	1.50	0.53	
Calcium oxide, . . .	4.71	3.90	34.93	
Magnesium oxide, . .	1.80	Trace.	1.35	
Potassium oxide, . .	0.19	0.08	1.60	
Phosphoric acid, . .	1.54	2.30	0.46	
Insoluble matter, . .	77.83	9.70	36.36	

Hard Pine Wood Ashes.

	Per cent.
Moisture at 100° C.,	0.75
Calcium oxide,	24.95
Magnesium oxide,	8.39
Potassium oxide,	10.16
Phosphoric acid,	2 24
Insoluble matter,	29.90

Nitrate of Potash (1 Analysis).

	Per cent.
Moisture at 100° C.,	1.75
Potassium oxide,	45.62
Nitrogen,	14.58
Insoluble matter,	Trace.

Nitrate of Soda (12 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	2.00	0.85	1.25	
Sodium oxide, . .	70.97	35.00	35.50	
Calcium oxide, . . .	0.41	Trace.	Trace.	
Magnesium oxide, . .	0.04	Trace.	Trace.	
Nitrogen, ...	16.26	14.44	15.75	
Sulphuric acid, . .	0.20	Trace.	Trace.	
Chlorine, ...	2 52	0.20	0.50	
Insoluble matter, . .	0.90	0.24	0.50	

Saltpetre Waste from Gunpowder Works (6 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	4.24	0.50	2.75	
Potassium oxide, . .	30.94	4.65	18.00	
Sodium oxide, . . .	45.92	22.08	34.00	
Calcium oxide, . .	*0.83	*0.71	0.75	* Only estimations.
Magnesium oxide, . .	*0.28	*0.09	0.19	
Nitrogen, ...	3.30	0.80	2.43	
Sulphuric acid, . . .	*4.85	*0.84	2.85	* Only estimations.
Chlorine, ...	56.00	37.66	48.30	
Insoluble matter, . .	†	–	–	† Not reported.

Nitre Salt-cake (2 Analyses).

	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	6.71	5.34	6.03	
Potassium oxide, . .	0.87	Trace.	0.87	
Sodium oxide, . . .	32.72	26.40	29.56	
Nitrogen, ...	2.29	–	2.29	
Sulphuric acid, . .	48.85	46.69	47.77	
Insoluble matter, . .	4.12	3.73	3.92	

Sulphate of Ammonia (21 Analyses).

	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	2.40	0.13	1.00	
Nitrogen, ...	22.23	19.70	20.50	
Sulphuric acid, . .	70.70	57.68	60.00	
Insoluble matter, . .	–	–	Trace.	

Ammonite.

	Per cent.
Moisture at 100° C., ...	5.88
Phosphoric acid, ...	3.43
Nitrogen, ...	11.33
Insoluble matter, ...	1.38

Dried Blood (11 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C.,	21.52	7.65	12.50	
Ash,	10.04	3.56	6.37	
Phosphoric acid,	6.23	1.53	1.91	
Nitrogen,	13.55	7.80	10.52	

Refuse Materials (Animal).

	Per Cent.			Remarks.
	Oleomargarine Refuse.	Felt Refuse.	Sponge Refuse.	
Moisture at 100° C.,	8.54	39.24	7.25	
Ash,	14.42	33.53	–	
Calcium oxide,	–	–	3.94	
Magnesium oxide,	–	–	1.27	
Phosphoric acid,	0.88	–	3.19	
Nitrogen,	12.12	5.26	2.43	
Insoluble matter,	0.96	8.44	39.05	

Horn and Hoof Waste (3 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C.,	10.27	10.08	10.17	
Ash,	14.62	1.05	7.63	
Phosphoric acid,	2.30	2.30	2.30	
Nitrogen,	16.10	11.84	14.47	
Insoluble matter,	0.24	0.24	0.24	

Wool Waste (3 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	10.12	8.43	9.27	*Saturated with oil.
Nitrogen, ...	*6.25	5.00	5.62	

Raw Wool and Wool Washings.

	Per Cent.			Remarks.
	Raw Wool.	Water Washings.	Acid Washings.	
Moisture at 100° C., . .	6.95	–	–	
Ash, ...	7.54	–	–	
Fat, ...	3.92	–	–	
Calcium oxide, . . .	–	0 28	0.61	
Magnesium oxide, . .	–	None.	0.20	
Potassium oxide, . .	–	3.92	4.20	
Sodium oxide, . . .	–	0.49	0.40	
Nitrogen, ...	12.88	–	–	
Insoluble matter, . .	3.63	–	–	

Meat Mass (6 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., .	18.75	8.16	12.09	
Ash, ...	14.66	2.90	13.60	
Total phosphoric acid, .	3.58	0.56	2.07	
Nitrogen, ...	11.50	9.69	10.44	
Insoluble matter, . .	0.77	0.40	0.58	

Refuse from Rendering Establishments.

	Per Cent.				
	Bone Soup.	Dried Soup from Meat and Bone.	Dried Soup from Rendering Cattle Feet.	Soup from Horse Rendering Factory.	Soap-Grease Refuse.
Moisture at 100° C., .	82.92	14.80	10.80	92.14	38.79
Ash, ...	7.07	8.40	7.50	–	43.13
Phosphoric acid, . .	1.26	0.53	0.46	0.14	11.04
Nitrogen, ...	1.14	9.97	14.47	1.12	2.21
Insoluble matter, . .	–	0.64	0.26	–	1.20

Bones (95 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	11.90	3.05	7.47	
Ash, ...	74.90	37.25	56.07	
Total phosphoric acid, .	29.83	12.06	22.50	
Soluble phosphoric acid, .	0.76	0.10	0.43	
Reverted phosphoric acid,	16.78	2.24	6.50	
Insoluble phosphoric acid,	23.37	8.13	15.70	
Nitrogen, ...	6.75	1.50	4.12	
Insoluble matter, . .	6.00	0.04	2.00	

Tankage (12 Analyses).

Moisture at 100 C., . .	28.09	5.46	14.61	
Ash, ...	37.06	19.40	23.23	
Total phosphoric acid, .	14.60	8.00	10.67	
Soluble phosphoric acid, .	0.27	0.27	0.27	
Reverted phosphoric acid,	3.25	3.25	3.25	
Insoluble phosphoric acid,	8.79	8.79	8.79	
Nitrogen, ...	8.07	5.82	7.08	
Insoluble matter, . .	2.00	0.56	1.23	

Fish containing 20 per cent. or less of Moisture (42 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	19.88	6.61	13.24	
Ash, ...	72.23	15.99	20.00	
Total phosphoric acid, .	16.64	4.33	8.25	
Soluble phosphoric acid, .	1.70	.37	.55	
Reverted phosphoric acid,	4.57	1.78	2.17	
Insoluble phosphoric acid,	7.16	2.11	3.80	
Potassium oxide, .	.45	.45	.45	
Nitrogen, ...	10.24	3.87	7.05	
Insoluble matter, . .	4.99	.74	2.50	

Fish containing between 20 per cent. and 40 per cent. of Moisture (8 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	38.11	20.58	29.34	
Ash, ...	36.50	16.87	24.14	
Total phosphoric acid, .	8.90	5.60	7.25	
Soluble phosphoric acid, .	*.82	.82	.82	* Fish Pomace.
Reverted phosphoric acid,	*2.87	2.87	2.87	* Fish Pomace.
Insoluble phosphoric acid,	*3.99	3.99	3.99	* Fish Pomace.
Potassium oxide, . .	†0.85	0.85	0.85	† Dry ground fish.
Nitrogen, ...	7.41	4.22	5.81	
Insoluble matter, .	2.89	0.82	1.85	

Fish containing 40 per cent. and more of Moisture (10 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100 C.. . .	50.58	40.35	45.46	
Ash, ...	20.78	1.92*	12.50	* Fish-liver refuse.
Total phosphoric acid, .	8.56	1.02*	5.08	
Soluble phosphoric acid, ,	1.51	0.83	1.17	
Reverted phosphoric acid,	2.02	0.64	1.33	
Insoluble phosphoric acid,	3.62	1.88	2.75	
Potassium oxide, . .	–	–	-	
Nitrogen, ...	7.60	2.43	4.97	
Insoluble matter, . .	2.44	0.16	1.35	

Whale Flesh.

	Per Cent.			Remarks.
	Raw.	Dry (with Fat).	Dry (without Fat).	
Moisture at 100° C., . .	44.50	–	–	
Ash, ...	1.04	1.86	3.20	
Fat, ...	22.81	40.70	–	
Flesh, ...	32.10	57.44	96.80	
Nitrogen, ...	4.86	8.68	14.60	

Lobster Shells.

	Per cent.
Moisture at 100° C., ...	7.27
Calcium oxide, ...	22.24
Magnesium oxide, ...	1.30
Phosphoric acid, ...	3.52
Nitrogen, ...	4.50
Insoluble matter, ...	0.27

Peruvian Guano (26 Analyses).

	Per Cent.			Remarks
	Highest.	Lowest.	Average.	
Moisture at 100° C., .	22.61	7.02	14.81	
Ash, .	61.65	13.58	37.61	
Total phosphoric acid,	23.10	3.43	13.26	
Soluble phosphoric acid, .	8.80	0.35	4.57	
Reverted phosphoric acid,	6.20	1.38	3.79	
Insoluble phosphoric acid,	16.50	4.67	10.58	
Potassium oxide,	4.08	1.14	2.61	
Nitrogen, .	11.26	4.44	7.85	
Insoluble matter,	11.91	1.30	6.60	

Bat Guano (9 Analyses).

	Highest.	Lowest.	Average.	Remarks
Moisture at 100° C., .	72.38	7.80	40.09	
Ash, .	72.14	4.34	38.24	One sample contained 1.31 per cent. potassium oxide.
Phosphoric acid,	6.53	1.00	3.76	
Nitrogen as nitrates,	1.80	0.24	1.02	
Nitrogen as ammoniates,	3.42	1.49	2.45	
Nitrogen in organic matter,	5.66	0.34	3.00	
Insoluble matter,	54.15	0.20	2.00	

Cuba Guano (5 Analyses).

	Highest.	Lowest.	Average.	Remarks
Moisture at 100° C., .	36.85	12.10	24.27	
Potassium oxide,	1.20	0.14	0.67	
Phosphoric acid,	24.35	11.54	17.94	
Nitrogen as nitrates,	1.00	0.24	0.62	
Nitrogen as ammoniates, .	0.26	0.14	0.20	
Nitrogen in organic matter,	1.48	0 23	0.85	
Insoluble matter,	3.40	2.95	3.17	

Caribbean Guano (Orchilla) (10 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., .	12.50	2.12	7.31	
Calcium oxide, . .	45.00	34.91	39.95	
Magnesium oxide, . .	4.13	2.46	3.29	
Phosphoric acid, . .	35.43	18.11	26.77	
Sulphuric acid, . .	2.36	1.80	2.08	
Insoluble matter, . .	2.40	0.17	1.27	

South American Bone Ash.

	Per cent.
Moisture at 100° C., ...	7.00
Calcium oxide, ...	44.89
Phosphoric acid, ...	35.89
Insoluble matter, ...	4.50

South Carolina Rock Phosphate (4 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	1.90	0.10	1.50	
Calcium oxide, . . .	–	–	*41.87	* Only estimate.
Magnesium oxide, . .	–	–	*3.03	
Iron and alumina oxide, .	–	–	*4.26	
Total phosphoric acid, .	30.51	25.81	28.03	
Soluble phosphoric acid, .	–	–	*0.27	* Only estimate.
Reverted phosphoric acid,	0.47	0.19	0.33	
Insoluble phosphoric acid,	30.31	25.07	27.69	
Insoluble matter, . .	13.74	9.18	11.61	

Navassa Phosphate (2 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C.,	–	–	*5.60	* Only one test.
Calcium oxide,	37.67	37.22	37.44	
Iron oxide,	11.79	8.75	10.27	
Alumina oxide,	–	–	*4.24	* Only one test.
Phosphoric acid,	34.45	34.09	34.27	
Insoluble matter,	–	–	*2.70	* Only one test.

Brockville Phosphate (1 Analysis).

	Per cent.
Moisture at 100° C.,	2.50
Phosphoric acid,	35.21
Insoluble matter,	6.46

Bone-black (5 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C.,	10.65	1.55	4.60	
Phosphoric acid,	30.54	23.47	28.28	
Insoluble matter,	6.60	1.53	3.64	

Phosphatic Slags.

	Per Cent.		Remarks.
	I.	II.	
Moisture at 100° C.,	0.10	0.37	
Calcium oxide,	41.87	49.82	
Magnesium oxide,	3.03	–	
Iron and alumina oxides,	4.26	–	I. German phosphatic slag.
Total phosphoric acid,	30.51	18.91	
Soluble phosphoric acid,	–	–	II. English slag.
Reverted phosphoric acid,	0.19	5.93	
Insoluble phosphoric acid,	30.32	12.98	
Insoluble matter,	13.74	5.06	

Castor Bean Pomace (3 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	10.18	9.25	9.98	
Calcium oxide, . .	0.96	0.77	0.87	
Magnesium oxide, . .	0.37	0.20	0.29	
Potassium oxide, . .	1.70	0.64	1.12	
Phosphoric acid, . .	2.22	2.03	2.16	
Nitrogen, ...	5.69	5.33	5.56	
Insoluble matter, . .	2.38	1.12	1.75	

Cotton Refuse.

	Per Cent.			Remarks.
	Cotton Dust.	Cotton Waste (Dry).	Cotton Waste (Wet).	
Moisture at 100° C., . .	34.46	5.53	34.69	
Ash, ...	50.93	–	–	
Calcium oxide,. . .	0.90	1.45	2.45	
Magnesium oxide, . .	0.90	0.87	1.13	
Potassium oxide, . .	0.19	0.89	0.80	
Phosphoric acid, . .	0.21	0.84	1.54	
Nitrogen, ...	0.50	1.32	1.30	
Insoluble matter, . .	47.46	49.68	41.33	

Cotton-seed Meal (5 Analyses).

	Per Cent.		Remarks.
	I.	II.	
Moisture at 100° C., ...	6.80	9.90	
Ash,.	5.77	–	
Calcium oxide, ...	0.39	0.22	I. Average of four Analyses.
Magnesium oxide, ...	0.99	0.56	
Potassium oxide, ...	0.89	1.21	II. Damaged.
Phosphoric acid, ...	1.45	1.26	
Nitrogen, ...	6.10	3.73	
Insoluble matter, ...	0.60	0.20	

Rotten Brewer's Grain.

	Per cent.
Moisture at 100° C., ...	78.77
Calcium oxide, ...	.26
Magnesium oxide, ...	.15
Potassium oxide, ...	.04
Phosphoric acid, ...	.43
Nitrogen, ...	.72
Insoluble matter, ...	.59

Tobacco Stems (5 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., .	12.18	8.95	10.61	
Ash, ...	15.00	13.30	14.07	
Calcium oxide, . .	4.76	3.39	3.89	
Magnesium oxide, . .	1.40	1.11	1.23	
Potassium oxide, . .	8.82	3.34	6.44	
Sodium oxide, . . .	0.68	0.16	0.34	
Phosphoric acid, . .	0.87	0.44	0.60	
Nitrogen, . . .	2.69	0.90	2.29	
Insoluble matter, . .	1.35	0.29	0.82	

Refuse Materials (Vegetable).

	Per Cent.			Remarks.
	Glucose Refuse.	Hop Refuse.	Sumac Waste.	
Moisture at 100 C., . .	8.10	80.98	63.06	
Ash, ...	–	–	6.80	*Potassium oxide.*
Calcium oxide, . . .	0.18	0.27	1.14	I. .15 per cent.
Magnesium oxide, . .	0.02	0.10	3.25	II. .11 per cent
Phosphoric acid, . .	0.29	0.20	–	III. .17 per cent.
Nitrogen, ...	2.62	0.98	1.19	
Insoluble matter, . .	0.07	0.63	2.25	

Sea-weeds.

	Per Cent.					Remarks.
	Eel-Grass.		Rockweed.		Wet Kelp.	
	I.	II.	Green.	Dry.		
Moisture at 100° C., .	45.61	25.17	68.50	10.68	88.04	
Ash, ...	20.39	10.81	23.70	55.75	2.26	
Calcium oxide, . .	1.56	2.70	–	7.66	–	
Magnesium oxide, .	0.09	0.12	–	0.21	–	
Potassium oxide, . .	1.61	0.21	–	4.89	–	
Sodium oxide, . .	2.51	0.74	–	7.90	–	
Phosphoric acid, . .	0.41	0.22	–	2.75	–	
Nitrogen, . . .	0.70	0.96	0.62	1.45	0.26	
Insoluble matter, . .	0.46	1.66	–	10.40	–	

Sea-weed Ashes.

	Per cent
Moisture at 100° C.,	1.47
Calcium oxide,	6.06
Magnesium oxide,	4.37
Potassium oxide,	.92
Sodium oxide,	8.76
Phosphoric acid,	.30
Sulphuric acid,	2.98
Sulphur,	.14
Chlorine,	6.60
Magnesium chloride,	.14
Insoluble matter,	63.65

Rockweed.

[I. Collected in May. II. Collected in December .

	Per Cent.	
	I.	II.
Fresh wet rockweed lost, in air, of water,	78.700	65.920
Fresh wet rockweed lost, at 100° C., of water,	90.400	76.920
Air-dried rockweed contained, of vegetable matter,	88.220	89.000
Air-dried rockweed contained, of water,	11.780	11.000
The filled pods left, at 100° C., of solid organic matter,	7.360	-
The fresh stems left, at 100° C., of solid organic matter,	30.650	-
The slime of the pods, dried at 100° C., contained, of nitrogen,	2.920	-
Rockweed, entire plant with filled pods, dried at 100° C., contained, of nitrogen,	2.286	1.721
Rockweed, air-dried, contained, of nitrogen,	2.017	1.432
" fresh (wet), contained, of nitrogen,	.487	.397
" dried at 100° C., contained, ashes,	28.930	24.890
" air-dried, contained, ashes,	6.220	22.150
" fresh (wet), contained, ashes,	3.770	5.825
The slime of the pods contained, ashes,	49.356	-

One hundred parts of the ash contained (I.) : —

	Per cent.
Potassium oxide,	4.842
Sodium oxide,	12.050
Calcium oxide,	2.691
Magnesium oxide,	2.753
Ferric oxide,	.338
Sulphuric acid,	7.986
Phosphoric acid,	6.240

Mud.

	Per Cent.						Remarks.
	Mussel Mud.	Mussel Mud.	Salt Mud.	Salt Mud.	Black Mud.	Fresh-Water Mud.	
Moisture at 100° C.,	60.01	2.24	46.36	60.37	56.55	40.37	
Ash,	27.29	72.02	49.28	33.09	39.60	–	
Calcium oxide,	0.93	23.39	0.90	0.91	0.91	1.27	
Magnesium oxide,	0.14	–	0.31	0.43	0.66	0.29	
Potassium oxide,	6.17	–	0.33	0.32	0.38	0.22	
Sodium oxide,	0.70	–	0.94	0.94	0.86	–	
Ferric oxide,	3.48	8.26	4.55	3.70	4.26	1.80	
Phosphoric acid,	0.10	0.35	Trace.	Trace.	Trace.	0.26	
Nitrogen,	0.21	0.72	0.39	0.40	1.64	1.37	
Insoluble matter,	–	37.60	43.55	26.20	31.84	18.26	

Soil from a Diked Marsh.

	Per cent.
Moisture at 100° C.,	33.40
Ash,	7.85
Calcium oxide,	1.24
Potassium oxide,	.26
Phosphoric acid,	.13
Nitrogen,	1.64
Insoluble matter,	3.65

Muck (5 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., . .	89.89	12.03	55.13	
Ash, ...	26.12	3.05	13.75	
Nitrogen, ...	1.47	0.26	0.91	

Peat (8 Analyses).

	Per Cent.			Remarks.
	Highest.	Lowest.	Average.	
Moisture at 100° C., .	85.38	*11.29	61.50	* German Peat Mass.
Ash, ...	33.72	1.20	7.71	
Calcium oxide, . .	0.50	0.50	0.50	
Nitrogen, ...	1.40	0.41	0.71	
Insoluble matter, . .	0.38	0.38	0.38	

Turf (2 Analyses).

	Per Cent.		Remarks.
	I.	II.	
Moisture at 100 C., . . .	25.58	13.00	
Ash, ...	3.28	9.43	
Nitrogen, ...	1.91	1.97	

Hen Manure.

	Per Cent.		Remarks.
	Dried.	Fresh.	
Moisture at 100 C.,	8.35	45.73	
Calcium oxide,	2.22	0.97	
Magnesium oxide,	0.62	–	
Potassium oxide,	9.94	0.18	
Phosphoric acid,	2.02	0.47	
Nitrogen in organic matter,	1.85	0.79	
Nitrogen as ammoniates,	0.28		
Insoluble matter,	34.65	39.32	

Poudrette.

	Per cent.
Moisture at 100° C.,	5.25
Ash,	35.45
Potassium oxide,	0.49
Phosphoric acid,	5.74
Nitrogen,	3.58
Insoluble matter,	4.65

Miscellaneous.

	Per Cent.	
	Soot.	Ashes from Blue Works.
Moisture at 100 C.,	5.54	12.74
Organic and volatile matter,	22.90	36.22
Magnesium oxide,	–	Trace.
Potassium oxide,	1.83	9.02
Cyanogen compounds,	–	Trace.
Insoluble matter,	35.34	12.30

METEOROLOGY.

The past year's meteorological observations have been a continuation of those of the two previous seasons, being on the same general plan as recommended to voluntary observers of the U. S. Signal Service, and described in the Third Annual Report. As soon as possible after the close of each month, a copy of our monthly records of observations is forwarded to the chief signal officer at Washington, D. C., and also to the officer stationed at Boston, Mass. A summary of each month's observations are published in our bulletins and annual reports, and are thus made accessible to the farmers throughout the State.

January opened with 3.50 inches of snow, and good sleighing. Between the 5th and 17th, 29 inches of snow fell, but during the thaw of the last eight days the snow nearly all disappeared, and at the end of the month only a little here and there was to be seen. The mean temperature of the month was 3.9° below that of any month of January for the last fifty years. Storms were frequent, and 22.50 inches of snow fell during February. During the evening of Feb. 18 there was a sharp shower, accompanied by thunder and lightning, and at 8 P. M. a slight earthquake shock was felt. Bluebirds were seen on the 13th, and robins on the 20th, of March. The temperature for the month of April was lower than for any previous April since 1875, and on the 18th there was a fall of 6.50 inches of snow. On April 8 the first frost occurred; the last, on May 14. Abundance of moisture characterized the growing months — June, July and August. The total rainfall for June was 5.09 inches; for July, 8.93 inches; and for August, 7.75 inches. The mean temperature for July (73.70°) was the highest for the same month since 1839, when it was 74.40°; July, 1863, it was 70.87°, the nearest approach to it. Similar relations are true of the total rainfall. During the month there fell 8.93 inches, the largest amount during any month of July since 1839, when it was 9.56 inches; in 1863 it was 8.63 inches, the next highest amount. Between 4.30 P. M. on the 23d of July, and 6 A. M. on the 24th, 3.50 inches of rain fell; and from 1 P. M. on the 24th, to 4.25 P. M. of the same day, 1.50 inches fell, making a total rainfall of 5.00 inches inside of 24 hours. It was the heaviest rainfall of the season, and did a large amount of damage, not only to the growing crops, but by the washing of roads and hillsides. Very heavy fogs characterized both August and September. The first frost occurred on the 17th of September. Nov. 11 there were several snow-squalls during the day, but the first snow of the season of any amount was on the 18th of December. The year closes with about four inches of snow, and good sleighing.

During the summer there have been sixteen thunderstorms, some of which were very severe, and did considerable damage. The first occurred on the 18th of February, and the last on the 2d of October. During those storms which occurred in the months of July and August, observations were taken every half-hour, and forwarded to the signal service officer at Boston, Mass.

Weekly crop reports were forwarded during the months of July, August and September, to the Boston Signal Service Station, giving the rainfall, temperature, amount of sunshine, and the condition of the different crops. Farmers had good weather for securing their hay crop, but, on account of the excessive moisture of July and August, they were seriously hindered with their rowen, some of it being spoiled before an opportunity came to secure it. Potatoes suffered from the continued wet spell, but a good crop of corn was obtained. The open fall was favorable for farm work.

The prevailing direction of the wind for the year was N.W. It was northwest in January, February, March, April, August, September, October, November and December; southwest in May and June, and south in July.

The number of days when the sky was less than four-tenths covered by clouds ("clear" days), was seventy-one; the greatest number, twelve, being in May, and the fewest, two, in October.

There were ninety-five "cloudy" days, or those when the sky was more than seven-tenths covered by clouds. December had the greatest number, sixteen; while April and May had the fewest, four each.

Of the remaining 199 days, only two of them appear as "fair" days, that is, between four-tenths and seven-tenths cloudy; the others were variable, being fair or cloudy one portion, and clear or fair another.

The highest temperature of the year was 93.6°, occurring on July 2; the lowest was on the 19th of January, — 22.2°. The maximum is 2° lower than that of last season (1886), which was 95° on the 6th of July; while the minimum is practically the same, last year (1886) being — 22.° on the 13th and 14th of January. The absolute range of temperature for 1887 is 115.2°; 1.8° lower than that of the season of 1886.

Summary of Meteorological Observations, 1887.

	Temperature. Degrees Fahrenheit.											Relative Humidity. Per ct.				Precipitation. Inches.	
	7 A. M.	2 P. M.	9 P. M.	Mean.	Maximum.	Minimum.	Range.	Absolute Maximum.	Date.	Absolute Minimum.	Date.	7 A. M.	2 P. M.	9 P. M.	Mean.	Depth of Water.	Date of Greatest Fall.
January, . . .	15.7	23.5	19.2	19.4	28.6	7.6	21.0	47.2	24th	—22.2	19th	-	-	-	-	4.57	29th
February, . .	20.3	27.8	24.3	24.2	32.1	15.7	16.4	43.8	9th	—3.8	5th	-	-	-	-	5.05	26th to 27th
March, . . .	22.0	33.0	27.2	26.4	33.6	17.1	16.5	46.0	21st	—2.4	5th	-	-	-	-	4.05	5th to 6th
April, . . .	36.3	49.1	40.6	41.6	51.6	30.4	21.2	74.4	10th	17.1	8th	-	-	-	-	2.97½	28th to 29th
May, . . .	54.5	70.8	58.6	60.9	73.1	47 3	25.8	86.5	20th	33.2	14th	83.0	54.4	72.9	70.7	1.13	28th
June, . . .	60.7	73 9	66.0	65.7	76.0	53.4	22 6	91.0	30th	38 5	11th	85 0	58.5	82.2	76.4	5.09	22d to 24th
July, . . .	70.0	81.5	71.7	73 7	83.7	64.0	19.7	93 6	2d	56.0	15th	89.7	64.9	85.6	80.1	8.93	23d to 24th
August, . . .	54.4	73.4	63.0	64.9	75 4	54.1	21.3	88.0	1st	42.5	14th, 28th	92.1	66.8	84.9	81.2	7.75	18th
September, . .	50.1	65.5	54.4	55.9	67.1	45.0	22.1	80.0	7th	29.5	27th	90.3	63.8	87.4	80.5	1.22	7th
October, . . .	41.1	56.0	46.3	47.0	58.8	36.6	22.2	74.4	8th	17.0	30th	88.9	55.9	79.4	74.7	2.10	21st
November, . .	32 0	43.5	35.1	36 5	45.7	26 8	18.9	64.8	7th	11.0	30th	-	-	-	-	3.35	15th
December, . .	26.7	31.5	25.8	26.6	34.0	17.3	16.7	51.0	12th	—6 0	31st	-	-	-	-	4.11	28th
Sums and Means, .	40.31	52.45	41.35	45.2	54.97	34.60	20.36	70 05	-	17.53	-	88.16	60.72	82 06	77.26	50.33	-

Miscellaneous Phenomena. — Dates.

	Frost.	Snow.	Rain.	Thunder-storms.	Solar Halos.	Lunar Halos.
January, . .	4.	5, 6, 9, 10, 13, 14, 15, 17, 19, 23, 24, 26, 30, 31.	1, 23, 24, 29, 30, 31.	-	7, 8.	4, 6, 7, 8, 11.
February, .	-	2, 3, 6, 7, 8, 9, 14, 15, 18, 22, 24, 26, 27.	8, 10, 11, 14, 15, 18, 24.	18.	-	1, 4.
March, . .	-	5, 14, 15, 17, 22.	6, 9, 10, 18, 19, 22, 28, 29.	-	5.	2.
April, . .	8, 9, 15, 21.	18.	5, 16, 23, 25, 26, 28, 29.	29.	-	1, 2.
May, . .	14.	-	6, 25, 26, 28.	6, 25, 27.	-	2, 3.
June, . .	-	-	1, 2, 4, 17, 21, 22, 24.	22, 23.	-	-
July, . .	-	-	5, 6, 10, 16, 17, 18, 21, 23, 24, 26, 29.	23, 24, 29.	-	-
August, . .	-	-	1, 2, 3, 11, 18, 20, 22, 23, 24, 28, 30.	11, 18, 20, 24.	-	-
September, .	17, 18, 27.	-	7, 12, 22, 29, 30.	7.	-	-
October, . .	12, 14, 15, 16, 17, 20, 23, 26, 29.	-	1, 2, 4, 11, 21.	2.	-	-
November, .	2, 3-5, 6, 9, 10, 11, 18, 19, 22, 29.	11.	10, 11, 15, 19, 20, 23, 25, 26, 28.	-	-	-
December, .	1, 2, 4, 6, 7, 9, 14.	3, 15, 17, 18, 21, 26, 31.	5, 10, 11, 12, 15.	-	-	-

RECORD

Of the Average Temperature taken from Weather Records at Amherst, Mass., for three consecutive months, during the summer and winter, beginning with the year 1836.

December, January, February.		June, July, August.	
1836–37, . .	25.396° F.	1837, . . .	69.130° F
1837–38, . .	26.386°	1838, . . .	69.550°
1838–39, . .	25.950°	1839, . . .	70.180°
1839–40, . .	20.626°	1840, . . .	68.770°
1840–41, . .	23.146°	1841, . . .	69.230°
1841–42, . .	28.516°	1842, . . .	68.210°
1842–43, . .	23.460°	1843, . . .	67.950°
1843–44, . .	21.320°	1844, . . .	67.260°
1844–45, . .	25.550°	1845, . . .	70.120°
1845–46, . .	22.140°	1846, . . .	68.406°
1846–47, . .	25.176°	1847, . . .	68.806°
1847–48, . .	28.966°	1848, . . .	69.210°
1848–49, . .	23.026°	1849, . . .	69.210°
1849–50, . .	27.570°	1850, . . .	68.820°
1850–51, . .	25.040°	1851, . . .	66.640°
1851–52, . .	21.620°	1852, . . .	66.830°
1852–53, . .	27.940°	1853, . . .	67.846°
1853–54, . .	23.670°	1854, . . .	69.856°
1854–55, . .	23.126°	1855, . . .	67.146°
1855–56, . .	20.820°	1856, . . .	69.225°
1856–57, . .	22.720°	1857, . . .	67.240°
1857–58, . .	26.956°	1858, . . .	67.930°
1858–59, . .	24.746°	1859, . . .	65.650°
1859–60, . .	24.790°	1860, . . .	66.540°
1860–61, . .	24.510°	1861, . . .	66.870°
1861–62, . .	24.470°	1862, . . .	66.490°
1862–63, . .	27.640°	1863, . . .	66.656°
1863–64, . .	26.060°	1864, . . .	69.336°
1864–65, . .	21.310°	1865, . . .	68.946°
1865–66, . .	25.676°	1866, . . .	67.400°
1866–67, . .	25.276°	1867, . . .	67.920°

Record of Temperature, etc. — Concluded.

December, January, February.		June, July, August.	
1867–68, . .	20.350° F.	1868, . . .	69.700° F
1868–69, . .	26.290°	1869, . . .	66.890°
1869–70, . .	27.866°	1870, . . .	71.700°
1870–71, . .	26.666°	1871, . . .	67.810°
1871–72, . .	24.630°	1872, . . .	70.790°
1872–73, . .	21.350°	1873, . . .	68.596°
1873–74, . .	27.286°	1874, . . .	66.306°
1874–75, . .	21.180°	1875, . . .	68.026°
1875–76, . .	28.156°	1876, . . .	71.780°
1876–77, . .	23.510°	1877, . . .	70.080°
1877–78, . .	28.506°	1878, . . .	68.896°
1878–79, . .	24.290°	1879, . . .	68.150°
1879–80, . .	30.506°	1880, . . .	69.286°
1880–81, . .	21.856°	1881, . . .	67.966°
1881–82, . .	29.256°	1882, . . .	69.866°
1882–83, . .	24.220°	1883, . . .	68.840°
1883–84, . .	26.506°	1884, . . .	68.960°
1884–85, . .	22.630°	1885, . . .	66.740°
1885–86, . .	24.846°	1886, . . .	66.100°
1886–87, . .	22.146°	1887, . . .	68.100°

Summary

Of Average Temperature from 1836 to 1862 (25 years).

December, January, February.	June, July, August.
24.53 F.	68.26° F.

Summary

Of Average Temperature from 1862 to 1887 (25 years).

December, January, February	June, July, August.
25.21° F.	68.53° F

RECORD

OF THE

MAXIMUM AND MINIMUM TEMPERATURE, AND OF THE RAIN-FALL,

FROM 1836 TO 1887, INCLUSIVE.

[The abstract, previous to the year 1883, has been obtained, through the courtesy of Miss S. C. Snell, from the observations of the late Prof. E. S. Snell of Amherst College. The remainder has been taken from those at the Experiment Station.]

MONTHS.	1836.						1837.						1838.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum	Date.	Minimum.	Date.	
January,	-	-	-	-	-	4.21	20.26	42.00	31st	2.25	4th, 5th	1.75	31.99	46.00	18th	6.50	31st	2.45
February,	-	-	-	-	-	3.83	26.69	39.75	16th	7.50	13th	2.42	19.55	35 50	9th	9.50	17th	1.67
March,	32.68	48.50	28th	17.75	12th	3.13	33.70	48 00	24th	11.75	2d	2.65	36.35	47.00	24th	17.50	2d	1.69
April,	47.27	59.25	28th	32.75	12th	1.98	47.42	65.25	29th	36.00	1st	4.33	40 72	55.00	29th	31.50	15th, 17th	2.02
May,	61.36	76.25	3d	45.50	27th	2.59	57.88	72.00	31st	38.50	1st	5.76	54.32	70.50	22d	41.50	4th	3.63
June,	66.37	77 50	9th	51.75	21st	3.45	68.15	77.00	30th	34.00	17th	4.49	68.63	78.00	12th	57.00	3d	4.90
July,	73.62	83.75	8th	65.50	8th	6.02	70.64	82.50	1st	65.50	30th	7.35	71.86	81.50	10th	61.00	23d	2.27
August,	68.00	78.00	1st	57.00	11th	0.96	68.61	79.25	2d	59.50	23d	2.57	68.16	78.00	25th	56.50	27th	3.95
September,	62.36	77.75	20th	45.50	29th	2.28	61.42	75.00	10th	53.00	30th	1.07	62.73	72.50	8th	50.00	24th	6.38
October,	47.88	67.50	2d	32.75	26th	3.02	49.97	61.25	24th	34.50	29th	2.06	46.53	64.50	3d	34.00	30th	4.12
November,	38.22	60.00	12th	22.50	26th	3.49	40.23	62.50	21st	17.25	26th	1.90	34.07	53.00	5th	11.50	25th	5.77
December,	29.24	44.25	21st	7.75	30th	5.80	27.62	48.00	31st	6.00	22d	2.35	23.52	37.50	15th	5.50	31st	0.96
Means and Sums,	52.70	-	-	-	-	40.76	47.72	-	-	-	-	38.70	46.52	-	-	-	-	39.81

MONTHS.	1839.						1840.						1841.					
	TEMPERATURE.					Rain in Inches.	TEMPERATURE.					Rain in Inches.	TEMPERATURE.					Rain in Inches.
	Mean.	Maxi-mum.	Date.	Mini-mum.	Date-		Mean.	Maxi-mum.	Date.	Mini-mum.	Date.		Mean.	Maxi-mum.	Date.	Mini-mum.	Date.	
January, . .	24.56	42.00	12th	1.50	1st	1.66	14.45	38.00	30th	—21.00	17th	3.15	25 63	50.00	8th, 9th	—17.00	5th	5.80
February, . .	29.79	39 00	27th	11.50	6th, 7th	1.75	28.50	56.00	23d	—14.00	5th	2.03	20.20	44.00	21st	—6.00	12th	1.50
March, . . .	37.54	50.50	27th	13.50	4th	1.69	34.97	64.00	4th	7.00	8th	3.18	31.90	60.00	26th	8.00	5th	2.85
April, . . .	52.18	60.50	28th	33.00	14th	4.14	48.95	79.00	23d	19.00	9th	3.98	41.63	67.00	28th	21.00	11th	4.52
May, . . .	60.71	67.50	28th	42.50	8th	3.49	57.06	88.00	28th	34.00	11th	1.91	54.39	81.00	24th	29.00	4th	3.47
June, . . .	65.40	71.50	21st	52.00	1st, 13th	3.30	65.50	88.00	29th, 30th	44.00	2d	4.60	68.35	90.00	30th	43.00	4th	1.65
July, . . .	74.40	77.00	20th	63.00	13th	9.56	70.56	94.00	17th	50.00	2d	3.34	69.53	94.00	23d	42.00	12th	2.55
August, . .	70.74	77.50	27th	53.50	29th	2.51	70.26	90.00	20th	50.00	10th, 16th	6.82	69.82	88.00	2d, 3d, 4th, 5th,	42.00	25th	3.18
September, . .	63.50	70.00	5th, 7th	43.50	29th	2.82	57.22	77.00	8th, 9th	36.00	15th, 14th	5.20	61.21	84.00	4th	46.00	27th	3.50
October, . .	53.32	61.50	19th	32.00	21st	1.78	47.39	72.00	6th	23.00	17th	5.04	42.81	64.00	30th, 31st	20.00	28th	3.73
November, . .	36.65	48.00	15th	23.00	22d, 23d	3.04	36.95	55.00	30th	18.00	21st	4.61	35.28	68.00	1st	13.00	30th	2.80
December, . .	28.93	46.00	5th	9.00	20th	7.09	23.61	44.00	10th	—2.00	25th	3.15	29.50	44.00	24th	5.00	23d	6.08
Means and Sums, .	49.81	-	-	-	-	42.83	46.28	-	-	-	-	47.01	48.85	-	-	-	-	41.63

MONTHS.	1842.						1843.						1844.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January,	25.55	37.00	31st	—10.00	6th	1 02	29.73	50.00	8th, 31st	—8.00	2d	1.99	13.93	39.00	13th	—22.00	28th	3.44
February,	30.50	55.00	4th	5.00	9th	3.78	16.48	37.00	11th	—15.00	17th	3.49	22.07	49.00	21st	—10.00	1st	2.18
March,	37.69	68.00	4th	13.00	12th	2.39	24.52	42 00	28th	7.00	19th	5.73	35.53	56.00	25th	5.00	5th	4.12
April,	46.50	82.00	22d	17.00	1st	2.92	44.63	70.00	22d	15.00	4th	4.82	51.95	83.00	14th	14.00	1st	0.57
May,	52.71	78.00	19th	30.00	21st	2.40	55.95	82.00	15th	35.00	3d, 4th	2.09	57.85	84.00	25th	33.00	22d	5.59
June,	64.10	84.00	19th	34.00	7th, 12th	3.18	65.28	86.00	27th	34.00	1st, 2d	5.18	65.55	86.00	27th	42.00	4th	3.00
July,	71.48	90.00	30th	49.00	22d	1.95	68.76	91.00	2d	47.00	6th	2.53	68.23	86.00	14th	40.00	5th	3.81
August,	69.05	82.00	18th, 26th	45.00	31st	7.42	69.81	84.00	31st	53.00	1st, 2d	9.38	68.00	84.00	17th	46.00	13th	4.93
September,	57.43	84.00	12th	30.00	24th	3.23	61.70	87.00	4th, 5th	30.00	28th	1.57	59.55	83 00	16th	26.00	28th	1.84
October,	47.44	70.00	9th	26.00	28th	2.84	44.98	60.00	21st	28.00	24th	9.45	47.55	70.00	10th	25.00	21st	6.49
November,	35.10	60.00	6th	13.00	29th	3.73	33.98	57.00	18th, 24th	17.00	15th	3.07	35.73	54.00	2d, 8th	3.00	30th	2.12
December,	24.18	43.00	5th	—2.00	24th	3.19	27 98	40.00	21st, 22d	2.00	14th	2.28	27.28	45.00	26th	—5.00	29th	2.49
Means and Sums,	46.81	-	-	-	-	38.05	45.32	-	-	-	-	51.58	45.94	-	-	-	-	40.58

MONTHS.	1845.						1846.						1847.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . .	21.52	46.00	25th	0°	19th	4.97	24.75	45.00	2d	−1.00	19th	2.74	25.50	44.00	5th, 6th	4.00	22d	4.86
February, . .	24.86	55.00	25th	—3.00	3d	3.37	20.14	40.00	5th	—6.00	19th	2.55	24.71	47.00	3d	—8.00	24th	4.88
March, . . .	36.93	71.00	30th	8.00	12th	3.56	36.33	59.00	20th	2.00	3d	4.35	29.24	52.00	25th	9.00	14th, 16th	3.57
April, . . .	45.59	77.00	24th	24.00	6th	1.70	50.06	76.00	18th	22.00	16th	1.54	43.28	77.00	22d	5.00	1st	1.41
May, . . .	56.15	88.00	12th	30.00	10th, 31st	2.42	58.29	83.00	26th	32.00	20th	4.33	57.48	84.00	29th	34.00	1st	1.91
June, . . .	66.71	90.00	8th	41.00	7th, 18th	2.57	64.96	87.00	18th	41.00	13th	3.10	64.73	88.00	28th	42.00	13th	4.44
July, . . .	72.12	94.00	14th	46.00	25th	3.31	70.66	93.00	11th	44.00	16th	3.25	72.42	91.00	19th	46.00	29th	4.48
August, . .	71.54	89.00	10th	42.00	29th	2 79	69.60	90.00	5th	47.00	19th	2.44	69.27	85.00	11th, 17th	48.00	20th	4.06
September, . .	58.30	81.00	4th	32.00	13th, 23d	2.58	65.48	88.00	6th	37.00	27th	0.47	59.30	85.00	4th	35.00	17th	3.63
October, . .	49.64	74.00	12th	17.00	22d	4.66	47.59	81.00	9th	25.00	26th	2.09	45.97	67.00	6th	15.00	27th	3.99
November, . .	41.49	65.00	4th	12.00	29th	3.90	43.05	61.00	8th	20.00	26th	4.96	43.15	70.00	4th	5.00	30th	4.17
December, . .	21.53	38.00	15th	—10.00	13th	3.91	25.32	45.00	28th	1.00	16th	3.10	34.24	59.00	11th	3.00	27th	6.41
Means and Sums, .	47.45	-	-	-	-	39.74	48.02	-	-	-	-	34.92	47.44	-	-	-	-	47.81

MONTHS.	1848.						1849.						1850.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . . .	28.95	56.00	1st	—12.00	11th	2.92	20.02	46.00	26th	—8.00	11th	0.99	25.90	45.00	27th	—2.00	31st	4.75
February, . .	23.71	43.00	23d	—2.00	11th	2.60	18.50	43.00	24th	—10.00	16th	0.99	28.42	52.00	26th	—11.00	6th	3.56
March, . . .	32.63	64.00	31st	4.00	15th	3.03	35.57	60.00	31st	12.00	5th	4.21	32.43	60.00	14th	8.00	4th	1.86
April, . . .	43.32	74.00	22d	25.00	3d	1.55	43.49	68.00	4th	21.00	15th	2.24	42.91	70.00	26th, 28th	19.00	11th	3.93
May, . . .	59.47	86 00	18th	32.00	1st	6.18	53.42	83.00	21st	32.00	3d	3.61	53 38	73.00	13th	31.00	12th	8.72
June, . . .	67 63	90.00	17th	39.00	2d	2.58	66.88	92.00	22d	39.00	9th	1.53	67.27	90.00	20th	44.00	12th	2.88
July, . . .	69.45	87.00	22d	49.00	16th, 17th	4.72	72.09	93.00	13th	45.00	3d	2.25	72.08	87.00	30th	48.00	27th	6.81
August, . .	70.56	87.00	17th	44.00	26th	1.53	68.85	83.00	4th	50.00	16th	7.86	67.10	87.00	6th	44.00	18th, 28th	6.50
September, . .	57.43	81.00	11th	31.00	28th	2.49	60.05	70.00	17th	37.00	3d	1.40	59.40	80.00	1st, 6th	32.00	30th	4.93
October, . .	47.31	70.00	1st, 17th	28.00	9th, 14th, and 28th	3.15	47.03	68.00	17th	29.00	15th	6.36	48.18	67.00	5th	23.00	30th	3.65
November, . .	33.49	52.00	4th	11.00	11th	3.09	44.08	63.00	4th	25.00	1st, 2d and 16th	3.65	39.95	63.00	4th	16.00	23d	2.63
December, . .	30.56	58.00	19th	—3.00	24th	5.54	28.40	43.00	20th	3.00	26th	3.36	23.45	49.00	1st	—15.00	31st	5.37
Means and Sums,	47.04	-	-	-	-	39.38	46.52	-	-	-	-	38.45	46.71	-	-	-	-	55.50

MONTHS.	1851.						1852.						1853.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January,	23.79	48.00	26th	—5.00	5th, 8th	1.66	19.57	43.20	20th	—15.00	22d	2.42	24.26	45.00	11th	—2.50	27th	2.11
February,	27.89	48.00	22d	—8.00	1st	5.08	25.17	47.40	11th	—3.40	20th	3.35	26.72	51.00	6th	0.50	15th	6.69
March,	35.51	73.00	31st	12.00	14th	1.28	30.86	53.00	13th	0.30	3d	3.26	33.82	56.40	30th	7.60	15th	2.39
April,	46.20	67.00	24th	24.00	13th	4.43	39.44	61.00	30th	23.30	4th	4.71	44.02	76.30	29th	27.40	11th	3.79
May,	55.61	82.00	13th	30.00	3d	4.07	56.05	79.00	6th	38.50	5th	2.30	56.70	84.20	26th	31.80	2d	5.40
June,	63.60	88.00	30th	41.00	17th	3.69	65.38	84.00	17th	43.90	12th	2.54	66.07	91.30	21st	39.00	1st	2.64
July,	69.13	87.00	17th	49.00	3d	4.31	69.95	90.00	9th, 22d	55.00	19th	3.38	68.73	85.10	9th	54.00	14th	3.59
August,	66.20	83.00	13th	39.00	27th	3.03	65.16	85.70	10th	48.00	4th	5.19	67.84	91.70	14th	45.90	29th	7.13
September,	60.93	80.60	12th	29.00	25th	2 05	58.37	85.00	3d	33.00	30th	2.48	59.54	84.70	5th	37.00	12th	5.66
October,	51.04	73.00	8th, 9th	31.00	17th	5.43	49.31	70.00	2d	24.30	27th	1.76	46.84	69.00	21st	24.90	30th	3.75
November,	34.54	56.00	2d	13.00	12th	5.30	36.42	50.80	3d	15.00	24th	6.43	39.14	59.50	19th	13.80	25th	6.24
December,	20.13	44.00	29th	—15.00	27th	3.17	32.85	56.00	7th	6.10	22d	4.88	26.31	42.80	10th	7.20	30th	1.84
Means and Sums,	46.21	-	-	-	-	43.50	45.71	-	-	-	-	42.72	46.65	-	-	-	-	51.23

MONTHS.	1854.						1855.						1856.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January,	22.75	50.41	12th	—9.60	29th	2.01	27.26	48.00	29th	10.70	11th	5.06	15.24	34.80	17th	—7.50	10th	2.48
February,	21.96	45.00	2d	—4.80	5th	4.53	19.83	42.00	15th	—16.00	7th	2.70	19.02	38.60	23d	—11.00	14th	0.79
March,	31.62	65.40	16th	14.00	21st	3.11	31.53	57.80	31st	7.80	1st	1.08	25.88	44.90	24th	—9.00	10th	1.12
April,	43.47	70.60	25th	23.70	3d	8.33	43.83	76.00	25th	17.00	2d	3.85	46.44	76.70	28th	16.50	1st	2.51
May,	59.49	79.00	15th, 16th and 28th	34.00	7th	3.19	56.65	81.00	16th	41.50	9th	1.49	53.58	89.00	24th	38.20	4th	5.31
June,	66.67	87.50	19th	39.80	1st	1.75	65.04	92.00	30th	48.00	12th	5.19	68.56	94.00	29th	48.00	1st	1.92
July,	74.08	97.00	20th	57.70	14th	3.53	70.87	91.60	21st	57.20	19th	6.10	72.93	95.00	18th	55.90	2d	1.96
August,	68.82	88.50	13th, 22d	50.80	29th	0.99	65.53	84.50	4th	44.70	31st	2.55	66.19	87.30	1st	48.20	26th	12.13
September,	61.50	90.00	6th	33.80	30th	5.46	60.82	85.00	12th	33.00	20th	0.55	60.79	78.90	9th	41.80	25th	3.47
October,	51.53	75.80	9th	27.00	20th	2.31	49.73	73.00	5th	30.20	31st	10.08	48.68	75.50	11th	25.00	25th	1.40
November,	40.27	66.00	6th	14.00	1st	7.48	38.84	63.00	16th	15.00	23d	4.12	37.47	61.00	4th	18.00	21st	2.85
December,	22.29	41.50	26th	—9.00	23d	2.39	28.21	46.20	1st, 2d	7.00	31st	5.41	23.20	41.80	12th	—7.00	19th	4.19
Means and Sums,	46.99	-	-	-	-	-	46.52	-	-	-	-	48.38	44.84	-	-	-	-	40.13

MONTHS.	1857.						1858.						1859.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January,	13.54	37.10	27th	—18.20	24th	3.55	28.81	61.40	25th	0	2d	3.52	22.94	30.40	26th	—19.40	11th	4.89
February,	31.42	61.80	25th	—2.70	3d	2.41	20.59	47 10	28th	—5.00	24th	1.60	25.59	44.10	16th	2.80	13th	3.54
March,	31.08	54.50	31st	7.00	3d	2.12	31.31	57.70	31st	—8.00	4th	0.80	36.74	56.60	28th	3.50	2d, 3d	6.27
April,	41.01	58.30	5th	14.30	2d	7.68	44.37	68.10	3d	28.50	7th	3.20	43.45	71.00	30th	28.70	9th	2.96
May,	55.19	86.40	26th	39.80	16th	6.82	54.10	74.20	31st	40.30	18th	2 98	59.19	86.00	7th, 8th	43.90	11th, 12th	4.08
June,	63.63	86.90	29th	49.00	8th	2.66	66.10	90.30	27th	51.00	15th	4.62	62.80	91.50	29th	45.00	12th	6.16
July,	70.87	90.30	12th	55.50	3d	4.98	69.80	92.00	11th	58.50	24th	6.73	67.73	90.00	12th	53.00	4th, 5th	2.61
August,	67.22	90.30	14th	53.60	19th	3.14	67.00	79.00	8th	58.80	4th	4.82	66 43	81.80	4th	47.40	30th	6.65
September,	59.90	85.70	11th	32.60	30th	3.04	50.90	85.20	9th	37.00	20th	4.14	57.10	73.80	27th	41.00	15th	4.47
October,	48.90	73.00	13th	25.00	22d	3 88	51.42	73.00	19th	31.50	26th	3.86	45.72	75.00	4th	24.80	26th	1.85
November,	39.46	67.00	9th	13.00	26th	2.07	33.01	59.00	1st	14.60	16th	2.16	41.07	65.80	13th	24.00	16th	2.96
December,	31.47	52.00	8th	2.20	27th	5.31	25.71	42.80	15th	0	26th	3.16	23.03	62.90	2d	—8.50	29th	4.85
Means and Sums,	46.14	-	-	-	-	47.66	45 40	-	-	-	-	41.59	45.98	-	-	-	-	51.29

MONTHS.	1860.						1861.						1862.					
	TEMPERATURE.					Rain in Inches.	TEMPERATURE.					Rain in Inches.	TEMPERATURE.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January,	26.52	50.30	21st	—8.00	2d, 3d	1.21	20.45	38.00	25th	—17.00	13th	4.34	22.31	42.90	1st	0	8th	5.25
February,	24.83	52.00	23d	—7.20	18th	2.93	29.22	53.50	28th	—20.00	8th	3.23	22.10	40.00	23d	—2.00	17th	2.84
March,	37.19	71.30	31st	22.80	23d	1.58	32.49	56.30	3d	5.50	7th	3.76	32.17	44.50	24th	13.80	3d	4.30
April,	43.99	68.30	17th	23.10	3d	1.28	45.50	80.30	23d	18.20	4th	5.65	43.55	72.90	17th	24.30	8th	2.28
May,	57.29	81.00	13th	38.90	1st	4.57	53.37	77.20	31st	33.00	2d	4.45	58.13	84.00	17th	44.00	25th	2.33
June,	65.22	83.00	29th	52.00	21st	3.57	65.48	84.00	10th	51.00	6th	2.60	63.39	86.00	28th	49.50	16th	11.69
July,	66.39	84.00	10th	53.00	28th	6.13	63.46	91.70	9th	56.70	2d	5.23	67.98	90.00	6th	51.90	19th	5.12
August,	68.01	84.40	8th	49.10	29th	2.68	65.67	90.00	3d	48.50	15th	4.10	68.11	88.00	9th	48.00	30th	2.98
September,	56.78	79.00	7th	32.00	30th	6.12	59.93	82.30	15th	41.60	25th	2.75	61.06	80.00	7th	39.00	26th	2.12
October,	48.85	69.90	31st	28.00	1st	2.18	51.52	75.50	3d	25.00	25th	4.53	50.96	83.00	8th	26.00	24th	3.28
November,	42.70	66.70	2d	15.00	26th	3.52	37.82	64.00	3d	17.00	26th	3.93	39.56	63.20	1st	18.00	16th	4.76
December,	23.87	37.50	21st	—7.00	16th	3.84	29.00	51.40	7th	—6.5	23th	2.17	27.55	52.00	15th	—1.30	8th	1.91
Means and Sums,	46.80	-	-	-	-	39.66	46.66	-	-	-	-	46.93	46.41	-	-	-	-	48.86

MONTHS.	1863.						1864.						1865.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January,	29.08	52.00	16th	5.00	18th	5.05	24.36	44.20	29th	—1.50	7th	2.20	18.73	39.50	13th	—4.50	28th	3.48
February,	26.29	45.30	27th	—9.00	5th	4.43	28.49	46.80	24th	—4.30	18th	1.12	25.03	45.40	23d	—1.00	14th	2.88
March,	26.13	47.30	25th	—6.00	13th	5.60	34.40	53.80	28th	15.00	22d	2.58	37.12	63.70	21st	13.00	6th	5.98
April,	45.48	77.00	28th	25.00	4th	2.33	43.54	64.80	22d	31.80	5th	2.57	49.01	79.50	27th	33.00	9th	2.90
May,	55.35	88.00	22d	38.30	7th	3.59	60.41	86.00	31st	40.00	3d	2.54	57.13	85.80	17th	42.80	1st	7.89
June,	59.03	85.60	15th	51.00	17th	4.09	65.70	93.50	25th	47.30	10th	1.38	69.23	87.00	17th	55.90	3d	2.94
July,	70.87	85.50	27th	55.30	23d	8.64	71.49	91.90	20th	53.90	26th	0.96	69.06	85.40	7th	54.80	15th	3.72
August,	70.07	90.00	3d	48.70	31st	6.11	70.82	98.00	1st	54.80	31st	4.40	68.58	90.00	4th	47.50	29th	1.86
September,	57.38	80.00	16th	32.00	23d	2.16	57.84	80.00	27th	41.00	26th	2.92	65.62	89.00	1st	35.00	28th	0.37
October,	49.90	71.00	19th	21.00	29th	4.04	46.37	68.70	4th	28.50	22d	2.94	45.97	72.00	1st	24.20	24th	4.98
November,	41.06	65.40	20th	18.00	30th	5.28	38.04	62.00	30th	10.80	17th	6.20	39.91	68.00	16th	18.50	8th	2.45
December,	25.34	51.50	14th	3.20	23d	4.87	30.18	49.40	1st	18.00	23d	4.63	28.92	54.90	27th	6.80	16th	3.54
Means and Sums,	46.33	-	-	-	-	56.19	47.64	-	-	-	-	34.44	47.86	-	-	-	-	42.99

MONTHS.	1866.						1867.						1868.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . .	21.93	40.00	18th	—14.50	8th	1.36	18.30	33.50	24th	—5.00	16th	1.32	20.21	39.50	3d	0	13th	3.52
February, . .	26.18	55.00	24th	—1.50	7th	4.62	31.23	50.00	14th	8.00	11th	3.65	18.21	45.00	21st	—18.30	8th	1.03
March, . . .	31.64	55.80	15th	11.50	18th	3.10	30.84	53.00	31st	8.00	29th	3.12	33.80	59.80	31st	—7.30	1st	3.25
April, . . .	48.63	84.20	21st	30.00	10th	2.03	45.49	66.00	15th	29.00	14th	3.79	41.96	67.50	1st	23.00	10th	4 27
May, . . .	54.63	80.00	12th	40.00	2d	4.48	54.05	75.50	28th	36.00	3d	4.61	55.13	75.00	7th	36.00	8th	7.86
June, . . .	65.82	90.10	25th	48.00	1st	5.63	67.06	85.00	6th	54.00	11th	5.67	66.17	88.70	20th	51.80	5th	2.44
July, . . .	72.91	94.00	16th	55.00	1st	4.02	68 14	90.00	4th	55.00	31st	4.00	73.97	94.50	15th	61.00	28th	3.28
August, . . .	63.48	81.60	2d	48.00	26th	3.96	68.56	83.50	7th	48.30	31st	9.16	68.97	85.00	31st	51.00	13th	5.67
September, . .	60.00	83.10	31st	35.50	16th	4.71	59.99	80.00	17th	39.00	28th	1.11	59.47	79.50	11th	36.20	18th	10.63
October, . .	49.50	73.00	8th	26.50	5th	3.38	49.90	76.00	18th	27.00	25th	3.85	45.30	68.00	11th	19.20	24th	1.37
November, . .	40.10	60.80	9th	16.80	26th	3.86	37.87	65.00	2d	17.50	18th	4.31	36.48	58.00	1st	23.80	20th	4.80
December, . .	26.30	51.20	7th	—3.80	21st	3.57	22.64	46.00	26th	—3.00	14th	1.51	22.82	42.70	7th	—5.00	27th	1.47
Means and Sums,	46.76	-	-	-	-	44.81	46.17	-	-	-	-	46.10	45.21	-	-	-	-	49.59

MONTHS.	1869.						1870.						1871.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . .	28.04	49.00	8th	3.00	23d	3.47	30.78	54.30	23d	5.00	9th	5.87	23.27	50.00	13th	—5.50	23d	1.96
February, . .	28.01	50.60	13th	—1.00	8th	4.14	25.34	55.00	18th	6.20	25th	5.25	25.95	50.60	25th	—9.50	5th	2.91
March, . . .	27.28	53.80	27th	—9.00	1st	5.46	30.88	50.50	31st	6.50	6th	2.71	40.53	55.50	19th	24.80	29th	3.99
April, . . .	46.45	74.00	20th	26.70	4th	1.53	48.26	78.00	14th	35.00	4th	3.70	48.00	74.80	9th	27.00	1st	3.09
May, . . .	55.87	83.00	12th	35.20	2d	5.65	58.27	82.40	16th	42.80	11th	1.72	57.84	92.80	30th	41.00	5th	3.82
June, . . .	64.72	80.70	29th	47.40	8th	5.99	70.45	93.00	25th	53.50	11th	2.73	65.38	88.20	3d	51.80	10th	6.58
July, . . .	69.08	89.90	16th	53.50	2d	2.98	73.55	91.20	24th	54.50	2d	2.53	69.18	85.60	13th	54.00	11th	3.52
August, . . .	66.87	87.20	20th	50.00	31st	1.04	71.11	91.30	19th	47.00	27th	2.83	68.87	85.00	7th	50.00	20th	6.45
September, . .	62.06	85.00	20th	36.30	28th	4.32	62 32	83.50	1st	40.00	12th	1.75	52.84	78.00	3d	32.00	22d	1.30
October, . .	46.68	71.40	2d	26.80	28th	11.36	52.02	71.50	2d	26.00	27th	4.49	50.95	73.10	23d	24.30	22st	6.09
November, . .	35.92	56.90	4th	16.90	26th	2.59	39.10	61.00	9th	24.70	17th	3.28	34.03	62.00	1st	7.00	30th	3.51
December, . .	27.48	45.30	1st	—7.50	9th	4.96	28.00	47.00	2d	1.00	30th	1.84	24.62	43.30	4th	—6.50	21st	2.67
Means and Sums,	46.54	-	-	-	-	53.49	49.17	-	-	-	-	38.70	46.79	-	-	-	-	45.89

MONTHS.	1872.						1873.						1874.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January,	25.11	42.90	20th	2.50	31st	1.51	20.56	42.30	14th	—22.00	30th	5.01	28.15	52.00	23d	1.20	26th	5.46
February,	24.16	50.00	25th	—2.50	1st	1.89	24.00	45.00	4th	—2.50	24th	2.17	24.48	49.30	20th	—5.00	2d	2.19
March,	25.27	44.00	28th	—4.80	5th	2.87	30.64	49.30	29th	1.80	6th	3.18	32.93	57.20	26th	9.70	24th	1.35
April,	45 03	84.00	26th	29.00	2d	2.20	43.23	66.20	29th	33.50	11th	1.74	38.32	63.00	14th	18.70	1st	6.03
May,	59.14	84.10	9th	43.70	4th	3.11	54.58	82.00	28th	39.00	3d	3.91	56.52	86.00	29th	39.00	7th	5.22
June,	68.14	91.80	30th	48.70	2d	3.25	67.48	90.00	19th	50.60	4th	1.59	66.18	93.00	29th	51.30	2d	5.06
July,	72.64	91.70	1st	59.10	23d	7.07	71.30	92.40	14th	56.10	19th	2.93	67.16	90.00	14th	38.00	5th	11.58
August,	71.60	88.80	8th	52.90	31st	5.28	67.01	86 20	2d	49.10	28th	3.47	65.58	84.00	10th, 11th	46.30	27th	2.69
September,	61.70	88.50	8th	39.50	4th	6.20	60.35	85.80	5th	36.20	22d	4.77	62.03	85.80	10th	39.00	23d	1.82
October,	48.24	69.00	6th	29.90	30th	3.64	49.93	70.50	19th	27.00	26th	6.36	47.60	66.00	8th	28.50	22d	1.85
November,	36.43	54.00	12th	10.00	30th	4.48	29.68	52.00	2d	6.50	28th	3.51	36.21	60.00	6th	16.00	14th	3.54
December,	19.50	40 30	2d	—8.00	30th	2.69	29.23	57.70	4th	7.00	1st	3.31	29.29	49.00	3d	0	31st	1.17
Means and Sums,	46.41	-	-	-	-	44.19	45.67	-	-	-	-	41.95	46.21	-	-	-	-	47.96

MONTHS.	1875.						1876.						1877.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . .	16.73	35.50	2d	—8.20	11th	2.90	29.85	63.00	1st	2.80	14th	2.31	20.05	43.00	27th	—3.50	24th	2.52
February, . .	17.53	50.00	23d	—4.00	10th	3.62	26.36	52.30	13th	—1.00	24th	5.53	30.78	50.00	22d	8.50	9th	0.36
March, . . .	27.79	51.00	30th	0	24th	4.20	31.60	59.00	7th	4.50	20th	7.14	33.30	52.80	23d	10.00	20th	6.97
April, . . .	40.80	63.00	29th	22.50	19th	3.33	43.60	63.30	14th	28.00	9th	3.11	47.80	75.80	24th	32.50	14th	2.45
May, . . .	57.14	84.70	23d	39.80	2d	2.19	57.50	86.00	7th	30.00	1st	3.96	58.50	84.50	31st	40.00	2d	1.93
June, . . .	65.84	89.00	24th	48.50	14th	2.89	70.61	87.70	27th	47.00	1st	3.87	67.77	88.00	2d	54.70	23d	4.59
July, . . .	69.30	91.50	6th	53.80	20th	8.15	74.19	95.00	9th	52.50	27th	4.84	71.13	89.10	26th	58.10	15th	6.47
August, . .	68.94	84.80	31st	32.00	27th	6.17	70.54	90 00	6th	49.00	21st	0.27	71.35	87.40	28th	54.80	31st	2.79
September, . .	57.27	84.70	3d	32.50	23d	4.65	59.10	90.00	1st	41.20	27th	3.71	63.31	85.70	14th	39.00	23d	0.91
October, . .	47.90	70.30	5th	26.00	13th	3.89	45.50	71.10	21st	23.00	29th	1.12	50.50	75.40	1st	25.30	28th	6.99
November, . .	33.11	56.20	13th	—1.00	30th	3.97	40.50	71 70	2d	18.90	30th	2.49	41.92	66.80	9th	19.40	29th	5.44
December, . .	28.26	55.00	23d	—9.00	20th	1.03	19.70	42.00	13th	—1.00	17th	3.22	33.09	55.20	17th	13.00	2d	1.02
Means and Sums,	44.22	-	-	-	-	46.99	47.42	-	-	-	-	41 57	49.12	-	-	-	-	42.44

MONTHS.	1878.						1879.						1880.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Meau.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January, . .	25.29	44.40	22d	—12.50	8th	3.58	21.55	50.10	28th	—4.50	17th	1.75	31.60	47.90	4th	2.00	14th	4.58
February, . .	27.14	53.30	27th	—3.20	3d	3.67	22.37	43.20	12th	1.00	22d	3.49	29.09	57.60	29th	—11.50	10th	3.60
March, . . .	39.24	65.10	10th	13.20	25th	2.57	33.00	51.60	11th	7.00	8th	4.98	33.46	59.80	4th	13.70	25th	2.68
April, . . .	52.17	73.10	19th	37.00	15th	5.85	43.18	72.40	28th	22.70	4th	3.85	47.54	77.70	14th	26.20	8th	2.64
May, . . .	57.38	83.20	3d	40.50	13th	2.36	60.60	83.00	31st	40.00	2d	3.32	64.15	93.00	26th	37.00	1st	1.90
June, . . .	64.73	90.20	30th	46.40	7th	6.00	66.26	90.30	1st	49.00	7th	5.37	68.52	91.10	24th	51.00	4th	1.40
July, . . .	73.33	92.20	18th	55.20	7th	2.16	71.00	91.40	4th	56.70	5th	5.75	71.81	90.50	10th	54.00	30th	6.34
August, . .	68.63	83.30	9th	49.90	26th	6.97	67.19	90.60	2d	53.20	28th	5.89	67.53	88.00	23d	45.70	16th	2.91
September, . .	63.20	84.50	1st	37.00	28th	2.82	59.02	85.60	2d	30.40	26th	2.59	63.24	90.00	5th	39.10	24th	2.69
October, . .	54.43	77.30	17th	27.00	29th	2.05	56.01	82.60	16th	20.80	26th	1.80	47.27	71.40	11th	22.90	29th	2.27
November, . .	39.11	57.20	2d	19.80	15th	5.34	37.37	68.20	15th	7.70	5th	2.35	34.91	59.20	6th	9.50	23d	2.50
December, . .	28.95	53.70	2d	11.70	29th	6.02	30.83	54.50	3d	—6.00	26th	4.85	22.79	38.90	6th	—5.00	31st	2.29
Means and Sums, .	49.47	-	-	-	-	49.39	47.36	-	-	-	-	45.99	48.49	-	-	-	-	35.80

MONTHS.	1881. Temperature.					1881. Rain in Inches.	1882. Temperature.					1882. Rain in Inches.	1883. Temperature.					1883. Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January,	17.92	38.00	7th	—12.40	1st	4.01	23.57	45.00	26th, 16th	—15.00	24th	5.44	21.00	42.20	31st	—2.50	23d	3.24
February,	24.86	47.00	10th	—7.00	2d	1.77	28.19	47.40	16th	—6.00	4th	4.23	25.02	43.10	4th	—1.30	24th	4.03
March,	36.20	50.80	16th	24.40	2d	4.86	35.13	56.20	20th	17.40	15th	5.20	27.26	51.10	2d	3.00	9th	1.70
April,	43.65	78.40	24th	22.10	5th	1.65	44.31	68.00	18th	23.70	1st	1.52	44.29	67.30	10th	23.50	1st	2.18
May,	61.70	89.00	25th	37.00	1st	4.28	52.86	78.00	31st	39.10	3d	6.50	58.60	89.00	26th	43.00	1st	6.20
June,	62.77	80.00	29th	47.70	4th	3.95	63.85	90.09	24th	52.20	1st	2.25	69.72	90.80	19th	53.70	2d	3.99
July,	70.64	87.20	13th	59.20	1st	1.50	71.89	92.10	27th	56.30	1st	1.83	70.42	93.00	4th	55.00	1st	3.69
August,	70.49	90.80	5th	56.70	17th	2.76	70.89	93.00	15th	49.70	19th	0.25	66.39	86.20	20th	43.40	28th	1.57
September,	67.35	94.00	7th	49.00	14th	2.37	63.23	87.70	19th	43.70	13th	11.85	59 43	79.80	2d	36.20	10th	3.17
October,	52.47	86.20	1st	29.00	27th	4.24	52.72	73.80	8th	32.20	28th	1.67	46.82	77.10	14th	23.20	18th	4.31
November,	40.30	66.70	9th	14.00	23d	4.58	36.45	66.10	1st	12.00	28th	1.33	40.43	67.20	22d	18.00	29th	1.80
December,	36 01	61.40	14th	8.50	11th	6.15	26.65	48.00	24th	0	20th	1.47	27.02	53.10	8th	—12.80	23d	2.99
Means and Sums,	48.70	-	-	-	-	42.12	47.73	-	-	-	-	43.54	46.36	-	-	-	-	38.87

MONTHS.	1884.						1885.						1886.					
	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.		Mean.	Maximum.	Date.	Minimum.	Date.	
January,	21.64	40.10	18th	—8.00	6th	3.60	22.73	57.00	12th	—18.00	28th	3 78	21.85	56 00	5th	—22.00	13th, 14th	5.39
February,	30.86	46.00	7th	5.10	29th	4.62	15.17	39.00	26th	—15.00	12th	3.88	23.10	52 00	15th	—11.00	5th	3.94
March,	32.89	54.00	25th	0	3d	5.67	23.29	50.00	28th	—11.00	18th	0.86	33.46	61.00	31st	—1.00	1st	3.31
April,	46.69	70.30	27th	31.20	1st	2.48	45.29	83 00	22d	19.00	15th	3.38	50.42	83.00	20th	21.00	7th	1.73
May,	57.35	85.20	22d	37.60	29th	2.02	54.77	85.00	19th	21.00	4th	3.08	57.26	82.00	30th	29.00	1st	3.10
June,	69.00	92.50	21st	50.00	15th	1.38	63.76	89.00	16th	35.00	6th, 10th	3.49	63.20	82.00	21st	40.00	4th, 19th and 20th	2.33
July,	68.64	93.00	2d	57.10	16th	3.75	70.41	93.00	17th	41.00	2d	2.07	68.80	95.00	4th	41.00	1st	3.82
August,	69.25	92.40	20th	48.80	25th	5.10	66.05	87.00	1st, 18th	34.00	28th	8.31	66.30	90.00	27th	39.00	22d	2.60
September,	64.35	90.00	10th	39.00	14th	1.25	58.32	81.00	14th	27.00	11th	0.85	59.50	83.80	9th	31.60	21st	5.48
October,	50.27	78.20	4th	26.50	26th	2 40	49.14	80.00	4th	24.00	26th	3.65	48.90	77.90	9th	17.00	17th	2.97
November,	38.43	61.00	23d	19.80	25th	2.53	39.80	70.00	8th	11.00	28th, 29th	5.54	38.34	65.50	2d	15.90	28th	5.25
December,	30.00	57.40	7th	—10.00	20th	5.58	29.59	65.00	10th	6.00	21st, 22d	3.54	22.99	49.00	11th	0.80	30th	3.61
Means and Sums,	48.29	-	-	-	-	40.38	44.86	-	-	-	-	42.43	46.17	-	-	-	-	43.53

MONTHS.	1887.					
	Temperature.					Rain in Inches.
	Mean.	Maximum.	Date.	Minimum.	Date.	
January,	19.39	47.20	24th	—22.20	19th	4.57
February,	24.15	43.80	9th	—3.80	5th	5.05
March,	26.41	46.00	21st	—2.40	5th	4.05
April,	41.61	74.40	10th	17.10	8th	2.98
May,	60.91	86.50	20th	33.20	14th	1.13
June,	65.67	91.00	30th	38.50	11th	5.09
July,	73.71	93.60	2d	56.00	15th	8.93
August,	64.92	88.00	1st	42.50	14th, 28th	7.75
September,	55.94	80.00	7th	29.50	27th	1.22
October,	47.00	74.40	8th	17.00	31st	2.10
November,	36.49	64.80	7th	11.00	30th	3.35
December,	26.65	51.00	12th	—6.00	31st	4.11
Means and Sums,	45.23	-	-	-	-	50.33

C. A. GOESSMANN,

Director.

JAMES P. LYNDE, *Treasurer, in Account with* MASSACHUSETTS AGRICULTURAL EXPERIMENT STATION.

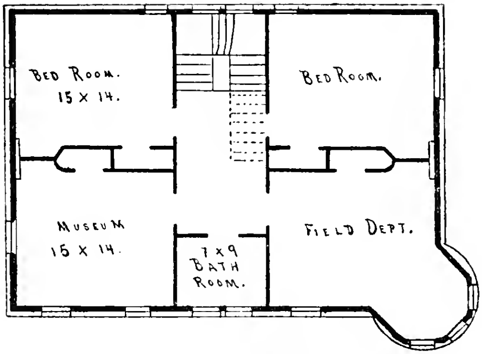
1887.		*Receipts.*		1887.	*Expenditures.*	
Jan.	1,	Cash in Bank,	$400 99		Salaries,	$3,191 45
	1,	Dr. C. A. Goessmann, Director,	77 82		Laboratory Supplies,	818 50
	7,	State Treasurer,	2,500 00		Printing and Postage,	782 17
April	1,	State Treasurer,	2,500 00		Office Expenses,	201 34
	11,	Dr. C. A. Goessmann, Director,	155 01		Farmer and Farm Labor,	1,842 05
June	22,	Dr. C. A. Goessmann, Director,	117 80		Farm Supplies,	560 82
July	6,	State Treasurer,	2,500 00		Stock and Feed,	645 92
Oct.	1,	State Treasurer,	2,500 00		Miscellaneous Expenses,	364 38
	11,	Dr. C. A. Goessmann, Director,	178 30		Repairs and Construction,	1,736 43
					Horses,	375 00
					Expenses of Board of Control,	148 75
					Cash in Bank Dec. 31, 1887,	263 11
			$10,929 92			$10,929 92

ATHOL, Jan. 1, 1888.

JAMES P. LYNDE, *Treasurer.*

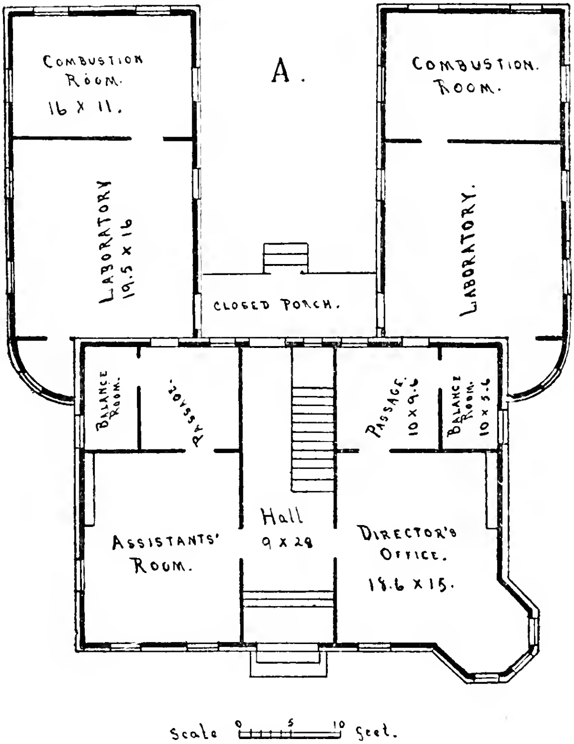
Examined, compared with the vouchers, and found correct. ALVAN BARRUS, *Auditor of the Board of Control.*

B.



STATION BUILDING — 2nd FLOOR.

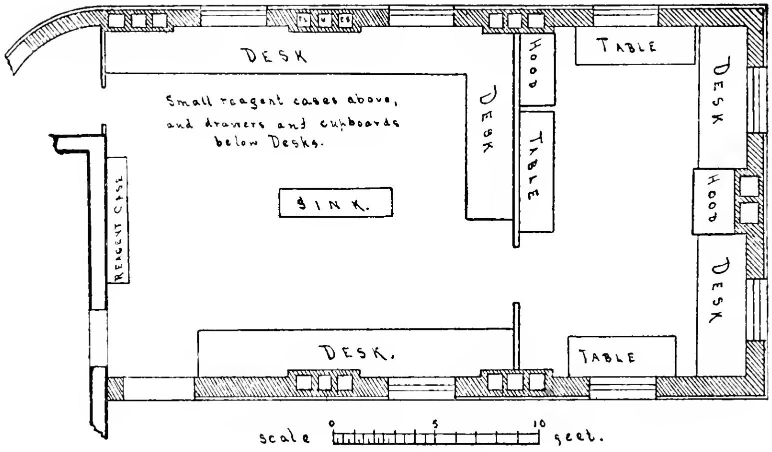
A.



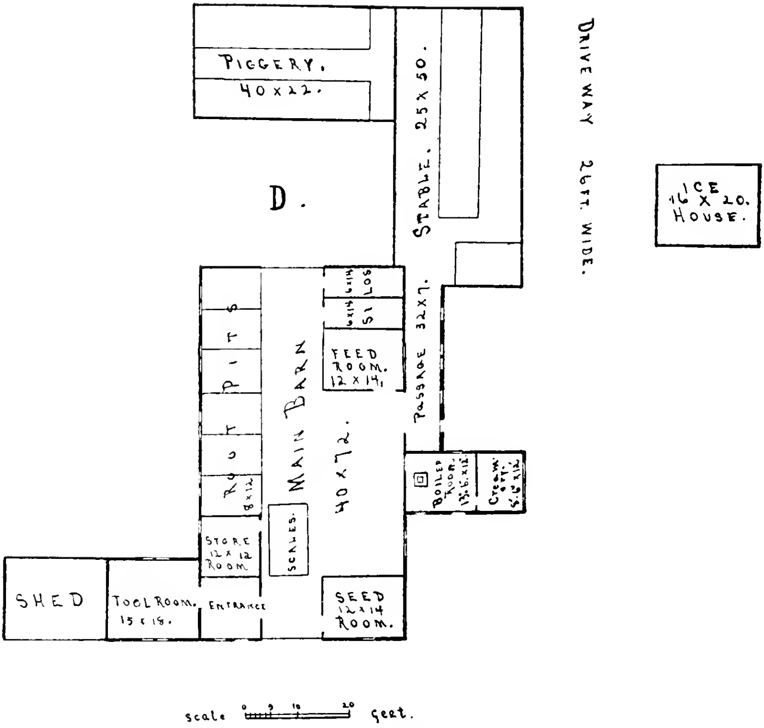
STATION BUILDING — GROUND PLAN.

A. LABORATORY BUILDING....... GROUND PLAN
B " " SECOND FLOOR

C.



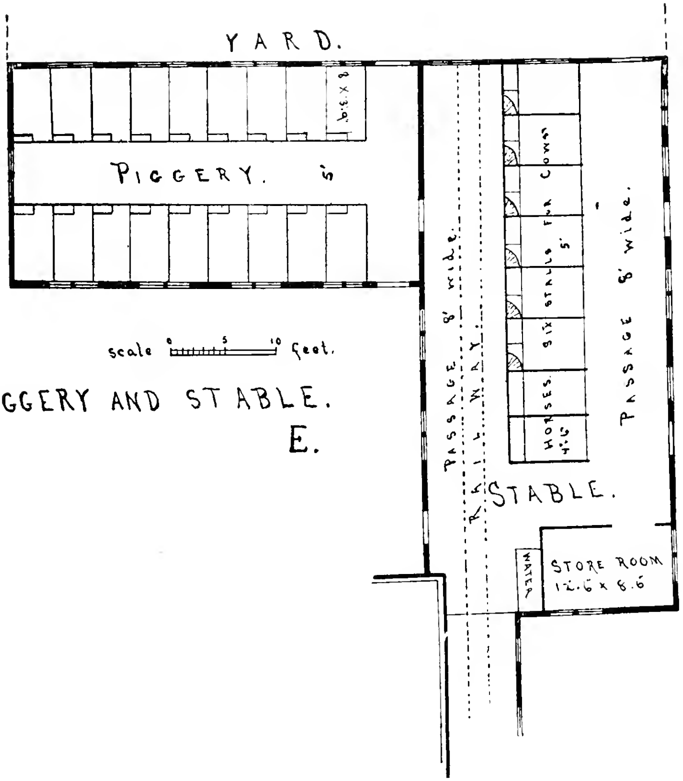
PLAN OF LABORATORY.



PLAN OF FARM BUILDINGS.

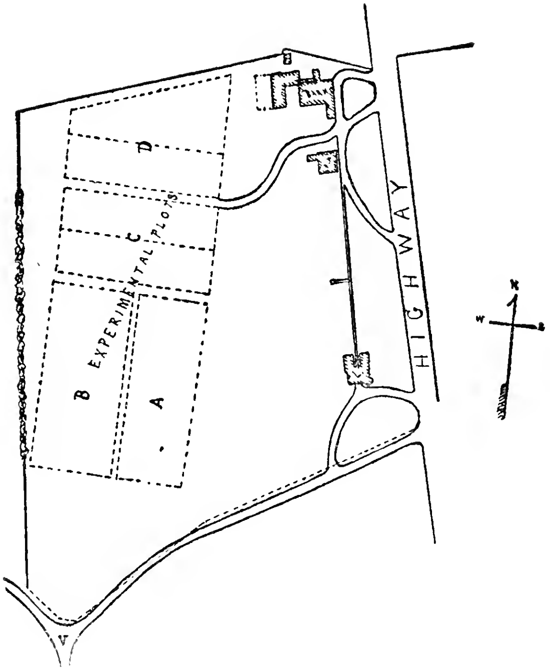
C. One Wing of Chemical Laboratory

D. Plan of Farm Buildings.



PIGGERY AND STABLE.

E.



Map of Land Leased to the

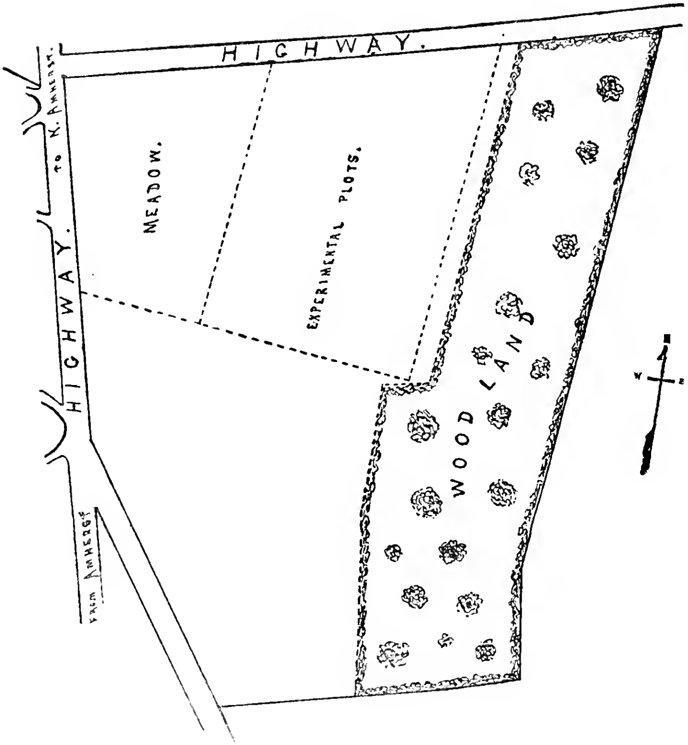
MASSACHUSETTS EXPERIMENT STATION,

FROM THE

AGRICULTURAL COLLEGE FARM,

West of the Highway.

Area taken, 17.72 Acres.



Map of Land Leased to the

MASSACHUSETTS EXPERIMENT STATION,

from the

AGRICULTURAL COLLEGE FARM,

East of the Highway.

Area taken, 30.52 Acres.

INDEX TO SECRETARY'S REPORT.