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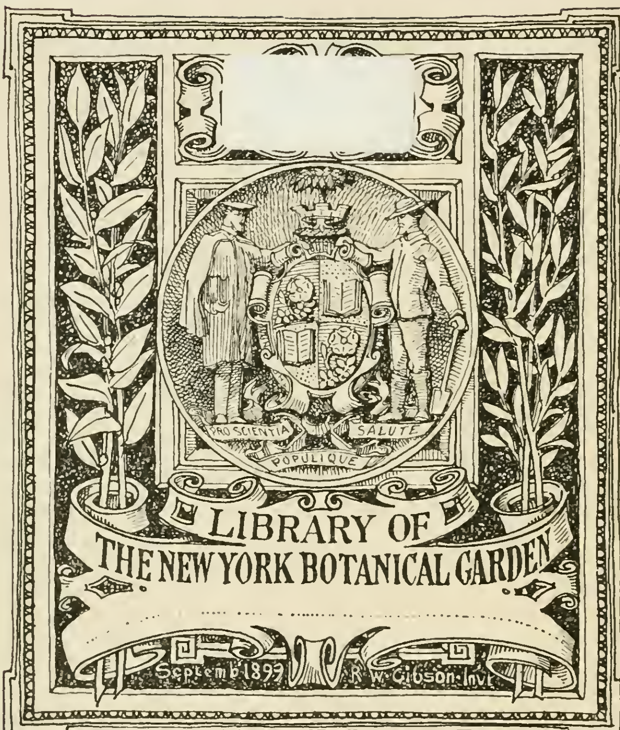
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FIFTEENTH ANNUAL REPORT

OF THE

SECRETARY

OF THE

Connecticut Board of Agriculture.

1881-82.

Printed by Order of the Legislature.

HARTFORD, CONN.:
PRESS OF THE CASE, LOCKWOOD & BRAINARD COMPANY.
1882.

To the General Assembly of Connecticut:

In accordance with the provisions of the Act creating a STATE BOARD OF AGRICULTURE, I have the honor to present the Report for 1881–82.

T. S. GOLD, *Secretary.*

WEST CORNWALL, January 4, 1882.

STATE BOARD OF AGRICULTURE.

1881-82.

His Excellency HOBART B. BIGELOW, *ex officio*.

APPOINTED BY THE GOVERNOR AND SENATE.

		Term Expires.
E. H. HYDE,	Stafford,	1882.
ALBERT DAY,	Brooklyn,	1883.
H. L. STEWART,	Middle Haddam,	1882.
J. P. BARSTOW,	Norwich,	1883.

ELECTED BY THE AGRICULTURAL SOCIETIES.

Hartford County,	L. S. Wells,	New Britain,	1882.
New Haven County,	J. J. Webb,	Hamden,	1883.
New London County,	James A. Bill,	Lyme,	1883.
Fairfield County,	B. K. Northrop,	Ridgefield,	1882.
Windham County,	Ralph W. Robinson,	Hampton,	1882.
Litchfield County,	C. T. Hickox,	Watertown,	1882.
Middlesex County,	J. M. Hubbard,	Middletown,	1883.
Tolland County,	Alfred R. Goodrich,	Vernon Depot,	1883.

ELECTED BY THE BOARD.

T. S. Gold, West Cornwall, *Secretary*.

OFFICIAL LIST.

Governor Hobart B. Bigelow, *President*.

E. H. Hyde,	Stafford,	*Vice-President*.
T. S. Gold,	West Cornwall,	*Secretary*.
Nathan Hart,	West Cornwall,	*Treasurer*.
Prof. S. I. Smith,	New Haven,	*Entomologist*.
Prof. W. H. Brewer,	New Haven,	*Botanist*.
Prof. S. W. Johnson,	New Haven,	*Chemist*.
P. M. Augur,	Middlefield,	*Pomologist*.

E. H. Hyde, T. S. Gold, H. L. Stewart,
Commissioners on Diseases of Domestic Animals.

James A. Bill, J. M. Hubbard, H. L. Stewart,
Auditors.

REPORT.

The Fourteenth Annual Meeting of the Connecticut Board of Agriculture was held at Room No. 50, Capitol, Hartford, Wednesday, January 12, 1881, at 10 A. M., Hon. E. H. Hyde, Vice-President, in the chair.

Present, Messrs. Hyde, Rockwell, Stewart, Wells, Day, Webb, Hubbard, Goodrich, and Gold. Mr. Bill was present at the afternoon session.

Committee consisting of Messrs. Day and Wells, on credentials, were appointed by the chair. The committee reported as members elect for two years, Messrs. Bill, Hubbard, Webb, and Goodrich.

Prof. Brewer, Chairman of Committee appointed at the Convention at New Britain to examine the offer of the Messrs. Storrs at Mansfield, reported. The report was accepted, and the committee discharged.

The report of the Treasurer was read and accepted, and referred to the Auditors.

On motion of Mr. Hubbard, the Board proceeded to the choice of officers. Gov. Bigelow being President *ex officio*, the list was filled as follows:

E. H. Hyde, Stafford, Vice-President.
T. S. Gold, West Cornwall, Secretary.
N. Hart, West Cornwall, Treasurer.
Prof. S. W. Johnson, New Haven, Chemist.
Prof. W. H. Brewer, New Haven, Botanist.
Prof. S. I. Smith, New Haven, Entomologist.
P. M. Augur, Middlefield, Pomologist.

The business of appointing the cattle commission was laid on the table.

Auditors, Messrs. Rockwell, Stewart, and Hubbard.

Messrs. Day, Webb, and Hubbard were appointed a committee to wait on the Governor and inform him that the Board was in session, and invite his attendance.

On motion of Dr. Goodrich,

Resolved, That Dr. Noah Cressy be appointed as Veterinary Surgeon to the Board.

This motion was laid on the table.

At this time Gov. Bigelow was introduced and took the chair.

The report of the committee on the offer of the Messrs. Storrs was taken up, discussed and tabled.

The Report of several veterinarians was read on different cases of diseases in animals.

The Board adjourned to 2 P. M.

The Board met at 2 P. M., James A. Bill in the chair.

The Secretary presented a letter from Prof. Collier on sugar making, and was directed to extend to Prof. Collier an invitation to give a lecture on the subject.

Messrs. Gold, Rockwell, and Webb were appointed a Committee to arrange time, place, and subject for the next winter meeting.

Resolved, That the Vice-President and Secretary be authorized to appoint members to visit Fairs.

The offer of Messrs. Storrs was taken up.

E. H. Hyde resumed the chair. On motion of Mr. Hubbard,

Resolved, That E. H. Hyde and Dr. Goodrich be a Committee to confer with the Messrs. Storrs and obtain in writing their offer for a Farm-School to be reported to the Governor or the Committee on Agriculture of the General Assembly.

The Report of the Committee on diseases of domestic animals was read and accepted.

Resolved, That the bill of Dr. Cressy be approved as far as the work has been done at the call of the commissioners.

The Cattle Commissioners were then appointed as follows: Messrs. Hyde, Gold, and Stewart.

Resolved, That the Cattle Commissioners be authorized to employ such veterinary assistance as they think necessary.

Resolved, That $100 be paid to Mr. Augur for his services as Pomologist.

The Board then adjourned *sine die*.

T. S. GOLD, *Secretary*.

WEST CORNWALL, Jan. 13, 1881.

A special meeting of the Board of Agriculture for the election of a Trustee of the Storrs' Agricultural School was held in Hartford, room 50, Capitol, April 14th, at 11 A.M. Present—Messrs. Hyde, Hickox, Webb, Stewart, Goodrich, Day, Bill, Hubbard, Gold, and J. P. Barstow of Norwich appointed by the Governor in place of J. T. Rockwell of Winsted, resigned.

On motion of Mr. Stewart an informal ballot was held. The vote stood E. H. Hyde, 10 ; Dr. A. R. Goodrich, 2 ; and on motion of Dr. Goodrich, E. H. Hyde was chosen by acclamation.

The chairman of the cattle commission reported their action in regard to the horses of H. S. Merwin of Durham, and on motion of Mr. Hubbard it was Resolved

That the Board of Agriculture hereby gives expression to its perfect confidence in the ability, integrity, and discretion of the gentlemen composing the cattle commission, and believe that their action in the discharge of their duties has been wise and conservative.

Mr. J. A. Bill was chosen auditor in place of Mr. Rockwell. The following resolution was then passed relative to the Treasurer's Bond.

Resolved, That the Treasurer be required to give or renew bonds annually to the acceptance of the Secretary.

The Secretary then reported that he had received a request from the State Agricultural Society that he should issue a circular with dates of time of holding the several fairs in the State, and also notify the several societies to meet in convention to fix time of holding their fairs.

The board then adjourned *sine die*.

T. S. GOLD, *Secretary*.

HARTFORD, April 14, 1881.

List of Fairs in Connecticut, 1881, with Delegates:

CONNECTICUT STATE FAIR, Mr. Barstow.
At Meriden, Sept. 20–23.

HARTFORD COUNTY, Messrs. Day and Augur.
No Fair.
East Granby, Oct. 5.
Pequabuck, Bristol, Oct. 5, 6.
Simsbury, Oct. 5, 6.
Suffield, Sept. 28, 29.
Union, (Somers, &c.) Broad Brook, Oct. 5.

NEW HAVEN COUNTY, Messrs. Wells and Northrop.
No Fair.
Guilford, Sept. 28.
Milford and Orange, Milford, Sept. 28, Oct. 1.
Oxford, Sept. 20.
Woodbridge and Bethany, Woodbridge, Sept. 28, 29.

NEW LONDON COUNTY, Dr. Goodrich.
At Norwich, Sept. 27–29.

FAIRFIELD COUNTY, Messrs. Webb and Hickox.
At Norwalk, Sept. 13–16.
Danbury, Oct. 4–7.
Ridgefield, Sept. 20–23.
Union, (Monroe, &c.) Trumbull, Sept. 22, 23.

WINDHAM COUNTY, Mr. Bill.
At Brooklyn, Sept. 13–15.
Woodstock, Sept. 20–22.

LITCHFIELD COUNTY, Mr. Hubbard.
No Fair.
New Milford, Sept. 28, Oct. 1.
Watertown, Sept. 27–29.
Woodbury, Sept. 14, 15.
Harwinton, Oct. 4.

MIDDLESEX COUNTY, Mr. Robinson.
No Fair.
Clinton, Sept. 21.

Tolland County, Mr. Stewart.
At Rockville, Sept. 27, 28.
Tolland County East, Stafford Springs, Oct. 6, 7.

A special meeting of the Connecticut Board of Agriculture was held at the call of the President at Capitol, Hartford, Nov. 2, 1881, at 12, m. His Excellency, Hobart B. Bigelow, President, in the chair.

Present—Gov. Bigelow and Messrs. Robinson, Hickox, Barstow, Webb, Hyde, Bill, Day, Hubbard, Wells, Gold.

The subject of the horses of H. S. Merwin was called up by Gov. Bigelow as the business of the meeting.

Hon. E. H. Hyde, chairman of the cattle commission, reported upon the condition of the horses and the action of the commission. On motion of Mr. Webb it was

Resolved, That the cattle commission of this Board be directed to use all lawful measures to prosecute the owner for violation of the law, and to secure the destruction of the horses of H. S. Merwin of Durham, which horses are affected with glanders, and are now quarantined by the commission for glanders, and recently pronounced glandered by Drs. Liautard and Law, distinguished veterinary surgeons, who recommend their destruction.

The meeting then adjourned *sine die*.

T. S. GOLD, *Secretary*.

Hartford, Nov. 2, 1881.

A meeting of the Connecticut Board of Agriculture was held at Newtown, Dec. 13, 1881, at 8 p. m.

Hon. E. H. Hyde in the chair.

Present—Messrs. Stewart, Hickox, Day, Robinson, Webb, and Gold.

The report of the commissioners on Diseases of Domestic Animals was read and accepted, and it was ordered that it be printed immediately and presented to the General Assembly early in the session.

The Board met Dec. 15 at 9 P. M.

The Secretary presented a circular from Gen. W. B. Hazen, chief signal officer, U. S. A., and the following resolution was passed:

WHEREAS, the system of furnishing by telegraph forecasts of the weather, for the benefit of farmers, has been in operation for several years,

Resolved, That the information thus furnished has been of great value to farmers, and we hope the system will be continued with greater facilities for extending its work.

The Secretary presented a communication from Hon. George B. Loring, Commissioner of Agriculture, requesting the appointment of delegates to conventions to be held at Washington, beginning Jan. 10th, four in number and each to last two days, *viz.:*

Agricultural Colleges and Societies, - -	Jan. 10.
Cattle, Breeding, &c., - - -	Jan. 12.
Cereals, - - - - -	Jan. 14.
Grape Culture and Wine Making, - -	Jan. 17.

Resolved, That this Board choose three delegates to each of these conventions and that they go at their own charges.

The following delegates were chosen:

1st. Agr'l Colleges, &c.—Prof. W. O. Atwater, Sec. B. G. Northrop, T. S. Gold.

2d. Cattle—James A. Bill, E. H. Hyde, Alexander Warner.

3d. Cereals—G. A. Bowen, J. J. Webb, Harry Sedgwick.

4th. Grapes and Wine—J. H. Dickerman, P. M. Augur, Albert Day.

Resolved, That the annual meeting be held Jan. 18th.

Adjourned to 8½ A. M., Friday, Dec. 16.

The Board met Friday, 9 A. M., and the following action was taken:

Resolved, That the Secretary be directed to furnish the letters of Drs. Law and Liautard to the Connecticut *Farmer* and the New England *Homestead* for publication.

The Board then adjourned.

T. S. GOLD, *Secretary*.

REPORT OF THE COMMISSIONERS ON DISEASES OF DOMESTIC ANIMALS.

To the Connecticut Board of Agriculture:

Your Commissioners have been called to investigate a number of cases of supposed contagious pleuro-pneumonia or other contagious diseases in our domestic animals. They have not often been of such a nature as to attract public attention or create any general alarm, and hence may be passed without specific detail.

PLEURO-PNEUMONIA.

The alarm in a supposed case of pleuro-pneumonia, that at first appeared of a threatening character, proved to be groundless.

Close watch has been maintained in that part of the State where the disease has heretofore existed, and the most vigilant inquiry has failed to detect any cases in the State during the past year, so that now our only danger is from fresh importation of the disease from infected districts.

CONTAGIOUS DIARRHEA IN CALVES

has appeared in fatal form on several farms, especially where veal calves are fattened for market. In these cases the calves were bought from different farms, and hence it could not be from any hereditary weakness, neither does it appear as affecting particular breeds. The calves, bought in perfect health, contracted the disease soon after they were placed in the infected pens, nearly all thus exposed being attacked.

Symptoms.—Profuse scouring, attended with pain, emaciation, and loss of appetite. As the disease advances, the dejections become whitish like curdled milk, and tinged with blood. The calf usually dies within a week from the attack, sometimes sooner. Natural recovery is very slow and attended with such a weakness of the digestive organs as usually to render the animal valueless.

Treatment.—Two or three tablespoonfuls of castor oil, according to the age of the calf. Follow in about six hours with laudanum, one teaspoonful, prepared chalk or magnesia, ginger, and tincture of kino, one or two tablespoonfuls of each, in two doses, with an interval of six hours. The laudanum, ginger, etc., may be mixed with wheat flour and finely-pulverized charcoal, then moistened and made into a half dozen balls the size of a large hickory nut, and given in two doses.

Medicine will do little good unless the animal is removed to fresh, clean quarters. The premises should be thoroughly disinfected by the use of carbolic acid or some other disinfectant, and no other calves should occupy the pens for a considerable period. The fraction of a year between one season's calves and another has been found insufficient to render the pens safe. Cleaning out the pens and supplying a layer of fresh earth answers for the floor, but this will not reach the walls, racks, and fodder, which may be more or less infected. Personal experience some years since taught us the exceeding difficulty of cleansing an infected calf-pen. We advise thorough work at the outset whenever the disease appears.

HOG CHOLERA

has been confined to a few pens, where it has been undoubtedly introduced from abroad, and has not spread in any locality so as to be general or considered epidemic.

Most other cases of possibly contagious disease have been so strictly local as to warrant the opinion that they were the result of local causes, and hence would possess little public interest.

GLANDERS.

The Commission have continued to examine, with the aid of competent veterinarians, all suspected cases of glanders that have been presented to their attention, and as the owners on receiving notification that their horses were glandered have promptly caused them to be killed according to law, with one notable exception, it will be unnecessary to enumerate these cases.

The tedious case of the horses of H. S. Merwin still remains on hand, and in order to a full understanding of it we copy the report of last year, and continue its history to the present date.

About the middle of July, 1880, we were informed that Mr. Merwin had horses suspected of glanders, recently brought from Vermont. July 20th, on information from Geo. H. Parkinson, a veterinary practitioner of Middletown, that these horses in his opinion were glandered, we sent notice of quarantine by him to Mr. Merwin, which was delivered July 21st. July 23d the commission visited the horses with Dr. O'Sullivan of New Haven, but his report was withheld till Mr. Merwin could also call a veterinarian, and then one horse was pronounced by him as glandered and the symptoms of the other such as "to demand close quarantine."

Thomas Bland, a veterinary practitioner of Waterbury, called by Mr. Merwin, reported to us August 1st that the horses were glandered.

August 4th, we again visited the horses and notified Mr. Merwin that one horse was glandered, and called his attention to his duty under the statute, and continued the quarantine of the other horse.

Dr. Tibbals of New Haven also saw the horses and reported to us his opinion that they were glandered.

August 11th, we notified John Marshal, first selectman of Durham, of the condition of the horses, and of the law.

In August, as Mr. Merwin refused to admit that the horses were glandered, and claimed that if glandered they should be appraised and slaughtered by the commission, and paid for by the State, the commission offered him to have the horses appraised and slaughtered, and if found glandered to be his loss, he also paying the veterinary expense, but if not glandered the commission would pay for the horses and expenses. This offer substantially was repeated at other times.

October 1st, Dr. Noah Cressy examined the horses at our call, and reported the existence of glanders as "decidedly doubtful," but says that "under such a doubtful condition they cannot be relieved from quarantine."

October 30th, we again examined the horses, and at this time withdrew the notice that required Mr. Merwin, according to the statute, to slaughter one of the horses, and quarantined them both.

December 1st, Dr. O'Sullivan made a second visit and sustained his previous opinion.

December 4th, we called Dr. Liautard, of the New York Veterinary College, to examine the horses. He reported that inoculation alone would settle the question of the nature of the malady, and with our authority took some of the virus from both horses to New York and inoculated two healthy horses, resulting in the production of glanders and farcy in both horses, and he reports "both horses from which the virus was obtained as being affected with chronic glanders." (Note.—The testimony of the veterinarians, by which the commission have been governed, is given in full with this report.)

The latter part of August Mr. Merwin sent us the opinion of Henry G. Newton, endorsed by other lawyers, that the commission were required to appraise and slaughter the horses if glandered, to be paid for by the State under the general law on contagious diseases of domestic animals.

The opinion of the commission that it was not our duty to appraise and slaughter horses affected with glanders has been sustained by Gov. Andrews and other legal authorities consulted by us. (Note.—This legal opinion is also appended to the report.)

The horses are still living, and the order of quarantine is still in force, no farther action having been taken by the commission. The case has proved a tedious one; we have spared no pains to elicit the truth, and our action has always been controlled by the best veterinary authority, yet tempered with a tender regard for Mr. Merwin, and not from any doubts of the nature of the malady affecting the horses.

E. H. HYDE,
T. S. GOLD,
H. L. STEWART, } *Commissioners.*

REPORT OF GEORGE H. PARKINSON.

NEW YORK CITY, Feb. 3, 1881.

August 4, 1880, in company with Commissioners Hyde and Stewart, I examined a pair of horses belonging to Henry S. Merwin of Durham, Conn. These horses were quarantined per order Commissioner, July 21, 1880, and I had seen No. 1 previous to this and condemned her for glanders, also warning owner to be cautious or to kill the animal.

No. 1. Sex and color—Mare, dark brown, near hind pastern white, with star in forehead. Age—About seven or eight years old. Disease—Glanders. History—This mare was received in exchange for another horse and a quantity of hay from A. E. Austin, liveryman of Meriden, who claimed to have brought the horses from Vermont in the spring. Mr. Merwin called the attention of Austin to the enlarged submaxillary glands and discharge from nose of one horse, but he passed it off (Austin) by saying that it was only a cold and would be all right soon.

Symptoms—About the same as on July 21st. Pulse 48; respirations 32; temperature $100\frac{7}{8}$° F.; breathing rather stertorous; also one or two scratches about body which seem to be healing kindly; coat looks pretty well; watery discharge from both nasal cavities, but not profuse, from the fact that the owner had probably wiped and washed nose out. Ulcers to be seen on both sides of septum nasi; both submaxillary glands enlarged, the left being the largest, but there are no nodosities visible. Prognosis unfavorable, and no treatment.

No. 2. Sex and color—Brown, but very much faded; hind pastern white, near fore heel white, the white forming a ring around entire coronet, blaze on face a little inclined to left side. Age and disease—About seven years old; glanders. History—This mare was received in exchange for another horse and a quantity of hay from A. E. Austin, liveryman of Meriden, who claims to have brought the horse from Vermont. This mare is rather thin in flesh, much faded in color, and has had two or three hemorrhages from right nostril since Mr. Merwin bought her. At the last attack they thought she would bleed to death. They called in the village physician, who injected a solution of Tincture Ferri Perchloride into nasal cavities, also a hypodermic injection of Ergotine.

Symptoms—21st July. Discharge from nose, slight enlargement of submaxillary glands, an ulcer in left nasal cavity on lower part of septum nasi.

August 4th. Pulse 44; respiration 24; temperature 100¾° F.; watery discharge from nose; slight enlargement of submaxillary glands and adhered together; in left nasal cavity there are two ulcers on septum nasi near lower extremity; anterior portion of lungs probably more or less affected; some cough on compressing trachea, but no nodosities visible. Prognosis—Unfavorable, and no treatment.

P. S.—These examinations were made at owner's farm, one July 21st, the other Aug. 4th. Mr. Merwin has owned these horses about three months, and he is very careful to wash out nose before any one examines them, and they being at grass would have a tendency to keep nose clean. But from what I can ascertain there is a muco-purulent discharge.

Yours, etc., GEO. H. PARKINSON.

REPORT OF DR. W. J. O'SULLIVAN, RECEIVED AUG. 7, 1880.

At the request of the Commissioners, Messrs. Hyde and Stewart, I examined, July 23d, two mares, said to be the property of H. S. Merwin.

Mare No. 1. The first examined being a dark brown mare, white star in forehead and white hind fetlock; this mare exhibited two ulcers on schneiderian mucous membrane (the mucous membrane lining nostrils), and the characteristic muco-purulent discharge, etc., of glanders.

The second mare was a light brown mare; the appearances in this mare were not sufficiently developed to warrant a decided opinion, but were sufficient to demand close quarantine.

W. J. O'SULLIVAN, M. R. C. V. S.

REPORT OF THOMAS BLAND.

WATERBURY, JULY 29, 1880.

MR. E. H. HYDE:

Dear Sir,—By request of Mr. Austin of Meriden, I examined two mares, the property of Mr. H. S. Merwin, of Durham, and the following are the conditions:

Black mare, star on forehead; enlargement of intermaxillary gland on left side, nodosities and ulcers in nasal cavities on same side, discharge from both nostrils, and cough. Tubercles may exist in the lungs, as there is undoubtedly a diseased condition of both lungs.

Dark brown mare with white strip on face and white feet, having, I believe, bled from the nose twice. Discharging from both nostrils; not any nodosities or ulcers perceptible in nasal cavities, and no enlargement of intermaxillary glands; pressure on trachea causing painful cough; auscultation revealing a slightly diseased condition of the antero-infero portion of both lungs. Although these conditions may be enough to condemn this mare as being glandered, yet the two most important diagnostic symptoms are absent. Still it is my opinion that both mares are suffering with glanders, one being farther advanced than the other.

Yours truly, THOMAS BLAND.

REPORT OF DR. NOAH CRESSY, RECEIVED JAN. 6, 1881.

HARTFORD, CONN., NOV. 2, 1880.

To the Honorable Board of Cattle Commissioners:

GENTLEMEN,—The condition of Merwin's horses in Durham, that I was called upon by your Chairman, Oct. 1st, to examine for glanders, was decidedly doubtful. The discharge which I saw that day was not characteristic of the disease. In fact, there was only a slight discharge, and not unlike that seen in distemper or sub-acute form of catarrh.

The submaxillary glands were not *much* enlarged, and were *said* to be improving in some respects, less swollen than formerly, and as *no chancres* could be found upon the nasal membrane, I could not concur in the opinion before expressed by other veterinarians.

These cases are interesting and unique, and nothing but the experiment of an inoculation will satisfy me of the true nature of the malady in question. And this should be resorted to *at once*, for a pathological demonstration. Under such a doubtful condition they cannot be relieved from quarantine, but the real symptoms of glanders are not yet manifest.

Yours very truly, N. CRESSY, M.D., V.S., Ph.D.

REPORT OF DR. LIAUTARD.

NEW YORK, Dec. 27, 1880.

E. H. HYDE, ESQ.:

Dear Sir,—On or about the first of this month you requested me to visit in Connecticut a pair of mares, the property of Mr. Merwin, which had been quarantined for some time as being suspected as affected with glanders, and to settle, if possible, the difference of opinion existing as to their positive condition between several veterinary practitioners and two veterinary surgeons, Messrs. O'Sullivan and Cressy, and thus to decide as to the following action to be taken by your commission.

Accordingly, on the 4th of said month, in your company, I visited the two mares of Mr. Merwin. After hearing the history of their case and the description of the symptoms they had presented, I proceeded to my examination.

The near mare, about 7 years old, 15 hands 2 inches high, with long tail, fair mane, a star on the forehead, some saddle marks, and a low stocking on the near hind leg, was found in good condition, with the maxillary glands slightly swollen, a slight discharge on the left side, and presented on the membrane of the septum nasi three or four superficial abrasions; this same membrane was slightly purplish slate color, and gave a slight rough sensation to the touch; the pulse was normal, the respiration normal, the temperature 101$\frac{1}{5}$° F.

The off mare was 8 years old, about 15 hands 2 inches high, with long tail, light mane, a stripe on the left side of the nose, middle-size stockings on both hind legs, a white ring on the near fore foot, and a few white hairs on the left side of the chest; also in good condition, with normal pulse and respiration, and a temperature of 101. I found her with the maxillary ganglions quite small, but tender, discharging from both nostrils, the discharge being slight, purulent, but not characteristic of glanders, and having on the mucous membrane of the nose, which was quite injected, numerous epithelial erasions. This mare, I was told, had a profuse attack of epitaxis in July last.

In the presence of the symptoms presented by these two animals, and taking into consideration their previous history, with the report that their condition had considerably improved recently, I could not condemn them as being affected with glanders; but, with the condition of the mucous membranes principally, and of the other symptoms, I believe it was justifiable to consider both as suspicious of being affected with the disease. It being important to have the question solved as early as possible, and considering that sometimes this suspicious condition lasts for months, I suggested the propriety of inoculating two animals of the same species with the discharge obtained from both mares. In this you agreed, and here, in a few words, is the result of the experiments.

Having received on two different pieces of glass the discharge, first of the near and then of the off mare, and having obtained two horses apparently free from disease, both were inoculated on the 9th of December and placed on observation, the septum nasi and the outer surface of the false nostrils being selected as the two best spots for inoculation.

A rabbit was inoculated on the inside of both thighs. This animal was found dead three days after, and at post-mortem it presented a diseased condition of the lymphatics of the legs. Though experiments on rabbits are not always successful, negative results would not have proved the non-contagious condition of a virus; but a positive result here is of much importance.

The two subjects of inoculation did not give the results as early as they generally do in similar cases, as, instead of appearing after four or five days, it was only towards the 19th of December, when I was on the point of looking at the result as negative, that they began to show themselves.

On the horse that had received the discharge of the near mare, farcinous cords, buttons, and ulcers on the face manifested themselves, with evident tendency to disease of the lymphatics of the neck; and on the other horse, which had received the discharge of the off mare, ulcerations on the membrane of the nose. As these were slow in their progress, to hasten the development of the symptoms this same horse was re-inoculated with his own discharge from these ulcerations, and with it, in three days, symptoms of acute farcy and glanders became evident on both sides of the face. Having thus decided by the positive result of those inoculations, both animals were destroyed.

On examination, the head of the first revealed small ulcers on both sides of the nostrils on the posterior part of the septum, lead coloration of the mucous membrane, infiltrations of the lymphatic vessels. The head of the second had also ulcerations, same appearance of the mucous membrane of the nose, and a suppurative collection on the left side in the nasal turbinated bone.

In the presence of the results obtained by the inoculation, of the symptoms manifested, and of the lesions revealed, I am brought to the conclusion to pronounce both mares from which the virus was obtained as being affected with chronic glanders.

Respectfully yours,

A. LIAUTARD, M.D., V.S.

LETTER OF DR. JAMES LAW.

CORNELL UNIVERSITY,
ITHACA, N. Y., Feb. 7, 1881.

HON. E. H. HYDE:

My Dear Sir,—Regarding the case of glanders: First, I know of no State nor province in which glandered horses killed by State or municipal order are paid for. The rule appears to be to place all such cases on the level with canine madness, and to be destroyed, without indemnity, as dangerous to human life. As to the propriety of paying for such animals a good deal might be said. The principle of withholding compensation when the animals killed had been suffering from an affection that threatens human life, would bring into this list malignant anthrax (bloody murrain), tuberculosis, milk sickness, Asiatic cholera in animals.

No one would think of seeking compensation for a *rabid* animal in which death would certainly have occurred at an early date in any case. *Glanders* and *tuberculosis* are not necessarily fatal, but genuine and permanent recoveries are rare, and the apparent recoveries so commonly seen are but a temporary covering up of the poison, to break out again whenever the patient is subjected anew to unhealthy conditions. These, therefore, are especially to be feared, since in these apparently convalescent conditions as liable to propagate a most dangerous affection, through milk and flesh, etc., to man and animals. The recovery from anthrax, on the other hand, is a full and permanent recovery, and insures the patient against any further attack of the same disease, just as does a first attack of small-pox, rinderpest, or lung plague. Slaughter for anthrax, rinderpest, or lung plague would, therefore, abstractly give the owner a much better title to indemnity than would compulsory slaughter for glanders or tuberculosis. If we look at the other side of the question, it will doubtless appear that the entire extinction of glanders in a State will be greatly hastened by giving indemnity for the animals killed. If the owner is assured that he can get a reasonable recompense for a diseased horse that is almost doomed to die in any case, that may infect himself or his employees fatally, and that he is liable to a fine for exposing in any public place, he will very naturally turn to the authorities for assistance in place of hiding away the disease. In New York it is illegal to use a glandered horse on the public highways, but the enforcement of the law is nobody's business, hence it is a dead letter, and hundreds of glandered horses are kept constantly at work in New York and Brooklyn. To meet such cases you must either employ a staff of inspectors and subject the whole equine population to examination, or you must encourage the owners to report by the promise of indemnity. For a *speedy stamping out* of the disease, I believe the offer of an indemnity would be a most valuable measure. I do not think the owner has any just claim to indemnity, but I think, as a matter of expediency, indemnity would work well.

2d. The history of your two cases, the manifest symptoms of glanders in the early stages, and the supervention of glanders in the two horses inoculated by Dr. Liautard, give the most irrefragible evidence that this is the disease you are dealing with. Any delay to test the matter further by additional inoculations seems to savor of obstruction, and would appear to be quite uncalled for. Dr. Liautard appeared as no partisan, and declined to give a diagnosis until he had tested the matter by inoculation. Bias is therefore out of the question. He took the only right course to be followed in doubtful cases, as horses with chronic glanders will improve or remain stationary under rest, good feeding, and good air; delay could therefore serve no good end. It would only strengthen the doubts. Inoculation gave the sole means of deciding. The inoculation of two subjects removed the objection that might have arisen to the inoculation of one—that it might have been constitutionally insusceptible to the disease,—and the contracting of the disease by both horses inoculated manifestly settles the question.

Yours very truly,

JAMES LAW, F. R. C. V. S.

LEGAL OPINION OF E. H. HYDE, Jr., AND OTHERS.

Hartford, Ct., Jan. 14, 1881.

To the Commissioners on the Diseases of Domestic Animals:

Gentlemen:—Section 1 of chapter V, page 497, of the Public Acts of 1880, prohibits under a penalty of fine or imprisonment, or both, the sale or use by any person of any horse or other animal having the disease known as glanders or farcy. Section 2 of the same statute makes it the duty of the owner or any person having charge of any horse, to cause the same to be killed immediately upon being notified by the State Board of Agriculture or the Commissioners on Diseases of Domestic Animals that such horse is infected with said disease, and provides for the punishment by fine or imprisonment, or both, of any person who shall neglect to comply with the provisions of this section.

Chapter LXXIII, page 534, of the Public Acts of the same year confers upon said board or commissioners the power to cause to be killed when, in their judgment, the public good shall require it, all animals which, in their judgment, are infected with, or have been exposed to and are liable to communicate to other animals any contagious disease, and further provides for an appraisal of such animals before they can be killed, and for a compensation therefor, based on such appraisal, to be paid to the owner thereof by the state.

The question which you desire to have answered, in view of these statutes, as I understand it, is whether the owner of a horse, who has been duly notified that such horse is infected with the glanders, incurs the penalties prescribed in the 2d section of chapter V, upon his neglect to cause said horse to be killed immediately upon receiving such notification.

I answer the question unhesitatingly and without qualification in the affirmative,—such owner is liable to prosecution and conviction under said section.

The contrary, however, is contended upon the ground that section 2 of chapter V is repealed by implication by chapter LXXIII.

It is true that a prior statute may be repealed by implication by a later statute whose provisions are inconsistent with and repugnant to the first; but courts do not enforce this rule of law except in cases where the necessity for it is imperative, and they are especially reluctant to apply it in respect to statutes passed at the same session of the legislature. If it can be avoided by a reasonable construction, they will not impute to the law-making power the folly of having enacted, almost simultaneously, laws whose provisions are so inconsistent and contradictory that one of them must be declared to be inoperative. Swift, in his digest, lays down the rule as follows: "Later statutes repeal prior contrary statutes. This must be understood when the statutes are expressly contrary or negative words are used; otherwise, if both the statutes can be reconciled, they must stand and have a concurrent operation." This rule of construction has been approved by our courts in numerous cases, and now let us apply it to the case in question. Prior to 1880 the legislature had created the State Board of Agriculture, and, for the purpose of preventing the spread of contagious diseases among domestic animals, had invested it with power to prohibit the introduction of such animals into this state, and when such diseases existed in this state to quarantine all infected or suspected animals, and to make all investigations and regulations necessary for the prevention, treatment, cure, and extirpation of such disease, and had further provided for the punishment, by a fine of not more than five hundred dollars, of any person who should fail to comply with such regulations.

In this state of the law the legislature saw fit to direct its attention to the specific disease of glanders, apparently considering it to be of such a dangerous character as to require a distinct and separate enactment for its extirpation. It was not thought sufficient to leave the control of this disease in the hands of the Board of Agriculture, and the legislature therefore dealt with it directly, and called into use for its suppression the machinery of the criminal law of the state. It constitutes the acts of commission and omission specified in chapter V, Offences against the Sovereignty of the State. It not only, by direct enactment and under suitable penalties, established a quarantine in respect to all animals infected with this disease, but especially directed its power against horses thus infected on account of their greater liability to spread the contagion, by commanding their owners to cause their immediate destruction. It will be observed that this statute is not an act in relation to the Board of Agriculture; it neither confers additional power nor imposes new duties upon the board. Its commands are directly to the citizen. It merely selects the Board of Agriculture, as it might have chosen any other agent, as the tribunal to determine a fact, and then charges the citizen, upon being duly notified of the existence of such fact, with the performance of a certain duty to the state.

The legislature, having thus dealt with the glanders, saw fit, at the same session, to enlarge the powers of the Board of Agriculture for the purpose of enabling it to encounter more successfully the evils attending the spread of contagious diseases in general among domestic animals, and therefore passed the act entitled "An act conferring upon the State Board of Agriculture power to kill diseased animals."

This act is not criminal in its nature; it imposes no new duty upon the citizen; it merely gives to the Board of Agriculture a discretionary power when, in their judgment, the public good shall require it, to kill not only animals that are actually infected with, but also those which have been exposed to, and are liable to communicate to other animals any contagious disease.

Is there anything in this act to relieve the citizen from the obligation imposed upon him, for the public good, by the 3d section of chapter V?

Has the legislature, in passing a general law giving to its Board of Agriculture a discretionary power to kill certain animals, annulled its positive edict that all animals infected with a particular disease shall be instantly slaughtered?

I think not. These statutes, to my mind, are not only not inconsistent, but in strict harmony, each working by its own methods to accomplish its particular object. The purpose sought to be effected by its two statutes are different, that of the one being the extirpation of a particular disease at all hazards, and that of the other the control, treatment, cure, and extirpation of contagious diseases in general, under the discretion and supervision of the Board of Agriculture. The methods adopted to carry into effect the intention of the legislature are entirely dissimilar. The former statute, applying only to horses infected with the glanders, enforces its provisions by the aid of the criminal law; the latter operating upon all animals infected with or suspected of contagion, invests one of the branches of the civil service of the state with discretionary powers as to its administration.

The state, in effect, by the enactment of chapter V, declared the act of keeping a horse known to be infected with the glanders to be a crime; and I fail to find in any subsequent act any intention on the part of the legislature to annul or modify the force of that declaration.

I will further remark, that not only were these statutes enacted by the same legislature, but they emanated from the same committee and were under consideration at the same time.

No case can be found in which it has been held that a statute of a criminal nature was repealed by implication by a subsequent statute of a civil nature, merely because both might apply to the same subject matter. The legislature may adopt as many methods as it sees fit to remedy a given evil, and so long as they are not inconsistent and do not conflict with each other, all will be upheld and allowed to have a concurrent operation.

In conclusion, I repeat that, in my judgment, the claim that chapter LXXIII repeals, by implication, section 2 of chapter V is unsound, untenable, and wholly without foundation in law.

Respectfully yours,

E. H. Hyde, Jr.

I concur in this opinion,

Charles B. Andrews.

I concur in the foregoing opinion,

T. E. DOOLITTLE.

I also concur in the foregoing opinion,

A. P. HYDE,
of Waldo, Hubbard & Hyde.
HENRY C. ROBINSON.
S. E. DUNHAM.

Since our last report your commissioners have continued their investigations and have found their previously-expressed opinion sustained, viz: That the horses of Mr. Merwin were glandered. While the general appearance and condition of the horses has improved, the indications of glanders still exist, and our opinion is based and supported by the authority of the most competent veterinarians in the country who have repeatedly examined them at our request.

The simple order of quarantine* was given Oct. 30, 1880. June 23, 1881, we renewed the notice to Mr. Merwin that his horses were glandered, calling his attention to the law, chap. V of the public acts.†

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† STAFFORD, CONN., 188

SIR:

You are hereby notified by the Commissioners on Diseases of Domestic Animals, that a certain Horse, described as follows:

owned by you, or of which you have the charge, is infected with the disease known as Glanders or Farcy. Your attention is called to Chapter V of the Public Acts of 1880, page 497, by which it is made your duty to cause said horse to be killed immediately upon the receipt of this notice, under a penalty of fine or imprisonment, or both.

Commissioners on Diseases of Domestic Animals.

* STAFFORD, CONN., 188

SIR:

WHEREAS, It appears to us, after due investigation, that the contagious disease known as the Glanders exists upon the premises. in the town of in this State; and

WHEREAS, It further appears that which are now kept by you on said premises have been exposed to said disease,

Now, therefore, by authority vested in us by the Legislature of this State, we do hereby place said premises and horses under strict quarantine, and you are hereby ordered not to remove said horse, or allow the same to be removed from said premises, nor to allow any other horse to enter said premises, without a permit from us. This quarantine will continue until removed by us.

Commissioners on Diseases of Domestic Animals.

April 23, 1881, visited the horses with Dr. A. H. Rose of New Haven. He pronounced the horses glandered, and with us reported to Messrs. Henry Davis and L. M. Leach, selectmen of Durham, that the horses were glandered.

At our request he took virus from both mares. With the matter from one mare he inoculated a horse at New Haven, which contracted the glanders.

These reports are appended marked No. 1 and No. 2.

April 19th, we visited the horses with Dr. J. W. O'Sullivan, and after a very minute examination he was confirmed in his former diagnosis, and with us reported to Selectman L. M. Leach that the horses were glandered.

May 5th, visited the horses with Dr. Parkinson, who sustained his previous opinion that the horses were glandered.

Oct. 15, visited the horses with Dr. Liautard of New York, and Dr. Law of Cornell University. Their reports, giving their unqualified opinion that the horses are glandered, are appended marked 3 and 4. With such a weight of veterinary authority we could give little heed to the claims of Mr. Merwin that the horses were not glandered and should be released, which claims were not supported by a single competent veterinarian, and in like manner we could not admit his claim that we should act under the general law and cause his horses to be appraised and slaughtered, to be paid for by the State rather than under the specific law for glanders, for we have acted according to the advice of the most eminent legal authorities in the State. We refer to the opinion of E. H. Hyde, Jr., endorsed by others and reprinted from last report. This opinion has received the verbal support of the late Hon. O. S. Seymour, member of the last General Assembly, Ex-Gov. R. D. Hubbard, and of the Hon. Jeremiah Halsey of Norwich, and is also endorsed by Ex-Gov. Charles R. Ingersoll. See No. 5.

Aug. 16, 1880, we applied for instructions to the Chief Executive Gov. Charles B. Andrews, without whose approval no bills for compensation for animals slaughtered under the general act could be paid, referring to the claim of Mr. Merwin for compensation and calling his attention to both laws, House bill No. 74, Chap. LXXIII, and to House bill No. 75, Chap. V.

For these laws see Nos. 6 and 7.

He replied Aug. 17th, 1880, that "the State cannot be made to pay for glandered horses under that statute to which you allude."

Mr. Merwin did not destroy his horses according to the notice given June 23d, and on inquiry for the grand juror of Durham to whom complaint could be made for the violation of the law, we learned that Mr. Merwin was the only grand juror in the town. We then presented the case to Hon. W. F. Willcox, State's Attorney for Middlesex county, and after a protracted investigation found that, though an unusual procedure, complaint could be made through him when, as in this case, there was no grand juror qualified to act.

We employed S. A. Robinson, Esq., mayor of Middletown, to prosecute the case, but on consultation with Gov. H. B. Bigelow we were advised by him to stay proceedings and act under the general law, causing the horses to be appraised and slaughtered. Proceedings were stayed, and at the request of the Governor a meeting of the Board was called at Hartford, Nov. 2d.

At that meeting the Board, being informed of all the facts in the case, passed the following resolution:

Resolved, That the Cattle Commission of this Board be directed to use all lawful measures to prosecute the owner for violation of the law, and to secure the destruction of the horses of H. S. Merwin of Durham, which horses are now affected with glanders, and are now quarantined by the Commission for glanders, and recently pronounced glandered by Drs. Liautard and Law, distinguished veterinary surgeons, who recommend their destruction.

We again consulted Mr. Robinson as to the best means of executing the expressed opinion of the Board, and requested him to take measures to carry it into effect. On mature consideration of the inevitable delays in legal proceedings, we again, Nov. 16th, ordered a stay of proceedings by our attorney. The case might not be terminated before the coming session of the legislature, and we preferred to place it in their hands than to involve Mr. Merwin and the Board in a legal contest and perhaps a considerable expense. We have done all that the law required of us, but have failed to secure the object sought for by the law, the protection of the State.

Mr. Merwin, at the session of 1881, asked of the General Assembly compensation for the loss from quarantine of his horses, and received $275.

A substitute bill was proposed which was not acceptable to Mr. Merwin. It provided that the horses should be slaughtered and if found glandered the loss should be borne by Mr. Merwin; but if found not glandered Mr. Merwin should receive six hundred and fifty dollars from the State treasury.

Henry G. Newton, Esq., attorney for Mr. Merwin, wrote us July 16th, proposing that Mr. Merwin would furnish a horse for inoculation, and also furnish a knife for inoculation, the horse to be inoculated by a veterinarian of our choice, and to remain in Mr. Merwin's charge after the inoculation.

We replied that we had already begun legal proceedings, but would refer the matter to the Board. No action was taken by the Board when the case was presented.

The selectmen of Durham have been kept informed of our action in quarantining the horses of Mr. Merwin, and also when we have given him the notice requiring him to slaughter them. They have expressed no desire to inform themselves of the facts in the case, or to sustain the law, but have embarrassed our action in our efforts to secure its enforcement.

The claim made by Mr. Merwin that the Commission should act under the general law instead of under the specific law for glanders has never been accepted by your Commission. The opinion of the Commission, that for glanders we were to act under the specific law, is based upon a knowledge of the intention of the Committee of Agriculture of the General Assembly of 1880, who reported both laws, and a knowledge of the intention of the legislature that enacted them, confirmed by the eminent legal authorities consulted by us.

The law on glanders, though of priority in passage, was prepared and acted upon by the Committee after the other. It was framed with the express design of restraining the powers conferred by the general law, and of saving the State from the possibly large expense incurred in slaughtering glandered horses. There was an imperative call for a law to protect the lives and property of our citizens against this specific danger, and this accounts for the prompt and somewhat hasty action of the General Assembly, with the special provision that it should take effect from its passage; hence it was in operation before the general law was passed, your Commission having been called upon and having taken immediate action under its provisions. Both laws were reported to the General Assembly by the Committee at the same time, Jan. 27th, 1880. The law on glanders, though presented to the Committee some time after the other, and receiving their approval as supplementary to it, passed the General Assembly Feb. 25th, but final action on the general law was delayed till March 25th, near the close of the session.

This case shows the necessity of some further legislation upon the subject. We have preferred to await the action of the General Assembly, rather than to urge the enforcement of the law against Mr. Merwin.

While we concur in the generally-accepted opinion that a glandered horse is not only valueless but dangerous both to the owner and the community, and while we do not know of any country, state, or municipality where glandered horses are destroyed by law in which the owner receives any compensation from the public treasury, yet we would suggest that in view of removing any appearance of hardship inflicted by the destruction of private property for the public good, and the more rapid and complete extinction of glanders, as so well set forth in the report of Dr. Law for 1880, that the General Assembly should be asked to provide some compensation to the owners of horses which may be declared affected with glanders by some established authority, and destroyed by them. Let the horses in their diseased condition be appraised by competent persons, destroyed by some established authority, and a part of their appraised value be paid from the State treasury.

In conclusion we wish to state that we have no personal pride to sustain in this affair. We could not consistently do otherwise than we have done, as the Commission, in view of the authorities we have consulted, and we submit the case to the Board and the public, hoping that it will receive a careful examination and that some way will be provided to protect the State.

E. H. HYDE,
T. S. GOLD,
H. L. STEWART,

Commissioners on Diseases of Domestic Animals.

HARTFORD, Dec. 13, 1881.

(No. 1.)

REPORT OF DR. A. H. ROSE.

NEW HAVEN, CONN., June 23, 1881.

HON. E. H. HYDE:

At your request I examined, April 23d, two mares, the property of Mr. H. S. Merwin, of Durham. The first mare I examined was a dark brown, white stripe on face, and white feet. There was a slight discharge from both nostrils; also a slight enlargement of sub-maxillary glands. A very congested Schneiderian mucous membrane. Loss of respiratory murmur, and dullness on percussion over the left lung, caused, in my opinion, from the existence of "tubercules." The second mare examined was a black, white star on forehead. This mare had enlarged sub-maxillary glands, nodosities, and small ulcers in left nostril; cough when pressure is made on larynx, slight discharge from both nostrils, marked dullness on percussion, and loss of respiratory murmur of both lungs, due to the presence of "tubercules."

Both of these horses, in my opinion, based upon the condition I found them in, and upon the foregoing symptoms and conditions, are afflicted with glanders.

I remain yours respectfully, ALVORD H. ROSE, D. V. S.
47 Crown street, New Haven, Conn.

(No. 2.)

Report of the inoculation of a horse with glanderous virus taken from the nostrils of a black mare belonging to Mr. H. S. Merwin, Durham, Conn.

The subject for inoculation was a bay gelding, 15 years old, 15½ hands high, weight 900 lbs., poor condition, and lame.

Below is the result of the inoculation:

Date.	Temperature.	Pulse.	Respirations.	Remarks.
April 25,	99	34	9	Normal.
" 26,	99.4	36	10	Slight elevation in temperature.
" 27,	100	36	10	Appetite good; animal seems more dull than usual.
" 28,	101.2		11	Discharge commencing to exude from one nostril.
" 29,	102.6	46	12	Discharge increasing, not very profuse however.
" 30,	103	48	13	Loss of appetite: nose swollen; limbs swelling; *auscultation* and *percussion*, no change.
May 1,	103.6	52	15	Animal extremely irritable; no appetite; occasional cough; eyes running; tendency to lie down.
" 2,	104.8	57	17	Animal discharging; staggers when walking; ears and extremities cold; no appetite.
" 3,	105.6	62	23	Animal down: cannot get up; discharge from eyes and nostrils: slight dullness on *percussion*, and loss of *respiratory murmur* over the right lung. Destroyed him, as he could live but a short time if left to himself.

(P. M.) There was an enlargement of the *sub-maxillary gland* on the right side. One *ulcer* on the right side of the schneiderian mucous membrane. Three or four *pin-hole ulcerations* of the left side of *schneiderian mucous membrane.* Enlarged *lymphatic glands* under the *chest* and *abdomen.* Lungs engorged with blood, and showing an extravasation of blood in the *air cells* and *bronchial tubes.* Lesions were mostly in the *head*, as usual in acute glanders produced by inoculation.

ALVORD H. ROSE, D.V.S.,
New Haven, Conn.

(No. 3.)

AMERICAN VETERINARY COLLEGE,
NEW YORK, Oct. 23, 1881.

E. H. HYDE, ESQ.,—

Dear Sir: At the visit which, in your company and that of Prof. Law, I made on the 15th inst. of the mares of Mr. Merwin, at Durham, I found them both suffering with glanders,—the symptoms at present leaving no doubt about it.

As I have said before, both animals ought to be destroyed at once.

Respectfully yours,

A. LIAUTARD, M.D.V.S.

(No. 4.)

CORNELL UNIVERSITY,
ITHACA, N. Y., Oct. 20, 1881.

HON. E. H. HYDE,—

Dear Sir: On October 15th, by your request, I visited Durham, Conn., in company with yourself and Dr. Liautard of New York, for the purpose of examining Mr. Merwin's two mares, which have been kept in quarantine by the State since July, 1880.

I found both mares at pasture, living in the open air, and therefore in those conditions which, above all, favor the subsidence of glanderous symptoms, and the occurrence of a delusive appearance of convalescence. I was further given to understand that they had been kept thus for the entire summer. Both mares were identified by yourself, Dr. Liautard, Mr. Merwin, and his hired man as those which had been in dispute, so that I need not specify marks of identification. The worst subject was discharging freely from both nostrils a yellowish-white matter, which dried up on the skin and hairs, agglutinating them firmly together after the manner of a glanderous discharge. The mucous membrane on both sides of the cartilaginous septum between the two nasal chambers was the seat of characteristic glanderous ulcers, nodosities, and cicatrices, and the sub-maxillary lymphatic glands presented the hard nodular and comparatively painless swelling which distinguishes glanders. This mare was unquestionably the subject of advanced chronic glanders at the time of my visit and examination.

The second mare suffered from a slight nasal discharge and a nodular enlargement of the sub-maxillary glands, similar to that of the first, only smaller; but I did not detect the same lesions of the nasal mucous membrane as in the first. This membrane, so far as could be reached by the eye, presented only a bluish discoloration, and some roughness of the surface. No distinct ulcers were observed.

I do not hesitate to pronounce both mares glandered at the present time and to advise their destruction. This conclusion I would found on the present condition of the mares, arrived at in spite of the most favorable conditions for recovery, had that been possible; but when it is added that three horses inoculated by Drs. Liautard and Rose with the nasal discharge of these mares died of glanders, and that a fourth inoculated by Dr. Cressy with the same matter, according to Mr. Merwin's testimony furnished us when at Durham, contracted a severe swelling and discharge from the nose, and extensive enlargements of the sub-maxillary glands, and was then conveyed away to some place to which even Mr. Merwin cannot now direct us, the cumulative evidence of glanders becomes so strong that no candid observer, even if an unprofessional man, can for a moment doubt its presence.

Yours very respectfully,

JAMES LAW, F.R.C., V.S.

(No. 5.)

LETTER OF EX-GOV. C. R. INGERSOLL.

NEW HAVEN, Oct. 25, 1881.

HON. E. H. HYDE, STAFFORD SPRINGS, CONN.:

Dear Sir,—I have at your request read the opinion of E. H. Hyde, Esq., under date of Jan. 17, 1881, accompanying the report of the Commissioners on Diseases of Domestic Animals, and I concur in its conclusions. Very respectfully,

C. R. INGERSOLL.

(No. 6.)

[House Bill No. 74.]

CHAPTER LXXIII.

An Act conferring upon the State Board of Agriculture Power to Kill Diseased Animals.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. The State Board of Agriculture, or in case said board have or shall appoint commissioners on diseases of domestic animals, under the provisions of section seven of the act to which this is an addition, then said commissioners may, when, in their judgment, the public good shall require it, cause to be killed and to be disposed of afterwards as, in their judgment, may be expedient, any animal or animals which, in their judgment, are infected with or have been exposed to and are liable to communicate to other animals any contagious disease.

SEC. 2. The said board of commissioners, after notice to the owners of such animals, or, if the owner does not reside in the town where such animals are, to either the owner or keeper of such animals, shall cause all animals before being killed under the provisions of the preceding section, to be appraised at the assessed value in their respective towns by the assessors, or a majority of them, of the town where such animals are kept: and it shall be the duty of the assessors of the several towns to make such appraisal upon the request of said board of commissioners, and two-thirds of such appraised value of such animals, if killed, shall be paid to the owner thereof by the State, upon the approval of the governor.

Approved, March 25, 1880.

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(No. 7.)

[House Bill No. 75.]

CHAPTER V.

An Act to Prevent the Spread of the Disease known as Glanders or Farcy.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. Any person who shall knowingly sell or offer for sale, or use, or expose, or cause to be sold, or offered for sale, used, or exposed, any horse or other animal having the disease known as glanders or farcy, shall be fined not more than seven dollars, or imprisoned not more than thirty days or both.

SEC. 2. The owner, or any person having charge of any horse, shall cause the same to be killed immediately upon being notified by the State Board of Agriculture, or the commissioners on diseases of domestic animals, that such horse is infected with the disease known as glanders or farcy, and any person upon receiving such notification, who shall neglect to comply with the provisions of this section, shall be fined not more than seven dollars, or imprisoned not more than thirty days, or both.

SEC. 3. This act shall take effect from and after its passage.

Approved, February 25, 1880.

FARMERS CONVENTION AT NEWTOWN.

The winter meeting of the Board for the year 1881 was held at Newtown, on the 14th, 15th, and 16th of December, in Sanford Hall, and was fully attended by farmers and others interested in agriculture, not only in Newtown and its immediate vicinity, but from other sections of the State.

The opening meeting was called to order at 10½ o'clock on Wednesday, Dec. 14th, by Vice-President Hyde, who called upon the Secretary to explain the business of the convention.

MR. GOLD. We come before you with an invitation headed, "The New Departure in Agriculture." We hear of "new departures" in many directions, and we have thought that a "new departure" was necessary, that reform was needed, that there was actual progress, and that means were at work now which were developing agriculture in accordance with the demands of the time; and you have embodied here in this programme, to some degree, those ideas.

We shall present first to you DR. STURTEVANT, well known to most of the farmers of Connecticut, who will treat upon "Agricultural Experiment—what we want to know and why we want to know it." Agricultural experiment runs back to the first history of the human race, and still we find there is yet much to learn, much that we desire to know, and we anticipate that we shall have this matter somewhat cleared up by Dr. Sturtevant.

"Commercial Fertilizers—Source of Supply and History of the Trade," by DR. EDW. H. JENKINS, of the Agricultural Experiment Station at New Haven, who is abundantly qualified to speak upon this subject. He will give us a history of the traffic, and tell us of the sources of supply. The enormous extent to which the trade in commercial fertilizers has grown within a few years, not only in our own State, but especially in some other States of the Union, is such as to demand on this subject the careful study of our farmers.

A paper on "Ensilage" will be presented by Mr. W. R. HURD, a man who has had practical experience, having built a silo, and who is feeding his cattle on ensilage. We trust that this paper will draw out a discussion with regard to the merits of this method of preserving food for our cattle. It is one that is creating a great deal of interest among farmers, and certainly indicates a "new departure in agriculture."

"Commercial Fertilizers—A Farmer's View of the Subject"—by J. M. HUBBARD. Those of you who know Mr. Hubbard, and most of you do, will feel assured that we shall get some good sound practical ideas upon the subject of applying fertilizers, with a caution not to trust too much to them.

"Fungi Injurious to Vegetation, with Remedies," by BYRON D. HALSTED. This subject is one of very great importance, for the farmer is continually meeting injurious growths which thwart his best efforts, and we anticipate that the subject will be so elucidated before us at this time that we may be able to cope successfully with some of the difficulties that we have so often experienced in this direction. Our fruits, our grain, and all our vegetable products have suffered from time to time from the visitation of fungi in various forms.

"Home Manufactures," by J. B. OLCOTT. I have only to say, that although we may not see how a lecture with that title can be made to bear on the general subject, we have such perfect confidence in Mr. Olcott that we know he will develope a good thing in that direction.

"The Farmer's Home," by Sec. B. G. NORTHROP, a gentleman too well known for his efforts to improve the educational and social interests of the State to need any introduction from me. That the farmer's home is the central point around which all our efforts to improve our agriculture should gather, is an idea which we hope will be established by Secretary Northrop. This is our ideal of the farmer's home:—the birthplace of sons trained in self-reliance, industry, and economy, masters in science, arts, and arms; daughters the light of other homes, our loving and earnest mothers,—the defence and foundation of the State. That the farmer is peculiarly privileged, and has an opportunity, in the direction of making himself a home, that no other class enjoy, is the point that we would set forth in discussing the farmer's home, and that it should be a home truly worthy of being the pride and the pleasure of every citizen of the State, a home abounding in good cheer, enriched with fruits and adorned with flowers, a center of intelligence and industry, the abiding place of plenty and love, ever held in affectionate remembrance by those who go out from it and to which they often return with willing feet.

"Associated Dairies—Methods of Raising Cream"—by EDWARD NORTON, the manager of the most successful creamery, I believe—I say it without fear of contradiction—in the country, considering the length of time the business has been conducted, the general success of the operations, and the pecuniary profit of those who patronize it. The Farmington Creamery, under the charge of Mr. Norton, has been in operation a number of years. It is not a new experiment, but an established success, and a new one is just opened at West Hartford, under his care, with all the modern improvements. I trust that Mr. Norton will demonstrate to us the way out of many of the difficulties that embarrass our dairying operations at present in the State of Connecticut.

"Farming as it was, as it is, and as it should be," by L. F. SCOTT, of Bethlehem. Some few of you are acquainted with Mr. Scott, and I trust that he will be able to present his subject in such a way that you will feel a good deal better acquainted with him than you do now, and we shall get some practical ideas from a practical man.

"The Adaptation of Agriculture to the Improvements in Implements, Machinery, and Transportation," by Prof. WM. H. BREWER. The increased facilities of transportation, the introduction of improved agricultural implements and machinery, have unsettled all our ideas of the value of land, from its location I mean, in relation to its proximity to markets. And this applies not only to lands in New England, but to land in the State of New York, in all our eastern States, even reaching to Ohio, and still farther west, and above all is it affecting the agricultural industries of the old world. Its effects there are almost revolutionary, at present.

No problem so important has agitated the nations of the old world as that of sustaining their agriculture in view of the improved facilities of transportation and the vast amount of products that the new lands of this continent are enabled to furnish with the aid of modern implements and machinery. How we may be enabled to adapt our system of agriculture in New England to these changed conditions is the lesson we are to derive from this lecture by Prof. Brewer.

After each lecture, there will be an opportunity for questions to the lecturer upon the subject presented, and we desire that the audience shall be free in asking their questions. Every speaker who comes upon the stand comes with the understanding that he is to be questioned upon the points that he makes. If they are not perfectly clear, question him. If you have any doubt with regard to his statements, question him. If you believe they are so important that you want them repeated, question him. Let it be understood that this is a place for free discussion.

A question box is provided, in which you are invited to put any questions of an agricultural nature, and, although we do not promise to answer every one, we will do the best we can. We shall have gentlemen in the audience who will be qualified to answer such questions both practically and scientifically. Farmers of Newtown and vicinity, I want to assure you that we have gathered here a circle of gentlemen who are intelligent in matters of agriculture, and who can answer these questions if there is any body who can.

I have thus gone through in brief the entertainment that we offer you here at this time, and we hope that it will be accepted as heartily and freely as it is given, and that the farmers of Newtown and vicinity will be here in force to enjoy it, and that our friends from abroad, in turn as they look out upon these pastures and fields of Newtown will admire what has been done here in improving the agriculture of the State.

The Chairman. You are now to have the pleasure of listening to a lecture from Dr. E. L. Sturtevant, of South Framingham, Mass.

AGRICULTURAL EXPERIMENTS: WHAT THE FARMER WANTS TO KNOW, AND WHY HE WANTS TO KNOW IT.

DR. E. L. STURTEVANT, SOUTH FRAMINGHAM, MASS.

At the present time, when natural and social progress is so dependent upon science in its applications, it must be recognized that agricultural pursuits can offer no exception to the rule, but that if progress is to be rapid and effective here, it must be through the taking advantage of all the aids that science has to offer. Science has indeed done much for the farmer. Chemic science has made possible the fertilizer through whose assistance our fields are permitted to regain their pristine productiveness, and many farms of the older States are held exempt from occupation by a peasant class, the curse of historical nations. Mechanical science has furnished the mowing machine and the thresher, thus enabling the sparse population of our western lands to accomplish the work which formerly required multitudes, and indirectly calling into extension the iron rail which has opened within our generation such immense areas to occupation, and rendered possible the many happy homes where education and culture add charm to effective labor. The printing press is removing some of the conservatism so prominent in scattered communities, and of old, identified with the circumstances of the cultivator of the soil; the telegraph keeps the farmer abreast with the markets of the world; the Agricultural College offers and thrusts upon our attention the opportunities for mind training in the way of farm usefulness. Scarcely an act of the home or field life of the farm but that is influenced to a greater or less extent by the discoveries of science, or but that may be favorably modified by a truer and juster conception of what science offers to the trained intellect and trained hand.

What then is this science which has done and which promises so much? It is the formulation into a name of the practice of a method, whereby accuracy leads to further accuracy, and verification is possible at every stage of the process pursued. *Science* is *knowing*, and more; it is methodical and verifiable knowing; it is *true knowledge.* Its application hence becomes the wise concomitant of the every act of man. We may have science developing and completing the tools which the farmer uses, as well as those which may be modified to his use, whether these tools be wood or iron, or intellectual methods. We may have a mechanical science, wherein mechanical processes are brought under the influence of knowledge of properties of matter, and the properties of their juxtaposition. So also we may have agricultural science, whereby agricultural acts are influenced so that they are performed not in darkness, but through the illumination thrown by knowledge over the methods of such acts, and their relations.

In order to simplify the discussion of agricultural science, a science which deals with such complexities as are offered by the changeable nature of the materials which are caused to react in the formation of food; such as the soil in itself, and in its relations to chemic, physic and vital changes; the plant in its almost infinite changeableness, in its reactions with nature and the acts of man; the man, the contriver of relations whose outcome is to fit the plant for his purpose, not for its own welfare; the various unions, whose sum finds expression in successful farming; in a word, in an application of knowledge to such varied elements, to such varied relations, I am disposed to believe that a separation of agricultural scientific study into two sections may be found convenient and practically useful. I think the student and the worker may better understand their part, if the factor of profit be the knife which shall divide agricultural thought into sections fitted for different styles of treatment. To one section I would apply the term *Agricultural Investigation*, and this term should embrace studies whose outcome is to be knowledge, without reference to the practical uses of that knowledge; the second term I would employ is *Agricultural Experiment*, or investigation carried forward with the aid of such knowledge as detail work offers towards determining practical profitable methods of farming.

Experiment is a factor in all science; it is the promoter and tester of facts; the touch-stone for truth. As in mathematical science, we have the "proving," whereby the accuracy of results is maintained; so in chemical science we have the balance which checks the results of analysis. We have here pure sciences, or sciences which possess a measure which gives exactness to their processes and expression. In vital sciences, we lack this well-defined measure, and experimental tests for the accuracy of our conclusion takes the place, offering opportunities for provings as reliable as in the pure sciences, so far as they are applicable, without the mathematical accuracy of expression. In the sciences bearing upon life-phenomena, we have frequent use for the methods and results of pure science, and in addition, must use the less accurately expressed data whose truth is measured accurately through experiment. As we measure force through its power of resistance, experimentally, so must we measure the effects that spring from the union of many forces, as in life, growth, development, experimentally, and assign relations to the data obtained.

Agricultural investigation is the determining and measuring of data connected with relations which may come more or less completely under our guidance and control, and deals with the precise sciences, as well as with those with experimental relations. Its objects, to the untrained observer, may sometimes appear trivial, or of little consequence, yet the investigation into the causes and effects of life, growth, development, decay, the relations of vitality to the inorganic realm, and the mutual interaction of all cosmic causes and results, renders agricultural experimentation possible, and gives accuracy and value to its deductions.

The great agricultural experiment station of the world, that of Messrs. Lawes & Gilbert, at Rothamstead, dates from 1834. It essays agricultural investigation as well as agricultural experimentation. In the first division are to be noted extensive, painstaking studies on such questions as the transpiration qualities of plants; on rainfall, evaporation, and percolation; on nitrification; on the sources of the nitrogen of vegetation; on the botanical results of experiments on grass; analyses of many kinds; discussions of chemical results, etc.; on the composition of foods; on the equivalency of starch and sugar in food; on sewage; on the composition of animals; on the sources of the fat of the animal body, etc. In the second division, are elaborate, long-continued, field-experiments with various crops and with rotations, as well as experiments on the feeding of stock, the results being tabulated comparatively, and the influence of varying causes discussed by the light thrown upon them by the many and minute investigations. And yet, despite the enormous resources of this station, and the length and continuance of its work, and its records of minute details, many questions of practical import to the farmer and citizen are as yet unanswered. We cannot but remark that field experiments are more fitted for purposes of verification than that of discovery; that even this superb series of field experimentation seems unfitted to offer the farmer correct reply to what he would know: What manure shall I use on *my* land? How much should *I* use? What special fertilizers, if any, should I apply? Mr. Lawes gives expression to a recognition of this fact in 1881, in his pamphlet on "Fertility," where in contrasting the interest in the science of agriculture in the United States, with that existent in England, he writes of "the comparative indifference to the subject which prevails" in England. I dislike even to seem to criticise the work at Rothamstead, so beneficent has it been to agricultural science, but I cannot fail to see the many almost insurmountable difficulties that exist, towards determining by field experiment, results that can be acceptable by the farmer, under a system which seems to confound the duties of discovery with that of verification.

One remark more upon the Rothamstead field experiments. There is a practical skill in farming here shown, which adds confidence to such deductions as these field experiments offer. On land not naturally of great fertility, crops of 13 bushels of wheat have been raised annually for twenty-eight years without any manurial application, and with farm-yard manure 48 bushels annually for a like period, or almost double the average production in Britain.

What shall we say in contrast of the claims of Professor Atwater for the Bartholomew series of four years' experiment with corn, as "decidedly the most instructive and valuable ever made to my knowledge by a private individual in this country," where on land which produced forty bushels of oats one year, but 6.2 calculated bushels of poor corn were raised the next year, followed by 3 bushels, a failure, and 13.5 bushels? Where in 1880, "the season of 1880 was unusually favorable," the application of 16 cart loads of hog-manure was followed by only 37.7 calculated bushels of crop? Where 51 lbs. of phosphoric acid produced 41.6 calculated bushels, 25½ lbs. of phosphoric acid produced 38 bushels, and 17 lbs. of phosphoric acid produced 33.5 bushels of corn? Where no duplicate plots were used to test accuracy? Where the variations of yield between the differently treated crops were no more than could be reasonably expected in a common field, each sixteenth of an acre being harvested separately for a comparison? Where the fertilizer used was not analyzed, nor the crop estimated free from moisture, nor observations recorded during the growth? Where the cultivation was so poor, that the no-manure plot of the first year is said to have produced only "very poor and green" ears? It is quite evident that in Mr. Bartholomew's experiment we do not know the condition of the land, nor the composition of the fertilizer, nor the potency of the soil, nor the influence of the season, nor the effect of culture. To uphold this method as "scientific" can do naught but injury. I pass by Professor Atwater's errors in calling some of the crops "good," as also attempting (p. 357, Rept. Conn. Board of Ag., 1881) to give the impression that the lack of phosphoric acid in the soil caused a total failure of the crops of 1879, for his table shows that wood ashes applied, certainly containing phosphoric acid, was followed also by failure. Nor do I criticise his attempt to show from the slight variations, that a ratio existed between the amount of phosphoric acid applied, and that of the crop harvested, for this may be an oversight of the figures given for 1879, nor do I select for discussion the discrepancies between his conclusions, as between the various experiments he reports on.

In truth, such field experiments as these are, carried out on farms, can have but little value for science, are apt to be misleading, and to be mischievous in the consequences deduced from their imperfect and incomplete records. In method and results they differ from field verifications which often can be carried on or observed with profit. Professor Atwater has heralded in this Bartholemew series of experiments a position which he will find untenable, and a position which in time the good common sense of the farm, born of experience, will condemn. His position ignores the methods and claims of science: his reasoning is defective.

The methods of agricultural investigation and experimentation must conform to the methods of science. They must be interpreted from verifiable data, and the results must be also capable of verification. Can value be assigned to the various elements which may be looked for in disturbance of results? Scientific progress gives favorable hope, but it is to the special investigator that we must look in order to obtain this power. It is by determining the character of crops and their variation under circumstances of fertilizer application, of tillage, and of atmospheric agencies as related to the plant; by determining the causes of changes in the plant; its method of growth and of feeding; its method of ripening; and its varied reactions with the acts of man and with those of nature.

In animal studies we need to know the composition of foods, the power of animals to digest, and the variations that occur through individuality or through breed. We would know the sources of animal nutrition and animal power and animal product. We would know the effects of changes introduced by man upon the reaction of the animal with his food, and much more.

Let us illustrate with the corn plant. What does the agricutural experimenter want to know? He requires the aid of the investigator to determine:

THE INVESTIGATOR.

1. *Plant-food.*

1. Character of plant-food.
2. Sources of plant-food, and causes which determine its availability.
3. Effects of special plant foods in excess upon growth and composition of product.
4. Effect of deficiency of supply of certain plant-foods.
5. Essential and non-essential plant-foods, in their various relations to plant products.

2. *The Soil.*

6. Physical relations of the soil to plant-food and plant-feeding.
7. Chemical relations of the soil to plant-food and plant-feeding.
8. Changes produced in the plant by its relation with physical and chemical soil conditions.

3. *The Plant.*

9. The plant, as modified by heredity.
10. How the plant feeds, and how it grows.
11. Germination, and the conditions which are involved.
12. Growth, and its conditions.
13. Development, and its conditions.
14. When the plant establishes its relations with the food supply of the soil, and when these relations are discontinued.
15. Changes produced in the plant by its atmospheric relations.
16. Changes produced in the plant by its soil relations.
17. Changes produced in the plant by the acts of man, including selection, protection, tillage, fertilization, etc., and the conditions involved.

4. *The Man.*

18. Selection, its influence in modifying products.
19. Protection, or the warding off of injurious competitors, including distance of planting, weeding, etc., and its influence on the plant growth and cropping.

20. Co-ordination, or the bringing of influencing causes into harmonious action, and the effect produced by varying factors of disturbance.
21. Interference, or the changes which are produced in the factors regulating plant growth and cropping through the acts of man, as in influencing water-supply, checking evaporation, root-pruning, leaf-pruning, harvesting methods, etc.

THE EXPERIMENTER.

Through a study of these complex conditions, agricultural investigation should be able to supply to the experimenter seed of a known potency of production, and uniformity of character. Without a seed which under uniform conditions shall furnish a uniform cropping, we are in the condition of a chemist whose reagents are impure and never twice of the same exact composition. The seed obtained, a portion should be planted by itself on a plot under maximum conditions of fertility, and under uniform culture as determined by experience in order to afford a verification of the quality of the seed, and the produce carefully studied should serve as a check upon the results obtained by the second portion used in the experiment proper. Upon carefully selected plots, upon land considered uniform, and whose history is to some extent known, the seed corn should be planted in a duplicate series, together with the quality and quantity of manures whose effects are to be studied in order to answer the farmer's question of "how much and what kind of manure can I profitably apply?" One of each series should be untilled, the other tilled uniformly according to the best dictates of judgment. There should be several plots left without manuring, and these should receive different kinds of cultivation, one certainly no cultivation whatsoever, and another as much intercultural tillage as seems desirable. In the duplicate plots which receive manuring, one portion should be untilled. Under this method, we may hope to receive tolerably correct replies, if the comparisons of results be skillfully made so as to eliminate the sources of misinterpretation; for we have as factors to use:

1. In the verification plot we obtain a measure of the uniformity and potency of the seed under the known favorable conditions.

2. In the no-manure plots we obtain a measure of the condition of the land in its relations to the seed, under two conditions, the one favorable and the other unfavorable to the crop.

3. In the fertilized plots we have expressed the yield from the seed used, under natural conditions and under conditions as modified by cultivation; in the duplicate plots we have also these same conditions, the amount of fertilizer varying.

4. In the experimenter we have a means for recording the variations noted in each plot, and for timing the occurrence of the varied phases of germination, growth, and development; of measuring the rainfall and its penetration, the soil and air temperatures, the rapidity and extent of growth, etc., etc , etc.

5. In the results, carefully tabulated for comparison, we have the data at hand for determining the value of the conclusions to be derived, and whether such conclusions are reliable and worthy of adoption. Results in harmony with the conclusions already attained by the investigator may be accepted; those results which are in conflict shall suggest further investigations.

The principal factors which the farmer uses are: 1. The seed. 2. The manuring. 3. The methods of planting. 4. The cultivation. Such a trial as is within his province must furnish values for each of these factors. Our sample experiment should offer hopes of determining the value of the seed, of fertilizer, and of culture in several varied relations; as to methods of planting, this should be determined beforehand by a carefully formed experience, as its introduction into an experimental series would render the attempt very cumbersome.

There is much for an agricultural experiment station to accomplish, both in the way of investigation, and in that of trials in the barn and field. In the laboratory and plant-house are required the qualities of a carefully exact, trained, and accomplished man of science; in the field, the same qualities, together with a knowledge of the practical requirements and workings of the farm. The true agricultural experiment station must be the bond which connects science with the farm. Investigation must keep pace with the highest aspiration of science, and its prophecies and data must be practically brought within the comprehension of the farmer; for such a station is in a sense industrial in its conception and in its existence.

Let us approach the subject on the farmer's side, and ask ourselves what as farmers we want to know? A few of the answers, space does not admit more, are as below:

ANIMALS.

1. Is the digestive power of animals noticeably influenced by the heredity of the animal? Will a short-horn digest a larger percentage of his food supply, than a scrub?

2. Will a highly bred animal digest a coarser fodder as completely as a scrub? Will a short-horn extract from coarse fodder as much nutritive material as will a Texan?

3. Will an over-fed, fully fed, or under-fed animal digest the largest percentage of their food supply?

4. Is the abundance of scurf on a milch cow an indication of the quality of her butter yield, or a mark of the efficacy of the food towards butter production?

5. The influence of breed and feed upon the butter quality of milk.

PRODUCTS.

1. To test digestibility of various samples of milk, with reference to the breed and feeding.

2. To test the characters and digestibility of caseine, separated by various precipitants from milk of various breeds.

3. To test the action of soaking, fermentation, and boiling upon the digestibility of cattle foods.

4. The feeding value of damaged grain.

5. The relations between quantity and quality in feeding.

SOIL.

1. To test the value of subsoils.

2. To test the value of a fallow.

3. Evaporative powers of different mixtures of soil and kinds of mixture.

4. To show the effect of various mulches in conserving the moisture of the soil.

5. The value of tillage as a conserver of moisture, and the conditions under which this function is performed.

SEEDS.

1. The germinating power of seeds of varieties of the same plant. Do the more improved varieties germinate as readily as the less improved, and is there a difference in their relative production of fertile seed?
2. The germinating power of seed from various portions of the cob in corn, or head in wheat.

3. How immature can a seed be and not lose its germinating powers?
4. The influence of deep planting and shallow planting of seed. What constitutes deep planting?
5. Aids and hindrances to germination, as occurring in practice.

PLANTS.

1. The transpiration of plants, as affected by variety, and its relation to the usefulness of the plant for droughty or wet localities.
2. The influence of special manures in changing the character of natural herbage.
3. The effect of cultivation on growth and product.
4. The effect of selection. Breed seed in two different directions, the one for good, the other for bad qualities.
5. Note the period when plants cease to derive nutriment from the soil, and the relations of the facts observed to farming.

MANURES.

1. The effect of various fertilizing agents on the evaporative properties of the soil.
2. The action of special fertilizers upon the quality of crops.
3. The influence of mixtures in fertilizers towards securing diffusion of fertilizing ingredients within the soil.
4. The influence of manuring in excess upon the quality of crops, due attention being given to the influence of the seed used.
5. The relations of fertilization as affected by tillage.

HORTICULTURAL.

1. To test the influence of irritation or movement upon the formation of fruit.
2. To test the efficacy of pollination in modifying the characters of fruit: too much or too little, or pollen from a plant which is allied, but will not hybridize.
3. The effect of castration upon the plant in influencing nutritive changes.
4. Experiments towards hastening the maturity of a species.
5. The influence of stock on scion.

All the above thirty-five questions I believe to be practical, and in their study will develop information which can be of direct use, and what the farmer wants to know; and I only offer them here as illustrations of what, in part, we may expect a station to accomplish in order to receive recognition from the farmer. These questions, in their solving, will require the utmost study that we can bring to bear, and will tax the resources of the laboratory, the plant-house, and the field, and the results, properly gained, may be considered scientific, as the questions deal with matters of a kind which admit of our test—*verification.*

This list of desired agricultural experimentation may seem to some to include the closely allied subject of agricultural investigation. A careful thought will, however observe that this list is separated from another list almost innumerable in its subjects that I could offer, by the consideration of profit—by the fact that all these experiments should be carried out so as to furnish information for the actual carrying out of profitable farming.

I do not touch, as will be seen, upon the political duties assigned to agricultural stations, such as are known as "control," and which includes analyses of fertilizers, opinions on seeds, etc., not that such are unworthy, but because these functions are not experimental, and do not come within the scope of my essay.

Why does the farmer want to know? In the early days of California mining, strength of muscle and endurance enabled all who would to dig from the soil the auriferous gravel and wash therefrom the grains of yellow gold. The student and the laborer and the mining expert were on a par, except so far as the strength of the laborer gave an advantage. This state of things, however, could not continue. As the virgin deposits became despoiled, new fields had to be sought, and the gold came to be procured through agencies which required the aid and application of a high intelligence. In time the laborer found himself a hireling, while the man of wisdom and educated skill became the owner or the worker of deposits. Mining is now carried forward under the guidance of a scientific experience, and its returns are based upon educated direction. Gold has its price, and so soon as this price appreciated to the cost, then ignorance offered not sufficient advantage to secure profitable success.

Farming is of the same genesis as the gold mining of California. In the time of virgin land, to be had for the settling, and in a region of favoring climate, any worker could obtain an easy subsistence from the soil. As fertility, however, became removed, and the access of population and markets gave value to the real estate, the expenditures for obtaining the crops sufficient for the subsistence now required by the presence of social relations advanced, and a greater skill in overcoming obstacles, inseparable from the new condition of affairs, became necessitated. As population increased, the value of the land became greater, its occupation as a farm became more difficult, its fertility decreasing, weeds and insect pests increasing in variety and number, the wants of the family ever growing, obstacles ever arising as competition of growers became more keen, and now we in the eastern states are in the position of the gold miner: like him, we need capital for the carrying out of our farming, for the employment of our labor; education, for the enabling us to recognize the means for securing the most favorable conditions under which profit is to be forced from a reluctant soil, in the presence of the adverse conditions of high cost for labor and artificial aids, and low prices for products induced by the many keen and earnest competitors whom the railroad brings to our very fields and yards.

The knowledge requisite to secure success under the simplest relations between the man and the soil, in the presence of an exuberant nature, ever ready to give, responsive to the slightest effort, is far less than that required for the ensuring of success under conditions that involve more complicated relations, such as subsist where man demands far more than mere subsistence from an unresponsive soil. In the one case, but a slight experience secures the simple conditions requisite for the success measured by the man's standard; in the other case, it is only a carefully-organized experience which can avail to secure the best results, measured by a different standard. It is through this organized experience that the man is enabled to secure the proper results, or those which are adequate to his labor and his necessities. Agricultural investigation and agricultural experiment, interpreted by a past experience, offers opportunity to the farmer to determine conditions of profit, and to determine the direction and extent of his efforts. "What the farmer wants to know," is the key which is to unlock the capabilities of the farm, and "Why he wants to know," is that he may derive the utmost from these capabilities, in order that he shall be able to share in the amenities of a cultured and progressive age.

We may say a few words, in concluding, upon some good that has been derived from our so-called field experiments. The labor expended upon them has been in a certain sense wasted, but the very knowledge which shows us how we might have done better, comes through a long series of fruitless trials. There is hence a negative value, which perhaps in the end has been beneficial. In some few cases, especially in those which partake of the nature of an investigation, much good has been derived, but yet on the whole, the results have served but little purpose as applied by the individual to an actual problem of farming. Where good has come, it has usually come in the way of verification, rather than of discovery. The time is now a fitting one to make use of the mistakes of the past in order to discover lessons for the future.

Mr. J. J. Webb, of Hamden, in the chair.

The CHAIRMAN. I hope gentlemen will be free in asking questions. This is a very important subject, and one upon which a great deal of information can be obtained by asking questions. As there seem to be no questions from the farmers, Prof. Miles is in the room, and I would be glad, and I have no doubt you would be, to hear from him in regard to scientific experimenting, as well as practical farm experimenting.

Prof. MILES, of Houghton Farm, Orange County, N. Y. I did not intend to say anything this morning upon this subject. The paper already presented has gone over the matter and covered most of the ground. There is very little for me to say. I will, however, remark, that this matter of farm experiments is not only one of great importance, but the experiments, as has been suggested in the paper, are exceedingly difficult to conduct. Very few are aware of the difficulties of conducting exact feeding or field experiments. Now, in the laboratory, we can make investigations and arrive at very definite results at once; we can control all the conditions under which we are experimenting. An experiment in animal feeding, or an experiment in the field, is a very different thing, for the simple reason that we can control but very few of the conditions. We are liable to be misled by the influence of conditions that we cannot control. It becomes important to eliminate the errors arising from these conditions that are beyond our control in these experiments.

One of the most important methods of eliminating such errors is a repetition of the experiments under the same conditions for a length of time; then a varying of the conditions, changing only a single condition. A great deal has been said in regard to animal foods, relative values, etc., and it would be apparently a very simple matter to ascertain the relative value of foods by making a test with the animals themselves; but when we get to the work itself we find that no two animals have precisely the same digestive apparatus; we find that the condition of the animal as to age, as to the amount of flesh it carries, has a very great influence. Peculiarities of breed, and the manner in which the animal has previously been treated, all have their influence; so that it becomes exceedingly difficult to make an exact experiment that will result in the advancement of our knowledge of agriculture. The experiments should be well planned, and then carried out for a long series of years. As Dr. Sturtevant has just remarked in regard to the experiments at Rothamstead, they have been conducted for a very long time, and there are perhaps no others in the world that have been conducted upon the same plan and for the same length of time; and the results which are of the most value are just now being obtained. I place very little dependence upon experiments conducted only from year to year in different localities. An experiment for a year upon one piece of land, and another year upon another piece of land, in another locality, will throw but very little light upon the laws or principles that are to guide us in farm practice. The peculiarities of season may have a very great influence upon the results, so that a field experiment must be conducted long enough to eliminate the errors arising from the variations in the seasons themselves. Mr. Lawes, in looking over his experiments for forty years, is enabled to pick out certain bad seasons and certain good ones, put them together, and see what the results are, and in that way he is arriving at conclusions which are very different from those that he would have drawn from the experiments thirty years ago. As he remarked to me, when he had experimented ten years, he thought he could generalize safely; when he had continued his experiments twenty years, he found it necessary to change his views as to what the experiments proved; and when he had gone on thirty years, he saw reason for still further changing his views. So that this matter of experimentation is not one that can be conducted to a successful conclusion in a short time. It is a question of time, patience, persistent effort.

Mr. HYDE. I would like to hear from a distinguished gentleman whom we have present, Major Alvord.

Maj. ALVORD. I did not intend to occupy any of your time to-day, but upon this invitation, I will say a word.

In connection with this subject of investigations and experiments in agriculture, it has occurred to me that one of the practical uses to which the experiment stations of the different states could be put would be to act as a sort of supreme court to receive, digest, and to report upon, so far as time permitted, outside of their own work, these various so-called experiments that are being conducted, now more than ever, all over the country, the reports of which are creeping into the newspapers. We all recognize how much interest has lately been developed in the line of agricultural experiment, and the result of it is that here and there, and all around, we find men who have given a little attention to some one thing, perhaps very carefully, generally with a great deal of carelessness; at all events, as a rule, for a very short time; perhaps upon a single piece of ground; perhaps during a single season; perhaps on animals for a very short time; yet so anxious is every one to know the results of these experiments or trials on the part of their neighbors or agriculturists generally, that our agricultural press feels in duty bound to give whatever it can find new in this line, and picks up these so-called experiments that are spread over the country, and the people, upon a very slight basis, or no basis at all, are led to undertake new methods. Now, if we could only have some tribunal in every State which could take up these experiments, as they are called, that creep into the public press, and give an opinion, after examining the conditions under which they are carried on, as to their value and reliability, what is worth keeping, what is worth practising, what ought to be thrown into the waste basket, just as our stations take samples of fertilizers that are sent to them, and tell what they think about them, it seems to me they would be doing a great deal of good in the right direction. As an illustration, we all know the big stories that we have read every few weeks about the yield of butter from milch cows. My belief is, that in ninety-nine cases out of every hundred, if not more, where these stories have been written and afterwards circulated through the country, they have been honest in the first instance. The man tests his cow for twenty-four hours (perhaps some of them are satisfied with that), or for a week, under the most favorable conditions, and publishes the result, and it goes all over the country that such a person has a very remarkable cow. He is honest in his story; he gives certain facts; but he does not answer the multitude of questions that ought to be fired at him right away. These stories, as I say, go into the press, and to a certain extent they are accepted as the standards of what a milch cow ought to do. Now, a friend of mine, who had been in previous years mainly a horse man, some two or three years ago became interested in a herd of dairy cows, and I remember his stating to me at that time, as his firm belief, that there were not as many cows in the United States that made fourteen pounds of butter in seven days as there were horses that had trotted in 2:22 or something of that sort. That was his opinion. At any rate, he brought down the number of fourteen-pound cows to some half dozen in the country. A declaration of that sort, published in a prominent journal, naturally brought out a great many statements, and a vast number of statements have been made since of animals that have done as much work as that in the way of butter making, or more.

Now, the question comes at once, what was the value of those different statements. This gentleman, being a man of considerable leisure, and feeling a good deal of interest in the matter, has gone to the trouble of following up these various statements that he has picked up in the newspapers, and through his correspondence, and propounded a long list of questions to every man who had put such facts on record about agricultural productions, or the production of milk and butter, and he has found that a small fraction of them were fraudulent to start with—made out of whole cloth; that just about one-third were totally unreliable; that another third were greatly exaggerated, and that another third had some basis to stand upon; so that he brings down the number that have any value or reliability to a very few.

Now, those of us who are breeding cows or who are feeding cattle for butter or milk want animals from the family of the third portion of this great number of which these stories are told, and we want to be assured, by some competent authority, that they are true. The person to whom I have referred is a private gentleman, who has no authority behind him in this matter, and those persons whom he decides against in the cases in which he acts as a self-constituted judge will of course oppose him directly. But suppose those questions were referred to a state authority in agricultural matters, or to a state experiment station, or to the exclusive authority of a state board of agriculture, and should be passed upon there; by that means, certainly, we should be protected against a great many of these matters which are creeping into print and attracting general notice which now are misleading, and I think a service could be rendered to the farmers of the country that would be fully equal to what we all recognize as the very great service which has been rendered to agriculture by the investigations of the commercial fertilizers of the country during the past few years.

The CHAIRMAN. I see Prof. Johnson, the director of the Agricultural Experiment Station of Connecticut, is present. We should like to hear from him, as the subject under consideration is one in which he is peculiarly interested.

Prof. JOHNSON. Dr. Sturtevant has read a very interesting and very valuable paper. He has made us ashamed that we have not such an experiment station as we ought to have, to grapple with questions the solution of which is so important to us, and the lack of whose solution is costing us every day a great deal of money. As director of the Connecticut Experiment Station, I have always felt that we had not a station in the true sense of the word. We have the beginning of a station; all enterprises must have a beginning; and we must be content, usually, with small beginnings. It has been impossible, with the resources at the command of the Connecticut Station, to do more than it has done; more than to carry on such work in the chemical laboratory as applies to the fertilizer trade, and to make some rather miscellaneous researches in other directions. As you know, the station has not at its disposal a foot of ground where any experiment can be made upon a living plant or upon a living animal. We have not even a window where we can carry on a successful pot experiment, and although land at a distance of a few miles has been placed freely at our disposal we could not use it to advantage because it is impossible to conduct experiments without constant and careful supervision. In the management of the Connecticut Station we have endeavored to do thorough work in the line of our opportunities, and where the results would be appreciated, and that has been the fertilizer field. It now seems that the work thus begun must be continued; that it has become a necessity. It would be perhaps more for the interests of the State of Connecticut to do other kinds of work, to attempt, for instance, to answer some of the questions which Dr. Sturtevant has proposed here, and others which will readily suggest themselves, than even to continue the fertilizer control. There is no difficulty in undertaking such investigations and in bringing them to a successful issue if the farmers of Connecticut will say, "we want it done, and here are the means to do it with."

It does not require any extraordinary genius to plan or to carry out an investigation. There are of course a few superior men who seem to have been born to invent and to discover. Of such, if I mistake not, Connecticut has had at least a fair share, and will doubtless produce more from time to time. Meanwhile we have plenty of average talent which can be made available for this purpose, if we will give it a chance to exert itself.

In the German countries, in Austria and Italy, the business of agricultural experiment has assumed national importance.

The twenty six experiment stations of Prussia are organized under the Minister of Agriculture, and all their business centers in his office. Since their first establishment some thirty years ago, the European experiment stations have educated a large number of investigators, and the rapidly increasing demand has created an adequate supply. They are not all first-class men, but they are all able to earn their wages, and to contribute to the ever-growing fund of positive information.

What Dr. Sturtevant has said with regard to the need of patient work and repeated trials, cannot be emphasized too much. Scientific investigation, the object of which is to find out truth,—bottom-fact which we can rely upon, and which will never "go back on us,"—requires always, and especially in agricultural matters, where there is such a complex of causes and factors working together, long-continued, patient, and most careful observations. Whether it is in field experiments, or in studies upon the feeding of animals, or in researches which have reference to some point in the nutrition of plants, repetition upon repetition and continual study are needed to bring out a true result. As Dr. Sturtevant has told you, some of the earlier deductions from Mr. Lawes' experiments were misleading. Thirty years ago, the president of the Royal Agricultural Society, Sir Philip Pusey, said,—"Mr. Lawes has demonstrated that nitrogen is necessary for wheat and phosphates for turnips." That was believed to be a truth which Mr. Lawes had ascertained after experimenting for a few years. Now, Mr. Lawes, as you will find if you read his recent writings, or if you look at the results of his experiments, is not so certain of that thing. He is only certain that *on his land* there was a large accumulation of nitrogen in the soil, able to carry on the production of wheat at the rate of sixteen bushels per acre for forty years. He has proved that by having tried it for forty years. There are symptoms, however, that the wheat crop is failing to some extent on his land, so that we can safely assert that if his successors will go on there for a thousand years, or two thousand years, or long enough, they will exhaust that nitrogen, and the land will cease to yield sixteen bushels of wheat to the acre. There are fields in the northern part of Connecticut where the natural supply of nitrogen is only equivalent to nine or ten bushels of rye every other year; to get larger crops out of those fields, you would have to add nitrogen.

One of the grand truths which is thoroughly enforced by Mr. Lawes' experiments is that soils differ, to a degree that cannot be inferred from external signs, and any conclusion as to what fertilizer is best for this or that crop, is to be judged of for each case by itself, and depends upon the lack or supply of the totality of plant food in the soil, and the coöperation or want of coöperation of all of the factors which work together for the production of a crop. We have learned from Mr. Lawes' experiments many valuable facts which could not be brought to light in any other way, and the longer these experiments go on, the more information we shall get from them. Probably Mr. Lawes has never got his money back from these experiments. But the farmers of England, and of the world will profit immensely by the investments which Mr. Lawes has put into his investigations. The State of Connecticut can now begin a similar work, which in time will be exceedingly profitable, and which will at once justify the outlay. We can get results in the matter of stock-feeding within five years from a single experiment station devoted to that purpose, which will help every farmer in the state, who is intelligent enough to master those results, and will take pains to apply them in his practice.

The statements which come to us from Germany, with regard to what is necessary to feed a thousand pounds live weight of this or that animal, under different circumstances, are the results of a large number of practical trials made by men skilled both in the handling of live stock, and in the scientific investigation of whatever influences go to assist or to hinder the use and economy of their food. The results are statistical in their nature, and they apply, as all statistics do, with more or less variation.

The true scientific character of those investigations was shown us last winter through the New Jersey station, which was established two years ago, very much on the plan of ours, and in connection with the Agricultural College of the State of New Jersey, which owns a farm, so that the station has been able to make some experiments on the feeding of cows, based upon the German results. These trials proved conclusively, as the figures show—(I shall reprint them in my report this year for the benefit of the farmers of Connecticut)—that a large saving in the cost of maintaining those animals was realized simply by varying the proportions of the nutrient elements of the feeding materials. By changing from the common hay ration, with a little grain, which is usually given in that part of New Jersey, adding a calculated proportion of cotton-seed meal and some other ingredients, so as to give a balanced ration, they obtained with much less cost, the same product in the way of milk that they had before, and effected a saving, if I remember rightly, of some thirty per cent.

We start here, then, at a great advantage. We have the benefit of many years' hard work at the numerous experiment stations in Germany and other European countries. It is full time that the State of Connecticut placed our experiment station on a proper basis. It ought to have, in the first place, the undivided services of some capable man as director, which it has not now. It ought to have its own grounds and laboratories, built in a style adapted to its purposes, and a full complement of able chemists, and assistants, with all needed apparatus and materials for carrying on the work of investigation by the methods which the science and art of our time have put at our command.

Recess until 2 o'clock.

AFTERNOON SESSION.

The meeting was called to order at 2 o'clock, by Vice-President Hyde, who introduced Dr. Edward H. Jenkins of New Haven.

COMMERCIAL FERTILIZERS, SOURCES OF SUPPLY AND HISTORY OF THE TRADE.

BY DR. E. H. JENKINS, NEW HAVEN, CONN.

Mr. President and Gentlemen:—At the suggestion of the Secretary of the Board I am to speak of the Sources of Supply of Commercial Fertilizers and the History of the Trade in them. The ordinary manure of the farm and various waste products which are sold at a low price, and often act rather as amendments than as fertilizers, do not come under discussion here. They may in some cases be more valuable to the farmer than any other application; they have a history as old as the art of agriculture and to some extent a commercial value, but the term Commercial Fertilizers is now limited to those articles occurring as natural deposits, like guano and Chili saltpeter; or manipulated in some way, like dried blood and fish scrap; or regularly manufactured, like superphosphates and potash salts, which are powerful fertilizers, are expensive in comparison with farm manure, and are regularly quoted in our market report.

The history of the trade in such materials dates back not more than about forty years. Not much earlier than that was the need of them appreciated and a demand created, of sufficient proportions to establish a trade. But, though no very extensive use was made of them prior to that time, the value of bone, fish, and even of superphosphate of lime was here and there recognized long ago in farm practice. The first settlers in this country learned of the aborigines on the coast that a fish planted in each hill of maize greatly increased the crop, bones were used as manure in England to some extent early in this century, and superphosphate of lime was made and applied by Sir James Murray in England as early as 1817.

In 1840, appeared a work by Justus Von Liebig, on Chemistry in its Relations to Physiology and Agriculture, a book which was of inestimable service, for it showed for the first time where the foundation of agriculture as a science was to be laid, it opened the way for the new science chemistry to enter and become a constituent part of our system of agriculture, it introduced the experimenter in the laboratory to the experimenter on the farm, and it laid down certain propositions with regard to the fertilization of plants which called for patient, accurate experiment and at once awakened widespread interest and intelligent inquiry into the many problems of agriculture, such as there had not been before. Prolonged and bitter controversy arose, on the subject matter of this book; the so-called "mineral theory" of Liebig was fiercely attacked and stubbornly defended, and over the meager treasure of facts and observations there was a bitter war of words; but one thing was not disputed, that the book together with Liebig's other contributions to the subject, marked an epoch and were the beginning of that movement which has created a science of agriculture, and enabled it to meet the demands which our modern life makes on the art of agriculture.

These demands are not as simple as they once were. Farming in any civilized country is a very different matter now from what it was a century ago.

In a country newly settled or under primitive conditions, we find a very large majority of the inhabitants are cultivators of the soil; the land is sparsely settled, and for this reason is cheap. The agricultural problem is reduced to its lowest terms. Here if anywhere, we shall find the peace and plenty of Acadia. Each takes from the land what he needs to support him, and does not bother to return anything to it. It might be a wanton waste of time and money to save and apply even the manure produced on his farm. But the population becomes bye and bye denser, and he cannot occupy quite so much room. So instead of letting land lie fallow he will practice rotation of crops or he will plant and cultivate a little more carefully. Acadia still, but "the murmuring pines and the hemlocks" of the poet must go. Prosaic potatoes and wheat are what is most wanted. Not only is the amount of land at the disposal of each proprietor growing smaller by the increase of population, but at the same time, the number of producers is relatively lessened.

The professions, trade, and commerce make their demands for strength and skill, and take them from the farm. Those who are left must work the harder and plan the more intelligently. No longer Acadia you see. By this time "the murmuring pines and the hemlocks" have all gone through a steam saw mill. Our ideal community are largely engaged in trade, and the farmers find a ready market for whatever they can sell. Nitrogen, potash, phosphoric acid, and all the other elements of plant food are being carted off from the land at quite a rapid rate. But what of it? There seems to be a plenty left.

Some farmers, to be sure, find the yield of their land increased by putting on stable manure. Others not. Some use *oil* as a fertilizer and like it; but *why* they use either they don't really know. The wants of the community, all this time, are becoming more complex. Food and clothing are not the only things to be got from the soil. The growth of different manufactures and of commerce make incidentally enormous demands on its fertility, and the problem becomes daily more and more pressing, how shall we bring our fields rapidly to their maximum producing power, and how shall we keep them there? Our land is becoming in places actually *less* productive than formerly. We are doing our best to meet the demands made, and we are rapidly coming to our wits' ends.

This was the situation when agricultural science became a living fact, because it was within reach and had become a necessity. And the use of commercial fertilizers and the beginning of a trade in them dates from this time when agricultural science had its birth.

My plan now is to speak of some of our common fertilizing materials, giving what facts I may which are of interest with regard to their past use, and the mode of their occurrence, and perhaps adding, by the way, a little useful information in regard to the present condition of the trade in them. It is natural that we should begin by speaking of Peruvian guano. It was the first costly fertilizer which found extensive use in this country, and it has been and still is, to a considerable extent, the farmer's standard of comparison. Nothing has been commoner in advertisements and testimonials with regard to fertilizers than the assertion "equal in effect to Peruvian guano." Pine Island guano, Soluble Pacific guano, fish guano, etc., applied to articles which probably contain no trace of real guano, bear testimony to the position which guano holds as a standard of comparison in the minds of farmers. Or can it be that the æsthetic soul of the inventor of such names, imagined that there was a suggestion of sentiment; of something lonely and very far off in the words Island and Pacific, which the young and tender crop would recognize and respond to!

Notice first the geographical position and origin of the deposits. They lie on the western coast of South America, chiefly in Peru, but in small amount in Chili, and Bolivia also. Not far to the east of them rises the great mountain system of the Andes, with its several lines of ridges and spurs standing guard over the most extensive and valuable store of chemical treasure in the world.

In the region where these treasures lie, the wind blows from the east and southeast uninterruptedly through the year, and the protecting mountains dry these winds completely. As the current, loaded with moisture from the Brazilian forests, strikes the eastern spurs of the Andes, it deposits most of its burden in heavy rains. As it climbs the higher ranges it is cooled still more, and when it passes the snow-capped summits the last traces of water are wrung from it, and it sweeps down over the plains of Peru, drinking up their water and making them, except by the water courses, a barren desert.

Rain therefore is almost unknown there, at least between latitudes 14° and 21° S. At Iquique rain falls in a light shower once in many years. In other places the fall of rain is as much of an historical event as the "Dark Day" was in New England. In such a country, and in such alone, can guano deposits be formed or remain; for from one-half to three-fifths of Peruvian guano is very soluble in rain water. Deposits are found in various places, but the most remarkable are the Chincha islands, which lie in the Pacific, not far from the coast. The islands are of granite, absolutely barren, and when first worked for the export trade were covered in places over 100 feet deep with guano, while in other places the deposit was not over four feet deep. It is entirely free from any admixture of earth. This guano consists mainly of the excrement of birds, together with their feathers and carcases, and has been accumulating for centuries.

Enormous flocks of birds, chiefly gulls, pelicans, cormorant, and gannet live on the coast, and these islands serve for their homes, their breeding places, and their cemeteries.

The waters about there teem with fish of various sorts. The stories told of their numbers are too fishy to be rehearsed, but we may well believe that the actual facts are something of which we can have small conception, and fish furnish all the food of the birds. What makes the excrement of birds particularly valuable as a fertilizer, is that the excretion of both kidney and intestines is mixed in the cloaca, and voided in a comparatively solid condition. What makes guano so far superior to any fresh manure of the kind is that the sole diet of these birds was fish, which are rich in phosphoric acid and nitrogen, and also that all the moisture was speedily taken out of the mass by the dry, hot winds continually passing over it.

Our lands are continually suffering a loss in nitrogen and other elements of plant food which through various channels finds its way continually to the ocean and passes out of our reach.

Through the agency of these birds, many million tons of these same elements have been recovered from the ocean, and stored up where of all places they would keep best for our use long before we felt the loss and desired its replacement.

The Chincha islands have furnished more and better guano than any other localities, but they are by no means the only sources of Peruvian guano. There are the Maccábi, Huanape and Lobos islands, names familiar to purchasers, from which large quantities have been shipped, as well as the province of Tarapacá. Nor is guano all of the same origin. On some islands it was formed largely from the excrement and carcases of other animals, seals, sea-lions, and the like. The Lobos islands are the seal islands, as the name implies.

The history of the use of guano and the trade in it, dates back at least to the time of the Incas in the 12th century. At that time the islands were an important subject of legislation. Each had its overseer or superintendent, and the guano was distributed among the coast provinces for use as a fertilizer.

The people found that on a soil described as remarkably sterile naturally, a mixture of white sand and clay with little humus and exposed to a burning sun, a moderate application of guano gave abundant harvests of maize. The old Peruvians had a proverb to this effect:—

> "Guano can work miracles,
> Tho' it is not numbered with the saints."

Stringent measures were taken to avoid waste and to prevent any disturbance of the producers of this miracle-working stuff. It was made a capital offense to kill the young birds or wantonly frighten them, or even to land on the island during their breeding season. It is said that since the guano trade with other countries has sprung up these birds have largely disappeared, but now where the deposits are no longer worked it is hoped that they will return to their old homes.

Various reports of the Islands came to Europe from 1604 on. Humboldt called the attention of European nations to them, and brought samples which were analyzed and the results published in 1806. The first importation into Europe, it is said, was not for use as a fertilizer, but was made by a Hamburg apothecary, at the request of Liebig and Wöhler, who employed part of it for the preparation of uric acid, in the course of their classic investigations on that subject. This was in 1837.

To give an idea of the colossal nature of the transaction,

"A whole ton," it was said, had come over.

In 1840, the same year in which Liebig's Chemistry in its Application to Physiology and Agriculture appeared, parties in Callao sent one ship load to England for use as an artificial manure. In 1842 Gibbs & Co., who became agents for the Peruvian government, imported one hundred and eighty-two tons to England, and from that time the trade increased till it reached enormous proportions.

For thirty years almost all our guano came from the Chincha Islands, but in 1872 when seven million tons had been exported from them and only about one hundred and fifty thousand tons remained, the Peruvian government resolved to hold the rest for home consumption, and exported only from the Maccabi and Huanape Islands. In 1874 one million tons had been shipped from them, and half a million tons remained. Since then large shipments have been made from the Lobos Islands, and lately all that has been sent came from these islands and the province of Tarapacá.

Not long after guano was introduced into England it found its way here, but we were somewhat slower than the English in bringing it into general use, no doubt because our need of it was less urgent. Its great fertilizing value was first most strikingly shown on the old exhausted farms of Virginia and Maryland, and so great was the demand for it there that in 1852 cargoes were sold before their arrival.

From then on the trade steadily increased till the war time, when it averaged eighty thousand tons a year. It fell off greatly at that time, and until lately only twenty-eight to thirty-five thousand tons have been sold annually.

From the first the high price of guano has operated against its universal use. The freight from so distant a port as Iquique or Callao is of course very heavy, and the other expenses have been increased by the miserable mismanagement of the Peruvian government. Another trouble with guano has been the unevenness of value in the different cargoes. One would be rich in nitrogen, phosphoric acid, and potash, the very next perhaps poor. To meet this trouble it has long been the practice in England to buy and sell it by analysis, paying a fixed rate per cent. for ammonia and phosphoric acid.

Another plan has been followed by Messrs. Hobson, Hurtado & Co., the agents for Peru in this country, which I think is even better. All the guano received is analyzed, sorted, manipulated, or rectified by them, and sold under certain brands with a guaranteed composition, so that the purchaser had comparatively little uncertainty as to the value of the goods, as analyses made showed the goods to be in every respect fully up to the guarantee.

I have as yet given no figures to show the composition of Peruvian guano. This is difficult because the genuine article has varied so widely from year to year and even from cargo to cargo, and has been so variously doctored. It has truly "suffered many things of many physicians," and was nothing bettered but rather grew worse, so that sometimes it is impossible to say from the inspection of an analysis whether it was made on a genuine Peruvian guano of very poor quality, or on one which had been mixed with sand or shells with fraudulent intent. In some of Prof. Johnson's reports as chemist of the State Agricultural Society, I find as high as 15½% of nitrogen and 15% of phosphoric acid. But of late no such material has found its way to consumers.

In his Station Report for 1876, Prof. Atwater gives as the average of seven analyses of "No. 1 Standard"—the highest grade—Nitrogen, 8.5; Potash, 3.7; Phosphoric Acid, 15.8; of which 12.1 was available so called.

In 1877, these figures were maintained.

In 1878, as far as I can find the figures did not vary essentially, though slightly lower all through.

In 1879, Potash and Nitrogen both fell a little.

I have no analyses of stock sold in this State in 1880, but during the last year there has been a very marked change.

The average of three analyses made at the Station gives Nitrogen, 6.2; Potash, 2.7; P_2O_5, 16.5; of which 8.2% are "available."

These figures which I have given have reference only to the Peruvian guano which has been used in this State.

The impression among dealers has been such as to shake confi dence in the absolute purity or genuineness of the article. It has of course been a trying time for those engaged in the guano trade, because of the anarchy which prevails in Peru and makes shipments almost impossible. At present it is impossible to say what is to be the future of the guano trade. I learn that there have been sales of thirty thousand tons to London capitalists for this country, and that several cargoes are on the way. That will meet the demand for the year to come, but beyond that nothing is certain. It is the opinion of those in a position to judge that the guano supply in Peru is by no means exhausted, and under a stable and enlightened government, such as its neighbor Chili enjoys, Peru might supply Europe and America with guano for years to come.

I have dwelt at some length on Peruvian guano, and will not stop to mention certain other places where guano of equally good quality has been gathered, for the yield has been small and the localities soon exhausted, or the quality of the deposits has become so inferior as to make their working unprofitable.

Of late an article has appeared in market called bat guano. It is a cave deposit found in Cuba and other of the West India Islands, in Arkansas and Texas, as well as in some parts of Europe, but the most of it has come to us from Samana Bay. As the name suggests, it consists of the excrement of bats which make the caves their resting places. Some small lots taken from the surface fresh were imported, showing 30% of ammonia largely in the form of urate of ammonia, but the underlying material disappointed expectations, averaging ⅛% ammonia and 4 to 5% phosphoric acid, and several cargoes have been rejected because they were not much better than garden soil. Owing to the ignorance of loaders the least valuable material has often been shipped, and even when the content of nitrogen is considerable, much of it may consist of the undigested cases of insects upon which the bats feed, which though highly nitrogenous are probably quite inert as a fertilizer. For these reasons the material does not find much favor with dealers.

I have said that from 50 to 60% by weight of guano is soluble in water, and that for this reason real guano in only found in rainless climates.

Now there are many secluded places, generally islands, which are the favorite resorts and homes of vast flocks of birds which live almost entirely on the fish of the surrounding waters, but these places are subject to more or less frequent rains which wash back into the ocean whatever is freely soluble in the bird deposits, or else these soluble matters enter into chemical reaction with the coral limestone and are in part retained. As a rule the nitrogen and potash are lost while the phosphates are retained and become a valuable source of phosphoric acid, forming what are called the phosphatic guanos.

In former years we received a great deal of this material from some small Pacific islands of coral formation under the name of American guano. In 1856 the United States assumed the protection of all the guano islands in the Pacific which lay within 10° of the equator north and south, and between longitude 150° and 180°. The islands chiefly worked were Baker's, Howland's, and Jarvis'.

The guano was brown, pulverulent and coarse grained, and could be shoveled without picks. It contained from 30 to 40% of phosphoric acid, and that from Jarvis' Island was largely neutral phosphate of lime instead of basic phosphate, a point in its favor when used for the preparation of superphosphate, for it required less oil of vitriol to dissolve it.

But at present nothing is imported from these places into our own country. It is said that Howland's Island is far from being exhausted, and there is still left some guano of excellent quality on Jarvis' Island, but it finds its way chiefly to the German market.

Our main supply of material of this kind comes now from the West Indies. Just at the mouth of the Gulf of Venezuela, in the Caribbean Sea, lie great Curaçao and little Curaçao Islands. For some years they have furnished large quantities of guano to Germany and the United States.

The little Curaçao guano from which most of our supply comes is poorer in phosphoric acid than the other, averaging from 25 to 28 %. Its mechanical condition however is better. It is fine and dusty with some hard lumps. Great Curaçao guano goes largely to Germany. It is hard and rocky but has from 38 to 42% of phosphoric acid, not over 2% oxide of iron and alumina, and some 6% carbonate of lime.

Orchilla guano has a somewhat similar composition, though I believe it is of inferior value and importance.

Another rock phosphate, the Navassa, is now extensively used in this country as material for the superphosphate manufacture. Probably it is not largely used in fertilizers which find their way to the Connecticut market, but most of it goes to the southern trade. Navassa Island lies southwest of St. Domingo and east of Jamaica. The phosphate deposits were formed under water and thrown up by volcanic action. It contains from 50 to 75% of phosphate of lime and a considerable amount of oxide of iron and alumina, which makes superphosphates prepared from it "revert" badly.

I come now to speak of the phosphorite in our own country, the South Carolina phosphate beds, which I believe are, and for some time will be, the chief source of raw material for our domestic superphosphate manufacture.

For most of the facts given in this connection I am indebted to an interesting printed report by Prof. C. U. Shepard, Jr., of Charleston, who has had a more extensive experience in the matter than any one else, and to verbal information received from him. As to the real extent of the deposits which can be worked to advantage, we at present are not fully informed, for the industry is still in its infancy. The existence of vast beds of phosphorite was known before the war, but they were not worked till after its close. This material is found in many places on and near the sea coast, but the larger part hitherto marketed has come from the region lying to the north and northwest of Charleston between the Cooper and Stono Rivers and from the region at the head of St. Helena Sound on the Bull and Coosaw rivers northeast of Beaufort. It is essentially a phosphate of lime soft enough to be got out with shovel and pick. The land deposits occur in a stratum from six to fifteen inches thick, though averaging not more than eight inches, and where worked do not lie more than six feet below the surface.

There are also submarine deposits consisting both of loose material brought down by the current and of fine regular strata. This is known in the market as "river rock."

The rock is always washed, drained, and dried somewhat before shipment, and some firms dry their material thoroughly by piling it up under cover around tubes which are supplied with hot air. Hot-air dried cargoes at present make up more than half the total amount shipped.

The extent of the industry is indicated by the following figures:

There were shipped from Beaufort and Charleston the following amounts of crude phosphate:

In 1875, - - -	122,790
1876, - - -	132,626

1877, - - -	163,220
1878, - - -	210,323
1879, - - -	199,365
1880, - - -	190,763
1881, - - -	266,734

We have noticed the chief *natural* sources of phosphoric acid which supply our markets. Time will not allow us even to name the other localities which supply other lands.

Besides these there are some considerable supplies of phosphates from waste or bye products. Occasionally we meet with bone-ash from the plains of South America. The plains furnish forage for vast herds of cattle which during the past 100 or 150 years have been killed annually in great numbers for their horns, hides, and fat, while the carcases have been mostly left for birds and beasts of prey. On account of the scarcity of wood the bones have been used for fuel in the factories where the fat was tried out, and in the neighborhood, of course, great heaps of bone-ash accumulated which have at last found their way to market. The supply is rapidly diminishing and will soon be exhausted. Then the spent bone-black from sugar refineries furnishes a small but constant supply of material, not suited for direct application to land but much prized as a basis for superphosphate because of its fineness, needing no treatment preliminary to solution in oil of vitriol. Bone-black superphosphates seem to be particularly popular with purchasers, and as the call for them continues the supply does not fail. Even when genuine bone-black is out of market some parties, bent on suiting the whims of customers, continue to turn out this popular superphosphate by a judicious mixture of mineral phosphates and lamp-black.

Lastly, we must briefly speak of bones as a source of phosphoric acid. No other fertilizing material comes into market in such a great variety of forms. We have bone-chips from the factories where knife-handles and other articles are made from them, bone turnings from the button factories, bone and—so-called—ivory saw-dust, either dry, or wet when the saws are run in water. We have bone refuse from glue factories, very fine and dry with little or no nitrogen, steamed bone, that is bone from which the fat has been extracted by cooking with superheated steam, and raw ground bone of all conceivable grades of goodness and badness. Some with fragments of bone as big as peas, some with 30 or 40 per cent. of salt cake added as a drier or make-weight, and some leaving little to be desired as to fineness.

The raw bones contain from $3\frac{1}{2}$ to 4 per cent. of nitrogen and from 20 to 25 per cent. of phosphoric acid. Steamed bone is generally a little poorer in nitrogen and richer in phosphoric acid, while bone which has passed through the glue factories contains often but a small fraction of one per cent. of nitrogen, and may run as high as 30 per cent. of phosphoric acid.

Now all the native phosphates previously noticed, with the exception of Peruvian guano, seldom come into the retail trade, being used chiefly as the basis of superphosphates. Bone, however, in variety of forms is offered everywhere to the farmer, and is perhaps more widely used with us than any other concentrated manure. It has been used longer than any other, and those who have no faith in commercial fertilizers as a rule make a mental reservation in favor of bone. Yet bone varies in quality—as regards its mechanical condition—as widely as other fertilizers vary in their chemical composition. A very fine-ground bone is quick-acting, but a coarsely-ground or greasy bone is one of the slowest things to decompose in the soil.

Grease in bone or in fish is a decided disadvantage, as it shields the other matters from the penetration of water and air, agencies which produce decomposition. For this reason steamed bone is more rapid in its action, and it is quite likely that our large bone factories will sooner or later exhaust the fat almost completely from bone, either with steam or with benzine. Besides the New York market as a source of supply, we have bone-mills in a number of places in this State. The general defect is carelessness in grinding. Much of the bone is quite too coarse to secure the best effects, but when its mechanical condition is suitable I believe the prices range a little lower than for New York bone. Those who are on the lookout can at times get a limited amount of bone sawdust from manufacturing concerns at a very low figure.

In our experience bone is a thing seldom adulterated with intent to defraud. Some firms who deal in it, however, have a brand of bone containing variable quantities (sometimes as high as 40 per cent.) of salt cake, sulphate of soda. This is added, as they claim, to dry and keep the bone from rotting or to cheapen it to meet a demand for a *cheap* manure! If a demand exists for a cheap bone manure of that kind it is a most senseless one. Ton for ton it contains not much more than half as much phosphoric acid and only three-quarters as much nitrogen as our best qualities of fine ground bone, while the price is by no means correspondingly less.

I have now rapidly enumerated the principal sources of supply of phosphates for commercial fertilizers. First, Peruvian guano, a thing by itself; a complete manure, containing sometimes as much nitrogen as phosphoric acid, besides a supply of potash; but introduced here on account of its historical importance, and from its connection with the phosphates which follow next.

Second, the washed guanos, or phosphatic guanos. Baker, Howland, and Jarvis Island guano—perhaps little Curaçao, and many others not spoken of; all of them soft, fine, pulverulent, and, we may suppose, more assimilable in their raw condition than those which follow.

Third, phosphorite and apatite; the former amorphous, the latter crystalline; both hard and rocky, from the action of heat and the pressure of surrounding strata—leaving it, in most cases, questionable whether they were of animal origin, or whether they are a part of the original earth-crust which has never been incorporated into plant or animal structure.

And, fourthly, we have noticed some waste products of varying assimilability, from bone-black, which, applied directly to land, would be quite inert, to ground bone, which is very rapid in its action.

I have not time to speak of the super-phosphate manufacture, nor does it fairly come within the scope of this lecture. We all understand the theory of it. These hard phosphates, when ground and mixed with oil of vitriol, are decomposed, and their phosphoric acid becomes soluble in water, and so easily taken up by plants.

Messrs. Mapes & Co., H. J. Baker & Bro., and G. B. Forrester offer brands containing from twelve to fifteen per cent. of soluble phosphoric acid, and not more than one per cent. undecomposed phosphate, at a low figure; but most so-called super-phosphates have from one-quarter to three-quarters of their phosphoric acid in an insoluble form, and no more effective agriculturally than the raw material from which they were manufactured. There is no apparent reason why soluble phosphoric acid, made from apatite or South Carolina rock, is not just as serviceable on land as that from bone—and, of course, it can be more cheaply produced; but if from one quarter to three-quarters of the material employed is not touched with acid at all, it makes a most serious difference whether the basis of the super-phosphate was bone or rock phosphate. There is, then, safety in purchasing high-grade super-phosphates, unless the buyer is perfectly satisfied with regard to the materials used in a low-grade article, and the price justifies the purchase.

We come now to speak of the source of our supply of potash fertilizers.

Twenty-five years ago the potash used in the arts was derived very largely from wood ashes. It was never applied in anything like a pure state as a fertilizer. About that time, the constantly-increasing demand and the very limited supply led to an investigation of other sources of potash, and practicable methods were devised for its extraction from orthoclase feldspar, which often contains 16 per cent. of it in combination with silicic acid.

These processes promised to help the difficulty somewhat, but still the demand was in advance of the supply, and the market was constantly rising, when, between 1860 and 1865, mines of potash were opened and developed in Prussia, which instantly relieved the want, made the production of potash from feldspar and wood ashes unprofitable, opened the way for the establishment of a number of new industries, and made it possible and rational for the farmer to apply potash salts in nearly a pure state to his land. At present, the supply appears practically inexhaustible.

In 1839, the scarcity of salt in Prussia (her salt springs furnished only about three-quarters of the salt for home consumption), and the geological formation in the neighborhood of Stassfurt, led to exploration and boring, with the hope of striking salt water, which could be economically handled for salt, or better yet, rock-salt itself.

In 1843, the first salt appeared, and in 1851 a salt-bed had been penetrated for a thousand feet without reaching the bottom. The boring had a total depth of nearly 1900 feet. The salt liquors which were raised at first disappointed expectations, for they contained comparatively little salt, but more of potash, and especially magnesia compounds.

A shaft was sunk, however, and at the depth of about 1,000 feet a bed of pure rock-salt was struck which is sufficient to meet all demands for that article for untold years, and added greatly to the wealth of the state.

As time went on, however, it proved that, highly-prized as the salt was, it was yet the least valuable of the treasures which were hidden below.

On this layer of salt there rested enormous beds of saline compounds known to contain a great deal of magnesia and some potash. To get at the salt below, these magnesia and potash salts had to be dug out and dumped on waste land at the mouth of the mine.

In 1860, the chemist Rose called attention to the waste, and the government encouraged fertilizing experiments with a view of utilizing this material, and also offered premiums to manufacturers who should devise methods of producing high-grade potash salts from them. In both directions there was complete success.

The economical manufacture of potash salts was accomplished; and the farmers, who were discouraged at first on account of the uncertain composition of the material supplied for experiment and the evil effects in many cases of the large quantities of chloride of magnesia which the crude stuff contained, found in the manufactured articles of standard composition an invaluable addition to their supply of fertilizers, and an addition most thoroughly appreciated in a land where the potato and sugar-beet crops fill such an important place.*

I have no time to speak of the various compounds in which the potash occurs there, nor of the somewhat complicated processes of preparation.

None of the potash which reaches the market, or only a very insignificant amount, is in the form in which it was mined. The salts from the mine are purified by solution, decantation from less soluble materials, and re-crystallization; the object being to make them as concentrated as possible, and to remove as completely as may be chloride of magnesium, which, even in small quantities, may seriously damage a crop.

In considering guano we have seen how, by the agency of birds, vast stores of fertilizing material have been recovered from the sea and stored in a safe, dry place for our use. The Stassfurt mines bring to light a whole inland sea evaporated to dryness, leaving its saline matters deposited in regular succession, stratum

* From 1863 to 1865 the price of chloride of potassium declined more than 50 per cent., and many of the factories were ruined. But more economical methods were at once introduced, and though the price has declined since, the business is a very remunerative one. It is believed that the price could be still further reduced, and yet leave a very good margin for manufacturers.

on stratum, just as they crystallized out of the sea-water in their order of solubility.

To show the extent of this industry a few figures will suffice.

In 1862 about 3,000 tons of high-grade salts were produced, in 1863, 9,000 tons; 1864, 21,500; 1865, 14,700; 1866, 26,782; 1867, 25,991; and from that time the production has gone on increasing. In 1877, 106,809 tons were produced; and it should be borne in mind that to produce one ton of high-grade salt requires the manipulation of over seven tons of the raw material.

This summary moreover does not include the production of Kainit, which is an item by itself.

The goods which come into our fertilizer market from Stassfurt are chiefly of three kinds. First the high-grade sulphate of potash, which was formerly made from other salts by double decomposition, but is now I believe chiefly made from the chloride of potassium by treating with oil of vitriol and subsequent calcination. This is the most expensive preparation but is preferred for use on tobacco and root crops, owing to the belief that the chloride injures the smoking quality of tobacco and lessens the percentage of starch or sugar in roots.

I believe that when the chloride is of high grade and is applied in proper quantity, not alone but mixed with phosphates and nitrogenous matters, this objection is by no means as serious as many suppose.

During the last year but one sulphate has been sent to the Station for analysis. It contained as guaranteed 80 per cent. of potassium sulphate with a very small percentage of chlorine. Its cost, $65, made the price of actual potash 7½ cts. per pound.

The muriate of potash, which is a perfectly safe application for grass and grain land, has been of good quality during the year. Seven analyses have shown from 72.7 to 86 per cent. of muriate of potash—80 per cent. is guaranteed—and prices have ranged from three and one-half to four and three-fifths cents per pound for actual potash—three to four cents less than for sulphate.

The third preparation used in Connecticut is Kainit. Three samples analyzed within twelve months have shown from 12.1 to 12.7 per cent. of potash, which is about the average, but the price demanded has been so high as to make it really the most costly source of potash. Actual potash cost from 7.1 to 8 cts. per pound, one-half cent more than in the sulphate even.

In New Jersey Kainit has been sold for from six to eight dollars per ton cheaper than here, bringing the cost of potash down to four and three-tenths cents per pound.

While the high-grade sulphate and muriate rule at present prices it is not economical for any one to pay more than ten to twelve dollars per ton for Kainit. The potash can be got as cheaply in muriate of potash, and the heavy ballast of common salt, Epsom salts, and Glauber's salts is not worth ten dollars a ton.

Within the last few years the quality of potash salts which have come into our Connecticut market has greatly improved, a fact which I am inclined to attribute rather to the supervision of the Experiment Station than to any unusually rapid approach of the millennium!

Formerly we received a great many miscellaneous things, some of them factory waste products and some of them from the Stassfurt works, which were worth nowhere near what was asked and paid for them. Let me mention one or two of them.

"Sulphate of Potash 75.9 per cent. Dr. Ulex analysis." This actually had 21.3 per cent. of sulphate of potash, the rest as chloride, and all the potash salts making but 62 per cent. of the whole instead of 75.9 per cent.

"Sulphate of Potash 55 per cent." had 15.9 per cent. of sulphate and 30 per cent. of muriate, besides 26.6 per cent. of salt.

Then we have had sulphate of potash so poorly manufactured that a large excess of oil of vitriol remained in it, making it sour and corrosive. It was used on a root crop and apparently ruined it.

In Germany, in the neighborhood of the mines, a number of preparations are offered and sold to some extent, which are frauds in that they are not what their name would imply.

"Crude sulphate of potash," "prepared Kainit," "Kainitic manurial salt," and the like are made up of mother liquors which are of no further use in the manufacture. Suppose one is stated to contain 50 per cent. of sulphate of potash. Analysis shows that it contains a good deal of muriate of potash and the rest is in combination with sulphate of magnesia and chloride of magnesia, a natural or artificial Kainit. If objection is made the manufacturer is ready with the reply that he meant all the time that the salt contained 50 per cent. of "potential" or possible sulphate; that is you could make—if you knew how—fifty pounds of sulphate of potash out of every hundred, and that this mode of statement—which to his uninitiated customer seems very much like what he has always been taught to consider lying—is a "usage of the trade."

In closing, I must briefly consider the sources of supply of our most expensive fertilizing material—nitrogen.

Already I have spoken of two nitrogenous materials, Peruvian guano, and ground bone.

We are also indebted to Peru and Chili for another fertilizer solely valued for its nitrogen, the cubic niter, or Chili saltpeter. It has long been known that saltpeter or nitrate of potash had a wonderful effect on vegetation, but it has been much too expensive for use in fertilizers, though I am informed by a New York manufacturer that he has lately used it to some extent in special fertilizers. The soda salt however is less valuable in the arts, as the base soda is cheaper than potash, and the fact that soda saltpeter attracts moisture, makes it unsuitable for the manufacture of gunpowder, an industry which consumes large quantities of niter yearly.

In northern Chili, formerly southern Peru, in the province of Tarapacá there is a vast arid region, a tableland, three thousand feet above sea level, stretching north and south for eighty miles. The trades blow all the year from the Andes, so that the climate is absolutely dry. There is no wood, no water, no vegetation there. Drinking water has to be brought forty-five miles. The only live things to be met with are the mules which carry freight to the port of Iquique and the vultures, who are prompt to call on a mule in distress. Lot's wife in her present state would find the climate by no means unfavorable, and would shine in Tarapacá society. On this plain occur vast deposits of nitrate of soda. It lies in strata five hundred yards wide and seven or eight feet thick in places, interrupted by deposits of common salt. It also occurs in hollows which look like dried up lakes, coating their sides and covering the bottom under a layer of salt. This crude nitrate of soda is purified at the coast by solution, separation from sand, and crystallization, and is then shipped to Europe and the United States.

With regard to the origin of these deposits we know little. It is conjectured that the nitrogen came in the first case from guano deposits on the shores of an inland salt lake or sea, that through atmospheric agency it was oxidized to nitric acid and then replaced muriatic acid in the salt of the lake and on evaporation was left in its present shape.

In 1820 the first cargo was sent to England, but was thrown overboard in harbor because the duty was so high that it would not pay to pass it through the custom house. In 1830 a cargo came to the United States, but there was no sale. In that year 18,700 tons were exported from Iquique; in 1840, 227,300 tons; in 1850, 511,800 tons: in 1860, 1,370,200 tons; in 1870, 2,743,400 tons. In 1872 the amount had risen to 4,000,000 tons, and in the following year the Peruvian government took the matter into its own hands and decided to export only 4½ million tons annually, so as to keep the price constant.

At present the region is in the hands of the Chilian government, and is likely to remain there.

Till now only one grade of nitrate of soda has appeared in our market, and that has never shown any fluctuation in composition, running from 94 to 96 per cent. of pure nitrate of soda with from 1 to 1½ per cent. of salt, 2½ per cent. of water, and a very little insoluble matter.

In Germany a manufacturing bye-product called potash-soda saltpeter has been introduced and found favor with farmers. It has 34 per cent. of potash-saltpeter and 61 per cent. of soda-saltpeter, equivalent to a little less nitrogen than the pure soda-saltpeter, but contains 15.9 per cent. of potash, which replaces an equivalent amount of soda. It has not yet appeared this side the water.

Owing to the high prices of ammoniacal matters which have prevailed the last season, it is probable that saltpeter will be very considerably used by manufacturers in the goods sold this winter and the coming spring. It is important in using manures containing nitrates that they should be applied immediately before the crop is put in. Nitrogen from a nitrate may waste more by draining in a few weeks than from fish or blood in all the winter months.

Another source of nitrogen is the ammonia salts, particularly the sulphate of ammonia, which is now chiefly obtained as a bye-product in the gas manufacture. When of fair quality it should contain from 16.5 to 20 per cent. of nitrogen, or from 77.7 to 94 per cent. of the pure salt.

I understand that lately there has come from England and been offered in our market a crude sulphate of ammonia, said to contain 7½ to 8½ per cent. of nitrogen. Its general look does not create a favorable impression, and low-grade ammonia salts are quite apt to contain sulpho-cyanide of ammonia, a substance rich in nitrogen but extremly poisonous to plants. Certainly no one should risk an application of such low grade stuff without submitting it first to chemical examination at the experiment station.

Our other nitrogenous manures are chiefly of animal origin, and have been made available by the progress of our manufactures. One of the most important is fish-scrap, the refuse left after extracting the oil as far as practicable from porgies or menhaden. This industry is not more than thirty years old. Previous to that time the fresh fish had been used on land in considerable quantity, but it is said that the oil of this fish damaged the land and made it unfit for cultivation. The first succcessful attempt to make a profitable manure out of fish is credited to a Mr. Lewis of New Haven, who operated in 1849. His work was suspended after a while, but others no doubt independently soon prepared fish in the same way. The fish were steamed or boiled until disintegrated, then pressed to remove oil, and the cake was dried and ground. This is essentially the process employed at present by most manufacturers.

The fish are thrown into large vats partly filled with water and boiled by steam. In from fifteen minutes to an hour the steam is shut off, the oil and water drawn off into settling tanks, and the remaining scrap is put into hydraulic presses and submitted to powerful pressure. Considerable gelatine is lost in the soup and considerable oil remains in the scrap, together with from 40 to 50 per cent. of water in spite of the pressing. This is removed by solar or steam heat, so that "dry fish-scrap" as we buy it averages about $7\frac{1}{2}$ to 8 per cent. of nitrogen, 6 to 8 per cent. of phosphoric acid, 6 to 11 per cent of oil, with from 12 to 20 or more per cent. of water.

The oil left in the scrap is a loss to the manufacturer and also a damage to the goods, for it hinders decay and makes the scrap less prompt in its action. Two patent processes are or have been in use to obviate this difficulty. Goodale's patent consists in washing the fresh scrap with a sufficient quantity of hot water, which removes the gelatine and so releases the oil, for it is claimed that it is this gelatine which retains the oil, and with it and water gives the scrap its slimy consistence and makes the drying such a tedious process It can then be re-pressed and dried much more easily, and the percentage of oil in the fresh scrap is reduced from say 15 to 2 per cent.

Another process, Adamson's, consists in extracting the oil with benzine. The manufactured product shows 3½ to 5 per cent. of water, less than 2 per cent. of oil, and between 10 and 11 per cent. of nitrogen. The plant required for the manufacture is, however, expensive, and the scrap needs to be quite dry before going into the extractors, so that for the present at least the process is not practicable.

The present extent of this industry and the use made of fish manures may be gathered from the fact that in 1875 the "ammonia" derived from fish manures was equal to that contained in 30,000 tons of Peruvian guano. The yield of the menhaden fishery was more than twice that of any other, and the value of the product was only surpassed by that of the cod, mackerel, salmon, whale, and oyster fisheries.

In 1880 there were 79 fish factories on the coast, employing 448 vessels and 3,200 men. 2,035,000 gallons of fish-oil were produced, and 45,000 tons of scrap.

Another very important source of nitrogen in our fertilizers is the offal of slaughter houses, which comes into market under a variety of names. Ammonite, azotin, dried blood—and here the trade distinguish kiln dried and red or steam dried,—tankage etc., etc.

Ammonite or azotin,—the terms are synonymous, but the manufacturers prefer the term ammonite,—has never appeared in the retail trade, but is extensively used by manufacturers for ammoniating their goods. It is prepared from pork and beef "cracklings," the refuse from tallow and lard melting, by extracting them with benzine. In this way all the grease is removed and the ammonite is left as a dry brittle material, which can be readily ground, is inodorous and will keep indefinitely. It contains from 12.4 per cent. to 15.7 per cent. of nitrogen and from 2½ to 5 per cent. of phosphoric acid.

Dried blood is used as well for ammoniating superphosphate, but it is also retailed more or less, and proves to be one of the cheapest and most valuable sources of supply of nitrogen.

In small slaughtering establishments much valuable material goes to waste if it does not indeed become a pest and poison to the neighborhood. All the blood and largely the intestines and other organs which are not valuable as human food are thrown away, or are only utilized in some small degree as fertilizers at certain seasons.

But at the wholesale establishments there is now scarcely a pound of the solid matter of the animals which does not pass into trade. In New Haven and possibly in other cities in the state, the largest slaughtering establishments have apparatus for converting offal into a fertilizer which will bear transportation and storing for a time. The blood when drawn from the animals flows into a tank where it is cooled. All the albumen is coagulated by cooking and sinks to the bottom, and the "soup" is thrown away. The solid residue of the blood, together with all the waste parts of the viscera are then put into a cylinder having a revolving shaft with arms, which are hollow and filled with steam.

The mass in this way is thoroughly mixed and dried till it contains not far from 10 per cent. of water.

The odor though unpleasant is not at all powerful, and if the material contains not more than 10 per cent. of water it will keep well. Some farmers the past year have got small lots direct from the driers, and, obtained in this way, it is one of the cheapest sources of supply.

Another way of preparing the blood is to dry it at a much higher temperature in kilns. The product is black, not red like the steam-dried; it is much dryer, and of course richer in nitrogen. It has no disagreeable smell and will keep without decomposing indefinitely in a moderately dry place. The market prices of these two kinds of blood are scarcely different, though it would seem as if the quality of the kiln-dried blood as a fertilizer might be somewhat injured if the heat was allowed to become too intense.

Tankage is another name given to a class of goods which contain no blood, but flesh and viscera, together with considerable bone. About the mode of preparation, I have not been able to learn. Some samples appear to contain a good deal of hair or wool which has very little fertilizing value.

I have no time to do more than briefly call attention to two articles which are being introduced into our retail market as constituents of commercial fertilizers, and which are of very inferior value in comparison with those already mentioned.

One of these is wool dust or shoddy, from the woolen factories, which is rich in nitrogen and convenient to use as a drier with *pasty* superphosphates. Like hair and horn shavings, it is rich in nitrogen, and when it can be bought at a reasonable figure and applied in sufficient quantity is a good thing; but it is not a fair thing to use for ammoniating superphosphates, as fish and blood are used, unless the price of the manufactured article is reduced considerably on that account.

The other article is leather.

The process of tanning is designed to make the nitrogenous matter of the flesh or hide just as insoluble and just as impervious to water as it can possibly be. For a fertilizer, we require that our nitrogenous matters shall be just as freely soluble and just as easily soaked by water as can be. It is as clear as day then that the waste product of the leather business is not one which is of the least value to the farmer in its original condition, and experiments with fresh and roasted leather prove this.

Of late, a process has been put in operation of this kind. Leather scrap from the shoe factories is first extracted with benzine. This yields an oil which can be used for a leather dressing, and in sufficient quantity to pay for the extraction. The leather is then roasted and ground and is ready for market, to be used in ammoniating superphosphates.

The physical condition of this product is excellent. It is dry and fine. It is claimed too that a considerable portion of the tannin, the preservative principle, is destroyed by roasting. However that may be, it is quite certain that a good deal is left unharmed, and theoretical considerations make it appear quite probable that the nitrogen is in a form not available for plants.

Practical trials made by Prof. Petermann in pots, in the garden and on larger field plots with oats, beans, and sugar beets, gave no increase over the unmanured parcels in the case of beans, and only a slight increase in the other cases, while dried blood or Chili saltpeter caused a very considerable increase in the yield.

While the farmer should welcome the appearance of any waste product which promises to be of service to him as a fertilizer as bone, blood, and fish scrap have been, it should be understood that he is not going to carry off every waste thing which no one else can use unless it is in just such a shape as will make it *pay* for him to take it. It is possible that, in time, a valuable fertilizer can be made from leather chips. It is certain that it has not been done yet, and the presence of leather in a superphosphate must at present excite distrust of its value.

A comparison of samples of dried blood and ground leather, shows how much alike they are in appearance, and when mixed in a superphosphate it would be quite impossible to tell leather from blood by its appearance.

By chemical tests, however, it is at present a simple matter to detect the presence of leather in any fertilizer, and we hope that it will not come largely into the Connecticut market without making itself known at the Experiment Station.

Mr. Hinman. I would like to ask the Doctor what there is in wool that is so quick to operate as a fertilizer. I had supposed it was nitrogen. Waste from the shoddy factories is one of the quickest fertilizers that I know of in actual practice; one of the quickest and cheapest, and one that will raise about as much disturbance in the neighborhood in the process of decomposition. If it is not nitrogen that decomposes so quickly and operates so speedily, I would like to inquire what it is.

Dr. Jenkins. I feel very confident that it is not the wool itself, for wool is of much the same nature as hair, although not as hard to decompose as hair. It must be some adherent substance.

Mr. Hinman. I mean what we call waste from a shoddy or wool factory. In decomposition, it is similar to horn shavings. Just about here horn shavings are used a great deal. They also in decomposition raise a great deal of discomposure in the neighborhood. They are also very similar in their operation. I have used more wool waste than horn shavings, and have found it very beneficial indeed and very powerful.

Dr. Jenkins. I have not heard before such a favorable account in regard to the action of wool waste, and it seems to me there must be differences in its composition or in the method of production.

Mr. Hinman. There are probably some gentlemen in the room who have used wool waste. There used to be a woolen factory at Sandy Hook. Wherever I have seen it or heard of it, it has always been with the same result, but it may have been a little different article from that with which the doctor is acquainted. I have used the waste from a factory in my own neighborhood entirely; I have never brought it from any distance. That was always uniform in its results.

Maj. Alvord. In visiting the large establishment of Mr. Wilkinson, who is a large blanket manufacturer, I saw large quantities of this wool waste, and was assured that he got better results from it than from almost any other fertilizing material that he could obtain. He is a maker of cheap blankets. I don't suppose he would feel complimented by having his establishment called a shoddy mill, but I think it might come under that head. He told me that the waste of his mill was saturated with a very large proportion of fish oil, and perhaps that would change Dr. Jenkins' opinion in regard to the material. At least, it is very greasy in its general character.

Dr. Jenkins. It seems to me that according as the mode of manufacture may vary, the value of the product will vary. I do not wish to be understood as saying that wool-waste is such an inferior article for fertilizing purposes as leather, and according to the mode in which it is manufactured, of course its value will vary. If you can get it cheaply enough, and apply enough of it, it will be a good thing. I do not know how its being drenched with fish oil would affect it. In one aspect of the case, I should suppose unfavorably. That is, any material which is soaked with grease I should hesitate about employing, since the oil would retard decomposition. Yet it may be that very crude fish oil contains some soluble nitrogenous matters which would be valuable fertilizers.

Dr. Sturtevant. I would say that the wool-waste from the burring machines of mills is very highly valued in Framingham, and produces remarkably quick and powerful results.

Mr. Hinman. Perhaps if I were to go a little more into detail in regard to the treatment of the two things I have spoken of, it would give some hints on the subject. I have used both horn shavings and wool-waste, and treated them precisely alike. I took both and mixed them with muck. I had the idea at that time that I could make myself rich by the use of muck. The horn shavings were entirely dry until I mixed them with muck. I don't know that I ever mixed any two things that seemed in their operation more nearly alike than these substances, the horn shavings and the wool-waste. Both made a very hot pile indeed, and would decompose in a very little while and produce an odor that was exceedingly disagreeable. To illustrate this I will tell a little story. I had a man at work for me who lived in his own home with his woman, who was hardly as neat as some of us would like our wives to be. I remember going there once when he was unable to do some little thing about the house, with another man to assist, and we were obliged to go to the window and put our heads out, the odor in the house was so strong and disagreeable. I set that man at work shovelling over a pile of this wool-waste and muck. I went up to the spot during the day and found him sitting on a stone some rods away from the pile, and when I asked him what the trouble was, he said: "The fact is, Sir, I can't stand no sort of stink." I thought if muck and wool-waste were so strong as to affect that man in that way, the pile must certainly contain a great deal of richness, under the old idea that we used to have, that good fertilizers must emit a great deal of odor.

Prof. JOHNSON. I would say, Mr. Chairman, that the differences which seem to prevail here with regard to the value of wool-waste are relative. Wool-waste put into superphosphates, for which you pay fifty or sixty dollars a ton, would be a poor investment as compared with dried blood. Wool-waste is an active fertilizer, and so is cow manure, if you have enough of it. But when you regard its commercial value and relative activity, pulverized wool is a poor ingredient, in a high-priced fertilizer, and a poor substitute for sulphate of ammonia, nitrate of soda, dried blood, or dried fish, because, although it makes a loud disturbance in the neighborhood, it does not do its proper duty so quickly, nor so well as these other materials. The strong odor comes from the fact that wool, like hair and horn, contains four or five per cent. of sulphur. Eggs are also rich in sulphur, and would make a very good fertilizer, but not because of the odor they may occasion. I think Dr. Jenkins' statement is substantially correct, that shoddy waste in a costly commercial fertilizer is an imposition, although not so great a one as leather would be.

Mr. Gold. I visited the farm of the late Dr. Grant, of Enfield, many years ago. Very many in the audience are familiar with it. He has brought it to a very high degree of fertility. He attributed his success partly to drainage, which he had introduced, but very largely from the extensive use of wool-waste. He had it from a particular factory near there, and the abundant application of it had certainly produced a fertility that I had scarcely seen anywhere else in the State. So that wool-waste, although it may be, as Dr. Jenkins says, an imposition in a high grade fertilizer, is yet an article to be saved and employed by farmers who can obtain it at a fair price. It certainly has shown its mark on Mr. Grant's farm.

Prof. Jenkins. Perhaps I have not brought out the point sufficiently, which is this: We have been in the habit of purchasing fertilizers manufactured with the use of nitrogen made from fish, or blood, or nitrates, which, when put on the ground, act at once. We are compelled to pay twenty, twenty-five, or thirty cents a pound for nitrogen. That is all right; we cannot do any better than that. Now, if the manufacturers who have been using those things, substitute wool-waste or leather, they are cheating us, unless they reduce their price. If they will tell us "this is wool-waste," and charge us only twelve or fifteen cents, all right, there is no objection; but when they give us a thing worth commercially only half as much as what we have been having and ask us the same price, then it is time for us to make objection. That wool-waste is a good fertilizer, if a man could get it cheap enough, seems well established, but it will not do to pay twenty-five cents a pound for it as nitrogen. Whoever does that is fifteen cents a pound out of pocket, or ten cents, at least.

Mr. Sedgwick. I would like to ask the Professor whether nitrogen derived from nitrates is more valuable than that derived from vegetable matter, such, for example, as cotton seed.

Dr. Jenkins. It depends upon what you mean by being valuable. In the market, on the average, it costs more; it is more valuable commercially.

Mr. Sedgwick. I mean, as plant food.

Dr. Jenkins. As far as its agricultural value is concerned, it is difficult to make a general statement. In some cases the application of nitrates would do more for the crop than the application of cotton seed, or dried blood, or anything of that sort; in other cases, the nitrogen of the nitrate would be largely lost, and so would not be as valuable as the nitrogen from the other sources of supply. In general, we say that the nitrogen in nitrates is more prone to waste from the soil than any other form of nitrogen, because it is readily soluble in water and passes through, and there is nothing to hold it, whereas the nitrogen from ammoniacal salts is held in a sort of physical or mechanical combination in the soil and is retained. I think some of Mr. Lawes' field experiments have gone to show that in his case, under the conditions which prevailed in those experiments, the nitrogen of rape seed was as valuable, that is, produced as good results, as the nitrates.

The Chairman. If there are no further questions on this subject, the secretary will open the question box.

Question. To what expense is a farmer to be if he wishes to send samples of earth to Prof. Johnson for chemical analysis?

Prof. Johnson. It will cost nothing but the freight. The answer to that question suggests another.—"What is the use of analyzing a sample of earth?" We had the idea extensively promulgated some twenty or thirty years ago, that if a sample of soil were analyzed by a competent chemist, the competent chemist could tell exactly what to put upon the field to make anything grow. Well, the competent chemist can generally tell what to put upon the field without making an analysis. Plenty of good manure will help in almost any case!

A little calculation will readily show what a chemist *cannot* do. You know that it has been frequently a matter of experience that a hundred pounds of Peruvian guano, of the old-fashioned sort that we had twenty years ago, would make the difference between a good crop and a poor crop, when it happened to be applied to the right land, with the right crop and right weather. That hundred pounds of Peruvian guano contained about fifteen per cent. of nitrogen, about fifteen per cent. of phosphoric acid, and about three per cent. of potash, to which its fertilizing value was alone due. The soil of an acre of land, taken to the depth of one foot, will weigh about four millions of pounds. Thirty-three pounds of fertilizer, and four millions of pounds of soil, assuming that the crop got all its nutriment from the first foot of ground, are the two quantities which, put one above the other, the smallest at the top and a line between, make the fraction which the chemist must figure down to if he will find out from an analysis of the soil what elements of fertility that soil is deficient in, viz.: $\frac{33}{4,000,000}$ or $\frac{1}{121,000}$. But, in fact, if the chemist in two analyses of the same sample of soil gets results which agree within $\frac{1}{10,000}$ he is lucky and his luck does more towards that result than his skill, for usually the tenth of one per cent. is about the limit of accuracy in chemical analysis. It may thus easily happen that the chemist cannot by analysis distinguish between two soils, one of which has had a dressing of one thousand pounds of the best Peruvian guano to the acre and the other nothing.

There are some cases in which a soil-analysis is really useful. A gentleman in Mansfield sent us a sample of soil two years ago. He had been draining a muck swamp, where nothing would grow; he could not even get buckwheat, and wanted to know what was the matter. We examined that soil and found in it a considerable quantity of copperas, sufficient to kill vegetation. We reported that to drain the land and let the air in, and to apply leached ashes and lime, would remedy the trouble. I believe it has been cured, has it not, Mr. Chairman?

Chairman. Yes, sir.

Prof. Johnson. But the cases where analysis fails to be of service have been more numerous. A tobacco grower in the western part of the State had a field that looked to be uniform except a small portion where he could not get any tobacco to come to maturity. The tobacco would start well, grow for a number of weeks, and then suddenly turn brown and die. He sent a sample of the soil but we could not discover anything out of the way. There was no iron compound or poison that we could find. But if any one has any question of that sort which he wishes answered, and will apply to us, we will do what we can; but the station cannot undertake to give the farmers of Connecticut an equivalent for their money in analyzing their soils, until we get some knowledge which has not dawned as yet. The more that we have done in the line of analysis of soils, the more unsatisfactory such work appears to be for common purposes. We have, however, learned that magnesia exists abundantly in all the Connecticut soils that we have examined. That would go to show that you need not buy Kainit, for there is magnesia in it. We have found that certain kinds of soil, those formed from the red sandstone, contain compounds of potash. If that is universally true, there is no need of putting potash on soils of that class. So far as that goes we have a useful indication; but an analysis of soil, to determine what kind of manure to apply, commonly fails of useful results.

QUESTION. Will the manure from a hundred pounds of offal passed through swine be of any more value than if composted?

Mr. GOLD. I should suppose it would not. If any one differs from that opinion, he can say so. It is a question whether the pigs would be any better for it. That is a question that comes home to every man who wants to eat pork.

Prof. JOHNSON. The question is whether a given amount of offal passed through pigs would be improved as manure over what it would be if composted. That depends. If the pig is young and growing, the offal will not all get through him, it will partly stay in him, and it will not be so valuable for manure as if it had been composted; but if it is fed judiciously, it will be worth more as pig than it could be as manure. If the pig is mature, and is neither gaining nor losing in weight, there will be no loss of the material by traveling through the animal. An animal that is neither gaining nor losing in weight takes nothing from the food that is of value as a manure, and the offal after having gone through an animal of that sort, will be, so far as nitrogen and phosphoric acid and all the valuable elements of manure are concerned, of just the same value as it was before it went in. That is, the quantities of these elements will be practically the same. The condition of them will be rather improved, for the offal will have been pulverized, composted, and concentrated. If the pig is old, has lost its teeth, and is losing flesh, then you will get a quantity of pig with your offal when it passes the animal, and the offal will be further improved as manure.

Keeping pigs on offal is bad business. But feeding offal (that is genuine and healthy animal matter, not mere slush) to pigs in moderate quantity as part of a ration, is a sensible process; there is no reason why it should not be done. But if you give too much offal, you will get a bad quality of pig.

QUESTION. Will corn from irregular rows produce corn with straight rows?

Dr. STURTEVANT. I suppose I am the one to answer that question. It will produce a large percentage of irregular rows and a small percentage of straight rows. Any kind of corn from straight rows will produce the largest percentage of straight rows and the smallest percentage of irregular rows. If you have got enough seed selected either from straight or crooked rows, you will have a hundred per cent. of either in time.

The CHAIRMAN. The next paper is upon ensilage, which is a subject in which every farmer is practically interested.

ENSILAGE.

By W. R. Hurd, Forestville, Conn.

When I accepted the invitation of your Secretary to speak upon this topic, it was stipulated that I should be permitted to give an extempore talk in place of a written paper; you therefore will not expect the finish and elegance of a more formal lecture for which I have neither taste nor time, if indeed I possess the requisite skill.

At the beginning, I wish to invite any one present to interrupt me at any point during the talk with question or comment, feeling sure that the value of the discussion will be increased, even if the thread of my talk be for the moment broken.

Some of you may have come here to-day, intending to decide for or against the adoption of ensilage upon what you hear from this platform. I ask you to do nothing of the kind, but to weigh carefully what you may hear, to investigate fairly and fully until you are convinced it is either a method for you to adopt or reject. Do not decide off-hand that you do not want it. Do not, on the other hand, move one stone or shovel of dirt; do not buy one board or nail for a silo, until you understand theoretically the principle underlying the successful preservation of forage in silos.

Honest inquirers are liable to be misled by two or rather three classes of writers; the too enthusiastic friends of a system; those people who understand with their elbows, and who are constantly misstating the claims of the friends of the system; and its foes. I have in my hand a clipping from a recent paper which, if authentic, illustrates the first class; if apocryphal, the second; it says: "Last year (1880), Mr. C. W. Mills fed for seven months one hundred and forty animals, cows and horses, from ten acres of corn fodder ensilage." That is the equivalent of eight and one-sixteenth head per acre for twelve months, and if full rations were fed, necessitated the yield of about nine hundred tons of ensilage on the ten acres. Pretty good farming that, even for New Jersey, where Mr. Mills lives. The same article says, "The past summer he fed for six weeks one hundred cattle, mostly milch cows, from five acres of oats sown in the spring," or, in other words, one acre of oats kept one hundred cows eight days, and one square rod, fed five head eight days. Fair crop that for even an ensilagist to raise. But, gentlemen, I do not believe Mr. Mills ever uttered any such nonsense as that. He is too sensible a man. You see many such articles. Another class while telling of results obtained under very favorable circumstances, are claiming by implication at least, that the system will give these results usually. The common farmer tries the "new ways," he only realizes a fraction of the result he is led to expect, he is disgusted and pronounces the system a humbug. Great crops of any kind are obtained only under favorable conditions of land, season, manures, and skillful culture, and without all these, great crops cannot be obtained. Furthermore the silo will not increase the *quantity* of the crop grown.

On the other hand, here is a statement from Dr. Abraham Robertson, in the *Mirror and Farmer.* He says, "I once gave an almond to a squirrel that had been caged six months, and been fed on cake, raisins, and other soft food. It picked up the nut, nibbled and dropped it, repeating these operations at least a dozen times. On examination, I found its teeth had not made the slighest impression on the nut. Having been fed only six months on an unnatural diet, had deprived the squirrel of its ability to eat its natural food. Farmers who have intended to make silos will probably consider this case analogous, and draw their own conclusions." Perhaps. I had supposed until I read this article that hay was an "unnatural diet," that in its "natural state," the animal browsed the twigs of trees as the food nature provided for its maintenance when snow covered the ground. I had supposed ground grain an unnatural diet. But I doubt if any farmer present would care to go back to the strictly "natural diets," or who believes so doing would render his stock more healthy, thrifty, or profitable. When I read these articles I feel like turning Churchman and reciting from the Litany. "Good Lord, deliver us" from friend and foe.

Your Secretary's request was for a chapter from my own experience, which will render me more personal in my talk than I should otherwise be. It is two years since my first attention was called to the method of forage preservation. After a careful study and investigation which extended over several months, and which was as thorough as I could make it, I decided to adopt the system. The knowledge of my decision caused no small amount of ridicule on the part of my neighbors, among whom, with a single exception, none had any faith in my success; in fact I was the laughing stock of the region—until I opened my silos, since when I have done most of the laughing.

What is the *principle* involved in this method of forage preservation? Simply, the *exclusion of air from contact* with the forage to be preserved. Indeed, so far as we need to consider it, the principle is identical with that of canning articles of human food. How can the air be excluded? First by *expulsion;* this is done by trampling the forage while filling the silo, and by heavy weighting when the filling is completed. Secondly, the air is *kept out* partially by the continued pressure of the weights, and partially by having the bottom and the sides of the silo so tight that the air and gases formed in it cannot escape. But trample and weight the mass as thoroughly as possible all the air cannot be expelled, some will remain, the oxygen of which uniting with certain elements in the forage forms carbonic acid gas, which being heavier than the air sinks to the bottom; this process goes on until the air is exhausted and the whole mass submerged in a bath of carbonic acid gas and is absolutely air-tight. So long as these conditions remain undisturbed, decomposition is impossible and the forage will keep.

But does the forage stay in its original condition? By no means. In the formation of the carbonic acid gas alluded to, considerable heat is developed; during this change the color of the leaf becomes something near that of steeped tea leaves, although often much brighter and lighter, a slight fermentation has taken place, and there is a vinous and many times a vinegary flavor perceptible. The changes which take place seem to render the forage more nutritious than in the green state. I am speaking now of the ensilaged corn plant which is the ensilage crop of to-day, which it will not be a few years hence. The same principle holds true of every forage plant in a greater or less degree. The action of the carbonic acid gas seems to change the starch into a more soluble, or rather a more digestible condition. It seems to do what the stomach does in the earliest stages of digestion. How do I know this? Have I made any chemical tests? No, I have not. How then do I know it? In this way. It has been the practice upon my farm for nearly twenty years to use corn forage for soiling purposes. I know that many of our adult cows have eaten one hundred and twenty-five pounds of the fresh corn in a day. I have on my place to-day one of these same cows that would eat one hundred and twenty-five pounds of fresh corn, together with her grain ration, and ask for more. The ration of this cow has been weighed for several weeks this winter, and has averaged sixty pounds of ensilage, which was all she would eat. The grain ration was the same in both cases. This cow, as do all my herd, gives more and richer milk, makes more and better butter on the ensilage ration than when fed on fresh corn. In view of these facts, I think I am justified in claiming that the change wrought in the silo renders the forage more valuable for feeding, my own experience showing a gain of over forty per cent.

In building a silo, it may be constructed of the various forms of masonry, of "concrete," or even of wood; it may be entirely above or entirely below the surface of the ground; or partly above and partly below; it may be on level land or in a hillside, as shall prove most convenient. But of whatever built, and wherever located, it is of great importance that perfect drainage be secured. It is of equal importance that the silo be thoroughly built as the pressure, both inward and outward, is very great. If built of any form of masonry, it is necessary to plaster the walls with cement, that the walls may be smooth and air tight; this is doubly necessary if brick are used, owing to their porous nature. My own silos are of stone laid in cement mortar and thoroughly plastered; were I to build again I should lay the stone dry, point and plaster it, saving a considerable sum. A friend of mine, to save the few dollars it would cost to plaster his silos, omitted this feature; the result is, at least ten per cent. of his ensilage is worthless. Do not fail to have your walls "plumb," that the boards used to cover the fodder may follow down readily as the mass settles. At an Ensilage Convention I attended last December, in Worcester, one farmer reported his silo was built of two thicknesses of inch boards with tarred paper between, and with which he was perfectly satisfied; of course the frame was made strong enough to withstand the pressure. The sample of ensilage exhibited from this silo was as good as that shown here to-day by me, but I do not remember that we were told if it came from near the walls of the silo, or from the center.

You say, "This is a new process; let us wait and see how it works." Gentlemen, it is not a new process; the experimental period is past; the principle is beyond question, and by it you can furnish cattle healthful, succulent food the entire year. Mons. Goffart began his experiments in France in 1850, thirty-one years ago. But it was not new even then, for "brown hay," which is simply another form of the same principle, has been in common use in some sections of France and Germany for generations; nay, it is older than this even, for I read not long since in an account of travel in Central Asia of the finding this same principle used in a mountain village of Afghanistan, where, to the travelers' inquiry "if this was a new thing," the villagers replied, "No, our fathers did it." Recent improvements in the method have been made, but the same principle remains. The next decade will see a still more marked progress both in the cost, the kind of crop, and the perfection of preservation.

I have said the corn plant is the ensilage plant of to-day. It is so because with farms in their present condition, and with average culture, a larger feeding value per acre can be obtained than from any other crop; it can be raised in four months, and the land used for other crops the remaining eight. So I say, raise corn, but I do *not* say make the corn fodder your exclusive feed. The corn plant is not, and never will be, a "complete food," whether fed green, cured in the old way, or ensilaged. It needs always the addition of some grain like wheat bran to get the most economical results. I shall be glad to see the day when farmers can raise cheaply forage crops that are more nearly complete foods, and thus save the cost of grain bills.

QUESTION. Would you be willing to mention some of the other crops?

MR. HURD. Clover, oats, winter wheat, the various millets, and if our climate is sufficiently humid for vetches, I think these will become a favorite crop. When our farmers reach the point that it can be afforded, grass will be largely ensilaged. Now it is worth too much to be so used. It must be kept for a cash crop, for on many, if not on most farms, cash crops are sorely needed while the owner is effecting a change of base. In other words, it will not pay to feed hay to our stock.

QUESTION. Will your cattle eat the poor fodder of which you spoke some time since?

MR. HURD. The total amount of inferior ensilage in my silo will not exceed one-fourth of one per cent., which is mixed with the better, and the cattle eat it all seemingly as well as the best, but I doubt if its feeding value is high.

I have seen several analyses of ensilage, but never any that satisfied me, and I doubt if, with the present methods, one satisfactory can be made. An analysis of ensilage and dry corn fodder I examined recently showed a difference in favor of ensilage of only five per cent. But you could not convince me or any of my men that there was no greater difference.

MR SPURR, OF FARMINGTON. Weight for weight? The ensilage weighs a great deal more than the dry corn.

MR. HURD. Yes, weight for weight.

MR. SPURR. Of course a cow will not eat sixty pounds of dry corn fodder in a day. That is what I was getting at.

MR. HURD. No, sir; certainly she will not. But by weight, take as a basis, to illustrate what I mean, one hundred pounds of green corn fodder and dry it; take another one hundred pounds and ensilage it; then the corn ensilaged would exceed in feeding value the corn dried by a good deal more than five per cent., and this basis is, I think, the only fair one, as in one hundred pounds of dry corn fodder you have several times as much plant growth as you have in one hundred pounds ensilaged. My lack of faith in a satisfactory analysis of ensilage lies in my belief that the drying process, which is the preliminary step to all analyses, of plant growths, if I am correct as to the methods pursued, destroys the very best part of the ensilage, and when the analysis proper begins you have simply dried corn fodder. If you doubt my assertion, then go next summer into your hay fields and notice the aroma which is evaporating from the hay and transforming the food that will make golden, fragrant butter into a food that can only make a white, flavorless substance called by courtesy butter because it is obtained from cow's milk. The process of drying destroys the most valuable portion of the crop. The earlier this drying can be stopped the more valuable the forage. Hence our best farmers want to get their hay into the barn as green as possible.

QUESTION. What should a silo cost?

MR. HURD. My own cost about two dollars and a half per ton capacity; much more than they would could I have personally superintended their building, and more than they would were I to build to-day. Prices vary greatly in different localities. One man can build so much cheaper than another. I cannot give a clearer idea than this.

A gentleman has just handed me a slip of paper which I am requested to read. It is headed, "Dr. Lawes on Ensilage," and says, "The eminent English agricultural chemist, Dr. Lawes of Rothamstead, thinks that the recent ensilage mania in America is a little premature, and that it is just possible that some of our most practical farmers are inclined to go a little further into the silos than the real merits of this system of preserving fodder will warrant." In a letter to one of our city contemporaries he says: "In order to show what the real loss is which takes place, and arrive at a just conclusion, that forty or fifty tons of corn should be weighed into and out of the silo, and samples of the corn as it goes in and comes out should be submitted to a careful analysis. When the results are known, it is possible that the exaggerated opinions which appear to prevail in some places with regard to the value of this process might be reduced to a more natural level."

Gentlemen, there is truth in that; there is also sophistry. Many men like to throw cold water on a fire even when no danger exists.

As to the cost of ensilage. My crop last year cost me $5.21, this year $3.21 per ton. In figuring this cost I have valued the land at one hundred dollars per acre and charged six per cent. interest; I have charged the *entire value* of stable manure and fertilizers used to the crop; all labor is figured at current market rates for day labor; ten per cent. for the wear of implements used, and a fair percentage of the general farm expenses. Figuring exactly as I would as a manufacturer who wanted to be sure and get the outside cost, and very differently from most of the figures I see made by farmers as to the cost of crops. Did I adopt their style I should reduce these figures one-third to one-half. But I do not care to deceive myself, nor you; I desire to know the worst side.

How large crops can be raised? How large did I raise? People talk about fifty to seventy-five tons; I have not seen any such, and scarcely expect to. I cannot tell with certainty, in tons, what my own crop was, as I have no scales; but I hope another year to give a definite answer to this question. My men say I had one hundred and fifty to one hundred and seventy-five tons. The editor of a leading New England paper who visited me while I was ensilaging was "certain there was *over* two hundred tons." My own best estimates placed the crop inside of one hundred and twenty-five tons. But while I cannot tell you the amount in tons I can in *feeding value*. I have now fed 2,100 rations and have rather more than three-fifths of the crop left, showing that I had some 3,700 rations—enough to keep ten head *one year*, or one and a quarter head to each acre for the entire twelve months; consequently, the eight acres will keep twenty head of adult cattle through the winter, and this notwithstanding I had less than a two-thirds crop, owing to the drought and poor judgment in selecting fertilizers. Can you beat this exhibit on hay ?

Question. How large a quantity of grain do you feed with the ensilage ?

Mr. Hurd. About two pounds of corn meal and the same weight of wheat bran; in all, four pounds of grain. I am feeding to the cows I have an average of sixty pounds of ensilage a day. Now I would like half a dozen of you to tell what you call a fair hay ration for dairy stock, remembering that they get four pounds of grain. (Several gentlemen said "twenty pounds," one "fifteen pounds," and two "twenty-five pounds.")

Dr. Sturtevant. Eighteen pounds is the maintenance ration for one thousand pounds of live weight at the New Hampshire Agricultural College.

Mr. Hurd. Take that figure. At home, year in and year out, hay is worth twenty dollars. Eighteen pounds will cost eighteen cents. Now, my ensilage ration, at four dollars per ton, has cost me thirteen cents. Is there any saving there ?

Question. I would like to ask Mr. Hurd if it costs him eighteen cents to get his hay into the barn ?

Mr. Hurd. It does not make any difference what the hay costs, because it is *worth* that, and you can get eighteen cents cash for it.

Question. You are figuring what your ensilage cost you; why not take what your hay cost you on the same principle ?

Mr. Hurd. One of the advantages of ensilage is, it furnishes a winter forage crop which can be raised outside of the meadows and enables the farmer to sell his hay—which in most localities in this State commands a price far beyond its feeding value to the farm. If ensilage had or could have a market value, then it would be only fair to figure both on the same basis, as an important portion of the profit derived from the system is in increasing the cash crops of the farm.

Question. If it is worth that for feed, it must have a market value, although it may not be taken in that shape at the present time. If you figure your hay at the market value, why should not your ensilage be figured at the market value to correspond ?

Mr. Hurd. Ensilage has not, and never can have, a market value, because it will spoil in a comparatively short time after it is taken from the silo. It has no keeping qualities except *in* the silo. You may take it out and cart it a few miles, and keep it for a day or two, but beyond that you cannot go.

QUESTION. Did you say sixty pounds of it a day will feed an animal?

Mr. HURD. Yes, sir; that is a good ration for a hearty animal.

You want to know how large a silo to build. A cube of ten feet will keep two cows a year; you can all make your estimates from this. If you prefer other proportions, very well; but let me emphasize DEPTH—*get all the depth you can.* You will thus save labor, and increase the capacity. A cubic foot at the bottom is worth a great deal more than a cubic foot at the top. My top foot weighs twenty-eight pounds; my bottom foot forty-five and a half pounds. If my silo was full, the bottom foot would weigh sixty pounds, and the top foot would weigh what it does now.

Enough has been said about the cost; now as to the feeding value. I wish, gentlemen, I could give this portion of my talk in my barn. It would be a great deal more effective than it can be here. I would like to have you examine carefully each animal and note their health and thrift. Not that I am a better farmer than others; it is the food, the ensilage, that makes the difference. Last year my cows, although they had averaged in milk more than six months, and some were drying off and due to calve in less than two months, increased in their milk ration, from five to fifteen per cent. No guess work about it. Every cow's milk is weighed separately, and when the milk gets to the dairy, it is weighed in bulk. When the milk is skimmed, the cream and the skimmed milk are again weighed—preventing the possibility of mistake in this statement. My butter sales increased last year over twenty per cent., before I had been feeding ensilage one month. Thus you see the entire advantage of this method is not in the *first cost* of the forage. I have here some samples of butter made from my cows' milk, which you will have an opportunity to taste, and see if you can detect any objectionable trace of ensilage in it.

QUESTION. Please tell us once more what rations your cows have.

Mr. HURD. Two pounds of corn meal, two pounds of wheat bran, what ensilage they will eat in four rations, besides an occasional hay ration to give greater variety.

Dr. Sturtevant. Approximately, how many pounds of ensilage?

Mr. Hurd. Sixty for the heartiest cows, from that down to less than forty.

Dr. Sturtevant. Including this extra feed?

Mr. Hurd. Yes, sir, that is the average ration. Now, in summing up this talk what have we? low cost; health of the animal, and consequently its thrift; increased growth and products. There is a great gain in young stock, for they can be kept growing twelve months in a year, instead of six or seven. Ordinarily, the young stock come out in the spring a great deal thinner in flesh and but little larger than they go in, in the fall. There is with ensilage no necessity of checking the growth at all through the winter. Then ensilage enables you to have plenty of feed the entire year; lessening the injurious effects of drought.

Mr. Sedgwick. You mean by that, in connection with a ration of grain?

Mr. Hurd. Yes, sir, if I was feeding young stock on hay, I should give them wheat bran, and consider it more economical.

Then again, ensilage increased the *quantity* of butter and milk, while it increased the quality of both. Thus, (and this you will see is a good deal like a dog chasing his own tail,) the more ensilage you have, the more stock you can keep; the more stock you can keep, the larger your manure pile; the larger your manure pile, the more land you can cultivate; the more land you can cultivate, the more ensilage you can raise; and so on, right around in a circle. Two winters ago I kept twelve head and two horses, and bought hay. This year I have got thirty-five animals on the farm, and in a few days I shall have thirty-six. I shall not buy three tons more hay than I bought two winters ago, all the result of eight acres of ensilage. Gentlemen, is there any gain in this? I built a barn recently to hold fifty head. My neighbors said I was crazy when they knew I was going into ensilage and barn building on so large a scale. They said "I could never fill the holes I was digging;" "If I did, it would all spoil;" "If it didn't spoil, I could never keep enough stock on the farm to fill the barn." This is the first year I have used my stables, and they are two-thirds full to-day. If I choose to buy stock, I can keep cattle enough to more than fill that barn and not buy a thing next winter except grain. I do not know whether I could have raised hay enough on my farm to have gained these results so quickly or not, but I have not faith enough to make the attempt.

I have here a sample of my own ensilage, and I have also a small sample of ensilaged clover, cured by a neighbor, who last summer put a second crop of clover, without cutting it, into an old disused cistern. He had very good success, is very much pleased with it. I have also a sample of what I did not suppose a year ago I should be able to show anywhere, and that is, a sample of genuine old German "brown hay," that is the results of an experiment of one of my men who is enthusiastic about ensilage, but has not the money to build a silo. Acting upon my advice, he put in a stack alternate layers of coarse hay and corn fodder; you can see the result for yourselves. He tells me his cattle eat it readily, and he says it is worth a great deal more to him than dry corn fodder, and did not cost as much as curing the corn fodder would. I do not recommend this method as desirable if the silo is possible for you, but I think there is enough in it for such as cannot now have a silo to look into. But if you try this way be sure and trample the corn down thoroughly, and to weight it heavily. This stack was twelve feet in diameter, and seven or eight large loads of stone were put on top.

Mr. AYRES of Farmington. Why would it not be better to use a screw, such as is used in a cider mill?

Mr. HURD. I don't know. It might. A silo as large as mine, forty-five feet long, fifteen feet wide, and sixteen and a half feet deep, would require so much power that the fitting up of screws would cost more money than to use stone.

Mr. AYRES. Would it not be better to build in sections?

Mr. HURD. I should prefer smaller silos than mine and more of them, although it would increase the cost, because there would be more cubic feet of masonry.

Maj. Alvord. I would like to ask whether from the rations you are now feeding of the ensilage, and the grain you expect to be able to make manure that will raise more than that same quantity of ensilage another year?

Mr. Hurd. Yes, sir. And the manure I am making will grow more than I had this year. I have no doubt as to this.

Maj. Alvord. Does your present ration make the manure to bring it?

Mr. Hurd. Yes, sir, I have now much more manure than I had last spring.

Mr. Hoyt of New Canaan. I was very much interested last winter in reading what Mr. Hurd said in the *Connecticut Farmer*, about his silo, and he mentioned particularly a calf that had made a wonderful growth. I would like to ask him what he fed that calf beside ensilage.

Mr. Hurd. Until she was four months old, she had new milk; just how much I have forgotten.

Mr. Hoyt. What did you feed her on through the winter?

Mr. Hurd. Remember it was a young calf, dropped the last of November, consequently, until nearly the first of April she had milk, and the latter portion of the time she had a handful of oats, perhaps half a pint a day, say from the first of March on. This, and what ensilage she wanted. She began sucking ensilage before she was two weeks old, and by the first of April she was eating from a peck to half a bushel a day.

Question. I would like to ask you if you feed your horses on it?

Mr. Hurd. No, sir, not to any extent.

Question. What is the objection to feeding it to horses?

Mr. Hurd. I do not like any considerable amount of succulent food for any working animals, I do not consider it will make as hard muscle.

Question. Did the ensilage come out as dry as it is now, or did it come out more moist?

Mr. Hurd. You can get from three to twenty drops from a piece of stalk. I have squeezed bits of ensilage not as large as the first joint of my finger, and have counted twenty drops of juice. Sometimes you will have hard work to get a single drop. That is more apt to be from the top than from the bottom of a stalk.

Question. Does the ensilage have any bad effect in scouring the animal?

Mr. Hurd. No, sir, not one of my animals has ever been scoured by ensilage, nor have I ever seen a case of it that was traceable to ensilage. I have heard it sometimes scoured animals, but have never seen such results.

Mr. Farrar of Huntington. I do not doubt that a great many gentlemen have been greatly interested in what has been said, and I heartily endorse every word from my own experience the past summer. Last spring I bought a little place in Huntington, of about ten acres. Soon after I moved on it, I received a letter from my brother, who wanted to know if I was going to put in a silo. I did not know what a silo was, and I had no means of knowing. I wrote him a postal card and asked him whether it went by wind or steam. I received in a few days a small pamphlet giving a description of the silo system. In that pamphlet I found that I could send to Billerica and get a book for fifty cents, which I did. I sat down and studied that book through and through. On my place were several trout ponds, and I converted one of them into a silo last August. I planted three-quarters of an acre of corn, and on that three-quarters of an acre I raised sixteen tons. Two weeks ago I uncovered my silo and found the fodder in excellent condition. I have one cow which came in in April last, and she gives me nine quarts a day, and the milk, butter, and cream are better than they were before she had the ensilage. My silo cost me $38, and I have enough ensilage to keep two cows from now until the first of April. I think that is cheaper than hay.

Mr. Barnard of Forestville. I think what has been done once can be done again. Mr. Hurd has raised some very good crops of corn, but I think he can do better, and the rest of us can do better. He expects to, and no doubt he will. I do not know why I cannot build a silo as well as Mr. Hurd, and I mean to build one. I have watched Mr. Hurd pretty closely in what he has been doing, and I am sure ensilage is a success. One thing Mr. Hurd left out; he told us how much hay he bought a few years ago, when he kept but little stock, and how much he could keep now and buy but little more hay. He did not say that those eight or nine acres of corn-land that he has raised his fodder on came right out of his meadow.

Mr. Hurd. I am very glad that my attention has been called to this fact, because it is an important factor in the results achieved on my farm. If I had that eight acres in grass, I should not have had to buy a pound of hay this season.

Question. If you had two samples of milk before you, one from cows fed on hay and grain, and the other from cows fed on ensilage and grain, could you tell the difference in the flavor of that milk?

Mr. Hurd. No, I don't think I could, but I might. I have a tolerably keen taste, and I don't know but I could *guess* shrewdly; still, I would not like to attempt it; I might get caught in the same trap that Dr. Bailey is reported to have caught one of his friends in. It is said, there was a party of gentlemen who visited his farm last winter, to examine and see what they could learn. He served a very nice farmer's lunch for them, with ensilage butter, cream, and milk. They tried his butter and milk, but none could detect the flavor of ensilage. In the party was one man notoriously over-critical, and who usually thought he could find a needle in a haystack. "Doctor," said he, "I would like to take just one glass more; then I will tell you what I think; I was not quite certain, but I thought I detected, at first, something that was a little different from what I had ever tasted before." The Doctor had provided a pitcher of milk from one of his neighbors, whose cows had never tasted any ensilage. From this pitcher the Doctor poured another glass of milk, the man drank it, and said, "yes, I can taste it very decidedly. I thought I could taste it before." I might get caught in the same trap.

Mr. FARRAR. What is the best variety of corn to grow for ensilage?

Mr. HURD. My preference is for Blount's Prolific. It is the quickest-growing variety I know of, and very large. I should select a large, quick-growing variety, preferably from the South. Whatever you select, select for the stalk, not for the leaf. The principal value is in the stalk, and only a small fraction in the leaf.

Mr. FARRAR. In cutting it, the butts drop right down and the leaves fly off. I conceive it right that those butts should be shoveled over the silo; is that right?

Mr. HURD. Yes, sir; spread it as evenly as you can. I use a hooded carrier, which carries the leaves and stalks together. Without the carrier the leaves, being lighter, fall nearer the walls, and then need mixing with the stalks. You must compact it thoroughly. Tramp, tramp, tramp, and then keep on tramping, if you would have the best success.

Mr. FARRAR. You spoke about water. I am a little suspicious about my silo; it is pretty near a brook. As I get to the bottom I find an inch or two of liquid.

Mr. HURD. How thick is it?

Mr. FARRAR. As thick as molasses.

Mr. HURD. There is no water there; it is the corn-juice.

Mr. FARRAR. The bottom does not smell as clean and healthy as the top.

Mr. HURD. Put it on the barn floor and let it lie twenty-four hours, and the smell will be gone, I think.

Mr. BRIGGS. If Prof. Johnson is present I would like to have him tell us how it is that green corn put into a silo is enhanced in value in its feeding qualities to about double.

Prof. JOHNSON. I cannot give any answer which will correspond with the question. We have enthusiastic testimony as to the feeding value of ensilage. We learn that the ensilage is made from a very thrifty and rapidly-growing kind of corn, which has an unusually good stalk, and it is not at all unlikely that the raw material is much better than the raw material of ordinary corn fodder; and if it is we should expect that the ensilage would be better than ordinary fodder. As to how it is that green corn fodder comes out of the silo better than it went in—well, I don't know. I am going to be just as frank as Mr. Hurd has been, and say that I don't believe that it is. Mind you, I do not know, and I do not believe that anybody knows, that it is better, although many people believe that it is better. Now, when I say I believe it is no better, I mean, in nutritive value; and when I say "nutritive value," I mean that there is no more food in the ensilage when it comes out than there was in the corn when it went in. I do not believe that it is any more digestible when it comes out than when it went in. I do not believe that the quality of it is in any sense better when it comes out than when it went in. I know there is less of it when it comes out than when it went in.

Now, there is one thing which you must consider: it comes out very palatable, and that makes a great deal of difference. I think I could select a couple of ladies who would take the same meat, and the same flour, and the same butter, and the same apples, and go to work and make mince pies, and the pies made by one of them would be very nice and the other's would not be fit to eat. The same nutriment would be in both, but the feeding effect would be different. You might have all my share of one of them. And in respect to ensilage, that is one of its advantages, that it gives us a very palatable food; it has a flavor about it which is agreeable to cattle, they eat it with more relish, and that is a very important thing. Mr. Hurd has told us he believes it to be more digestible, and he has given us some facts which justify him in this conclusion. I do not gainsay his facts; they may be correct. A great many trials have been made in Germany upon the digestibility of food, in the only way which we can reasonably adopt of testing that question; that is, by feeding the food for a period of time to a number of animals, and determining whether they increase in live weight and in dead weight, if necessary, or in the yield of milk, and also by making a chemical analysis of the fodder before it enters the animal and after it leaves the animal. Now, chemical analysis applied in this way is, from a scientific point of view, a very crude, rough thing, but it is the best thing we have got, it is the only thing we have got which will give anything like exact results, and therefore we have to use it; but I have yet to learn that there is any demonstration that such material as corn fodder is improved in digestibility by any process of souring, or siloing, or cooking, or anything else. I will not say that it is not improved in digestibility, but I say it is not improved in feeding effect, or, if it is in some cases slightly improved, not enough to pay for the trouble. I hold that it is unproved as yet; it may be true, but I hold it as yet unproved, that there is any increase of digestibility. But whatever will make an animal eat with a relish will naturally tend to increase the digestive power of the animal.

I want to make one explanation here in regard to the difference between the practical man and the scientific man. It is a remarkable difference, and it is a very essential difference. The practical man believes a thing to be true until it is proved to be false; the scientific man believes a thing to be false until it is proved to be true; and that is the necessary position in which the practical man and the scientific man look at questions. The practical man wants something that he can use, and he knows perfectly well that it is very difficult to find out what is actually true. If he waits to find out what is true, he will wait until it is too late. Mr. Hurd could not stop to have it demonstrated that ensilage is more or less digestible than corn fodder before he went into it. He finds something that he thinks is a good thing, he goes into that thing, and, looking at the result, he finds sufficient reason to believe that it is more digestible. The scientific man wants to know if it is demonstrated. He cannot afford to take anything that is not demonstrated to be true. For his purpose, it is necessary to throw away all the evidence that does not demonstrate the thing. He can take such evidence as Mr. Hurd has given us in regard to that question; he can use that as a motive for investigation. He will not accept it as a fact that corn fodder is made more digestible by packing it in a silo until it is demonstrated by more exact experiments that we cannot account for this result in some other way.

Now, so far as I can gather, I do not think it possible, I do not think that actual investigation makes it even probable, that corn fodder is made more nutritious. It may be more digestible. One thing is very certain, that we have a very slight chemical change taking place in the silo when the thing is properly conducted. We have some carbonic acid formed in there which expels the air, and that is formed at the expense of the corn fodder. Some of the corn fodder is actually burned. But that process does not go on long, because the oxygen is shortly consumed. There is fermentation there, due to the development of those minute plants, fungi, which produce ordinary yeast fermentation, alcoholic fermentation, lactic acid fermentation, and this process goes on to a slight degree. They have very little effect in changing the constitution of the fodder. They act only on the sugar which is in the juice. That is the only material there which is essentially altered. The fiber of the corn is not essentially affected by these changes. It makes no difference whether it is or not; the animal is able to digest the fodder, to a large extent, if it is only properly proportioned in the ration.

I am glad to see this subject introduced so enthusiastically, because it shows that we have the capacity for getting interested in these questions, and this silo question brings us closer in contact with questions with which a few years ago we had no possible proximity—with questions of scientific feeding. Now, we have had carried on in New Jersey, during the last winter, scientific and practical experiments on the feeding value of ensilage. It was done in the New Jersey Agricultural Experiment Station. I regret very much that I have not here, as I intended to have, a copy of the paper in which the results are published. I shall print that in my forthcoming report of the Experiment Station, as an argument for the station, as well as valuable information for every farmer who is interested in this subject. The ensilage made in New Jersey was subjected to chemical analysis, which I think more of in respect to fodders than Mr. Hurd does as yet, and by the help of that analysis a ration was fixed, mainly of ensilage, but with the addition of some other materials of which cotton seed was the principal—I have forgotten the others. The ration was calculated on the basis of the German standards, which have been reduced from a very great number of experiments, and that ration was fed to milch cows. The animals ate it with relish. In some cases it produced a little scouring, but that was checked by diminishing the ration somewhat, and kept well in hand without difficulty, and the result amply justified the experiment. It showed that the animals keep up the quality and quantity of milk, but it did not show that there was any miraculous power in ensilage. It responded to the chemical analysis and gave the results which the analysis led the chemist to anticipate. I do not doubt that fresh corn fodder could be put into a ration, and produce practically the same results. I think ensilage is a first-rate thing, for anything which is attractive to the animal is an advantage to it, if not to the farmer. This keeping cattle all winter long on dried grass alone is simply a brutal piece of business. It is a wasteful piece of business, it is a brutal piece of business, to make an animal grind over a lot of almost worthless material for the purpose of extracting a small quantity of nutriment.

Mr. Hurd. I am very glad that Prof. Johnson is here, and has said just what he has. It cannot but have a favorable effect upon the future discussion of this question. At the same time, I want to ask him just one question, and that is, how in the present state of knowledge he would account for the fact that my cows consumed from one hundred to one hundred and twenty-five pounds of green corn fodder a day, when the same cattle will not eat over sixty pounds of ensilage, if there is not an increased quantity of nutriment in the fodder in that condition? What other possible solution is there when seemingly the cow eats the ensilage with greater relish than she ever did the corn?

Prof. Johnson. I cannot tell you.

Mr. Hoyt. Since that question has come up, I would like to have the Secretary read a short article which I find in the *New England Farmer* of December 10th.

ENSILAGE IN NATURE.

The Stomach of a Ruminant a Silo in Miniature.

If the following statements, by Mr. L. B. Arnold, concerning the nature of acids, are true, they afford one of the strongest arguments in favor of the system of preserving green food in silos that we have seen published. They appeared originally in the *New York Tribune*.

"The anatomical construction of ruminants, notably their stomachs, indicates that their natural diet is bulky, green herbage designed to be swallowed rapidly, and with little mastication, into a capacious reservoir, to remain till the animals have time to retire to some place of rest and quiet, to pulverize the half-ground mass by thorough mastication. But this is not the only purpose served by holding green food in a huge sack for several hours before discharging it into the division of the compound stomach for digestion proper. A mass of succulent matter packed in a wet and warm place will soon ferment and become sour. In the stomach, lactic acid begins to form very soon after the bruised herbage is swallowed. Though this is generally regarded as forming no part of actual digestion, it is not without some bearing upon it. Herbaceous food always abounds in crude, woody fiber, which, when it enters the stomach, is indigestible from being insoluble, and in this condition is useless as food. If it could be digested, it would serve the same purpose that is served by its more soluble associates, starch and sugar. By souring, some of such fiber is rendered soluble and digestible, and thus increases its food value. To the greater extent to which this action upon fiber goes on in the stomachs of ruminants above that of non-ruminants may be ascribed the better results of feeding herbaceous food to the former.

An evidence of the more complete digestion of woody fiber in ruminants than non-ruminants may be seen in the condition of their respective solid excrements. For example, take those of a sheep and a horse. In those of a sheep the fiber is almost exhausted, while in those of a horse it is so little affected that it constitutes the great bulk of the offal. In this respect the cow also makes better use of fiber than the horse. As a green and coarse state seems to be the natural condition for ruminants to receive their food in, it would be very desirable to furnish it to them in that state the year round, but where six months of the year are winter, this is difficult. To supply this defect it has been the custom to dry the green food for the frosty season. Though the process of drying does not necessarily destroy or change the food elements of herbage, it has the effect of changing the action of the stomach upon them. Souring in the rumen does not go on as readily with dry food as with green. The same preparation for digestion is not made. The fiber, in particular, will hardly get soaked through before it is time for it to go out of the organ in which it was deposited. This impedes digestion and renders it imperfect. Aside from completeness of digestion, a cow can accomplish less on dry than on green food, because she can digest so much more of the latter in a given time. This fact is an argument in favor of ensilage, which, being green, digests so much more rapidly that more of it above the food for support can be utilized in the shape of milk. Ensilage, when skillfully preserved, varies less from the natural condition of food for the cow than when preserved by drying.

Green food in a tight silo and in the stomach of a cow is closely analogous in respect to condition and changes. The paunch of a ruminant is a silo in miniature, or, if you please, a well-built silo is a huge rumen for the reception and preparation of food for digestion. In each the food is partially comminuted, and in each exactly the same action is begun, namely, lactic fermentation. It may be carried a little further in the silo, if it remains long, but as far as they go the character of the changes in both is alike. The great disturbing element in ensilage is not the simple development of the lactic acid. It is the development of alcohol and vinegar, which only goes on when air is admitted to the silo. Their formation is accompanied with alteration and destruction. In some of the early earth pits more than half the original value of the food was lost by the penetration of air through walls of loose earth. So long as air is kept from the ensilage, alcohol and vinegar can no more form in it than in the stomach of a cow. The lactic fermentation will go on anyhow, closed or open, in the silo as in the stomach, but the change will be confined to the formation of lactic acid, the effect of which upon the food in which it occurs, though supposed to be favorable, has never been definitely determined. But, whatever that effect may be, the ensilage, in a perfectly tight silo, will scarcely be more altered from its normal condition than the cud of a cow from the grass it was made of. The point is to make the silo tight. Failing in this, changes detrimental to quality and waste have been the rule. But recently improvements in the construction have been very great, and loss and injury have correspondingly diminished. A perfect exclusion of air is the end to be aimed at.

Prof. JOHNSON. I would like to ask Mr. Hurd if the corn fed as fodder and the ensilage were of the same kind of corn and would compare closely together as to the time of cutting and all that?

Mr. HURD. We have always raised a large-growing variety of corn for soiling purposes. We have never until we began ensilaging used Blount's prolific. I do not think there can be forty per cent. difference in the variety of corn, and I credit it to ensilage.

Prof. JOHNSON. We should consider this an open question. Of course it is hardly conceivable that Blount's prolific should be forty per cent. better than other corn, and yet there are great differences in corn. It is possible, too, that there are other differences in the two experiments which would influence the result. If I had only such testimony as Mr. Hurd has given, I should say at once that it goes very far to show that the ensilage is improved in digestibility; but we have had some comparative trials made with ensilage and with hay, straw, roots, and other feed, and those experiments as I understand them have failed to show such improvement in digestibility. It may be true that in this case there was a difference; in the cases to which I refer, there was, to my mind, evidently no such difference. I have had no practical experience myself with ensilage, but at my left hand is a gentleman who believes (and I think he is correct) that he made the first silo in America—Dr. Miles, formerly professor of agriculture in the Michigan and Illinois Agricultural Colleges, and now director of experiments at Mr. Houghton's farm at Mountainville, New York, where investigations have been begun, which, if they can be carried on for forty years, will give us in this country something like the results they have in England from Mr. Lawes' experiments.

Dr. Miles. I have very little to say on this subject. I am rather looking for information in regard to it myself. I suppose I made the first ensilage ever made in America. I put up pits of fodder corn in 1875. I likewise put up some broom corn. This was done in the State of Illinois. The results of those experiments were satisfactory to me in several respects. I would say that I took up the matter in consequence of the statements that had been made in the foreign publications which I had access to. I saw that people were using ensilage to a considerable extent in France and Germany, and I wanted to see how it would work over here. I was satisfied that there would be no difficulty whatever in keeping fodder in good condition for feeding to animals and that the animals would relish it. I was satisfied, however (I may have been hasty in my conclusions), that it would not pay out west, where corn is cheap and corn-stalks are sold at ten cents an acre. That is, the advantages gained would not justify us in the labor involved in putting up this fodder. I published the results in 1876, I think, in the "Country Gentleman," and there made the suggestion that we adopt these terms, "silo" and "ensilage," as convenient terms for describing this process. The papers before that had, in their little items, referred to the French practice and the German practice of ensilage, and had attempted to make a rough translation of the terms, and they spoke of "pitting corn fodder" and "potting corn fodder." The favorite term used in English papers was "potting," and in America it was "pitting." The first silos were made in earth. An excavation was made in the ground, and fodder put in, and then covered with earth, precisely as we cover potatoes in the fall; and I saw in one of the very latest numbers of a French periodical that I have that a gentleman who has practiced the system to a considerable extent had silos of masonry, which he prefers to earth pits. So that it would not be difficult for anyone to make an experiment on a small scale in regard to the matter.

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I think ensilage is undoubtedly a desirable addition to our winter feed for our cattle. It is desirable to have some moist food. Undoubtedly, the roots that are grown in many places are a very desirable addition to the fodder of our stock during the winter. It is possible that the ensilage may take the place of root culture. I think, however, that the claims of those who have adopted the system have been extravagant. I think they have overrated its advantages. I do not think there is any evidence to show that there is any considerable improvement in the quantity of nutritive material that can be obtained upon a given area, and it seems to me that they lose sight of one point,—the relative advantages of this fodder cut green and the growing of the crop until it matures, so that they have grain to feed with the stalks. Where farmers are raising these large crops of fodder corn they have the land in a condition that should yield at least fifty or seventy-five bushels of corn to the acre, if not more, and it would be no more than fair, in making the comparison with the ensilage, to take that corn with the stalks and feed it. And it seems to me, too, that in making the comparisons that have been made this afternoon it is no more than fair to compare the cost of your ensilage with the cost of any other crop; with hay, for instance, as one gentleman has suggested. Now, if you figure up hay at twenty dollars a ton, that will be one thing in regard to the matter; but if you go west, where I have seen hay sold for six dollars a ton, your figures would show very differently in regard to the relative advantages of the two systems. So that if you are going to compare ensilage with any other cattle food it would certainly be fair to figure up the cost of that cattle food, and compare that cost with ensilage.

I would state that we have a silo of masonry, made in the best possible manner, for the purpose of testing the advantages of ensilage at Houghton Farm. We have not yet opened the silo, but shall do it before long. We have taken steps to ascertain what is lost and what is gained. We shall have the feed and experiment with it. Analyses will be made by Prof. Johnson, in order that we may have all the light upon the matter that he will be able to give in regard to it. I think it is a matter that needs investigation. I think the exaggerated statements that have been flying about in the agricultural press rather tend to retard the introduction of the system. The statements are made in such a manner that they can hardly be believed. To illustrate the manner in which this thing is figured, in a book published on this subject of ensilage, I find an analysis of the ensilage, an analysis of the fodder corn, and comparisons made. The ensilage has 19.3 per cent. of dry matter; the corn, 14.96 of dry matter. Now, how are these facts used? I turn over the leaf and I find the statement that there is a gain in the dry matter of 19 per cent.! How that difference can be figured into 19 per cent. I cannot conceive. I cannot compare the analyses throughout, but I will just take another item that comes to my mind. The fat is .62 per cent. in the ensilage, and .26, I think, in the corn before it was put into the pit. Now, the writer says, "here is a gain in fat alone of 138 per cent." Now, statements like these do not have any force. They are exaggerations and misrepresentations of the facts.

I have no doubt that, under certain circumstances and under certain systems of management, ensilage will prove a very valuable addition to our cattle food. I think, however, that very many who practice ensilage believing that it is going to be the royal road to success, that they can neglect everything else upon the farm, will find that their sanguine anticipations are not realized. I have seen the statement that one man had seven acres of corn that he put into a silo, and he says if he had fifteen acres, his profits, at the same rate, would have been between three and four thousand dollars. Those statements are a little too strong. I would rather wait and ascertain what the results are. I have no doubt that ensilage will be more desirable to the eastern farmer than to the western farmer, and that it will be of more advantage, in the long run, to the man who farms on system and brings in the ensilage as part of the general system of farming in which it is not made the all-in-all. I think when we have investigated this matter and it settles down to the level where it belongs, we shall find ensilage, in many localities, and under certain systems of management, a very desirable addition to our cattle food. I think a great many are going to be disappointed in it. I think a great many who are so enthusiastic in it now will not be so enthusiastic in it five or ten years hence. I cannot learn that the system of ensilage is extending in France or Germany. In Germany they have been using for years this brown hay; it has been a common article of cattle food there; and the manner in which the ensilaging of fodder corn was discovered was this: a sugar manufacturer had a quantity of fodder corn that was struck with frost; he thought it was going to be spoiled and dug some pits in the earth, put it in, and covered it up. It came out in good shape, and he followed up the system afterwards. There is muc to be learned in regard to the varieties of fodder. I hope we shall have some results to present that can relied upon and that will be of value before long.

Prof. Johnson. I would make one or two further suggestions in regard to the question put by Mr. Hurd. One is, that in the conversion of one hundred pounds of green corn into ensilage, we lose something of the substance of the corn, a loss that mainly falls upon the sugar. Dr. Miles has just said that a comparison of the analysis of fodder corn and that of ensilage showed that the fodder-corn had 14.96 per cent. of dry matter, and the ensilage nineteen per cent. I will say fifteen and nineteen; a difference of four per cent. in the solid matter between the corn as it went in, and the ensilage as it came out. Now, it is the dry matter which does the business. It is not the eighty-five per cent. of water in the green corn, it is not the eighty-one per cent. of water in the ensilage which feeds the animal; that only waters the animal; it is the dry substance; it is what is left after the water is taken out that nourishes. This loss of dry substance will make a great difference in the quantity which it is necessary to give. Of 100 lbs. of ensilage we supply 19 lbs. of solid nutriment, but in 100 lbs. of fodder corn we give only 15 lbs. Then it would require 127 lbs. of corn to supply 19 lbs. of food. 127 : 19 : : 100 : 15.

In other words, we should need to take 27 per cent. more of green corn than of ensilage to get a given quantity of solid food.

And there is another point, and perhaps a more important one than that. A ration which satisfies an animal must satisfy it by giving it a sufficient quantity of all requisite nutritive material. The animal must have what chemists call albuminoids; that is, substances like raw beef and white of egg in chemical character. It must have, next, carbhydrates, such as sugar, starch, and digestible fibre. Now, green corn contains but a small quantity, about one per cent., of albuminoids. The animal must eat, and eat, and eat, in order to get enough of that, and it is overloading itself with sugar and water and fiber, because of the exceedingly small quantity of that ingredient. When corn has undergone this fermentation, the albuminoids are not diminished at all, probably; but the sugar is diminished in quantity, and it therefore takes less consumption of material thus concentrated to satisfy the wants of the animal than it did of the original corn. It is also not improbable that Mr. Hurd's animals have had, in his experiments, a better proportion between their grain and their ensilage than they had between their grain and their fodder corn.

In the New Jersey Station Experiments, the chemist endeavored to adjust the different ingredients so as to get a proper proportion of nutritive elements, and when he combined foods with concentrated ensilage as the analysis showed he ought, to fit the German standard, he got a satisfactory result in feeding. The New Jersey experiments go to show that ensilage is as good as, but not any better, than other kinds of fodder.

I think the discussion of this matter will be of great service, and I shall be very happy to learn that ensilaging *does* increase the digestibility of fodder. Please understand that I do not now deny such an effect; I simply say that I see no satisfactory evidence of it; and the scientific evidence on that subject, so far as I am acquainted with it, leads me to disbelieve it. If it shall be found to be true, I shall be very happy. I have no prejudice against ensilage, nor against its digestibility;

The discussion of this subject will be of great use to us; and if intelligent men among us, working on ensilage, think that they take out from their pits something that is a great deal better than they put in, that is a motive to study the subject.

Adjourned to 7 o'clock.

EVENING SESSION.

The meeting was called to order at 7 o'clock by Vice-President HYDE, who introduced as the lecturer, Mr. J. M. HUBBARD of Middletown.

COMMERCIAL FERTILIZERS—A FARMER'S VIEW OF THE SUBJECT.

BY J. M. HUBBARD OF MIDDLETOWN.

A farmer's view of the subject of commercial fertilizers is simply any view, is it not, that a farmer may take of it? You suspect immediately that I desire to anticipate and forestall certain criticisms upon the paper which it is my task to read before you this evening. Well, you are perfectly right about it. If I can establish the point that my title allows me to omit or include anything I choose, to board the train of thought which this title draws after it at any convenient station and leave when I think I have gone far enough, it will afford me shelter from some criticisms which might otherwise take effect seriously. You would not expect me to go over the whole subject, to begin at the beginning and try to exhaust it, or even to touch all of its points. That would be too absurd, and besides I should leave nothing for you, each of you to fill out for yourselves. I would not do this if it were in my power. I have no wish to settle every question. Indeed, I have very little expectation of being able to settle any. But I do like to open questions and contribute my share toward their settlement. What I bring you to-night is not an ordered exposition of the subject, or of any part of it. Still less is it a recipe warranted to cure if taken according to directions. I have never felt any call to do work of that kind. I bring you simply some thoughts upon the subject. I hope they may be found somewhat pertinent, somewhat helpful, and in this hope I submit them to your consideration.

Civilized human society is a very complex organization. It is the outcome of forces which are often obscure, and they interact and modify each other to such an extent that it is not easy to trace the stream of consequences that flow from each, back to its source. From time to time new forces come into play, and we have an opportunity to note the changes which follow their action. In some cases these changes are very wonderful. It is simply impossible for human foresight to anticipate them. To the great Weaver the web of human progress is simple and clear, but the scope of our observation is so limited that we cannot follow the threads nor trace the pattern. It seems to us confused and intricate. It is, however, easy to see that from time to time the form and substance of social and industrial life have been greatly modified by the introduction of some new force or the use of some new material, which, at its first discovery, may have been regarded as only a toy or a curiosity.

The magnetic needle, for example, making practicable the navigation of the broad oceans and bringing a new world to the notice of European civilization—how differently would the history of the world have read, if this secret had still slumbered in the hiding place of unknown forces. The use of coal as fuel, the application of the expansive force of steam to drive machinery—can any one imagine what our conditions would be if we had never known or used either of these? To come nearer our own time, the uses to which we put electricity will illustrate the same idea. For years after its discovery this force was the plaything of the scientist, and an object of wonder and curious regard to the multitude. It was mysterious, and seemed to border upon the magical, but only a few dreamers saw in it any possibility of usefulness. Now it carries our messages over land and under sea, caring nothing for space; asking nothing of time; knowing no weariness; needing no rest; the most wonderful messenger that ever did the errands of the human brain. Of late we have required it not only to carry our messages but to deliver them in our own uttered speech. We burden this messenger, not only with our thought, but with our intonation and accent as well, and all we send is faithfully delivered. And as our new servant has proved swift and faithful, we propose to see if he is not strong as well. He has run swiftly upon errands; we now propose to harness him to our cars, and make him grind in the prison house of our factories. Beyond doubt he will be made to do it all, and what further tasks may be laid upon his ample shoulders I would not dare to prophesy. I would not dare to set anywhere a limit, and say, beyond this nothing shall be asked of him. One thing I fully believe. The forces which are to do the work of the world in the future are to be chemical, rather than mechanical forces.

It is a mistake to think, as we are sometimes inclined to, that there is little or nothing left for those who come after us to discover or to conquer. Alexander wept because there were no other worlds to subjugate, but he who attempts the conquest of the hidden forces of nature has no occasion to weep for any such reason.

Nature is an expression of the infinite God, and in all its parts, as well as that called man, it was made somewhat in His own image, after His own likeness. It all partakes of the infinite. It has no further boundaries. Push discovery as far as you may, something higher, better, and more difficult of attainment lies still beyond. No small portion of the value of every attainment is to be found in the vantage ground it gives us in this unending struggle with the mystery round about us.

The subject of this paper is Commercial Fertilizers, and it may occur to this audience, as it does to me, that the connection between the subject and the line of thought into which I have allowed myself to be drawn is not very obvious. And yet there is a connection. The introduction and general acceptance of commercial fertilizers in common farm practice was the introduction of a new force in agriculture. How far its influence will reach, and what changes it will bring about we can see in part. and at present only in part. The main purpose of this paper is to direct attention to these changes; to note and outline those that are most obvious; and thinking of these I was led to think of the wonderful results which other causes had drawn after them along the track of progress. A glance at some of them seemed to form an appropriate introduction to the consideration of this one.

The term commercial fertilizers is hardly capable of exact definition. As commonly used, it comprises all fertilizing substances offered in the markets. The list is a constantly increasing one, and includes some substances long used as manures and purchased for that purpose, so that it is only in a qualified sense that the use of commercial fertilizers can be said to be of recent origin. Ashes, bones, and fish, have long been bought and used for this purpose, but their use was limited, and the trade in them local. They were not in form adapted to transportation, storage, and easy application to the soil. The market was not supplied with them. They were not quoted in its reports. Their influence upon production was but slight, and no great change in the business or work of the farm was consequent upon their use. The general introduction and use of commercial fertilizers must be distinguished from this local and occasional use of some articles belonging to the list This general movement has already produced great changes in farm practice, and far greater changes are likely to follow. I would like to look both ways in this matter; looking backward, to mark and measure the direction and force of this new impulse, and then forward to see whither it will lead, and where it will land us.

In my own mental chronology this general introduction of commercial fertilizers dates from the earlier importations of Peruvian guano into this country. This article was in convenient form to handle and transport, ready for immediate application, and wonderfully prompt and effective in its action. I well remember the first instance of its use upon my father's farm. An old pasture, moss grown and bush-infested, was broken up for the usual summer fallow in preparation for a crop of rye. It gave a good opportunity for a trial of the new fertilizer and an application of about 150 lbs. per acre was made. For a test, one corner of the field was left without any application. The result showed that the guano had more than doubled the crop of rye, and the grass for several years afterwards testified that its benefits extended beyond the first crop. This was the common experience, and guano was received into favor at once. How other articles have been brought forward as competitors for the public favor, and how some have succeeded and some have failed, I cannot now stop to recite. Most of you have been interested spectators of the movement and are familiar with all its details. But perhaps I ought not to pass to the consideration of results without a few words upon the broad question of profit in the use of these articles. There are not wanting those who do not believe in them ; who think they are not worth their cost, and that the agricultural community would be better off without them. I do not propose to argue this question at length. Most farmers do use them, and their action testifies more powerfully than any words that they had rather pay for them, than to do without them. They may assert that these articles ought to be furnished for less money, or that they should produce greater results. They may think of themselves that they are not growing rich as fast as they deserve to, and may choose to exercise their inestimable privilege of grumbling. But still they buy, and we are entitled to take their action as proof of the general statement that the use of commercial fertilizers is profitable. This is really more than it is necessary for me to prove. To establish the value of any article, it is only necessary to prove that it can be profitably used. It is possible to waste or throw away our choicest treasures. When once the fact of value in anything is established by sufficient evidence, the negative testimony of many failures to find it can have no weight. A large and increasing number of persons have found the use of commercial fertilizers profitable. The failures must be ascribed to ignorance or neglect of the conditions of success, and not to the worthlessness of the articles used.

We will now turn our attention, if you please, to the consequences of this new departure and endeavor to learn something of their extent and character. I name first what is perhaps the most obvious of them all. It has emancipated farmers from the limitations imposed by a dependence upon home or local supplies of manure. "Cultivate no more land than you can manure well," has been the oft-repeated injunction of agricultural writers and speakers. It is an injunction both wise and important. But when coupled with the condition that only home supplies of manure are to be used it means limitation—a limitation which makes farming in all but exceptional circumstances comparatively small business. I am speaking, of course, of farming in Connecticut, and here and wherever similar conditions prevail, home supplies of manure are not as a general rule sufficient. I am willing to admit that the fertility of a farm may be maintained and some profit realized under this restriction, but it can be done only by a corresponding restriction of production. The largest production—the most profitable production—cannot be attained while the business of the farm is thus hedged about and hampered. The business cannot grow to meet the demands of the market nor respond to the gracious invitations of opportunity. What, for illustration, could a manufacturer do if limited for material to one small local source of supply? He might have command of abundant power, help might be easy to obtain, and the markets of the world might call for his productions with imperative demand, but all in vain. The limitation of one necessary element of production is the practical limitation of every element, and under such a limitation enterprise is crippled, and limps along with no chance of winning any worthy prize. Agriculture under primitive conditions does not feel this restriction, for the work of primitive agriculture is mainly to gather, while the task of advanced agriculture is chiefly to produce. Let me try to make this distinction clear, for I regard it as important. Primitive agriculture may do much to secure favorable conditions for production. It may give the soil the best possible opportunity to produce, but it adds nothing to its power. To it the soil is a storehouse, from which it draws supplies, large or small according to the skill and labor expended. But to advanced agriculture the soil is more a workshop than a storehouse. He who manages a farm under this system, invests not only labor and skill, but material as well. He needs to know not merely what the soil has in store for him already, but what its possibilities of production are with the material he can supply to it. His farm is his factory, and he manufactures his crops as truly as the foundry-man his castings or the weaver his cloths. Much of American agriculture is still primitive in character. There are situations even in Connecticut, where only primitive agriculture can be a practical success. In such situations it would be a grave mistake essentially to change its character. I do not mean to speak of it with the slightest disrespect, but I do mean to say that when all other conditions favor a change and invite to an advance, it is a misfortune to have that change prevented or that advance hindered by an insufficient supply of crop material.

Wherever population is dense and conditions of soil and climate are favorable, the soil should be the farmer's factory and not merely his storehouse. If he runs a factory, he must supply material as well as labor. And if he is to fill the measure of his capacity and opportunity as a producer, he must not be restricted in his supplies. This was his condition previous to the introduction of commercial fertilizers, and I count the removal of this restriction a great service to advanced agriculture. We have commercial fertilizers to thank for it.

It is one service, but not by any means the only one nor would I say the principal one. That which, in my thought, takes precedence of every other, is the spirit of inquiry awakened concerning our business and the increase of knowledge which has come or is coming in consequence of the use of these articles. The time is not yet far enough behind us to be the olden time, when our knowledge concerning the sources whence plants derive their food was very limited and our philosophy of fertilization very crude. Land which would produce large crops we called rich, and it was our wish and purpose to make our land as rich as we could. Heavy growth followed the application of manure and so we concluded that manure made land rich. Heavy growth also followed the application of Peruvian guano, and so we assumed that Peruvian guano made land rich. It was the diminished effect of succeeding applications of this article and the obvious poverty of the soil resulting from its continued use without other manures that gave many farmers their first lesson in scientific fertilization. Fertility which was beforetime thought of as a unit, was now found to be composite in its nature, and it became necessary to inquire what were its elements. I do not claim that we have as yet made any great attainments in this line, but we have at least made a beginning. We have commenced to inquire, we have commenced to listen, we have commenced to think. Just try to imagine a meeting of farmers thirty years ago, listening with interest to the Professor of chemistry, while he expounds to them the composition of plants and the sources whence they draw their supply of material; telling them of mineral and volatile elements, coming, the one from the earth, and the other from the air; expounding the ordinary ratio of the elements to each other and the absolute necessity of a full supply of each; showing how the plant may, as it were, starve in the midst of plenty, if but one essential ingredient be wanting. Or, changing the figure, he reminds his hearers that the man who has the contract to build a house must provide stone, brick, mortar, glass, and nails. He must have timber, boards, and shingles. The amount of nails needed may not be large, but unless he has them he cannot build the house. Without this essential element the house remains simply unorganized chaotic material. None of the blessings of home can be derived from it; none of the sweet associations of home can cluster around it. And using this for an illustration, he proceeds to show how you may have in your soil abundant supplies of silica and lime and potash and nitrogen, that carbon and oxygen are abundant in the atmosphere and easily obtained, but until phosphoric acid is supplied no plant can be built. Some of your accumulated materials will remain, some will waste, but no use can be made of any until that which is lacking is supplied. And then he may go on to tell how that not only must all these materials be supplied, but they must be in suitable form and condition. It is nails the builder wants, not pig iron, and he can neither clapboard nor shingle his house with rough-hewn logs. And so he will tell you that your phosphoric acid must be soluble and your nitrogen compounds such as have been proven suitable, or the building of the crop must be delayed until the requisite transformation can be acomplished. To conclude, he may give you the very latest concerning nitrogen, its sources of supply and the varying feeding capacities of different plants as related to it. That will answer perhaps for the outline of a scientific agricultural lecture of to-day. It might of course, be varied greatly, and he who does not like it is at liberty to construct one entirely different. But be your scheme what it may, if you bring into it the common science of to-day upon this subject, you would make it both unintelligible and uninteresting to the well-informed farmer of thirty years ago. Our thoughts have been turned into other channels, and our very speech "bewrayeth" us. It has become enlarged and enriched by the introduction of terms which our fathers had no occasion to use. Nor is this additional information and newly awakened thought upon a matter of mere curious speculation. If it were you would not find farmers meddling with it. It leads directly to practical results of the highest importance. I do not see how we can now stop short of that point where we shall know with reasonable certainty just what material our crops need; and supplying that and only that, shall be able to eliminate from our business operations one uncertainty against which we have been compelled to insure at heavy cost. The waste involved in the supply of material for which there was no need, and which could not be used, has been. in the aggregate, simply enormous, and we ought to be able to prevent it. We are not very near that point as yet, but we have started thitherward, and notwithstanding obstacles and perplexities and apparent failures and temporary strayings from the path we must and shall ultimately reach it, and so far as I can see this movement, creditable in present performance and full of beneficent promise in the future, received its primal impulse from the use of commercial fertilizers.

I have, in this connection, a few things to say which I do not expect will command the unqualified assent of this audience. I offer them as suggestions rather than assertions. They are, perhaps, not susceptible of proof. At all events, I shall not attempt to prove, but only very briefly to state and illustrate them. I believe that farmers who are habitual users of commercial fertilizers are also those who best appreciate and most wisely use whatever manures the farm produces. I believe that the use of commercial fertilizers has led to a better understanding of that wonderful process of development of plant food from the inorganic elements of the soil which constitutes natural fertility. I believe that the use of commercial fertilizers has led to a better understanding of the value and importance of tillage, and that in all these particulars a better understanding has been followed by an improved practice. Consider, if you please, how that until the use of commercial fertilizers became common, we had no standard of valuation by which to estimate any fertilizer. The standard which we have is not claimed to be perfect, but it is year by year improving, and the practice of referring to it all manures which are valuable simply for the plant food which they contain is year by year increasing. Using this standard, we soon came to know something about what it could not measure as well as about what it did measure. We learned that some fertilizers have a value quite outside their value as sources of plant food. I do not mean that this had never been thought of or suggested before, but rather that the thought has now for the first time taken definite philosophical and practical form in the common mind. In what does this value consist? This question opens up a very interesting field of inquiry. We are led by it to investigate the constant production of plant food in the soil through change of form or condition in its elements and the agencies by which this change is effected. If certain beneficent applications have brought nothing of value to the soil, they must have the power of developing something of value from the soil. We learn that some substances, not of much value as plant food, are of great value in aiding these transformations which develop natural fertility. Home supplies of manure partake largely of this nature. Some articles sold in the markets are chiefly valuable for this quality. We are learning to think and act with discrimination, and ought certainly to be able to value more justly and use more profitably all sources and means of fertility. Closely allied to this inquiry is that which relates to the value of tillage.

Of what value is plant food in abundance if the crop cannot reach it? You cannot study the question of food without, at the same time, studying in some of their aspects the consumers of food. No one is so keenly alive to the importance of having food for his family or his animals used to the best advantage as he who has paid his money for it. The same feeling governs in regard to food for plants. This bag of fine powder which you can take on your shoulder and carry across the field has cost you five dollars, and it will not do to waste it. If the plants cannot find and reach it after it is applied, you might as well have never bought it. Whatever conditions are necessary to enable your crop to find and appropriate the food you have purchased for it must be known and supplied. I think few farmers have used commercial fertilizers long without having their methods and practices of tillage improved in consequence. They have demanded better implements of tillage, and this, like every demand which represents a real need, has been supplied. It may seem fanciful to some that I should find one of the causes of improved implements of tillage as well as improved theory and practice in the impulse which the use of commercial fertilizers has given to agriculture. But I think the connection can be readily traced. I cannot now follow it step by step, and having given you these few suggestions, leave the matter with each one of you for such consideration as you may choose to bestow upon it.

I count it no small gain to agriculture that those who do its work and those who teach its science have at last found a meeting-place—a common ground whereon to stand—a subject of common interest to think about and to talk about. Up to the time when commercial fertilizers occupied a large space in the farmer's thought there was no such common ground. The farmer demanded direct and immediate benefit from the teachings of science. Whatever was remote was to him uncertain, and he would have none of it. And this was the character of most that was offered him. It may have been of great value, and his refusal of it most unwise; but he acted according to his own habit of thought, and took no risks. But he had not used commercial fertilizers largely or long before he had accumulated an assortment of problems which had a bearing obvious and direct upon the profitable conduct of his business. One fertilizer succeeds splendidly on a certain field or with a given crop, and fails elsewhere or when applied to a different crop. A fertilizer which does finely at first, afterwards loses its effect, and seems actually to impoverish the soil. If the man of science can explain these things to him, he commands his interested attention from the first. And, once entered upon inquiry upon these and similar points, there is no branch of science pertaining to agriculture to which the inquiry may not turn easily and naturally. "All roads lead to Rome," declares the ancient proverb; and such is the unity of science, that, once started upon her broad highways, the traveler's feet are ever turned toward the seat of her power and the center of her dominion. The answer of the man of science to the farmer's questions may at first seem disappointing. We find that he does not often answer with a prescription to be blindly taken, or with a recipe to be unquestioningly followed. Nor is he always ready with a clear solution of the particular problem which is puzzling our brain and disappointing our hopes. Perhaps he cannot tell. It may be that even he does not always know, but he is able to point us to the teacher who does know, and from whom all his knowledge comes. He leads us into the great school of Nature. To this he has the key, and he knows something of the methods of instruction there; and in this perhaps consists the chief advantage he possesses over us. If the question be, What does my soil need? his direction is, Ask of your soil; and he shows us how to put the question and how to interpret the answer. If we ask, Why does this crop behave in such a manner? he says, Observe the action of the crop under test conditions, and you will find out. Sometimes, with the humility of true wisdom, his answer will be a frank, I do not know. It is not a difficult matter for a man whose store of information is small, to ask questions which the wisest of men cannot answer. Such intercourse as this breaks down the barriers between the learned and the unlearned, draws them together, and gives to each a knowledge of the other which he could gain in no other way than by personal intercourse.

It is often a surprise to an uneducated man to find out that there are so many things which the educated man does not know. He finds, and is both surprised and gratified to find that the difference between himself and his educated neighbor is, one of degree and not of kind, and that the knowledge of the wisest man is small compared with the great unknown that surrounds us all. His self-respect is enhanced by this experience. He comes to value the real knowledge which he does possess more highly and is more inclined to add to it. And when once the desire for knowledge is awakened in any heart the way to acquire it will surely be found. I am not authorized to speak for the other party to this intercourse, but I venture to suggest that it is at least possible that its benefits may be mutual. Something may be learned by observation, even in a limited sphere, which may not be found in any book and which may furnish the missing link in a chain of demonstration without which all the other links would be useless. I should like to believe that something of this kind might occasionally happen, and that thus the meeting together of those rich in knowledge and those poor in the same currency might be for the advantage of both classes. The intercourse between them establishes a common fund of knowledge, and even if at first the contributions to it are nearly all from one side I should hope that it might not long remain so. Neither side will lose anything by their contributions, but I should like to believe that both might be contributors to it and both be enriched from it.

The agriculture of the future is to depend largely upon supplies of plant food brought from sources outside the farm, and prepared for the farmer's use by men who make that their business and bring to it capital, skill, and business talent commensurate with its importance. This new departure in agriculture is already firmly established. It involves a revolution which is not to go backward.

Our movement is away from, not towards primitive agriculture.

We are to be not gatherers merely but makers of our product.

If at liberty to use such a combination of words I would say: we are to be manufacturers of agricultural products. The sources whence all these supplies of plant food are to be drawn we cannot at present expect to know.

We draw them now in part from natural deposits which are being exhausted with greater or less rapidity. Some of them may last a long time, but sooner or later the last shovelful of guano will be gathered from tropic islands where for so long a time it has been accumulating for our use. Sooner or later the mines of phosphatic deposit will fail and all those sources of supply represented by limited deposits will be exhausted. New discoveries may put the point of exhaustion far in the dim future, but no matter how great the stock may be, a steady reduction will at length exhaust it.

There is, however, a source of supply which we have as yet only touched lightly and for which there is no such thing as exhaustion. I refer to the wastes of civilized life. It has long been known that they contain valuable fertilizing material. It has long been known that they were dangerous to the public health. Given on one side the imperative necessity for their removal, and on the other the need for the fertilizing elements they contain, and the ability to pay for them and it needs only skill and business talent to bridge the gap and confer a benefit of inestimable value upon both parties. Can anyone doubt but that the requisite skill and talent will be forthcoming? Not just yet, perhaps, but when the need presses, when sources which are our present dependence shall fail, when an increased population demands increased production, and larger supplies of plant food are required to meet the demand. The matter of cost will regulate itself. Food must be had, and the necessary cost of production must be paid for it. We may as well give full recognition to this new department of productive industry.

The preparation of plant food is a trade. The business of supplying it to those who feed plants is of sufficient importance to stand alone. It will give large employment to labor. Capital and skill will find wide scope therein. I welcome the new auxiliary to agriculture. The field which it occupies is an important one. It has demonstrated its right to exist. It has fully deserved its recognition. In every direction its work and influence have been beneficent. It has that rare quality of beneficence which recreates offensive and dangerous elements and makes of them willing and useful servants of our common need, and thus it renders a double service.

The new departure in agriculture has many phases of interest, but of all its developments, I think no other promises such far-reaching results or opens up such a vista of change and improvement as this. It marks a step forward toward the golden age, when everything on earth shall find its place and use, and no man miss his work, or fail of his reward.

Mr. Sedgwick. When I came into the hall this morning, almost the first word I heard was the name of Prof. Atwater, and the remarks of the speaker struck me as something like an attack upon him. I do not feel called upon to defend Prof. Atwater as a scientific man at all. I think he is fully able to defend himself; if he is not, he must go down, as far as any defense I can make is concerned. But it seems to me that the object and purpose of the experiments which he has made have been misapprehended. As I understand him, and as those who know him and have talked with him on the subject, understand him, they are not undertaken with the idea of proving scientific truths absolutely, from the fact that they are not conducted by men who are competent to do that kind of work; but they are intended to guide farmers in their practice. I am confident that every one who has taken any part in them, has found that they are valuable for that purpose, and has learned something from them which is valuable in his practice.

Let me illustrate by just one point in regard to those experiments. They have proven the fact,—they have not demonstrated the scientific truth, understand me, but they have proven sufficiently for farmers to accept the fact as a guide in their practice, that the application of nitrogen in large quantities to the corn crop is wasteful; that the man who buys a highly nitrogenous fertilizer, or applies a fertilizer to the corn-crop that contains a large proportion of nitrogen, throws his money away. The whole tenor of the experiments conducted for three or four years, points directly, with very few exceptions, to that fact. If that is true—and not only these experiments, but all our farm practice, where these experiments and the results of them have controlled it, seems to justify that conclusion—if that is true, it makes all the difference to us between cultivating at a profit and cultivating at a loss. I do not know that that has any scientific value at all, but it has a practical value, and that is what these experiments are designed to have. We cannot wait thirty years for the continual trial of these experiments on the same ground, in order that we may get *certainties:* we must accept *probabilities*. These experiments give us *probabilities*, and they are of great value to us in that way. I think it is a mistake to judge them in the way I understand they were judged by the lecturer this morning, that is, by scientific rules, as if they were instituted for the purpose of proving truths of science. They were not instituted for any such purpose at all.

They were instituted to aid farmers in their practice year by year, and for that purpose they are valuable.

Mr. Hurd. Speaking as the gentleman did a few moments ago of the uselessness of a large amount of nitrogenous matter for the corn crop, I would like to have Mr. Hubbard tell us his impression of what is a good fertilizer for a fair corn crop. I would also, if it is not presuming too far, ask Prof. Johnson to follow with his ideas, provided he does not agree with Mr. Hubbard.

Mr. Hubbard. I think, as far as that question is concerned, every man must find out for himself. I think I know pretty well what is a good fertilizer for my farm; but I am not sure that it would be the right one for Mr. Hurd's farm.

Mr. Hurd. I asked that question not so much for the purpose of getting Mr. Hubbard's personal experience on his own farm, but, knowing that he has been more or less intimately acquainted with the experiments carried on by Prof. Atwater, I thought he might be able to cover a larger area.

Mr. Hubbard. Those experiments indicate very clearly that the leading element of corn fertilizers should be soluble phosphoric acid, a smaller proportion (I cannot give any definite proportions or percentages) of potash, and a small percentage of nitrogen; but much the larger, the leading element, should be phosphoric acid. That was the conclusion to which those experiments pointed, and I think it was a very valuable one.

Mr. Hurd. That is just the conclusion I wished to draw out.

Mr. Spurr, of Farmington. Will Mr. Hubbard tell us what to buy for corn? I have never used any chemical fertilizers whatever; I have always relied on what I could get from the farm. If I was going to buy anything for a corn crop I should not know what to buy, and should be wholly at the mercy of the dealers.

Mr. Hubbard. I cannot answer such a question as that. I would recommend you to buy certain fertilizers and experiment with them and see what results you obtain. I do not know what you ought to buy. Those experiments to which I alluded, and which were spoken of so contemptuously this morning, were simply applications to parallel and contiguous plots of ground of fertilizers each of which was distinguished by the predominance of some element, and less of a single element of the three which are considered necessary to enter into a complete manure; that is, phosphoric acid, potash, and nitrogen. Get the three and apply them and see which does best; get combinations of the three in different forms and apply them and see which does best; then you will know something about it. I do not know any way by which I can tell any man what to buy; it must be studied up by himself. That I consider the great value of these experiments—they give people some practical knowledge of the matter. No one can try them for a few years without getting some idea which will be of value to him in the conduct of his farm. I do not know a person who has carried them on in a small way who does not say that he has arrived at some facts which are of practical value to him in his farm operations. I do not say that we have got many conclusions yet, but a little knowledge is better than dense ignorance. If we can see a little light, it is better than walking in the dark all the time. These experiments give us a little light, and we shall get increased light as we go forward in the way they point out.

Mr. Webb. I was going to ask one question: what fertilizer has been manufactured or discovered superior to stable manure for a crop of corn?

Mr. Hubbard. Not any; if you can get enough of it, nothing on earth is superior. If Mr. Webb has got all the stable manure he wants or can use on his farm, I would not recommend him to buy anything; but if you have got to buy stable manure, as I have to, you cannot afford to buy it for corn. I can grow a good crop of corn with the application of twelve dollars' worth of fertilizer to an acre.

Mr. Webb. Would it not be wise policy for a farmer to buy the constituents of a fertilizer and so combine them as to make a fertilizer containing constituents as nearly conforming to the constituents of stable manure as possible?

That being the fact, where is the benefit of applying a double quantity of nitrogen for the purpose of experimenting, and publishing the results for the benefit of the farming community?

Mr. Hubbard. Stable manure is one of the most variable things that I have any knowledge of. It may be rich in nitrogen, it may be exceedingly poor in nitrogen. It may be rich in phosphoric acid, it may be exceedingly poverty-stricken in that element. I do not see how it can be used as any standard by which to measure the composition of any other manure. As to the use of applying fertilizers, one containing a very small proportion of nitrogen, another containing a larger proportion, and another containing a very liberal proportion, to the corn crop, and publishing the results, if those experiments show what the value of nitrogen is, it seems to me a very clear gain. If the nitrogen is proven to be of value, we can continue to use it. We do not expect, of course, that these experiments are to be profitable in the direct production of crops; they are not tried with any such idea as that. They are valuable for the information we derive from them, and if by trying these comparative experiments with different proportions of nitrogen in the fertilizer we find that a very small proportion of nitrogen does as well as a large proportion, we are under no necessity of paying for the large proportion, if the small will answer our purpose just as well.

Mr. Webb. The point I wanted to make was this. If I want to buy a special fertilizer for a crop of corn, I will supply, as far as I can, the constituents of stable manure, the analysis of which is taken as the basis. I buy these constituents in the form of phosphoric acid, nitrogen, and potash, and when I go to the chemist to buy these articles, I have got to do precisely the same as I do when I go to buy stable manure; they are of different qualities in the market, they vary in their analyses the same as stable manure does. I may buy kainit, I may buy muriate of potash, I may buy sulphate of potash, and they will all vary in their analyses. You have the same variations precisely in the combinations of any manures that you go into the market and buy that you have in the composition of stable manure. I think that stable manure is so near a universal fertilizer that the experience of all practical farmers is that we can get no fertilizer superior to it. We may get one cheaper under certain conditions, we may get one to use as an auxiliary under certain exigencies, under the exigencies which almost every farmer experiences in the State of Connecticut and in New England; but in supplying that, I do not think it is absolutely essential in the experiment that he should double the quantity of any of those ingredients. I think the Almighty, if you put the manure into the ground, will take care of it and the crop will come in due time.

In regard to putting into the ground just exactly what you take out, or what you expect to take out, I do not think that is quite fair to those that are to come after us. I know two men who can farm it and take up every red cent they put into the ground every year, and when they die, it will be all gone; they will leave nothing behind them. But they are unusually smart. Thank God! there are but few such men.

Mr. Hinman. It seems to me that it hardly follows, that because stable manure is the best manure that we have, taking one year with another, and one soil with another, that our friend Webb is quite right in his idea. He is talking of a manure largely composed of organic matter. Take the phosphoric acid, the nitrogen, and the potash out of stable manure, and I would not give any more for the products you have taken out than I would for a given quantity bought in any other commercial fertilizer. I do not care if there is twenty per cent. of nitrogen in stable manure. If I know that five per cent. is enough on my soil, I would not buy the other fifteen per cent. if it is in the stable manure. Now, as to laying it up for those who are to come after me, I believe that nitrogen is something that goes off in the air, or leaches through the ground; at least, one gentleman said it should be applied in any form only just before planting the crop, because it is so volatile. At any rate, I would never buy nitrogen I did not want. Experiment has shown that to many farmers in the State of Connecticut nitrogen is of no value except in very small quantities to fertilize corn, and having discovered that, knowing that it is so on my farm, I will not buy it in large quantities. I believe that Prof. Atwater's experiments have shown us more in that line, and been of more advantage to us, than any experiments ever made by Lawes and Gilbert in England, or by any other men under Heaven, any where.

Mr. Webb. I want to ask the gentleman two questions. One is, if he knows how much nitrogen he has on his farm to feed the crops he is raising; and the second is, if he knows anybody else who does.

Mr. Hinman. I want to say this: that I used those fertilizers in combination, and I used dried blood alone. I got nothing whatever from it. I used kainit alone on corn, and got nothing whatever from it; and after using it long enough—I don't propose to follow a thing thirty years with my financial condition as it is at present, and all the while be making a loss—I think it is time for me to give it up. Four years is about long enough for me to try an experiment of that kind. When I put on dried blood alone, I got nothing; when I put on kainit alone, I got nothing; when I put the three in combination, phosphoric acid, potash, and dried blood, I got my best crops.

Mr. Webb. Why didn't you leave out the nitrogen?

Mr. Hinman. I was going right on to explain that. Where I put the three together, as I said, I got the best crops; where I put the three on alike, I did not get the best crops. I found by those experiments, so far as experiments will show anything, that to a certain extent I could profitably add nitrogen; after I got above a certain quantity, I did not get any benefit from the extra amount. I would not put on any more than I think I can get my pay for. I have not any children, and the men that come after me can buy their own nitrogen.

Mr. Backus. It seems to me that no farmer doubts the value of barnyard manure; the question is, however, after having exhausted all their resources and finding they can still farm more land with profit, whether good commercial fertilizers are not worth all they purport to be worth, and are not cheaper than manure bought at liveries and places where it costs ten or twelve dollars a cord, and has to be hauled a great distance, involving a great deal more labor and expense to get that manure available to the plant, and also the transportation of large quantities of matter that are of no value to the plant. I would like to ask Mr. Hubbard whether a good fertilizer, at forty dollars a ton, is not cheaper than stable manure bought at eight, ten, twelve, or even six dollars a cord ?

Mr. HUBBARD. I hardly see how it is possible to answer such a question as that, situations differ so much, prices vary so much, and the manures, and the opportunities to get them, vary so much. I recommend every body to save and use all the farm manures that they can possibly produce, and if they have opportunities to purchase where the cost is not too great, and the labor of hauling it is not too great, I think it is a very good practice to purchase yard manure. But I cannot on my farm produce near enough to run the farm profitably, as I am running it; perhaps somebody else could. Beyond that, I do not know of a farm that can be run to the highest profit on the manure that it produces. Some farms are run that way, but they are not those which are run most profitably, according to my observation. I think the conditions of agriculture are such here, in Connecticut, that we might lay it down as a general rule, that there are no farms, unless they are very rare exceptions, that can be run at the highest profit, depending solely upon home supplies of manure. Then, what are you going to do ? Do the best you can. If you are so situated that you can buy manure, you may be sure always that it is a good thing, if it does not cost too much. If that is the best thing, in your opinion, buy it. But the conditions vary so that it is impossible to give any general answer to such a question as that. I cannot afford to buy stable manure in New York, (as some people do who have farms along the river,) and ship it from there to Middletown. I think that for farmers who are situated away from convenient and cheap means of communication, commercial fertilizers are their only resource, and I think they are satisfactory resources.

Mr. Sedgwick. I am not aware that the experiments of Prof. Atwater have been attacked in the sense of their not being practical in their results. Certainly no experiments which have been carried on in this country have attracted more attention from fertilizer men, or the general average of whose results have so corresponded with the ideas of men in the fertilizer business as those of Prof. Atwater. It is only a few years since that Peruvian guano was the standard for commercial fertilizers, and no super-phosphate which was put upon this market was considered a good article unless it contained six or eight per cent. of nitrogen, Peruvian guano being the standard, which they say contains fifteen per cent. of nitrogen. The experiments of Prof. Atwater show that so large a percentage of nitrogen is not profitable for the ordinary farmer to use. Furthermore, if you watch the analyses of commercial fertilizers as they have been put upon this market for the last five or six years, (I have had occasion to do so recently,) and compare them with the analyses of commercial fertilizers published in the reports of our State Board of Agriculture for the last ten or twelve years, you will see that in nearly all the best brands of fertilizers the percentage of nitrogen has steadily decreased, while the percentage of phosphoric acid and potash has increased. I know a certain high grade super-phosphate which was put upon the market a few years ago, containing no potash whatever, but which was very high in nitrogen, and that same article is now being manufactured with a less percentage of nitrogen, and a greater percentage of phosphoric acid and potash, and it gives just as good results, practically, to the farmer as it did when it contained nitrogen in excess.

This being so, there comes in another question, the question of the cost of the fertilizer to the farmer. The enormous demand for fertilizers in the past few years has increased the price of nitrogen immensely, the supply being practically limited and hard to get at, whereas the supply of the other ingredients is practically inexhaustible. The addition of one per cent. of nitrogen increases the cost of the fertilizer from four dollars and a half to five dollars a ton. If the farmer can get the same results from a fertilizer containing only three per cent. of nitrogen instead of six per cent., and have a corresponding increase of phosphoric acid and potash, it is a decided benefit to him. In other words, he is not paying his money for what he does not want.

Right here come in the experiments of Prof. Atwater, which confirm what the fertilizer manufacturer has known, and he is applying the results of those experiments to his business. Prof. Atwater shows conclusively that whereas twenty-four pounds of nitrogen to the acre will produce a paying crop of corn, seventy-four pounds is a decided loss, for it only increases the yield 6.1. Thus the seventy-four pounds are used at a loss, while the twenty-four pounds pay a profit. This is a fact which is well worth learning.

One other thing in connection with commercial fertilizers; it is, or ought to be, the policy of every farmer to make all the yard manure he can. It is the basis of all good farming; there is no question about it. But he can in connection with that, use commercial fertilizers, and get a better result from both; or he can use dung one year, and get a good crop, and the next year use the commercial fertilizer and get a still better result from the commercial fertilizer. Let me illustrate this point. I was down on Long Island the other day, where probably in one single county they use more commercial fertilizers than they do in the whole State of Connecticut. I saw a farmer there who told me he had used commercial fertilizers until this year, for the last five years. When he began to use them, he said he got very large crops, but his crops decreased until a year ago; that year he only got two hundred and fifty bushels of potatoes to the acre, while his neighbors got three hundred and fifty. He said this year he went back to stable manure, and got better results from stable manure than he ever did before. That illustrates this very point. You need a change, and there is something in the chemical action of dung, which perhaps scientific men do not get at, which is a permanent benefit to the land; on the contrary, chemical fertilizers may extract something from the soil which the dung does not, and, using the two in connection, you may get a greater advantage from both than by following one system alone.

There is another thing. There are many farmers who believe it to be a fact—I have believed it to be a fact—that where you buy grain and feed it out to your stock, you are increasing the value of your farm; in other words, you are adding to the value of the manure which you apply to your land. Well, sir, the milk business has been conducted on the Harlem railroad, probably for the last twenty-five years, I do not know how much longer, and it has been the custom of the majority of farmers on that road to buy their grain. Now, if it was the fact that buying grain and feeding it to their stock, and putting the manure on their land increased the fertility of their farms, it would be evident by this time; but the actual fact is, that they do not get as large crops to-day as they did before they went into the milk business. How do you account for that? The idea that it is policy to buy meal and grain for the purpose of enriching the farm, that is, that the value of the manure is made greater by feeding grain to the stock, seems to be altogether wrong. The whole subject is a complicated one, and it is only by combining these things and finding out how they operate on his own land that a man can get at the whole gist of the matter. That is my opinion.

Mr. Webb. This nitrogen question was brought up some time ago in one of our agricultural papers, and it was brought forward very promptly in these statistics which have been referred to, and I wondered from whom the suggestion came, that we did not want a double dose of nitrogen. Nobody had suggested it that I had ever heard of, or that such a thing was required, or that such a thing was necessary in successful farming; but since the gentleman has been speaking, it has occurred to me that the first time I wanted to buy blood for the purpose of mixing my own fertilizer, I went to a slaughter-house and bought it at twenty-five dollars a ton. The next year I went and the man said, "we have raised the price; we are asking thirty dollars; and are offered that for all we can make, but we want to reserve a certain portion for the neighboring farmers, and we can supply them in small quantities." I found the same rise in price of nitrogenous materials at the fish factories, and at the oil factories, and was told that the fertilizer manufacturers wanted them all. The last time, it was thirty-five dollars a ton, and they did not care a snap whether we took it at that price or not, for they had a demand for all they could make. Now, then, if we do not require nitrogen, I want to know who under heaven does. We need it, we want the privilege of buying it, and we do not want them to tell us, "you don't want it, and you don't need it, because we can supply it to you in a better form than you can make it yourselves." I don't believe a word of it.

Mr. SEDGWICK. I do not think that Mr. Webb has got at just what I intended to say. I do not say that nitrogen is not necessary to the plant, I know that it is necessary; but he goes on to say further than that, or to imply, rather, that the enhanced price of nitrogenous material is owing to the fact that the fertilizer manufacturers want it for their fertilizers.

Mr. WEBB. Is not that so?

Mr. SEDGWICK. To a certain extent it is; but I would say here, that the fertilizer man is willing to make anything that the farmer wants; that is his business. If the farmer wants a fertilizer containing twelve per cent. of nitrogen, it can be made for him, provided he will pay for it. Any compound which he wants the fertilizer manufacturer will be very glad to furnish him at a given price. So that does away with that argument. Here is another point. The experiments of Lawes and Gilbert show that in the first foot of one acre of ground there are eight thousand pounds of nitrogen; and this was on land which had been cropped for some years. Now, then, we have in most of our soils, particularly on sward ground, a vast store-house of nitrogen. If we can draw from that, we can get it in a cheaper form than we can by buying it, and buying it and putting it there is not a profitable thing for a farmer to do.

Mr. Webb. Don't you buy it then.

Mr. Sedgwick. I don't intend to. I am only giving facts. Here is another point. I have heard farmers say this year, "I bought so and so's ammoniated super-phosphate, at forty-five dollars a ton; I bought the acid phosphate, the South Carolina rock super-phosphate, at twenty-four dollars a ton; and I got just as good a crop from one as I did from the other. How do you account for that?" I do not account for it, but I notice that in some sections where that thing has been going on, the ammoniated super-phosphate trade has been growing less and the acid phosphates have been growing into demand. There comes in the practical sense of the farmer himself. Scientific men will say they are exhausting the fertility of the soil by using phosphoric acid. That is their lookout, not mine. My lookout is to furnish them what they want, and if they are getting good results from that class of goods, that is the kind of goods that the manufacturer will make.

Mr. Augur. I have been very much interested in this whole discussion, and it seems to me that we all agree on this one point: that we need all the stable manure that we can make—the more the better. Those of us who can buy stable manure from grain fed horses, without paying too high a price, would like to do it; we believe in it. I believe that the mechanical effect of stable manure is excellent upon the soil. But, admitting all this, as Mr. Hubbard has so justly remarked, we need something more. We find in Middlesex county that all our farmers who make farming profitable, in addition to what manure they make upon their farms, make a large investment for commercial fertilizers, and the question is, what shall we buy? Well, if I understand the matter rightly, (and I think I had it from Prof. Johnson and Prof. Atwater,) we need not feel at all afraid of putting in too heavy a stock of phosphoric acid and potash, for if we do not use it all this year, it will be there years after. Like a deposit in the bank, we can surely draw from it. It is not exactly so in regard to a surplus of nitrogen; it is a little more volatile. If we do not draw it from the soil, it is liable to leach out or evaporate, and it is less certain to remain in the soil than either of the other two elements.

Now I would like to add my testimony to the value of Prof. Atwater's experiments. I had a set of his experimental fertilizers, and I must say that I learned a great deal from it, and in consideration of my own experiments and those of a great many others, I was led to adopt the ideas that Prof. Atwater suggested, to some extent, which have been already brought out, in regard to the corn crop particularly. I may not state the figures exactly, but if I understand it rightly, in every instance, in a large series of experiments, a one-third ration of nitrogen paid a profit; a two-thirds ration, in some instances, if I remember rightly, paid, but in more instances, while it augmented the crop, yet it did not pay a profit; the cost of the extra one-third of nitrogen exceeded the increased value of the crop. A full ration of nitrogen was found still more unprofitable. I cannot state exactly in regard to the result of a full ration of nitrogen, as my memory is a little treacherous about figures; but I was going to tell of a little experiment that I tried, after having adopted that idea. I have a peach orchard of some eighteen hundred trees which is on a high hill, to which it is very difficult to haul any considerable quantity of stable manure, and we have depended for fertilizing that tract largely upon commercial fertilizers. The year that I planted out that orchard, I planted nine acres of the eleven with corn. I used the rock phosphate, which cost some twenty-eight or thirty dollars per ton, and for my potash I used a high grade muriate, which I supposed to be, and still think to be, the cheapest form in which we can get it; and for the nitrogen I used what I was led by Prof. Johnson and others, through our experiment station, to believe to be the cheapest source of nitrogen, Peruvian guano, but I was a little cautious not to use an over dose. I had a very satisfactory crop of corn on rather cheap land, a crop on which I could figure out a very handsome profit. While I believe with our friend Webb in making our soil better constantly, if we can, in making a crop like the corn crop, save the most expensive element which we have to buy, that is, the nitrogen, and get a satisfactory crop at a profit, I believe it to be policy to do so; and, as has been remarked here before, I regard Prof. Atwater's experiments in that line as having done us farmers a great deal of good.

Mr. Inglis, of Middlefield. I for one have been very much interested in what has been said here to-night, and with your permission I would like to make one or two remarks, as I know something about some of the experiments that have been alluded to here. I would just like to make one remark, however, in regard to those who use commercial fertilizers, of whom it has been said that they leave their land in a poverty-stricken condition for those who come after them. There may be exceptions to the rule, but as far as my observation goes, those who use commercial fertilizers the most are those who have their land in the highest state of cultivation. Notwithstanding this remark, my last instruction to my men this morning was to go to work raking leaves in the woods.

There have been a number of questions asked here by some gentlemen who have not used commercial fertilizers at all, in reference to the best fertilizers to be used upon corn and upon other crops. I have been exceedingly pleased to hear the remarks by the lecturer, Mr. Hubbard, in reference to his experience with Prof. Atwater's manures, and also with the remarks of my friend deacon Augur, and I do feel like saying that when I heard the reflections, as I thought, cast upon Prof. Atwater this morning, I felt a little like putting a bee in that gentleman's hair. I do not know very much about commercial fertilizers, sir, but for nearly all I do know about them I am indebted to Prof. Atwater. Here is one gentleman from Middletown; here is another from Middlefield, in the immediate vicinity of Middletown; there is another from the immediate vicinity of Middletown, who have experimented with Prof. Atwater's sets of fertilizers, at his request. He has urged us to do it. I think I have hardly ever met that gentleman when he has not asked me, "Can't you take some of these sets? Can't you do something to help on these experiments?"

I will just say one word in reference to some experiments made by me, at his request. Some years ago, he got out a number of sets of fertilizers. I presume most gentlemen know what I mean when I say that. There was phosphoric acid alone, potash alone, nitrogen alone, and the different ingredients mixed in various proportions, and there were others besides. Where I used the phosphoric acid alone, it was much superior to anything else. One of my neighbors, an enterprising farmer, says that the potash went far ahead of anything else with him. A man living only about a mile from me applied the same set of fertilizers that I used, and his experience was that the sulphate of potash went far ahead of the others. So that, as has been said by Prof. Johnson and a great many others, we have got to find out what we need for ourselves. I will say that in my experiments I used phosphoric acid on my land, applying it to different crops and in different places, and the result was the same in reference to corn and turnips; the same on low land and on high land. As the result of these experiments, instead of buying a high grade fertilizer, containing a large proportion of nitrogen, I select that which is highest in phosphoric acid. I do not know whether I have fully answered Mr. Webb's question. In reference to manufacturers of fertilizers buying up dried blood, there has not been that importation of guano into this country of late years that there was previous, so that these men have had to obtain their supply of nitrogen from other sources.

Mr. Smith. I want to ask Mr. Augur a question or two in reference to his experience in raising that crop of corn on about nine acres, as I understood him. Did you apply this commercial fertilizer that you referred to to the whole nine acres on which you raised the corn?

Mr. Augur. I did.

Mr. Smith. Could you be certain that that application was beneficial to the corn? Not having left any part of that field without that application, how could you know certainly that the fertilizer which you applied to that corn was so very beneficial?

Mr. Augur. I am aware that I should be considered lame in that point, but I applied that fertilizer broadcast, which I think is the best way to apply fertilizers, and I was so confident, from previous experiments on the same kind of land, that phosphoric acid was what my corn crop needed most, that I made a liberal application of that, for two reasons: I calculated to apply more than my corn crop needed, for I had a peach orchard coming on, from which I have picked fruit the past seven years, and I did not feel afraid to put in phosphoric acid rather liberally. But I admit the force of the suggestion made by the gentleman; I should have left a row or two without any application; but I have seen the difference so strikingly, that I know that on most of my land phosphoric acid is the element that I want more than anything else, perhaps. As I remarked, I made the application broadcast, and I think there is a great advantage in applying commercial fertilizers liberally enough so that you can afford to put them on broadcast. If you put a spoonful of super-phosphate in a hill of corn, how long is it before the roots of the corn have gone away from it and covered the whole ground. I believe that in top-dressing our orchards, or in manuring our corn fields, or, in fact, almost anything else, the very best way to apply any fertilizer is to do it broadcast over the entire surface.

Mr. Gold. Mr. Sedgwick says that the farmers on the Harlem road have been shipping milk for some twenty-five years, that they have been buying considerable quantities of grain, and that their farms have not improved, but have deteriorated under this practice, and hence that the purchase of grain does not tend to improve the fertility of farming lands when managed as they commonly are. I somewhat question his statement that their farms have deteriorated; on the other hand, I think they are as productive to-day as they were twenty-five years ago. The farming that was practiced in that region twenty-five or thirty years ago was very largely sheep husbandry, the fattening of cattle, and the raising of grain both for home consumption and for export. This raising of grain caused them to plough their fields extensively, and they got large crops of timothy and clover for a short period succeeding this ploughing of their fields. We know that sheep husbandry, properly conducted, increases the fertility of the land; so also does the fattening of cattle. Now that they have gone into the milk business, they have ceased to plough, to a very great extent, and perhaps to some extent the crops of grass are diminishing from the neglect of ploughing; but the opinion of farmers in our vicinity is that their lands are in a more fertile condition to-day, have more capacity of production, than they had thirty years ago, and are really producing more. We have had a succession of unproductive seasons the last five or six years, and they are no criterion of the grass-producing capacity of Litchfield, or Duchess county. We must take that into account. With a return of good seasons, it is my opinion that the Harlem valley, through Duchess county, will show that it has not deteriorated under the system of purchasing grain and selling milk. I merely wanted to suggest this correction of Mr. Sedgwick's statement.

Mr. Sedgwick. Mr. Gold, in the main, is undoubtedly right, but it is a fact—I have it second-handed, but from excellent authority, Mr. Reed—that they do not raise so much there, they do not get as large crops of hay, as they did twenty-five years ago. It may be due to the fact, as Mr. Gold suggests, that they do not plough their land as much as they used to, that they do not cultivate their land. I cannot speak of that section called the "oblong valley," but so far as the lower part is concerned, say from Pawling down, where the land is more gravelly and hilly than it is in the eastern part of Duchess county, I have heard others say that their crops are not so large as they were before the introduction of the milk business; but how largely it is due to the seasons, or to the fact that they do not plough as much as they did formerly, I do not know; but I think probably that does affect the question largely.

Mr. Robinson. For nearly thirty years I have been experimenting more or less with commercial fertilizers. I have used different kinds of guano, bone, and a great many of the super-phosphates of lime. With the guanos I was generally successful. I have had several kinds of super-phosphate that were nearly worthless, and other kinds that I have found very good. I have been so well pleased with them that I have come to the conclusion that I cannot farm it without super-phosphates on my soil, which is a gravelly loam, with a bottom of clay. I cannot plant, nor sow, nor do anything on my farm without it. I cannot even plant a row of peas, or a hill of cucumbers, or sow a bed of beets, without super-phosphate of lime, and if I did not think it paid I certainly should not buy it, for when I first began to use it it was pretty expensive.

Now, one gentleman inquired what kind of special fertilizer he should buy. I cannot tell him, any more than Mr. Hubbard could, but I would recommend to every farmer to make all the stable manure he can; and, furthermore, I would recommend him to use phosphates, if he cannot make stable manure enough. I suppose I am situated differently from my friend Mr. Webb. He lives where he can probably get stable manure pretty handy; I cannot. I can buy stable manure sometimes, but I have to cart it some two or three miles. It costs more to bring that stable manure to my farm than the super-phosphate does. I have used it on grass land and on all sorts of crops, and I am certain that it pays well. I would recommend every man to try one kind, and then another, to try different kinds, side by side, and see which produces the best results, and when he finds which kind best answers his purposes, if he can get it of a party who is reliable, let him stick to it, unless the dealer begins to cheat. As long as we have these analyses, we can rely upon these things, generally. I have been in the habit, of late years, of buying mine of parties who manufacture it in Putnam (Mr. Bosworth), and I must say I never have had occasion to find fault with them yet. Probably there are others who make just as good an article as they do, but they are reliable. They have had their phosphate analyzed and promise to keep it up to the analysis, and I believe they do; at any rate, I have used it a number of years.

Mr. WEBB. I apprehend that the two gentlemen, from the inference which they draw from the question I asked, misunderstand the position which I take. I think the use of special fertilizers is necessary to successful agriculture on every farm almost in the State; but in obtaining these fertilizers, if I can buy muriate of potash for the potash, phosphoric acid, and nitrogen, in their simple forms, and mix them myself, at a saving of twenty-six per cent., as I have done this last year, I think it is my duty and my privilege to do it; and in doing that I prefer to use a certain proportion of nitrogen. My object in asking the question which I did was to ascertain if it would not be advisable, in preparing special fertilizers, to prepare them so that they should contain as nearly as possible the constituents of stable manure.

In regard to taking up all you put down on your land, I hope the chemists never will succeed in teaching us how to do that, because the natural acquisitiveness of mankind would tempt them to take a little more, and the next generation would be worse off than I was when I bought my farm. I have had twenty-three years' experience with a run-down farm. I have been feeding it my level best for all that time, until you cannot hear a jingle in my pockets.

Mr. HUBBARD. I want to say one word in relation to the ration of nitrogen used in these experiments which have been alluded to. Mr. Webb, I think, referred to it as a "double dose," a "big dose," an "extraordinary dose" of nitrogen, or something of that kind.

Mr. WEBB. That was the idea.

Mr. HUBBARD. I think that the largest ration of nitrogen used in those experiments was precisely that prescribed in Prof. Stockbridge's formula as the quantity of nitrogen that the corn crop would take from the soil, as I understand it. That was the largest proportion used in these experiments, and then two-thirds and one-third were used in comparative experiments. The result was, that the use of one-third of the normal, natural ration of nitrogen was profitable; that the use of two-thirds was sometimes profitable, but not generally so; and that the use of a full ration was never so in any experiment that was tried.

Now in relation to this general question of exhaustion of the soil. I am speaking of myself simply, but I propose to take from my soil more than I put into it, and I have very good authority to fall back upon. Messrs. Lawes and Gilbert have taken from a certain portion of their land sixteen bushels of wheat to the acre for thirty years, steadily, and put on nothing. Are they robbers? Is that experiment simply robbery?

Mr. Webb. I should hate to take their land after them.

Mr. Hubbard. Perhaps you would. I have an idea like this: that we are entitled to draw upon the soil for something every year; that every year the natural processes going on in the soil are developing a certain proportion of plant food, changing the inorganic constituents of the soil into conditions suitable for the plant, so that the plant is capable of using them, and that it is our right to take them; that we do not in any proper sense rob the soil by taking them, we do not destroy its fertility, we do not leave it in an exhausted condition, but that it is simply the natural yield of the soil, to which we are entitled. I do not think we are required either by a wise policy or by any moral law of obligation to those who come after us to give to the soil everything we take from it. We are obliged, I think, to put on the soil enough to maintain its fertility. That I propose to do as far as I know how. I do not propose to put on anything more than that. I do not propose to apply anything to my land with the idea that somebody who is coming after me, some fifteen or twenty years hence, may get some part of it.

Question. What kind of fertilizer do you use yourself?

Mr. HUBBARD. Almost everything. The one I like best is good finely ground bone, mixed with muriate of potash. I do not believe there is anything better sent abroad to put on grass or corn, only I want with it a little soluble phosphoric acid generally for corn. But for a general fertilizer I do not believe there is anything better in the market than a good article of finely-ground bone and a fair proportion of muriate of potash mixed with it. But I do not confine myself to any one article. I am always dabbling in some new thing, and generally losing a little money by it, but finding out a little something, I hope.

Mr. SEDGWICK. I was in hopes that Mr. Hubbard would answer, or least endeavor to give a satisfactory answer to Mr. Hurd's question as to what was the best fertilizer for corn. Now comes in the deficiency of special fertilizers, and it has two sides to it. Some maintain that a fertilizer made on the basis of the elements contained in the ash of the crop contains the elements sufficient to furnish food for the growing plant. Why is not that a good answer to give to Mr. Hurd? I will ask Prof. Johnson about that.

One other point. Mr. Hubbard speaks of a full ration of nitrogen derived from Prof. Stockbridge's formula or Prof. Vielle's. The experiments of Prof. Atwater show that with one-third of the ration, that is, twenty-four pounds, there was a profit made in applying nitrogen. The analysis of the corn plant showed that there was a much larger proportion of nitrogen in the corn plant. I would ask Prof. Johnson where the corn plant got its excess of nitrogen in that case.

Prof. JOHNSON. In a great many cases, the corn crop gets its nitrogen largely from the inverted sod, which is recognized in New England as an excellent basis for a corn crop, and in considering the supply or need of nitrogen that is to be taken into account. In answer to the question, "What is the best corn manure?" I should say, *there is no such thing!* Dr. Atwater's experiments cover, I believe, seventy-four cases. Mr. Inglis has told us that within a mile from him potash is the fertilizing element needed; whereas, on his land, phosphoric acid is the requisite. There are thirty thousand farms in Connecticut; when these experiments shall have been tried on thirty thousand farms, then we shall be in a position to answer the question statistically.

I have seen an account of a farm which for a dozen years or more was run by chemical manures alone. All the stable manure produced (and a good many cattle were kept), was sold off and commercial fertilizers were used instead. It was a large farm, under a regular and rather complicated eight-year system of rotation of crops, a thing which we do not know much about here in New England, and a very important factor, too, in the management of a large farm, when it can be looked after properly. That farm went on increasing in its productiveness during those dozen years, yielding annually a large amount of stable manure, which was sold to advantage to gardeners and others in the vicinity, who could not get along without it, or thought they could not, and "chemicals" and other fertilizers were purchased to make up the deficiency. That is a case that stands on record as a fact. It is not, however, the general rule. Mr. Lawes has been for forty years raising wheat on one field without the application of any fertilizer whatever, and he has proved that in its soil there are ample stores of phosphoric acid, of potash, and of everything that a heavy wheat crop requires, but only nitrogen enough to give about fifteen bushels to the acre. By adding a certain number of pounds of sulphate of ammonia or nitrate of soda, Mr. Lawes easily doubles the crop. He also doubles the crop by the application of stable manure; but he has to put on four or five times as much nitrogen in stable manure to get this double crop as is needful to apply in the shape of ammonia salts or nitrate of soda. That land is relatively destitute of available nitrogen. There are thousands of pounds of unavailable nitrogen to the acre in the soil, but the annual change of nitrogen from an unavailable to an available condition is only sufficient for fifteen bushels of wheat to the acre. But as these experiments go on, after a long period of time, doubtless, a change will come over that soil. Very likely the nitrogen will outlast the phosphoric acid, and after many years the wheat crop will fall off from fifteen bushels to ten bushels, and the addition of nitrogen will not double it nor help it, but phosphates having been exhausted must be supplied again in order to restore the present rate of productiveness. I have no doubt that the day is coming when Mr. Hubbard's land will have undergone a similar change—it may not be in his time, or in the time of his grandchildren—but if he and they continue to follow the suggestions of his late experience and use phosphoric acid as the predominant element of their fertilizers, his land will get relatively overstocked with phosphoric acid, and putting on more of that will then be as unprofitable as putting on "the full ration" of nitrogen is unprofitable now.

I may say not only that there is no best corn manure for all farms but that there is none for any one farm, taking all time together. If the addition of one-third of the full ration of nitrogen is now sufficient, and we need to apply also phosphoric acid and potash perhaps, but phosphoric acid predominantly, the time will probably come when there will be a surplus of phosphoric acid stored in that land, and when the yield will notably diminish unless the manuring is changed, and then a double dose of nitrogen will give a big crop, and nitrogen will be, or appear to be, the best corn manure. We have got to consider not only the conditions which now exist, but the conditions which we by our processes of cropping and cultivation are constantly producing. In the broad sense then there is no *best* fertilizer for any crop which we can formulate as suitable for universal use. Every man must find out for himself what are the immediate wants of his land, after a time, if we feed our land with the proper special fertilizers—Mr. Hubbard giving predominance to phosphoric acid, Mr. Inglis giving phosphoric acid, Mr. Inglis' neighbor giving potash, Mr. Webb giving what suits his case best—we may all get our lands up to that high condition in which we can go on with the same fertilizers, pretty nearly, for the same course of cropping just as in the past we have been going on with one fertilizer, viz., stable manure, provided our soils have and retain the good physical qualities to which the use of stable manure so largely contributes. Where the farmer is able to keep cattle and make plenty of stable manure, consuming his hay and bulky products on the land, and exporting only milk and concentrated products, potash accumulates in the soil.

If you will compare the composition of grain and milk, with the composition of ordinary plants, you will find that under that system you export nitrogen and phosphoric acid, but send away very little potash. Potash constantly tends to accumulate in the soil, being converted by the weathering process, from the unavailabe state in which it exists in rocks and earthy matters, into an available form, and under the system of the application of stable manure, it is constantly going round in a circle, from the land to the forage, thence to the cattle and manure, and back again to the land, as long as you feed your hay and straw, and simply export the milk and other animal products. If, on the other hand, you raise beets for the sugar manufacturer, or export bulky vegetable products, then there will be a constant drain of potash from the soil. The conditions which thus tend to alter the composition of your land, are all entirely within your means of understanding.

It appears to me that the farmer who correctly apprehends the principles of agricultural science ought to be able, after a few years of observant experience, to take a fairly accurate inventory of the available capital or crop-producing power of his farm, field by field, should also be able to reckon to within a few pounds the annual export of the several elements of his crops; should likewise follow with a close approach to accuracy the re-distribution of the stock of plant-food on the farm caused by the removal of the green crop from the pastures and meadows, the transfer of potash, lime, nitrogen, etc., to the plow-land in the stable manure, and finally, to reckon what kinds and quantities of plant-food must be imported to make good the export, and what must be purchased in addition to increase the fertility of the several fields, and of the farm, as a whole, to the highest point of profit.

I should say that the intelligent farmer, after some experience and study of his soil, might keep a practically accurate credit and debit account with the land which would make evident on the balance sheet what was needed in the line of fertilizers.

He would have to study the characters of his soil, its producing-power without manure, for various crops. He would have to consider the peculiarities of the crops which his circumstances would justify cultivating. He would perhaps need more full and exact knowledge of the habits, and make-up of the plants he grows, than can readily be found. He would easily see that between clover and timothy, as between potatoes and corn, there are wide differences of structure. He would ask for exact estimates of the comparative feeding power of these plants. He would demand to know the mass, the depth, the penetrating power of their roots, so that he could judge between his crops as now he can compare his animals in respect to their wants and their capacities.

A crop that has a short period of growth, or that grows very rapidly at some stage of its development, makes a different demand on the soil from one which has a long period of slow and steady growth. The former may not remove from the soil as much plant-food of any kind as the latter, but it may require a richer soil and more abundant nourishment, because it has the habit of rapid growth—it may demand more plant-food in a given time. The clover crop is one which, on soils favorable to it, requires no nitrogenous manures, but is able to supply itself with nitrogen from the soil and atmosphere. In many localities it is used as a manure for the wheat crop. The clover is a steadily-growing biennial plant, with a massive root-system which penetrates the soil deeply, and if cut or fed off in blossom, comes on with a heavy aftermath, and besides yielding a large amount of the best forage, leaves in the soil two or three tons per acre of roots and stubble. When the clover-ground is broken up and sown to winter wheat, the latter finds a rich manuring of clover roots which, the ensuing summer, fully sustains its rapid growth, while without such preparation the wheat crop would be a comparative failure.

The different kinds of plant-food have each a separate nature and history, and each is differently related to our crops. If you put potash or phosphoric acid on a soil of average quality, you need not fear that any surplus not consumed by the current crops will go to waste. The soil, if it be anything better than a sand-pit or a gravel-bank, will retain these elements with a firm grasp. It is otherwise with lime, with sulphuric acid, and especially with nitrogen. These substances are more freely soluble in water, and are therefore liable to be carried down or away by heavy leading rains. To conserve them against loss is as important as to restore them when deficient, and *amending* the texture of the soil, increasing its water-storing power by suitable tillage, by incorporating with it porous vegetable matters in stable manure or buried green crops, is a necessary part of any rational system of treatment.

To prevent waste of valuable fertilizing elements, there is no plan so simple and efficacious as constant occupation of the tilled land with living vegetation.

When the corn or potato fields have been harvested, why not break up the surface lightly with a horse hoe, and sow to rye, with fertilizers on poor land, if need be, and in spring-time turn under the young grain for another planting, rather than leave the ground to pack and leach under the latter and early rains.

These, and similar suggestive considerations, I believe justify us in concluding that we cannot fertilize by recipe, and that there is no best corn manure.

Adjourned to Thursday, at 10.30, A. M.

SECOND DAY.

The convention was called to order at 10.30 by Vice-President HYDE, who introduced as the lecturer Mr. Byron D. Halsted, of the "American Agriculturist."

FUNGI INJURIOUS TO VEGETATION, WITH REMEDIES.

By Dr. Byron D. Halsted,

MANAGING EDITOR OF THE AMERICAN AGRICULTURIST.

Fungi, the plural of fungus, is the name applied to a large class of flowerless plants, of which the toadstools and mushroom are the most conspicuous members. The group is very low, if not the lowest, in the scale of vegetable life. Many of the fungi are exceedingly small and can only be seen with the higher powers of the compound microscope. In some the whole plant is not more than 1-30000th of an inch in length. Many of the diseases of an epidemic nature, among both animals and plants, are caused by minute fungi; but before speaking of these I will endeavor to give a general idea of this peculiar group, and show how its members differ from other plants.

Unlike ordinary plants, fungi have no leaves, stems, roots, flowers, or seeds. Their structure is of the very simplest, being entirely cellular; that is, made up of little cells or sacs. A ready way to get some specimens of these peculiar plants for study is to place a piece of bread or cake where it may be kept warm and moist. In the wet weather of summer the housewife can oftentimes provide the desired fungi in the form of mould, of which many kinds develop on various foods with surprising rapidity. They by no means confine themselves to articles of food. While spending a summer at the sea shore, at the end of a week of very warm and wet weather, I took my Sunday suit from the closet, and found it covered from top to bottom with fine specimens of moulds; even the insides of my boots were blue with a forest of fungi.

When the mould first appears upon bread, it consists of a number of very minute threads, or filaments, much resembling a spider's web, which extend over and through the bread. These filaments increase in number until the whole surface is covered with a white cottony coating. Each thread consists of long, slender tubes, closed and joined end to end. These are the cells, and are filled with the matter which has been absorbed from the substance upon which the fungus grows. The growth of a fungus is the simple increase in size and number of the cells which compose it. These threads, composed of rows of cells, are called *mycelium*, and they answer to the roots of higher plants in that they take up the nourishment for the growth of the plant.

Like all other living things, a fungus provides for the reproduction of its kind; and in this respect it outdoes most forms of life, both in extent, and multiplicity of methods. As the formation of seed is the end and aim of flowering plants, so the production of spores is the final stage in the life of a fungus. Seeds and spores are for the same end, but in structure they are widely different. A seed contains a little plant or embryo already formed within the protecting seed-coats, while a spore is a simple cell, with a thick cell-wall, enclosing a mass of homogeneous matter called *protoplasm*. In germination the seed develops the young plantlet; the spore sends out a long and delicate filament. In the bread mould small stalks will rise in a short time from the cobwebby mass, and as they grow their upper ends will gradually increase in size and become dark-colored. In these enlarged tips the spores are formed, and when ripe burst through the covering and are carried away by any passing breath of wind, to form another crop of mould on some bread or other nourishing substance. In the common blue mould which grows very luxuriantly on many articles, especially cheese, we have the spores borne naked and in rows on branches which are quite regularly disposed near the tip of the stalk which bears them.

The spores thus far described are formed by a simple cutting off, or dividing up, of the fungus plant, and may be compared to the bulbs of "top onions," bulblets of the tiger-lily and some other flowering plants. All such methods of reproduction are called non-sexual. The sexual organs of flowering plants are the stamens (male) and pistils (female) of the flower, and a seed is produced only by united action of these two organs. In fungi, something similar, though more simple, occurs, the result of which is a spore, which, so far as it is produced by the action of two different parts, more nearly resembles a seed than does the kind first described. This spore is produced by the union of the contents of two cells to form a new one, which is thereby specially endowed with vitality and capable, under favorable conditions, of forming a new plant. These spores serve to keep the species over the winter or other trying times. The small, delicate, non-sexual spores, which are produced with such rapidity and in such great abundance, are for the rapid propagation of the fungus when circumstances are favorable.

The whole group of fungi is wonderfully strange in all its ways. From the common toadstool, which has the reputation of a most rapid growth, to the small microscopic yeast plant that aids the housewife to make light bread, they are all peculiar and interesting. Some are not only fit to eat, but furnish the most delicate morsels to the human palate. Others are our worst enemies, in the shape of human diseases, striking down their victims as a plague, while still others find a field of activity in our grain and other crops, blighting and rusting them until they are almost worthless. The catalogue of complaint that could be laid at the door of fungi is a long one, and the worst of all is the unobtrusive manner of their working, undermining where all without seems strong and healthy. The deadly blow is frequently struck long before the outward effect is apparent, and the victim is beyonp recovery before the "disease" is known to be at work.

Spurred Rye or Ergot.

One of the strangest of the injurious fungi which work upon the Farmers' crops, and do much to destroy them, is the Spurred Rye, or Ergot (*Claviceps purpurea*). This fungus has long been known, and the trouble it has caused to agriculture and to the human family is beyond computation. Like most other fungi that prey upon higher forms of vegetation, the ergot has its favorite place upon the plant it has chosen from which to derive its nourishment; in this case it is the grain. Though several species of the grass family develop ergot, it is most frequently found upon the rye. From this fact it has long been called *Secale cornutum*, the Latin for "horned rye." These common names, "spurred rye" and "horned rye," come naturally from the horny texture and peculiar shape of the fungus when it has completed its growth. There is a decided resemblance of the affected or ergotted grain to the spur of a cock, it being hard, pointed, and somewhat curved. It attacks the grain while it is quite small, and changes its soft substance, starch, etc., into a horny material abounding in a poisonous matter, with a heavy and disagreeable odor. The spurred rye, when fully developed, contains not far from 30 per cent. of an oil to which the offensive odor is largely due.

It is impossible to consider the methods of propagation of this fungus without the necessary figures or illustrations, but suffice it to say that spores are formed in large quantities upon the surface of the young growing ergotted grain, and as they drop off and float to other grain, the trouble is rapidly propagated. A second form of spore is developed in large quantities from the full-grown ergotted grain, after it has remained dormant for some time and is brought into favorable conditions of heat and moisture. This is the winter state of the fungus—a state that is common to many other species of this lowly organized group of plants—and when spring comes the spores are formed in great quantities, and the work of propagation of the ergot, and of destruction, is again begun for another season.

Ergot possesses remarkable medicinal properties, and when properly used has been of great benefit in the practice of medicine. It has been a much abused drug, and the evils which it has caused in the hands of unscrupulous practitioners and quacks, weigh very heavily against the good it has done. Ergot, as has been stated, occurs on several pasture grasses, and when eaten by cows has caused abortion, sometimes to an alarming extent. It has long been observed in England that this complaint in the dairy was in some way associated with old pastures upon which the cattle had fed. The ergot appears only in the heads of grasses, and upon newly seeded land the stock keep the growth short, and few or no plants run to seed; while on old pastures, frequently a large per cent. of the surface bears ripening heads of grass. As a precaution, the heads should be cut by going over the pasture with a scythe or mowing machine, as soon as they show themselves. Other precautions, such as removing the animal, which has suffered abortion from the rest of the herd, etc., do not fall within the province of this lecture.

Ergot has been frequently eaten (without knowledge) by the human subject, when it was present in rye that had been ground and made into bread, and with the most dreadful results. In some countries in Europe, where rye is the staple food, and after an unusually moist season, when the fungus has been abundant, epidemics of ergot poisoning, or ergotism, have raged with much loss of life. The person ergotized suffers convulsions, followed in some cases by loss of limbs by gangrene, and ultimately death. There is little to fear in this country, as we are not a rye-eating people.

THE POTATO ROT.

There is probably no disease of cultivated plants that has caused so much suffering to the human family as the "wet rot" in potatoes. This disease occurred in a most violent form in 1842, and again in 1845, when it spread over a great part of the United States, Great Britain, Ireland, and portions of Central Europe, causing a partial or entire destruction of the potato crop, and with it untold amount of suffering to those people who rely largely upon the potato for their daily food.

It has been known to botanists for thirty years that the potato rot is caused by the growth of a microscopic fungus, known to science as *Peronospora infestans*. It is a near relative of a number of parasitic fungi of the same genus, which prey upon other agricultural plants, such as the grape mildew, (*P. viticola*), lettuce mildew, (*P. gangliformis*), etc. This fungus first manifests its presence as a frost-like covering on the under side of the foliage of the potato plant, soon causing the leaves to curl; and so rapid is its destructive work at times, that in a few hours the green and vigorous vines are changed into a brown mass of decaying vegetation. Next after the leaves, the stems are attacked, and from them the disease passes down to the tubers, where it does its greatest work of destruction.

The fungus consists of a number of very fine threads, which grow in all directions through the tissue of the tuber, and, absorbing nutriment for its growth from the tuber, it induces a decay that is rapid in its work, producing a worthless and disgusting mass of rotten vegetable matter. As a general thing, the disease is of a milder type, and only a few leaves or a few plants may at first be attacked, from which, if left alone, the rot spreads until the whole field is more or less affected.

The rot makes its appearance from the first to the middle of August, and is always associated with rains; that which is called "muggy" weather being most favorable for its development.

In midsummer, the farmer should be on the watch for the brown spots on the leaves, and, as soon as found, the crop should be harvested; any delay will allow the fungus time to spread to the stems, and from them down to the tubers, and then, should there be a damp spell, the potatoes are quite sure to rot. After digging, the potatoes should be placed in a cool and dry place, thus surrounding them with conditions the most unfavorable for the further growth of the fungus that may be already present in the substance of the tubers.

With a knowledge of the time of year that the fungus makes its attack, it is evident that, by growing quick-ripening varieties and planting them early, the crop may be gathered before the time for the rot to come. On this account, in particular, the growing of early sorts is recommended.

As a precaution against the propagation and spread of the fungus, the vines of all the potatoes should be gathered after digging and burned, thus destroying many millions of minute spores that would otherwise remain to cause further trouble. Any tubers that are at all affected should be thrown out, and either fed to stock or burned. The storing of one such potato may communicate the rot to the whole bin

The Potato Disease in Europe.

The heavy losses which the farmers of Great Britain have experienced during the last five years from the potato rot, have given rise to serious doubts whether this valuable crop can be grown with profit in European countries in the future. Like every other agricultural trouble, this one stimulates thought, and leads to new methods of culture, that are experimental, and it may be beneficial. Of late much attention has been directed towards the finding of a "disease-proof" variety of potato, or at least the production of sorts, that though attacked by the rot, are able to withstand it, and not be seriously injured. To encourage this work of finding out the best kind of potato, prizes have been offered at different times, and elaborate experiments, to test the varieties, have been carried out, without any very satisfactory results. But a great deal of good has grown out of this seeking for a disease-proof potato, especially in the way of improving the varieties through carefully selecting the tubers, and their proper cultivation. Knowing that the disease is a parasitic fungus, the development of which is favored by warm, moist weather, and hindered by the opposite, there is little hope of finding a variety of potato that will differ so materially from all others, that it will be proof against the attacks of this fungus. There are, nevertheless, certain precautionary measures to be taken. These are embodied in brief, in an English treatise on the disease. I take the following: "Secure good seed if you can, entirely free from disease. Plant early—on light land, five inches, on heavy land, three inches deep—and earth up well. Have the rows from two feet eight inches to three feet apart in gardens, and three feet or more in the field, for late varieties; may be rather less for others. If there is danger of frost, cover along the rows with short litter, about enough to hide the plant from view. Plant, if possible, in land not occupied by the same crop the previous year; and plant the late kinds if possible in a field by themselves. Use medium size sets, or cut sets if large, about twelve to eighteen inches apart in the row, according to size. If the sets are very small, they need not be so far apart. Manure in autumn, and use potash salts or bone phosphate in the spring; or else make a compost of manure, earth, ashes, etc. Earth up twice. The tops may be cut off of those required for seed, if the tubers are large enough. Harvest late kinds sooner than is usually done. If there appears any disease amongst the crop, sorting over will be required. If you have the convenience, store your crop for a time, and not put in pits until November. On harvesting, separate the diseased from the healthy ones." The direction given to "earth up twice," is not needed with us; while in the moist climate of Britain, the crop is benefited by "hilling;" the conditions are quite different with us, and, unless in a very wet summer, flat culture gives better returns.

While the potato crop is an important one with us, its failure does not bring such consequences to our farmers, as it does to the Irish peasant, whose life, and that of his family, may be said to almost depend upon the success of their all-important potato crop.

The Wheat Rust.

The farmer who sees his hard-earned grain, almost ready for the harvest, shrink to worthlessness at the withering touch of a destroyer, naturally asks the important question: "What is this so-called rust that covers my hands and clothing with an orange-colored powder?" It is a minute fungus known to botanists as *Puccinia graminis.* With the statement that the rust is due to a minute parasitic vegetable, let us endeavor, with the aid of the microscope, to more fully understand its real nature and its habits of life.

To begin at the proper place in the life history of this fungus, we must observe that grain stubble, in autumn, is often covered with small, black, or dark-brown streaks, which might be easily mistaken for weather-stains. If the whole plant had remained upon the ground, the leaves and stalks would have had these same dark patches and lines upon them. The dark spots are due to a vast multitude of dark colored spores which have developed from the interior and ruptured the epidermis, or skin of the leaf and stem. These are the winter spores and germinate in early spring, each one producing a crop of smaller spores. These spores find their way to the leaves of the barberry, and if there are no barberry bushes, it may be to some other plant, where they germinate, sending their filaments into the tissue of the leaf, and in the course of a few days a yellow spot is formed on the barberry leaf, and shortly after a number of minute cups are formed from the bursting of the epidermis of the leaf. As these cups are close together they are often spoken of as "Cluster Cups." Each cup is packed with spores which are formed in rows and break from their attachment, and are carried away by the wind. These spores soon find their way to the growing wheat, upon the leaves and stems of which they germinate and send their absorbing threads through the plant tissue.

After a short time these threads congregate at certain places near the surface of the wheat leaf, and, in enlarging rupture the epidermis, rapidly ripen the myriads of yellow spores which give the rusty color to the parts affected, and the common name of rust to the fungus. From these filaments, and in these same spots, the brown spores appear later in the season and close the cycle of changes of this polymorphic fungus.

This is a rather complicated story, but it will be understood if we compare this rust fungus to an insect which presents itself in the very unlike states of caterpillar, chrysalis, and butterfly. As the insect has to pass through these several stages to complete its career, so does this wheat fungus assume these unlike forms, living in one state upon one host-plant, and in its next stage upon another, until it has completed its round. From the fact that the plant in its different states is very unlike in appearance, such fungi are called polymorphic. It is not very long since the different states of this fungus were each regarded as different fungi, and have been described as distinct species. That the presence of barberry-bushes in the vicinity of wheat fields had a direct relation to the occurrence of rust, has long been maintained by grain growers. Indeed, so strong was this belief that it has been incorporated into the laws of some states, which have legislated the barberry out of existence. It has been asserted that the rust was due to the pollen or flower-dust of the barberry, and scientific men in denying the possibility of this, have, on their part, erred in asserting that the barberry could have no influence on the wheat. This is one of many illustrations of the fact that a popular notion has a real foundation, and a scientific investigation, while it shows this to be the case, often demonstrates the popular reasoning to be at fault. Thus the popular notion that the barberry had an unfavorable effect upon wheat was right; ascribing this effect to the pollen of the barberry flowers was wrong, and it remained for the scientific investigation to show the real relation between the barberry-bushes and the wheat rust. The fact that the barberry does not grow in all places where rust occurs on wheat, has been presented as disproving the relation between the two, but it must be remembered that we are dealing with fungus spores, excessively minute bodies, so light and airy that they go with the wind and may be carried to great distances. We must not overlook the fact that a single "cluster cup" may produce half a million of these spores, and that there may be a thousand of these "cups" upon a single barberry bush. I have seen whole rocky hillsides devoted exclusively to the growth of these "cups," so to speak, where the barberry which clothed them was so affected as to give a rusty color to the entire landscape. Such a locality is a hot-bed for the propagation of wheat rust for the whole country.

Remedies.—The destruction of the barberry in wheat-growing districts seems to be imperative. It has been recommended for an ornamental hedge, and is well suited to this use, but there are other shrubs quite as ornamental for this purpose which have not the unfortunate failing belonging to the barberry. No one should willingly cultivate a shrub which may injure his neighbor's crop of wheat. By destroying the barberry we materially reduce the means by which the rust is propagated. The burning of the wheat stubble will destroy the dark winter spores which carry the pest over the winter season. It goes without talking that if we kill all the rust spores there will be an end to the rust, and to do this there must be concerted action on the part of all farmers by destroying all barberry-bushes and all grain stubble. This is too much to hope for until we are driven to it, and until then we may expect the rust to make its appearance about the time the grain is filling, and will be the most fatal if there is a series of showers with alternate hot sunshine, thus providing the most favorable conditions for the propagation and the development of the fungus. These conditions, over which we have no control, will decide in a great measure whether the elaborated nourishment shall be turned into a crop of worthless golden rust, or go its natural way and produce a harvest of grain.

The Corn Smut—(*Ustilago maydis*).

The smut in Indian corn, which has long been an annoyance to farmers, is a fungus, and therefore a minute parasitic plant, which, instead of growing from the soil and elaborating its own food, vegetates in the growing tissue of the corn plant, and robs it of its nourishment. It is difficult for any one to tell, owing to its minuteness, just when and where the smut plant begins its growth upon the corn; it may be that the spores, as particles of the smut, cling to the grains of corn and are planted with them. As the moving air is known to be constantly carrying invisible fungus germs from one place to another, it is more probable that they first reach the corn plant in this way, and enter it by germinating upon the surface and sending the young threads into the substance of the stem and leaves. After growing for a time, the parasite prepares for the production of a new crop of spores, by means of which the smut plant is perpetuated. This it does by first accumulating a mass of threads in certain favorite portions of the plant, usually the young grains of growing corn. At first the affected grains are noticed of unusual size, followed shortly by a darkening of the interior, together with a constant increase in size, until at last the grain has assumed large dimensions, is soft throughout, and made up almost entirely of black spores. On account of the ears of corn being covered with husks, the early stages of the smut are not seen, and the first that is observed is the black, worthless mass that is the final stage of the parasite. The production of spores is not entirely confined to the grains, but they frequently make their appearance in the male flowers, situated at the top of the stalk, and comprising what is commonly known as the tassel. The number of spores that a single smutted ear will produce is almost beyond computation. Corn smut is injurious to animals if eaten by them to any considerable extent; it acts both as a poison and mechanical irritant. Moist seasons are peculiarly favorable to the development of the smut plant; therefore it is much more common one season than another. A large number of the plants belonging to the grass family are more or less affected by various kinds of smuts. Specimens of smut upon the oat may be gathered in almost any field of this grain; the abundance of it varying in different localities and from year to year. The presence of a smutted grain in a field is in just so far a loss, and if in large quantities it is a positive evil to stock that feed upon it. A preparation is made from smut which is a powerful medicinal agent, and is employed in place of ergot, or "spurred rye," the parasitic fungus which grows upon the rye. This latter is a well-known cause of abortion in cows, and a similar result may be expected from the various smuts when eaten in large quantities.

All persons who suffer from smut upon their grain desire to know the remedy or remedies, and this is a part of the subject very difficult to treat. The smut plant is so small in its beginnings, and also so rapid in its growth, that its presence is not known upon the grain until its destructive work is done. If the smut enters the plant from spores which cling to, and are sown with, the grain, it is to be expected that a thorough cleaning of the grain would be a proper precaution. The application of any substance that would kill the spores and not injure the grain naturally suggests itself. The soaking of the grain in a solution of sulphate of copper (blue vitriol), followed by an application of lime, has proved of value. Precautionary measures of this nature are all that seem to be within the reach of the farmer. If the spores can be kept from finding their way to the growing grain the smut will not appear. With corn the best way to rid the field of smut is to pass through it and gather and burn all the affected ears and stalks. In this way the many millions of spores are kept from being spread and continuing the pest. With the smaller grains, as wheat and oats, this method, though it is the most effective, would probably be impracticable.

The Onion Smut.

A few localities in the Eastern States have long been known as the centers of the onion crop. In some of these, where the onion has been the chief product for the last half century, the culture has within the past few years greatly diminished, and in some cases it has been altogether abandoned. This change is due to the appearance of a destructive pest in the form of a fungus known as the onion smut. This smut makes its appearance while the onions are quite small, and if they are not entirely destroyed, are of very little value. A careful examination of a diseased plant in the early stages of the smut, shows that the fungus consists of a multitude of small filaments, or threads, collected in knots and stringy masses within the substance of the onion leaves and bulbs. At a later period a vast multitude of dark particles are found; these are so fine that they can only be seen in a mass as a black, dusty powder. At this time the skin of the leaves becomes broken, usually in long, narrow lines, and this dust, which is really the spores of the fungus, is set free. Unlike the rusts, the smut fungus is not believed to pass in its development through distinct states or forms, upon widely separated plants, and, therefore, for its prevention we do not have to look outside of onion plants. It is generally supposed that it has come from the wild onion, or garlic, and, therefore, in the extermination of all such wild plants in the region a remedy may be found. When the smut has been allowed to perfect itself, the soil is more or less filled with the spores, and gives truth to the expression among afflicted onion growers, that "the disease is in the ground." The question of ridding the soil of the onion smut resolves itself into simply this: "How kill the spores therein?" Manuring the land, and giving it the highest culture, and continuing the growing of onions, will not do it. It may be that by so doing the smut will not be very troublesome, simply because strong, healthy plants are better able to withstand its attacks. This is a law which holds good with diseases in general; the better the health—the more vigorous the subject, the greater the vitality; the less disposed is the subject to disorders.

But this is not the best way to treat the onion fields that have been smutted, because they are usually already under good culture. There seems to be but one way—cease growing onions on the land for a term of years sufficient to exhaust the vitality of the dormant smut spores in the soil. Grow other crops, and in the course of four or five years the smut spores will have died. At present, the trouble is not wide spread, and knowing the fatal nature of the pest, every precaution should be taken that its limits be not extended. Those buying and selling seed should bear this in mind, for a little care in not taking seed from a smutty locality may make thousands, if not millions, of dollars difference in the great and growing onion interest of our country.

THE BLACK KNOT—(*Sphæria morbosa.*)

The conspicuous excrescence often found upon plum, and wild and cultivated cherry trees, and well named the black knot, is an old enemy to the fruit-grower. From its destructive nature it early received the attention of scientific men, and much has been written and said upon this subject, in fact, much more than was really known. Some have claimed that the knot was caused by insect stings, a form of gall, in nature like those on the oak, willow, etc. The fact that the knots—especially the old ones—frequently contain insects and their eggs, remains, etc., was accepted as evidence that such was the case. Though many investigators have found a fungus present in the knot, it having been first described by Schweinitz, in 1838, yet, until the recent and thorough investigation made by Professor Farlow of Harvard University, all doubt of fungus origin was not cleared away. The following are his reasons for believing that the disease is not caused by insects: "First, the knots do not resemble the galls made by any known insects. Secondly, although insects, or remains of insects, are generally found in old knots, in most cases no insects at all are found in them when young. Thirdly, the insects that have been found by entomologists in the knots are not all of one species, but of several different species, which are also found on trees that are never affected by the knot. On the other hand, we never have the black knot without the *Sphæria morbosa*, and the mycelium of that fungus is found in the slightly swollen stem, long before anything that could be called a knot has made its appearance upon the branch; and furthermore, is not known to occur anywhere except in connection with the knots."

The black knot is most conspicuous in the winter season, when the trees are free from foliage, and they range in size, from half an inch, to a foot or so in length. The excresence does not usually surround the branch, but, growing from one side, often causes the branch to bend away from that side, or twist it into an irregular shape. When the knot is a large one, it usually kills the branch, or continues to spread up and down from the old knot, until death comes to the branch. In the spring the affected part increases rapidly in size—one might almost say puffs out—and the whole, growing larger, becomes thick and soft; a rupture of the bark soon follows, and the soft substance coming to the surface expands rapidly, and is soon coated with a characteristic greenish color. All this time the threads of the fungus have been increasing rapidly; in fact, the swollen substance is made up largely of these threads, and as they develop and become exposed by the rupture of the bark multitudes of the spores form on the ends of filaments. This takes place about the time the plum and cherry trees are in flower. These spores continue to be formed, until midsummer, when a new development begins, which is for the production of the winter spores. As autumn approaches, the black color develops, the outer surface hardens, and frequently the interior soft substance is destroyed by insects, and only a shell remains. In this crust are small nodules or protuberances, on the inside of which a multitude of small sacs are attached. These spores are not fully developed until very late in the season. The choke cherry (*Prunus Virginiana*), is a favorite home for the black knot, as the neglected fence rows in winter show. Next to the choke cherry, in the severity of its attacks, are the cultivated varieties of cherries and plums. "The Morello cherry is more susceptible than any other variety, and next in order comes the Mazzard." Some varieties are free from the knot.

Remedy.—Like all troubles caused by fungi, the black knot is contagious, and is propagated by the millions of spores it produces, one crop of which is developed through the spring and summer, and the other in the late autumn. The knife is the remedy. Cut off the knots, wherever and whenever found, and burn them. This can best be done in autumn, after the leaves have fallen, and the knots are exposed to view. The choke cherry bushes and trees might better be cleared away entirely, if situated near plum or cherry orchards.

The Apple-Leaf Fungus—(*Rœstelia cancellata*).

Observing upon a neighbor's apple tree leaves that were turning crimson in spots, I picked some for examination. A friend, noticing the spots, remarked that he supposed "there would be swarms of insects coming out of those blotches before long." Deformities of plants are no doubt generally ascribed to insects, and very naturally, as in many cases the abnormal growths, such as the various galls, oak-apples, etc., are caused by insect stings. There seem to be three general classes of diseases, or troubles, among plants: 1. Those caused by insects, and therefore of animal origin. 2. Those which arise from vegetable parasites, the most common ones being members of the fungus group. 3. A class which, so far as I know, is due to neither of these two. A group of true diseases, where the plants are "out of health"—a real sickness, brought about by one or more of a multitude of different and often unknown causes. The leaves of the apple tree are doubtless infested by a fungus, which has been known for a long time, though it is not fully understood even now. It has been stated that there are several stages in the life of the wheat rust-plant, in one of which it is on the barberry. The fungus on the apple leaf belongs to the same group, and is the "cluster-cup" form of the species, resembling the "barberry state" of the wheat rust. The cup is deeper, the neck extends much further above the surface of the leaf, and is more finely fringed about the edges, but in a general way a description of the one will answer for both. If these "cluster-cups" upon the apple are but a form, or a single stage of some fungus, the question naturally arises: on what plant (or plants) does the other form (or do the other forms) appear? This question has been an interesting and difficult one for students of these subjects; but it is generally considered that the "cedar-apples" of the red cedar—those bright orange masses which appear in spring after a shower, or during a long rain, and are sometimes taken for the flower of the cedar, and frequently eaten by children as the fruit—are caused by the same fungus, this being the last stages of the species. Not long ago I saw an apple tree that was growing with its limbs interlocked with those of a cedar, and on those limbs the fungus was unusually abundant; in fact, the leaves were so covered that there was scarcely room for another "cup," while the other trees of the orchard had only the usual amount. The cedar tree was also more infested with the so-called "apples" than others in the woods near by. Besides attacking the leaves, and thereby injuring the fruit-producing power of the tree, the fungus attacks the fruit itself. Prof. Wm. H. Buckout of the Pennsylvania Agricultural College gives an excellent example that has recently come under his notice.

To quote Prof. Buckout's remarks: "Mr. Washington Campbell, of Linden Hall (Center Co., Pa.), brought me the leaves and fruit of the apple locally known as the 'Pound' (Fallawater of Downing), upon both of which the 'cluster-cups' were thickly scattered. Those upon the fruit were in patches about the size of a small coin, and most frequently found upon the 'eye.' Sometimes, however, they were upon the side, and unconnected with either the 'eye' or stem extremity. The flesh of the apple was somewhat discolored in places, and rather hard and knotty in lines running to the core. The fruit was thus unfitted for use, and when attacked became stunted and one-sided in its growth. Mr. Campbell's apple crop was very materially diminished by this means. Many of the 'cluster cups' upon the fruit were longer and larger than those upon the leaves. This was very distinct to the unaided eye. A second point of great interest to fruit-growers is the connection of the 'cedar-apples' with these 'cluster-cups.' I am glad to be able to add evidence which is so conclusive that in my own mind there is no longer any doubt of the specific identity of the two forms which are apparently so different in their nature. The trees from which the specimens were taken were rather closely set, young and thrifty. Two red cedars were growing very near them. One was small, and upon it were found a half-dozen of 'cedar-apples'; the other was a moderate-sized tree, upon which were very many. Upon the apple trees nearest the cedars scarcely an apple or a leaf escaped infection. A few rods off was an older orchard, separated by a narrow roadway; only an occasional apple upon these trees showed the fungus. It appears as if the 'Pound' apple was more susceptible to attack than other kinds; for one or two trees of other varieties, and apparently equally exposed, showed less of infested fruit."

Two practical methods of destroying the pest are suggested. In the spring gather and burn all the cedar-apples—if it is thought best to not sacrifice the cedar trees, and in the autumn rake together and burn the apple leaves.

The Peach Curl Fungus.

Soon after the peach leaves unfold from the bud, and before they have reached one-half their natural size, they are frequently seen to be distorted into very strange shapes, and of an unnatural color, often variegated with red, and otherwise highly colored. This is the "peach-curl," and is an old and prevalent injurious deformity, the cause of which has been variously ascribed to aphides, or plant-lice, lack of some food element in the soil, and even to electricity. The trouble is due to a fungus (*Taphrina deformans*), which grows within the tissue of the young peach leaf, and brings about the peculiar external appearance so often met with in the peach orchard in early spring. The fungus does not confine itself to the leaves, but works in the young stems, causing them to take on strange shapes and unnatural colors, and to finally wither, turn brown, and at last die.

This pest, though somewhat different in its manner of growth, is a close relative of the black knot, which has proved so destructive to the plum and cherry trees. The black knot is a much more conspicuous parasite than the peach curl, as it works almost entirely upon the stems, and even large branches, and becomes very noticeable from the distortions and black color which the branches assume. The only remedy for the "curl" is the knife. All the branches, with their leaves, which are affected, should be cut off and burned. The disease is propagated by means of small spores that are found in the leaves later in the season, and by burning they are destroyed. The peach "curl" is easily seen when once the eye is trained for it, and an orchard, unless it is badly affected, can be gone over quite rapidly, and the diseased parts removed. There is no doubt that it is injurious, and it is also evident that unless means are taken to keep it in check the trouble may increase, and in time become a serious matter in the peach orchards. Those who have had their plum orchards ruined by the black knot know something of the way in which a fungus can destroy valuable fruit trees. The peach "curl" belongs to the same destructive class.

The American Grape Mildew.

In order to become more thoroughly acquainted with the prevalence of grape mildew, the writer, in the summer of 1877, sent a list of questions to the leading grape-growers in the country. From the replies, many of which were very full, it was evident that in the mildew the grape-growers have a serious and destructive pest. The literature of the subject shows that it is no new thing, and that grape mildew has received considerable attention from horticultural writers. The mildew is a minute fungus, known to botanists as *Peronospora viticola*. This fungus is best observed on the leaves, where it makes yellowish-brown patches on the upper side, while beneath there is a white forest of the spores. The smooth-leaved varieties show the mildew to the best advantage, as it is not obscured by the dense growth of hairs of the "woolly" varieties. The threads of the fungus run in all directions between the cells of the leaf, and after a short time reach the breathing spores, or stomata. The threads of the fungus pass out, and reach the air, through these breathing spores of the leaf—often half a dozen from a single "pore"—and branch so as to appear like a miniature tree. Upon the tips of these branches the spores are rapidly formed. It is the vast multitude of these little branched tops, with their clear, transparent spores, which gives the white, frosty appearance of the infected spots as seen by the naked eye. The contents of the spore, a few hours after it is ripe, divide into from six to ten oval bodies, which soon rupture the spore-wall and escape, each provided with two little hair-like processes, by means of which it can rapidly move about. Here, then, we have each spore producing a number of moving bodies, which, after finding a suitable locality, germinate and reproduce the millions in a new place, and it may be on another plant.

Besides these non-sexual spores, just described, there is another kind always formed within the tissue of the grape plant, and is sexual, as it is necessary that the contents of two different threads should mingle in order that one of these spores may arise. These spores are large, and covered with a thick cell-wall, slow in their formation in comparison with the exceedingly rapid development of the aerial, non-sexual spores. They are only produced late in the season, and serve the special purpose of carrying the mildew over the winter. They germinate in the same way as the smaller spores, by producing a number of motile bodies, which, when finding their way to the grape plant, repeat the trouble of the previous year.

This mildew makes its appearance any time from the first of June to the last of September, depending very largely upon the state of the weather—a succession of warm rainy days being the most favorable for its development. I have often been asked what varieties are most susceptible; but the question cannot at present be answered. The strong thick-leaved varieties, like the Concord, appear to be less affected, while some tender thin-leaved varieties are almost ruined. Although this mildew is peculiar to America, it flourishes upon foreign vines, when brought to this country, "even more luxuriantly than on American species." The mildew of Europe, which, at times, has proved so disastrous in the vineyards of Madeira, is a fungus of a very different kind from this, and demands separate consideration, as we have it also.

Flowers of sulphur, used with a bellows, early in the season, when "an ounce of prevention is worth a pound of cure," followed by repeated dusting, as circumstances of weather, etc., decide, is the remedy for the grape mildew. "Early and overbearing are prolific sources of mildew," therefore judicious thinning will do much to keep it off.

The Lettuce Mildew.

For a number of years the market gardeners in some localities have suffered more or less severely from the attacks of a mildew on their early or forced lettuce. The numerous complaints in the spring of 1880, led me to inquire into the trouble, which had reached such magnitude that one gardener stated that it was taking away from him, and those engaged in the same business around him, the source of their very living. A circular was addressed to many of the leading growers of early lettuce, Secretaries of State Horticultural Societies, and others from whom information could be gained.

From the responses to these questions it is inferred that the lettuce disease is at present confined to the Atlantic States, and that it is most prevalent in those localities where lettuce has been grown upon the same ground for a considerable length of time. There is no doubt but that it is a fungus, as a microscopic examination of the specimens abundantly show; in fact the mildew upon the lettuce is not a new thing, it having been described a number of years ago. It first manifests itself upon the older and outer leaves as a fine frosty coating, soon causing the leaves to turn dark colored, wilt down, and rot away.

The lettuce fungus is a near relative of the grape mildew, belonging, as it does, to the same genus of parasitic pests. In general structure, methods of growth, and propagation, it is therefore much like that of the mildew of the grape. When the surface of the lettuce leaf is examined with a hand lens, the white substance resolves itself into a miniature forest of small stems and branches. The tips of the branches are of a peculiar star-like form, and from the radiating points the spores are formed and when ripe are easily detached.

The portion of the fungus beneath the surface of the lettuce leaf consists of winding threads which, as they pass between the cells of the lettuce tissue, form projections that pass through the cell walls and serve as suckers to absorb the substance of the cells. This is the real nature of the trouble, a multitude—a forest so to speak—of small plants, living upon and drawing away the life of the lettuce.

In the way of remedies we have, up to the present time, but little to suggest. The fact that the trouble is in nature very similar to the grape mildew, and that the use of flowers of sulphur has proved the most effectual in the latter case, it is to be presumed that it is also the remedy for the lettuce mould. There is this difficulty in the use of sulphur in the case of lettuce; the foliage is the portion both dusted and eaten, and unless the leaves are thoroughly washed—as they ought to be any way—a sense or suspicion of eating sulphur would be developed that would tend to greatly diminish the consumption of this excellent green. food. Lime sprinkled upon the plants has proved of considerable value in some cases as our correspondence indicates.

In those localities, or rather on that soil, where the crop has been ruined, it is suggested that the growth of lettuce be abandoned for a time, for there is no doubt but that the soil has become foul, and an absence of the lettuce-plant is essential to the eradication, by death by starvation, of the minute fungus spores.

The Raspberry Fungus.

So soon as the leaves of the raspberry and blackberry bushes, both the cultivated and those growing wild, have reached two-thirds their natural size, and sometimes before, they are frequently noticed to be covered on the underside with a number of large patches of orange color. This spring I have received numerous letters, containing specimens of the plants affected by this trouble, with the anxious and important question: "what can we do; for this disease is destroying whole rows of our raspberry bushes?" The trouble is a parasitic fungus—a little plant which sends its fine microscopic filaments through the substance of the young growing leaves, and after a short time breaks through the surface and develops a vast multitude of minute spores constituting the fine dusty powder with a rich orange color. This fungus, unlike the grape mildew and other similar and comparatively slow acting parasites, is so rapid in its development, and has its course so nearly run when it shows itself, that up to the present no preventive has been found. So soon as a bush is seen to be affected—and it usually attacks the whole raspberry plant if at all—the best way is to cut it down and burn it at once, thus clearing the ground of a useless bush, and at the same time destroying a vast multitude of spores, that would otherwise find their way to other bushes, and there reproduce the trouble.

The various species of fungi that have been here described do not exhaust the list of those that are destructive pests on the farm or in the garden—but it is hoped that enough has been said to show that in this lowly group of plants the farmer, orchardist, and gardener meet some minute and very dangerous foes.

Mr. SPURR of Farmington. I have one question I would like to ask the lecturer. He says this smut is very hurtful to cows. Suppose a man has got an acre of corn which he calculates to feed to his cows, and his crop is attacked with smut, of course it is not all affected, and he wants to feed what there is, how is he going to protect himself? How is he going to be safe in feeding that corn to his cows? I have had some experience of that kind myself. I have tried to get rid of the smut in the corn, tried to keep it away from my stock. Every ear that was affected I endeavored to cut off and drop on the ground, and leave it there, so that the cows could not get it, but I have had difficulty with cows this fall from that cause.

Mr. HALSTED. That is an important question. In a case like that, you have to decide whether you would rather have the cows or the corn. If I knew that the corn was going to kill my cows, or was going to injure them so that the injury would be more than the value of the corn, I should certainly burn the corn. I do not know as that answers the question fully.

QUESTION. Should not the gentleman have carried the smut from the field, and not left it on the ground?

Mr. HALSTED. I think Mr. Spurr ought not to have left the smut upon the ground, because it is just like sowing the ripe seeds of the smut plant. As long as you leave them on the ground, do not destroy them, you may reasonably expect to have smutty corn. I am very glad that you are one who has practised cutting off the smut. If you had gone a little further and burned it, it would have been still better. You were not, perhaps, thorough enough in collecting the smut. I feel very confident that if you had removed it all, you would have had no trouble. The only question is, how can you re-

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move it, and will it pay? That is a question that always comes up in considering a matter of this kind—will it pay? I certainly do not think it will pay you to go over a wheat field or a barley field and pick out all the smutty plants. If you think it would, I wish you would try it. It is a question of experiment.

QUESTION. I would inquire how smut affects stock?

MR. SPURR. I went through the corn fodder when I fed the cows every morning and tried to cut off and drop on the ground all of this smut; perhaps there was some that I did not see. I supposed I had cut it all off, so that the cows would not get any of it, but this fall I have had more trouble with abortion in the cows than I have ever had before. I have attributed this trouble to the cows getting some of this ergot on the corn. Now, what I wanted to ask Mr. Halsted was, whether he thinks, if a man is particular enough, he can keep it from his cows?

MR. BILL. Does it affect them in any other way than by causing abortion?

MR. SPURR. I could see no trouble with the cows whatever until after I began feeding the corn. I began to feed it the first of August and fed them through August and September all they would eat, and about the twentieth of November this trouble came on me. I never had had it before to any extent.

MR. WEBB. This is a matter in which I feel a great deal of interest. There is something that has troubled me and damaged me to the extent, as near as I can cipher, of one thousand or two thousand dollars. A person who has a large milk dairy well knows this difficulty among his cows. It is a thing not easy to get rid of and it is one which is very expensive. Now, those of us who have raised corn will recollect that two years ago there was an unusual amount of corn smut. That year this trouble commenced in my herd of cows, and since I have been troubled every year to a considerable extent and I have suffered very largely; not, perhaps, in the number of animals, as much as some others, but when you have established a dairy, your milk product has to be renewed by new cows or by fresh cows, as it is reduced by the failure of those that are going out of milk, and it causes a person to keep a largely increased number of cows in order to supply the demand, and it is a great deal of trouble and a great deal of expense. I have for three years been in the habit of going through my corn field, and cutting off this smut, but I have left it on the ground. I find it on all portions of the corn stalk, a good deal upon the tassel and a good deal in the ear, and in the first, second, and third joints below the ear, even to the ground. I have found large quantities of it even at the sixth joint. While the gentleman was speaking, I was thinking—"You did not half do your work; you should have carried that smut off in a basket." The question then came,—"Will it pay? How much do the wages and board of a man cost a year, and how much damage have you suffered, do you think, at a rough estimate, in three years? Fifteen hundred dollars—five hundred dollars a year for the pay of a man and his board. Well, you could have kept a pretty good man for that, and you would not have had to employ him for over a month." I think it would pay any person who has a large milk dairy and who raises corn to take the utmost pains to carry off this smut in a basket and haul brush and even cut hickory wood, if necessary, to make a big fire and destroy it. I have a very strong suspicion that that is the cause of our trouble, and I am so far satisfied of it that when I cut my corn next year I shall send two men into the field to cut off the smut and carry it off and burn it. I shall have another man to go through my fodder corn and be very particular and cut off all this smut and carry it off, and I will keep a fire in the field, if necessary, all summer, and fight it out on that line.

Mr. ————, of Warren. I would suggest, right here, that perhaps this difficulty is not all owing to the smut in corn. I know many farmers who have serious trouble in regard to this matter who feed no fodder corn; it must come, therefore, from something else. I think our speaker hinted to us, in fact, said, that this ergot or smut grows upon the grass in our pastures in certain seasons of the year. Does not the trouble come from that, instead of corn fodder? I rose to ask Mr. Halsted if we can detect this ergot upon the grass in our pastures? My suspicion is that that is where our trouble comes from, and I would like to have him state if there is any possible way for us to detect it with the naked eye on the grass in our pastures?

Mr. Halsted. Yes, sir, it is very easy to see whether grass is affected with ergot or not. If you look at it after it has headed, you will find a long, horny, hard grain, more or less grooved, and you may make up your mind that that is ergot. In regard to the corn fodder, it is very easily detected.

Mr. ————. Much of the grass in our pastures is very low and has very small heads; it is very difficult to see the seeds. How can we detect it in those small heads of grass?

Mr. Halsted. Usually you can see an affected grain quicker than you can an ordinary grain, because the ergoted grain is much larger. In the case of rye, it is four or five times larger in dimensions than an ordinary grain of rye. Now, I wish to say that I am not very much acquainted with animal physiology, but it may be that this abortion is caused by something outside of fungus. I do not say that it is the sole and only cause of abortion in cattle: I think it is not.

Prof. Brewer. I was going to suggest that we stick to the fungus question. As regards the question whether smut is the cause of abortion in cows, if we get to discussing it here, we can discuss it until to-morrow night. That subject has been discussed for fifteen years. There have been commissions appointed to investigate it, and they have tried experiments, proposed remedies, and so on. I think it is the general belief that corn smut injures cattle. Now, what as to its prevention? I have made a good many inquiries in regard to that matter myself, and there is but very little information from positive observations to be had. In a great many places they soak the corn before planting in a solution of blue vitriol, or blue stone, the same as they do wheat, but

I have yet to find a man who says that he has ever found that it prevents smut. They sometimes do it for a time, because in the same regions they soak wheat in that way. And, furthermore, it puts the corn in such condition that the worms do not eat it, and the crows, if they pull it up at all, will pull up but very little of it.

When it comes to smut in wheat, I think there is no question whatever that the disease is propagated through the seed. I do not myself believe that it is affected by the weather. I have not found that the weather makes any diference. Those regions of the United States that have no wet weather when the wheat is coming to perfection are the regions that are liable to suffer from smut. On the dry hills of Virginia, in the Middle States, and in California, smut is an exceedingly common disease in wheat. In California, the rains generally cease about the time the wheat is heading, and they have to blue stone it to protect it from smut. There have been abundant experiments; they have been trying them for two hundred years now. It is two hundred years ago this very year that they began to soak wheat in brine as a preventive of smut. In some places they use first strong brine and then lime. I think it has been pretty well demonstrated that lime does not help the matter. It helps the wheat to grow, but does not have much effect on the smut. You may soak wheat in water and then roll it in lime and sow it, and the smut will scarcely be checked at all. But if you soak it in strong brine and then roll it in lime, the lime does the young wheat plant good, but it does not have any very great effect upon the smut.

I may say here, that special schedules were sent out last year from the census bureau to the principal grain-growing countries of the United States, and what I say now is from information derived from the answers to those schedules. It appears that the most common remedy for smut is blue stone, sulphate of copper, and two or three ounces of salt to a bushel of wheat, and where that is practised, it is reasonably effective in preventing smut. I do not mean that there is not a smutty head to be found.

Now, I believe that in the case of corn, smut will undoubtedly be propagated by throwing down the smutty ears. I have been inquiring into this matter for a number of years, and it seems to be a fact, that in the older portions of the United States, where it has been the habit of farmers, if they found a smutty ear, to throw it upon the ground, (possibly the hogs are turned in afterwards, and they eat the corn, and the smut is left on the ground) smut has increased. I will venture to say that persons who hear me whose recollection extends back twenty-five years will say, that twenty-five years ago they never saw a field of corn that had one per cent. of smutty ears in it, but in 1877 and '78, there was smut on the corn in this State to such an extent that the smutty corn was stated as high as fifteen per cent. While I have no knowledge of anything that would absolutely prevent it, I have no doubt whatever that it will be diminished in quantity to a considerable extent if the smut is destroyed.

Mr. Spurr. One question Mr. Halsted did not answer; that is, if a man of common intelligence can go through a piece of corn and cut off this smut so that there will not be enough left to injure cattle?

Mr. Halsted. I think he could. I cannot answer that question positively, because I do not know how much it takes to injure cattle. If I knew that, then I might be better able to answer the question. But a man of average intelligence can gather all that he can see, and he can see all of the large quantities; he can see any ear that is smutty at all. He might miss a good deal of it that is covered up by the leaves, because this smut forms and breaks out a great many times at the joints, and the leaves at the joints will cover and hide from view the smut that is there oftentimes, and in that way the smutty corn would get to the barn and to the manger.

Mr. Cheever, of Sheldonville, Mass. I wish to add my mite to this discussion. Prof. Brewer has told you that he has known of no instance where the soaking of seed corn in sulphate of copper has been reported upon favorably. I wish to state one case where there was a favorable result. Two years ago I received some sweet corn seed of a new variety, said to be very desirable, for trial. I planted it in a garden with other corn which was not unusually smutty. The new seed grew and produced corn that was exceedingly smutty, so much so that I was inclined to condemn it and wrote the party to that effect. He replied that he did not know that there was any difficulty of that kind; it seemed to him that my experience was peculiar. I planted that seed again this year and again the corn was exceedingly smutty, so much so that it was really not worth raising. I also got a new paper of seed from him and planted that, and the crop from that seed was also very smutty. From my own seed raised from the smutty corn, I selected a portion and soaked it in sulphate of copper. I planted that in another part of the farm, and where, in the first place, I had from fifteen to thirty per cent. at least—the smut was so severe that it ruined the stalk growth; it appeared on every stalk, in every part of it—on the field where I planted the soaked corn, not one per cent. was smutty. It was cleaner than the average of my field corn. This is but one experiment, but it would seem to be worth following up.

I was put on a committee to study corn smut this summer by the Franklin Farmer's Club. I tried to find the most smutty ear I could in my corn crib, and I found nothing that had more than one black kernel; that was the remains of last year's smutty corn. I shelled that corn and planted it after soaking it in the vitriol. The corn from that seed was clearer from smut than the average of my field planted without preparation. These are only indications; they are simply first experiments.

Prof Brewer. I may state that in the answers to the census schedules that I speak of, I found a number of cases where people stated that they believed it helped, but they had nothing to prove it. They believed it helped, and they wanted to be on the safe side.

Prof. Miles. I will say nothing in regard to the presumption of this smut being propagated by the seed, but in regard to its being conveyed through the soil I have a large number of instances in my mind. I have in my mind now two pieces of corn, one grown upon land where corn had not been planted for a number of years, I do not know how many, and the other grown in a field where corn had been grown repeatedly. The seed was the same on those two fields and the management the same. In the field where corn had not been grown at all, there was no smut to speak of; in the other field, where corn had been grown previously, there was a large quantity of smut. I have observed this same thing in a number of instances at the west, so that I have no hesitation in saying that one of the best preventives of smut is to destroy the smut entirely and not let it go down upon the soil, if you are going to grow corn in the same field again.

I would like to ask Prof. Brewer if, the year there was so much smut, there was not more abortion among cows than during the year previous to that.

Mr. Gold. If that question is to be raised again, I would like to say a word upon it. My dairy has been affected. I have been unable to trace abortion, in my experience, to the action of smut upon corn. It comes and it goes with a certain mysterious, contagious, or infectious influence. It comes into a neighborhood or a dairy and stays there, and then it leaves again, and we cannot give the why nor the wherefore. I live on the borders of a long infected district. Dutchess county, west of us, has been long infected, but it did not come into western Connecticut until very recently. I have traced it as it has spread from farm to farm, and as it came into our town. When I told Prof. Johnson that it was on the farm adjoining mine, he said, "Well, it is moving on headquarters; we shall hear more from it." We have heard more from it. It did move right on, and for two or three years we have been suffering; but for four months, I am happy to say, I have had no case. I hope it has "moved on."

Mr. Webb. The first trouble that I had was in 1879, and that was a year when we had not an unusual quantity of smutty corn, and since then I have been troubled more or less every year, until I have suffered a good deal of damage; but I am happy to say, with Mr. Gold, that for the last four months, it has "moved on," and I hope it will continue to "move on."

Mr. AUGUR. I would like to call Mr. Halsted's attention to one matter which I think he did not mention, and that is a fungus which attacks the strawberry plant, which is usually called the strawberry rust. What have your observations been in regard to that?

Mr. HALSTED. There are quite a number of fungi that attack the strawberry plant. The strawberry rust is one that falls in that group of rusts, something similar to the wheat rust and the raspberry rust, and on account of its working inside, getting all ready and then popping out all at once, we do not know anything about it until the injury is done. Rust or smut is a most difficult thing to treat. There are no remedies for it that I know of. You can only take them after they have done their work and try to prevent their doing the same thing the next year by destroying the spores by burning the plant, and that would be the remedy I would suggest for the strawberry rust.

Mr. BURR, of Fairfield. I am engaged in the cultivation of small fruit. I have had a great deal of trouble from strawberry blight, and by examining it with a simple microscope I made up my mind that it was a fungus. It seems that sulphur is a cure for blight in the grape, and I wish to ask the speaker whether there is any probability that it would be a remedy for the blight on the strawberry. I would say, further, that I have experimented somewhat with sulphur, and on my first trial, I thought I was benefited; but from repeated trials I have made up my mind that the benefit, if any, is very slight.

Mr. HALSTED. I think sulphur would be very little if any use at all. In the case of a fungus of that description, where it is working internally, running through the tissue of the plant, thoroughly investing it, having passed through its vegetative state and gone on to the state of producing spores, the application of sulphur would be so much sulphur thrown away.

Mr. BURR. I wish to ask one other question—whether sulphur would be an advantage in regard to the potato rot. The speaker has said that the fungus which produces the potato rot belongs in the same group with the grape fungus. That being the case, I should think that sulphur might be beneficial. I made an experiment last summer and thought I was benefited by the use of sulphur.

Mr. HALSTED. I think you will find sulphur to be of service in destroying the potato rot fungus. I may be misunderstood in saying that the application of sulphur to the rusted plant, as in the strawberry rust or the wheat rust, would be of no value. I mean, in saving that particular plant. That is the way I understood the question to be put. It might injure the spores, it might even kill them, and in that way it would be a means of preventing the propagation of the trouble the next year and succeeding years, but to save that plant I think would be impossible, or that portion of the plant that is rusted. It is used up.

Prof. BREWER. As Dr. Halsted was reading his interesting paper, I noted down two or three little things, one of which relates to rust-proof varieties. I think that there has been no one direction in which more observation has been expended than in the endeavor to find some variety of each plant which disease would not attack. I may say that so far as the special inquiries on wheat were concerned, I did not push that line of inquiry further in the census schedules to which I have referred than this: I found that in a good many districts a variety would arise which for a year would seem to be almost rust-proof. Everywhere there is a difference in varieties; some are attacked more than others; but in each locality a variety would spring up, or would be brought in, which for a year or so would be almost entirely exempt, but when that variety had been cultivated in that same region three or four years, it would come to be infested the same as the other varieties. Now, this may arise from either one of two causes: it may be that the variety itself changes in that vicinity, or in that district, so as to be more susceptible to the disease, or it may be that the fungus itself undergoes modifications. Now, undoubtedly these low orders of vegetation undergo modifications and form varieties just the same as the higher kinds of vegetation do, and if we can create new varieties of grain, why may not new varieties of fungus be also created to prey upon that grain? They both are formed in obedience to the same natural laws, and I have no doubt that that is entirely possible. But as a matter of fact, wherever we have got a variety of grain, or of potatoes, that seemed for a time proof, or partially proof, against parasitic diseases, we have found that by the cultivation of that variety in regions where other varieties were cultivated that had the disease, it in turn became diseased. I think there is no hope of any permanent salvation in that way, but very frequently there may be partial help by the introduction of a new variety which is less liable to the disease.

Mr. Wakeman, of Westport. Can we kill this smut that comes into our onion crop by cultivating the ground with different crops after it comes in? If I am not mistaken, the lecturer stated in his address that it could be killed by cultivating the ground three or four years.

The Chairman. I think a fact which the chair can state in reference to the gentleman who makes this inquiry may be interesting. I met him accidentally at his place a few weeks since, and on my asking him how many onions he had raised this year, he informed me twenty-six hundred barrels.

Mr. Halsted. I look upon the spores of this onion smut in the soil just the same as I do on seed in the soil. Seeds have a certain length of vitality. They will exist in a dormant state for a certain length of time, varying with the different species, and then the life passes away; it may be one year, five years, or twenty years. Now, in regard to the spores of the onion smut, they have a certain length of life in the spore state; if they do not come to the conditions of growth within that time, they die. I think that we can, by not growing onions upon land infested with onion smut for a certain length of time, bring the land back to its normal state through the death of the onion smut spores.

Prof. Brewer. I had something to do with the beginning of this onion smut discussion, when it was brought up before this board a number of years ago. A number of letters were sent to me on the subject. The question was entirely too much for me, so I turned over the correspondence to a bigger and a better man, that is, to Dr. Farlow, and Dr. Farlow took the thing up and investigated it. The statements made to me before that investigation by Dr. Farlow began, and incidental to it, were, that if the cultivation of onions was abandoned upon soil where the smut had appeared for five years, the infection would remain in the soil for that length of time, and if onions were again put upon it, they would be somewhat infected ; but, as one man told me, seven years would kill it. All I know about it is this statement that was made to me by an onion cultivator, I believe down at Westport. Somebody told me that he had known one field where they had ceased to cultivate onions for five years, and when they put them on again, the onions rusted ; in another case, where they had ceased growing onions for seven years, there was no smut when they planted them again. I do not know anything more than these reports which were sent in.

Mr. WAKEMAN. I have yet to find a person who will say that by cultivating a field where the smut has made its appearance seven years, or even ten years, he has killed the smut.

Mr. ROBINSON. I hold in my hand a potato that has been what we farmers call "worm-eaten." I would like to have the speaker tell whether these spots are the effect of worms or of some disease.

Mr. HALSTED. I shall take it home and look at it carefully with a compound microscope before I pass judgment upon it. I have seen potatoes, many of them, that just as soon as I picked them up and looked at them for half a minute, I could say they were affected with the genuine wet rot —*peronospera infestans;* but this is not one of that kind. This may not be affected at all by disease. I should think it had been troubled with worms of some kind, or perhaps hit by a hoe, or fork, or spade. Beyond that, I should not be able to say there was anything bad about it. The way I should have to do would be to cut off a slice of the potato and put it under a bell jar, with a little water so as to get a humid temperature, and let the thing develop so as to see whether the fungus would develop and form its spores, and in that way get the whole history of the plant.

Prof. BREWER. Prof. Johnson has looked that matter up within a year or two. He examined a whole lot of potatoes. I think you will find a description of his investigations in one of the reports of the experiment station, and what his conclusion was.

Mr. ROBINSON. I want to find out whether planting a potato that has that scab upon it will produce the same disease again, if it is a disease.

Mr. BURR. I was speaking of an experiment that I tried with sulphur on potatoes. I had a man at work for me, and gave him a milk-pan full of sulphur when he was planting potatoes, and told him to put about a tablespoonful in each hill, and mix it thoroughly with the soil. When he came to dig the potatoes, he called my attention to the appearance of them, and where this sulphur was put there was very little of that appearance there is on that potato,—I don't know what to call it,—and the potatoes there were very much smoother. Whether from the effects of the sulphur or not I cannot say, but I think it must have been, because you could see that where the sulphur went, the potatoes were smoother.

Mr. JENNINGS. I would like to make a little further inquiry in regard to onions, because that is a crop that concerns us a good deal. The speaker said that smut might be transmitted in the seed, so that it might be carried in the seed from one smutty piece to another piece that was comparatively or entirely clear from the smut. Now, it is a fact, that if we take onion sets, no matter how small or how large, and set them out, if they grow on smutty ground, no matter, we never see an instance of smut in those sets. A good many are raising onions from set onions. We take very small ones; if we can get them as small as peas, so much the better. By sowing the seed very thickly indeed, eight or ten pounds to the acre, and getting very small onions, we can raise them on this smutty ground and get good, fair-sized onions, and there is no sign of smut whatever on those onions. In regard to the seed which we raise from onions, I have found, in my own experience, where it has been carried west and sold, there has been no indication whatever of smut. So I conclude that it is not carried in the seed. It seems to be something, so far as onions are concerned, that affects the young plant from the seed sown in the spring. This is my experience, as far as I know in regard to it; and the question I wanted answered was simply this—because it makes quite a difference with us in raising our seed and sowing it and selling it to our neighbors and friends—whether onion seed raised on smutty ground can transmit smut elsewhere through the country like a contagious disease in animals?

Mr. HALSTED. If I had a piece of ground, I should not thank any one for bringing me any soil from a smut infested field. I think that he would be liable to bring the onion smut, in so far as he would bring with the soil the onion smut spores. Now in regard to the carrying of the onion smut by means of seed, I think that anything that is transmitted from one part of the country to another is liable to take with it these little germs of fungus life, and if the onion seed comes from an onion field infected with smut, it would be much more apt to take with it, adhering to the surface of the seed, the spores of onion smut than anything else, and in that way it would be taken from one part of the country to another. And, further than that, it would be put into the soil with the onion seed and in the best possible conditions, it may be, for development.

Mr. JENNINGS. Suppose that seed is thoroughly washed with water, would that clean off the spores that would be likely to adhere to it?

Mr. HALSTED. One of the best things the seedsman could do to prevent the spread of the onion smut would be to thoroughly wash the seed that he is distributing. My view is that the spores adhere to the rough surface of the angular seed of the onion.

Mr. Hoyt. I have been very much interested in the remarks of the speaker, and would like to relate a little of our experience with fungus. We raise a great many small plants which we put in the cellar preparatory to planting the next season. I have noticed on roses, grapes, and more particularly on our small apple stocks which we have stored away, a little blue mold, and after a time that mold turns red, when the tops of the trees or shrubs are perfectly green. When those plants were set out, they would refuse to grow. Finding that trouble, and not knowing the cause, we finally learned, years ago, to use the " ounce of prevention." We use a great deal of sand, sawdust, and moss in the cellar where we store our plants, and now, every season, when we get the cellar clear of stock, we clean out that material, which we use for packing, entirely, and it is quite a job. We used to let that material remain and use it another year. We do not do it now, because it gets pretty well infected with fungi, and since we have taken that precaution, we do not suffer so much damage as we used to.

Recess until 2 o'clock.

AFTERNOON SESSION.

The meeting was called to order at 2 o'clock by Vice-President Hyde, who introduced as the first speaker, Mr. J. B. Olcott of South Manchester.

HOME MANUFACTURES.

By J. B. Olcott.

Mr. Chairman, Ladies, and Gentlemen:—

What do we mean by Home Manufactures? In thinking the matter over, we shall find that we mean a number of different things. An American citizen, sojourning in a foreign land, with a purse that gives him leisure, will be apt to look upon every product of American industry as a home manufacture. We send our agents abroad in order that they may obtain this large, national, view of home.

But supposing we are having a great exposition of natural and artificial produce anywhere in the United States, the American visitor will be likely to discriminate among the States and sections in favor of his own locality. He will be very willing to see that his own State, or his own section of the north or south, east or west, has made a brave show of goods, and his heart will warm with not ignoble pleasure that these evidences of industry, intelligence, and wealth, have come from the immediate vicinity of his own home.

This is the ordinary feeling and sentiment in respect to home manufactures to-day. This is what our public speakers and newspapers may be full of, in a general way, without touching any individual interest. Farmers are as glad as any class of men in the whole body politic, to know that their nation, or their section or state, stands abreast of the rest of the world in the pursuit of manufactured goodness.

But we all know, Mr. Chairman, that these national or sectional views of our manufacturing interest are but superficial views. They touch merely the epidermis, the scarf skin, of farm life. The farmer is the last man to disregard the outward signs of prosperity. To his skilled eye every blade of grass, spear of grain, stem of tree, or animal among his flocks and herds shows upon the outside for all it is worth. He admires, greatly, the sheen of his corn in growing weather. Though dwelling in the midst of pastoral quiet, his blood is stirred by the din of booming business abroad, in the air. The kiting of fancy stocks, even, is as pleasant to him as the rustling of corn leaves in the summer wind, if he has never known the bottom to drop from under the finest speculations, or crops to fail by the ground refusing to carry out the first sappy promise of the season.

Aged men will remember, however, when home industry and home manufactures had a different signification; when their own door-sills and hearth-stones were the headquarters of business; when the shop or mill was an adjunct of the farm; when every kitchen, or the spare room was a domestic factory, devoted to furnishing the wants of the household. Then every farm-house was a "kindergarten" school, a nursery of industrial genius and domestic art. Then boys learned the whole of a trade, with the use of tools they might easily own. Then girls were familiar with the construction of textile fabrics—linen, wool, cotton, and silk, from their earliest recollection. Then we had home manufactures in the strictest sense, for every farmer's home was a manufactory.

How that state of things has been all but swept away from New England, by education, fashion, law, custom, and accident, many middle-aged people know by actual experience, and many young ones by credible hearsay. In some localities the new generation of workers is as foreign to the old Yankee civilization as if it had been transplanted from the old world, and is less like the best Yankee type than that now immigrating from certain northern parts of Europe.

Instead of nourishing those old hives of industry, many things have tended to weaken and destroy them. Where one after another, the children were tempted away, and families were broken up, what else could the old people of the ancient farm do but die, or how could the old sciences, crafts and arts of life by which they lived so well do but perish with them? Another Wendell Phillips might make a long list of the arts that are lost to the Yankee farm. So popular has been recently, and perhaps still is the notion of an extreme division of labor that many see no connection between agriculture and mechanics. Farm life is no longer considered in certain circles the life of universal intellect, but the merest drudgery of digging the earth. Over and over again has the present speaker been called to account by the men of his time for talking and writing of this, that, or the other matter—indissolubly connected with intelligent farming—by the question, "What has that to do with agriculture?" It is not enough to say that a farmer should take such laws and gospels as are made for him and be content, but in the minds of some people he must give over every item of his manifold avocations—he that once held them all—that any other class may choose to take. I am bound to admit right here, however, that these are always but partially educated people.

Some of us know how the laws of our commerce have favored the transplanting of entire industries, capital, machinery, and men to our shores, and brought them directly in competition with our home manufactures. But hold! Perhaps in the course of a few pages we have made the change of actors upon the manufacturing stage seem too abrupt. In one town, or district, it began, may be, seventy-five or a hundred years ago, in another fifty, in another twenty-five—in still another, possibly—some old fashioned town—the transformation from farm independence to dependence has scarcely yet begun.

The intermediate stages are sometimes very pleasant ones. In 1852, I well remember returning home after several years absence, and going into one of our mills where all the handsomest daughters of the farm in town were gathered into one large, airy room, at some light, clean, factory work. I—I was younger then, and came near going off the handle with surprise and delight—never having seen such a sight in my life. Neither do I expect to see such a sight again in my native town. We have girls enough, and some as good as we ever had, but so many inferior ones, now, as to mar the picture wherever we see it. That day, when the flowers of our farms were offered so freely to the mills, marked a decline in home manufactures.

I would never cry for spilled milk, but I do mourn for that particular crop of girls. Every middle-aged manfacturer will remember them, and what bright, dutiful, and conscientious workers they were. Manufacturers know how hard it is to fill their places to-day, but they rarely think, and I am afraid some of them don't much care for the bloom that went with them from the farm. I shouldn't care myself how many of them left the farm in their pursuit of happiness, so long as it was the polite custom of society, and the settled policy of the state to keep enough of such at home for seed. Whoever turns the matter over in his mind, will conclude, as I have, that home manufactures of the one or another stamp, get their best recruits from the off-shoots of ingenious and self-respecting agriculture. There is in agricultural human nature a tendency to develop in the direction of manufactures. The best mill-operatives we import are farmers and gardeners, as well as mechanics, and we are breaking, to-day, the family manufactures of entire neighborhoods in the north of Europe, to fill vacancies at our power spindles and shuttles. It is not for the intere t of the State to push things so far in this direction, that a few may grow very rich while many fall into slavish ignorance and poverty.

Even while the guns in the great battle of human liberty were still echoing there were traitorous managers, and legislators who did no less than forge anew the bonds of human slavery. The national fiat which liberated the negro forever upon this continent, set free also the capital which could invest itself directly in a simple, ignorant man, and left it to lay hold of the ways and means, and natural advantages by which simple and innocent men must always work. Mr. Atkinson tells us that for every million of dollars invested at the North, under the old order of things, the South was expending one and a half millions in land and slaves. The statesman, who is at the same time a farmer, must ponder over the profits of manufactures which wreck in the end, both land and labor. Continual levies upon new, virgin soil, north or south, are continually required where the loom and spindle are taken from the hands of the common people.

The emancipation act relieved capital of a burden, for what cares any tyrant for owning the bodies of people if he can control the land they stand on, the tools they know how to use, in part, and the water that falls from the clouds and runs curbed by the will of an autocrat? As a young man I thought little of these things, but now I can speak feelingly with our third President—that "eternal vigilance," and nothing else, "is the price of liberty."

Verily, it is time for a "new departure in agriculture," when railways assume to control states, and corporations claim "the same rights as railways." It is time for farmers to show their hands in associated work. It is time—I might say—for every family by ingenious legality, to take advantage of the corporation laws, and make head against the organic tyranny of monopoly in whatever shape it appears.

Perhaps some one will think I ought to tell here what branch of manufactures a farmer should take home with him. My faith is that an earnest, prayerful spirit is its own best guide. One wise man says, "I could easier teach twenty men what it were well to do, than be one of the twenty to follow my own teaching." Our circumstances constrain us. Don't let them make slaves of us. I would gladly take advice of a dozen or twenty of you, but after all, your liberality would be best pleased to have me work out my own mind.

Butter-making is a legitimate branch of farm manufactures, despite mammoth city mills, and manufacturing really good butter is never likely to be overdone. The chief trouble is that a large proportion of our people can't distinguish poor butter when they see it. If it were not so how would our mistakes and the produce of tallow factories be sold at all? Every writer, now-a days, allows a cow to be a machine, and the machinist and his wife who own a good one or a number of them surrounded with the proper manufacturing tackle and raw material, well managed, are having easy times this winter, while a good many other machines have run their operatives out of employment.

It is not so much the right to make any particular thing on the farm that I stickle for as the right to make every or anything good the farmer can. We must claim this because it is a fact of New England development over and over again that the full grown manufactures we brag of sprang from an ordinary farm chrysalis. Necessity is the mother of invention, and sometimes necessity has to reside in the country in order to manufacture wit for the town.

I urge my village and city friends to let the country thrive because they are sure to find their account in it later. It is not well to induce every ingenious family to leave it. I hate to see rural roadsides robbed to trim city churches for a day, even at Christmas time. If we scatter good seed in the country it is sure to come to the town sooner or later in the natural current of human events.

We must take care of our big mills, of course, and we must take care that they do not swallow all the little ones at one fell gulp. It is enough for the big mills that the little ones exist, happily, to teach economy and furnish fresh levies of recruits that have been drilled to apply themselves to details in various directions. Men specially trained to one idea are not wanted in our home manufactures now, nearly so much as we used to pretend we wanted them. Versatility is called for.

If our tasteful and quick-witted mothers and grandmothers were alive and had the markets which our present manufacturers have, don't you forget that they would make the hand loom distinguish itself by its ability to shift the pattern of every web without degrading the quality. The most precious fabrics in the world are still woven by hand, and might as well be in New England if our young people only knew the latent artistic skill within them. It is undeniable that we are working wonders with our power machines. We can manufacture clothes for every naked savage on the continent of Africa in a week and throw in hat and boots and a patent time-keeper to match, but for all that, I noticed that our most powerful mill-owner set a hand-loom to work when he wanted a wedding dress for his daughter. Right on the heels of the Centennial exhibition, when the newspapers were telling us how we were ruining Switzerland with our American watches, I happened into the village store and found the watch-maker's window filled with elegant Swiss goods. I forget how many watches had been sold within a week, but remember the reason very well. "Folks don't want their watches all alike."

The machine must have its patterns and sell a good many pieces of a pattern to pay, while the clever hand-worker need never make two things alike. It is impossible to forestall his market, or run him off the track, for there is no knowing which is his market or what track he will take next.

There are many domestic arts that would be greatly helped by a little machinery. Don't let us run away with the doctrine that only big mills can be made to pay. That depends altogether upon the management. We may and have for thousands of years got along without big mills, but we must have little ones for education. One of the greatest sawyers of Michigan timber began, to my knowledge, with a mill and a stream of water that would barely furnish the power to slit a Long John potato into planks. I tell you, Mr. Chairman, that we need little mills as much as we need little fish, for the big ones to swallow, and we continually need small mills at which the independent, trained workmen of the large mills may graduate.

The other rainy day I found a nice townsman busy as could be making an axe helve for himself. It was worked out by "John Allen's pattern," of wide-grained, tough, butt hickory, and was fit to make a wood-chopper's eye leak. He said it might take him a day to finish it, and he didn't want to sell it because, I presume, he thought I didn't want to give its value. To trust to, for going into the woods for a day's chopping, I dare say it was really worth more than a dozen of the average machine helves in market. I suggested to the artist that he could do well with his eye for timber, and might serve the public too by setting up an eccentric lathe to work tough rived hickory by John Allen's pattern.

Now when we talk of encouraging home manufactures, do we mean at our own house or at everybody's house? The latter is my idea of home manufactures. If a boy on a Connecticut farm shows a taste for tools give him a chance to use them, right at home. When he gets big enough, let him knock up a little shop or a little mill in the old way close by home. His father's farm may be fifty years back in the woods, but it is fifty times easier building a mill there, or anywhere in Connecticut, than it was fifty years ago. No matter if the shop or mill does not consume all his time. He can spin or weave or knit or make buckets a part of the time, and farm or garden a part of the time as his grandparents did. Connecticut was once especially famous for her handy men. Now the man who can turn his hand to whatever is necessary to be done is the scarcest man in New England, and he is especially scarce upon Connecticut farms, because we have allowed our diversified farm and family industries to be wrecked. The only way for a boy to determine what he can do best is to try many things. It may be for my profit, if I hire him, to give him a one-sided development and keep him at that one thing which I can make the most money by, but it is not always the best thing for the boy or man, because industries will break. and the operative who is only part of a machine is liable to be counted out with the pieces of his broken machine.

Every person of experience knows the value of a diversified industry. The Rev. Mr. Hatch of West Hartford lays great stress upon this point in his Thanksgiving sermon printed in *The Farmer*. Unless we have more than one article of produce or manufactures to sell, we are very liable to come to grief. We have scarcely a manufacturer who does not try to secure himself against the competition of farming by cultivating the land for himself. We should have scarcely a farmer who does not try to secure himself against loss and disaster, by attending to the mechanics and arts of his business. Successful families like successful states must maintain a diversity of industries.

We have a good deal said and written, now-a-days, about the tariff. The way to fool the people in the matter of law is to give them a new code every little while, which they do not understand. The worst laws become endurable when we have adapted ourselves to them. As the tariff now stands small industries, anyone may see, are growing up everywhere. The people know what they are doing. But supposing we alter the tariff and make it what they call "discriminating"? Who is to be discriminated against? Those, I take it, who cannot afford to pay a Washington lobby, the beginners of small industries at home, all over this broad land.

The sore point in regard to the destruction of our old style farm manufacturers is that modern society gives too little credit for the help it got from that humble training. The old woman of Tolland county, who could produce woolen goods from the sheep's back, linen from flax seed, and curiously dyed silk from the egg and mulberry tree, is mightily injured in her feelings, when her grandchildren are robbed of their water-power under the flowage law.

Flowage law? And what, pray, has that to do with agriculture? Much, every way. Possibly some in this farmers' meeting do not know that we have a flowage law, or what a flowage law is. Farmers' conventions are usually experience meetings, gatherings to compare notes and report progress. Scarcely a year ago I knew nothing about a flowage law, but since the last annual meeting I have been studying its provisions and have experienced its force. Shall I read it to you? My copy of the statutes opens directly to it.. Ignorance of that law may cost some valley farmer the possession of his mill-site even while I am speaking, if any grasping capitalist has been conspiring against him under its provisions.

It is better, and will save time, for you to look at the text for yourselves. Mark the crookedness which may take private property for private use under the guise of public use. Even while judges and states have been questioning the violation of common law. Under current bull-dozing construction of public use, a sugar-mill may constrain beet and sorghum lands for public use. Sites for hotels and groceries may be seized and confiscated at the will of a strong communistic party.

Mark the crookedness of adding fifty per cent. to the sworn appraisal of three honorable commissioners! What was that for except to throw dust in the eyes of legislators at the passage of the law? If private property is taken for genuine public service, for public water, a county house, a school or a grist-mill—the scarcest public servant in our section—what occasion has the public for paying fifty per cent. above its true value to its owner, where all his circumstances are honestly and fairly taken into consideration according to certain good points in this law? That fifty per cent. is an insult to the judge, commissioners, and all parties concerned, and a scandal in the commonwealth.

I would not abolish this law any more than I would abolish beetles and wedges, or broad axes. Like these tools, a flowage law is necessary.

But these are powerful and may be dangerous tools in the hands of unscrupulous men. I would surround them with a better educated society and common sense, as a restraint against hasty and unwise action. I would teach our manufacturers that they of all men, in the ups and downs of their bu iness enterprises most need the safeguard of a conservative and prosperous farming community, developing naturally, in the old way of New England, into manufacturers. It is not yet a fact in history that manufacturing gets an enduring thrift by the ruin of agriculture, the destruction of domestic art or the natural evolution and growth of farm and family industries. On the contrary, it is generally true that the happiest developments of manufacturing occur where the children of the soil grow up to the full use and enjoyment of their hereditary industrial rights and privileges protected by law and custom.

Our flowage act as construed and put in force in the popular mind of my neighbohood, brings farm lands under a sort of pre-emption—as Indian lands have been—to the first stake-driver who comes along. Under its provisions an enterprising young man went right out of our halls of legislation in March, and drove his stakes in the most valuable grass land we had. They were plaguy rough, pitch-pine stakes with nails in them, fit to smash, and did smash both of our mowing machines, and put their drivers in mortal terror of unseen snags where the grass was stoutest. We need a little civil service reform there, Mr. Chairman! I would respectfully submit to whoever is in authority, that no flowage petitioner need set any traps for man or beast, in seeing what he can do on a peradventure. A sliver of sawed pine, painted white, and no heavier than a peeled willow twig, is a sufficient mark in a meadow for a surveyor's informal flowage lines.

After driving his stakes, which he thinks tantamount to a title already, the rampant flowage petitioner proceeds to invite the owners to trade. It is precisely like trading—this is the popular feeling and apprehension—with a robber, who holds a pistol at your head. The farmer must take the terms offered, or suffer the chances of the court.

No matter if you have a first rate dormant water power on the same ground—one that your father has partly developed for your benefit, and that you propose to improve in the old natural order of righteous farm evolution for the benefit of your children, and the community at large, the outrageous communism of this law, misconstrued and misconstrued, as I believe, to the everlasting disgrace of intelligent mechanics and agriculture both—may be taken from you under a nominal damage with fifty per cent added.

Now, Mr. Chairman, and gentleman of the Connecticut Board of Agriculture, although this talk in a certain narrow phase of it is my business—a peculiar farm experience—I deny that it is altogether my business. In a large sense, it is your business. It is a public matter, covering the agriculture of this State—of every New England State, I fear—and in prospect, perhaps, every new and old state of the union. It is a new slave law involving human rights that we are putting in force. The interests concerned are so immense, that my own individual interest sinks into nothingness. Only by the fact of my being an eye-witness to infinite public wrong in store for us, have I a right to raise a voice in the matter. One farmer, more or less trodden, under the heel of corporate despotism, is but another sparrow fallen to the ground. What need have I to ask you to take heed of such a trifle? Is it not written already in the inmost heart of humanity that little things shall in no wise be forgotten?

But this I will ask you. Look well to your home manufactures. Beware what manner of workmen your mills turn out. No manufacturer may safely walk through his mill and close his ears to any jar or disagreeable sound among his machines. No citizen, let alone a statesman, may safely turn away from the least injustice. We are all in the same boat. What hurts me hurts you. We were all shot down, and we all suffered death with President Garfield! We shall all be tried and hanged let us hope, with the assassin Guiteau! Whatever our manufacturers do, or are hindered from doing, is our own doing.

In my eleventh year I went into a mill and worked for a shilling a day gladly; and I have been in and out of our mills ever since. You may or may not believe that I love them, and would be glad to work with the best men in them. But as the best managers are not, neither am I blind to their faults. They have not changed human nature. They are not and never have been our sole or only means of salvation. There is nothing about the discipline of mill-owning more than of farm-owning to prevent the abuse of unlimited power and wealth. It is the binding effect of justice to all classes which holds the social world together. Unless the perfect class bricks we are now making are held together by the mortar of truth, and justice, between man and man, we shall build nothing better than babels and end with confusion of tongues.

Look you. What has been the main source of our present spurt of prosperity? Nothing but the fact of our having millions of acres of fertile lands within railway reach. Nothing but the fact of our having so many hundreds of thousands of picked laborers ready to step upon our shores. Nothing else but these two things spared us from a most dismal time of gathering up and saving the pieces after our civil war. Are these fortunate incidents anything for us to be particularly proud of? Rather ought we not to be ashamed that we have done no better with our unparallelled advantages?

This bit of luck should not make us forget possible—yes, imminent future mischances. This good fortune of ours should not blind us to the ill fortune of our neighbors. Is not the rim of every humming city and village grinding, like hades among the wreck of abandoned and depopulated farms? Has not the draft of wit and muscle for our valley improvements left whole districts in the neighboring hills with a look as though a blast of fire or dry rot had swept the country? Are not our dirty streams and worthless forests fished and hunted by vagrant sportsmen? Are not our institutions of reform crowded with too healthy boys and girls, while schools of whales by the million go unfished for, and thousands of tons of our produce and merchandise float under foreign flags? Are not far too many of the boys and girls of the farm debauched by the lax morals and dissolute habits engendered by sudden wealth? We were growing a frightful pauper list, while the sons of too busy mill-owners and speculators were spending the income of townships.

In solemn truth, Mr. Chairman, the picked men who follow the Board of Agriculture in its rounds, must not be deceived by a superficial prosperity like the gloss of corn manured in the hill, where rains are frequent upon hungry land. Our hearts are full of hope still, or we could not bear this needful work of inspection. If our home manufactures tend in the whole or in part to endanger our liberties, and degrade our civilization, the sooner the danger is known the better. In the same hopeful spirit I will read you three or four paragraphs from the pen of a recent writer, whose study of the tendency of his time has attracted much attention. His plan of salvation—by the way, is simply to lay all the taxes directly upon land, thus practically, he thinks, abolishing private ownership, after awhile. The book has received more notices from the press than any book, almost, of the last few years. I told an old farmer that there was an earnest book with such a plan—himself a large land-holder. He smiled a little, rubbed his chin thoughtfully, said that would be an interesting subject; it might be important, and he advised me to look into it if I had time. The fact is, there is a little ripple of feeling around our manufacturing villages, akin to the great swash of sentiment now agitating the bosoms of the close-packed masses of Europe against their tyrannical landlords. Young trans atlantic Ireland throws stones at grizzly old farmers, old women steal their fencing, and the cast-off servants of the rich set traps of grog for the rising American "hoodlum." The veteran farmer of New England who came in possession of his land when no one, scarcely, would pay taxes on it, who has barely kept his head above water in the rush of near railway competition, while every money-making manufacturer felt bound to keep his own dairy, and grow his own hay and vegetables, may be expected to smile a little broadly at the rank communism which refuses to pay him a shilling per day for his labor in the rise of water-power or a corner mowing-lot.

The book is new to me—perhaps not yet thoroughly digested—and the more significant in its objectional features, because of the law just published now referred to which is new to me. But I am not of those who reject a thing entirely, because of its disagreeable parts. Nowhere have I found the possible decline of modern civilivation described as here:

Forms are nothing when substance is gone, and the forms of popular government are those from which the substance of freedom may most easily go. Extremes meet, and a government of universal suffrage and theoretical equality may, under conditions which impel the change, most readily become a despotism. For there, the despotism advances in the name and with the might of the people. The single source of power once secured, everything is secured. There is no unfranchised class to whom appeal may be made, no privileged orders who in defending their own rights may defend those of all. No bulwark remains to stay the flood, no eminence to rise above it. They were belted barons, led by a mitred archbishop, who curbed the Plantagenet with Magna Charta; it was the middle classes who broke the pride of the Stuarts; but a mere aristocracy of wealth will never struggle while it can hope to bribe a tyrant.

And when the disparity of condition increases, so does universal suffrage make it easy to seize the source of power, for the greater is the proportion of power in the hands of those who feel no direct interest in the conduct of government; who tortured by want, and embruited by poverty, are ready to sell their votes to the highest bidder, or follow the lead of the most blatant demagogue; or who, made bitter by hardships, may even look upon profligate and tyrannous government with the satisfaction we may imagine the proletarians and slaves of Rome to have felt, as they saw a Caligula or Nero raging among the rich patricians. Given a community with republican institutions, in which one class is too rich to be shorn of their luxuries, no matter how public affairs are administered, and another so poor that a few dollars on election day will seem more than any abstract consideration; in which the few roll in wealth, and the many seethe with discontent at a condition of things they know not how to remedy, and power must pass into the hands of jobbers who will buy and sell it as the Prætorians sold the Roman purple, or into the hands of demagogues, who will seize and wield it for a time only to be displaced by worse demagogues.

Where there is anything like an equal distribution of wealth—that is to say, where there is general patriotism, virtue, and intelligence—the more democratic the government, the better it will be; but where there is gross inequality in the distribution of wealth, the more democratic the government, the worse it will be; for while rotten democracy may not in itself be worse than rotten autocracy, its effects upon national character will be worse. To give the suffrage to tramps, to paupers, to men to whom the chance to labor is a boon, to men who must beg, or steal, or starve, is to invoke destruction. To put political power in the hands of men embittered and degraded by poverty, is to tie firebrands to foxes, and turn them loose amid the standing corn; it is to put out the eyes of a Samson, and to twine his arms around the pillars of national life.

Even the accidents of hereditary succession, or of selection by lot (the plan of some of the ancient republics,) may sometimes place the wise and just in power; but in a corrupt democracy the tendency is always to give power to the worst. Honesty and patriotism are weighted, and unscrupulousness commands success. The best gravitate to the bottom, the worst float to the top, and the vile will only be ousted by the viler. While as national character must gradually assimilate to the qualities that win power, and consequently respect, that demoralization of opinion goes on which in the long panorama of history we may see over and over again transmuting races of freemen into races of slaves.

As in England in the last century, when Parliament was but a close corporation of the aristocracy, a corrupt oligarchy clearly fenced off from the masses may exist without much effect on national character, because in that case power is associated in the popular mind with other things than corruption. But where there are no hereditary distinctions, and men are habitually seen to raise themselves by corrupt qualities from the lowest places to wealth and power, tolerance of these qualities finally becomes admiration. A corrupt democratic government must finally corrupt the people, and when the people become corrupt there is no resurrection. The life is gone, only the carcass remains; and it is left for the ploughshares of fate to bury it out of sight.

In view of these remote possibilities, for this country,—sparsely peopled as it is—we should think Mr. Henry George, the author, would allow there still might be good chances in honorable citizenship for land-owners and home manufacturers. I trust that his "Progress and Poverty" paid him well, and that he has invested the proceeds in a bit of land that pleases him.

My friends here must not run away with the idea that I am pitching into manufactures, when I am only trying to discriminate among them. Every class has members which it cannot control without outside help. Manufacturers vary as farmers do, just as you light o' chaps. Farmers selling wood in cities are met by official measurers. Yet I have seen a farmer with such a reputation for integrity, that his loads of wood were never measured by any one but himself, and he had no trouble in selling a great deal of wood, as fast as he chose to haul it to market. Not long ago, a villager of my section complained to me of the "pig" pork he had engaged to be delivered to him having the teats shaved off. I had to explain, that the fellow who sold him the pork was a recent graduate of a mill, not a farmer who had been tested as such and was satisfied with his life, but one who already wanted to sell his place.

The manufacturer in the beginning grew up from a farm, and the stricter and more thorough was his rural education the better manufacturer he made. All his life he was a farmer by sympathy, and ever ready to consider the rights and wrongs of the farm. Such men would rather buy what they want in the open market, or go without, than seek to depress valuable farm property by insidious social changes and long-continued adverse legislation. It is the thoughtless, ambitious, half-educated, enterprising young fellows, who were not pinched in the last panic, that start up and do the mischief. It is the unwarranted exploits of these men who give our corporations their bad names, and finally, perhaps, bring their joint-stock fellowship in iniquity to grief.

I was riding with a youngerly manufacturer the other day, during a half-hour's interval of his immense business. I say youngerly, but he is already gray and bald and somewhat given to philosophy. "What do you think?" said he to me; "It is settled across the water (meaning in England) that manufacturing develops better men and women than agriculture does."

"Wal," said I, doubting his judgment in such an important matter—for how can a manufacturer, driving through an old country by railway, form anything but a hasty railway-man's opinion of that country?—"If the laws and customs of a country are so constructed that manufacturing, or politics, or preaching, or any other employment or profession pays better than farming for a long series of years, be sure bright boys and girls will be attracted from the latter business till an apparent show of degradation will result. Then," says I, "if the worst comes to the worst, with such a foundation employment as agriculture, delegates will have to run the other way."

Whether convinced or not, he didn't say any more upon that head. The fact is, American agriculture is beginning already to attract recruits and capital from other employments, as the decaying agriculture of Greece and Rome did. I am sometimes afraid, however, that our agricultural poets, philosophers, and politicians know as little really of the springs of national life and have as little power to hinder the approach of national destruction as ancient farm poets, philosophers, and politicians did in their time. Perhaps you noticed what a weak agricultural paragraph the President had in his message? And what energy our government shows in protecting the foreign citizen escaping to our shores? We want the nation just as quick to protect old settlers from oppression as new ones. A back-country farmer or mechanic in dread of his property or life must not have his children taught by the course of humdrum events that a renegade Russian or German is of more importance in the eye of the national or state government than he is.

There are several reasons why a manufacturer should wish to flow the intervale rather than take the water of a stream upon his wheel by canal. Where valuable eastern bottom lands have been long depressed or kept at a standstill by western railway produce, flowage is cheaper. A canal requires digging and banking at fearful prices per yard as the cost of grading and excavation is figured and sub-let by modern contractors. No matter if the land in question has the greatest latent agricultural value if the owners are in no condition to develop it. In periods of agricultural depression and factory booms, they probably have no desire to do so. So it may seem politic to a mill-owner to flow if he can; partly for the sake of acquiring valuable property, and by a view—more or less dimly acknowledged in his own mind—for the purpose of depressing agriculture still more in his neighborhood, and turning the minds of ignorant people still more decidedly towards the chances of labor in his mill. Level meadows make a capital basin for a reservoir, you know, and to throw a wooden dam across the narrows below is easy—a colony of beavers could do that—and where our bottom lands are under water in the midst of a sandy and gravelly country, no very enviable views of farming will be seen from factory windows, especially during dry seasons like the two last.

Did it ever occur to you how a farmer feels who happens to own a Naboth's vineyard that the king corporation of the day has its eye on? He can't improve it any. His wife will tell him it is of no use; his children will beg off from working there, and his neighbors will laugh at him. The price of the land is fixed in the public mind, and it is hung to the owner like a millstone. Supposing it is ground that a great city wants to make a reservoir of. You might suppose that a large body of people could easily chip in a penny apiece and give the farmer enough at least to make him feel that the whole world is not against him. But no. The people of the city don't know anything about the matter, or they are taught that farmers are "stingy, dogs in the manger, unprogressive," and so forth. City people are taxed enough, but the money is divided between appraisers, contractors, and noisy, voting labor. Does the press know? Very little. The best farmer, the most precious man to the state, is not a grumbler. He suffers in silence. This is the formal kind of notice such a matter gets from the fine print of a newspaper:

The board of commissioners, of the last season, deemed it wise to obtain the fee simple of the entire low ground before taking any steps towards a connection. The matter was placed in the hands of a committee of the board, of which Mr. —— was the acting chairman. He has arranged with thirteen of the owners, purchasing 211 acres out of the 227 needed, at a price averaging about $7 per acre, exclusive of the standing wood on the same. The remaining 16 acres, owned by three different parties, are in process of being taken by the appraisal of commissioners appointed by a judge of the supreme court.

Of the actual facts here hinted at I know nothing. The parties may have been abundantly satisfied with seven dollars per acre for anything I have heard to the contrary. Rural speculators may have bought the condemned tracts for less money and so made something out of the trade. But I do know that the student of national life and decay will have to grope among such low-down details to find out what is the matter, or this nation and this civilization will only blaze anew the old road to ruin that so many other nations, careless of the common people—except to keep them in ignorance—have followed.

For remedies I would prescribe—what? Nothing new—except, possibly, a stricter honesty in dealing with the soil, where all dishonesty and robbery begins—more attention to honest farming and honest home manufactures. Some may believe in legal remedies—more laws. I have very little faith in law except as it is backed by the public mind. Laws that have to be enforced by stealth, like the flowage law, do no great harm to any but the stealthy society that uses them. I believe our best manufacturers are ashamed of it; but I wouldn't give a cent to have farmers get on their farm boots and kick it off the statute books. We don't want farm law nor manufacturing law, but laws so just and reasonable that every one, high and low, must respect and obey them. It scared me last year to hear Prof. Beal tell how the farmers of Michigan could get anything they asked of their legislature. I am afraid the farmers of the Peninsula State will over-reach themselves as our mill-men did in their flowage act. Any class dipping its fingers too deep in the public pot leads surely to excess the other way. Let the farmers of Connecticut beware of "legal" temptation.

Are we manufacturing very queer notions of law and justice or not? Our theories of justice and the practice of our courts often disagree. One case spread thin by the newspapers, amuses many people. Possibly that is a gain. Who will rise and explain the law so that people shall confide in it? Ordinary honest men sometimes appear more afraid of our courts than rogues do. A flood washed forty cords of my father's wood fifty rods down the stream and piled it upon his neighbor's land, who immediately claimed the wood. My father calculated that a law suit would cost as much as the wood was worth, and so let the wood go. Did his fear of the courts cheat them out of one righteous chance of getting a living, and by so much leave them exposed to unrighteous legal temptations?

My neighbors elected me grand juror one year, but the two complaints which came to my ears during my official term were so ridiculous, that I laughed them out of countenance. Then I wasn't elected grand juror any more. One neighbor told me I didn't scare up business enough for the courts. Perhaps so; but I didn't know, and who does know, what school is appointed to pierce the darkness as to legal matters in these dark ages? Sometimes I get to thinking that we spent too much of our capital in the State House, leaving too little means afloat for the common people to get justice—like a farmer who builds a mighty barn, which so exhausts his cash that he cannot afford a decent shelter for himself.

Is it true, as some say, that the law is only for the strong? During our recent troubles, plenty of people told us what a fearful thing it was to go to law, but it must be a more fearful thing finally for the State, if upright men grow in dread of its statutes. If the law is, as some say, a lottery, even then there must be an occasional prize drawn, or no one will take a venture in it. My own opinion is, that human law is, or should be a normal development from natural law, as mechanics is a natural growth out of agriculture; and that if either development grows wrong, it is because farmers and mechanics do not take their due share in the trouble of setting it in order.

Last spring when this flowage business was first sprung on us, I was away in the village at work as hard as ever I could. The powers of evil like those of good, are always in sympathy. While we were in dread of water at one end of the farm, we were in mortal terror of fire at the other. The evil spirits of the village outskirts kept my wife and children fighting fires in the woods for about a fortnight, or until the rains came. But the fires grew so frequent as to arouse that side of the country. One day, Em. said, the people of one of our mills were all turned out to help her, and help themselves. A little wearing, a little friction of the elements is proper and even necessary under any civilization. But when it comes to pursuing farmers with floods and fires as in some parts of the State, or with poison as in some others, then we may as well understand that good men of all classes—farmers, manufacturers, or lawyers—will unite against it.

There may be some who will say that things have been said here which are not warranted by the facts, or by the opinions of eminent men and jurists. Please look at "Angell on Water-courses," a Massachusetts law-book, where flowage is said to have begun in colonial times. Began among farmers who wanted grist-mills, and saw-mills. The State of Alabama has pronounced a statute extending the right of eminent domain to machinery and several public utilities, unconstitutional. (See note, p. 668.) Michigan, I believe, still confines the right "to such mills only as are in the habit of grinding for toll." (See p. 680.) Judge Hand of the New York Supreme Court says: "The legislature of this State, it is believed, has never exercised the right of eminent domain in favor of mills of any kind. Sites for steam-engines, hotels, churches, and other public conveniences might as well be taken, by the exercise of this extraordinary power." (See p. 662.)

Chief Justice Parker of Massachusetts, referring to the flowage of his State remarks: "We cannot help thinking, that this statute was *incautiously* copied from the ancient colonial and provincial acts, which were passed when the use of mills, from the necessity of them, bore a much greater value, compared to the land used for the purposes of agriculture than at present."

Whether Judge Parker said this during a period of financial depression when mills were being burned to get the insurance, I have no means of knowing. Certain it is that good judges have looked with suspicion and dislike at the overthrow of common law rights by flowage acts, since their beginning in our legal history.

It would be a pity, wouldn't it, to transform a good farmer into a middling lawyer or legislator by obliging him to defend himself with the weapons of these professions? Every man to his calling, certainly, but we are continually being called to new duties outside our special business.

I urge home manufactures, because the nearer home things are made the nearer right they will be made. Panics are organized, and the wheels of industry are stopped when the world becomes too full of manufactured rubbish, catch-penny trifles, and things we foolishly continue making, reckoning without our host, while distant consumers have set their hearts upon something else.

In conclusion, I would advise farmers to study mechanical arts as the proper supplement and outgrowth of their natural studies. Quite as earnestly I would recommend mechanics to study agriculture as the natural safeguard and remedy for a too artificial life. The natural enemies and enslavers of agriculture, mechanics, would disconnect both, in order to weaken and control both.

Mr. Hinman. Before Mr. Olcott leaves, I would like to ask him one question. If I understood him correctly, his objection to the flowage law is, that a corporation doing private business may take private property for its uses, and that this is not in accordance with the general law, that the public is entitled to certain rights over and above any private individual. There is a principle laid down in the law of all nations, that the public in general are entitled to certain rights; that what the public demand as for their benefit, they may take from a private individual. Now, do I understand your objection to the flowage law to be, that you object to that principle of the common law entirely, or do you claim that when a corporation takes land under that law for manufacturing purposes they are not taking it for the public benefit, but for their own private benefit?

Mr. Olcott. I did not object, in the paper I read, to the right of the public to take private property.

Mr. Hinman. The point I wanted to get at was whether you consider that a private corporation taking property for manufacturing purposes is not taking it for public use?

Mr. Olcott. That would depend upon circumstances altogether. If they wanted to start a hotel or a grocery store, it might be a matter of some public convenience, but we should hesitate about letting them have it.

Mr. Hinman. Suppose it was to establish a manufacturing business, then would it be for public use?

Mr. Olcott. That would depend upon what use they were going to make of it, altogether. I should not question that it might be a matter of public policy for the State to encourage manufactures in that way, and it might under certain circumstances be of the greatest public use, but whether it would be under all circumstances is a question. As I view it, a broad axe is a grand tool, but in the hands of an idiot it may do a great deal of mischief. I simply say, that a broad axe is not a thing to put in the hands of an idiot.

Mr. Hinman. I dissent entirely from the view the gentleman takes of the flowage law. That law was passed with the idea that any manufacturing establishment, located upon any of our streams, was likely to be a greater public benefit than almost any other enterprise that could be started there. If Mr. Olcott were asked if the little village of South Manchester, located in his immediate vicinity, is not of more public value than the establishment of a railroad in that vicinity would be, I am sure he would be compelled to say "yes." I say that to every farmer in the vicinity of Manchester, the establishment of the silk manufactory there was of immense value. The manufactories of the Naugatuck valley distribute upwards of eight millions yearly among their employees, as wages. Mr. Olcott's idea that if the manufactories were not there, the hills would be occupied by farmers, is all wrong. They would have been depopulated years and years ago. They could not begin to compete with the West to-day in growing grain for export. The only things we can grow in that valley are what we can sell to those manufacturers. Put us in competition with the West, and we are beaten at once. That law was enacted with the direct idea that there might be manufacturing villages established throughout our State, and can be sustained only upon that idea. That a railroad, or highway, or any other improvement, may not damage a particular individual, or may not hurt his feelings, I do not pretend to say; but I do say that any thing which is for the general good, we should all be willing to acquiesce in.

Mr. OLCOTT. Perhaps Mr. Hinman would allow me to ask him one question.

Mr. HINMAN. I won't dodge.

Mr. OLCOTT. Whether he would say that in every instance in which the flowage act is brought into exercise, it would be a public benefit? All the question I raise is, whether we should not consider these things? I think if Mr. Hinman will read what I have said carefully, (I have gone over it hastily,) he will not object so much. I am only saying that we should consider whether it is always of public use; that is all.

Mr. HINMAN. My answer would be very short to that. No human law is perfect and will fit every single case. It is necessary that our laws shall be so formed as to meet general cases as they rise. I know of no law that may not by some chance inflict hardship upon particular persons. I say very plainly, that there are cases in which the injury to a private individual may be greater than the benefit conferred upon the public. The property may not be put to any public use, or be of any public benefit; the man who undertakes to establish a mill may fail and swindle all the people about, and certainly it would not be any public advantage in that case; but the law, as a law, is one of vast importance to our State, and one that we should be very poorly off without.

The CHAIRMAN. The question box will now be opened by the Secretary.

QUESTION. With a good farm to work upon in Connecticut, what has a boy to gain in the long run by leaving the old home here and going west?

Mr. GOLD. He cannot gain anything, says one. Does anybody object to that answer?

Mr. WEBB. I will tell you one thing he can gain—a wicked experience.

QUESTION. If a field covered with heavy oat stubble is to be planted next spring, which is the better way, to turn that stubble in or to burn it?

Mr. AYRES of Farmington. Turn it in, by all means.

Mr. Burr. In reply to that I will state a little experiment that I tried. I was ploughing a lot that was very weedy in the spring; I ploughed up half of it and burned over the rest. I planted the field with grain, and the crop was very much better where it was not burned.

Mr. Robinson. I would inquire if there is anything in that stubble which would not be left on the ground in the ash, provided it was burned? If the stubble was burned over, it would be very much less work to plough that field, plant and hoe it, than if it was turned in. Now, if there is nothing in that stubble but what would be left in the ash after it is burned, why is it not a better way to burn it?

Mr. Gold. If it was *so and so*, as Mr. Robinson says, then his conclusion would hold; but I do not understand that it is *so and so*.

Mr. Hale. In case the soil was stiff and heavy, would not the mechanical action of the stubble be worth a great deal, to say nothing about its value as manure, in loosening the soil? I think it has considerable value in that way.

Mr. Ayres. In clearing up two fields upon my farm, the brush, leaves, and everything upon one were burned, and then the land was seeded down; on the other, we were very careful not to have the brush, leaves, stubble, etc., burned; and the one upon which the material has rotted down is very much the best piece of land, and I take it, and my neighbors take it, that burning the brush and leaves injured the land. I thought that would answer the question in regard to the ploughing in of stubble.

Question. What constitutes a successful farmer?

Mr. Spurr. Perhaps a good farm would help him a good deal.

Mr. Fenn. Brains to run it would be another essential thing.

Question. How can a dozen or more calves be raised profitably from the milk of four cows?

Mr. Barnard of Bristol. I would say, by the addition of a little wheat meal gruel to the milk.

Mr. Kimberley. I say by feeding those cows high enough to make them give twelve pails of milk a day.

Mr. Gold. Various kinds of porridge are provided as substitutes for part of the milk with very great advantage. I have never found anything better than a porridge made from linseed meal and flour; but, as the gentleman says, a porridge of wheat meal would doubtless be the best addition to the milk of those cows.

Mr. Barnard. I would like to ask Mr. Gold what quantities of oil meal he would use a day for a small calf?

Mr. Gold. We never feed anything but pure milk when the calves are young. After the calves get to be a few weeks old, we begin by putting a handful of oil meal into two or three quarts of water, which is scalded, and when it is cool enough to be mixed with the milk, it is used. Then we increase the oil meal and diminish the milk, increasing the amount of porridge which is given, sometimes substituting Indian meal or wheat meal for a part of the oil meal; but linseed meal has had my preference. Mr. Hart can speak upon the subject of feeding calves upon linseed meal.

Mr. Hart. I can answer that question by saying that I have raised calves that never knew what milk was, never were fed with milk at all. I am now raising calves, or they are being raised on my farm, with a less proportion of milk than twelve calves to four cows. I do not purpose that they shall have any milk after they are about three weeks old. They are now fed on skim milk, and getting a less quantity than twelve calves would get from four good cows. My substitute is ground oats mixed with the milk. Warm water is added to the milk and to the oat gruel, and they are allowed to eat through the day, as they want, dry oats ground, with hay. They are doing very finely, and when I was on my farm last week, I found they were progressing very satisfactorily. This is an important matter to milk producers. The shippers of milk in the Housatonic Valley, when they first commenced, relied upon cows that were brought in from New York State, or wherever they could be obtained, and ceased raising their own cows, until the results satisfied them that they were pursuing a wrong policy, and that they must resort to raising their own cows if they wanted to obtain the best results. We miss the succulent food of the June grass in raising our calves that are dropped in the fall of the year, and therefore I am trying the experiment this year of raising the heifers from my best cows, feeding them as I have told you. So far I am satisfied, and I believe the experiment will be entirely successful. As soon as I get oil meal, I am going to add that.

Mr. Barnard. Do you take the pains to sift the hulls of the oats out?

Mr. Hart. Not at all. They very soon become accustomed to it, and eat it with great relish.

Question. Has any one followed that practice long enough to know whether the heifers raised in that way will make cows that will give large quantities of milk?

Mr. Hart. Years ago, thirty, perhaps, I was studying the question of raising calves by cheaper methods than by feeding them on milk, requiring the milk for other purposes in order to produce an income, and I read in an extract from an English journal that cows raised upon linseed meal would make better milkers than those raised upon any other food, and it gave as a reason, that it was a laxative food, enlarged the milk glands, and as they grew up, these were larger than in cows raised upon milk. The statement looked to me reasonable, and the first year I tried it upon fourteen calves, and, as I said in my opening remarks, a majority of those calves never knew the taste of milk. They were taught to drink without being allowed to suck at all. I used whey and oil meal exclusively, and the result was the best dairy cows that I have ever raised or ever been able to get.

Mr. Bill. I rather like the reply given by the gentleman in front: feed those cows so that if the calves have but one teat apiece, they will find enough milk there. Milk is the most natural food for calves. The finest Devons, those lady-like in appearance, are the cows that will raise your calves naturally, and make good cows.

Mr. Hart. I believe the proof of the practice is in the result. We formerly raised our calves as Mr. Bill has proposed, giving them all the milk they would drink, and we never failed to lose a large percentage by what we call murrain before they were a year old. I have never lost one that was raised upon oil meal and these other substances, and I have raised a great many more in that way than I have upon milk.

Mr. Weed of Danbury. I would like to inquire of Mr. Hart what he does to counteract the scours in calves when he feeds oil meal? I have fed it with skim milk, and that has been my trouble.

Mr. Hart. If you will use in connection with it ground oats, I do not think you will have any difficulty in that respect.

Mr. Gold. If the trouble with your calves from scouring is from contagious diarrhoea that has got into your calf pens or your stables, you have got something more to do than merely withhold the oil meal.

Mr. Bill. I will say to this meeting that I have raised from ten to thirty calves a year. I have tried every way to raise those calves and raise them cheap. I say to you here, that I had never had any success in raising good calves except by letting them draw their own milk. I have drawn that milk, or caused it to be drawn, and fed to the calves, and somehow the milk did not appear to do the calves that amount of good, they did not grow as well, as when they took it naturally from the cow. I have fed them in every way to try to raise them cheap, and it has only had the effect to put those calves back in their growth. When I have let my calves draw the usual amount of milk, I never have had one that had the scours, I never had one that did not thrive; but whenever I have tried to raise them in any other way, I have had more or less trouble.

Question. Will Mr. Gold inform us what fertilizers he used in raising his large pumpkin?

Mr. Gold. Well, sir, my faith is in barn yard manure, that was all that was used.

M. Sedgwick. In this connection, I would like to have Mr. Gold tell this audience where he gets his pumpkin seed. He raises the most wonderful amount of pumpkins of any farmer that I ever saw. It is a perfect sight to go into his corn fields and see the pumpkins, and if I am not mistaken, he has some different seed from what most of us possess.

Mr. Gold. I obtained my seed of Mr. Robert Little. Mr. Sedgwick is one of our best farmers, and I have no doubt he has been as successful in raising pumpkins as myself. I believe in the pumpkin as one of the natural crops of Connecticut, and we should continue to cultivate and encourage it here and not lay it aside. I give it a fair chance, that is all.

Question. Why will not cabbage do well on the same ground two years in succession?

Mr. Halsted. A possible reason may be stated something like this: That the cabbage plant is troubled very frequently by a fungus called the cabbage fungus, or the club-foot fungus. We must bear in mind that it is a disease that attacks the root of the plant, and if the cabbage is infested with this disease, it is intimately associated with the soil in which that crop grows. Let us suppose that the first year there is a certain amount of this disease; spores are formed in large quantities by this club-foot fungus, and they are thrown off and incorporated with the soil. Plant the soil again with cabbage the next year, and there you have the spores ready for quick and thorough work upon the coming crop. They take right hold and go to work, and usually the result is you have a poor crop of cabbage, if you have any at all worth harvesting, the second year; that is my explanation.

Mr. Wakeman. I think we can raise cabbage a second year and a third year on the same ground by putting on plenty of manure. The cabbage is a gross feeder, requires a great deal of manure, and takes a great deal of strength from the ground the first season. I have heard of parties raising cabbage six, seven, and eight years in succession by giving them high cultivation.

Question. Is steamed food of any benefit?

Mr. Webb. I know how it is myself, and I have known a good many others who have found out how it was themselves.

I was in hopes the public curiosity was fully gratified in regard to that subject. My own experience is, that I would not give a cent a ton to have any article of food that I feed my cattle steamed. It is a great deal of expense and a greal deal of trouble. I have an impression that the souring of the food, the presence of steam from the food and from the steam box in the stable, and the combination of circumstances resulting from it, has a bad effect on the health of the cattle. As I said once in the "Country Gentlemen," speaking of steamed food, I waited like an old fogy, as I called myself, five years before I went into it; then I put in some works and continued it five years, like an old fool, as I found myself.

Question. What should we do to rid ourselves of the cabbage worm?

Mr. Augur. Mr. Chamberlain, of the reform school farm in Meriden, who has been very successful in raising cabbages, told me a few weeks since that brine strong enough to bear an egg not only had the effect to kill the worm, but also improved the cabbages.

Mr. Kimberley. Worms were quite plenty on my cabbages, and I was told to throw a handful of fine salt over them. I did so, and the cabbages headed nicely and I had a good crop; no worms upon them.

Question. What is the best way to prepare slaughter-house refuse for a fertilizer?

Mr. Van Hoosear. I should say, compost it with horse manure.

Prof. Brewer. If the question means on a large scale, as it is done in slaughter houses, there is no better way than to dry it. But the machines are expensive, and it would not pay an ordinary farmer to prepare it in that way. If the question refers to the small quantity that would result from killing pigs or a beef or two, I do not know what would be the best way.

Mr. Bill. I do not think Prof. Brewer got the idea as I got it from hearing the question. Around cities where there are slaughter houses, many farmers buy the refuse for the purpose of putting it on their farms. I have heard a great many complain that the land was injured because they did not know how to fix it for the farm. That I think is the point of the inquiry. I would like to hear the Professor upon that point.

Mr. Sedgwick. I would say, in that connection, that a farmer would probably get the best results in using that material by extending it with five or six times its bulk of earth. It is in too concentrated a form to be applied as it is obtained from the slaughter house.

Question. Is insoluble phosphoric acid of any value as a fertilizer?

Prof. Brewer. So long as it remains insoluble, no. Most forms of phosphoric acid are very slightly soluble, decompose slowly; some of them very slowly indeed; and there is nothing of value as a fertilizer, in the popular sense of that word, that is insoluble. No solid goes into a plant as nourishment. It must go into it in the form of liquid or gas.

Question. Are Colorado beetles killed by eating Paris green or by its external application?

Mr. Gold. I suppose that they eat it. Does any one differ from me in that opinion?

Question. Will lightning rods properly constructed and put up afford protection to buildings?

Mr. Plumb, of Trumbull. I do not think they are reliable. I knew of a house in my neighborhood that was apparently well protected by rods, and it was struck by lightning, and the lightning left the rod and went into the house, and did considerable damage. I made up my mind that lightning-rods were no safeguards against lightning, however they might be put up.

Mr. ———. The insurance agents tell me that they will insure buildings without lightning rods at the same rate that they do buildings with lightning rods.

Prof. Brewer. That does not apply to ships. I believe that when lightning rods are well put up they afford protection against lightning. They very frequently are not well put up. They are very frequently insufficient in size. Lightning-rod men, it is said, sometimes have smooth tongues, and it is also said they sometimes put up too small rods. I have in my possession various specimens of bad rods; one, for instance, that was put up on the City Hall, I think, in New Haven; it rusted out in a year or two, and was taken down. It was not more than one quarter large enough. I believe there is not a case on record of any iron building ever being injured; there is not a case on record of a ship that has been properly protected ever being injured. There are innumerable cases of churches that have been struck over and over again before the days of lightning rods, and never struck afterwards, where the rods have been properly put up. It seems to me that if lightning rods are well put up, they are a protection. It is true that insurance companies generally will make no difference as between buildings that are protected by lightning rods and those that are not, and they make no difference because they cannot know whether the lightning rod men put them up well, or the persons on whose buildings they are put keep them up well afterwards.

QUESTION. Will you tell us how to put them up well?

Prof. BREWER. In the first place, you want a rod large enough to convey off any charge that may come. If the rod is iron, it should be at least three-quarters of an inch in diameter; if copper, not necessarily so large. A rod one foot high will protect two feet each way. That is on smooth surfaces. If you have a chimney on one end of a house, and you put your lightning rod on the other end, and there is a fire in the chimney, then the lightning rod will not protect it in that proportion; the electricity runs down on the warm current in the air. The rod wants to be carried down into moist earth, far enough to be a protection, and buried in some good conducting material, like pulverized charcoal. Fifteen years ago, when we proposed to put up lightning rods upon the school with which I am connected, we were visited by divers and sundry agents; they were very anxious to put up rods for us, because, if it was known that we had employed a particular rod, it would be considerable of an advertisement for it. We were so importuned that we did not use any of them. We examined a good many lightning rods, and concluded to put one up ourselves. We found that the largest rods that were offered us only contained one-third the conducting material that they should have had; and not only that, but the copper in those rods was sold at from three to seven times the amount that we could buy it for. We took four large wires and twisted them together and put up a rod. I may say that it had not been up but a little while before the rod was struck by a flash which was sufficiently severe to jar down glass in the building, wake everybody up in that vicinity, and melt the tops of the wires. But the rod protected the building perfectly.

QUESTION. I will inquire whether it would be necessary for the rod to be higher than any other object; for instance, a tree standing near the house. Would it be necessary that the rod should be higher than the tree in order to afford protection?

Prof. BREWER. Yes, to protect the tree, but not to protect the house.

Mr. SEDGWICK. A year ago this past summer, my farmhouse, which has two large elms close by it, and which is protected by a lightning-rod on the opposite end from the trees, was struck by lightning. The lightning struck one of the trees, glanced from that to the rod, went down the rod almost to the ground, and came in through the side of the house, making a hole through the plaster large enough to stick your finger through, and shaking up the neighborhood pretty thoroughly. In that case, the tree did not answer as a perfect conductor, nor the lightning-rod either.

Mr. HART. Would a lightning-rod terminating in a cistern constantly filled with water afford adequate protection?

Prof. BREWER. No; I believe there are some cases where that has not been sufficient. I may say that you may have occasionally a discharge so exceedingly severe that the building must be a good deal better protected than buildings ordinarily are to escape injury. The one of which I spoke, that melted the wire, was an illustration. There are cases on record where an iron rod, three-quarters of an inch in diameter, has been heated red hot; but such cases are exceedingly rare. I dare say that in the case Mr. Sedgwick mentioned there was an exceedingly strong discharge, and his rod was not large enough to carry the electricity all off.

Mr. Augur. I would like to ask Prof. Brewer if the lightning-rods which are made and offered to the public at present are any of them sufficient, or as they should be?

Prof. Brewer. I cannot answer that question, whether *any* of them are. I know that a good many are not. It is possible that some of them are. It is not true that surface makes any difference. We get two things mixed. When electricity is still upon the conductor of an electrical machine, it is only on the surface; but when in motion it moves through the whole mass. The amount of electricity conveyed through a rod has nothing to do with its surface. If you take a wire and roll it out flat as a ribbon, it will convey no more and no less electricity than the round wire. The electricity that is collected in a Leyden jar, for instance, is only upon the surface; but when it moves, like the electricity that is used in conveying messages by the telephone, or any form of electric apparatus where the electricity is in motion, or in a lightning-rod, it moves through the mass, and the larger the conducting mass the more easily it moves. As a consequence, an iron ship, or an iron car, or even a car upon a railroad with a large amount of iron about it, is never injured by lightning. Take it on the western plains, where emigrant-wagons have been repeatedly struck. I dare say many of you have seen emigrant-wagons having lightning-rods attached to them. There is no case on record where a railroad-car has been struck, and the reason is, that there is a very large amount of metallic surface, and a great iron rail underneath the car to carry off the electricity.

Question. Will scions taken from a tree bearing odd years, when grown upon another stock, follow the habit of bearing the odd year?

Mr. Augur. I think there is no certainty about that; they may or may not. There are so many other circumstances that intervene, that I think that cannot be calculated on with certainty.

Question. To obtain the bests results in feeding green corn-stalks to milch cows, should they be wilted before feeding, or fed as soon as cut?

Mr. Hart. They should be wilted, according to my experience.

Question. How long?

Mr. Hart. From twelve to twenty-four hours.

Mr. Spurr. I have fed a great many green corn-stalks, and the only advantage in wilting them that I can see is in the less weight we have to handle. I have tried the experiment of feeding them to cows as soon as cut, and feeding them after wilting for twenty-four hours, and I could never see any difference, except that it is less work to handle the stalks after they are wilted, because there is less weight.

Mr. Hart. I adopted that practice because my cows would eat wilted stalks better than fresh cut.

Mr. Cheever. Feed your cows with such food as they like. If they like wilted corn fodder better than freshly-cut, give them that. If they prefer green corn fodder, give them that.

Mr. Webb. My experience has been that they prefer wilted corn fodder to any other. After it has been wilted twenty-four hours, they eat it with a better relish and with less waste.

Question. One of our farmers has for a number of years applied solely horse manure to his land, and the result is not satisfactory. The soil is a sandy loam, well located. Is the kind of manure the cause, and why?

Mr. Gold. I do not understand the drift of that question: whether it is the manure that is at fault, or the land that he puts it on.

Mr. Crosby. My experience has been that fresh horse manure is very poor for sandy, light soils. It works admirably on heavy soil.

Question. How did sweet corn originate?

Prof. Brewer. Nobody knows when or where. That is just what I would like to find out. Dr. Sturtevant thinks sweet corn is the latest of the varieties. In the very earliest descriptions of corn that we have, we find there were various kinds. The earliest picture of corn that I know anything about, the engraving of which was made in 1549 or '50, shows several kinds. The earliest writings about corn in Mexico speak of several kinds. But Dr. Sturtevant, who has been looking up the matter of sweet corn, says that he can find no allusion whatever to it before the seed catalogues printed in the early part of the present century. I have also been looking up the authorities on the subject, and I have found no allusion to sweet corn before the present century. I have not the remotest idea where or when or how it originated, and if anybody can throw any light upon it he will really do us a favor by making it known.

Recess until 7.30 p. m.

EVENING SESSION.

Vice-President HYDE occupied the chair, and introduced as the lecturer of the evening, Hon. B. G. NORTHROP.

THE HOMES OF OUR FARMERS.

By HON. B. G. NORTHROP.

The homes of any nation form a true index of its condition and character. The homes of the people of any calling plainly tell their traits and state—their thrift, foresight, and ambition, or their sloth, slackness, and improvidence. The Indian's low wigwam alone, shows how little he cares for the rich acres of the prairie around his hut. As "the hope of America is the homes of America," so the hope of our farmers is the homes of the farmers. When one's home is his pet and pride, he feels new interest in his farm, and new nerve to improve every acre. But neglect and slatternliness around the home are too plain signs of shiftlessness and improvidence in the management of the farm. No better service can be rendered to farming interests than that which shall tend to improve and ennoble the farmers' home life.

The farmer's home should be healthy, intelligent, social and sunny, attractive and tasteful.

First of all, the farmer's home should meet *the best sanitary conditions.* Physical vigor is the foundation alike of mental growth and business success. The material precedes and conditions the intellectual. Health is the prime essential to success in any calling. "The first wealth is health." "The health of the people is the foundation upon which all their happiness and all their power depend," are mottoes worthy to be memorized in our schools.

Startling statements have been widely circulated as to the unhealthiness of farming. Statistics have been summoned to prove that farmers are short-lived and as a class predisposed to insanity. A few years ago a prominent physician of New York mustered statistics and arguments to prove that the cultivation of the soil is not the most healthful mode of life for the laboring classes—that farmers are not long-lived, but are especially liable to depression and insanity. The figures of various lunatic asylums were summoned to confirm his conclusion.

Two facts are here to be noticed at the outset. Many persons, reared on the farms of New England, follow business callings in the cities and villages, becoming merchants, manufacturers, clerks, agents, or adventurers in chimerical schemes, who, when failing in health or business, return to the old homestead, and as a dernier resort, resume farming. But long since estranged from this calling, with no interest or ambition in it, driven to it by stern necessity, depressed in spirits, bankrupt at once in purse and hope—is it strange that their health and even reason should give way?

The second fact bearing on this subject is the error of many lunatic asylums in taking down the calling or profession of the patients. The class just named are counted as farmers, though they really broke down in other pursuits which occupied most of their lives, and though the final failure was delayed or alleviated by the very calling, which in the hospital record has the credit of being the procuring cause.

The "hired men" are often confounded with the land owners and real farmers. Many day laborers—those occupied with odd jobs of all sorts, but more in farm work than any other *one*, are often classed as farmers on the hospital list. The friends of the patient naturally name the most reputable of his various kinds of labor, though he may have been a jack at all trades.

Says Dr. Earle, Superintendent of the Lunatic Hospital at Northampton: "Out of 1,074 admissions, 126 are set down as farmers. But in these are included, not proprietors or land owners alone, but the mere laboring agriculturalists as well. The number under this head is the largest of any in the table. Let no one hastily infer that, of all classes, farmers are the most subject to mental disorders. Nothing could be more erroneous. In the four counties from which this hospital chiefly derives its inmates, agriculturalists are overwhelmingly more numerous than any other section of the population as classed by occupation. So far as mere employment is concerned, as a generative cause of insanity, the farmer unquestionably is less liable to that disorder than perhaps any other person. He is in a sphere more nearly natural than the artisans, the mechanics, and the professional men of a civilization abounding with artificial conditions and influences."

The eminent New York physician cited above, who so confidently affirms that farmers are short-lived, says in regard to England: "In passing through a lunatic asylum, the visitor is surprised to find that the most numerous class of unfortunates are from the farm, yet in England only about one-fifth of the population is agricultural." But the number of farm *laborers* is large as compared with those there recognized in the census as farmers – or the managers of large estates. When I recall what I saw of the miserable condition of these farm laborers in England and Scotland, I only wonder that insanity is not *more* common among them. Lest I may seem to exaggerate, I quote the words of the favorite of the working classes of Great Britain. Says John Bright: "Fearful suffering exists among farm laborers in almost every part of this kingdom. What wretched, uncared for, untaught brutes, in helpless, stolid ignorance, are the people who raise the crops on which we live, and what dirt, vice, and misery in the houses where seven or eight persons of both sexes are penned up together in one rickety, foul, vermin-haunted bed-room—their wages reduced to the very lowest point at which their lives can be kept in them. They are heart-broken, despairing men—reduced to such brutality, recklessness, audacity of vice and extreme helplessness that they have no aspirations to better their condition." Rev. James Martineau says: "Where is the laborer by whose hand the soil has been tilled? In a cabin, with his children, where the domestic decencies cannot be." Says Rev. Dr. Riggs, of London: "His cottage is too often a wretched double cell, where penury cowers, chastity can hardly survive, female delicacy must be unknown—the house only a shelter, full of cumber and litter. Such are the homes of a majority of our English peasantry in the southern, western, and south middle districts, and of many in most parts of England, and in wide districts of Scotland and Wales." That insanity should abound among such a class is not strange. Dr. A. E. Macdonald, Professor of Medical Jurisprudence in the University of New York, and Medical Superintendent of the New York City Asylum for the Insane, recently stated that the proportion of the insane to the sane in different countries was about 1 to 1000. In New York State, according to the latest statistics it was 1 to 800, but in England it was 1 to 300. It is a well attested fact that insanity is *specially* prevalent in England.

A careful investigation of the question of the health of the farmers of Massachusetts was made a few years since, under the direction of the State Board of Health. Some fifty eminent physicians, practicing in different agricultural districts, were invited to give the results of their wide observations and experience on the various aspects of this question. The Board of Health published an elaborate report, embodying the conclusions and practical suggestions of these competent judges. As the most authoritative testimony available on this subject, I quote freely from this valuable document, summarizing its most important statements and conclusions. The most reliable statistics as to the longevity of farmers are contained in the Massachusetts Registration Reports.

Thirty-seven of these annual reports have been issued, in the last of which is given the following table, showing for the last thirty-five years the average age at death of the citizens of Massachusetts, who were engaged in one of the following occupations and were over twenty years of age :

All classes and occupations,	51.15
Cultivators of the earth,	65.57
Active mechanics abroad,	53.05
Professional men,	51.27
Merchants, financiers, agents, etc.,	49.06
Active mechanics in shops,	47.97
Laborers, no special trades,	47.91
Employed on the ocean,	47.15
Inactive mechanics in shops,	44.45
Females,	39.72
Factors laboring abroad,	37.42

This table shows that the average age of all classes and occupations at death, was 51.15, but that of the farmers was 65.57, or 14.42 above the general average, and 12.52 more than the next highest class, namely, active mechanics *abroad*, that is those not confined in shops. Though the replies of the medical correspondents and other reasons slightly reduce these high figures, the general conclusion is, that a farmer's chances of long life in Massachusetts are greater than those of any other class.

But it does not follow that the wives and children of farmers are longer lived than those of men in other callings. That they are shorter lived than the farmers themselves, was made clear. Farmers' wives are too often brought under influences tending to shorten life. Favorable as these statistics are, there is undoubtedly much *needless* sickness among farmers, and more still with their wives. Every effort should be made to discover and remove the causes of disease. The science and art of sanitation which are now doing so much to prolong human life, should especially brighten the farmer's home. Barbaric races are comparatively puny and short-lived. Old men are seldom found among savages, and the rate of mortality is proportioned in some measure to the degree of barbarism, while early deaths everywhere diminish as the science of sanitation advances. The increase of knowledge, the influence of Christianity, and the advance of civilization have greatly lengthened human life. This fact is abundantly established by statistics in all the most educated countries of the world, and by the careful investigations of Life Insurance Companies and Public Boards of Health.

"In ancient Rome, in the period from two hundred to five hundred years after the Christian era, the average duration of life. even *in the most favored classes*, was thirty years." In Geneva, Switzerland, the statistics show that the average length of life in that city in the sixteenth century, was 21.21 years—in the seventeenth century, 25.67. In the first half of the eighteenth century, 27.75—in the last half, 36.25, while to-day it is about 43 years. Many similar statistics might be given, showing that there has been marked progress in the length of life during the past few centuries. This progress will surely continue as men study the causes of disease and the means of preventing it.

Our wisest sanitarians declare that at least one-third of the diseases of modern life are preventable. Dr. Simon, chief medical officer of the English Privy Council, says that "the deaths which we in each year register in this country (now about five hundred thousand), are fully a hundred and twenty-five thousand more numerous than they would be if *existing knowledge of the chief causes* of disease as affecting masses of population, were reasonably well applied throughout England." It is probable that with our greater population, a still larger number of lives in America might be prolonged by the more general study and observance of the laws of health.

In speaking of the causes of the wonderfully rapid accumulation of wealth and capital in modern times, Professor W. H. Brewer says: "The material wealth and working capital of the civilized world has more than trebled within less than a life-time, and now more than equals all that had been saved in all the thousands of years that had gone before, and that too, while there has been a more general enjoyment of the comforts of life and a much greater indulgence in its luxuries. The causes usually assigned for this rapid growth are the invention of modern machinery, the use of steam as a motor, the modern means of transportation, the application of the natural sciences to the arts and industries, the spread of popular education, the diminution of wars and the production of the precious metals. All these have had their influence, but the greatest of all causes is to be found in the better average health of civilized countries and the longer average term of life which is now secured to working men." The Connecticut Board of Health say, "Sanitary science has proved that many of the diseases which act as the principal factors in producing death, are preventable and controllable by practical hygienic measures, from the neglect of which, not only are many precious lives wasted every year, but many also crippled and dwarfed by disease ; lucrative enterprises abandoned, hopes blasted and poverty and want induced, if not pauperism, vice, and crime, from the distress caused by the losses resulting from unnecessary sickness and death. It costs to be sick and more to die, and if we simply estimate the cash value of the lives wasted each year, during the productive period of life in this State, the sum would be expressed in many millions of dollars." Such facts and statements clearly show that there can be no investigation more important than that which discovers the secret of health and the sources of sickness. The motto "health is wealth," applies to none more than to farmers. It is a good omen that they are beginning to learn that many of our pestilential diseases may be prevented. *How* to prevent disease and pestilence is a question which should be carefully considered both in our schools and homes.

What are the causes which tend to injure the health of farmers and their families, is one of the practical questions on which the report named above gives the professional opinions of many medical experts. The more prominent of these causes are *sanitary* defects, pertaining to barn-yards, hog-pens, privies, cess-pools in too close proximity to wells and hence impure drinking water, filthy cellars, lack of ventilation, ignorance of hygienic laws, overwork, and want of recreation. Much prominence is given to the matter of improper diet and poor cooking. Good yeast bread is too scarce, and vile compounds with cream-tartar and saleratus or soda are too common, because they are so quickly and easily made. There should be more fresh and less salt meat, less frying in fat and more boiling, broiling, and baking. There should be no ground for the complaint of Dr. Derby, of Boston, that "no improvements in the manner of preparing food for daily use, stand the least chance of adoption, unless they are labor-saving."

Every girl should learn the art of cooking, and first of all how to make good yeast bread. With the rich as well as the poor, this should be regarded as an indispensable part of a girl's education. Her future housekeeping, even if living in affluence, will be more likely to ensure her own comfort, as well as that of her family, if she has a practical knowledge of housework. Our children should be early taught, both in the family and school, that to learn to be useful is alike their duty, privilege, and interest. In order to give a practical expression to this view, I offered a series of prizes last summer to the girls in the Morgan School at Clinton, who should make the best yeast bread. The fine loaves of some thirty competitors, made the duty of the lady "judges" one of real difficulty. Though a great number of valuable prizes are given out at each anniversary of this Institution, none awakened greater interest, than the bread prizes which were distributed last season by the hand of Lieut.-Gov. Bulkeley. It would be well if the wholesome sentiments he then expressed in favor of teaching the art of bread making to our girls, could be widely heard and accepted. Valuable as prizes may be in stimulating youth to highest effort and excellence in the various school studies, the stimulus now greatly needed by our girls is that which shall create new interest in the art of cooking.

Pies and cakes are used to an injurious extent. Wendell Phillips says that "since slavery is abolished, the next great revolution needed is the abolition of the American nuisance of pies." This article is seldom, if ever, found on the Continent of Europe, though still used to a limited extent in England and Scotland. The excessive use of unwholesome pastry is pronounced by the medical authorities as the most frequent cause of dyspepsia.

The more common diseases among farmers are first, pulmonary affections in various forms; second, rheumatism; third, dyspepsia; fourth, fevers, especially of the typhoid type. Every possible precaution should be employed to guard against these insidious enemies. We need to reiterate the old motto, "An ounce of prevention is worth a pound of cure."

The farmer, with his active out-door life, can digest almost anything, and often thrives on a wretched diet, but the wife and daughters, living too much in-doors, grow pale and dyspeptic on the same fare. They need to learn and practice the pedestrian habits of the women of England. It is largely because they exercise daily in the open air, that the latter retain so long the bloom and vigor of youth. More out-door exercise would promote the health and prolong the lives of American women. Though dyspepsia stands third in the list of diseases among farmers, it is the first in its prevalence among their wives and daughters.

In many cases farmers' wives suffer from overwork, and sometimes this is true of their children. The duties of the farmer's wife are *excessive*, when to the bearing and rearing of children is added general housework, including the cooking for farm laborers, besides her own family and the care of a dairy.

The *location* of the farmer's home is often in a low, damp, and unhealthy spot. Low ground is preferred as more accessible, more shielded from winds, nearer springs, and more convenient for digging wells. The early settlers in New England sought the hills and mountain sides to escape malaria. When that danger disappeared, the tendency of their descendants was to the valleys, and many now suffer from damp locations, near wet meadows, and little above the water level, or on hard pan which, holding the surface water, is always wet and cold. In such cases, cellars are damp and the drainage poor. It is by no means affirmed that farm houses are more likely to be badly located than houses in our cities and villages, but in the latter, there is little or no choice. Farm houses may be and ought to be *better* located than city residences. Low sites, where the house drains are sluggish, the fogs frequent, the air stagnant, and the effluvia from out-buildings confined, should always be avoided.

Next in importance to location is cleanliness in the surroundings of the farm house. The fact that these are already preferable to those around the tenement houses in our cities is no reason why they should not be still better. Typhoid fever is one of the four special dangers of the farmer. This preventable disease is invited by the putrescent animal and vegetable matter around his house, which poisons the air he breathes and the water he drinks. This mischief comes usually from faulty drains, sometimes from an open, stagnant drain under the kitchen window, or from neglected privies or cess-pools too near the well. Sometimes a cellar made foul by cats, rats, or decaying vegetables, taints the air of the whole house.

The direction that needs greatest urgency and iteration to householders is, *look carefully to your wells.* Visiting every town of Massachusetts while officially serving that State, and more recently every town in Connecticut, I have often learned of the ravages of fatal diseases caused by drinking impure water. Some of our towns, naturally favorable to health and longevity, have suffered fearfully from the prevalence of diseases evidently caused by neglect of hygienic laws. Hence, in the very constitution of most of our Rural Improvement Associations, in specifying their purposes and aims, I have placed prominently, "the promotion of public health by securing better hygienic conditions," and many sanitary improvements have already been made, especially in the matter of drainage, removal of waste, and guarding wells and water-supplies from impurities. Many wells are found to be vitiated by surface water, fouled by impurities and decomposing substances lying on the ground.

Dr. Derby says: "A well receives drainage from a circular area, whose diameter is one to three times the depth of the well, varying with the character of the soil. A well twenty feet deep should have no privy, pig-pen, barn-yard, drain, or slops or garbage thrown upon the surface, within thirty feet in any direction." This rule, which gives the minimum distance, is often violated. Col. Waring and most sanitary engineers would make the distance much greater. If the waste water from the kitchen were thrown upon a *new* spot each time till the old place was dry, the sun and air would purify the ground, and though this plan is untidy in appearance, the *well* would not suffer.

When I take the liberty of remonstrating with householders as to the proximity of their wells to sources of contamination, I often get the reply: "My father and grandfather used the same well and they were long-lived;" and my answer is: "The longer in use the worse for *you;* the more time there has been for conduits to form from the cess-pool to the well. New wells are not so soon affected, but old ones thus surrounded are more liable to be foul." When asked—"Is not the water in that tumbler clear and pure?" I reply: "*Apparently* it is, but that is no *proof* of its purity. The eye and taste cannot detect impurities that may be fatal in their effects. The saline property coming from the kitchen sink may make it more sparkling and agreeable to the taste." In some cases, the well is at the edge of the barn-yard, so as to supply both the stock and the family, or close to the back door, where the slops are habitually thrown near it. Bad water is harmful to all stock, but especially taints the milk of cows.

The Connecticut State Board of Health report very many cases of typhoid fever and other diseases as traceable to such wells.

When not properly covered or curbed, wells are often fouled by decaying leaves, dead rats, toads, and the like. After the fatal ravages of typhoid fever, diphtheria or dysentery, impure drinking water has been plainly proved to have been the cause, both by chemical tests of the water and by careful excavations which discovered the conduits running directly from the cess-pool to the well. The fact that the pursuits of the farmer are favorable to health and longevity is no reason why he should not exercise the utmost caution in guarding against all these preventable diseases. The art of promoting health and prolonging life should be carefully learned in the school and applied in the family.

Pulmonary affections stand first among the four most common diseases of farmers and indeed of the community at large. Two causes are assigned for this result. One is, needless exposure to cold and wet, especially wet feet, and another is bad posture. There is no harm in facing all kinds of weather, provided one is suitably protected, but relying on his physical vigor and endurance, the farmer risks the wet and cold without the wraps essential to security. The theory of hardening one so as to mind neither wet nor cold, is fallacious. No degree of health, strength, or endurance is ever gained by getting wet through or chilled through and through. The attempt to harden one's-self in this way is a hazardous experiment.

The second cause of pulmonary trouble is a stooping posture. Some work, like setting out plants, spading, hoeing, mowing, and weeding, favors a cramped posture, but none of them necessitates it. Indeed one can better bear *any* work if he keeps his chest expanded and his lungs well inflated. He can do any kind of farm work better by bending at the hip than by curving the spine and contracting the chest. The French, Swiss, and German farm laborers are far more erect than American farmers. The admirable attitude of the scholars in the schools of Europe was a mystery to me, till I learned that the military spirit was all pervasive. Every boy in Germany, expecting to spend at least two years in camp, is early trained at school to be "erect as a soldier." "Sit up" is the order everywhere enforced. Well would it be if our farmers' boys and all our youth, so commonly enervated by stooping, would imitate this example in European schools. No words need such iteration by American teachers as "sit up." Nothing would tend more to promote national health, or guard more effectually from pulmonary attacks. The importance of this subject is strikingly illustrated in the history of the Japanese. Until recently chairs were not used in Japan, but the people sat upon their feet placed behind them in a stooping posture, contracting the chest and compressing the vital organs. The Chinese use chairs and sit comparatively erect. Hence, compared with them, though a people kindred in many other respects, the Japanese are short-lived. But, compared with the French and Germans, we, as well as the Japanese, are a race of stoopers. Our youth should learn that they will live the longer and be the stronger, if they sit erect, walk erect, work with a firm back-bone, and sleep at least straight, keeping the form in the position to favor full and deep breathing. Then sleep will come the sooner and be the more refreshing.

The farmer's home should be one of intelligence. To no industrial calling is education more essential than to the farmer. He needs to keep posted as to the improvements in agricultural processes and products, implements and stock. All science bears directly or indirectly on his calling. Hence a first-class agricultural paper is a good investment, and a good weekly paper should keep him familiar with the movements of the day. Farming need not be and should not be a plodding routine life. For his own sake and that of his family, the farmer should not be ignorant of current events at home and abroad. The brain and body should work together for the highest health of each. As a general rule, the dull and stupid die first, while those who exercise most both mind and muscles live the longest. The farmer labors most cheerfully and satisfactorily when his mental horizon is broadened and his eye can look far beyond the sphere of his daily work.

A farmer's home should be intelligent for the children's sake. His thoughts, sympathies, and efforts should all center in their well-being. No birth-day presents are better for them than choice books. A list of choice books for youth, with their prices, will be furnished free to any teacher or parent in Connecticut, on application at the office of the State Board of Education, Hartford. A child will read a book with greater interest which he owns himself than one which he borrows. The all-important habit of reading will be still further encouraged if children are supplied with a suitable juvenile journal like "Harper's Young People," "St. Nicholas," or "Youth's Companion." Children should be trained to read *aloud* in the family good papers or books This will deepen their interest in what they read, both from the contact of mind with mind and from the questions and discussions sure to follow and to add attraction as well as information. At frequent intervals the year round, and regularly in the winter evenings, this genial influence should cheer and instruct the circle around the family hearth. A pure taste may thus be formed, which will exclude the flash literature so tempting and mischievous to those not trained to appreciate the good and noble in thought and style.

Cheerful conversation should be one of the daily attractions of the home—conversation on what they daily see, and do, and *read.* Conversation is an art which now needs to be specially cultivated in the home. Properly practiced, it becomes a prime educator, awakening curiosity, sharpening perception, cultivating attention, quickening both the memory and imagination, and developing versatility, tact, and vivacity. To learn how to talk well should be the constant aim of both home and school training.

The farmer's home should be social and sunny. Guizot said: "There was nothing France needed so much for its regeneration as fireside diversions." The isolation of the farmer's dwelling should suggest the special necessity of his favoring home amusements. Children are active, restless, eager for occupation, which should be both work and play. They need amusement, as truly as sleep. Play helps the mental, social, and physical growth. It is the dictate of Nature. The young of all animals play. For the children's sake, appropriate amusements, sanctioned and sometimes shared by parents, should occupy fit intervals for recreation. All men need recreation in some form. To move constantly, like a machine, in well-oiled grooves is not the secret of mental or moral health. The greatest and best men love at times to unbend to an innocent sportiveness. Gloom and goodness have no natural affinity. "A merry heart doeth good like medicine." Certainly to the mental health of children, cheerfulness is as essential as water to the fish. Joy quickens the moral as well as mental powers, for goodness does not more certainly make men happy than true happiness tends to make them good; while gloom chokes out the very life of the soul. A heart without hope is like a ship without sails. No right enjoyment ends with the present moment. One may be ever happier, for having been happy. The pleasant memories of to-day may enter into the very texture of our being. A sunny childhood tends to illumine a life-time, and when the lapse of years obscures other memories, this remains the last that time can ever efface. To formulate the pleasure and pain of each passing period of human existence in the style of Isaac Taylor, "an hour of life is the present good and ill plus the good and ill of all past hours, dimly or vividly reflected upon it."

We need more heartily to cultivate home *affections*, provide home *enjoyments*, and foster home *courtesies*. In the every-day intercourse of home, there should be a more sacred observance of the amenities of life and a freer interchange of kindly feeling. As flowers seem worthless only to the thoughtless, so the morning and evening salutations in the family may seem little in themselves, but when fitly observed are mighty in their *influence*. As the sunbeam is composed of myriads of minute rays, so the home should be illumined and brightened by nature's richest hues without, and still more by winning smiles within, cordial greetings, loving looks, gentle words, sweet laughter, and nameless little kindnesses. Such amenities and affections should be the sunshine of home. They refresh and purify the social circle. Like the clinging vine, they twine themselves around the heart, calling forth its purest emotions, and securing its most healthful activity. Such a home is worthy the name, Ordinance of God. Such a heaven here will help prepare its members for the heaven above. Such an *ideal* may be an inspiration towards its realization.

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, from which they may reap a harvest of happiness and virtue. The memory of a beautiful and happy home, and a sunny childhood, is one of the richest legacies parents can leave their children. The heart will never forget its hallowed influences. It is a fountain of enjoyment to which the lapse of years will only add new sweetness. Such a memory is a constant inspiration for good and restraint from evil. If taste and culture adorn our homes and grounds, our children will find the healthful pursuits and pleasures of rural homes more attractive than the pomp and glare and whirl of city life. Such early occupations and enjoyments will invest home life, and then school life and all one's future, with new interest and value, with new significance and joyousness. Life is ever what we make it. We may by our blindness or folly or sin live in a world of darkness and gloom, or we may live in a world full of sunlight and beauty and joy, for the world without always reflects the world within.

Foremost among the sensibilities to be cultivated in the home are the affections. They are the spring of all noble action and the groundwork of our usefulness and happiness. Here are found the motives which most strongly stir the human soul, which form the characters of men, enlist their energies, and determine their history. In the affections, most of all, are found the impelling forces of human nature, the best dynamics of the mind, prompting its most healthful activity, without which the mind is like a well-furnished factory, with no propelling power—its cards and jennies and looms all still as the grave, while the engine is cold. But kindle a fire in the furnace below, and lo! a thousand spindles and shuttles resound with the choral din of industry. So, kindle a glow in the sensibilities, and all the springs of mental life are at once in motion. Without this vivifying power, the intellect is like an iceberg, resplendent indeed, but only with a cold and sterile brightness—so the cold and selfish soul is sterile in heroic virtues. But the affections dignify homely drudgery, make tough toils pleasant, painful sacrifices easy, and perils and privations cheerfully endured. There is often a genuine heroism in the home, unsurpassed if not unequalled by any which the world loudly lauds on the battle-field.

I know well there are those who deem such talk of home affections effeminate and unmanly. While woman may feel, it is the glory of man to think and reason, is the shallow sneer of the cynic, and unfortunataly not his only. The notion is common as it is mischievous. Our educational processes aim too exclusively to train the intellect and ignore the sensibilities. The two so necessarily influence each other that neither can reach its full strength alone. Even the lower emotions, such as the grand, the awful, the terrible, the ludicrous, and especially the beautiful, feed the activity of the mind. Still more our social, moral, and religious affections, our emotions of gratitude, reverence, humility, and love are to the mind what air is to the lungs. The culture of these sensibilities is essential to give man individually or socially his fullest development and power. Character is molded more by feeling than thinking, or rather by thought only so far as it awakens emotion, and thus moves the will. Says Brown: "By our minds alone we are mere spectators of the machinery of the universe, by our emotions we are admirers of nature, lovers of man, adorers of God."

These principles of our social nature should be cared for in early life, and so influenced as to form habits of courtesy and kindness in all the child's relations to the domestic circle and school associates. The school, like the family, should be valued as a social institution, constantly furnishing occasion for the culture of social virtues and performance of social duties. Let children early learn that the affections expand as well as adorn the mind, promoting their happiness as well as usefulness, that true enjoyment springs not from selfish pursuits or solitary gratifications, but from sympathy and fellowship in happiness. By cheerful obedience to parents and teachers, and by all the numberless opportunities of daily life, let them learn the luxury of giving pleasure—of doing good. For they will please and profit most, both themselves and all around them, who aim not to please, but to *give* pleasure. There is a heaven-wide difference between these two motives. One may aim to please in order to tempt or cheat. The Devil is the greatest expert in pleasing in order to ruin. But one who habitually strives to *give* happiness is acting under an ennobling principle. Let our youth be so trained to the practice of truth, honesty, sympathy, and benevolence, that they shall be spontaneously mindful of the rights, interests, and happiness of all around them. Let them learn in contrast the meanness and misery of greed and selfishness, of rage and revenge, that the churl imbitters first and most, his own life, that all discordant passions bring disquietude and pain, and especially that an irritable spirit is a perpetual fountain of bitterness. Outbursts of passion, like those of Guiteau, are not to be excused as the sole effects of hereditary or constitutional tendencies. Whatever may be one's natural bias, the temper is not *fixed* by nature like one's complexion, but may be disciplined and should always be under control. Its *early* restraint or indulgence, largely determines the sunshine or shade of one's future, whether he shall be the child of reason, or the slave of a lawless master, the victim of paroxysms of passion, for when uncontrolled, the temper becomes a petty tyrant, destroying one's influence, happiness, and health and often shortening life.

An eminent physician, Superintendent of a State Lunatic Asylum, says: "A cross and fretful temper is a fruitful source of insanity. Hence when any man finds himself habitually ill-humored, he should employ every means in his power to get rid of the infliction." It is the law of our mental constitution, that emotions, propensities, and processes of thought once distinctly manifested, tend to repeat themselves automatically. Hence the urgent necessity of restraining the child that is habitually peevish under the slightest provocation. When he finds that nothing is gained by fretting, but that some loss or deprivation is sure to follow every outburst of petulance, he soon learns the all-important lesson of self-command.

Our State Reform School sadly illustrates the value and need of a social and sunny home. In answer to my inquiry as to the causes of juvenile crime, Dr. Hatch, when Superintendent of that institution, said to me: "Three-quarters of these boys are orphans, and of the remainder, the majority are children of parents who have either separated, or who live unhappily together"; that is, these boys had been trained for crime, mostly in the street school. The endearments of a happy home they had never known. The house where they only ate and slept had been the scene of strife and contention, which repelled its inmates. Who can tell the wearing and wasting of hope and heart and health on the part of children, especially of intemperate parents by their spleen and passion which often lacerate like the tearing of flesh from the bones, or else sear and harden against all good influences. From such homes it is not strange that after the evening meal, so many boys habitually hasten to some shop, saloon, or bar room where they throng together, leading an exposed and gregarious life.

The farmer's home should be tasteful and attractive.

My interest in the work of Rural Improvement centers in the improvement of the homes and home life of our people. But much as has been done in this direction, there still remain too many homes and grounds desolate, neglected, and repulsive, where taste and trees, shrubbery. hedges or creeping vines, with a lawn. would make "the wilderness blossom as the rose." Unquestionably neglect and slatternliness in and around the house repel from their rural homes many youth who might otherwise be bound in strongest ties to the fireside. Our farmers and mechanics and their thoughtful and thrifty wives are beginning to realize how easily and economically, often without any outlay of money, they can surround their homes with flowers, the Virginia creeper, grape vines, or trees, and thus increase the beauty, the attractions, and market value of the homestead. These embellishments of the home and grounds help to cultivate domestic sentiments.

Without a Rural Improvement Association our best towns fall far short of what they might be and ought to be. Too often, neglected private grounds, dilapidated dwellings, barn or sheds, or a street ugly with piles of decaying brush or chips, discarded fruit cans, broken harrows, carts or sleds, a front fence with pickets missing and a disabled gate, give an air of shiftlessness that sadly mars the effect of an otherwise beautiful village. Here an Association is needed to develop that private taste and public spirit which will remove such defects and disfigurements. When every citizen is thus stimulated to make his own grounds and wayside not only free from rubbish, but neat and attractive, the entire town becomes so inviting and home-like as to give new value to its wealth and new attractions to all its homes. Such affectionate care and attention to the homes indicate a kindly, intelligent, home-loving people; and no better praise need be given to any people, than that they tenderly cherish their homes and therefore tastefully guard the surroundings of their daily life. These surroundings, trifling as they seem to many, are the more important, because they are constant forces in moulding character.

Modern civilization relates specially to the homes and social life of the people, to their health, comfort, and thrift, their intellectual and moral advancement. In earlier times and in other lands, men were counted in the aggregate. They were valued as they helped to swell the revenues or retinues of kings and nobles. The government was the unit, and each individual only added one to the roll of soldiers or serfs. With us the individual is the unit, and the government is for the people as well as by the people.

It is a good omen that public interest in the embellishment of rural homes and villages is widely extending, and that the varied charms of the country with its superior advantages for the physical and moral training of children are attracting many thoughtful men to the simple enjoyments and employments of rural life. With the growth of public taste, the day is not distant when beautiful country seats and villages will abound throughout Connecticut. Dr. Bushnell, with his keen observation and intense love of rural scenery, was wont to say, "No part of our country between the two oceans is susceptible of greater external beauty than Connecticut." A taste for rural adornment is a source of physical, mental, and moral health as well as enjoyment. The parentage of parks, lawns, trees, flowers, vines, and shrubs becomes a matter of just pride and binds one to the spot he has adorned.

The hankering for city diversions and excitements, and ambition for easier lives and more genteel employments, have brought ruin to multitudes and financial disaster to the nation. A great peril to the land to day comes from the swelling throngs, ranging from the reckless tramp to the fashionable idler, who are ever devising expedients, foul or fair, to get a living without work. The disparagement of country life has been one of the worst tendencies of the times.

There is protection as well as education in the fervent love of home. Patriotism itself hinges on the domestic sentiments. When one's home, like that now hallowed ground at Mentor, becomes the Eden of taste and interest and joy and love, those healthful local ties are formed which bind him first and most to the spot he has adorned, and then to his town, county, State, and country. Said Garfield to his neighbors, as he last looked upon his beautiful Mentor home: "You do not know how much happiness I there leave behind." His history shows that whatever adorns one's home and ennobles his domestic life, strengthens his love of country and nurtures all the nobler elements of his nature. On the other hand the nomad with no local attachments, can have no genuine patriotism. As content in one place as another, and truly happy nowhere, he is like a tree planted in a tub, portable indeed, but at the expense of growth and strength. The home should be the first place to develop a love of flowers, vines, and shrubs by cultivating them, and thus early foster a taste for the beautiful in nature, in art, and still more in character.

All the utilities, beauties, and grandeurs of nature culminate in the formation of character. As the human face, beaming with kindness and intelligence, is the most beautiful of all visible objects, so, of all objects of thought, character has challenged the highest admiration and prompted the profoundest investigation. Now character is formed mainly in the home. The Hebrews always magnified the home, and it has been the home, in every age, in the face of civil disabilities and of persecutions unparalleled, that has magnified that marvelous race. Archdeacon Hare said: "To Adam, Paradise was home, to the good among his descendants, home is Paradise." Says Goethe: "He is happiest, be he king or peasant, who finds his happiness at home."

It has long been my aim to improve the home life of our farmers and of all our industrial classes and to help them realize that the highest privilege and central duty of life is the creation of happy homes. The best product of Christian culture is a refined and kindly Home.

THIRD DAY.

The meeting was called to order by Vice-President HYDE at half-past ten o'clock, and the Convention was addressed by Mr. Edward Norton, of Farmington.

ASSOCIATED DAIRIES—METHODS OF RAISING CREAM.

BY EDWARD NORTON, OF FARMINGTON.

When I promised Mr. Gold to address you on the subject of Associated Dairying, I supposed that this meeting would be east of the Connecticut river, where there is comparatively little sale for milk or butter, or of dairy products. In that region a discourse on this subject might be of value. It might seem a little like missionary work.

But here, in the heart of the milk region, it is a different matter. Your market for milk is already made, and you do a large and successful business. As a whole, there is not so profitable a mode of dealing with milk as to sell it at once. Doubtless you have already considered the policy and wisdom of working together or separately, and I can add little to your knowledge of this subject. Doubtless there are some present who can add greatly to the information which I shall lay before you, and I hope to hear from such in the discussions which may follow. It is difficult to present all that one would say in a brief discourse, and I have preferred to touch only on the leading points as they occur to me.

The subjects allotted to me are two, Associated Dairies, and Methods of Raising Cream. I regard the first as of so much greater importance at present, that I shall give most of my time to it. The term Associated Dairy applies to the factory system as distinguished from the single farm dairy, and as a rule, factory buildings are erected for this purpose, with the necessary appliances and machinery, which are owned and controlled by the patrons sending milk. But they are sometimes built by individuals and rented, or otherwise run as may be agreed.

I propose to speak first on the history and present position of Associated Dairying in this country; second, on the benefits occurring from the system.

First as to the history. All writers point to Jesse Williams of

Rome, New York, as the originator of the factory system of dairying, in 1850.

Some others had tried the same plan before, but he was successful in such a way as to induce others to follow in his track. Progress at first was slow, as is usual in such cases. In 1860, in ten years, about thirty-eight factories were erected. During the war, the scarcity of labor made factories desirable, and by the end of 1866 five hundred factories were in operation—the cheese factories being devoted to cheese alone—the creameries to a mixed sale of cream, butter, and skimmed milk, or skimmed milk cheese. In 1870, the product was so great and of such quality, that factory butter and cheese were included in the regular market quotations, and from that time until now, always at higher prices than farm dairy products.

In 1872 Mr. Willard estimated the number of factories in New York State alone to be over one thousand. This number has increased so greatly, that it is now supposed to be nearer two thousand.

In parts of Canada and Ohio and Pennsylvania, many factories were in operation in 1872. At about that time I heard it gravely urged in a dairyman's convention in Utica, that there was a natural dairy belt of country beyond which the production of butter and cheese must necessarily be small. Portions of New England, and perhaps Western Virginia might be included, but outside of the favored region were prolonged droughts, and no good summer pasture. (At this time very few creameries ran through the winter.) But what a change a few years has brought about! A few winter factories in the neighborhood of Elgin, Illinois, have demonstrated that grain and meal can take the place of our superior hay, and that winter made butter can be as good as any other, and more cheaply produced than in the East. The superior enterprise of the Western dairyman has grasped the situation, and invented various methods of gathering milk and cream suited to a sparsely settled country. Patrons find that dairying in many cases pays better than selling grain, and so the purchase and breeding of cows is going on on a great scale in northern Illinois, Wisconsin, Minnesota, and Iowa—the northern States making more cheese than the others. It is stated that one hundred and fifty cheese and butter factories have been erected in Iowa during 1881, making a total of over five hundred in that State, and many more will be added next spring. Like the dragon's teeth sown by Cadmus, they spring up armed and equipped for battle, and they increase and spread as rapidly as the Western prairie fire.

Even the staid Dutchmen of Pennsylvania and New York have caught the fever. In the fall of 1879 a creamery was built in Quakertown, Pa., on the North Pennsylvania Railroad, about sixty miles from Philadelphia. In January, 1880, a statement was printed claiming a return of 5.35 cents per quart for milk on that one day. During that spring I visited Quakertown to see how such profits were realized, and found the whole country-side in excitement. "Why," said an old farmer to me, "one year ago we would have laughed at the idea of building one creamery, and now forty are going up." On the 15th of September, 1881, so many creameries were in operation, mostly in the above section, that they met and established a Board of Trade in Philadelphia.

It is estimated that more than six thousand factories are now in operation over the northern United States and Canada. It is moderate to say that the milk of 300 cows is sent to each, making a total of 1,800,000, or 2,000,000 cows contributing to these factories. Probably 2,500,000 would be nearer the truth.

As a necessary consequence of this great movement in manufacturing, has come the establishment of a Board of Trade in central points for the purpose of marketing. These have proved to be of the greatest benefit both to the seller and the buyer. The purchaser has no longer to run around to find what goods are for sale, and the salesman need no longer be the victim of unreported changes in the market. Then, too, the maker is by comparison with the goods of his neighbors and by the prices they bring, stimulated to do better himself. The sales at the Boards of Trade on stated days furnish the basis of prices for their respective sections of country, and are widely announced by telegraph.

The Dairymen's Associations through their meetings and printed reports during the past ten years, have exercised a wide and important influence. They have engaged the best talent in the country in their service, and their reports are a mine of information on almost every topic. The earlier reports were much taken up with cheese making—later, butter making and the treatment of milk has assumed more prominence. The subjects in the 15th Annual Report of the American Dairymen's Association for 1880, are as follows :

Hygiene in the Dairy Herd.—*Prof. James Law.*
Cattle Plague.
Hygiene in the Manipulation of Milk and its Products.—*Prof. F. E. Engelhardt.*
Facts, Figures, and Reflections in the Dairy Business.—*T. D. Curtis.*
Ensilage.—*J. B. Brown.*
Dairy Buildings.—*Prof. E. W. Stewart.*
Methods of Setting Milk.—*Prof. G. C. Caldwell.*
Improvements in Cheese-making.—*Prof. L. B. Arnold.*
Milk Records.—*Solomon Hoxie.*
The Centrifugal Cream Separator.—*Edward Burnett.*
Winter Butter Making.—*Freeman A. Cole.*
Report on Dairy Implements.
The International Dairy Fair of 1879.—*John R. Chapman.*
Needed Improvements in Butter Making.—*C. J. Newton.*

These meetings are large and fully attended, and are of great value also for the debates and exchange of opinions on the various topics presented.

From this brief sketch you can see what a revolution is in progress among the farmers of the northern states, and all working in their favor by ensuring to them the best possible prices near their homes.

We shall soon hear the cry that this thing is overdone, and doubtless this will be the case with inferior goods, but as yet the supply seems hardly equal to the growing demand.

The benefits accruing from this system, are—

1st. In the quality of the product. Under this system the cloud of secrecy which hung about the best individual methods has been swept away, and the very best makers are employed by the factories. The milk of most of the farmers of a town is gathered into a building erected for the purpose, and is made into butter or cheese by one man or woman, instead of fifty. The whole is of uniform quality, day after day; so that it generally gets a reputation of its own, which it retains as long as the same conditions remain. The whole generally commands as high a price as the best produce of the best single maker of the town before, and often receives a much higher average. This is a point which the best home butter makers are slow to confess, for in theory, the milk of a single herd of cows fed and treated with care and cleanliness, with first-rate dairy appointments should produce a better article than the milk of all sorts of herds of cows sent to a creamery. But in practice, it is the other way. I hold in my hand the last quotation of the market. 8th December, creamery fancy, forty to forty-two cents, wholesale; State dairy, good to prime, thirty-seven to thirty-nine cents; choice fresh, thirty-four to thirty-five cents; dairy cheese not quoted at all.

Under the factory demand, a class of experts have grown up, who have trained themselves to the business, and whose tenure of situation is dependent upon their intelligence and skill in their business. The farmer who makes a poor article can get along in some way and persuade himself that he does about as well as the rest. (I have seldom found a man who would acknowledge that he came short.) But the foreman in a factory cannot hide his talent under a bushel.

These experts are assisted by each other and by their employers, by the patrons and by the dairymen's conventions, and by the united pressure of associated factories upon the State, so that the aid of science is called in both at private and public expense, with the object of improving dairy products. The inventive genius of the country also is called into play, so that countless methods, called improved, are offered to the public. The ordinary mind is overwhelmed in the effort to grasp and discriminate between them all—to prove all things and hold fast the good.

2d. We see a benefit also in the quantity of the product. Before 1870, American dairy produce commanded a very low estimate abroad, neither butter nor cheese coming up to the standard. Now the makers of English cheese can hardly hold their own in the home markets. In 1864, New York produced 85,000,000 lbs. of butter, and 72,000,000 lbs. of cheese. Last year about 100,000,000 lbs. of each. But though the quantity increases so greatly, the demand, both at home and abroad, keeps up with the supply. Of course there are seasons when the market will be glutted and prices will be low, but the steady increase of demand is quite as remarkable as the increase of supply.

3d. The system has given a definite value to milk and greatly cheapened its production. Of course the value of milk differs very greatly in different localities, but wherever there is a creamery or cheese factory, the farmer may be sure of getting about the value of his milk, according to the season.

The associated dairy relieves the farmer from all the expense and labor of manufacturing his milk and selling. It takes all that he makes or can make, almost at his own door, and gives him a certain market.

It also *pays* him for his milk. It is a responsible body at home with whom the farmer has to deal. There is no store pay, or promissory notes, but cash in hand semi monthly or monthly, regularly. When prices are low, it pays little, but it pays all the times will warrant; when they are high, it pays as well as the rest.

Factories cannot make bricks without straw, nor can they by any scientific process turn a poor article into a good one. But where they are properly managed, they bring up the standard of all they receive, and keep such an oversight of their patrons as results in mutual good, and hence their effect upon the people.

Their united action has given a direction to the thought and labors of tens of thousands of farmers, and has already elevated dairying to be one of the great acknowledged industries and powers of the land. Heretofore, with few exceptions, each dairy farmer has worked independently, picking up his knowledge by experience, and dependent for his pay upon the neighboring grocers. The associated dairy teaches the value of coöperation, of casting aside the distrust with which many farmers regard their neighbors, and joining heartily for the common good, as being the best means for personal good also. In this, as in many other things, "union is strength."

Thus far, you will notice, I have not mentioned Connecticut. What progress has this old State made in this direction? The answer is short. East of the Connecticut river, not one factory. In the Western part of the State there are, I am told, about three creameries. At Durham one, at Cheshire one, opened this year. West of Hartford, five. In all about ten.

As I have hitherto spoken in general terms, I will go somewhat into particulars about the Farmington creamery, to show you that creameries need not be a failure here more than elsewhere.

The Farmington creamery was erected in the spring of 1870 by a stock company; capital $4,000, increased to $4,500, with 32 stockholders. It received milk about five months in 1870, from 75 to 100 cows, taking about 80,000 quarts of milk.

Opening again early in 1871, it has been run continually, winter and summer, ever since, and has steadily grown, adding about 100,000 quarts a year to its receipts. It should be stated that Farmington, originally quite a dairy town, had quite run out in this direction, and the people as elsewhere had to reorganize their herds.

In 1880 the milk received was 1,304,742 quarts, and the amount paid to patrons for milk $40,155.97.

The highest price paid for milk since 1876 has been 4.78, the lowest 2.10.

Number of patrons, 57; size herds 2 to 30 cows.

Three patrons received over $1,700 each; eight, between $1,000 and $1,700 each; thirty between $500 and $1,000; sixteen below $500.

The monthly payments per quart were as follows:

January, 1880, 3.50; February, 3.40; March, 3.60; April, 3.10; May, 2.40; June, 2.40; July, 2.60; August, 2.60; September, 2.09; October, 3.40; November, 4 cents; December, 3.80; average for the year, 3.15½.

The average for 1881 will be about 3.30.

Sales in 1880: Butter, 88,760 pounds; cream, 24,048 quarts; new milk, 6,965 quarts; skimmed milk, 857,595 quarts; cheese, 13,399 pounds.

Milk received in 1881, about 1,400,000 quarts, and payment to patrons will be about $45,000 for the year.

Average payment to patrons since 1876 as follows:

1876, 3.29⅙; 1877, 3.57½; 1878, 3.00; 1879, 2.79⅙; 1880, 3.15½; 1881, 3.27.

The total amount paid since opening:

1870–71, $12,070.96; 1872–80, $199,861.24; 1881, $45,000; making a total of $256,932.20.

The number of patrons in 1881 was 60. My own herd of cows in 1880, about 25 in number, received from the creamery over $70 per head, over $1,700 in all.

The total number of cows now between 700 and 800.

The effect of this creamery upon the town has in my opinion been very marked; in promoting harmony among the farmers and general good feeling; in checking the tide of emigration from the town and selling out of farms; in keeping a number of young men at home; in the general improvement of farms, and increase in number and quality of the cows.

Great efforts have been made in Farmington to improve the quality of the cows. Besides the thoroughbred Jersey and Guernsey cows, there are a great many high-bred grades and crosses. So many this year that the color of the butter will satisfy the customer without artificial coloring, and of such quality that last Saturday it brought fifty cents per pound.

In contrast, let us see what satisfies creamery patrons elsewhere. Farmers who have sold their cream at their doors this last summer in Iowa, have netted eight to twelve cents per cow per day, or from $20 to $30 per head for the year, besides leaving all the skim milk at home.

The writer waxes enthusiastic over this system and says: As long as cows can be pastured on other men's land through the summer, and in winter on hay costing less than $2 per ton, and on grain raised on his own land, we see no more profitable way of farming.

In Central New York the farmers almost universally practice summer milking. As a rule, they average from 1.75 to 2 cents per quart for the eight summer months.

In view of the success of properly managed creameries throughout the country, it is a matter of surprise that instead of ten in this State, there are not 100 now in operation. There is not so much capital needed as good business management, and proper coöperation on the part of the farmers. In large districts there seems to be a lack of faith, and farmers hold off for others to spend their money and insure success before they join.

Farmers in the eastern part of the State say to me: "This is an excellent plan, and I wish somebody would come and start a creamery with us." Like Artemas Ward, they are willing to sacrifice all their wives, cousins, and uncles in the cause, but are not quite ready to put their own shoulders to the wheel. In this they may be to some extent wiser than some who have started creameries in a small way in this State, who seem to have forgotten that something more than a factory is needed to insure success. We must add business experience in the management, and coöperation among the patrons. Every town can furnish sufficient business talent, but a small factory cannot, or thinks it cannot afford to hire it, and in consequence suffers accordingly. This difficulty has been met in many places by placing several factories under one management. I could name a number of persons or firms who hire or control from five to twelve, or even twenty factories—the competition from other factories forcing them to pay full prices for their milk.

In the case of the Elmwood creamery, opened three months ago, the difficulty has been met by several individuals who have formed a stock company and built a factory, without waiting longer for the farmers to move in the matter.

Judging from my own experience in creamery matters and in selling milk, I think that the time will come when the farmers of these valleys, who now send milk to New York will be forced for their own safety to form dairy associations. From year to year the railroads carry cheap milk from greater distances at about the same rates as they do yours, and the competition becomes sharper. The factory districts of New York and Pennsylvania are now reached, and will supply vast quantities if the price paid will warrant.

Would it not be wise and prudent for you, who lead public opinion, to take the initiative and devise some plan under which groups of creamery associations, each representing a town, with their factories built as needed, shall combine for one common interest, so as to control your city sales, and the amount sold, and take measures for elevating the standard of quality as well as the quantity.

Under some such system the milk which is sent to New York, may be made to be precisely alike and always of one standard, and furthermore that standard can in a few years be raised, just as it has in Farmington, so as to be unapproachable by any other like systematic effort.

[The remainder of this address on methods of raising cream was crowded out at the meeting by the pressure of other matters, and will be revised for some other occasion.]

Mr. Webb. Will the gentleman state again the date of the establishment of the first creamery, and where?

Mr. Norton. Near Rome, N. Y., in 1850.

Mr. Webb. I have heard that assertion made a good many times and have felt that I would like some opportunity to tell what I know about it, and this is perhaps as appropriate an occasion as I can find. In the early spring of 1844 I was in St. Louis, engaged in the commission business, and received a consignment of cheese from central Ohio. They weighed from ninety to one hundred and fifteen pounds apiece, and they were nice cheese. None of them weighed less than ninety pounds. Having been raised on a farm in the East, and having seen what we used to call pretty large cheese—Goshen cheese—I asked the man from whom the consignment came, "How do you make this cheese? You must have a large dairy." He said, "We make the cheese, but they are not made from one dairy. There are several large dairies in our neighborhood that combine, and the cheese is all made at one place."

Mr. KIMBERLY. I would say that I worked in a cheese factory from 1847 to 1853. That was Mr. Lewis M. Norton's cheese factory in Goshen. He made pineapple cheese from four hundred or six hundred cows while I lived with him. The curd was brought to his factory. I think that was the first cheese factory that was started. A Mr. Hurlburt went from there and started cheese factories in New York somewhere.

Mr. SMITH. I was about to say that I had always supposed that Lewis M. Norton was the pioneer in this associated dairy business, and probably it is a fact, as Mr. Kimberly has just stated.

Mr. NORTON. I did not intend to be understood as saying that there had never been any factories of this sort before. But this was the first factory that led to the establishment of a great many others. The man who established this factory did it in such a way that others took up the matter and followed it up. It is well known that there have been more or less associations of this kind, some as far back as twenty or thirty years, but the business was not established in such shape that it attracted public attention.

Mr. DAY. As this discussion is likely to take considerable time, I beg leave to interrupt it for the purpose of presenting a resolution for the consideration of the meeting at this time.

Whereas, The Connecticut Agricultural Experiment Station, by seven years of trial in temporary quarters, and with limited facilities, has proved itself essential to the best interests of Connecticut agriculture, therefore, be it

Resolved, That the General Assembly be solicited to make a special appropriation to give it independent facilities and to widen the scope of its work.

Resolved, That this Convention appoint a committee of three to present this subject to the General Assembly and to take means to secure their favorable action.

Mr. Chairman: I see no reason why there should be any remarks offered by me in advocacy of this resolution when I see, as I have seen from the opening of this meeting until the present time, such an assemblage of intelligent gentlemen—gentlemen who know their own business, who know their own wants, and who are able to judge for themselves what facilities they require to meet those wants. As is stated in the resolution, the Connecticut Experiment Station was established some seven years ago, and I recollect very well the enthusiasm and the joy with which we hailed the establishment of that station. Connecticut legislation is sometimes a little slow and the people are generally careful, and by this conservative action they generally arrive at results that are tangible and reliable. The sum of five thousand dollars was appropriated for the maintenance of this Experiment Station. Perhaps the legislature of the State of Connecticut thought they would wait and see whether it was likely to be a success on a small scale. They have found out that it is a success, that it is more than a success, and that it has more than answered the anticipations of those who were earnest in the establishment of the station. Now, then, I do not know of a man who is not proud of his own State; I do not believe there is a man here who is not proud of having been born in Connecticut, where common schools were first established, and in a State that has sent out some of the best business men and some of the most intelligent and leading minds of the whole country. I know that we have abundant reason to be proud of such a State as this. I believe that Connecticut was the first State of the Union to establish an experiment station. In that, as in all other enterprises that she has undertaken, she was the pioneer. I am proud of that. Prof. Johnson has stated here that the beginnings of the Experiment Station were too small; that their means were circumscribed; that they were not able to extend their operations in such a way as to meet the public demands. Now, what is the wealth invested in agriculture in the State of Connecticut? Is it too much to say that it is from two-fifths to one-half of the entire wealth of the State? Who pays the taxes of the State of Connecticut? This wealth two-fifths or one-half, I assure you, gentlemen, pays its reasonable share. If it does, is it too much to ask the legislature for an appropriation commensurate with the wants of this institution? I hope the audience will pardon me if I seem a little egotistical in attempting to enlighten an assembly like this in regard to their wants, when I know that they know just as much about the necessity for establishing facts instead of propounding theories as I do. We want science and truth instead of theory, and I trust, Mr. Chairman, that these resolutions will meet the hearty approbation of this convention.

Mr. Hart. The dairy interest and the associated dairy interest in the State of Connecticut demand something from this Experiment Station. Those engaged in the associated dairy enterprise receive milk from the farms in their neighborhood, and in applying the various tests to it they find a very great difference in the quality of the milk. They attribute this difference to various causes that we can all imagine, but we cannot all assert positively. Therefore we need further tests that shall decide the question whether we are imposed upon or not. Feeling the need of this, I have been in correspondence with Prof. Johnson to see if we can employ the resources of the Experiment Station to determine whether or not it is a fact, as our own tests indicate, that we are sometimes imposed upon, and, becoming aware of the fact that the means at his command are so limited as to circumscribe his investigations, I am heartily in accord with these resolutions. He has indicated his willingness and desire to enter into an investigation of this subject by analyzing milk, which will be of great service to the dairy interest. We want a standard of quality. We cannot arrive at that standard without a critical chemical analysis, and we cannot arrive at the fact that we are imposed upon without seeing the evidence of it. Therefore I second these resolutions, and hope the discussion here will bring out an interest that shall act upon the legislature of the State and influence them to furnish the means to go into this investigation intelligently and successfully.

Secretary NORTHROP. I most heartily approve of these resolutions. I cannot doubt that they will meet the cordial assent of this assembly of practical farmers, and that the results will more and more demonstrate the economy of the appropriations made for the Experiment Station. I think there can be no need of a full discussion of this subject, which must commend itself to every intelligent and thoughtful farmer.

Mr. SEDGWICK. Those of us who attended the meeting at Meriden, in which this discussion first came up, and around which gathered the interest which afterwards gave us the Experiment Station, have noticed with admiration and pride the growth of this station. We all know that the interest which built up our Experiment Station was first awakened by the fact that the examinations made by Prof. Johnson, for the Connecticut Board of Agriculture, showed us that we were being defrauded in fertilizers. That was the main thing which built up our Experiment Station. Well, sir, what has been the result of this station, not only to the agriculture of Connecticut, but to the agriculture of the whole United States? Dollars and cents would not express it, sir. The result has been that it has driven out from the market nearly every worthless fertilizer that was offered at the time it was first organized, and you will notice, if you read the pamphlets of the fertilizer manufacturers, that they point with pride to the analyses made by the Connecticut Experiment Station testing their goods. And these reports are published over the whole United States, showing that what the station has done has been not only for our benefit, but for the benefit of the country at large. But this is not the only field that we need experiments in. Mr. Hart has designated one, and there are other departments of our ordinary farm operations which will bear scientific tests, but owing to the limited means of our station, owing to the lack of ground in which they can experiment, they cannot undertake such operations; but it seems to me, as a farmer and tax payer of this State, that we have arrived at a point where we can afford to open up other avenues of investigation into which our scientific men can enter, and that we ought to impress upon our legislature the fact that we need an appropriation large enough to enable us to obtain the benefits of their experiments. I cordially endorse everything that has been said, and second the motion, for the adoption of the resolutions.

Mr. Hinman. When this resolution goes before the General Assembly, it will naturally encounter some opposition. That General Assembly will be composed of men from different ranks of life, engaged in different pursuits. There will be a very large number of farmers, there will be some lawyers, some merchants, and some manufacturers. If this proposition is carried, it must be carried by a majority of that assembly, and we must secure that majority in advance, if possible. Now, it is worth while to consider where the opposition will come from. I want to say right here, that it will not come from the lawyers, it will not come from the merchants, it will not come from the manufacturers, but, if it comes at all, it will come from the farmers. It behooves us, therefore, as members of this convention, feeling the desirability of the proposed action, to go home and labor with the men who will represent our farming towns, labor with them in advance, and have them go up there with the idea that they can do something for us and for themselves in this way.

Mr. Fenn of Milford. I want to ask Mr. Norton if he has had any way of testing the milk which is brought to his factory, and whether he has paid the same price for milk, regardless of the quality.

Mr. Norton. We have adopted various ways of testing milk in Farmington; we have tried all the simpler ways which have been published; the most satisfactory way with us has been with the churn. We have felt the need of some standard to fall back upon which shall be thoroughly trustworthy, and which the farmers must accept, as well as ourselves. I have corresponded somewhat with Prof. Johnson, and have already sent him some milk to be tested. I think that all who have anything to do with creameries feel the need of some method of testing which shall be agreed upon as authority on both sides. For that reason I think that the

Experiment Station promises to be of great value to our dairy interest. Of course, every honest man who deals in milk wants to have the value of it estimated as nearly as possible, and then he will be satisfied. If he does not get enough, he can make it better.

Prof. Brewer. I wish to make a statement here as one of the officers of the Experiment Station. I suppose there is no need of discussing at all to this audience the value of the institution, or what its value has been to the State. I think that is past all argument. We know this, that in the simple matter of the analysis of fertilizers alone, (I speak now without any fear of contradiction,) it is the only safeguard which the farmers of this State have from being swindled beyond all account. There is absolutely no way of telling the value of a fertilizer by looking at it, by smelling of it, or even (present company of course excepted), by the word of the seller. We of course must have some check, and there has yet been no other way devised than some form of examination by persons who are not pecuniarily interested. This State began the examination of commercial fertilizers very early, earlier than most of the states. Many of you do not remember, but I remember very well, when Prof. Johnson began the work of analyzing the commercial fertilizers in the market, and the first thing he did was to show that the specimens that were sent out in little tin boxes for trial were of a very different chemical composition from that which the farmers of Connecticut bought in the bags. He made those analyses before he went to Europe, and after he got away, he was assailed by some of the agricultural papers because of the statements he had made. There was one agricultural paper published in the interest of a concern that was systematically swindling the public that came out and accused Prof. Johnson of lying; it accused him of falsifying analyses; brought imputations against his character; and that controversy was not settled until another man who took up the cudgels for him—I mean Mr. Harris, of western New York, dressed himself as a German laborer, and speaking German very well, went to that establishment and applied for work, as a laborer, and, himself a chemist, went into that establishment and worked as a common laborer for two weeks, and found that the statements made by Prof. Johnson at the outset were correct. Then you recollect that for a number of years the State agri cultural society had analyses made. Then it was done by the Board of Agriculture. It finally came into the hands of the Experiment Station. This State was the first to establish an Experiment Station, and what was the effect of it? The effect was to drive those swindling fertilizers from the State, mostly, not wholly. There is no law, nor anything else which will prevent all swindlers from coming in; they will leak in. One of the twelve Apostles was a Judas. Now, as I have said, the Experiment Station has done a glorious work. It has not stopped frauds in fertilizers entirely, but it has well-nigh stopped them. It has driven those fertilizers so completely out of the State, that the man who was at the head of the agricultural department in Georgia told me that when they began to work there, fertilizers from other states came in, and that one of his first acts was to discover ten thousand tons in one lot that was being sold at forty or fifty dollars a ton, which was worth less than eight. Those fertilizers were driven out of the State of Connecticut.

Now, we have had an Experiment Station for seven years; what we are talking about now is how to obtain the means to establish it on a broader and firmer basis. When it was started, the farmers looked upon it as a sort of trial and wanted it run as cheaply as possible. It has had quarters for five years free of rent furnished by the Sheffield Scientific School. At the time it went there we said that we had a couple of rooms which could be fitted up for the purposes of the station, and it could have those rooms for five years free of expense. The School fitted up the rooms with all the necessary apparatus for laboratory experiments at an expense of several hundred dollars; it loaned the institution apparatus to begin with, and they have been slowly buying the apparatus that has been used since. The five years are up next July, and the Scientific School wants the rooms for its own purposes. For two years students have made application to come in who could not be received because there was no room. We cannot, in carrying out the trust that is placed in our hands of those buildings for educational purposes merely, longer give those rooms to the State under these terms. Next July we have got to make some other arrangement. There is no danger of the Experiment Station being killed. If we cannot have a sufficient building we will rent, but that is going to curtail our work considerably.

Now, we want to go before the legislature and ask, in the first place, for a special appropriation to put the thing on a permanent basis, that it may not be left in a shanty or old cabin that somebody may give it; and, furthermore, that we may have a little more to extend the work and extend the scope of the institution. People are complaining all the time of the difficulty of getting along on account of western competition. How do western farmers get along? What is New York doing now? Running an Experiment Station at an expense of twenty-five thousand dollars a year. If we think that we can compete, by taking up the old methods, with enterprising men living on newer lands than we, without adopting the new methods, we are mistaken. We can hold our own and a little more by adopting all the means that we have in our power. We want the farmers of this State to see it in the right light and to help along this movement to put the Experiment Station on a firm foundation.

One word more I wish to say. Very frequently the inquiry comes up, "Why can we not get land somewhere else?" It is not always that you can get land that will be as cheap in the end. I know a State that wanted to found an agricultural school; it did found an agricultural school. A public-spirited man came forward and gave it a farm for that school. They better have paid that man half a million dollars to have kept his farm. He gave them a farm of two hundred acres. It was in such an inconvenient place that that State, which has spent between one and two millions of dollars there, has spent it at an enormous disadvantage. Now, to take a farm, even if that farm is worth ten thousand dollars (the interest on that would be six hundred dollars a year), and put the station in a place where it would be comparatively inaccessible to the farmers, and where it would cost from a thousand to fifteen hundred dollars a year more to carry on the laboratory work, would not be at all economical. Laboratory work has to be carried on under certain conditions; it is like any trade. I will venture to say that there are a thousand farmers in the State of Connecticut who would give a nice plat of ground to a sewing-machine company, or any thing of that kind, if they would go and plant their works there; but a sewing-machine company could not afford to do it, nor a plow manufacturing company; they want a location where they can do their work to the best advantage, and not be put continually to extra expense in carrying it on. It is just so with us. My belief is that it would be a very easy thing to get quarters where they would not do us any good. It would be a very easy thing to get quarters where it would cost a great deal to carry on the station.

Now, what we want to do is to have an appropriation made so that the money can be expended where it will do the most good to the farmers. I am willing to answer any questions that I can appertaining to the institution, and if I cannot answer them I will say so.

Mr. Hart. How much money does it want to put it on a reasonably permanent foundation?

Prof. Brewer. That is a question which I cannot answer specifically. We ought to have, I should say, from five to ten thousand dollars as a plant, and then an increase of the appropriation for the annual expenses. We can get along with our present means, but we cannot get along well enough. A man who has a grain farm can frequently do his threshing with a two-horse power threshing machine, but it is a good deal better to have a larger machine. I have known grain farms where they have had five-horse power machines. We can use a small sum, but if we have more we can use it to a great deal better advantage.

Mr. Bill. I would inquire of the Professor where it is intended to take the Experiment Station to? Can the State obtain suitable rooms or accommodations except at New Haven, where the station is now located?

Prof. BREWER. Yes, sir; we could obtain anything with the money.

QUESTION. What is the present annual appropriation?

Prof. BREWER. Five thousand dollars. That covers all the expenses such as have not been heretofore covered by gift. The present year, there is an income of about seven hundred dollars additional to that from the licenses for the sale of commercial fertilizers. Then there is a small sum which comes in for analyses made for private parties. Dealers and others sometimes send in fertilizers for analysis, and the station claims the privilege of retaining and using the money that is paid for those analyses. We have had one case (I will give it as an illustration) where a man sat right down in our midst and manufactured a fertilizer from mud which was raised out of the harbor, and sold it as a fertilizer specially adapted for certain crops. That is what some people like, and they would rather pay such a man twenty-five dollars for a spurious fertilizer than pay five dollars for having it stopped.

Mr. HART. Soon after the commencement of the analyzing of fertilizers in this State, I was on a train going to New York, and a couple of gentlemen, strangers to me, sat in the seat behind me, and I overheard some of their conversation. I heard the words "Experiment Station," and one gentleman said to the other, "Oh, all you have to do is to send a check in there, and you can get such a report as you have a mind to." I turned round and said, "Gentlemen, you do not know the men who are at the head of that institution, when you make that assertion."

Mr. BILL. I have been for the last thirty years, every year about the legislature, asking them to do something to advance the agricultural interests of the State, and, sir, Mr. Hinman has stated to you the fact, that the only opposition to the farmers' interest comes from the farming members of the legislature. That is true. I have been to the leading talking men, representing the cities of the State, and told them that we wanted aid for this very institution, and they were perfectly willing to give it, but the farmers said, "It is not necessary, we are getting poor; we are going down hill." And the next day those very farmers would vote fifty thousand dollars for some foolish project, when they would not lift a finger to aid the agricultural interests of the State. Now, I say to you, representing the agricultural interests of the different towns of the State, it is for you to see the farmers of your own towns who are going to the General Assembly, and say to them that this is for your protection; that you have been swindled long enough: and had it not been for this very Experiment Station at New Haven, many of you would be worth hundreds of dollars less than you are to-day, because you would have invested your money in those worthless commercial fertilizers.

I only rose to say these few words. Let this large body of intelligent farmers say to themselves, "we will put this matter beyond peradventure; we will have this appropriation; we will make suitable preparations to secure it," and you will have it. That is all there is to it.

Prof. Brewer. A sugar planter in Louisiana informed me personally, after looking over one of the earlier reports of the Experiment Station, that he had paid more than fifty thousand dollars for the very fertilizers which we had condemned, and he said, "Judging by the results that we have obtained on the sugar plantation, and looking at the analysis, I have no doubt that I have been swindled out of more than thirty thousand dollars of the fifty thousand I have paid." Now, that fifty thousand dollars would have been paid by Connecticut farmers, if it had not been for the check put upon such things by the Experiment Station. I was going to say, in regard to the dock mud fertilizer man to whom I referred, that he did not, I am sorry to say, quite get his dues from the State of Connecticut. He, however, left the State, and outside he was not treated so kindly. Here we let him depart in peace; there they gave him board at the public expense.

Mr. Augur. I represent one of the farmers' clubs of the State, and I know very well the feeling in our farmers' club, and in our community. It is unanimously in favor of a generous appropriation to this Experiment Station. We know its operations too well to doubt in regard to the benefits which it confers upon the farmers of this State.

The matter of fertilizers has been alluded to; I want briefly to mention another matter, and that is, the testing of seeds. Our Experiment Station has given some attention to that matter, and what has been the result? I will tell you. The leading seed dealers in the country, when they import seeds from Europe, now, import them with a warranty as to their vitality, and, if I understand the matter right, they will not agree to pay for them unless they come up to a certain test. How was it before? We all know how we have been swindled with poor seeds. But this is only one thing. There are numerous problems which are yet unsolved. There are some things which may be regarded as probabilities, but they cannot be regarded as certainties. We want these gentlemen at the Experiment Station to make demonstrations there, in the interest of farmers.

Now, I agree with Mr. Hinman. I know, from having been a member of the legislature, that it is a fact that when a matter of this kind comes up before the legislature in which farmers are vitally interested, the strongest opposition comes from the farmers themselves. This thing ought not so to be.

The CHAIRMAN. The chair is very glad to see such enthusiasm on this subject. Gentlemen seem to be proud of showing their hands, and he hopes they will be as proud of showing their hands before the legislature in favor of the enactment of this law. The chair is happy to see a gentleman present from whom we shall all be glad to hear on this subject—Prof. Johnson.

Prof. JOHNSON. Prof. Brewer has been asked the question how much was wanted for the Experiment Station, and he very modestly said, "we will take what we can get, five thousand or ten thousand dollars, and make the best of it." Now, this is a practical question, and we might as well face it fairly and squarely now as ever. The station wants a building built for and adapted to its purposes; just as a creamery wants a building built for and adapted to its purposes; just as a manufacturer wants such a building. The rooms which we have occupied in the Sheffield Scientific School happen to make a very good chemical laboratory and offices. There are inconveniences, but the building has done very well. We probably could not find in the city of New Haven, or in any city in the State, rooms which we could rent at a reasonable rate which would be anywhere near so well adapted for that purpose. I have been looking about to see what I could find. We can get plenty of rooms, but we should have to spend about half of our time in going up and down stairs, and we housekeepers know that is exhaustive of strength, and prejudicial to the best results. We should be unable to carry on our chemical work if we had to go into a city house, which otherwise would give us the accommodations we want. We want, then, in the first place, a building made to suit us, adapted to this special work. We do not need any very expensive structure. A plain brick building, as I have said in my last report, having the capacity of a good-sized dwelling-house, would answer our purposes admirably, but it is necessary that it should be planned for the work, and built accordingly.

Now, with five or ten thousand dollars, we can put up a building of that kind; but if we are going to do anything beyond working analyses of fertilizers and milk, and work of that class, which can be done in a laboratory, if we want to do anything which connects itself more immediately with vegetable and animal production, we want land; not a large amount, but we want a place where we can put out some seeds and watch carefully the growth of the plants. We want some land with a good exposure, such as we cannot get usually in a city lot, on account of trees and near buildings. An acre of land would do very well, two acres would do better, but twenty acres would be too much, unless we have more money to use upon it than we are likely to get. We want also upon that place a plant house, built especillay for this kind of work, having certain characteristics in common with the ordinary green house or propagating house, but otherwise somewhat different. In a house of that sort, we can carry on experiments in the comparison of fertilizers, as to their feeding power for vegetation; we can compare different soils as to their power of supporting crops; we can carry on multiplied and valuable observations under conditions very much under our own control, free from vicissitudes of weather, free from the accidents which insects or birds or boys may occasion, and acquire a vast deal of knowledge in that way in the course of a few years. To do that we want this plant house, and we want assistants competent to look after the work, and the results of a plant of that kind, properly carried out, will be very large for the outlay.

Then there is the question of feeding. There are certain problems in feeding which can be studied with the help of a couple of cows, or a couple of sheep, or a couple of goats, and a little stable where they can be put, with scales to weigh them upon, suitably arranged for supplying them with regular rations, and with a place where the rations can be stored. We can carry on valuable experiments in that way. The most of what is now known with regard to the feeding of cattle, horses, and other domestic animals, that is, carried on scientifically, so far as it is in advance of what has long been known as the result of ordinary practice, has been learned in just this way in the ten, fifteen, or perhaps now twenty Experiment Stations in Germany, in which experiments are carried on upon this plan. It is not necessary that we should have a farm. A farm would be an embarrassment, because the man who knows how to experiment scientifically can not know much of anything else; if he knows that well, he ought not to attempt to do anything else, and a place adapted specially to this purpose wants to be free from any embarrassment from outside affairs. We do not need much land for exact experiments on plants. Mr. Lawes, in England, and others, can afford to use a good deal of land and lay out a great deal of money, and valuable results have come from such experiments, but I would not advise that sort of expenditure in the present state of investigation in New England.

Now, to equip a station in such a way that it can immediately take hold of questions of this sort will require a larger outlay than five thousand or ten thousand dollars. We want our station so located that we can have an abundance of running water and illuminating gas, which we have to use as heat in the laboratory, so that we cannot have a chemical laboratory outside of city limits. We can not set it up in the country, because we cannot there command those conveniences, and the absence of those conveniences is fatal to the doing of good work, rapid work, and economical work in this line. To purchase land within city limits is expensive. I do not know what an acre of land could be got for with access to gas and water. Such land is held at a high price. It may not be worth it, but it costs a thousand or several thousand dollars per acre where it is in a good situation; and while that is a large outlay it is an economical outlay, for you get your money back. The manufacturer who has got work to do which requires that he should be convenient to the telegraph, post office, and railway station, will purchase land at the cost of many thousand dollars an acre, because that first outlay is a saving to him in the convenience of doing his work.

We want then, a building adapted for this purpose. We want it in a city, because we can do the work there more economically than in the country. We want to put in money enough so that we can make a good thing and turn out work rapidly. I should say, if I were the State of Connecticut and had the handling of the money, that I would give twenty-five thousand dollars to plant this institution. Then it could be done liberally, comfortably, not extravagantly.

Now, a station of this sort wants a great many things which it has not got. What could I do as director of the station in planning and carrying on experiments if I were ignorant of what other people were doing and had been doing for twenty-five years past in other countries? Nothing. I should simply be groping in the dark and spending years in getting to a point where hundreds of men around me and in foreign countries, who have been doing this work, could put me in five minutes. I want to start where they have finished; I want to stand upon their shoulders when I begin;

and for that purpose we must have the literature upon this subject, and that is a large literature. As it happens, I have been accumulating that literature, more or less, at my own expense for thirty years back. I have a tolerably good library in that direction, but I have not nearly all that ought to be in a State institution of this sort. I often find that I have been mousing around where somebody has been traveling in broad daylight, and I might have known it if I had the information at hand. The new experiment station ought to have in its possession, as part of the property of the State of Connecticut, accumulated for the benefit of the State, a complete library of the literature of agricultural experiment gathered from all quarters where this sort of thing has been going on. It ought to have the results of all the work now being done by the hundred experiment stations in operation in Europe. I have the reports of a few of those stations; I have a number of journals in the German language, some in French which give the results, but there are many more which I do not have, and which I can not have on my own account.

Now, we ought to have a station able to expend five hundred dollars a year in getting this outside information. That information, if it were disseminated through the State of Connecticut, and put practically in the hands of the farmers of Connecticut, would be worth a thousand dollars a week. The information which is scattered abroad, if it could be made available to you, as it is made available to farmers in other lands, would be worth that amount of money, or something like it. That, then, is one of the things which ought to be done. We want an experiment station set up on the same basis that a post office is set up, not with luxury, but with convenience. We do not want any plush-covered chairs, or any gilt spittoons, but we want the things to do the work with. They cost money, but they do not cost any great amount when we consider them in relation to the interests which are served.

I should say that twenty-five thousand dollars would give us a model station, equal to anything they have anywhere, and I should say that eight thousand dollars a year would run such a station very comfortably. It is no more than they have in New Jersey, and I suppose they could use more there with advantage. There is one thing you must remember, that when a man is qualified for this special line of work, it is done at a great deal of expense. If I had what my education has cost me invested at four per cent., I would be willing to retire; I could live comfortably; but I cannot have it; it is sunk capital for me, to a large extent; and when a man fits himself for scientific work, he is unfitted for other kinds of work. I can not go out now and change my occupation; I have got into a rut; I am unfitted by my training in this direction for the general business of life. You have got to pay a man, if you are going to induce him to go into this sort of thing, a reasonable salary. Sometimes you will find a man who will do it for nothing, and when you do, you are lucky, and he is not lucky. In Germany, experiment stations have been going on for about twenty years. Their chemists are paid very low salaries, as everybody is paid a low salary who works for the government. They have to work very economically; they do not work very hard; and now those who are running the experiment stations have succeeded, some of them, in obtaining the pension which the government officials enjoy in that country as a reward for working for small wages, and working in a line which unfits them for general business. They work there very cheaply, but when they have got done, or are disabled, then they have enough paid them to live on. If you would pay pensions here, you might get your work done more cheaply, but if you will not, you will have to pay more than is paid abroad. It costs money to get good assistants in places of this kind, and at the rates which the station has been able to pay, we shall not be able to keep the men that we have been employing or to get good successors. We have had some excellent chemists in our employ, who, after working a year or two, have gone west to go into some large manufacturing or mining establishment as chemists, where, in three or four years, they will be enjoying more income than the whole station has.

Now, we ought to be able to pay good men such salaries as will induce them to stay with us and devote themselves to the work. I have had, since I came to this meeting, inquiries which were made in a very friendly way, but which filled me with perturbation, for fear that I should have to lose some of the best help that I have now in the station, and perhaps be induced to go away myself.

Mr. Smith. I am very much pleased with the remarks which we have just heard, especially with the leading idea of the remarks, that we should not be too modest in the amount of money which we asked the legislature to appropriate for this object. I believe that we should be more likely to be successful before the legislature, more likely to obtain the appropriation which we asked for, if it was a generous sum, something commensurate with the importance of the object, than if it were a small amount, like four or five thousand dollars. If we should present this subject to the legislative committee as Mr. Day has presented it here, and represent its overwhelming importance to the business of agriculture, and then couple with that a request for the modest sum of four or five thousand dollars, it would look inconsistent to the average legislator, the effect would be unfavorable upon his mind, and he would be more likely to oppose the whole thing than if you asked for a more liberal sum.

The question was then put, and the resolutions were adopted unanimously.

The chair announced the committee authorized by the last resolution as follows: Albert Day of Brooklyn, James A. Bill of Lyme, Philo Clark of Newtown.

Mr. Sedgwick. I offer the following resolution:

Resolved, That the committee just appointed be instructed to ask of the legislature the sum of twenty five thousand dollars as a special appropriation to equip and put upon a permanent basis the Experiment Station, and that the annual appropriation be increased to eight thousand dollars.

Certainly, Mr. Chairman, twenty-five thousand dollars is a very small amount for the State of Connecticut to give to an object which has already saved the farmers of this State thousands of dollars. Why, sir, it is less than a tax of one dollar upon each farm in the State for one year.

Mr. WEBB. In regard to this matter of the Experiment Station, I know personally of the saving of several thousand dollars to the State in the stopping of the sale of these fertilizers, and it was done among the first work of the station. I feel very thankful indeed for the benefit which I have received personally in the transaction of my business from the knowledge I have obtained from the perusal of the reports of the station. I feel that I can prosecute my business more intelligently and more successfully than I could before the station was established. Aside from all this I do feel, and I acknowledge it, a great deal of pride that the State of Connecticut was the first of the States of the Union to establish an Experiment Station; that it has had a wide and extended and profitable influence not only upon this my native State but upon all the States, and that the larger and more wealthy States are copying after our little State. I am proud also to learn that instead of the first cheese factory having been established in New York, or even in Ohio, as I had previously supposed, it was established in Connecticut. I am proud of that, and I would not give a cent for a man or a boy who has not some State pride. Now, I say to every man, look at this matter in a business point of view. Investigate it, and do not touch it unless you are convinced that it will be a profitable thing. When you are satisfied of that, take hold of it, cherish it, sustain it, be proud of it. That, I say, is a point worthy of consideration after all the others.

Prof. BREWER. I wish to say only a word. When I said that we needed from five thousand to ten thousand dollars, I had in mind what was wanted merely to carry out the facilities that we had. The facilities that have been given the institution really cost a good deal more than that. No five thousand dollars, or even ten thousand dollars, would have made the addition to the building which Mr. Sheffield made, and which has been occupied by the station, and furnished the fixtures which the Scientific School has put in there. I merely meant that a special appropriation of five or ten thousand dollars would furnish laboratory facilities perhaps equal to those that we have had. I trust that this resolution will pass. The very fact that we have started here, and that other States are inquiring about the matter, makes it necessary that something should be done to relieve the director of this station from the labor of answering those inquiries. If you knew the piles of letters coming in all the time, saying, "We have got to do something. What shall we do? How much will it cost? What should be the equipment?" you would realize what a burden it is to answer them. I was looking at one of the letters a short time ago, and I will venture to say that if Prof. Johnson had answered all the inquiries which it contained it would have required the labor of two or three weeks on his part, and that of a clerk, to look up the information.

Mr. Augur. A single word only. I imagine that when this matter is brought up in the legislature there will be very few who will seriously oppose an appropriation for the Experiment Station, but a good many will ask, "Can't you make it a little less?" The thought came up in my mind, "How much do we pay for the military of our State?" If I mistake not, over a hundred thousand dollars per annum. How much do we pay for the support of the insane? Now, gentlemen, we do not complain of these things, only if we can afford to pay a hundred thousand dollars or more for the military of our State, can we not afford to pay for the support of the Experiment Station, and to do it liberally?

Mr. Webb. I want to put that in another light. We do pay these expenses, we pay them freely; and if we have to pay them ought we not to surround ourselves with all the protections which we can in order to enable us to pay them?

Mr. Bill. The point is, we want to make farming honorable, creditable, and profitable to our sons. In the year 1837, in the West, I had many a time to fight for the Nutmeg State, and I would fight for her to-day; and when I hear of farmers sending their sons West, and letting the fields of their native State run up to brush, I am sorry, as a farmer, to hear of such things. I have endeavored to instil a love of agriculture into the minds and hearts of my children, and to make them understand that it is a creditable, honorable, and profitable business, if conducted in the right way; that if they would stay here and wear the clothes that they would wear at the West, let tobacco and rum and beer alone, they would make more money and enjoy life better than they would at the West. I have been so far successful, that they are all with me and around me. My brothers and sisters have large families, living upon the same hill; they have instilled into their children the same principle, that Connecticut is the State to live in; and the result is that the taxes on the real estate in that vicinity are four times what they were when I was a boy with my brothers and sisters upon that hill. Now I say to you here, that you can build up this Experiment Station, you can do for agriculture what you should do for it in the State of Connecticut. I am talking to farmers here just like myself, and I tell you that you can keep your sons and daughters at home, and have that happy life in your old age that we are all looking forward to, with our children and grandchildren about us. Now go to the legislature and ask for an Experiment Station and you will get it, provided you do not ask too much. Take care of it, take care of these farms in the State of Connecticut, and you will be better men, your children will be better, and you will enjoy your life better by keeping them at home. Do it, and you will never regret it.

The question was then put on Mr. Sedgwick's resolution, and it was unanimously adopted.

Mr. Norton. The subject which was assigned to me was "Associated Dairies" and "Methods of Raising Cream." The latter part of this subject is one in which many people are interested, but I hardly feel competent to give the information which many have asked for. Of course I could give you the various methods which are now in use, but that I suppose is not what is desired by many people. They want to have me say what I think is the best method. That, it appears to me, I am not called upon to do—am not competent to do at present. It is the business of the Experiment Station, one of the matters which we can properly refer to them when they are in proper shape. Then it would come to you with some authority and you would know what is the best way.

Recess until 2 o'clock.

AFTERNOON SESSION.

The meeting was called to order at 2 o'clock by Vice-President Hyde, who introduced as the lecturer of the afternoon Mr. L. F. Scott, of Bethlehem.

FARM LIFE AS IT WAS, AS IT IS, AND AS IT SHOULD BE.

BY F. L. SCOTT.

Mr. President, Ladies and Gentlemen:

I *am* used to "farm life," but not much used to writing and reading lectures, but this one was written sitting in the same chair in which the great Doctor Bellamy sat to write all his sermons, and perhaps that may in part account for the line of thought in the fore part of this lecture upon "*Farm Life* as it *was*, as it *is*, and as it *should* be."

And in speaking of farm life as it was we have to go back to the first farmer. After God had created the world, and all things else were created, then He created man, and gave him a larger farm than any one now on the earth; so large that it took four large rivers to water it, embracing nearly all the eastern country, or, in fact, the whole world. To stock this large farm He gave him cattle and dominion over every living and creeping thing. He also gave him the seed of every plant and herb on the earth, that nothing should be lacking to carry on the farm. Then He told him to dig, and eat bread by the sweat of his brow. Now this shows that our Creator designed that man, whom He had created in his own image, should be a farmer, but Satan came and told the farmer that he "need not dig," and that if he would eat of a tree of knowledge he would not want to dig. And Satan is telling our sons and our daughters the same thing to day. It is very evident that God created the land for man to cultivate. He also created rivers, creeks, and springs, like veins in the human body. These were to water the earth, that it might bring forth, when the husbandman had cast forth the seed that He had so generously given him, that the tiller of the soil should have an abundance for a thank-offering. But farmers multiplied, and divided up the land, and it seems there was nothing done but farming for about one hundred and thirty years. Then, as farmers and cattle and every living and creeping thing increased, the land being overstocked, and pasture growing scarce, they were obliged to journey out to newer country, and necessity made it necessary to build movable tents. After this, inventions increased, and farming began to wane, and wickedness increased, as at the present day when farming lags, but after the descendants of Adam had in a great measure forsaken farming, and the land was going to waste contrary to creative design, God was wroth with them, and destroyed them off the face of the earth. And this brings the history of the first farmer to a close.

But we will continue "Farm Life as it was," by the history of our Pilgrim fathers. When they landed on Plymouth Rock this country was one vast, unbroken wilderness. Just imagine to ourselves what they had to contend with ; not an acre of tillable land in a thousand miles. But farming was their only occupation, and land they must have. They went about clearing it in good earnest. The sound of the woodman's axe could be heard, redoubling strokes on strokes, until the giant oak was hurled from its stronghold, and God's *sunlight* let in, to cause food to grow for those starving Pilgrim farmers, who were in earnest in this work of making these farms of the wilderness bud and blossom like the rose. And this same earnest work has been carried on by succeeding generations, until this large domain has come down to us, clear and fertile, ready for the plow of all those that will put their hand to it, thus lightening the labors of the farm, and giving us double and treble returns for our labors. That was one degree of "Farm Life as it was." But after the trees and stumps had disappeared there arose another formidable enemy for the next generation to encounter. Much of the land in the New England States was covered with stones, which greatly impeded the plow, and these multiplied by every plowing, but by this time farmers had become used to hardship and toil, and they were strong, like the blacksmith's arm, and they had large families of strong, healthy boys. They were not brought up on sweet cake and sugar candy, but plain farmers' food made them strong, and they took hold with a will, and these stones were drawn and placed together which now mark the dark lines all over our New England farms, many of which are now broken down and trodden under foot of cattle.

Let us glance at the farmer of a century and a half ago, for nearly all were farmers then, very few professional men in those days—they all had to dig for a living—they arose early and toiled late, and eat the bread of carefulness; they usually had large families, with a very small income. Doctors and lawyers were ignored, for they were healthy and peaceful; how to maintain their large families was their careful study, but they all "had a mind to work," and as the family increased the capacity of the farm increased. The farmer sowed flax, the boys and girls pulled it, the boys whipped off the seed rainy days, on a barrel or block, the farmer broke, hatcheled, and swingled out the shives over the end of a board with a flax knife, the mother applied her foot to the wheel, and her fingers to the distaff; and girls spun the tow on a large wheel; this made the filling to weave into the warp the mother had spun; it was then woven into cloth and whitened in the the dew; this constituted the apparel of the whole family in summer; the wool from the sheep was manufactured at home in like manner for winter wear; the cattle, sheep, and swine were killed at home for food for the family; the skins were tanned for shoes and pantaloons, the shoes were made at home by a cobbler that went from house to house, "whipping the cat," as it was called; they had no factories or boughten goods in those days; they raised all they ate and wore; if they had a surplus it went to pay the blacksmith and shoemaker; sometimes a peck of beans to pay the minister for marrying a couple; the pie crust was shortened with Indian meal; the dough-nuts were raised with cob ashes. Now this may appear like cheap fare to some of our young ladies, but with it came contentment and rosy cheeks, such as are seldom seen at the present day. These large families of girls and boys were a whole society of their own, and were the happiest gatherings in their own homes that could be found. They had their apple bees, their husking bees, and their spinning bees. The young people went to those bees many times in their home-spun—they saw each other as they *were.* No airs or affectation put on, the young men selected wives in the neighborhood; from these wives and mothers have sprung the great and good men of this nation, and these mothers lived to a good old age, to see their children, and their grandchildren the honored of the land. In the town I live in, there was a young lady married October 9, 1817, to a young man in Woodbury, that was born in Newtown; she was 23 years old when married, and her bridal tour was from her father's house in Bethlehem, to her husband's father's in Woodbury, a distance of five miles, and this was made on horseback, riding on a pillion behind her husband, who had six acres of land set off to him as his portion, on the opposide side of the road, and a little below his father's house; there was no building on it, and this six acres of land was their all, for every young man was poor in those days, and how to get a house on the lot, would have puzzled a young farmer of to-day. But the young wife undertook, as her part, the spinning of tow, and weaving of bagging and selling it, until she had an amount sufficient to buy the nails and glass for the house; and nails were no small item in those days, as they were all wrought, and cost from twelve to sixteen cents per pound. They moved into the house soon as the first floor was laid, before the doors were hung, and finished it as means and opportunity afforded. Now, where is the young lady of to-day, that would volunteer to do what that young wife undertook, and that was only a small part of the battle of life; she raised three sons and a daughter; the sons are now some of the best business men in the State, men of integrity and worth, always on the right side of every good cause, and have honored our legislative halls and senate chambers. And the position of the farmer's wife is an enviable one, the cares and duties of home are her pride; with a heart full of love and sympathy for the suffering ones of earth, she rises in her dignity above the trifling things of this world, she is an help-meet to the farmer; the first chosen of God; and she carries a sway in the world that no devotee or slave to fashion can put down; and still those dignified mothers and daughters rode to meeting on horseback on a *pillion* behind their husbands, fathers, and brothers, over the hills, in an old pent highway, shut up between farms, and then they went into a great cold meeting-house, the largest building in the parish, if they were able to have any, for all went to meeting in those days, all paid liberally for the support of the Gospel, and reverenced the Sabbath and the sanctuary. These old-time farmers and their families had very few of the conveniences of life, no wagons or carriages, no sewing-machines to help make up the home-spun garments of the family, no musical instruments of pleasure. I can remember when musical instruments were first introduced. A sturdy farmer in our town had some excellent daughters, and one day they asked their father if he would get them a musical instrument, as some of their acquaintance had one; the father replied, "yes, I will get you one;" but time went on, and they saw no instrument, and they asked him again; he went up chamber and brought down a spinning wheel, and said to his daughters, "that is the best musical instrument in the world, it is a Heaven-born music that no manufacturer can excel."

Now those girls married young, and married good, substantial farmers, and one of them has always lived within a good stone's throw of our worthy Secretary, T. S. Gold ; another one in another county, and I presume they have made just as good wives as if they had had a piano, for I do know they have been excellent wives and mothers, and it saved the farmer enough to comfortably set out the girls in those days of "farm life," for their wants were few compared to the present day. "Farm life," as it was in those days, is nearly the same now in our new west. Many a night have I staid in log-houses in the western country, some of them with only loose boards laid on the ground for a floor, and as prayer and praise went up from them each morning, I many times thought there was more real happiness in those log-houses than in many mansions of the east, that are crowded with thousands of dollars, that would be considered worse than useless by the farmer's wife of the olden time. They had no aspirations for anything beyond what they needed. With that they were therewith content, which saved no small sum to be laid by to secure farms for the boys and household goods for the girls when needed.

Now is there not something about those farmers and families of olden time worth remembering? They have taught us that they have fought a good fight, in the battle of life, in clearing these hills and valleys for our inheritance, and in founding our primary institutions of learning, and building those great, old-fashioned meeting-houses, where everybody went to meeting. It was the farmers of New England that have done all this. Who have ever showed more heroism or philanthropy? Who have ever filled more honored graves than the early farmers of New England? They have taught us that earnest and persistent labor, with true economy, will accomplish all things.

In passing to "Farm Life as it is," we notice many very pleasant things, for we see on every side thrifty, well-to-do farmers following in the footsteps of their illustrious predecessors. Could Adam look hundreds of years adown the stream of time we think he would be lost in amazement to see some of our modern farms, with the machinery that is used to carry them on, and the buildings, with their every comfort, all of which speak well for the modern farmer. We only wish there were many more. The introduction of mowing-machines in this generation has done much toward making a paradise of New England, but whether these nice farms will be kept up to their present standard depends much on the next generation, while on the other hand we see many farms that were once the home and pride of our grandfathers, now nearly overrun with bushes, only a little green spot around the old home left fertile, furnishing barely enough to keep the wolf from the door, and some places are abandoned altogether. Now what is the cause of all this? And echo answers what? One hundred years ago our grandfathers lived and thrived on these farms, educated their children, and died wealthy. Now if any one can tell the true cause why the farms that made our fathers rich, we are starving on, we think he will find the philosopher's stone—for on all sides we see farmers going to the wall, because farming don't pay.

I shall not attempt to solve this problem, but will give a few hints in that direction. Of course much of this arises from the question of labor. The olden time fathers and mothers did all their own work, and I have often thought that if there was any one thing that I wanted to live my life over again for, it would be to be able to do my own work, and it makes a vast difference whether we say, "*come*, boys," or whether we say, "*go*, boys," and go another way ourselves. We all know the result, but still the cause is not removed.

This generation has not seen such crops as were raised seventy years ago with no fertilizer but the land. I can remember riding a horse forward of a yoke of oxen for my father to plow, with an old wooden plow, with a wrought-iron share on it, sharpened by a common blacksmith. That plow was a very rude instrument. It turned over and up about half of the furrow slice, the rest fell back again, thus loosening the soil. The second plowing cut and tore it crosswise, and the third loosened it still more. Then followed the old wooden-tooth harrow, in shape of the letter V; it bounded and pitched this way and that, as it came in contact with stones and clods, tearing and reducing the clods to fragments. By this time the land was light as a feather-bed, and it grew large crops of all kinds—nearly every lot on the farm would do it without fertilizers. No such crops have been raised on those fields since the introduction of the iron plow.

But I am not going to stake my reputation as a farmer by standing up here and telling these old and intelligent farmers that the iron plow has done all this, for not one of us would use any other. But the removal of every stone from the land, then turning over so flat, and following with the small steel tooth harrow, packs the land like a mortar bed, and, in many instances, the roller following these, and then we expect a *big* crop. In some cases we might about as well look for it in the public highway. I never used the roller on such clean land but once, and I never had a good crop on that field until it was loosened with the plow, and I have not had a poor one since.

Several years ago there was a great mania for rollers. Nearly every large farmer had one. A wealthy neighboring farmer built a very large, nice heavy one, and used it a few years. One day a neighbor came to borrow it. He was told that he could have it under one condition, that was, that he should never bring it back, and he never did. He used it and left it standing in the field. I saw it stand there until it rotted down, and there has not been a roller used in that neighborhood since. But these are not all the reasons why farming "as it is" don't pay. Fifty years ago the dairymen in the town of Goshen, in this State, used every fall to drive into the adjoining towns a great many cows to be wintered, many times at the halves, for they could summer more than they could winter. But now only about twenty cows can be kept on the farms that used to keep sixty. Surely the iron plow has not done all this, for they have not plowed any. Fifty years ago these same dairymen used to make cheese a specialty. They took it to New Haven on wagons, and sold it for six cents a pound, and made money by it, and now we grow poor making and selling it for twelve cents a pound. Why this is so remains a hidden mystery.

Many farmers at the present day practice skinning their farms, and using the money for other purposes than farming. If the farm goes down to the amount of money taken from it, have we gained anything? will it not take more to put the farm back again than all they have robbed it of? We must feed our farms if we expect them to feed us. What we gain from a well-fed farm is not skinning any more than the labor from a well-fed ox or horse. From all these we coin money; it is not borrowing from one to pay another.

As I have before stated, *Satan* is telling our sons that if they will partake of a tree in *College*, they need not work; they can get their living by their wits. He is telling our daughters that it is degrading to go into the kitchen and help their mothers do the necessary work of the household, a work which God evidently designed woman to perform, by adapting woman to the work, and adapting the work for the woman. It is a most healthful work, a constant change of position, just suited to a slender form and constitution. To be sure, there is that eternal round of washing dishes, and other things that was never intended for a stout, robust man to do, and it is saddening to see this work so much shunned by the average woman of to-day. "They toil not, neither do they spin; yet Solomon in all his glory was not arrayed like one of these;" and it is believed by many that the thousand dollar dresses and other things to match are causing much of the financial trouble of the country.

An honest, industrious farmer was once asked why he did not succeed better in his business relations. He had always been a hard working man. His reply was, "*Wife*, *silk* and *satin*; *boy*, *Greek* and *Latin*."

In the large proportion of American homes there is an ever-present need to study economy. We are not obliged to buy every nice thing we see because others have them. We can *look* on what others have. We could do no more if we owned them. If the father carries his fair share of church expenses, and public philanthropies; if the mother has all the help she needs about her housework; if the children start in life with the best possible outfit as to mind and manners, there ought to be no question as to the character of the personal indulgence which drains down the moderate resources on which the education, the recreation, and the charities of the whole family depend; and I think no one has a right to spend money on his own undoing. I have known families go without many of the necessaries of life nine months in the year in order to save money to go to some fashionable watering place three months in the year, when they were an hundred per cent. better off at home. Some farmers spend *too* much time running to market. A few dozen of eggs or some trifling thing is an excuse for a day's journey to the city, when the expenses far exceed all they carry. The wear and tear of horses and wagons are considerable, to say nothing of our own time, and nothing being done at home while absent; and many times cattle get into mischief when we are gone; the eye of the master is not there. And the most important part is our time, which is money. One of the queens of England offered "*millions* of *money* for an inch of time."

Now, if time is precious as that, how ought we to prize it? I have known farmers talking politics three hours at a time, which was a dead loss to the farm and the nation. I will say nothing about farmers' wives gadding about to get the news and spread it, for the wives of successful and progressive farmers do not do it.

If we hire men to do our work, and do nothing ourselves to pay them, the farm must eventually go to the hammer;

> "For if by the plow we thrive,
> Ourselves must either hold or drive."

And it is poor economy to have more men than we can profitably keep to work, for men that we hire take very little interest to economize labor; it wants the oversight of the master with his helping hand. It will not pay to hire our work done if we can *possibly* get along without, and, in order to more fully illustrate, I will mention a case that happened in my own neighborhood. An old farmer that had cleared his farm brought up a large family, three of which were sons. These he kept at work with himself; and when the boys were old enough to take charge of the stock in winter, the father kept school, and he was also Justice of the Peace, and did some public business. In this way they worked along until the oldest son wanted a farm to himself. One was bought for him and paid for, and in a few years the second son wanted one, and it was provided; and the old farm kept its acres all in good order. Then the father died, and the youngest son took the homestead. He also was a hard-working farmer, and after a number of years he also died, and his only son and *child* inherited the farm; but he did not like work very well, hired his work done, and drove to the village himself; and in three years the farm was sold under the hammer.

Now, it may sometimes be best to have help, but we should know how we are to pay for it. To illustrate still further, I will mention a case in one of the western States, of a man that bought a farm and thought he must have help, and he hired a good man. When the year came around he had to sell a cow or two to pay him, and hired him another year, and at the end of the year he had not wherewith to pay, and was obliged to sell his oxen to pay with. The man asked if he wanted him another year. The reply was "*No!* last year I had to sell cows to pay you, and this year I have had to sell my oxen to pay you, and next year I shall have nothing I can sell to pay you." The hired man replied, "*Well*, I would have no objection to take the farm for pay." "*Well*, then what shall I do?" "*Oh*, work for me, and get them back again." Now, there are hundreds of cases in this country like these, and they teach us that it is best to know how we can pay before we hire or buy.

Another very unfortunate thing for "Farm Life as it is," is the general discontent of our boys; the girls we expect very little of now-a-days—their little fingers were not made to soil. But before I get through I will tell what a tiny hand can do. But the *boys*—and it brings a shudder over us when we take the pen to write their history—it seems as if *Satan* had been at work a hundred years to spoil all the boys. Their reasons for leaving home are as two grains of wheat hid in two bushels of chaff; you search all day ere you find them, and when you have found them they are not worth the search. The shops, stores, and professions take up the boys, consequently the trades get fewer apprentices, and mechanics are stirring up our farmers' boys to learning their trades, telling them of the daylight to dark labors on the farm, without time or money to see anything *but* the farm, and the inducements to a trade are very flattering. They are not told of early hours in short days, and the first year they are often set to do something foreign to the trade, such as drawing lumber and tools from place to place; the second year they work a little, and the boss charges full pay for them, and we have to pay for our own boys' work, what they could have done just as well had they staid at home; then at the end of three years the boy goes for himself, a poor mechanic, scarcely earning a livelihood all his days, when if he had staid on the farm, adding to what he had learned before, he could have been master of the farm, and when the strength of the father failed then he could start in life with a good home of his own, a good member of society, a power in the land.

It is often thrown in the farmer's face that we keep our boys too close—up soon as light in the morning, and dig until dark from April to December, not a day of their own unless it be a rainy day to go fishing and get wet through for nothing. There may be some such hard-hearted cases, but they are rare—not half so many as fifty years ago. The discontent arises more from hearing the stories than the reality, and the stories are a libel on the farmer, which I intend to prove before I am through. The average farmer boy sows more *wild* oats than *tame* ones. Young America has got to splash, and every few days a good horse must be hitched before a new buggy with a new whip and a twenty-five cent cigar, and long before night they start off for the village, driving by every one on the road, and nothing to do when they get there. They do not get up in the morning until breakfast is ready, then stalk around through the day, playing with guns, watches, and revolvers, to say nothing of the money they use up; and they have to be indulged in all these, but it is far from working from daylight until dark eight months in the year. Soon the city cousins come and their head is filled with the sights and scenes of the city ; then they begin to be tired of farm-life, and want their liberty. Everything they do drags, but indulgence goes on. And here let me say, that indulgent parents (generally mothers) have spoiled more boys than rum ever did. After having all they want at home, they go to the city; indulgence goes on; they eat and drink everything that money will buy; they get unsteady and lose their places, lounge about saloons, get into bad company; but the *end is not yet.* But it would have been a thousand times better if they had been compelled to stay upon the farm and worked from daylight until dark. I have heard farmers say that they about as lief bury a boy as to let him go to the city. I do not say that there are no good boys, for there are many that are true as a needle to the pole—always where they should be. I have in my mind now a good farmer, his wife, a son and a daughter; they all love the farm. The son went to New York with his mother, and he was so sick of it that he could hardly stay over night—wanted to go back in the morning. That boy never complains of long days' work; he loves them. I have sat at their table and it seemed to me that if there was anything on earth that could make a family *happy* it was those four sitting around that table. I had rather have the mark that that son and daughter will make than the mark that many will make going to the city. There are other farmers' daughters that are an exception. I heard a young lady of twenty years exclaim, "No, I will not go to the city to live: I love the farm, its labors, its cares, its duties; I love to hear the birds sing; I love to see the lowing herd as they wend their way to the milk-yard toward night." In the town that I live in, a good old Deacon was remonstrated with for having his daughters feed the calves. He replied that it would not hurt his daughters to feed his calves; and it seems it did not, for they married early and well—one a merchant and the other a farmer, and the one that married a farmer was the mother of a professor in college, of whom I shall speak when further along. I am acquainted with a farmer's daughter that has taken the whole charge of a dairy of twenty-two cows the past season, making over one hundred and twenty-five pounds of butter a week, besides doing the washing for the family, with three or four hired men, and doing some cooking besides. That girl can sing loud as any one, and play the musical instrument. or teach school, but prefers house-work to them all. That looks a little like the olden time; we hope there are many more of them.

But we will return to the boys. They are not all of the same turn of mind. One is for invention, another mechanical, another fond of books or mathematics, another for speculation. Some have none of these tastes, only for persistent everyday labor on the farm. Nothing disturbs them. But it is useless to force a boy out of his natural bent or aim in life. It is unwise to spoil a good mechanic, to make a poor farmer. If a boy has a strong desire for mechanical work, let him learn the trade of his choice, for a good trade and master of it is better than a poor farm with a poor farmer on it, for failure is stamped upon it, the inevitable result of a mistaken calling.

Some boys have a desire to do everything. They will try one thing a while, and then another, until they have tried everything they hear of, and never finding their proper place, turning out at last to be "a square peg in a round hole." Such seldom ever succeed in life. It is a long, straight, steady pull that *wins.* As I have said, when a boy gets his head full of city notions he is so persistent in his notions and shirking, that we are constrained to let him go, for if he was any one else, boy or a hired man, we would not have him around one week, but when he goes we feel it, for we know not what he will do or make. Amos Lawrence, the great merchant prince of Boston, said that ninety out of one hundred that went into mercantile life failed in *business.* That is not very encouraging for a farmer's boy to leave home, when he knows not where he can lay his head the first and many succeeding nights.

Up in Litchfield county there lives an old farmer that has always worked hard, cleared up his farm for his boys, but one after another they have gone and left the farm, and now the youngest and last one is about to leave. The old man sits in his arm-chair, with the tears running down his furrowed cheeks in torrents, as he exclaims: "Joseph is not, and Simeon is not, and will ye take Benjamin away also?" "Oh, what shall I do?" Now, young men, if you knew the anguish that is in that old man's heart, some one of you would stay at home with your parents, a cheer to their declining years and strength. It is downright murder to leave them. Somehow the boys have a notion their parents care little about them. In the early settlement of Connecticut, near the Naugatuck river (which is noted for its sudden rise), there lived a farmer, who had occasion to send his boy over the river a long distance, that would occupy him all day. The boy took a horse, as they had no bridges. After the lad had gone it began to rain, and poured down all day, so that the river filled its banks. The father, feeling anxious about his boy, went down to the river and concealed himself, and waited the approach of the lad on the opposite side. The boy came up to the swelling tide and began to cry, but thought he must attempt to cross. He urged forward his faithful pony, and clung to him with a death-like grasp. When in the middle of the strong current it seemed as if horse and rider must be lost. The father dare not speak, for fear of frustrating the lad, but the horse, being used to it, headed up the stream, and finally reached the shore. The father clasped his boy in his arms, and exclaimed, "you are safe, my noble boy." Now, my young friends, do you think there was *love*, emotion, and gratitude? I will not ask these parents, for none but parents will ever know the emotions of that father's heart, as he watched his boy crossing that turbulent stream. This is only a parallel case, to show the anxiety parents have for their children, and when a son goes out alone into this uncharitable world there is a sad melancholy hanging over the minds of parents. It is but one step short of laying him in the tomb, but there is always hope while there is life.

I will draw but one more picture, and turn to the bright side, for "farm life" has a bright side. In one of the shore-line towns in this State there lives a good farmer (a family connection) that has a large, nice farm. One day his son said to him: "Father, I don't want to stay at home any longer. These hired men of ours get their pay every week, spend their money where and how they please. It is not so with me." The father waited a moment, and then replied to his son : "The hired servants have not a dollar to their name; they have no home of their own, and probably never will have. Now you see this nice farm and its surroundings, they are all yours. I cannot occupy it much longer, and now I am only laboring for you." But the boy had become so intoxicated with the idea of freedom, and, although he had previously taken a pride in driving the best four-horse team in the county, and that is saying much, *still* they had lost their charm. The boy left, and obtained a situation as brakeman on the cars, and in less than one year was thrown from the platform, run over, and instantly killed, almost within sight of his farm. Now, my young friend, do you think there was anguish in that frenzied family?

"Farming as it should be" is the most healthful, the most useful, the most noble employment of man, and the first lesson to learn in it, is to establish a good reputation. Right and wrong are realities; they are no relative terms of indefinite application. *Character* is all there is of us. If we do an act because it is *right*, we are made better. We feel it ourselves; others see and feel it. If we do a wrong, we are made lower. And there is one thing about this worth remembering. A life-long *good* character *can* be *spoilt* in an hour by our own acts. Honesty and square dealing are respected by all, and appreciated by those we deal with.

As we have before stated, "farm life" has a bright side. As we come from the field at the close of our labors for the day, we are or should be met with the cheer and smiles of those we love, which relieves the pain of aching limbs and brow, and makes more soft the downy pillow; "the sleep of the laboring man is sweet whether he eat little or much," and after refreshing sleep he rises again with the lark, and, with an elastic step and cheerful countenance, he goes to the labor he loves with spirits as buoyant as air, and exclaims, "Who does not love to be a farmer, and see the grass grow?" We know there are some that do not take this cheerful view of farming, and I look with sincere pity upon those farmers who are settling down into discouragement over the condition of their farms; their crops are light for want of manure, which is little for want of crops; from want of anything to sell they are too poor to buy fertilizers, and in utter hopelessness they exclaim, "farming is poor business." Well, such farming is "poor business." I do not speak of this to add to their discouragement, but to give them a word of cheer, to point them, if I can, to some way to better their lot. I believe the cheapest and easiest way to bring up a run-down farm, one that any man can use, is by green manuring. Suppose your farm is *too* poor for clover, and grass makes only a feeble growth; put on it a manurial crop that will grow, such as rye or buckwheat, turn this under with your plow, and you can raise something better; keep feeding your soil with everything your shovel and team can command—anything that will bring a green mantle over your fields. Soon you can set the clover pump to work, pumping up to the surface the inexhaustible resources of your subsoil. If an animal dies. don't stop to bewail your luck, and exclaim "everything goes to the dogs on my farm!" don't send it to the dogs at all, but compost with muck or soil, and thus secure a most valuable fertilizer. Sampson performed a wonder by taking honey from the dead carcass of a lion; outdo that wonder by extracting corn from the dead carcass of your cow. Pick up all the bones you can find, put them under cover and mix with them two or three times their bulk of ashes, moisten them with enough water so that the ashes will act on the bones, stir them over once a week, and in a few months you will find the bones so tender that you can cut and crush them with your shovel; beat the whole into a powdery mass, and you will have a manure better than the average of the superphosphates which you feel *too* poor to buy; give a handful of this to each hill of corn, and see how it will wave its banner of green, and pour into your basket the golden ears of corn.

But in bringing your soil into good condition do not neglect green manuring; let every wind that blows over your fields bring them a blessing in the shape of atmospheric plant food; do all these things patiently, and hopeful, without urging your soil beyond what it can do, and you will yet out of the fullness of a grateful heart exclaim, Bless God for the farm.

An intelligent gentleman of New England birth, after many years residence amid the fat prairies of the West, returned to the scenes of his early life, sat again beneath the parental roof. The scenes of his boyhood passed before him like a panorama; dilapidated house, innocent of paint, and devoid of comfort; the tottering chimney, and the paneless windows; the crumbling walls and decaying sills, all of which combined to form a cheerless and unattractive home, had been transformed into a residence of rural beauty; the old hovels had given way to barns combining comfort; the rude fence of half-rotted rails which separated the hapless and hopeless tenement from the highway was superseded by a handsome paling, which relieved the green back ground with its coat of white; woodpile and the pig's trough which had been the ornaments of the front yard, were banished. Even the old well-sweep had surrendered to a modern pump and flaunting wind-mill; in pious wonder he viewed the scene, and then bent his footsteps to the fields where he was wont to labor. But here, indeed, the change was greatest of all. The sterile knolls where he remembered to have fruitlessly urged even white beans to give reasonable returns, were covered with verdure, or their burden of golden grain glittered in the sunlight. The pasture fields where fennel and sorrel had taken full possession to the exclusion of succulent grasses were now thickly set in timothy, red-top, and clover, and sleek, lusty cattle ruminated in the shade of vigorous trees, whose branches gave little comfort to the small and scrawny herds of his fathers. The meadows, where the swaths used to be little thicker than the sunbeams that turned them into tough and wiry hay, fairly groaned beneath the burden of rich and ripening grasses; where wheat had once refused to give back the seed the ripening cereal gave token of rich returns. Indeed, all was changed as if touched by a fairy's wand. But our pilgrim was not satisfied with figures of speech nor flowery flights of fancy. Gaunt poverty had been driven from her primeval haunts, and new evidences of wealth abounded. Where want had cut sharp lines in the faces of men, and in the forms of brutes, simple plenty was lost in absolute abundance. A barren hard-pan, with the thin stratum of cultivated earth which it supported, had been changed into a rich and friable soil. What agency has been at work, he queried, to produce these remarkable results? have the elements been more propitious than of yore, or has the master-mind of man sought out and applied the cause of so wonderful an effect? As to all earnest questioning, so now to these queries did the answer come, green manuring with plaster has done it. And what it has done there it will do in hundreds of cases all over the land.

The renovation of old farms is a question of time, forethought, and experiment, not labor alone; but still labor is an essential element in all farm management; without it no great results are obtained. And here let me say to every young farmer, when you awake in the morning don't roll over, but roll out; it will ditch every slough, cut every bush, and make the farm shine. I do not wish it understood that we are to work every moment of our lives, by no means; but systematic, regular hours for labor, sleep, and recreation. More will be accomplished in that way than any other. If when we start in life we get in the habit of rising early and following out steady, systematic effort, we shall be astonished at the result. The want of *system* has sent many a farmer to the wall. We all remember the first beginnings of our army in the late rebellion. Let *system* be written upon every tool of the farm, and let those tools have a place and every tool in its place; and then remember the fables of the "Hare and the Tortoise," and the "Lark in the Wheat;" never depend upon friends to help us out. I always think of the old man's prayer, "Good Lord deliver me from my friends."

If we do our own work we should have the best of tools; but never buy tools to lie idle or go to decay. A Dutch farmer once showed me an ox-cart that he said had not been wet in twenty-five years, and it looked almost like a new one. He said that a neighbor bought one at the same time of his and it had rotted out, and his second one was now nearly gone in the same way. Thus we see the economy of housing. But what shall we say of the farmer who has no tools and is *too* stingy to buy them? I was once trying to sell a man a mowing machine. He said his land was *too* rough for one. I said to him, "My friend, if you will give me your interest money I will remove every obstacle and put a mower and horse-rake into the meadow free gratis." But he loved his money *too* well for that, and in a few years he mowed his mow out, died in the harness, a middle-aged, worn-out man, and his money was scattered to the four winds. One day another penny-wise farmer came to me and asked if I knew where he could lend a few hundred dollars in a safe place. I replied that I did not want it myself, but thought I could show him where it could be placed to his advantage if he would step into my house. I took up an agricultural paper (the *Country Gentleman*), and said to him, "This will tell where you can put your money out for from fifteen to twenty per cent. interest." His eyes began to brighten. I then showed him the sketch of "Echo Farm." That, he said, was all very well; "I like the pictures, but how about the twenty per cent. interest?" I asked, "How many acres of land have you?" "A little over one hundred." "Do you use a mowing machine on your farm?" "No; my meadows are not smooth enough." I invited him to the door for an outlook, and said to him, "You see those smooth meadows; not a stone or stump in one of them. A few years ago those meadows were covered with rocks, stone, and trees, much worse than yours are. Do you see those long lines of stone-wall surrounding the fields in every direction, one thousand rods of which you can see? All were built in one year. And in these three large barns you see every creature I keep has neat and comfortable quarters. These barns pay fifteen per cent.; the mowing machine pays fifteen per cent.; the stone-walls save twenty per cent. in chasing unruly cattle." The man replied, "If I should lay out my money so I should never get it back again." I said to him, "I never wish to get it back. I have only a short time to stay on the earth, and then I can take it with me just as well as you can your money."

This would teach us not to follow extremes in either direction; and we should never get a hobby of our own and ride it to the disgust of our intelligent neighbors. If they are not *willfully* blind they will notice our improvements by our better crops and management, if we truly have them; but many times we are mistaken in our notions, and they know it. But there is one thing that none can be mistaken about; and that is, to make all the manure on the farm that we possibly can. We may differ about the way to do it, but the amount, *never*. We must have it. The barn-yard is of more importance in farm economy than the house-yard, because out of it are the issues of crops. All animal and vegetable wastes of the farm should be composted; gather up all the fragments, that nothing be lost—leaves, straw, turf, soil, muck, all should have a place in farm economy. Muck is of the most doubtful utility, unless thoroughly dried and used for an absorbent only—then it pays. There may be a difference of opinion how to apply the compost when made; and that is of as much importance as to make it. The old time-honored practice of burying manure in the bottom of a deep furrow is not my practice. My land does not leach upward. A thorough mixture with the surface soil will give the best results ninety times in a hundred. I am aware that many even in these latter days do not see the point, and they have a right to their opinion if they can afford it. I never attempt to disturb any man's opinion about farming, politics, or religion. If true farm economy is carried out, New England is as good a place to own a farm as any, West or South. We have schools and churches, wood and water, and healthful breezes; and as the Southerner says, "them *Yankees* always have money."

We often hear young men saying, "There is not room on the old farm for all of us, where there are three or four, and we must look for something else." I think that a mistake; for on every side of me there are cases where two, three, and even four have staid on the old homestead until the eldest wanted to settle in life, and then provisions were made for them. About two miles from where I live there is a good farmer, his wife, and two sons; the daughter helps her mother in summer and teaches school in winter, and the three men work together. One day the boys came in from work, and after the frugal meal one of the boys said, "Father, what are we boys going to do for ourselves? This farm only a little more than supports this family, and where is *our* revenue coming from? We must begin to look for ourselves." The father replied, "You see that good, snug little farm adjoining ours on the south; the owner wants to sell it, and if you will both turn in and work the same as you have done, I will go right down and buy it." "We will do it," exclaimed the boys. The farm was bought, the old and the new ones were brushed up a little, the milk of forty cows went to the station every day. and both farms were made to produce nearly double their former amount, and were soon paid for; then money began to accumulate again. One of the boys taught school in winter and boarded at home to help take good care of the stock. One day the oldest son came home and said, "Father, that large, nice farm on the north of us has to-day been offered for sale. The only son has gone to the city or somewhere else to seek his fortune, or more likely his ruin, and the old man says he can do nothing with the farm alone, and has offered it for sale to-day."

The father says: "*That* is a good farm and good buildings. You go up and buy it, and one of you can live there and see to the stock, and we will all work together as we have done." The farm was bought; the oldest son married a poor girl, and moved on to the place; the three men worked together every day. They have now four hundred acres of good land, and each a house near each other. They have one hundred acres of good corn land; they plant ten acres of corn each year, and get around in the rotation once in ten years. They cut one hundred acres of stout grass, and keep good paying stock to consume all the forage on the farm, while the milk-can continues to go to the station every day, and last year they told me that they had paid for the last acre, and owed no man a dollar. And now, my young friends, does this look as if farming was poor business? Just look at what they can accomplish in another twenty years. This is not an over-drawn picture. I have lived by them all my life, and had much deal with them. They are straight-going business men. One of them is in the legislature for this winter, and what they have done can be done in almost every neighborhood in New England, and that shows what a power there is in concentrated and well-directed labor. What would these three men have accomplished had they been separated, and on different farms in different towns? We have all seen the result of separation. "United we stand, divided we fall." I can point you to many similar cases in this State, and in the State of New York, where the boys have all staid at home, worked and pulled together, and as one after another wanted a farm to settle on, it was provided. This is farm life as it should be. Not a living soul that has a mind to work can dispute it.

In some book—I think it was in one of our State Board reports—I noticed the question asked: What effect it had upon our young men to send them to college? whether they were better fitted for farmers, or would like work any better or as well? That question remains on the pages of that book to-day unanswered. I will not attempt to fully answer it, but will give my version of it. That they are better fitted for farming may be questioned by some; that they will love work any better, I think will be denied by the majority.

There may be exceptions. There is a young man now in college from our town that intends to be a farmer. His father has but a small farm, but when the boy comes home he is out to the barn in fifteen minutes, with pail in hand, ready for business. He reads everything that can be found concerning the farm, and if it were not for the name of college the thousand dollars spent there had better be laid out in improvements or additions to the farm. Generally those that are sent or go to college are those that do not love work over-much. One farmer had three or four boys, and one of them did not like to work very well, and he was sent to college to get him out of the way. His father had occasion to buy a yoke of oxen, one of which proved to be very dull and shirkish. One day the farmer exclaimed: "I don't know what I can do with that ox, he is so lazy." One of the boys at home said: "Father, send him to college."

If a man is to get his living by education alone, then by all means send him to college, if you are able. Many times young men are not made any better by a college life, but when a young man aspires to a higher life, and is bound to get an education, even if he has to work it out with his own hands, such are usually benefited by education, and many of the great men of this country were such. They could be named by scores. There were two such young men in our town, both of them poor. They commenced at Suffield, built fires, took care of doctors' horses, and anything to pay their way, and while in college they kept night schools and various other work to keep along. One of them run out of funds, and came home. He came over to my house, and wanted to work for me until he had earned one hundred dollars. I set him to work, and paid him the amount. Then he returned, and in due time graduated with honor. That young man now holds an important position as professor in a medical college in Chicago. I saw him a few days ago, and asked him if the education he labored so hard to get was of use to him now. He replied that it was, and he was using it to advantage, and thanked me for my assistance. The other young man also graduated with honor, and is now pastor of a large church in Cleveland, Ohio, with a salary of $2,000 a year. There are many cases all over the country where a man's education is all he has to lean upon. It is his farm. But to send boys to college because we do not know what else to do with them or our money, and when they will never be likely to use their education to advantage, is a mistake. They are morally and physically worse, and had better have staid at home and dug potatoes.

There are two things that I want to tell young farmers not to do. One is, never go to law. Better pay twice over, because you are sure to do it if you go to law, and get no satisfaction at last. Set down your foot that you will starve every lawyer, for if you don't they may rob you, for that is their farm. One other thing is, never run in debt, for interest gnaws worse than any canker-worm. It eats when we lie down and when we rise up, when we work and when we are idle, when we sleep, and when we are at church. It is as relentless as the sword. And there is one other thing nearly as bad. That is, draining swamp land. Nine times out of ten it is burying money in the mud. Better use it to buy upland. I have tried reclaiming swamp quite *too* much. I now think of what the farmer told his son. The father had worked in the swamp with about as much satisfaction as we usually get. One day he called his son to him (a very good boy), and began to whip him. The boy says: "Father, what are you whipping me for? What have I done?" "There, now you will remember never to touch a swamp."

But farther back I promised to tell what a tiny hand could do, or facts and fallacies of matrimony, for there is no one thing that so much enters into the weal and woe of farm life, as the choice of a companion. It is one of the greatest events of our life; and yet there is the *least* consideration given to it of any transaction we ever make. In almost every town you can select a dozen or more young ladies that are sensible, sober-minded, steady young women, the salt of the earth, and to all appearance would make the best of farmers' wives, and yet I will venture to say, that none of our young farmers are particularly crazy after them, but they will seek in another direction, and get some one wholly unsuited to the position they are called to occupy. Soon the milk from the dairy has to be sold, then the cows, and finally the farm sold, and with it all their earthly happiness. And even some of our best farmers' daughters are aspiring to something higher than the farm, but they make a grave mistake.

Cease pointing the finger of scorn at our hardy sons of the soil. Take to the farm, its labors, its cares, its duties, and love them as you do the farmer, then will these sterile hill-tops bud and blossom as the rose, and a generation shall rise up and call you blessed, for upon the young ladies of this generation hangs the *future* of our agriculture, and if you would have an Eden home, keep the old farm-house in order, always have a bright light and a cheerful greeting when your husband comes home at eve; and there are a great many ways you can be useful in the world, for the word *useful* is written in large characters upon everything.

About seven miles from where I live, there lives a wealthy farmer; he has a good farm, and as well fenced as any in the State, he has one daughter at home, that is well educated and refined. One day this fall this daughter was out on the farm, and found one of her father's cattle choked with an apple; her father was gone, but she looked up her brother, and the two tied the heifer to a bar-post, and put a plow-clevis into the creatures mouth to hold it open, and the young lady's hand and arm being smaller than her brother's, she stripped up her sleeve, and put her arm through that clevis up to her shoulder, and she could only reach the apple with the ends of her thumb and fingers, but she pinched the apple in two and brought out a part of it; the second time she brought out the rest, thus saving the life of a valuable animal. Now that is what a tiny hand can do, if there is the disposition, and if I were a young farmer, I would never have it to think of, that I had not tried at least, to make a wife of that young lady. From just such farmers' daughters as that have sprung the great men of this country, and such will help, advise, and economize, and be true helpmeets all their days. We have many *noble* women that are true, sensible, and eloquent; look at the language of Lady Garfield, the impromptu speech that she made to those surgeons when told that her husband must die. "Gentlemen, you shall not give him up; he is not going to die, he is going to live; I feel it, I know it; go back to your post, every one of you; leave it not until every remedy is exhausted; until death itself has set its seal upon him. For I will not believe that he is dying. Go back and do what you can, you cannot do more. But don't give up. I am his wife, and I say that we will not give up until the end itself is upon us."

Now, here is the eloquence of a Saint Paul, without a moment's warning, and if Lady Garfield's boys do not make a mark in this world, I shall wonder, for it is from just such mothers as that who have given our great men their minds, and instilled into them their own love and purity, and everything that is good and noble, and just, that makes a *man*. And on the young ladies of this genration, hangs the destiny of our future great men.

But before I close, I will say a few words to our young men. Now, my young friends, there are a great many young *lady* Garfields in this country, from among them *choose ye;* the ball room is a poor place to choose a wife, it has caused many a sad regret in after life, that could have been avoided by a little patient waiting, and a good deal of reflection and consideration; choose as our grandfathers did, of those in the neighborhood, whom they had a chance to know best.

But by all means choose some one, as soon as you are twenty-one, and before we get a law that the old bachelors shall support all the old maids.

By all means buy a home first, and then settle down in life young, you will make the best husbands and wives, the best neighbors and citizens.

But as this is simply farm life, and the programme has set me up to tell the whole world how farming should be, I will close by making a few appeals to farmers as they should be. Now the best farmers are usually those that are filled with agriculture, knit into every fiber of their existence, it is their meat and drink, they roll it as a sweet morsel under their tongue, they take an agricultural paper, as every farmer should, they read and inwardly digest. But some farmers are offended if asked to take an agricultural paper, they want no book farming, with their cattle running in the highway all winter, giving to the public the best of fertilizers, while their farms are running down, down ten per cent. a year, still they want no book farming. "Ephraim is joined to his idols, let him alone."

There is one thing appears very strange, and that is, builders, manfacturers, professions, stock-jobbers, and all but farmers, have a ring, or trades-union, they club together and run up prices to suit themselves, and all are governed by them, but the farmer, the most independent man on earth, takes products to market, and takes just what the merchant sees fit to give him; not a word to say about it, and then he takes back from the merchant the things he needs at home, at the merchant's own price; no voice in it. Now if farmers would combine, as all others do, they *can* starve the world. All other powers in the land cannot make these toiling farmers budge one inch, if they say the word. The kings and queens, and the lazy ones of earth must be fed, and the farmers may say (as Pierpont has it), "hold thy *tongue*, for thou art *weak* and I am *strong*." But how is this combination to be brought about? Not by a few grangers that promise much and accomplish little; not by State conventions, or large bodies at first, but let it begin in neighborhoods, in farmers' clubs, or granges, let it be agitated there first, then by larger bodies, until the whole country is in motion; we must have enthusiasm, for great designs are not accomplished without it, it is the inspiration of everything great; without it, no man is to be feared, and with it, none are despised. These great trunk lines of railroads are a monopoly, they hold a tremendous power all along their lines, from the Atlantic to the Pacific. If they want a law to their liking, they can give all our legislatures a free pass over their roads, and they can get the law. But farmers are *too* honest for all such things. and to their praise be it spoken.

Physicians cannot conscientiously pray to have the people sick, but they can pray for their daily bread, and so can the farmer, but they must add work to their faith if they don't want to submit to the bulls and bears, and Chicago corners. For we can hold the fort in spite of them if we will, and the time is coming when farmers must look out for themselves. Send farmers to the legislature if you would have farm-laws, for what do the lawyers and demagogues care for us, so long as they can make their own laws and profit by them? But these two things I want to warn all farmers against, and one is, not to put all your fertilizers and manure on the richest piece of land on the farm, and let all the rest go hungry, for sooner or later the farm will go to the wall. The meadows are beginning to show it now, and 'tis said, "*famine* begins at the hay-mow." Another is, never allow a stock of cattle to tread down, or gnaw down your meadows; stamping is much worse than gnawing, and both are bad enough.

If farmers of the present day would attend to their farms as close as the olden time farmers did, and let everything else alone, farming would be a much better business than it was then, in fact. I think there never was a time except in war time, that farming could be turned to so good advantage as at the present day. There is a demand for everything that we can raise, and still about one-half our farmers would sell their farms to-day if they could, but there are few buyers except the foreign element, and that is destined to own and control this country—not a very bright picture. But there is one thing that will save us, and that is *retrenchment;* go back as far as practicable to the well-trodden paths of our worthy ancestors, "then shall we sit under our own vine and fig-tree with none to molest, or make afraid." My advice to one and all is, stick to your farms and be content.

The CHAIRMAN. Mr. Norton kindly gave way this morning to the discussion in regard to the Experiment Station. I hope now he will favor us with the remainder of his address.

Mr. NORTON. I think, as I said at the close of the exercises this morning, that I better not say anything more; but it is a subject in which very many are interested, and there are probably many in the audience who would like to say something upon it. I understood from Prof. Johnson that he had some statements to make in regard to reports from abroad with reference to deep and shallow setting of milk. They will probably be of interest, and it is a part of the subject upon which I was to speak.

Prof. JOHNSON. The question of the best method of setting milk, as you are all aware, has occasioned a good deal of discussion, and there is a great variety of opinion about it. I did not come here prepared to give any opinion myself upon that matter, but seeing that the question would probably be discussed here, I requested Dr. Jenkins to make a translation of an account of some experiments on that subject made in Germany. I hoped Dr. Jenkins would read it, but he prefers that I should.

In the year 1876, W. Fleishman made two series of interesting experiments on the setting of milk for cream at the Experiment Station in Raden, in the Grand Duchy of Mecklenburg.

This station is devoted entirely to the investigation of questions connected with the production and handling of milk. It is on a dairy farm where two hundred cows are kept, and stands in the closest connection with the practical management of the dairy which serves the station both as a field for observation, and as a means for carrying out its investigations, while the station in its turn renders to the dairy important services.

The experiments to be described were undertaken with the purpose of learning how completely the cream was separated by Swartz's system—deep setting at a temperature of 36° to 41°—and also what length of time should be allowed for the cream to rise in order to secure the best results. But just at the time when the experiments were begun, the cows were put on their winter feed. This introduced a remarkable change in the quality of the milk which seriously damaged the value of the results as far as the points specially under examination were concerned, but on the other hand gave to the investigation a special value which it would not otherwise have had, inasmuch as all these disturbances were accurately observed and were corroborated by analytical results.

In the first series, three trials were made with morning's, and three with evening's milk by Swartz's system. The tin vessels used for setting were of the usual shape, sixteen to eighteen inches deep, and held about sixty-six pounds of milk. A complete chemical analysis was made of the milk, but the quantity of fat only was determined in the cream and buttermilk.

In all the trials, an extra vessel of milk was used for observing the temperature at the bottom, in the center, and at the top, and the temperature of the surrounding water at similar heights was also recorded. In two cases parallel trials were made by the Holstein method which has been in favor in that part of Germany, and which consists essentially in setting the milk without preliminary cooling in shallow pans, so that the milk is not more than two inches deep, and keeping the temperature between 54° and 59°.

The following table gives the results of the first series:

	Lbs. of ice used for 1 lb. of milk.	Av'ge temperature when skimmed.	Average depth of milk in inches.	Percentage amount of fat in the milk.	PER CENT. AMOUNT OF THE TOTAL FAT WHICH WAS REMOVED IN SKIMMING AFTER—		
					12 hours.	24 hours.	36 hrs.
1. Tin vessels with morning milk,	.47	35.6	17.3	3.98	82.4	87.5	.....
2. Tin vessels with evening milk,	.40	35.6	17.3	3.98	78.3	83.0	.....
3. Tin vessels with morning milk,	.43	39.2	16.1	3.51	34.8	44.1	.....
4. Tin vessels with evening milk,	.37	39.8	15.6	3.92	63.3	69.0	.....
5. Tin vessels with evening milk,	1.08	33.1	16.8	3.98	54.5	60.1	61.2
6. Glass vessels with even'g milk,	.....	59.0	2.1	3.98	69.2	82.9	92.1
7. Tin vessels with morning milk,	1.00	33.8	16.3	4.03	59.3	66.2	68.1
8. Glass vessels with morn'g milk,	.....	55.4	2.1	4.03	62.5	76.9	81.4

It is noticeable that in these experiments with the exception of No. 3, the milk had a very uniform content of fat, 11 per cent. being the range of difference. No. 3, was the milking on the warmest day of October, when the average temperature was 65°, and the maximum 71°.

The result of the skimming in the first experiment compared with the others shows a striking difference, and illustrates how dangerous it is to draw conclusions from experiments with a single lot of milk without proving that the milk was perfectly normal.

In all these experiments from No. 2 on, the milk was not normal. The cream was unusually slow in rising, and in the dairy it was noticed that the milk soured very much sooner than it had done before. This peculiarity was not due alone to the warm weather, but also, as was proved by direct trial, to defect in the food.

The herd were given in their ration, chaff from grain which had rusted badly, and during the milking, dust from this chaff settled in the milk.

The specially tardy rising of cream when deep set, seemed to have connection with the fact, that under the microscope the fat globules were not separate, but collected in little bunches.

There were only three possible points which could assist in explaining the behavior of the milk; the cows were all near the end of the period of lactation, they had just changed from summer to winter feed, and the dust from the chaff got into their milk.

All the experiments, however, indicate that the greater part of the cream is secured after twelve hours' standing.

The increase of yield of that which stood twenty-four hours, deep set, over that which stood twelve hours, was :

In the First trial, ...	4.2 per cent.
Second trial, ...	4.8 per cent.
Third trial, ...	(9.3 per cent.)
Fourth trial, ...	5.7 per cent.
Fifth trial, ...	5.6 per cent.
Seventh trial, ...	7.0 per cent.

The increased yield in thirty-six hours over that in twenty-four hours, deep setting, was :

In the Fifth trial, ...	1.1 per cent.
Seventh trial, ...	1.9 per cent.

With shallow setting and higher temperature there was an increase after twenty-four hours :

In the Sixth trial of	13.7 per cent.
Eighth trial of . . .	14.4 per cent.

over the yield in twelve hours; and after thirty six hours:

In the Sixth trial of	9.2 per cent.
Eighth trial of . . .	4.5 per cent.

over the yield in twenty-four hours.

And with shallow setting the yield was greater than with deep setting:

	After 12 hours.	24 hours.	36 hours.
In the Sixth trial, ...	14.7	22.9	30.9
Eighth trial, . . .	3.2	10.7	13.3

From these experiments it is evident that a change of feed may create disturbances in the milk which are much more injurious with deep than with shallow setting. There is no reason to suppose that the low temperature makes this difference. It is more likely that it is due to the fact that the butter globules which cohered abnormally, and so were hindered in their movement, have to move about seven or eight times as far to reach the surface with deep setting as they do with shallow setting.

Between June 12th and July 1st, 1877, a second series of experiments was carried out at Raden on the same plan as the first. The results were as follows:

	Lbs. of ice used for 1 lb. of milk.	Av'ge temperature when skimmed.	Average depth of milk in inches.	Percentage amount of fat in the milk.	Fat removed in the cream, expressed in per cent. of the total fat in the milk, after— 12 hours.	24 hours.	36 hrs.
1. Tin vessels, morning milk,	0.55	41.6	16.0	3.26	75.2	86.6	87.4
Glass vessels, morning milk,	.....	58.5	2.1	3.26	81.6	85.3	91.4
2. Tin vessels, evening milk,	0.47	38.3	16.0	3.05	82.8	92.0	92.1
Glass vessels, evening milk,	.....	56.3	2.1	3.05	86.8	85.5	90.1
3. Tin vessels, morning milk,	0.53	41.0	16.0	3.44	89.8	91.6	92.6
Glass vessels, morning milk,	.....	55.4	2.1	3.44	77.7	88.8	89.4
4. Tin vessels, evening milk,	0.54	40.1	16.0	3.04	82.2	87.7	88.6
Glass vessels, evening milk,	.....	58.4	2.1	3.04	74.4	90.1	92.8

In round numbers, it took 1 lb. of ice for every 2 lbs. of milk to keep the water at the required temperature. That the morning milk was a little richer in butter than the evening milk may be explained by the fact that the cows grazed at pleasure through the night while by day they were driven slowly through the fields, and also by the fact that the lower evening temperature is more favorable for the milk secretion than the heat and sultry air of the daytime. The milk for these trials was drawn from the vat holding the whole milking of the herd, and may not have been a perfectly accurate sample of the whole.

Taking the average result of these experiments we find that the yield was:

	12 hours.	24 hours.	36 hours.
Deep setting, at 40.2°, ...	82.5	89.5	90.2
Shallow setting, at 57.2°, ...	80.1	87.4	90.9

With deep setting the yield of fat was about two per cent. more than with the Holstein method at the end of twelve and also at the end of twenty-four hours, but after thirty-six hours there was very little difference between the yield by the two methods. The average *increase* was:

	12–24 hours.	24–36 hours.
Deep setting, ...	7.0	0.8
Shallow setting, ...	7.3	3.5

Taking these results and those of the first series, together with the observations hitherto made, it may be regarded as most probable that with deep setting, using the quantity of ice employed in these trials, it does not pay to let milk stand more than twenty-four hours, and if a larger amount of ice is required it may not pay to let it stand more than twelve even; while if the Holstein method is followed it will pay to let the cream rise for thirty-six hours.

We see that in the first twelve hours more fat separated by the Swartz method than by the other; a fact which is all the more striking if we consider that the fat globules had to rise seven or eight times as far in the first case as in the second. Such observations as these, repeatedly made, have raised the much vexed question, "What temperature is best for raising cream?" But such a question is not quite fairly put. In neither method does the milk for the whole twelve hours keep the same temperature. From the time milk is set in ice water its temperature changes from minute to minute sinking without interruption till at last it reaches about the temperature of the surrounding water, and from then on is nearly stationary. The question would be better put thus: Does rapid or slow cooling give the larger yield of fat within a reasonable time?

To the first question, what *constant* temperature—that is, unchanging from the time of setting to the time of skimming—is most favorable, the author on theoretical grounds, supported too by observation, would answer—a higher temperature than obtains in Swartz's system. The milk serum becomes more and more dense as the temperature sinks and offers increased resistance to the rise of the butter globules.

But to the other question—Which method of cooling, slow or rapid, will give the larger yield of fat within a reasonable time—he would answer, rapid cooling is preferable. The more quickly the milk cools from the sides and bottom of the vessel in which it stands, and in consequence of this the more promptly the perpendicular currents through the milk to and from the surface are checked, the sooner can the butter globules move freely and without interruption to the surface. At the same time it must be borne in mind that the cooling should not go below a certain point, for as it approaches 32° the serum becomes thicker and the subsequent rise of the butter globules is very slow.

In accord with this view is the observation that by the Holstein method, where the temperature never goes very low, the rise of fat goes on continuously after the temperature has reached the minimum, while in the Swartz system, in which the final temperature is only 8° above freezing, the cream rises very slowly after the minimum has been reached.

Some dairymen consider the minimum point to which the milk is cooled a matter of chief importance, and there is much debate whether 37°, 39°, or 42° is the best minimum.

Now this end temperature which is aimed at by the use of ice has an important bearing on the yield of butter, but it exercises an indirect and not a direct effect. If the operator is a believer in the lowest temperature he will use more ice to secure it; but the more ice he uses the quicker does he cool the milk, and the more cream will he secure in the twelve hours' setting. The increase, however, will not be due immediately to the very low temperature to which he brought the milk, but rather to the *rapidity* with which he brought it there.

The results of the second series of trials showed that, although the deep setting at low temperature gave more butter than the Holstein method within twenty-four hours, yet, after thirty-six hours, the latter yielded a little more than the former. The great practical question, however, is, which *pays* best,—which will give the larger profit from 100 lbs. of milk. The Holstein method is one of the most complicated and difficult to carry out successfully. Summer and winter it requires constant strife to keep the temperature within the prescribed limits. In summer great care is required to prevent souring, and not infrequently the cream sours a little before skimming. The principle of the method is faultless, the carrying out of the principle in practice is very difficult.

The system of deep setting, though less perfect in principle, is undeniably much simpler and easier, the quality of the butter is more uniform, and, though the total amount produced may be somewhat less, under many circumstances it will be found more profitable than the Holstein system.

Though deep setting at low temperature avoids the disturbing influence of hot and cold weather, it is exposed to other dangers, and in a greater degree than the Holstein system. Especially it happens at times that the milk separates the cream very incompletely, and much less completely by the Swartz than by the Holstein system. The first series of experiments at Raden illustrates this in a striking way, and confirms the observation with exact numerical results.

This temporary disturbance has been observed in dairies all over northern Europe, and since it most frequently occurs in autumn, it has been believed that the milk of cows near the end of their lactation, had this peculiar quality of working badly by the Swartz system. Experiments in Denmark confirmed this view. In November and December, 1876, Fleishman carried out comparative trials in the Raden Experiment Station with milk from three cows, which had calved on March 4, April 1, and April 7, and were old in milk, and from three others lately calved, on November 3, November 13, and December 2, new in milk. In the case of two cows old in milk the yield of butter was less at a low than at a medium temperature (59°–62°).

But milk from the third cow, old in milk, which calved April 7, gave *more* butter when set at a low than at a medium temperature.

The milk from two cows fresh in milk yielded better when set at a low temperature, the milk from the third yielded best at 59°–62°. From these results Fleishman concludes that if this trouble about the prompt rising of cream is more *frequent* with cows old in milk, it is not by any means confined to such.

In the Raden dairy the quantity of butter produced from the herd began to diminish rapidly from the second week in October, 1876, a time when many cows were toward the end of lactation, and the change from summer to winter feed was being made, and did not fully come up again to the previous yield till some time in December. The same thing occurred again in the spring of 1877.

On the fifth of May the decline began, and to make one pound of butter there were used

On May	20,	1877,	38	lbs.	milk.	Stall feeding.
"	21,	"	42.6	"	"	" "
"	22,	"	40.9	"	"	" "
"	23,	"	35.3	"	"	" "
"	24,	"	33.6	"	"	Pasture.
"	25,	"	25.0	"	"	"
"	26,	"	23.0	"	"	"

It should be said that deep setting was practiced here throughout. The yield improved at once when the cattle went to pasture, and in this herd of 128 apparently healthy cows the yield of butter increased 85 per cent. within six days! Now, in the week from the 20th to the 26th of May the majority of cows were in the 4th or 5th month of lactation. Evidently, then, this trouble about the tardy separation of cream is not connected closely with the changing phases of lactation; it must have other grounds. Let us consider further this special case at Raden.

There had been no change in the management of the dairy. In every particular the milk was set and the butter prepared as it had been for months before. Nor was this remarkable falling off in the butter yield the result of poorer feeding. On the contrary, the ration had been improved. The stock of straw for litter was low, and the straw for feed was taken for litter instead, and red clover which had been saved for an emergency was substituted. This raised the milk yield, which had been falling off gradually since March 31, as the following extract from the dairy record shows. The average yield per day and head was:

From April 1–7,	1877,	19.9	lbs.	milk,	with ordinary winter feed.
" " 8–14,	"	19.8	"	"	" " "
" " 15–21,	"	19.0	"	"	" " "
" " 22–28,	"	18.7	"	"	" " "
" " 29–May 5,	"	18.3	"	"	" " "
" May 6–12,	"	19.5	"	"	with clover in the ration.
" " 13–19,	"	20.3	"	"	" " "
" " 20–26,	"	19.6	"	"	put to pasture.
" " 27–June 2,	"	18.1.			

For the cause of this trouble we are left then to examine the place where the cattle were kept.

As spring came on the litter in the stables had to be economized, and, in consequence, although all was done that could be, the place became more and more uncleanly, and the milk was affected by it.

In the morning it was impossible to clean out the manure before milking, and it was noticed that though the morning's milk was strained both at the stable and the dairy, it was not as clean as the night's milk, and did not give as much butter quart for quart.

This abnormal behavior of milk has not yet been sufficiently investigated, but the author ventures an opinion which may stimulate investigation in one particular direction.

The milk secretion furnishes a more delicate index of the general state of health of the animal than any other phenomenon connected with its life and the course of its vital processes, and the energy in the function of the milk gland suffers as soon as any error is made in the feeding or care of the animal. Granting this, and also that in the production of milk the waste, or fatty degeneration of the tissue of the gland plays an important part, we shall have to admit that the varying energy of action of the milk gland may impart varying properties to the milk. The relative proportion of different constituents in the milk may not be greatly altered by slight derangements in the animal economy—that is, a proximate chemical analysis might show nothing abnormal, and yet the qualities or properties of those constituents might be seriously affected. Possibly these derangements may affect the relative amount of some of the elements in the ash, and these in turn will influence the quality of the casein in the milk: it will be more or less perfectly held in solution, and will consequently offer more or less resistance to the rising of the butter globules.

Pending investigation, I believe that one can only count on perfectly normal milk when the function of the milk gland is entirely undisturbed, and the degeneration of the tissue goes on to its last stages without arrest. Very probably the quality of the milk suffers whenever the food or drink disturbs digestion, or its taste does not please the animal, or the general care is poor. That an animal cannot feel well, and cannot produce normal milk when for days and weeks it has no dry bed, or when its flanks are covered with a crust of manure, is as clear as day.

The difficulty with the separation of cream, whether it occurs in the fall when the cows are old in milk, or in spring, when the stables are becoming more than usually foul, in my opinion is due to slight disturbances in the activity of the milk gland which produce abnormal physical properties in the milk itself. The appearance of adhering butter globules which has been noticed above, indicates either that the degeneration of the tissue has not been complete, or that the casein is not completely dissolved.

It should be remarked in closing, that the other methods of milk setting suffer at times more or less in the same way from tardy separation of cream, but we have very little accurate information with regard to the matter, because the usual method of keeping the dairy account is so imperfect. Only when a rational and complete system of dairy book-keeping comes into general use, can we secure statistical material which will enable us to judge intelligently of the practical value of the various methods of milk setting, and butter making.

I would add that it is the testimony of German writers on milk that the deep setting system is the best for them.

Question Box.

Question. What are the best three grapes for a farmer's garden?

Mr. Williams of New Jersey. I should plant for my own use, first the Worden, which is the earliest and best of the black grapes that I know of, in preference to the Concord; it is larger and better every way. If I wanted three black grapes, I would add the Concord for the second, and perhaps for the third I would take the Wilder for my vicinity. I think it would be hardly safe for me to recommend the Wilder for your climate, for I fear it is too rigid for it.

Mr. Crosby. I would suggest the Brighton for this region in place of Rogers' No. 4, or Wilder. I think it is a grand grape in every respect. I don't think any better can be had than the other two mentioned.

Mr. Williams. I will endorse everything the gentleman has said. The Brighton has got a little foreign blood in it, but of the red grapes, it is one of the very best of that character.

Mr. Wakeman. For my own use, I should take Ives' seedling, Moore's early, or Brighton, and the Concord.

Mr. Hale. If I were planting only three, I would plant first, the Worden, and then the Brighton, which I think is the finest red grape that grows, and the Lady, a white grape, one of the very best here in Connecticut.

Question. How can our old pastures be brought into a state of fertility?

Mr. Gold. I suppose that bone dust is as good as anything that can be used for that purpose. Re-seed with or without plowing.

Question. What is the best grain for sheep in the winter?

Mr. Gold. Oats may be considered to be the best grain. Corn, wheat bran, linseed meal, might be considered good, and perhaps they would be cheaper, but when you ask for the *best*, without regard to the price, I suppose that the experience of flock-masters would lead them to say *oats*.

QUESTION. Ought the raising of tobacco to be encouraged or discouraged? In other words, is it right or wrong, and why?

Mr. SELEYE. One of our Board of Education came to me the other day and said, "I believe this tobacco raising is the worst thing that ever happened to our country." "Why," said I, "you raise it?" "Yes; but I have thought, for some time, it was a bad thing. I find, in visiting schools, that every little boy and girl who can turn up a leaf and find a worm, is taken out of school to do it, and it is perfectly demoralizing to the educational interests of the State." If that is true, I should say it ought never to be raised.

Mr. GOLD. One answer to the question is suggested to me by the story of the little girl who felt very badly when the old drake was killed. She did not know whether it was right or wrong. The next day, when they came to eat it, she said, "I guess it was right to kill that drake, it is so good!" I think there is a certain class of men who would answer in that way with regard to tobacco.

Mr. PLUMB. The question is, are we not better off without it than with it? If we are, then we ought not to raise it. I say it is a perfectly useless thing, and does more injury than good. I used to raise it once myself, but I learned better and discarded it entirely.

Mr. SELEYE. I think this is an important question, and if the Board of Agriculture is not competent to meet it fairly and properly, we do not want any Board of Agriculture. If the raising of tobacco is wrong, we ought to discard it, and try to influence our neighbors to do the same thing. I think we ought to have a free interchange of opinion on this subject, and if it is a good thing, let us continue it; if it is not, let us abandon it.

Mr. WEBB. I raised tobacco for a while, and I thought most of the talk against it was sentimental. I said, if it produced money, and made the pot boil, I should continue to raise it. I was taken sick once and my tobacco barn blew down, and I have had thanksgiving ever since, because it was for my interest to give up that crop. But so far as the question of morality is concerned, whatever action this board may take, the people will raise tobacco right straight along, as long as they find it for their interest to do so. There is a great hue and cry against the vice of intemperance; and it is a great sin and evil. It is one of the temptations of the adversary that are all around us. But man has the power to resist them, and if he does not believe in chewing tobacco, let him let it alone, let him exercise his influence over his children to induce them to let it alone, and let public sentiment, as far as it can control it, but do not denounce it as a sin. If you do, your children will not believe you, and the devil will take them one side and tell them it is not, and, from their natural depravity and wickedness, they will be likely to believe him, as have many of the children who have gone before us, and as will many of the children who will come after us. Only use persuasion against it. You cannot stop it. I do not think it is worth while to spend our breath on it. I will not croak a word against tobacco raising, if you find it for your interest to do so.

Mr. Gold. I apprehend that the gentleman misunderstood me if he understood that the Board of Agriculture desired in any way to choke off or prevent a discussion on this subject. It was not in my mind to do anything of that sort by the little story to which I referred, but merely that we might pass on as rapidly as possible to the other questions in the box, which are full of matter.

Question. What is the effect of Paris green on grapes?

Mr. Crosby. It does no harm to grapes, provided they are not any where near fit to eat.

Question. When is the time to mow Canada thistles?

Mr. Augur. From the 25th of June to the 25th of September.

Question. What is the effect of brine upon pear trees?

Mr. Cheever. It will kill them, if put on strong.

Mr. Augur. I have not as much faith in the use of salt for any of these things as some, and if applied injudiciously it works mischief. I think it is not productive of good qualities in fruit. It will not stay the operations of the curculio unless applied to a dangerous extent, and I do not believe there is very much benefit to be derived from the use of salt in that way.

Question. Would salt be beneficial to the plum or other trees?

Mr. Augur. I think it is favorable to the quince.

Mr. Gold. I think that it is favorable to the plum, and use it to some extent, applying a quart to a common-sized tree, in the spring on the surface as far as the roots extend. The plum tree grows naturally upon the beach, and salt air and salt rather favor it. I have also used salt with apparent benefit on the quince.

Mr. Plumb. It is said that salt will kill vegetation anywhere. I had a patch of Canada thistles last spring that I thought I would destroy with salt. I took an instrument two inches wide and dug below the surface of the ground and cut off every particle of root, and had a man follow along and put in a handful of salt; but it did not kill them. They came up as fresh as ever.

Question. Are potatoes good food for cattle?

Mr. Stewart. There is no doubt about their being good food, but I think the profit of feeding them, at present prices, is very doubtful.

Question. Is cotton-seed meal good to make cows give milk?

Mr. Stewart. Yes, one of the very best things you can give them, if you don't feed them too heavily.

Mr. Gold. Dr. Sturtevant says it is the most milk-producing food he has ever experimented with.

Question. Which will you receive the most benefit from, wood ashes at twelve cents a bushel, or muriate of potash at the usual price, applied to sandy loam, or any other soil?

ANSWER. Ashes, every time.

Mr. HINMAN. Would you give twenty-five cents for the ashes?

ANSWER. Yes.

QUESTION. Can a young married couple buy a Connecticut farm on credit, and expect to pay for it in a moderate time from the products of the farm itself?

ANSWER. They may expect to do it; whether they will or not is another thing.

Mr. ———. It has been done a great many times.

Mr. GOLD. The majority of our successful farmers have done just that thing. Their patrimony where they have had any has been small, for families have been large, and the division of the paternal estate has given but a small sum to each child. Few farms are held by inheritance, so called, where the possessor has not paid nearly or quite their market value to the other heirs. Of course the success of the enterprise will depend upon the judicious selection of property, but more upon the man himself and his partner. The practice of the money lenders in every rural district gives testimony to the public faith in such an undertaking. It is considered a safer investment to loan money to a farmer buying land than to loan it for a commercial or manufacturing enterprise. Most of the land in the State has been bought and paid for from the earnings of the cultivator, and there is nothing in the present outlook to controvert the experience of the past.

Recess until 7.30 P. M.

EVENING SESSION.

THE ADAPTATION OF AGRICULTURE TO THE IMPROVEMENTS IN IMPLEMENTS, MACHINERY, AND TRANSPORTATION.

BY PROFESSOR WM. H. BREWER, OF YALE COLLEGE.

The adaptation of Agriculture to the modern improvements in tools, implements, machinery, and transportation, is the greatest industrial problem just now before the world. It is the prime cause of a serious disturbance felt in many countries of Europe, and it is a subject of special interest here in Connecticut.

Inasmuch as civilized communities can only be fed by agriculture, it must be the most universal, as well as the oldest of industries, and of necessity must go on in some form in every civilized country of any considerable extent, whether the other industries flourish or not. Their prosperity is dependent on its methods and its possibilities, because it must supply the food of the people. All the food derived from the fisheries and hunting, is so small in amount compared with that produced from the soil, that in this connection it may be ignored; and it is fair to-say that the food of civilization depends upon Agriculture and the methods of transporting its products.

From the dawn of history, down to within about a hundred years, the art of Agriculture remained practically stationary, that is, it made no essential progress. During the last half of the last century it began to improve, and the rate of progress, slow at first, increased, until during the present century, the applications of modern science, and modern invention have more than once revolutionized the methods of the farm. And going along with this, new methods of transportation combined with modern sentiments pertaining to trade and commerce, have also revolutionized all the conditions of agricultural competition, and these complete revolutions have taken place in much less than a single lifetime. Indeed, any twenty years of the present century have seen much greater changes in this industry, than any twenty centuries have before, from the very dawn of history down to the time of our own national independence.

Certain conditions pertaining to America, have made the changes here more rapid than in other countries, and on such a stupendous scale, that all the civilized world feels the effect of it. Our increase of population has been unprecedented in the world's history, and yet our food production has more than kept pace with it, until now, the United States, according to Mulhall's tables, (*Balance Sheet of the World*, p. 38, 118,) grows 30 per cent. of the grain and 30 per cent. of the meat of the world. One result of this is, that "American Agricultural Competition" is a disturbing element over nearly all of Europe in one way or another, causing distress on the farms of Great Britain and Ireland, solicitude in France and Germany, and divers effects in various other countries. In more than one place, the modern phases of this great fact are producing a feeling of consternation as to what the ultimate result will be.

But the new phases of this competition are not merely questions between nations, but also between the different sections of the United States. New England as well as Old England feels the effects of agricultural competition with the wide and easily tilled prairies of the West, and if this new competition produces less distress here than there, it is because of the different systems of land tenure and different social conditions, and not that the competition is less sharp—in fact, it is sharper, for we have no ocean between us and the fertile prairies. A barrel of flour is brought from the mills of Minnesota to our own cities, for about the same sum that a cartman charges for bringing it from the nearest railway station to our own door. Illinois, Dakota, even distant California and Oregon, are to-day in closer agricultural competition with Connecticut, than Western New York or Pennsylvania were within the memory of some of the persons who are now listening to me. Such are the facts we have to face, and to which we must adapt our Agriculture.

Now let us for a moment consider some of the elementary principles which underlie the matter, to better understand the real nature of the problem that Connecticut farmers have to work out.

All the productive industries of civilization may be grouped into four great classes which are very unlike each other in their products, in their methods, in the principles regulating the amounts of their production, and indeed, in the very conditions of their existence. They are Agriculture, Manufactures, Mining, and Fisheries. Because Agriculture produces the food, it is more intimately involved in all the problems of civilized society than either of the others, and as it is absolutely essential to the very existence of civilization, it is the most adaptative. It cannot be killed in any country, short of the destruction of that country itself and the extermination of its inhabitants. It modifies itself to suit any conditions imposed upon it, and is shaped by every force which touches it; whether physical, economical, social, or political. It is perfectly plastic in its nature, it yields to every pressure, and is responsive to every influence; under changing conditions it is moulded into new shapes, but it is never destroyed. Herein it is unlike the other classes of industries. Manufactories, or mining, in a country may be suppressed or even annihilated by hostile laws or war, or unsettled political conditions; oppressive competition may prevent their starting, or if already started and prosperous, may utterly destroy them. But not so with Agriculture. Despite the worst of governments, the most grinding of oppression, foreign war, domestic revolution, competition, even robbery and plunder, *it will still go on in some shape.* It can modify its methods to suit the hardest conditions, but it cannot be killed so long as there is any one left to dig.

Take the history of Ireland as an illustration. When hostile armies from without invaded the island and domestic wars from within desolated their fields and destroyed their crops, the people did not entirely starve. The invading armies were sometimes supplied with scythes to cut down the growing grain, cavalry were turned in to trample it down, the contents of their granaries thrown out and trampled into the mud, or carried off, stacks burned, cattle killed, all their other industries were destroyed, but their agriculture adapted itself to even such hard conditions. A new kind of plant, first brought to Europe by a slave trader from America, but left in Ireland by Raleigh, in 1610, was taken up, and *potatoes* became the crop, and the national food a full hundred and fifty years before it was adopted by the common people of other civilized countries. It probably saved the Irish from practical extinction, as a race. The new food-plant was well suited to their climate and soil, it yielded abundantly, the labor of one man would feed thirty or forty, it was easily cultivated, it was alike adapted to garden and to field cultivation, it was specially adapted to hand cultivation; if the team was killed and plow broken, only the spade was needed to prepare the soil, plant the crop and to harvest it. But the special character it had which most adapted it to their uses, was that it could not be destroyed by the foe. No stacks to be burned, cavalry might be turned into the potato patch, but did no harm to it; neither the enemies horses nor the neighbors cows would touch the green tops; if mowed off by the scythe, they grew again and no special harm was done, only by digging the crop up hill by hill could its growth be stopped, and even then, the tubers could not be destroyed or even materially injured—they would not burn, if thrown upon the ground they were not materially injured, they were too heavy and bulky to be carried off; even if dumped into the neighboring bog, they remained sound, to be fished out as good as ever by the miserable inhabitants, as actually occurred more than once. Moreover, it was a crop that could be used green as well as ripe, as soon as the young tubers were large enough they could be eaten; on the other hand they were not injured if they remained in the soil after ripening; the harvest might be put off for a more convenient season. Simple as was their cultivation, the spade or hoe the only implement necessary, their preparation for the table was even more simple. The crop required neither sickle nor reaper, nor thresher nor mill, nor even oven; just as dug from the soil they could be roasted in the ashes and eaten with salt.

No, hard as were the conditions, Irish agriculture was not killed even by all that, it kept alive after a fashion, and is to-day one of the liveliest questions in European politics, and not European merely, for the "Irish Land League" is agitating the local politics of more than one American town.

I have cited this one example of adaptation of local agriculture to unfriendly conditions, because it is a striking one and a very simple one, but it is not more remarkable than numerous others; the history of the world is filled with them; various countries and districts about the Mediterranean could match this. I have cited it merely to illustrate the great law spoken of, that agriculture cannot be killed in any country short of destroying its inhabitants or its civilization, but that it can be modified to any extent. When it feels the force of any pressure on it, it yields but does not break. Under any amount of new pressure, no matter how heavy, the new question is not, shall this industry continue to exist? but rather, what shall it be? Connecticut farmers feel the pressure of western competition more sharply than English or Irish farmers do, so far as it is a purely agricultural competition, but there are no signs that Connecticut agriculture is dying out. The question is, what is the most profitable shape for it to take, and not, shall agriculture be continued in this State. It will continue, and that means that it will go on and be profitable, it will adapt itself to any amount of western competition, and how to best do this is the problem, on each and every farm in the State.

Until these latter years, the history of nations has been mostly the story of its rulers, and its great men, and not of its laborers in the fields; of its wars and its conquests, and not of its industries; and particularly not of its agriculture. But of late years, the history of this industry has become one of especial interest because of its peculiar relations to the history of human progress. We get our earliest glimpses of it in Egypt. Men have lately learned to read the hieroglyphics, and we have a pretty clear idea of the agriculture of that fertile valley from very remote times. There are abundant pictures on their monuments, and in their writings, so that we know the conditions and methods of their agriculture, of a period long before Abraham was born, and a thousand years before Moses wrote, as well as we do that of Europe during the middle ages. From that time down to about a hundred years ago, there was essentially no progress in this art, or at most too little to be of any account. The preparation of the soil, the sowing of the seed, the cultivation of the crop, the methods of harvesting, threshing, cleaning, and storing, were as complete, as excellent, and indeed essentially the same that they were three thousand or four thousand years later. And the tools and implements about the same. Why this was so, I need not here repeat; suffice it to say, that the art, without improving as a whole, modified itself in each country, in accordance with the law of adaptation spoken of, and was ready to start forward so soon as the social, political, and intellectual conditions of Christendom favored, and about a hundred years ago, a combination of political events and intellectual movements took place in Western Europe, and Eastern America, which has brought about the wonderful changes I have spoken of. The first hundred and fifty years in the history of this commonwealth was under the old condition of things.

Then most of the food had to be grown near the place of its consumption for land transportation, for any considerable distance, was out of the question. Each district had to grow most of the grain for its bread, or go without. Then a larger variety of crops were grown on each farm than now, we had then to grow all that we now grow, and many others. Flax, hemp, dye stuffs, etc., etc., were needed for the small local manufacturers, and for the manufactures that went on in every household. The laws of trade and commerce, and the sentiments regulating them, were such that there could be no such wide commerce in agricultural productions as we now have.

The methods of the farm were all different then from now. In all olden times the *tillage* of the crops rather than the methods of gathering them occupied most of the thought and care. For example, in *Ellis's Husbandry* (London, 1750), everything relating to clearing the soil, plowing, harrowing, sowing, preparing the seed, and tilling the crops is dwelt upon at very great length. Chapter after chapter is devoted to these subjects; but in all the eight volumes, there is not one chapter,—not a page, on the best methods of harvesting the cereals or threshing them. Now, it is in the gathering of crops and preparing them for markets, and in transporting them, that the greatest advances have been made by modern invention.

In my Report to the Census Bureau, on the production of cereals in this country, I have discussed at length the causes which have made American farming exceptional, and how it came that in this country there has been such a development of agricultural machinery. This I will not repeat here, suffice it to say that this has been the only country in which agriculture has been absolutely free, politically and entirely respectable, socially. The only one where the land has had to bear no special burdens, nor did its possession convey any special privileges, where it could be freely bought and sold by anybody, and where farming was as respectable as any other vocation. Whether a man pursued farming, or some other business, was a matter of taste and not of social rank or political privilege. There were places, where for a time, the ownership of real estate affected the right of suffrage, and in early days there were sometimes enactments compelling the cultivation of grain for fear of famine, and embargoes were sometimes placed on grain; but all this passed away long ago, and has had no effect on our agriculture during the last fifty years, which includes the periods of greatest changes. During this time, our agriculture has been perfectly free to adapt itself to conditions of soil, climate, and competition, untrammelled by unfavorable land laws, by social or class pressure, or by political repression.

Under the conditions existing in this State, down to well into the present century, New England grew her own bread-stuffs, for her population as it then was, and as people then lived.

New England was never much of a grain-growing region. Corn grew well, but wheat did not, compared with its growth in the colonies west and south of us. Its cultivation was encouraged in every way then possible, but nevertheless wheat was not abundant. I have taken much pains to look this matter up.

It must be borne in mind, that at the time of the settlement of the New England colonies, and indeed long after, wheat bread was a luxury over most of the world. Throughout Europe barley and rye were the chief bread-plants. Barley first, and rye following next. Wheat was for the rich, and this remained the condition of things until well into the present century, when old restrictions on commerce in breadstuffs were relaxed, or entirely removed, and new methods of producing, handling, and transporting grains were devised. Now, when everybody we know eats wheat bread every day, and at every meal, it is hard to appreciate how very modern this blessing is. Only this very week, a cultivated English lady of middle age, told me that barley bread was common in her younger days in that part of England where she lived. The bread of the common people, and the coarse bread of the rich was made of mixed grains, and mostly of the coarse grains, as the "black bread" of all Continental Europe is to-day.

Here let me digress to explain. When I say that "wheat bread" was a luxury, I mean bread made of fine wheat flour alone. All our cereal grains contain certain nitrogenous compounds, to which chemists give the general name of *Albuminoids*. They are the most costly of the elements of vegetable food. In wheat, these albuminoids consist mostly of what is called *gluten*, and this gives that character to the flour which enables us to make light bread of it. The albuminoids of the other grains are perhaps equally nutritious, but they have this special quality in a much less marked degree. Rye follows next to wheat, then Indian corn, then barley, then oats and buckwheat, and lastly rice. From the last three of these, we cannot make a light bread at all. Oatmeal may be as nutritious as wheat flour, as rich in albuminoids, but it is so difficult to make light bread of it that most authorities say that it cannot be done. Some Scotch authorities, however, say that a reasonably light bread can be made of a good Scotch oatmeal by a skillful Scotch housewife. Now, wheat flour and wheat meal are ingredients used in many coarse breads to make them lighter and more easily digestible. Rye is used for the same purpose. Barley bread is so heavy of itself that barley meal is seldom used alone. In the coarse black bread of Europe, rye is used to give lightness, and barley meal, buckwheat, and even bean meal are used as the heavier ingredients. These heavy breads may be nutritious, but they are less easy of digestion and much less palatable. In the Colonies barley bread was always rare. The cultivation of barley began everywhere as soon as that of wheat; but Indian corn, bought from the Indians or grown by the Colonists, was so much better for bread than barley, that the latter was everywhere soon abandoned as a bread-grain. Rye flourished well in all the Colonies; it flourished relatively better than wheat in this State, and its flour mixed with that of Indian corn became the basis of the common bread of the country, and "Rye and Indian" remained a common bread down to the time when modern machinery made it easy to farm on an enormous scale on the western prairies, and modern methods of transportation and handling grain made it possible to get it here cheaply.

Now, to return from the digression. As I said, New England was not much of a grain-growing region at any time. Many early writers on American agriculture speak of its inferiority to the colonies west and south of us. For illustration see "*American Husbandry*, containing an Account of the Soil, Climate, Productions, and Agriculture of North America," 2 vols., London, 1775; pages I, 52, 75, 77, 97, 98, etc. Philadelphia and New York were the great ports of shipments of American grains until long after that. At the time of the American Revolution and before, agriculture furnished the principal articles of exportation from New York and southward, while five-sixths of the New England exports were fish; agriculture furnished less than one-sixth. But the country grew enough grain to feed its people, and not only all the field crops and nearly all the garden vegetables now grown, but also flax, hemp, and a multitude of small crops now unknown here. Remember that agriculture is perfectly adaptative; the people had to be fed from the soil, because transportation of food for any considerable proportion of the population from a distance, by the methods then in use, was impossible.

But there was an intelligent class on the farms; no part of the Old World had such a farming population, and farming in America in those days was of necessity farming in a humble way. It was just the population to intelligently adapt their agriculture to their conditions, and to change it as fast as the conditions called for change. The early settlers scratched the unwilling soil with the rude wooden plows of their time, sowed the grain by hand, cut it by hand, bound the sheaves by hand, threshed it with a flail, winnowed it with the hand fan or the hand fanning-mill, as all the world did. So much hand labor was necessary that, even had means of transportation then been as good as now, the farmer of Illinois, Dakota, or California would not have had the enormous advantage he has now; he could plow a little more ground, but after that, in the sowing, harvesting, etc., he could work no faster than his eastern competitor. It is indeed no wonder that in early times bread-stuff was so precious as it was. One is struck, on looking over the early Colonial records, how the Assembly (or Court) would be applied to for the privilege of sending half a dozen barrels of meal to Boston, or somewhere else outside the Colony. Some of the applications were for as small a quantity as two barrels. Now ships are loaded at San Francisco or Astoria with wheat which has already traveled hundreds of miles by land, to still go five-eighths of the distance around the earth.

Then, the wooden plow scratched an acre a day; now, gang plows will plow ten acres; then, tools were made on the farm and ironed at the neighboring blacksmith shop; now, they are bought from the great manufacturers in the larger towns. Then flax and wool were dressed, spun, woven, and the fabrics made up in the farmer's family, even the buttons made at home; now clothing is bought ready made, and made by machine. By all this change some New England industries have been entirely destroyed, other new ones made; but agriculture cannot be destroyed, it has simply shaped itself to the new conditions.

We may class the improvements which have revolutionized agriculture into seven great classes, viz.:

1. Improvement in the tools and implements of the farm. They are more effective, and perform more with less human labor, and are more specialized.

2. Machines for the gathering of crops and preparing them for the market.

3. Methods and facilities for transporting and handling agricultural products.

4. Appliances and methods for the better management of live stock and the utilizing of animal products. All dairy apparatus would be classed here.

5. A better knowledge of the laws pertaining to the improvement of varieties of cultivated crops and breeds of animals.

6. A better knowledge of the laws pertaining to the fertility of the soil and the means of maintaining it.

7. New uses for agricultural products, and methods of manufacture involving chemical science, such as the manufacture of glucose from grain, sugar from beets, oil and glycerine from lard, etc.

It will be seen that the most of these are aids to all farmers alike. The one great agricultural advantage which the West has over us is, that they have a great breadth of fertile soil easily tilled. When we have said this we have said all. Modern methods of transportation put that land into competition with ours, which is harder to till, and, as a whole, less productive for grain. Practically the cause of the competition is in the modern facilities for the cheap transportation of agricultural products, so let us contrast the old with the new condition of things.

Until the days of modern railroads the profitable transportation of any of the cruder agricultural products for any considerable distance in this country was impossible. Roads were poor, population sparse, and land abundant enough so that even poor crops would feed the people. Even now it very rarely pays to carry by land the agricultural products of any region more than a very few miles by the methods employed before railroads came to be used. In connection with my work for the census office, on the production of cereal grains in the United States, I spent much labor in trying to find out how much it cost the farmers to haul their grain to market by wagons. Numerous answers came in, of course varying widely, but the majority of answers were from half a cent to a cent per bushel per mile for wheat. Very many were above a cent per bushel. I take the majority, and in the grain-growing regions. Now at that rate the transportation of a crop soon eats up its profits, and that was the condition everywhere before we had railroads. Then grain could only be carried any considerable distance where there was means of water carriage. We do not appreciate how isolated the outermost settlements were before railroads. Parkinson tells of (*Tour in America*, I, p. 156), meeting in 1798 near Philadelphia a wagon with five horses. The man had come 350 miles to the Philadelphia market with nine barrels of flour and two sheep. The flour at that time sold at seven dollars a barrel, but he had to have *some* money to buy things that could not be made at home. Our first rebellion, the farmers' "whiskey insurrection," under Washington's administration, grew out of the transportation problem. A farming community had settled west of the Alleghany mountains. They must sell *something*, because a farming community cannot make all the articles demanded by civilization, and to buy these they must sell something from their farms. There was no crude product, but the grain could be distilled into whiskey, and seven bushels of wheat thus concentrated could be carried on the back of a single horse by the trails to the eastern markets. When a government tax broke up this industry there, it produced a rebellion, the evils of which we need not now discuss. It is the transportation problem only that it is cited for. In Ohio even this means was impracticable, and the efforts of the pioneers to overcome the difficulty by growing silk or other precious products, forms a curious item in the history of the times. It was under such conditions of transportation that Connecticut farms were settled, and the vocation here pursued for nearly 200 years. Then scarce crops in any region meant increased prices, and if the season was bad, the farmer found partial compensation in the higher price brought by what he did raise.

How completely all this is changed. Grain in the West is produced in enormous quantities; is sold and graded. It is then carried in bulk and handled by machinery, and a railroad transports on an average a *ton* of grain for about what it costs a farmer to haul a bushel. On the great through routes it is less. The average freights on wheat last year (1880) from Chicago to New York by rail, was twenty-six and four-tenths cents per bushel. This year (1881), owing to "cut rates," much has come at prices of from twelve to sixteen cents per bushel.

As further illustration of the marvelous facilities now provided for transportation of grain this year (1881), much grain has gone from St. Louis, (Mo.,) to Liverpool, (England,) via the Mississippi river and New Orleans, at through rates of twenty-six and one-half to twenty-eight cents per bushel, including all charges of freight, handling, and ocean insurance. It has even gone from St. Paul, (Minn.,) to Glasgow, (Scotland,) via New Orleans, for twenty-five cents, exclusive of ocean insurance. I need not further dilate on the means by which this is done; how that steam power is used where man's muscle once was. Ships were once loaded and unloaded by men carrying the grain in and out on their backs. It then took a week or more; now the elevator does it in a few hours. I was reared on a wheat farm in New York State. When I was a boy it took several days to load a canal-boat, and word was passed about among the farmers as to how many days a given boat would lie at a certain place to receive its cargo of wheat. The last canal-boat I saw loaded was in Buffalo, last year. The wheat was taken from the hold of a lake steamer, weighed, and transferred to the canal-boat. The captain was swearing because of delays. It would take three hours, he said, to load his 8,000 bushels at that rate, and it ought, he thought, to be done in less than half that time.

Now, what are the obvious results of all this? Why a complete revolution in the *distribution* of agricultural products. Formerly, bad years made high prices, now the grain flows this way or that for great distances under the slightest pressure of prices, and thus prices are equalized; a bad year in England does not mean that English farmers will get much higher prices for their crops, it means that more wheat will come from the great Mississippi basin, or from California, or Oregon, or Australia.

And so it affects us also. But I promised that I would tell something about how grain was grown in those great grain growing regions of which we hear so much.

The great grain region par excellence, has Illinois as a center. A circle 800 miles in diameter, with Peoria in its center, includes the region of greatest production, although some localities of great celebrity for wheat lie outside of that. In Ohio, Indiana, Illinois, and the states in cultivation in that circle. I need not dilate on the methods of culture. They only differ from ours in such ways as larger farms, more level and easily tilled lands, and no manuring would indicate. I will merely note a few cases where the culture of wheat is more specialized, and where the scale on which cultivation is carried on has brought certain regions more prominently into notice.

And first, the Red River Region of Dakota, the famous Dalrymple farms so often described. Here, at the time of my visit last year, 75,000 acres of new land were owned by a few farmers, and all was under the management of Mr. Dalrymple. Wheat growing had begun there five years before, and 25,000 acres were in crop. This was divided into "farms" of about 6,000 acres, with a "superintendent" over each. These farms are again subdivided into "sections" of 2,000 acres cropped land, each having its own farm buildings. The land is level as the sea, the soil without stones, a deep, black sandy loam, the sand very fine. There is no system of farming practised thus far, practically only wheat is grown, the land is plowed, spring wheat sown broadcast by machine, and after harvest plowed again for another crop of wheat the next year. After the first crop, gang plows are used, two plows in the gang, drawn by four horses, and plowing five acres per day. Everything is done by machinery of the best kind that can be so done. There were at the time of my visit 125 seeders (or broadcast sowers), 200 pairs of harrows, 155 self-binding harvesters, (6½ foot cutting-bar,) three kinds were in use, and 26 steam threshers. The threshing is done from the shock, about 25 men and 20 horses working to each thresher. The product of that management that year was over twelve times as much wheat as was grown in the whole State of Connecticut the census year.

Let us look at another phase. Wheat growing, as pursued in California. That also is a treeless region, ready for the plow without clearing off the timber. A dry, rainless summer, follows a mild rainy winter. The wheat is sown any time from October to February, grows during the cool winter; there are showers in the spring; it ripens in May or early June. And as the rains have then ceased, and there is no fear of damage by wet, it is harvested as fast as is convenient. The harvest goes on six, eight, even ten weeks. The grain cures standing, and may be threshed as fast as cut. The wet winter and dry summer make various processes and methods there practicable, which are not possible east.

The ground is plowed with gang plows, 4, 6, 8, even 10 plows to the gang, drawn by as many horses, and plowing 5, 8, or even 10 acres per day according to the nature of the soil and the quality of the work. The seed is sown broadcast, by machine, and covered by harrowing.

It is in harvesting and preparing for market that the methods are most striking. For example, let me cite the ranch of Dr. Glenn, in the Sacramento Valley. He is the greatest wheat-grower in the world, so far as I know of; his crop some years amounts to about a million of bushels. I will briefly describe the harvesting as I saw it going on. The grain is cut by headers, each with 16-feet cutting-bar and driven by six animals. The cut grain is hauled to the steam thresher, where a 26 horse power straw-burning engine drives a 44-inch cylinder machine. The "crew" and appliances consisted of 7 headers, and 21 header-wagons, requiring 35 men and 84 animals to cut the grain and deliver it at the machine. Here 31 men and 10 horses were employed. This, with the "riding-boss" or overseer, makes 67 men and 95 animals in the whole "crew." This crew and its machines and appliances averaged 3,825 bushels per day, equal to 57 bushels per man per day.

On the large ranches, a whole season's crop will be cut, threshed, cleaned and sacked ready for market at an average of fifty bushels per day per man, and this is often done. I have taken much pains to study out the relations between the effectiveness of human labor when supplemented by modern machinery in gathering grain, compared with that employed at the beginning of this century. To cut grain as then cut, thresh and clean for market, each day's human labor did not average in this country over four bushels. I think that the average was less rather than more. What the average now is I cannot say, but probably more than 20, and, in such conditions as pertain in California, over 50 is often done. Indeed, this is by no means the limit. Many machines are at work in the great Central Valley which cut, thresh, and clean for market in the same operation. One visited, at work on Mr. Hoffmann's ranch in the San Joaquin Valley last year, will illustrate. A huge machine driven by 20 mules, worked ten abreast, averaged 36 acres per day, and would cut 40 acres. It was worked by four men, and cut a swath a rod wide. To see the huge monster moving resistlessly over the great plain, the broad swath going down before it, and the sacks of clean grain strewn along the way from its side, made it the most impressive piece of machinery I have ever seen. About 200 bushels of wheat per day was a fair product for each man's day's work.

It is by such means that the production of grain in the United States has reached such great proportions, not only actually in bushels, but relative to the population. The production of wheat in the whole country, the several census year's crops, shows some very remarkable figures; in 1849 by the methods then in use, it was less than half what it is now. The figures are:

1849,	4.3 bushels	per head of	whole	population.
1859,	5.5	"	"	"
1869,	7.8	"	"	"
1879,	9.	"	"	"

The total product of grain in the United States the last census year (1879), amounted, in round numbers, to 2,698 millions of bushels, or about 55 bushels per head of the total population, the great bulk being grown in regions brought into competition with us comparatively lately.

Now, what is the immediate effect on our own agriculture of this competition with new and fertile regions of such vast productive power? First, it causes a greater specialization of our crops. We do not try to grow our bread. If wheat is grown, it is incidental to something else; and in this way there will always be some grown here. We no longer grow hemp, nor flax, nor woad, etc., etc., but concentrate our attention on such products as pay best. We do such things as can be done on our scale just as economically as on a large scale. It is only some of the farming operations that can be done cheaper and cheaper as the scale upon which it is done increases, in fact this is true of but few farm operations.

Next, we strive for excellence of product, as well as greater yield. Hence improved animals, improved crops, such as we grow. I never saw more attractive exhibitions of corn than this State can show, although we cannot show so much of it as the bigger western states can.

The next effect of this new order of things is a decrease in the strictly rural population of all the older districts. This, however, is not necessarily accompanied with a decline in agricultural production. The decrease in rural population is brought about in several ways, viz.:

1st. Fewer people are required to run the farm. With modern tools and machines, land is tilled and crops managed and gathered with much less human labor, as has been explained. So, with the same amount of land tilled, and same product obtained, fewer hands are necessary.

2d. Less land is tilled and more put into pasture. This requires less population on the farms. Such has been the effect in all countries.

3d. Country mechanics are less needed. In former times, each farming neighborhood had its blacksmith to make and mend farm tools, wagon-makers, shoemakers, harness-makers, tailors, etc., etc. Now these have gone into the towns.

4th. Country manufacturers on a small scale, here a carding machine, there a grist mill, or a tannery, and the many scattered small establishments which have given way and succumbed to changes in methods of manufacturing.

5th. Country stores have declined, and country professional men, lawyers, etc., have gone to the larger towns, and the farmers now go to the larger places to trade.

All this has tended to greatly decrease the population of what are more strictly farming districts, but this does not necessarily show any decline in agriculture. In fact, my belief is, that Connecticut grows much more now, and does it more profitably than under the old condition of things. *Connecticut Agriculture is not declining;* this little State can to-day show a most honorable record. So far as grain-growing is concerned, there is, on the whole, a decline, for the reasons shown. But even here the decline is not so great as is popularly supposed. For convenience, let us tabulate our chief grains, as returned at the several periods of National Census. We have now five such enumerations, covering 41 years. The chief grain crops are corn and oats. The figures, in bushels, are:—

	Corn.	Oats.
1839, - -	1,500,441	1,453,262
1849, - -	1,935,043	1,258,738
1859, - -	2,059,835	1,522,218
1869, - -	1,570,364	1,114,595
1879, - -	1,880,421	1,009,706

Corn has not materially declined for forty years; and oats not so much as is popularly believed. Next follow rye and buckwheat, both grown in smaller quantities, and both show greater decline.

	Rye.	Buckwheat.
1839, - - -	737,422	303,043
1849, - - -	600,893	229,297
1859, - - -	618,702	309,107
1869, - - -	289,057	148,155
1879, - - -	370,733	137,563

Each of these have declined to about one half, but what rye has lost in bushels, it has perhaps more than gained in the increased value of the straw; indeed, the crop is probably grown more for the straw in this State, than for the grain. The figures for wheat and barley, are:—

	Wheat.	Barley.
1839, - - -	87,009	33,759
1849, - - -	41,762	19,099
1859, - - -	52,401	20,813
1869, - - -	38,144	26,458
1870, - - -	38,742	12,286

The total aggregate of these six grains at the respective dates, is as follows:—

1839, - - - -	4,114,936 bushels.
1849, - - - -	3,084,832 "
1859, - - - -	3,630,076 "
1869, - - - -	3,186,773 "
1879, - - - -	3,449,951 "

The total decline is not large, relatively, and for the last thirty years, which marks the whole period of great railroad transportation, and the competition it has induced, there has been no actual decline in total production of grain; the figures show fluctuations, but the State has held its own even in grain-raising. The village and city population has greatly increased in that time, so that more bread and feed for animals have been needed, and the importations into the State are greater; but our own soil produces about as much grain, and as good grain now as it did thirty years ago, and but few of the very best states show better yields per acre.

The total figures of the last census enumeration are not yet ready, so I cannot make certain comparisons that would be interesting, but let me cite some old figures. In connection with my late census work I had some calculations made based on the census of 1870, which are of interest in this connection. In the reports of that census, there was a column of the total value of all farm productions given by States. First, I divided this total value of each State by the number of persons employed in agriculture. I extended the calculation to but twenty-three of the then existing States. Of that number, Pennsylvania stood first, with the amount $707.34 per person employed in that vocation. Then followed New York and New Jersey. Connecticut followed fourth, with $608.93. Every one of the fertile States west of New York and Pennsylvania was behind us. In Illinois it was $586.70; in Iowa, $544.01; in Ohio, $499.38, etc. These figures show that human labor paid well in crop product in this State.

I next divided the total value of all farm productions by the number of acres of improved land. In this, New Jersey led, with $21.61; then followed Mississippi, Utah, and New York; then Connecticut, with $16.08; all the so-called Western States being below us.

I next divided the cash value of the farms by the number of persons engaged in agriculture. In this, New Jersey led, with $4,079.39; then followed Pennsylvania, New York, and Delaware; then Connecticut, with $2,846.11; and again the States that seem more favored were below us.

Whether considered as to capital employed per hand, or value of product produced per acre, or value of product per hand, the place of Connecticut was high.

It is probable that the figures for 1880 will not be relatively so good, for several reasons; one important one is that the census year was an unusually favorable one in most of the Western States, and relatively better than here. But the figures are encouraging.

No; Connecticut agriculture is not dead yet, by any means. With nearly fifty organizations of farmers in the State for the promotion of agriculture, with the use of commercial fertilizers and a State Agricultural Experiment Station to aid in the intelligent use of all scientific helps, I have no fears but that the State will hold its own, and with increasing density of population the utilization of all farm products will be more and more complete. When we can learn, as a State, to love sheep more than dogs, that will be another gain.

With the decrease in the average size of the farms, and greater number of farms that inevitably takes place as a result of our system of land tenure, there will be intenser and intenser culture, and a looking after those products in which we are on a level with or ahead of the West, to supply our local or near markets. Of the seven classes of improvements spoken of, five help us as much as they do the West; and when that country becomes denser settled, and the land taken up, and when the inducements to take up new lands in order to make money on the rise in the value of the land will be less, then the apparent disadvantage under which we labor will be less. So far as making money by farming is concerned, the new States have the advantages noted, and which will grow less and less.

One more thought and I must close. From what I know of the comforts of farm life and the farmers' home in Connecticut and in the newer States, there is a phase in which I think you have an enormous advantage. How often have we heard returning men say that if they would live as poorly here, and subject themselves to the same privations that they were forced to in the newer regions, that they would make as much money, or more; but that the increased comforts and superior school and church and social advantages of an older community more than compensated for the attractions of a more fertile and more easily tilled but new and distant prairie. Of our rural scenery, and the healthfulness of our climate, and their value as an element in the problem, each can work out an estimate of its value for himself.

In conclusion, I believe that the total value of the agricultural productions of this State will continue to increase as a whole, in obedience to that law of adaptation I have discussed, and the State continue to be proud of its intelligent and thrifty farmers.

At the close of this address resolutions were heartily passed, thanking the exhibitors for their generous contributions of fruit and other products, especially to the Green's Farms Farmers' Club and the Guilford Canning Company; to the Press, for widely extending a knowledge of the meeting and its proceedings; to the Railroads, for the facilities furnished to those in attendance; to the speakers, who have brought the fruits of their study; to the hotels and citizens of Newtown, for the many courtesies bestowed, with the assurance that these kindly acts will long be remembered, and that we thus gather strength to do our duty as citizens of the State.

After a general testing of the fruit on the tables, the Convention adjourned *sine die*.

REPORT OF P. M. AUGUR, POMOLOGIST.

The year 1881 will be remembered as one of special barrenness of the apple orchards of Connecticut; generally the same may be said of the quince, while the pear produced abundantly, the grape produced fairly, and in most instances, orchards of the peach, especially those on elevated situations, where they received good culture, bore good crops at highly remunerative prices, so much so, as to offer a strong incentive to plant the peach largely. The plum, where exempt from attacks of curculio, yielded splendid crops at good prices. And the small fruits where they had generous care and high culture, were decidedly remunerative.

The market for all fruits has been quick at good prices.

How shall we equalize our fruit crops so as to have no glut in the productive year, and no want in the barren year? This is a question which has been repeatedly propounded of late, and deserves careful consideration.

In answer I would say, first, more uniform care and culture would secure more uniform crops; but still we must all admit there is a strong tendency to over-production in alternate years with intermediate barrenness. And as the relative scale of prices between 1880 and 1881 is as one to four, we desire to secure a prompt and adequate remedy.

In view of the evident facts I offer the following suggestions specially with reference to the apple. With a probable heavy apple crop in 1882, lessen the production as follows:—

1st. Top-dress your orchards generously, and where practicable plow them carefully in early spring, thereby securing a fresh abundant growth in 1882. While this is highly important in giving a new and stronger growth to the orchard trees, it may not lessen the crop, while it would materially increase its value.

Therefore, 2d. Systematically prune out a considerable portion of the young bearing branches, thereby materially reducing the amount of bearing fruit spurs. These two steps will greatly augment the size and quality of the fruit without so much exhaustion to the tree, and with greater probability for fruit the following year; both these operations may, however, actually, and probably will, increase the value of the coming fruit crop of 1882.

So, 3d, provide abundance of stools, step-ladders, and longer light ladders, and in the blooming season, commence on orchards of young bearing age, by contracting for the entire extinction of every blossom, especially on Baldwin and other alternate even year bearers. Boys and girls of twelve to sixteen years of age may easily do this, and at such rates as to make it an object to employ them to considerable extent.

Were this to be repeated every year, it *might* or *might not* pay; but the probability is strong that *once changed* and out of *the old ruts*, a cycle of years of odd year bearing, might follow much to the profit of the orchardist; in fact, the experiment has in many known cases been tried with satisfaction. We would not advise this on an old tangled unpruned orchard, but on such as offer the best results with convenient access and least outlay; neither should the practice extend over too much ground, we should seek simply to equalize our fruit crops; yet, had I twenty acres of Baldwin, or Roxbury Russet apples, I should have little fear of glutting the market in odd years; should they all come into bearing then.

In any case the remarks about top-dressing, cultivating, and pruning may be judiciously adopted.

The question has often been asked, will scions from an odd-year tree be sure of bearing the odd year ? We say no; there are so many conditions and surroundings that affect the growth and fruitage of trees, that there is no certainty about it, and an orchard whose trees were grafted from scions alike, differ often in their bearing years. Yet I am free to say, if I could just as well use scions or buds from odd-year trees, I should choose them. And in our nursery practice, whenever practicable with any kind of fruit-trees, we choose scions or buds from the best bearing trees, rather than the same kinds in nursery rows.

Insect Depredations.—It is a lamentable fact, that thousands of trees in every part of our State are destroyed every year by the apple-borer, which is most destructive in the quince and apple trees; and the peach-borer, which causes great destruction among peach trees; the more promising and vigorous the tree, the more inviting is its soft cellular tissue as food for the growing larva; consequently the careful fruit grower needs to be ever on the alert to prevent the ravages of these destroyers.

Wherever an orchard or even a tree is found infested with borers (which is easily seen by the borings about the collar of the tree, or with the peach, by the exuding of the gum), it should be thoroughly probed and cleaned with a sharp-pointed knife, after which it should have a free application of soap.

Trees which are exempt from the borer in spring, may be kept so usually by an application of a mixture of unleached ashes and lime, from two quarts to twelve quarts, (according to size) around the collar of the tree in May; or like exemption may be secured by a wash of whale-oil soap, or by a soapy whitewash, say one quart of soft soap to three or four pounds of lump lime slacked, to a suitable consistency, to apply with broom or brush to the trees.

It may here be remarked that these applications are worth all their cost in promoting and maintaining the health of the trees, as well as in preventing the injury by borers.

The canker-worm, tent caterpillar, and all other insects that prey upon the foliage, may be easily and speedily subdued by a weak solution of *London-purple* or *Paris-green* applied when the insects first make their appearance. *London-purple* has the advantage of mixing more readily in water than *Paris-green.* The same remedy is said to be quite effective with the curculio, rose-bug, and apple-worm.

Now the question is pertinent, is it safe to make general use of these poisons? Undoubtedly they should be used with great care and discrimination; on the early summer fruits I would not use them, specially not near the ripening period. I would not use them on an orchard in grass, for pasturage, or soon to be cut for soiling, or for hay, nor where lettuce, cabbage, or other truck crops would receive the drippings from trees, but for grape vines, or trees whose crop is in jeopardy from insect ravages, and whence the drippings can effect no harm, I would not hesitate to promptly use these poisons, never in greater strength than necessary, and with full confidence that intervening rains would remove all danger.*

How shall we avert the attacks of fungi upon our trees, and plants?

So far as we know, there are no agents more efficient in combatting fungi than carbolic acid, sulphur, potash, and lime.

For trees under the incipient attacks of blight; after removing, so far as visible, the infected branches, wash thoroughly the trunk and branches with the following: sulphur, one part, quick lime,

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* I cannot agree in recommending the use of these poisons. The danger overbalances the advantages, and I shall stop eating fruit when these practices become common. T. S. G.

nine parts, slack well together, and when of proper consistence to apply to trees, add to each pail of wash one-half gill of carbolic acid, or one quart of soft soap, with that amount of carbolic acid incorporated; stir well and apply.

To prevent the development of yellows in the peach, we would advise the same wash for the trees, and a free application to the soil of good unleached ashes and lime, also a liberal dressing of finely ground-bone. Or in place of ashes use muriate of potash. There is no doubt this disease is both hereditary and contagious. Therefore plant pits and use buds only from healthy trees, and destroy forthwith all infected trees. To avert so far as possible *mildew* and *rot* in the vineyard, remove and burn all mildewed leaves and decayed fruit as soon as practicable in autumn; in spring dress broadcast with a free application of finely slacked lime, later at intervals of three or four weeks, from June first, use the sulphur bellows thoroughly; although this may seem to be too much labor and care, there is no doubt that the more perfect fruit will justify all the extra labor and care.

What varieties of fruits shall we plant? and how shall we plant?

Much is lost by very injudicious planting; let us consider this question as carefully as its importance demands. Suppose the area be, including buildings, sixty to eighty square rods of land.

You want fruit the year round; you cannot raise many varieties ripening at the same time, as the area would be insufficient. Eight varieties of apples would carry the season from July to June, as follows: E. Harvest, Gravenstein, Fall Pippin, Fameuse, Hubbardston Nonesuch, R. I. Greening, Baldwin, Roxbury Russet. For twelve varieties, add E. Williams, Chenango Strawberry, Grimes' Golden, Red Canada.

The above varieties are delicious as dessert fruits, or valuable for culinary use, and can hardly be superseded by new varieties.

The grape stands next to the apple in value and importance, and the following varieties with good care, will furnish abundance of fruit:

Early Victor, Worden's Seedling, Concord, for black. Delaware, Jefferson, Diana, Catawba, for red.

Martha, Lady, Prentiss, and Pocklington for white; of the above give the Early Victor an early place to secure early grapes. Give the Diana and Catawba a southern aspect to secure ripening, for they are excellent keepers, and ought not to be dispensed with. All should receive good pruning and good culture.

The Early Victor commencing in August, and the Prentiss, Diana, and Catawba, by sealing the cut stems with wax, and packing alternate layers of cotton and grapes, carry the grape season easily to March or nearly half the year.* Other varieties, perhaps equally good, might be added or substituted as the planter pleases, *but* we caution our readers to beware of imposition. Tree dealers sometimes canvass the country with sample grapes of some new variety *not known*, and by showing some choice grapes, (foreign perhaps, as has been done), induce purchasers to believe they will get just such grapes, when they are sure to be disappointed.

Therefore we advise planters to make their own selection from reliable men, as few *small planters* can afford to give up small places to doubtful varieties.

The following list of well known pears may be adopted commencing with Doyenne D'Ete, Clapp's, Bartlett, Sheldon, Onondaga, Seckel, Beurre D'Anjou, Lawrence, for eight: add Dearborn's Seedling, Goodale, Winter Nelis, and P. Barry, for twelve varieties. This will give a six months' succession of fine pears.

First list for peaches—a succession, Waterloo, Mt. Rose, Foster, Old Mixon Free, Crawford's Late, Stump the World.

Second list—Amsden's, Early Rivers, Troth's Early, Early Crawford, Reeves' Favorite, Steven's Late.

Quinces—Orange, early; Champion for late.

Plums—*for profit*, Lombard, Shropshire Damson.

Sweet Cherries—Gov. Wood, Rockport Bigarreau, Downer's Late Red. Sour Cherries—E. Richmond, Emp. Eugenia.

A good list of Strawberries—Gipsey, Crescent, Duncan for early, Chas. Downing, Miner's Prolific, Seneca Queen, for medium, Longfellow, Kentucky, Glendale, for late. New varieties of great promise—Mt. Vernon, Bidwell, Finch's Prolific, Manchester, Jersey Queen.

A good list of Raspberries is the following—Black, Souhegan, M. Cluster, Gregg,—Red, Reliance, Turner, Cuthbert.

Blackberries—Snyder, Taylor's Prolific.

Gooseberries—Downing's, Smith's Improved.

Currant—Cherry, White Grape.

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* Add or substitute as a bearer Hartford Prolific, and for quality, Brighton.—T. S. G.

As you are aware, the list might be extended so as to include many more valuable varieties all through. For instance Downing describes about 1,000 varieties of pears—many of these are good. We need only the best or most reliable, and it is always better for a novice to fill his list with those varieties which, on the whole, succeed best in his neighborhood, than to fill up the ground with new things, most of which usually fail to be most desirable.

THE OUTLOOK FOR FRUIT.—The apple orchards of Connecticut may be expected to bloom most abundantly, and if the season favors, a heavy crop will probably be produced.

The peach in most cases, in our State, will probably be a failure. Of pears, grapes, plums, and quinces, we may expect a moderate crop. The tender small fruits where unprotected have suffered somewhat.

We earnestly advise all who produce an abundance of apples to save by drying, using a large evaporator (where the quantity will warrant it), for the perishable portion of the crop; and also, to convert by a copper syrup evaporator, cider into jelly. The dried fruit and the cider jelly of 1880, have been freely used in our family this winter, and also the dried fruit for market bringing good prices, having kept finely.

To make a good jelly, apples not over-ripe should be used, free from rot. The cider from a mash mill is said to be the best for jelly making. It should at once after grinding go to the press, and immediately from the press to the evaporator. The success in making jelly depends much upon this; therefore use firm apples, putting in none that are soft or mealy, and expedite the process as rapidly as possible. Wild apples and crab apples make a good jelly.

The cider needs reducing from eight to one, making a jelly weighing from ten to eleven pounds per gallon. Some use sugar, but it is not necessary.

In some sections of the country, cider is made by the mills at the usual rate, and the jelly boiled for two cents per pound. Some charge twenty-five cents per gallon for making the jelly. Others give two pounds of jelly for each bushel of sound apples brought to the mill. Others vary the prices in accordance with localities and conditions, but when thousands of bushels of valuable fruit go to waste, as it probably may this year, a cheap luxury may be provided by having mills and copper evaporators in each apple district of our State; the same evaporator may also be used successively for maple sugar and syrup, cider jelly, and sorghum; only taking care to keep it properly clean, specially so, after each operation is finished.

Winter Exhibit of Fruits, Grains, Vegetables, Nuts, etc., at Newtown, December, 1881.

The exhibition of apples was less in extent, owing to the very small crop in our State generally, but winter pears were exhibited in greater variety than usual, there being fifteen different varieties on the tables.

Corn and grain were in usual variety, and the show of vegetables in excess of anything at any previous meeting. As a whole, the exhibit was eminently satisfactory.

The collection consisted as follows, commencing on the left of the stage: T. S. Gold, Secretary of the Board of Agriculture, had, as usual, the largest and most beautiful collection of fruit; twenty-four dishes of apples and seven dishes of winter pears. Also a choice sample of sorghum syrup and a plate of pop-corn; Nathan Hart of West Cornwall, a beautiful dish of the Lady apple, the price in New York of such at the time of the meeting being $12 to $16 per barrel; P. M. Augur of Middlefield, four dishes of apples; Col. A. Warner, member-elect of the Board from Windham County, from Pomfret a choice dish of winter pears; H. Sanford of Newtown, three dishes of apples; A. J. Jackson of Wilton, five dishes of apples and two of pears; J. N. Whiting of Torrington, one dish of apples he considered a seedling, but which is identical with the Northern Spy; M. C. Hawley of Hawleyville, one dish apples and four varieties of pop-corn; Miss Flora M. Clarke, a beautiful dish of apples in variety and nicely trimmed, presenting an attractive appearance; E. B. Weed of Bethel, three dishes of apples; E. C. Barnum of Newtown, a basket of choice Dunmore potatoes, generously offered for distribution; L. Burr of Monroe, a large dish of Beurre D'Anjou pears; J. W. Bunnell of Southport, two Champion quince trees, also two dishes of very large Champion quinces, some specimens weighing fourteen ounces each; C. L. Bostwick, Sandy Hook, choice samples of honey; also L. B. Lake of Newtown, a choice exhibit of honey; Gen. Noble of Bridgeport, sent one of the largest and finest collections of winter pears ever exhibited at the winter meetings of the Board, embracing eleven varieties; T. S. Gold of West Cornwall, a beautiful mammoth yellow field pumpkin, which occasioned much remark and attracted much attention. G. E. Wheeler of Newtown, three nice squashes; A. J. Jackson of Wilton, a collection of apples and potatoes; R. W. Robinson of Hampton, member of the Board, potatoes and corn; L. S. Wells of New Britain, member of the Board, a collection of corn and potatoes; M. C. Hawley of Hawleyville, beets; Gilbert Williams of South Britain, marrow-beans, and a collection of corn, oats, wheat, and buckwheat; Theron E. Platt, Stone Edge farm, a collection of rye, wheat, and oats; Aaron Sanford of Newtown, samples of leaf tobacco of fine texture; Chas. T. Beardsley of Newtown, also choice samples of leaf tobacco; E. C. Ayer, corn yielding eighty bushels per acre; H. A. Hawley, Hawleyville, white onions (choice); George S. Platt of Milford, a choice collection of sweet corn; Dennis Fenn of Milford, a fine collection of sweet corn, also turnips and squashes; M. C. Hawley of Hawleyville, pop-corn; D. N. Van Hoosear, President of the East Wilton Farmers' Club, a collection of corn; John N. Wheeler of Newtown, some choice walnuts; Mrs. J. H. Guy of Middlefield, some extra choice walnuts, large, white, thin-shelled, fine flavored; G. S. Sturges, Esq., choice samples of corn; Philo Clark of Newtown, choice apples, corn, and as a crowning ornament of the stage, a thirty-year old Century plant; George W. Miller of Middlefield, varieties of Dent corn; George W. Bradley of Hamden, a very choice collection of corn of the same varieties as exhibited at the international exhibition at Paris, drawing a prize and very honorable mention; also choice sample of evaporated apples from E. L. Johnson & Sons, Newtown.

But the joint exhibit of the "Greens' Farms Farmers' Club" won, as it deserved, the attention of all visitors, and every one's praise.

The exhibit consisted of apples from H. B. Wakeman and H. G. Birge, also pears from Mr. Birge; potatoes from W. J. Jennings, Pride of America, and Mammoth Pearl; F. Mills, White Elephant; H. B. Wakeman, Beauty of Hebron.

Wheat from H. B. Wakeman, S. B. Sherwood, E. Beers, Austin Jennings, J. H. Jennings, Walter Jennings, and S. B. Wakeman.

White Onions from T. B. Wakeman, H. B. Wakeman, and S. B. Wakeman.

Yellow Onions from Austin Jennings, Wm. J. Jennings, A. H. Sherwood, and E. Beers.

Red Onions from J. H. Sherwood, S. B. Wakeman, Austin Jennings, and F. Mills.

Onion Seed from H. B. Wakeman; red and white also from Green's Farms Farmers' Club; by S. B. Sherwood a collection of several varieties of corn; from Austin Jennings a collection of corn; also collections of corn from J. Elwood, J. H. Jennings, E. Beers, J. H. Sherwood, H. B. Wakeman.

Rye by D. B. Bradley, E. B. Adams, Nellis Sherwood, and Walter Jennings.

Oats by W. J. Jennings and S. B. Wakeman; Champion quince by J. W. Bunnell; also Hull & Jennings exhibited a model of a valuable implement for onion-growers, viz.: a smoothing harrow, which on land free from stones dispenses with the rake in leveling.

The above collection from a single neighborhood merits, as it has received, the highest praise.

The exhibit of the Connecticut Agricultural Experiment Station consisted of forty samples of fertilizing materials in glass jars, suitably labeled. They represented, first, the crude phosphatic and nitrogenous materials which do not come directly into retail trade, but farm the basis of our manufactured fertilizers, superphosphates, etc. Second, such chemicals as are usual in compounding fertilizers, and are also retailed for direct application to land; sulphate and muriate of potash, kainit, nitrate of soda, sulphate of ammonia, etc. Third, waste products which have a high commercial value and extensive use as fertilizers, such as the various kinds of dried blood, ammonite, cotton and linseed meal, fish-scrap, ground bone, bone shavings and the like. Fourth, certain fraudulent or inferior articles which have lately been sold in this State.

Most of the articles exhibited were from stock sold in the State and analyzed at the Station within the last year, and showed the varying prices which have been paid for phosphoric acid, potash, and nitrogen, by our farmers. For instance, from $3.50 to $10.11 per hundred pounds has been paid for phosphoric acid in ground bone; soluble phosphoric acid in light grade articles has cost about $11.00 per 100 pounds. Actual potash in muriate has cost from $3.50 to $4.50, in sulphate $7.50, but in kainit from $7.10 to $8.00 per 100 pounds. Nitrogen has been bought in one case for $17.85 in cotton-seed meal, while in another case $37.29 per 100 pounds were paid for it; it has been purchased in dried blood for $18.80, and in castor pomace for $20.84 per 100 pounds.

The exhibit showed in a striking way the need of care and judgment in purchasing fertilizers, and the direct saving of money to the purchaser who is willing to exercise his judgment in this direction.

Another exhibit illustrating a greatly increasing business closely connected with the producer's interest was that of a dozen cans of very delicious tomatoes (the Gen. Grant Tomato), put up by the Sachem's Head Canning Co. of Guilford, who have canned during the season over 32,000 bushels of tomatoes of unrivalled quality. A trial at the hotel satisfied all visitors of their great superiority. Another Company in Guilford have put up nearly the same quantity of tomatoes as above.

The Strawberry Show in June, 1881, *at Agricultural Room*, *No.* 50, *State House*, *Hartford.*

By invitation of T. S. Gold, Secretary of the Board of Agriculture, and Chairman of the Fruit Committee of the American Pomological Society of Connecticut, leading fruit growers in our State, as the Hale Brothers of Glastonbury, J. B. Olcott of Manchester, Col. Dewey of Hartford, P. M. Augur & Sons of Middlefield, and others, exhibited an unexpected array of beautiful strawberries.

By invitation, E. W. Durand of Irvington, Essex Co., N. J., sent a twelve quart crate each of the Jersey Queen, and the Superb; both seedlings of his own production, and both very showy, beautiful, and excellent. Messrs. Hale exhibited a large number of varieties of great excellence, as did Mr. J. B. Olcott.

The exhibit was admired by all who saw it, and was duly commented upon by the Hartford papers, and the request was made by several that a more general and extensive exhibit be made in June, 1882, in Hartford; the notice to be made general, with a full exhibit of strawberries from all sections of the State, and that those raising new varieties by hybridization from all sections of the country be invited to join in the exhibition. We trust the arrangement will be fully consummated.

COMMUNICATIONS.

Peach Orchard of E. Woodruff & Son, Guilford.

In the year 1875 we purchased a tract of land—one of the highest points of the town—situated about one and one-half miles north of the village, and well-known throughout the community as Hungry Hill. At the time we purchased this land, a small portion of the ground on which now stands our peach orchard was thickly covered with junipers; the remainder was heavy timbered, principally hickory and oak. We at once proceeded to clear the land from timber and bushes, with the intention of planting a portion with peach trees. The piece we selected was nearly at the top of the hill, with a northern exposure. The soil is a light loam, with a heavy clay subsoil, very stony. In the spring of 1876 we plowed it as best we could, clearing off the small roots and stones, leaving the larger roots and stumps for time to act upon, that we may remove them with less expense. In the spring of 1877 we planted 160 trees (one rod apart). A number of varieties were planted, all have done well, but those which have succeeded best are Crawford's Early, Crawford's Late, Old Mixon, and Stump the World. We have planted a few each year since, until at present we have about 400 trees. The ground was so covered with brush from the forest trees that many ashes were made by burning it. We have added a few ashes since, and once a slight dressing of barn-yard manure. Aside from this, no fertilizers have been applied. The soil at present seems to be in good condition. In 1877 and 1878, the orchard was planted with potatoes—the crops were good. In the fall of 1878, we sowed the orchard with wheat, and seeded to grass, noticing many articles which have been written from time to time that peach trees would grow quite as well in grass if hoed two or three feet from the trees, as if kept under cultivation; but our experience has taught us never to seed to grass if you expect any fruit. In the summer of 1879 our orchard was visited with seventeen year locusts which did us great damage. At first we thought it entirely ruined; many of the trees were so stung that nearly all the limbs fell from them, and have never entirely recovered. We immediately plowed it, and have kept it under cultivation to the present time. In 1880 we had a few peaches. In 1881 about 250 of the trees blossomed well and fruited nicely—some of the smaller ones having but few, while the larger ones were well loaded.

The drouth was so severe during the summer, that we began to fear the peaches might be injured unless some measures were taken to protect them. We acted accordingly, and by about the middle of August we carted about ten tons of salt hay into the orchard and mulched thoroughly, with the exception of a few trees near the corner, which we left as an experiment. We were perfectly satisfied in the results we derived from mulching. The trees which we did not mulch had less peaches and much poorer. We had from 250 trees now in bearing, over 200 bushels, averaging $3.55 per bushel. The trees have made a fine growth this year and are looking well, and in closing, I would state that I think the three essential things that will lead to successful peach culture in Connecticut, are lands well-elevated, trees perfectly healthy from the first, and good culture.

Cuthbert Raspberry—M. A. Doolittle, Clinton.

My 150 hills of Cuthbert Raspberries produced very fine results. I picked from that plat of Cuthbert's of 150 hills, over 300 quarts of berries which netted me twenty-five cents per quart by the crate shipped to Greenwich. I shall set them out largely in the spring.

The Bearing year Changed—James T. Hubbell, Wilton.

In the circular the question is asked, "Have you tried any means to secure better crops of apples on the *odd* or barren year, if so, with what success?" On my father's farm we have never "tried" any means to bring about any such result, but we have however plenty of apples on the *odd* years. This result was brought about by a hail-storm which visited a limited portion of Wilton, in May, 1875, which was so severe in some parts of its track as to beat off apple-blossoms and young pears.

Since that time the odd or barren year with others has been our harvest. I have seen it stated that the French fruit growers, when any of their trees show a disposition to bear biennially, beat off about half of the fruit blossoms and thereby secure average annual crops. I cannot of course guarantee the success of the French plan, but I think that our experience lends it some support. This year we have had a full crop of apples, and an overflowing crop of pears. I would say that some of our neighbors' trees were touched by the same storm, and their experience has been similar to ours, but not perhaps quite as marked. As next year will be the "year of plenty," it would do no harm for our farmers to experiment on some one tree and note the result.

ACCOUNT OF FIELD EXPERIMENTS WITH FERTILIZERS, 1881.

BY PROF. W. O. ATWATER.

The last four reports of the Connecticut Board of Agriculture have contained accounts of a series of field experiments which were begun in 1877, at the suggestion of the writer, then director of the State Experiment Station, and have been continued until the present.

The enterpise has been assuming larger and larger proportions, until the demand for space for report has outgrown the limits of this volume. At the invitation of the U. S. Commissioner of Agriculture, I have undertaken to prepare a somewhat extended *resumé* of results of the experiments for publication in the Report of the Agricultural Department. Meanwhile, since a number have been carried out in Connecticut, and the Secretary of the State Board assures me that many readers of the report will be interested to know the outcome of another year's work, I give a short account of some of the Connecticut experiments, and a still briefer reference to the results obtained elsewhere. As the general results are very similar to those detailed in former volumes of the Connecticut report, such a brief statement will, I think, be as satisfactory to most if not all its readers as a larger one, and will give opportunity to dwell more fully than I have previously been able to do upon another topic which seems to me worthy of consideration, namely: the usefulness of such work to the experimenters and the communities they influence, as well as to agricultural science in general.

Accordingly I shall select a few salient examples of work done by Connecticut farmers and hope that what they are doing may serve as an incitement and an encouragement to their fellow craftsmen to do likewise. I regret that severe pressure of other engagements necessitates a rather crude and hasty putting together of the material at hand.

The experiments have been of the same general character as in previous seasons; the modifications and enlargements being such as have been naturally suggested by experience. The description of the experiments and their results, therefore, must be more or less similar to what has been said before.

The experiments of the five seasons have been conducted by a number of Agricultural Colleges and Experiment Stations, and by several hundred farmers, in all of the states east, and some west of the Mississippi, and in several of the provinces of British America. Their extensive circulation is due in large part to the *American Agriculturist*, which proposed them to its readers, and arranged, with the hearty coöperation of several prominent dealers in fertilizers, to provide the materials, subject to analysis by the writer, and at prices just covering the cost.*

I may say that both the journal which proposed the experiments, and the parties who put up the fertilizers have displayed a great deal of enthusiasm in the undertaking, doing this, as I happen to know, at pecuniary cost to themselves, and with no prospect of gain other than would come with the credit for encouraging the enterprise.

GENERAL AND SPECIAL EXPERIMENTS.

These experiments have been of two classes: The first, which may be called general experiments, involved the use of seven or eight or more different kinds and mixtures of fertilizing materials containing nitrogen, phosphoric acid, and potash. These were intended to be used by farmers as a means of learning by actual trial what fertilizing ingredients would most benefit their soils and crops. The second class, the special experiments, have been of more complicated character, and have had for their object the study of the feeding capacities of some of our more common cultivated plants, with special reference to the nitrogen supply.

THE REPORTS AND THEIR VALUE.

With each set of experimental fertilizers were sent blanks, on which the experimenters were requested, if convenient, to report results. I cannot refrain from saying again and with increased emphasis what I have said in previous reports, that it has been a matter of surprise as well as satisfaction, not only that so many of the experimenters should have taken the pains to make the reports, but also that they should have done this so well.

The trials of the first season were all of the simpler character, and intended for soil tests. It was, however, my feeling from the start that the experiments might gradually be made to assume a

* The following firms coöperated in furnishing the materials: Messrs. H. K. Baker & Bro., 215 Pearl street, New York; Geo. B. Forrester, 188 Pearl street, New York; and the Mapes Formula and Peruvian Guano Company, 158 Front street, New York.

more strictly scientific character; that they might be successfully directed toward the study of some of the more abstruse problems of soil fertilization and the nutrition of plants. It was for this purpose that the special experiments were devised, and their results will form the chief topic of the present article. To explain their plan and purpose I quote briefly from last year's report.

THE FEEDING CAPACITIES OF PLANTS.

The experiments bring us face to face with one of the most important problems with which agricultural chemistry has to deal, the different capacities possessed by different plants for gathering their supplies of food from soil and air, and the effects of different ingredients of plant-food upon their growth

A vast deal of experience in the laboratory and in the field bears concurrent testimony to the fact, though we are still deplorably in the dark as to how or why it is so, that different kinds of plants have different capacities for making use of the stores of food that soil and air contain. Thus leguminous crops, like clover, do somehow or other, gather a good supply of nitrogen where cereals, such as wheat, barley, rye, and oats, would half starve for lack of it, and this in the face of the fact that leguminous plants contain a great deal of nitrogen, and cereals relatively little. Hence a heavy nitrogenous manuring may pay well for wheat and be in large part lost on clover.

SPECIAL EXPERIMENTS UPON THE EFFECTS OF NITROGENOUS FERTILIZERS.

For the systematic study of this question, a special experiment was devised in 1878, and conducted by a number of gentlemen. Similar series were repeated in 1879, and with slight variations, in 1880, and with some further changes suggested by experience in 1881. The plan and purpose of the experiments are set forth in the following statements, prepared for the use of experimenters of the season of 1881.

Special Experiments for Nitrogen Tests, 1881.

EXPLANATIONS.

The Object of this experiment is to test the effects of nitrogenous fertilizers in different amounts and combinations upon the growth of the plant, and inferentially its capacity to gather its nitrogen from natural sources.

The Fertilizers.—The ingredients and amounts are such as are used in ordinary practice, Phosphoric acid and Potash being supplied in about the proportions that occur in a corn crop of fifty or sixty bushels, and nitrogen in one-third, two-thirds, and full amount in same crop.

Forms of Nitrogen.—The Nitrogen is supplied as Nitric Acid in Nitrate of Soda; as Ammonia in Sulphate of Ammonia, and as Organic Nitrogen in Dried Blood.

Quantities of Nitrogen.—The nitrogen is applied at the rate of twenty-four pounds per acre in "one-third ration"; forty-eight pounds per acre in "two-thirds ration"; and seventy-two pounds per acre in "full ration."*

Arrangements of Plots and Fertilizers.—The ingredients are supplied as:

Partial Fertilizers,	Group I. Nos. 1—3. each by itself Group II. Nos. 4—6. Two by two.	Thus testing the effects of ingredients separately, and capacity of soil.
Complete Fertilizers,	Group III. Nos. 7—9. Nitrogen as nitric acid in nitrate of soda. Group IV. Nos. 10—12. Nitrogen as Ammonia in sulphate of ammonia. Group V. Nos. 13—15. Nitrogen as organic nitrogen in dried blood.	Nitrogen in one-third, two-thirds, full ration.

The schedule (see page 348) provides for twenty plots, of which two are unmanured, and eighteen supplied with the experimental fertilizers. Of the latter, three, Nos. 6a, 6b, and 6c are duplicates of the "Mixed Minerals," No. 6. This gives four plots of "mixed minerals," one on each side of each of the three groups, III, IV, and V, in which latter the effects of nitrogen are to be tested.

*The experiments of Mr. Bartholomew, Mr. Fairchild, and Mr. Newton in 1880, described beyond, are upon a somewhat different schedule. Mr. Newton's experiment of 1881 was on this schedule, as were all the others begun in 1881. The differences are briefly as follows:

In the experiments of 1881, nitrogen is supplied in group IV as ammonia, and in group V as organic nitrogen, while in the experiments of 1878 and 1880, as may be seen in table one, the nitrogen is supplied in group IV as "nitrogen" mixture, and in group V in other forms. A further difference is found in group V, which, in 1878 and 1880, supplied the nitrogen as a 2-3 ration, but in 1881 in varying quantities. I may add, that, as the result of the experience of three seasons, the arrangement of 1881 seems to me very well adapted to its purpose, though some modifications, especially the use of larger quantities of phosphoric acid and, in some cases, of smaller quantities of nitrogen seem to me advisable.

This duplicating the "mixed mineral" serves the three-fold purpose of testing the uniformity of the soil, replacing unmanured plots, and showing more accurately the actual effects of the nitrogen.

DIRECTIONS.

Read carefully the explanations herewith, and the "Directions for the Experiment," and "Condensed Directions," which go with each set of fertilizers. The main points are to (1.) Select level or nearly level and uniform land. (2.) Lay out the plots accurately (see figures for calculating dimensions in "Condensed Directions"). (3.) Distribute the fertilizers evenly over the plots. (4.) Conduct the experiment carefully, and (5.) Make an accurate report, for which blanks will be sent in due season.

Please indicate the boundaries of the plot, by *strong* stakes, and, if convenient, arrange to *repeat the experiment with the same fertilizers on the same plots through a series of years and crops.*

SIZE OF EXPERIMENTAL FIELD. "ONE ACRE" AND "TWO ACRE" EXPERIMENTS.

Experience implies that, under ordinary circumstances, plots of one-twentieth acre each, making one acre for the twenty plots, will suffice. Where convenient, however, it would be well to use two acres. This has been done to advantage when two crops, as corn and potatoes, have been grown side by side on each plot for comparison, an excellent plan for testing the comparative feeding capacities of the plants.

If practicable leave an unmanured strip, say three feet wide, between each two plots, to prevent the roots of each from feeding on fertilizers of the next. This will increase the whole area, but will make the experiment much more valuable.

KIND OF CROP.

The kind of crop will, of course, be selected by the experimenter. Experiments are needed upon all our ordinary crops, but especially on wheat, barley, rye, oats, corn, sorghum, grass, clover, onions, potatoes, roots, and in the South, sugar cane and cotton.

EXPERIMENTAL FERTILIZERS.

SPECIAL NITROGEN SET, 1881.

No.	MATERIALS.	AMOUNTS. Acre Set. For 1-20th acre plots.	Two Acre Set. For 1-10th acre plots.
1.	Nitrate of Soda,	7½ lbs.	15 lbs.
2.	Superphosphate,	15 "	30 "
3.	Muriate of Potash,	7½ "	15 "
4.	Nitrate of Soda,	7½ "	15 "
	Superphosphate,	15 "	30 "
5.	Nitrate of Soda,	7½ "	15 "
	Muriate of Potash,	7½ "	15 "
6.	Superphosphate, } Mixed	15 "	30 "
	Muriate of Potash, } minerals	7½ "	15 "
7.	Mixed minerals, as No. 6,	22½ "	45 "
	Nitrate of Soda,	7½ "	15 "
8.	Mixed minerals, as No. 6,	22½ "	45 "
	Nitrate of Soda,	15 "	30 "
9.	Mixed minerals, as No. 6,	22½ "	45 "
	Nitrate of Soda,	22½ "	45 "
10.	Mixed minerals, as No. 6,	22½ "	45 "
	Sulphate of Ammonia,	5⅝ "	11¼ "
11.	Mixed minerals, as No. 6,	22½ "	45 "
	Sulphate of Ammonia,	11¼ "	22½ "
12.	Mixed minerals, as No. 6,	22½ "	45 "
	Sulphate of Ammonia,	16⅞ "	33¾ "
13.	Mixed minerals, as No. 6,	22½ "	45 "
	Dried Blood,	11¼ "	22½ "
14.	Mixed minerals, as No. 6,	22½ "	45 "
	Dried Blood,	22½ "	45 "
15.	Mixed minerals, as No. 6,	22¾ "	45 "
	Dried Blood,	33¾ "	67½ "
6a.	Superphosphate, } Mixed	15 "	30 "
	Muriate of Potash, } minerals	7½ "	15 "
6b.	Superphosphate, } Mixed	15 "	30 "
	Muriate of Potash, } minerals	7½ "	15 "
6c.	Superphosphate, } Mixed	15 "	30 "
	Muriate of Potash, } minerals,	7½ "	15 "

Nos. 6a, 6b, and 6c, are simply duplicates of Mixed minerals, No. 6.

SPECIFICATIONS.

Materials to be weighed and mixed with greatest possible care and accuracy, put in eighteen bags numbered as above, and each bag furnished with a label stating number and contents per schedule above. *Minimum* percentages as below.

Muriate of Soda to contain 16% nitrogen; Sulphate of Ammonia, 21% nitrogen; Dried Blood, 11% nitrogen.

Superphosphate (dissolved bone-black) to contain 15% of soluble, and 16% total phosphoric acid.

Muriate of Potash to contain 50% of potash.

No. 6, the mixture of Superphosphate and Muriate of Potash, is designated as "Mixed minerals." This is duplicated in Nos. 6a, 6b, and 6c. The same mixture forms the basis of Nos. 7 to 15 inclusive, which consist of "Mixed minerals," with the addition of nitrogen compounds.

The fertilizers were supplied, in part at cost, and in part gratuitously, by the *Mapes Formula and Peruvian Guano Co.*

It would be wrong to omit reference to the assistance rendered by a fellow enthusiast in agricultural chemistry, Mr. C. V. Mapes, without whose wise counsel and generous and substantial help in many ways the enterprise must have been much less successful than it has actually been.

I now proceed directly to a brief statement of the results of the experiments of three Connecticut farmers, Mr. W. I. Bartholemew of Putnam, Mr. Charles Fairchild of Middletown, and Mr. W. C. Newton of Durham. Mr. Bartholomew began, in 1877, an experiment with corn covering a small number of plots. In 1878 he undertook a special nitrogen experiment, and in 1879 another. This latter and the simpler one of 1877 have been continued until the present. These experiments have been in operation for five years; have covered nearly one hundred plots; have been repeated on the same plots with the same fertilizers and the same crop, year after year, and on other parts of the same field, and on contiguous fields and with other crops; they have been quoted in more or less detail in a number of state agricultural reports and elsewhere, and are decidedly the most instructive and valuable ever made, to my knowledge, by a private individual in this country.

Mr. Fairchild has also been experimenting for five years, but his nitrogen experiments have been in operation for only two seasons. Mr. Newton's first nitrogen experiment was in 1880; also that of 1881 was on an adjoining portion of the same field, and on a larger scale.

In their reports the experimenters have distinguished between "good" and "poor" produce, and have also given the amounts of stalks and straw. Mr. Bartholomew has had between the experimental plots intervening plots, all of which were cultivated alike—the last season with potatoes fertilized with a mixture of nitrate of soda, superphosphate, and potash salt—as a test of the uniformity of the soil. Lack of space compels me to omit these details in the table which follows (Table 1.) I hope to give the accounts in full elsewhere.

TABLE I.—SPECIAL NITROGEN EXPERIMENTS.

EFFECTS OF NITROGENOUS FERTILIZERS UPON CORN AND POTATOES.

EXPERIMENTS FOR STUDYING THE CAPACITY OF THE PLANTS TO OBTAIN THEIR FOOD FROM NATURAL SOURCES, AND THE EFFECTS OF DIFFERENT FERTILIZERS UPON THEIR GROWTH, WITH ESPECIAL REFERENCE TO THE NITROGEN SUPPLY.

Potash and Phosphoric Acid (with Sulphuric Acid and Lime) supplied in proportions contained in a crop of 50 to 60 bushels of Corn, Nitrogen in one-third, two-thirds, and full amount contained in same crop.

A. 1878. W. I. BARTHOLOMEW, Putnam, Conn. *Soil.*—Hill land, dark loam, compact subsoil,—worn-out meadow. *Weather.*—Favorable.

B. 1879, 1880, and 1881. As above, being an adjoining portion of same field. The experiments of 1880 and 1881 were repetitions of that of 1879 with the same fertilizers and crops on the same plots. *Weather.*—1879, cold, wet, unfavorable; 1880, favorable; 1881, very unfavorable.

C. 1880 and 1881. CHARLES FAIRCHILD, Middletown, Conn. *Soil.*—Upland, sandy loam, sandy subsoil, rather dry,—worn-out meadow. *Weather.*—Favorable both seasons.

D. 1880. WILLIAM C. NEWTON, Durham, Conn. *Soil.*—Dark loam, subsoil moist. Had grass in 1879, after rye in 1878, and oats in 1877. *Weather.*—Favorable.

FERTILIZERS.			B.	B.	B.		A.	B.	B.	B.		C.	C.	C.	D.
			Potatoes.				Corn.					Corn.	Potatoes.	Oats.	Corn.
			1879.	1880.	1881.		1878.	1879.	1880.	1881.		1880.	1881.	1881.	1880.
	Kinds and amounts per acre.	Nitrogen per acre.	Total.	Total.	Total.	Total Average.	Total.	Total.	Total.	Total.	Total Average.	Total.	Total.	Total.	Total.
		lbs.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.	bu.
0	No manure,......................	....	46	78	44	56.0	17.7	7.7	22.2	7.3	13.7	31.5	28.0	26.9	22.5
1	Nitrogen mixture,........	24	42	90	48	60.0	15.1	7.4	20.1	8.5	12.8	37.5	42.0	38.1	42.5
2	Superphosphate, 300 lbs.,.........	....	78	112	58	82.7	39.9	36.5	43.2	12.4	33.0	45.3	56.0	33.8	27.5
3	Muriate of potash, 150 lbs.,.......	....	46	116	50	70.7	19.1	7.7	24.7	10.0	15.4	30.0	60.0	31.3	25.0

4	Nitrate of soda, 150 lbs., Superphosphate, 300 lbs., ...	24	114	112	58	94.7	41.9	41.4	45.1	16.7	36.3	50.0	94.7	51.9	42.5
5	Nitrate of soda, 150 lbs., Mur. of potash, 150 lbs., ...	24	52	112	52	72.0	21.1	7.1	24.0	5.5	14.4	26.5	68.0	42.5	45.0
6	Superphos., 300 lbs., Mur. pot., 150 lbs., Mixed min'l fertilizers,	....	115	114	74	101.0	43.1	42.0	52.8	25.2	40.8	46.0	90.7	33.8	22 5
7	Mixed min. fertilizers (as No. 6), Nitrate of soda, 150 lbs., ..	24	130	152	100	127.3	51.7	45 7	50.0	28.8	44.6	57.3	124.7	54.4	52.8
8	Mixed mineral fertilizers, Nitrate of soda, 300 lbs., ...	48	148	202	96	148.7	47.3	46.8	54.0	22.6	42.7	62.3	138.7	59.4	70.0
9	Mixed mineral fertilizers, Nitrate of soda, 450 lbs., ...	72	130	144	90	121.3	47.3	42.2	56.2	18.8	41.1	59.9	120.7	59.4	81.3
6a	Mixed min. fertilizers (as No. 6), .	....	......	......	....	....	......	......	....	....	....	48.3	94.0	36.3	30.0
00	No manure, ...	....	56	62	60	59.3	......	8.5	37.8	12.4	19.6	37.3	122.7	27.5	....
10	Mixed mineral fertilizers, Nitrogen mixture, 150 lbs., ...	24	166	116	114	132.0	50.0	44.0	47.2	31.0	43.1	58.5	144.7	51.9	45.0
11	Mixed mineral fertilizers, Nitrogen mixture, 300 lbs., ...	48	142	142	108	130.7	50.7	44.5	48.8	31.4	43.9	66.4	144.7	55.6	67.5
12	Mixed mineral fertilizers, Nitrogen mixture, 450 lbs., ...	72	146	138	114	132.7	56.4	39.1	50.9	31.1	44.4	68.0	110.0	59.4	80.0
6b	Mixed min. fertilizers (as No. 6), .	....	......	......	....	....	......	......	....	....	....	48.3	....	33.8	27.5
13	Mixed mineral fertilizers, Sulphate of ammonia, 225 lbs., ...	48	156	140	102	132.7	58.1	.2	51.2	24.4	43.5	57.3	135.3	61.9	42.5
14	Mixed mineral fertilizers, Dried blood, 450 lbs., ...	48	158	158	110	142.0	55.0	40.7	52.0	33.6	45.3	54.3	134.7	53.8	60.0
15	Peru. guano, "Standard," 550 lbs., Muriate of potash, 150 lbs.,	48	132	154	102	129.3	55.3	38.5	50.1	30.0	43.5	51.5	133.3	54.4	56.7
16	Mixed min. fertilizers (as No. 6), .	....	124	158	90	124.0	......	36.5	52.3	31.8	40.2	39.8	96.0	35.0	33.3
17	Farm manure, ...	....	......	......	....	....	49.8	......	....	......	....	....	....	... .	....
000	No manure, ...	....	......	......	....	....	......	......	....	....	....	39.8	....	26.3	25.0

The plan of each of the three gentlemen is to apply the same fertilizers on the same plots year after year. But while Mr. Bartholomew is repeating the same crops, corn and potatoes, on the same plots, Mr. Fairchild has already commenced, and Mr. Newton proposes, a rotation. Mr. Fairchild's rotation is one which he has found advantageous in his farm practice: the first year corn, the second, potatoes or oats, in this case oats on one half and potatoes on the other half of the experimental field, with wheat sowed in the fall to make the crop of the third year, to be followed the fourth year by grass and clover seeded with the wheat. In the following years he proposes to see how long the grass can be kept up with the artificial fertilizers. I believe that Mr. Newton expects to follow a somewhat similar plan of rotation.

MR. BARTHOLOMEW'S EXPERIMENTS.

The most interesting feature of Mr. Bartholomew's corn experiments is the constant efficiency of phosphoric acid and the uniform failure of the nitrogen and potash to materially increase the yield. With potatoes, on the other hand, although phosphoric acid is more efficient than anything else, still nitrogen and potash are also decidedly helpful.

I wish here to call attention to another experiment, by Mr. Bartholomew, with corn, commenced in 1877, and continued until the present. The plots were ten square rods each. The fertilizing materials have been:

No. of Plot.	Fertilizers.				Furnishing Valuable Ingredients.			
	Kind.	Lbs. per Acre.	At price per ton.	Cost per Acre.	Kind.	Assumed per cent.	Lbs. per Acre.	Cost per Acre.
1	Dried Blood..........	320	$40.00	$6.40	Nitrogen.........	10	32	$6.40
2	Dissolved Bone black.	320	35.00	5.60	Phosphoric Acid.	16	51	5.60
3	Muriate of Potash....	320	45.00	7.20	Potash...........	50	160	7.20
4	Dried Blood..........	160	37.50	6.00	Nitrogen.........	5	16	3.20
	Dissolved Bone-black.	160			Phosphoric Acid.	8	$25\frac{1}{2}$	2.85
5	Dried Blood..........	$106\frac{2}{3}$	40.00	6.40	Nitrogen.........	3.3	$10\frac{2}{3}$	2.13
	Dissolved Bone black.	$106\frac{2}{3}$			Phosphoric Acid.	5.3	17	1.87
	Muriate of Potash....	$106\frac{2}{3}$			Potash...........	16.7	$53\frac{1}{3}$	2.40
6	Plaster..............	320	10.00	1.60				

Wood ashes, dry and leached, and farm manures, were likewise employed, as indicated below. A number of brands of manufactured fertilizers were also tried, with results according with those from the regular experimental fertilizers.

The experimental field is part of that on which Mr. Bartholomew's other experiments have been made. The soil Mr. Bartholomew describes as "hill land, dark loam, moist, with clayey subsoil. The land of this experiment was, in 1874, an old meadow, yielding about one ton of hay per acre. In 1875 it was plowed, dressed with twelve cart-loads per acre of yard manure, planted to corn, and gave 35 bushels per acre. In 1876 it was sowed to oats, with no additional manure; yield 40 bushels." In 1877 experiments were began with corn. The land has thus been out of grass for six years—one with oats and four with corn. The seasons of 1877 and 1878 were on the whole favorable. In 1879 the spring was late, the crop was injured by storms and frost killed the corn September 25th, before the corn was matured. The season of 1880 was unusually favorable. In 1881, a hailstorm, July 8th, nearly destroyed the crop, so that with the very unfavorable season the produce amounted to very little. The yields per acre have been as follows:

Plot.	Fertilizer.		Yield of Shelled Corn per Acre in Bushels.				
	KIND.	AMOUNT PER ACRE.	1877.	1878.	1879.	1880.	1881.
1	Dried Blood..........	320 lbs...........	13.7	10.0	....*	21.2	....*
2	Superphosphate......	320 lbs...........	41.6	39.8	21.7	39.3	12.8
3	Muriate of Potash....	320 lbs...........	15.5	11.0	....*	17.5	....*
4	Mixture I & II........	160 lbs. of each...	38.0	35.4	22.4	37.0	11.3
5	Mixture I & II & III...	106⅔ lbs. of each..	33.5	30.5	20.7	33.3	8.7
6	Plaster...............	320 lbs...........	19.4	11.0	....*	15.0	....*
0	No Manure..........	....	6.2	3.0	....*	13.5	....*
7	Wood Ashes, dry.....	32 bushels........	34.9	30.4	....*	38.8†	....†
8	Wood Ashes, leached.	48 bushels........	37 7	36.6	24.6†	37.7‡	....‡
9	Hog Manure..........	16 cart-loads... .	41.1	46.6	....	37.7	15.1.
10	Hen Manure..........	20 bushels........	54.9	56.7	....	....	....

*Entire failure.

†Dissolved Bone-black 480 lbs. per acre, instead of Ashes in 1880. Nothing in 1881.

‡Ammoniated Superphosphate 480 lbs. per acre, in place of Ashes in 1880. Nothing in 1881.

In speaking of the results in 1881, Mr. Bartholomew says: "The land on which these experiments have now been conducted for five successive years was also plowed the two previous years, making seven years in succession under cultivation. The soil has become very light, has washed considerably on to the adjoining meadow, and seems to have become unfitted for corn. The plot fertilized with a good cart-load of farm manure has produced but little more than that with phosphate. I think the condition of the soil has become such that but little more can be learned from the effect of fertilizers upon it." He also says that what with the bad season, a destructive hail-storm, and the long-continued planting, the yield was an entire failure. The plants were all very small, and none but Nos. 2, 4, 5, and 9, had ears enough to be worth husking. Indeed, so poor was the quality of the corn, even on these plots, that the calculations which are based upon the weight of ears, are hardly accurate. Mr. Bartholomew suggests that it will hardly be worth while to publish any account of the experiment the past season, since that it was a failure. I take the liberty, however, to give the above statements, because they seem to me both interesting and valuable. The land has refused to produce corn in good quantities for a number of years in succession with any of the fertilizers used. This is worthy of record, especially in view of the fact that on another part of the same field corn and potatoes are being cultivated continuously with different fertilizers. Again the main feature of the story of the first year is that of the fifth; without phosphoric acid failure, with it a larger or smaller yield, as more or less is used, and very little help from potash or nitrogen. But there is this addition that phosphoric acid alone is unable to carry the crop year after year.

Indeed, the statements made in former reports of these and the other experiments made by Mr. Bartholomew (See Report of Conn. Board of Agriculture, 1880, pp. 355, 357), might be repeated with perfect correctness here. I quote, however, only the following:

"And in all of the scores of trials which Mr. Bartholomew has made in amplification of these experiments, the same results have been obtained; corn has responded largely to phosphoric acid, less to nitrogen, and scarcely at all to potash. I cannot forbear repeating that Mr. Bartholomew has uniformly got the best results by using a moderate dressing of farm manures, supplemented by superphosphates. Indeed, in his case, as in many others, the proper use of commercial fertilizers is to supplement the farm manures. But it should be remembered, that while nitrogen and the potash have produced so little effect on corn, on potatoes they have been as uniformly useful and profitable."

Some time since, in writing to Mr. Bartholomew concerning some of the details of his reports, I took occasion to ask if he would state in what ways, and to what extent the large amount of experimental work he has done has been of actual benefit to him as a farmer. He answered as follows:

"In reply to your question I will say that I have learned to place great confidence in commercial fertilizers when properly used, as furnishing the most reliable and economical materials for increasing my crops."

"I have learned that the effects of the different substances used, although varying much from each other, are nearly identical in different fields and in different years on my farm, always showing a tendency to the same characteristics."

"I have learned that these fertilizers are much superior in quality to those we obtained before the establishment of the Experiment Station."

"I have learned that this farm, which my father, after fifty years of acquaintance and cultivation, pronounced ill-adapted to the raising of corn, gives me, under similar treatment, with the use of phosphate of lime in addition, in corn one of my most profitable crops."

"I think I have learned that by the proper use of commercial fertilizers as indicated in the different trials, I can obtain, at fair profit, finer potatoes, free from disease and blemish, than by any other means known to me."

"I have learned that by the use of one or more of these substances as adjuncts to farm manures, I have been enabled to obtain at small expense, superior crops of corn, oats, and potatoes with less manure, while the remainder of the manure applied as top-dressing to grass lands, has materially increased my crops of hay."

"And finally, to include the whole matter, I find that I am keeping much more stock, getting better crops, and better satisfaction from my farm than before."

MR. FAIRCHILD'S EXPERIMENTS.

Mr. Fairchild has made some computations of the increase of yield and pecuniary outcome of his experiments the last season, which seems to me very interesting, and are given, with other details, in TABLE II herewith.

TABLE II.

EFFECTS OF NITROGENOUS FERTILIZERS.

EXPERIMENTS WITH OATS AND POTATOES IN 1881, BY MR. CHARLES FAIRCHILD, OF MIDDLETOWN, CONN.

SOIL.—Dark loam, loam sub-soil, moist—had oats in 1877, rye in '78, grass in '79, and corn fertilized as below in '80.

FERTILIZERS. Kind and Amount per Acre.	Yield.			Increase.			Cost of fertilizers, freight, etc.	Pecuniary Result.			
	Oats.		Potatoes.	Oats.		Potatoes.		Val. Increase.		Gain.	
	Grain.	Straw.		Grain.	Straw.			Oats.	Potatoes.	Oats.	Potatoes.
	bus.	lbs.	bus	bus.	lbs.	bus.					
0 No Manure,	26.9	1,180	28.0	....	....	......	....	......	......	......	....
1 Nitrogen Mixture, 150 lbs.,	38.1	1,820	42.0	11.3	627	13.3	$6.00	$9.75	$9.98	3.05	$3.98
2 Superphosphate, 300 lbs.,	33.8	1,800	56 0	6.9	607	27.3	6.00	7.42	20.48	1.42	14.48
3 Muriate of Potash, 150 lbs.,	31.3	1,720	60.0	4.4	527	31.3	3.75	5.50	23.48	1.75	19.73
4 Nitrogen Mixture, 150 lbs., and Superphosphate, 300 lbs.,	51.9	2,660	94.7	25.0	1,467	66.0	12.00	22.55	49.50	10.55	37.50
5 Nitrogen Mixture, 150 lbs., and Muriate of Potash, 150 lbs.,	42.5	2,160	68.0	15.6	967	39.3	9.75	14.40	29.48	4.65	19.73
6 Sup. Phos., 300 lbs., and Mur. Pot., 150 lbs., "Mixed Minerals,"	33.8	2,280	90.7	6.9	1,087	62.0	9.75	10.30	46.50	0.55	36.75
7 Mixed Mins. (as No. 6), 450 lbs., and Nit. of Soda, 150 lbs. (⅓ ration),	54.4	3,500	124.7	27.5	2,307	96.0	15.75	28.97	72 00	13.22	54.25
8 Mixed Mins., 450 lbs., and Nitrate of Soda, 300 lbs. (⅔ ration),	59.4	3,860	138.7	32.5	2,667	110.0	21.75	33.88	82.50	12.13	60.75
9 Mixed Mins., 450 lbs., and Nitrate of Soda, 450 lbs. (full ration),	59.4	4,380	120.0	32.5	3,107	91.3	27.75	36.52	68.40	8.77	40.65
6a Mixed Minerals (as No. 6), 450 lbs.,	36.3	1,760	94 0	9.4	567	65.3	9.75	8.56	48.98	1.19	39.23
00 No Manure,	27.5	1,280	4	....	....	......	....	......	......	......	.....
10 Mixed Mins., 450 lbs., and Nitrogen Mixture, 150 lbs. (⅓ ration),	51.9	3,140	122.7	25.0	1,947	94.0	15.75	25.43	70.50	9.68	54.75
11 Mixed Mins., 450 lbs., and Nitrogen Mixture, 300 lbs. (⅔ ration),	55.6	3,380	144.7	28.8	2,187	116.0	21.75	28.93	87 00	7.18	65.25
12 Mixed Mins., 450 lbs., and Nitrogen Mixture, 450 lbs. (full ration),	59.4	3,780	144.7	32.5	2,587	116.0	27.75	33.40	87.00	5.65	59.25
6b Mixed Minerals (as No. 6), 450 lbs.,	33.8	1,760	110.0	6.9	567	81.3	9.75	7.18	60.98	2.57	51.23
13 Mixed Mins., 450 lbs., and Sulphate of Ammonia, 225 lbs. (⅔ ration),	61.9	3,700	135.3	35.0	2,507	106.6	21.75	34.29	79.95	1 5	58.20
14 Mixed Mins., 450 lbs., and Dried Blood, 450 lbs. (⅔ ration),	53.8	3,080	134.7	26.9	1,887	106.0	21.75	26.10	79.50	4.35	57.75
15 Peruvian Guano, 450 lbs., and Muriate of Potash, 150 lbs. (⅔ ration),	54.4	2,980	133.3	27.5	1,787	104.6	21.75	25.85	78.45	4.10	56.70
16 Mixed Minerals (as No. 6), 450 lbs.,	35.0	1,760	96.0	8.1	567	67.3	9.75	7.87	50.48	1.88	40.73
000 No Manure,	26.3	1,120	29.3	....	....	......	....	......	......	......	.....
A Bone, 150 lbs.,	31.3	1,680	54.0	4.4	487	25.3	3.00	5.33	18.98	2.33	15.98
B Bone, 150 lbs., and Muriate of Potash, 100 lbs.,	35.0	1,960	74.0	8.1	767	45.3	5.50	9.07	33.98	4.57	28.48
C Same as B, and Sulphate of Ammonia, 100 lbs.,	45.6	1,980	......	18 8	787	......	10.75	15.03	....	4.28	......

EXPLANATIONS.

The plan of the experiments has been explained above. Some repetitions here may, however, be convenient for the reader. *The Object* of these experiments was to test the effects of *Nitrogenous* Fertilizers, in different amounts and combinations, upon the growth of the plants. *The Fertilizers.*—The ingredients and amounts of the fertilizers are such as are in ordinary practice, Phosphoric Acid and Potash being supplied in about the proportions that occur in a corn crop of 50 or 60 bushels, and Nitrogen in one-third, two thirds, and in the full amount in the same crop. Thus the 300 lbs. of Superphosphate furnished about 48 lbs. of Phosphoric Acid; the 150 lbs. of Muriate of Potash about 75 lbs. of Potash. *Forms of Nitrogen.*—The Nitrogen was supplied as Nitric Acid in Nitrate of Soda; as Ammonia in Sulphate of Ammonia, and as Organic Nitrogen in Dried Blood, and in a mixture of these in equal parts in "Nitrogen Mixture." *Quantities of Nitrogen.*—The Nitrogen was applied at the rate of 24 pounds per acre in "one-third ration," Nos. 1, 4, 5, 7, and 10; 48 pounds per acre in two-thirds ration," Nos. 8, 11, 13, 14, and 15; and 72 pounds per acre in "full ration," Nos. 9 and 12.

General Plan of Experiment.—Nos. 1 to 6 are "partial" fertilizers, furnishing the ingredients each by itself, and two by two, thus testing their effects separately and the capacity of the soil.—Nos. 6, 6a, 6b, and 16, "Mixed Minerals," are duplicates, each furnishing Phosphoric and Potash (with Sulphuric Acid and Lime).—The others from 7 to 15, are "complete fertilizers," each consisting of the "Mixed Minerals," with Nitrogen added in "one-third," "two-thirds," and "full ration," as above.—The plots were parallel strips, eight square rods each. In 1880 corn was planted over the whole field. In 1881 the whole was divided into halves by a line crossing the plots, and one-half devoted to oats and the other half to potatoes. Mr. Fairchild proposes to follow with wheat and grass, thus running the experiment through a regular rotation of several years, the same fertilizers being applied to the same plots year after year, while the crops succeed each other, as in his ordinary farm practice. The cost of the fertilizers includes $5.00 per ton for freight and applying. Potatoes are estimated at 75 cts. per bushel, oats at 55 cts. per bushel, and oat straw at $12.00 per ton, which are fair rates for the region and season.

In his experiments, which have now been going on five years, Mr. Fairchild has been getting light upon a number of questions of importance in the cultivation of his farm. some of which may be expressed thus.

1. Do crops on my land demand more nitrogen, phosphoric acid, potash, sulphuric acid, or lime, than the soil supplies?

2. How do different crops differ with respect to their power to gather these materials for themselves, and their consequent demand for them in fertilizers?

3. In what forms, quantities, and ways can I use these fertilizing elements with profit?

As the result of tests on the plan of the "general experiments" referred to above, Mr. Fairchild found that Phosphoric Acid and Potash generally brought profitable returns, but on what crops and to what extent Nitrogen would be advantageous seemed less certain. In 1880 he commenced a special Nitrogen experiment, selecting for the purpose an old "worn out" pasture, laying out 25 plots of one-twentieth of acre each, applying fertilizers and getting corn as shown in Table 1. In 1881 he devoted one half to potatoes and the other half to oats, with results as shown in Table 2. By using the same fertilizers on the same plots year after year, through his regular rotation, Mr. F. is gaining definite information as to the effect, the cost and profit, of the more expensive ingredients of the fertilizers used, particularly of the Nitrogen.

MR. FAIRCHILD'S EXPERIENCE.

Some time since Mr. Fairchild favored me with a visit at my study, and gave quite a number of details concerning the results of his experiments and experience. With his permission I made notes of some of the conversation, and on looking them over after his departure, took occasion to send him a few further questions in a letter which he has kindly answered. The observations seemed to me so correct, apposite, and valuable that I asked the privilege of putting them in print. The argument, strongly urged that they would be very useful to his fellow farmers, finally overcame the objections which his modesty interposed. I quote, as nearly as practicable, his own words in the statements which follow.

" . . . On the whole, phosphoric acid in superphosphate and bone, and potash in muriate, have thus far proved most efficient.

At the same time, in many cases at least, I like some nitrogen also, and think a 'complete fertilizer' is the most profitable for me."

" . . . As to the outcome of my experiments with nitrogen, that depends upon soil and crops. . . . In my experience thus far, nitrogen in small quantities has generally proved profitable. Bone and potash give a moderate yield of corn and oats on very poor land, but I like a good, handsome crop, and twenty-four pounds of nitrogen added, has more than repaid the cost in increased yield of corn and oats. That is, mixtures containing 'one-third-ration' of nitrogen have been uniformly more profitable than 'mixed minerals' alone, or than mixed minerals with a two-thirds or a full ration of nitrogen; and this is my experience on a larger scale. . . . "

"Yet in a number of cases potash salts with bone, and also with superphosphate, bring excellent crops without nitrogen, and the addition of nitrogen would be unprofitable."

"My neighbor, Mr. Williams, had a very fine piece of corn this year, with only 200 pounds per acre of bone dust, and 150 pounds of muriate of potash, the two costing seven dollars per acre. I have noted quite a number of similar cases in this district. But my land was very badly run out when I took hold of it, and seemed to demand a little nitrogen. So far as I have observed, soils that have been well manured, seeded down, kept in grass awhile, and then plowed again, do well with potash and phosphoric acid, without artificial supply of nitrogen. My corn in last year's nitrogen experiments, rose with the amount of nitrogen added, but the increase was not enough to pay the cost of the 72 pounds, or even of 48 pounds, though it did pay for the 24 pounds. And with the oats on the same plots the past season the yield rose with increase of nitrogen, but the smallest quantity was the most profitable, as you can see by comparing Plot No. 7 with Nos. 8 and 9, and No. 10 with 11 and 12."

"But the potatoes gave a better response to the nitrogen than the oats. With them the two-thirds ration, 48 pounds per acre, was the most profitable, and the value of the increase exceeds the cost of the fertilizer. With 48 pounds of nitrogen, the gain was $57 to $65, while with either 72 pounds or 24 pounds it runs from $40 to $59. I notice also, as a result of my experiments, that the potatoes seem to respond to the potash much more readily than either oats or corn."

MR. FAIRCHILD'S FORMULAS.

To my question, "Have you arrived at any formulas as most suitable for fertilizers for your crops?" Mr. Fairchild answered as follows:

"Yes and no. That is, I have made up my mind what will probably do well on my land and under my conditions for some of my crops. But I cannot say what would be most advantageous elsewhere, nor do I yet know exactly what will prove best for me years hence, or with crops I have not tested. For my corn I expect to use, next spring, 250 pounds of fine ground bone, 150 pounds muriate of potash (containing 50 per cent. actual potash), and 24 pounds of nitrogen in the cheapest form I can get it. So far as my experiments go, they indicate that sulphate of ammonia and nitrate of soda do rather better than dried blood. Nitrate of soda is cheap now, and I rather expect to use that."

"With potatoes and oats I have not experimented so much. Judging from the past season's experience, it seems probable that the quantities of bone and potash salt I just mentioned, and about double the nitrogen, will make a good mixture. For oats I am inclined to make use of the same proportions as for corn, but I think smaller total quantities would do upon these crops. According to analysis an oat crop takes less from the soil than one of corn, and my experience indicates that oats will do well with less manure. I expected the large quantities on some of the plots of the nitrogen experiment would make them lodge badly, but the weather or something else kept them up all right."

BONE *vs.* SUPERPHOSPHATE.

Mr. Fairchild concludes that for his purposes fine ground bone, which he gets at a bone mill near home, is more economical than superphosphate. He reasons thus:

"The bone we are using is of a high grade, and contains, by analysis at the experiment station, about 25 per cent. of phosphoric acid, and 3 per cent. or more of nitrogen. The bone sawings [from hard bones used in making knife handles, buttons, etc.] run up to 26 per cent. phosphoric acid or over, while the softer bones, ground, average perhaps 23 or 24 per cent. I pay $37 per ton for the bone, and can get a plain superphosphate, dissolved bone black, for a little less, say $33. That is to say, the superphosphate, with 16 per cent. of phosphoric acid, mostly soluble, costs me nearly as much as the very fine bone dust with 25 per cent. phosphoric acid and 3 per cent. nitrogen. I suppose the superphosphate acts more quickly, but I have tried the two side by side several years and do not see a great deal of difference in the effects on corn, oats, potatoes, or grass. If I use 300 pounds of each per acre I have from the superphosphate 48 pounds of phosphoric acid, and from the bone 75 pounds of phosphoric acid and 9 pounds of nitrogen. I have got as much corn, oats, and potatoes, the first season from 200 pounds of bone dust as from 300 pounds of superphosphate, each being used with other materials, as potash salt, or nitrate of soda, or both, and feel reasonably sure that in most any case I should get as good a yield from 300 pounds of bone as from 300 pounds of superphosphate. If I use the superphosphate I have only the 48 pounds of phosphoric acid, about what a corn crop of 50 or 60 bushels would take from the soil. But if I use the 300 pounds of bone, which costs very little more, I get just as good a yield, and have the extra phosphoric acid and nitrogen left over. Now I understand chemists to say that the extra phosphoric acid will stay in my soil until future crops take it away, and that although the nitrogen is slippery stuff and gets away pretty easily, still in bone it is pretty stable. So I calculate that bone is cheaper on the long run for me than superphosphate."

"But 'circumstances alter cases.' I was talking with a man from Long Island the other day who told me he had to pay $45 per ton for fine bone dust, while we get the finest sawings for $37. Still even at $45, taking into account the nitrogen, I think I should use the bone dust, though others might find the superphosphate preferable."

Mr. Fairchild has some experience with commercial fertilizers and stable manure together, and like many other experimenters whose conclusions have come to my knowledge, he thinks the proper use of commercial fertilizers is to supplement the manure of the farm.

He says that if he is going to depend on stable manure alone for corn, he "would not think of using less than 36 loads (on a wagon that carries about 30 bushels) per acre. But 12 loads or one-third of what I should call a fair dressing, with the addition of 200 pounds of bone-dust, and 150 pounds of muriate of potash which cost me $7.00, has brought, during the past three seasons on three different fields, each of very poor land, an average of 65 bushels of shelled corn per acre, and an excellent growth of stalks, and so far as I can see, corn, manured in this way leaves the land in very good condition. In one case for instance, a succeeding crop of oats with no manure, gave 40 bushels per acre. For this region these are good yields."

How this plan would work on other crops Mr. Fairchild is not yet prepared to say. He is inclined to think his best plan is to use his stable manure for corn, and piece out with bone and potash salt, and to follow with other crops using commercial fertilizers alone. But he adds "that others may find it best to use the manure on other crops, and depend upon commercial fertilizers alone for corn." This he regards as "much cheaper so far as the corn is concerned, than to haul manure from city stables."

In this way Mr. Fairchild gave me results of his experimenting enough to make a long article, fortifying every point by facts; oftener saying "I do not feel sure," or "one cannot judge such a thing from a few experiments," than giving a categorical answer to my questions, showing everywhere the spirit of the true investigator, and refraining from positive conclusions as long as there was room for doubt.

One of the questions to which I solicited a brief answer was this, Can you state some of the ways in which your experiments have been of direct practical utility to you?

The answer was this, "I think they have helped me, and will help me in many ways:

1. They show what fertilizing materials my crops must have.

2. They show me in what quantities, in what forms, and in what ways I should apply different fertilizers.

3. They save me money by enabling me to buy what I want without using a large quantity of materials I do not want.

4. I think I shall thus be enabled to raise all kinds of crops on very poor land with profit.

WHY BOYS LEAVE THE FARM.

One of Mr. Fairchild's remarks impressed me greatly. It was this:

"Under the old system of farming, it is no wonder the boys leave the farms. You can't blame them. I did so myself, came back, tried again, and should have given up once more if it had not been for these experiments, and what I have learned in connection with them. As it is, I find myself giving up outside work, devoting myself more and more exclusively to my farm, supplementing the labor of my hands with the labor of my brains, and I feel the benefit in my purse, in my home, and in my mind."

These details of Mr. Fairchild's experiments, and these words as he spoke and wrote them, I have given for a purpose.

Like thousands of boys brought up on an eastern farm, Mr. Fairchild took Horace Greeley's advice, and went west. But circumstances called him home again, and he concluded to try to bring up the old farm. It was up-hill work, and he eked out his income by teaming and other outside labor. Some years ago I became acquainted with him as one of the attentive and intelligent participators in farmers' meetings. One day he took me out to his farm and showed me what he was trying to do. I very well remember a meadow on which he told me he had applied, a year or two before, nearly a ton of fish-scrap per acre which he had to buy with the proceeds of his outside labor, and haul several miles. So far as appearance showed, it had done no good at all. I naturally inquired if he had tried potash salts. This suggested the experimenting which he began at once.

After one or two seasons' experience, in response to an inquiry as to how he was getting on, he told me he thought he was learning something that would be of great use to him, and added that he found himself devoting more attention to his farm. The next season he told me that he was having better success with his farming, and was giving less time to other enterprises. A year later, calling at our laboratory to make some inquiries he remarked, that he was taking scarcely any contracts for teaming, but was devoting himself almost exclusively to his farm. Last spring he called again and remarked, "My wife tells me I must set up a prescription-shop, so many of my neighbors are coming to find what fertilizers I use for my corn." A few weeks ago he was in again to bring reports of his experiments, and at that time occurred the conversation reported above.

MR. NEWTON'S EXPERIMENTS.

In 1880, Mr. Newton made a nitrogen experiment with corn, on the same plan of those of Messrs. Bartholomew and Fairchild, but with very different results, in that the corn paid scarcely any heed to either superphosphate or potash salt, but responded to the nitrogen in every case, the yield rising and falling with the amount of nitrogen applied, as appears in the figures of Table I.

Generally, corn has responded to the mineral fertilizers, and got little or no help from the nitrogen. Indeed, Mr. Newton's case is the only one I have met in which corn has responded profitably to the largest ration of nitrogen. So rare and interesting a case demanded further study. Accordingly Mr. Newton laid out a new experiment in a more favorable place—the former was on the slope, and the latter on the top of a hill, both being in the same field—and on a larger scale, using two acres instead of one.

The experiment of 1881 was on the schedule described above (pages 346–8), in which the nitrogen groups differ somewhat from those of former years. The results obtained in 1881, appear in Table III.

TABLE III.

EFFECTS OF NITROGENOUS FERTILIZERS ON CORN.

EXPERIMENT OF MR. W. C. NEWTON, DURHAM, CONN., 1881.

SOIL.—*Hill, land; Dark loam; subsoil moist;* WEATHER, *unfavorable.*

Fertilizers Per Acre.	Shelled Corn Per Acre. bushels.
No Manure,	12.5
Nitrate of Soda, 150 pounds,	22.5
Superphospate, 300 pounds,	13.8
Muriate of Potash, 150 pounds,	15.0
Nitrate of Soda, 150 pounds, + Superphosphate, 300 pounds,	23.8
Nitrate of Soda, 150 pounds, + Muriate of Potash, 150 pounds,	23.8
Superphospate, 300 pounds, + Muriate of Potash, 150 pounds, (mixed minerals,)	13.8
Mixed minerals, 450 pounds, + Nitrate of Soda, 150 pounds,	23.3
Mixed minerals, 450 pounds, + Nitrate of Soda, 300 pounds,	41.7
Mixed minerals, 450 pounds, + Nitrate of Soda, 450 pounds,	56.7
Mixed minerals, 450 pounds,	16.3
Mixed minerals, 450 pounds, + Sulphate of Ammonia, 112.5 pounds,	28.5
Mixed minerals, 450 pounds, + Sulphate of Ammonia, 225.0 pounds,	42.5
Mixed minerals, 450 pounds, + Sulphate of Ammonia, 337.5 pounds,	48.3
Nitrate of Soda, 450 pounds,	53.8
Mixed minerals, 450 pounds, + Dried Blood, 225 pounds,	28.8
Mixed minerals, 450 pounds, + Dried Blood, 450 pounds,	33.8
Mixed minerals, 450 pounds, + Dried Blood, 675 pounds	40.6
Mixed minerals, 450 pounds,	20.6
No manure,	13.8

Nothing could be more striking than the effect of the nitrogen and the almost entire failure of the other materials to increase the yield. As in the experiment of 1880, the corn ignores the superphosphate and potash salt almost entirely, but responds to nitrogen in every form and rises and falls with the amount applied. Even nitrate of soda alone at the rate of 450 pounds per acre, despite the unfavorable season, raises the yield from 13 bushels with no manure to 54 bushels per acre.

I was surprised at the outcome of the experiment of 1880, and wrote Mr. Newton as much, and expressed the wish that he would try again. In his report of the second experiment he says facetiously but forcibly: " So you see Nitrogen is king of my hill."

The very fact that Mr. Newton's experiment is such an exception, renders it all the more interesting and valuable.

THE GENERAL OUTCOME OF THE EXPERIMENTS OF 1881.

Taking into account the experiments as a whole, of which those detailed above are samples, I do not see that I can alter in any material way the conclusions given in previous reports, and which I do not repeat here, for the simple reason that they have been stated in this volume as it seems to me times enough.

That season, seed, and tillage are extremely important factors of plant-growth, are facts that everybody knows, no one fully understands, and too few recognize in their practice.

That soils vary widely in their power of supplying food to plants, and that oftentimes a soil needs draining or other amendment as much or more than manure, are other facts which everybody knows and but few act upon, and which consequently need continual urging by example and by precept.

That the best way for a farmer to find what ingredients of plant food his soil and crops want, and with what fertilizers they can best be supplied, is by direct experiment; and that such experiments as have been detailed in these reports, when properly conducted, do bring reliable answers and are within the power of ordinary farmers, are facts that seem to me to have been so thoroughly illustrated as to make further discussion of their practicability and utility, unnecessary here.

As to the feeding capacities of different plants, the results of the last year's special nitrogen experiments, which have been much more numerous than those of previous years, simply confirm and amplify what has been said before. Corn with rare exceptions gets on fairly well with little or no nitrogen in manures, but generally responds to phosphoric acid and often to potash.

Potatoes have seldom failed in a favorable season to respond profitably to nitrogen, phosphoric acid, and potash, each and all. The data for other crops are still too meager to permit reliable generalizations.

IN CONCLUSION.

The truth I wish especially to enforce in this writing, and which I repeat once more because it is so important, is this.

We want more light. We want more reason in farming. We want more men to study, to read, to think, to experiment, to get facts for themselves, for their neighbors, and for the community at large, and to give still greater strength to the movement that so happily characterizes our time, the agricultural revival that is so rationally and rapidly pervading the land.

The strongest objection I have known to be urged against the experiments I have advocated in these volumes the past five years, is that farmers generally cannot, or at any rate will not, make them. Very true. Twenty years ago, hardly a man in the state would have thought of such an undertaking. But twenty years ago, an Experiment Station in Connecticut was impossible. Ten years ago matters were improved. Eight years ago the actual movement began which resulted in the Station. Ten years hence, there is every reason to believe it will be on a far better footing than it is now.

To-day, we have a few men like Mr. Bartholomew, Mr. Fairchild, Mr. Newton, and others, whose good work, it has been my privilege and pleasure—and I esteem it a privilege as it is a pleasure—to describe. Ten years hence, I hope there will be many, that we shall have not half a dozen or a dozen in a state, but as many and more in each county, and all doing better work, because working in the light of larger experience.

What Mr. Fairchild, and Mr. Bartholomew, and Mr. Newton, and others are doing, still other Connecticut farmers can do, and that is what we want done. As an enthusiastic supporter of agricultural investigation of my acquaintance says, "Such men are lighthouses." They are needed everywhere.

But such men would do more, and a great deal of unlooked for talent would be brought out, if a little more substantial encouragement and help could be furnished. Unfortunately very few farmers can afford to both pay the bills and do the work. A few hundred dollars invested in sets of experimental fertilizers, to be placed in the hands of proper men, would secure a vast amount of intelligent, faithful, useful work, and the benefit to the agriculture of Connecticut and the country at large, would be very great.

From all around us comes the complaint that the boys are leaving the farms; that the old homesteads are deserted; that the sturdy, native stock which has given us our material, our intellectual and our moral strength, is running out; that foreigners with lower ideals of life and character and less capacity for progress are coming in, and that, unless something happens to change the current, our old land-marks, our great influence, our sterling character, will be gradually swept away. I do not share these forebodings so fully as many, because I believe the change will come. But it cannot come without more rational as well as more profitable farm practice; without increase of intellectual life, as well as of crops; without better culture of the mind, as well as of the land.

I was much struck the other day by a forcible remark of a friend, who in speaking of farmers' clubs and the men who support them, said: "Where there is one man talking in the meeting, there are a hundred busily thinking at home. The fact is, that we are in the midst of an awakening of agricultural thought that is really phenomenal. With the thinking comes improvement, better tillage, better crops, better stock, and better profits, and what is best of all, a higher intellectual and, I trust, moral life. The agencies that speed this movement, the forms of nutriment on which it thrives are manifold. With the rest, such men and such work as has been here referred to, are doing, I believe, not a little to help the good cause along.

Had not the relation of this article to previous ones seemed to call for the heading it has, it would have been entitled, "The Use of Brains in Farming."

OFFICIAL LIST OF AGRICULTURAL SOCIETIES IN CONNECTICUT, 1881–82.

Name of Society.	President.	Secretary.	Treasurer.
Connecticut State,	James A. Bill, Lyme.	L. E. Coe, Meriden.	Wm. H. Gross.
Hartford County,*	J. C. Capen, Bloomfield.	Warren Rowley, Hartford.	Wm. H. Gross.
New Haven County,*	D. N. Clark, Woodbridge.	C. P. Augur, Whitneyville.	Frank S. Platt.
New London County,	H. W. Kingsley, Franklin.	Joab B. Rogers, Norwich.	F. L. Gardner.
Fairfield County,	Jonath. E. Wheeler, Saugatuck.	Henry T. Shelton, Bridgeport.	Wm. A. Curtiss.
Windham County,	Gurdon Cady, Central Village.	Willard Day, Danielsonville.	A. Wylie.
Litchfield County,*	Harry Sedgwick, Cornwall Hollow.	D. C. Kilbourn, Litchfield.	E. C. Jones.
Middlesex County,*	J. M. Hubbard, Middletown.	G. W. Wilson, Middletown.	G. W. Wilson.
Tolland County,	Charles H. Owen, Buckland.	F. R. Tucker, Rockville.	Wm. W. Andross.
Bloomfield,*	H. G. Fish, Bloomfield.	J. E. Cox, Bloomfield.	H. W. Rowley.
Chester,	J. H. Gilbert, Chester.	E. S. Smith, Chester.	E. S. Smith.
Clinton,	George E. Elliot, Clinton.	S. G. Redfield, Clinton.	E. E. Post.
Danbury,	John W. Bacon, Danbury.	B. C. Lynes, Danbury.	J. W. Bacon.
East Granby,*	C. H. Hanchett, East Granby.	H. L. Clark, East Granby.	J. W. Thompson.
Guilford,	Arthur S. Fowler, Guilford.	J. Seymour Benton, Guilford.	George B. Spencer.
Harwinton,	James Mather, Harwinton.	Addison Webster, Harwinton.	Addison Webster.
New Milford,	W. D. Black, New Milford.	Charles D. Blinn, New Milford.	Charles Randall,
Meriden,*	W. J. Ives, Meriden.	L. E. Coe, Meriden.	L. H. W. Yale.
Milford and Orange,	Albert N. Clark, Milford.	Edward G. Miles, Milford.	Charles F. Smith.
Oxford,	Wooster B. McEwen, Oxford.	Wm. W. Hughes, Oxford.	E. B. Treat.
Pequabuck,	Mills H. Barnard, Bristol.	Geo. A Gowdy, Bristol.	G. A. Gowdy.
Ridgefield,	E. H. Smith, Ridgefield.	E. L. Smith, Ridgefield.	D. Smith Sholes.
Simsbury,	Edmund A. Hoskins, Simsbury.	Phelps Tuller, Simsbury.	Jay Barnard.
Suffield,	M. J. Sheldon, Suffield.	H. F. Fuller, Suffield.	H. F. Fuller.
Tolland County East,	W. Holman, Tolland,	R. S. Hicks, Stafford Springs.	R. S. Hicks.
Torrington,*	E. T. Weston, Torrington.	C. James, Torrington.	C. James.
Union (Falls Village),*	Milton H. Robbins, Lakeville.	M. W. Dean, Huntsville.	O. M. Brinton.
Union (Somers, etc.),	Henry Abbe, Enfield.	John T. McKnight, Ellington.	Chas. M. Abbe.
Union (Monroe, etc.),	Henry S. Mills, Birmingham.	Joseph Tomlinson, Birmingham.	S. H. Blackman.
Waterbury,*	Samuel Root, Waterbury.	C. N. Hall, Waterbury.	G. S. Parsons.
Watertown,	Henry E. Scott, Watertown.	Alanson Warren, Watertown.	F. B. Hand.
Westbrook,	R. H. Stannard.	G. A. Post.	T. D. Post.
Woodbridge and Bethany,	Theron A. Todd, Woodbridge.	S. G Davidson, Bethany.	S. G. Davidson.
Woodbury,	B. S. Russell, Woodbury.	Charles E. Strong, Woodbury.	Geo. P. Crane.
Woodstock,	Geo. Austin Bowen, Woodstock.	H. T. Child, Woodstock.	E. T. Warner.

* No Fair.

RETURNS OF AGRICULTURAL SOCIETIES, 1881.—FINANCES—RECEIPTS.

SOCIETIES.	Cash on hand.	Single Admission Tickets.	Membership or Season Tickets.	Grand Stand.	Donations and Unclaimed Premiums.	Entrance Fees, Trials of Speed.	Other Entrance Fees.	Rent of Grounds.	State Appropriation.	Other Sources.	Total.
Connecticut State	$2,300 84	$3,706.14	$659.11	....	....	$739.00 all	....	....	$2,500.00	....	$9,915.09
New London County	165.04	1,472.45	....	$109.63	....	....	$706.50 [1]	$505.50	300.00	$544 19 [2]	3,803.31
Fairfield County	621.26	2,768.19	....	433.50	$21.00	670.00	50.75	1,193.44	....	1,516 01 [10]	6,651.89
Windham County	181.63	1,143.75 [3]	....	....	8.30	187.50	20.00	395 00	200.00	133.84 [4]	2,290.02
Tolland County	375.68	196.45	22.82	176.34	....	40.00	....	94.10	200 00	....	1,105.39
Chester	100.18	64.10	.75	....	25.00	....	5.00	21 25	100 00	....	316.28
Clinton	221.37	124.97	102.00	....	....	....	2.00	8.00	100.00	19 00 [5]	577.34
Danbury	2,514.88	6,363.52	....	778.80	....	445.00	7 50	1,279.75	100.00	185.17	11,674 62
Guilford	400.00	120.00	56 00	....	44.00	....	....	....	100.00	80.00	800.00
Harwinton	305.65	....	1.00	....	....	....	....	258.00	100 00	....	....
New Milford	22.41	1,765.41	....	170.47	....	400.00	....	312 60	100.00	130.43 [6]	3,001.32
Milford and Orange	121.15	434.00	80 00	60.38	....	355.00	16.00	135.00	100.00	80.00	1,375.53
Oxford	1.00	19.65	43.00	....	....	....	10.80	1.50	....	....	75.95
Pequabuck	481.45	....	....	....	....	....	492.35	150.00	100.00	112.50	1,384.80
Ridgefield	.94	337.17	....	....	....	24.00	1.00	129.50	100.00	54.50 [7]	647.11
Simsbury	4.00	325.00	449 00	....	....	66.00	....	37.25	100.00	....	981.25
Suffield	....	334.18	17.00	....	2.50	147.50	4.00	76.50	100.00	60.83	....
Tolland County East	....	1,248.23	99.00	110.65	....	350.00	....	137.50	100.00	....	2,035 38
Union (Somers, etc.)	46.25	....	7.00	....	....	....	....	....	100.00	....	153.25
Union (Monroe, etc.)	43.94	659.20	219.00	47.83	....	135.00	27.00	113.25	100.00	97.24 [8]	1,442.46
Watertown	230.00	1,065.00	450.00	....	....	620.00	25 00	445.00	100.00	....	....
Westbrook	14.85	118.99	141.00	....	84.20	....	....	....	....	178.54	537.58
Woodbridge and Bethany	5.00	334.35	99.25	....	....	....	....	61.40	100.00	....	600.00
Woodbury	23.08	247.70	93.00	....	....	73.00	....	....	100.00	....	....
Woodstock	....	1,049.41	187.35	62.50	7.00	36.00	13.00	243.50	100.00	29.50 [9]	1,722 26

[1] Total Entrance Fees. [2] Trotting Association, $100.00—Merchants' Bank, $444.19. [3] Including Membership and Season Tickets. [4] Due the Treasurer. [5] For Special Premiums, $15.00—Advertising, $4.00. [6] Bills Payable. [7] Grass, $40—Pasture, $9.50—Use of Tent, $5.00. [8] Advertising, $91.97. [9] Advertising. [10] Hay and oats, $16.01—Loan, $1,500.00.

RETURNS OF AGRICULTURAL SOCIETIES, 1881.—FINANCES CONTINUED.

SOCIETIES.	Expenses of Fair.	Premiums for Speed.	Other Premiums and Gratuities.	Permanent Improvements.	Other Expenses.	Cash on hand.	Total.	Indebtedness of Society.	Real Estate.	Personal Estate.	Number of Members.	No. of Stockholders—Joint St'k.	Capital Stock.	Estimated Attendance.	Admission Tickets.	Season Tickets.	Grand Stand.
Connecticut State	$2,630.22	....	$3,546.50	....	....	$3,738.37	$9,915.09	....	....	$3,738.37	....	....	....	....	$ .40	$1.50	....
New London County	1,407.14	$1,646.40	all.	....	[1] $749.77	....	3,803.31	$6,266.24	$10.000.00	300.00	325	....	....	4,500	.35	....	$ .15
Fairfield County	2,119.40	1,155.00	767.00	$1,973.07	[15] 569.00	600 68	7,274.15	10,800.00	21,401.04	250.00	[16] 227	163	$30,000.00	[17] 12,350	.25	....	....
Windham County	787.52	1,383.75	all.	118.75	....	....	2,290.02	133.84	3,500.00	75.00	....	....	....	[2] 8,000	.25	50	....
Tolland County	416.70	180.00	40.00	408.55	[8] 60.00	.14	1,105.39	1,000.00	2,000.00	100.00	305	....	....	1,394	.25	[19] ..	.10
Chester	57.53	84.65	all.	....	21.58	15	316.28	....	....	....	....	....	....	750	.10	....	....
Clinton	58 58	....	239.70	70.00	....	209.06	577.34	....	....	....	205	....	....	1,454	.10	....	....
Danbury	3,105 07	1,330.00	1,755.60	3,356.84	....	2,127.11	11,674.62	....	10,000.00	2,000.00	....	191	8,000.00	[3] 27,044	.25	....	.25
Guilford	166.75	....	202.50	....	....	20.75	390 00	....	....	420.75	112	...	....	3,000	.	....	....
Harwinton	258 00	....	....	....	....	....	....	....	....	3.00	74	....	....	[14] 10,000	Fre	...	....
New Milford	1,107.75	876 00	948.22	....	[4] 69.28	.07	3.001 32	2,571.85	3,406.94	503.28	....	153	7,957.50	[5] 7,700	.25	...	....
Milford and Orange	469.50	750.00	145.38	....	....	10.65	1,375.53	250.00	1,200.00	....	60	...	....	....	.25	1.00	.15
Oxford	40.00	....	....	....	....	....	....	....	....	....	42	....	....	....	.20	1 00	....
Pequabuck	1,166.36	....	....	....	....	18.44	....	300.00	....	....	....	....	....	....	.25	....	....
Ridgefield	313.05	130.00	235.15	....	[18] 37.50	....	....	....	....	....	....	....	....	....	....	....	....
Simsbury	60.74	160.00	170.60	431.82	....	158.09	....	....	....	....	....	....	....	[6] 2,500	.25	....	....
Suffield	271.21	319.00	152.40	....	....	19.15	....	....	....	....	17	....	....	[7] 3,000	.25	....	....
Tolland County East	405.04	745.00	243.25	450.14	[8] 149.25	42.70	2,035 38	2,400.00	3,000.00	400.00	82	....	....	[9] 6,400	.25	.50	.10
Union (Somers, etc.)	25.50	....	42.00	....	....	85.75	153.25	....	....	....	320	....	....	1,200	....	...	....
Union (Monroe, etc.)	274.25	350.00	462 75	176.41	207.33	28.24	1,470.70	650 00	2.000.00	....	137	....	....	[10] 2,400	.25	1.00	.15
Watertown	970.62	1,100.00	848.50	....	....	46.26	....	....	....	50.00	....	....	....	[11] 3,000	.50	....	....
Westbrook	148.58	....	250.55	....	....	138.45	537.58	....	....	....	....	....	....	....	....	....	....
Woodbridge and Bethany	320.88	....	....	....	....	....	....	....	....	....	....	....	....	3,300	.25	1.00	....
Woodbury	250.00	....	....	....	....	....	....	....	....	....	....	....	....	....	.25	1.00	....
Woodstock	470.69	133.00	789.65	....	[13] 305.48	23.44	1,722.26	284.00	5,725.00	15.00	309	....	....	....	.25	.50	.15

[1] Interest, $722.47; Trotting Association, $25.00; Fines to do., $2.50. [2] Tuesday 500, Wednesday 3,500, Thursday 4,000. [3] Monday 500, Tuesday 1,000, Wednesday 1,562 Thursday 8,719, Friday 13,878, Saturday 1,385. [4] Watering Tank. [5] Wednesday 1,000, Thursday 4.000, Friday 1,500, Saturday 1,200. [6] Tuesday 1,000, Wednesday 1,500. [7] Tuesday 1,500, Wednesday 1,500. [8] Interest. [9] Thursday 2,000, Friday 4,400. [10] Thursday 800, Friday 1,600. [11] Monday 40, Tuesday 800, Wednesday 1,200, Thursday 2,000. [12] Wednesday 300, Thursday 3,000. [13] On note. [14] One day. [15] Insurance, $99.00; Interest, $570.00. [16] Life Members. [17] Tuesday 340, Wednesday 1,275, Thursday 7,200, Friday 2,100. [18] Insurance. [19] $1.00 and $5.00.

NUMBER OF ANIMALS EXHIBITED.

SOCIETIES.	Bulls.	Milch Cows.	Heifers.	Calves.	Working Oxen (pairs).	Steers (pairs).	Fat Cattle.	Horses—except speed.	Horses—speed.	Sheep.	Swine.	Poultry (coops).	All other Stock.
Connecticut State	51	106	58	..	109	35	6	107	..	101	15	170	..
New London County	..	..	..	..	..	..	..	..	..	..	..	..	..
Fairfield County	12	13	11	6	5	4	3	37	..	16	11	40	..
Windham County	6	32	56	30	42	28	4	39	19	72	6*	25	..
Tolland County	11	25	16	19	3	9	4	32	5	2	20	43	..
Chester	2	2	..	..	5	..	..	..	2	..	..	..	..
Clinton	..	11	8	7	18	5	3	14	..	21	15	54	..
Danbury	..	..	..	..	40	25	..	..	..	..	..	180	..
Guilford	..	..	..	..	..	..	..	..	..	..	..	..	..
Harwinton	..	..	..	..	..	..	..	..	..	..	..	..	..
New Milford	8	41	23	14	95	40	1	26	34	15	..	200	..
Milford and Orange	6	14	3	2	13	7	..	10	32	10	15	7	..
Oxford	..	..	..	..	..	..	..	..	..	..	..	..	..
Pequabuck	..	..	..	..	..	..	..	..	..	..	..	..	..
Ridgefield	3	1	12	..	11	..	..	33	10	..	3	16	..
Simsbury	..	..	..	..	..	..	..	..	..	..	..	..	..
Suffield	..	..	..	..	..	..	..	..	..	..	..	..	..
Tolland County, East	..	..	..	..	..	..	..	..	..	..	..	..	..
Union (Somers, etc.)	4	8	3	2	30	20	4	15	..	..	..	4	..
Union (Monroe, etc.)	5	15	..	..	13	10	2	34	12	21	5	19	58 prs.
Watertown	15	24	24	11	150	32	6	..	..	39	35	..	50
Westbrook	10	11	12	10	100	20	3	30	..	18	19	31	20
Woodbridge and Bethany	4	14	..	..	19	..	9	40	..	37	1	37	..
Woodbury	9	7	12	4	9	15	..	22	9	2	9	6	..
Woodstock	..	..	..	..	..	..	..	..	..	..	..	..	..

* And Pigs.

ANALYSIS OF PREMIUMS AND GRATUITIES PAID.

FARM STOCK.

SOCIETIES.	Bulls.	Milch Cows.	Heifers.	Calves.	Working Oxen.	Steers.	Fat Cattle.	Horses—except speed.	Horses—speed.	Sheep.	Swine.	Poultry.	All other Stock.	Total.
Connecticut State	$317.00	$384.00	$96.00	....	$97.00	$76.00	$27 00	$346.00	......	$160.00	$57.00	$107.00	....	......
New London County	51.50	134.25	60.00	$12.75	46.00	36.75	11.00	146.75	$1,027.00	78.00	25.00	12.75	$72.25	......
Fairfield County	12.00	7.00	23.00	15 00	30.00	15 00	16.00	119.00	1,155.00	7.00	20.00	72.00	....	$683.25
Windham County	22.00	48.00	48.00	56.00	133.00	59.00	9.00	177.00	375.00	24.00	29.00	77.50	....	1,057.50
Tolland County	12.00	.0	....	3.00	8.00	15.00	4.00	41.00	220.00	5.00	10.00	19.00	....	356.00
Chester	....	1.00	2.00	....	6 50	....	....	....	1.50	....	1.00	....	1.50	14.00
Clinton	7.50	6.00	5.50	4.00	14.00	4.50	2.50	10.50	......	15.00	12.50	16.75	4.00	102.75
Danbury	12 50	45 00	16 00	7.00	168.50	36.00	....	259.25	1,330.00	10.00	9.00	117.25	82.50	2,093.00
Guilford	3.00	7.00	3.00	1.50	31.00	5.00	3.00	25.00	......	....	9.00	6.50	....	94.00
Harwinton	....	....	....	....	....	....	....	....	......	....	....	....	....	......
New Milford	12.50	78.00	28.00	16.00	202 00	22.00	6 00	61.00	876.00	8.50	....	26 10	....	1,308.10
Milford and Orange	5.00	5.00	1.00	.50	25.00	5.00	30.00	750.00	2.50	4.00	3.00	....	....	830.00
Oxford	1.50	3 50	1.00	....	10.50	5.00	4.00	2.00	7.50	1.00	1.00	1.00	....	38.00
Pequabuck	25.00	33.00	10.00	18.00	49.00	13.00	6.00	24 00	100.00	8.00	6.00	50.00	....	......
Ridgefield	5.00	2.00	11.00	....	32.00	....	....	43.50	130.00	....	5.00	9.50	....	238.00
Simsbury	12.00	13.50	14.00	3 00	31.00	11.00	35.00	160.00	......	....	....	....	....	278.50
Suffield	13.00	13.00	18.00	7. 0	16.00	7.00	2.00	35 00	319.00	2.00	7.50	....	....	......
Tolland County, East	....	....	....	....	....	....	....	....	......	....	....	....	....	......
Union (Somers, etc.)	1.25	6 25	4.00	....	13.00	10.00	....	2.00	......	....	....	....	....	36.50
Union (Monroe, etc.)	8.00	20.50	....	....	21.00	17.00	7.00	61.00	350.00	14.00	13.00	8 25	70.00	595.75
Watertown	25.00	97.00	34.00	16.00	115 00	37.00	8 00	97.00	1,100.00	28.00	18 00	....	21.00	......
Westbrook	7.00	14 00	6.00	6.00	14.50	5.00	3.00	16.50	......	10.00	7.00	13.50	2.00	104.50
Woodbridge and Bethany	5.50	13.75	....	....	13.00	....	11.00	41.75	......	5.00	2.00	30.00	....	122.00*
Woodbury	15.00	13.00	9.25	2.50	36.00	32.00	....	52.00	250.00	3.00	1.50	11.00	....	424.25
Woodstock	....	....	....	....	....	....	....	....	......	....	....	....	....	......

* Out of town premiums paid in full; those in town, 75 per cent.

ANALYSIS OF PREMIUMS AND GRATUITIES.—Continued.

FARM PRODUCTS.

SOCIETIES.	Indian Corn.	Wheat.	Rye.	Barley.	Oats.	Beans.	Grass Seeds.	Potatoes.	Carrots.	Beets.	Parsnips.	Turnips.	Onions.	Other Products.	Total amount paid for Grain and Root Crops.
Connecticut State	$14 00	$3.50	$3.50	$3.50	$3.50	$7.00	$2.00	$19.00	$5.00	$8.00	$1.00	$2.00	$5.00	$28.00	$105.00
New London County	....	....	....	....	....	....	....	....	....	....	....	....	....	....	34.75
Fairfield County	3.50	2 50	2.50	1.50*	2.50	....	....	11 00	1.00	1.50	....	1.00	4.50	24.00	65.50
Windham County	1.50	3.00	1.50	1.00	1.50	1.00	....	9.25	....	....	....	....	....	15.50	34.25
Tolland County	....	....	....	....	....	....	....	....	....	....	....	....	....	....	36.08
Chester	3.25	1.00	.75	....	.50	4.00	....	7.00	.75	.75	.50	1.50	.75	....	....
Clinton	5.60	1.00	.50	.30	.50	5 10	.80	8.60	.50	2 70	....	.60	2 00	2.25	30.45
Danbury	2 00	1.00	2.00	....	3.50	.50	....	16 00	1.00	1.50	....	3.25	7.75	14.50	43.50
Guilford	7.25	1.25	.75	....	1.00	6.00	....	14.75	1.00	2.75	.50	1.00	2.25	12.75	51.25
Harwinton	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
New Milford	4 00	1.50	1 00	....	1.50	1.25	....	7.50	.50	2.15	....	.75	2.00	.50	22 65
Milford and Orange	1.25	1.00	1.00	.50	.50	1.00	....	8.00	50	1.00	.50	.50	1.50	.50	17 75
Oxford	....	....	....	....	....	....	....	....	....	....	....	....	....	....	10.65
Pequabuck	2.25	1.50	1.25	.25	.75	.25	....	....	....	....	....	....	11.25	....	....
Ridgefield	2.25	3.00	2.50	....	.25	.75	.75	6.00	.25	.75	....	....	4.50	4.00	25.00
Simsbury	2.00	....	....	....	....	....	....	5.00	....	1.50	....	....	3 50	....	12.00
Suffield	1.00	....	2.00	....	2.00	....	....	5.00	.50	.50	....	....	1.75	5.25	17.00
Tolland County, East	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Union (Somers, etc.)	....	....	....	....	....	....	....	.50	....	....	....	....	....	....	.50
Union (Monroe, etc.)	6.00	1.50	3.00	1.50*	1.50	4.00	....	16 50	1.00	7.00	.50	....	9.00	8.25	59.75
Watertown	3.00	.75	.75	.75	.75	.75	3.75	17.00	.75	2.25	.75	2.25	2.25	18.00	53.75
Westbrook	8.00	2.00	.50	....	3.00	2.50	1.00	6 00	.80	2.50	....	....	2 50	....	28.80
Woodbridge and Bethany	9.50	1.25	1.25	.50	1.25	2.00	....	21.75	.75	6.00	.50	1.75	4.50	....	....
Woodbury	....	.25	.75	....	.25	.75	....	2.00	....	.75	....	....	.75	....	5.50
Woodstock	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....

* Buckwheat.

ANALYSIS OF PREMIUMS AND GRATUITIES.—Continued.

FARM PRODUCTS.

SOCIETIES.	Fruits.	Flowers.	Other cult. crops.	Butter.	Cheese.	Honey and Wax.	Bread and Cake.	Sugar, Syrup, Preserved Fruit, etc.	Total amount paid Farm Products.	Agricultural Implements.	Mechanical inventions, etc.	Fine Arts and Fancy Articles.	Decorated Carts & Trains of Oxen.	Medals.	Diplomas.	Miscellaneous.
Connecticut State	$155.00	$22.00	....	$20 00	$10 00	$3.00	$9.00	$17.00	....	....	$79.00	....	$85.00	5	110	...
New London County	22.20	13.00	....	12.25	5.50	..	4.50	...	....	2 25	25.00	20.00	....	..	..	$31.00
Fairfield County	71.50	61.00	....	2.00	. ..	2.00	18.50	15 00	$235.50	12.00	151.40	....	....	18	20	. .
Windham County	56.50	48.50	....	14.00	14.00	2.00	9.00	5.00	149 00	22.00	52.75	68.25	....	..	1	...
Tolland County	47.00	2.50		5.00	4.50	...	3.00	....	92.98	....	8.00	10.25	....	..	..	...
Chester	10.65	2.00	$7.00	.30	....	.30	.90	7.50	49.40	....	2 30	9.50	. ...	..	..	9.45
Clinton	25.40	3.60	2.40	1.25	....	1.25	7.30	10.75	51.95	6.80	2.25	20.10	10.50	..	.	15.00[1]
Danbury	125 00	41.00	....	.	2.00	....	35.00	21.50	322.00	86.00	116 00	52 00	[2]120.00	..	26	16.40[3]
Guilford	32 00	1 00	2.75	.50	.50	1 50	5.75	4.00	99.25	....	2.25	7.00	....	..	..	...
Harwinton	....	....	....	...	...	....	....	....	....	....	....	...	....	..	..	...
New Milford	19.00	6.75	....	3.00	....	1.25	6.00	4.50	63.45	11.00	79.55	11.75	86.00	..	..	...
Milford and Orange	23.00	3.00	....	2.00	2.00	1.00	4.00	8.00	60.75	....	10.00	115.00	....	..	2	...
Oxford	...	....	....	....	.90	....	....	....	21.20	....		....	....	..	..	...
Pequabuck	24.00	2.00	....	....	....	1.50	3.00	.. .	....	43.00	5.50	....	....	..	..	...
Ridgefield	10.25	5.00	....	.50	.50	.25	10.75	7.75	35.00	9.00	11.50	46.65	....	2	..	...
Simsbury	4.50	....	....	2 00	....	....	1.50	1.50	21.50	3.00	9.40	5.20	....	..	..	...
Suffield	....	12.40	....	....	....	....	3.00	....	50.40	4.45	....	50.75	....	..	..	...
Tolland County, East	....	....	....	....	....	....	...	....	....	....	...	....	....	..	..	...
Union (Somers, etc.)[4]	1.50	....	....	....	....	....	1.00	1.00	4.50	....	....	1.50	....	..	..	...
Union (Monroe, etc.)[5]	54.75	10.75	....	6.00	3.00	1.75	17.00	4.75	157.75	....	5.00	72.50	....	..	..	...
Watertown	20.00	9.50	....	6.00	2.00	....	4 50	6.00	95 75	4.75	25.00	50.50	40.00	2	..	...
Westbrook	31.70	3.00	....	.50	....	...	12 50	13 00	100.00	19.50	17.00	6.00	9.00	1	.	25.00[6]
Woodbridge and Bethany	39.50	6.50	....	....	2.50	.50	4.00	2.50	....	....	....	....	43.00	..	..	...
Woodbury	5.50	2.75	....	1.50	....	....	1.00	.25	22.00	....	8.50	10.00	....	..	2	...
Woodstock	....	....	....	...	....	....	...	....	....	....	....	....	....	..	..	...

[1] Draft Cattle. [2] Embraced under Working Oxen. [3] Dealers' and General exhibits, $177.00; Ladies' and Domestic Industrial, $239 40. [4] All Premiums not called for in thirty days are given to the Society. This was a considerable amount. [5] Premiums not called for, $18.25. [6] Shell Fish, $.50.

OFFICIAL LIST OF FARMERS' CLUBS IN CONNECTICUT--1881-2.

Name of Club.	President.	Secretary.
New Haven County......	Prof. Wm. H. Brewer.	Cullen B. Foote.
Bethlehem..............	L. F. Scott.	G. F. Stone.
Bristol.................	S. R. Gridley.	John Winslow.
Cheshire................	Charles S. Gillette.	N. S. Platt.
Chester.................	A. H. Gilbert.	C. E. Lord.
Clinton.................	John P. Johnson.	Joseph H. Sperry.
Columbia................	Joseph Hutchins.	W. H. Yeomans.
East Windsor............	Daniel W. Bartlett.	John S. Fitts.
Guilford...	Sidney W. Leete.	R. H. Woodruff.
Hamden..................	G. W. Bradley.	C. P. Augur.
Killingworth............	L. L. Nettleton.	Francis Turner.
Lebanon.................	O. E. Pettis.	Wm. Huntington.
Meriden.................	Oliver Rice.	L. E. Coe.
Middlefield.............	J. T. Inglis.	P. M. Augur.
Morris..................	A. C. Tracy.	S. W. S. Skilton.
Mystic..	Josiah Hammond.	Silas Whipple.
Naugatuck...............	J. B. Tolles.	M. S Baldwin.
Newington......	H. A. Whittlesey.	J. S. Kirkham.
North Stonington........	T. W. Wheeler.	F. S. Peabody.
New Britain.......	L. S. Wells.	A. C. Blake.
Pomfret.................	C. D. Williams.	B. S. Warner.
Tunxis..................	E. C. Ayer.	A. Porter.
West Cornwall...........	H. C. Hart.	T. S. Gold.
Westport................	Wm. J. Jennings.	S B. Sherwood.
Willimantic.............	Arnold Warren.	N. P. Perkins.
Wilton..................	D. N. Van Hoosear.	D. H. Van Hoosear.
Wolcott....	Hermon Paine.	Edwin Todd.
Woodstock...............	A. A. Paine.	Dr. G. A. Bowen.

TREASURER'S REPORT.

NATHAN HART, *in account with*

THE STATE BOARD OF AGRICULTURE.

RECEIVED.

Jan. 12, 1881,	Balance from Report of 1880, - - - -		$802.99
Jan. 3, 1882,	From State Treasurer, - - - -		2,500.00
			$3,302.99

PAID.

Jan. 13, 1881,	Treasurer's expenses, 1880, - - - -		30.00
" 13, "	P. M. Augur (services), - - - -		100.00
" 13, "	Dr. N. Cressy, veterinary service, - - -		115.00
April 5, "	J. M. W. Yerrington, stenographer, - - -		111.00
" 12, "	Dr. W. J. O'Sullivan (veterinary), - - -		11.00
May 24, "	Dr. N. Cressy, " - - -		11.25
Aug. 23, "	Dr. J. H. Parkinson, " - - -		15.50
" 23, "	P. R. Day, - - - - - -		10.00
" 24, "	The Case, Lockwood & Brainard Co., - -		210.10
Sept. 1, "	B. D. Norris, by E. H. Hyde, - - -		15.00
Nov. 29, "	S. R. Gridley, carriage hire, - - - -		12.50
" 29, "	E. C. Vinton, - - - - - -		10.00
Dec. 16, "	L. S. Wells, - - - - - -		8.45
" 16, "	R. W. Robinson, - - - - -		34.25
Jan. 7, 1882,	Dr. James Law (veterinary), - - - -		60.00
	Dr. A. Liautard, " - - - -		30.00
	C. T. Hickox, - - - - - -		30.55
	Albert Day, - - - - - -		51.25
	Dr. A. H. Rose (veterinary), - - -		34.50
	J. M. Hubbard, - - - - -		32.70
18,	Dr. A. R. Goodrich, - - - - -		5.25
	J. J. Webb, - - - - - -		18.50
	James A. Bill, - - - - -		36.50
	Prof. W. H. Brewer, - - - - -		13.30
	P. M. Augur, - - - - - -		26.25
	N. Hart, Treasurer, - - - - -		30.00
	Dr. Cressy (veterinary), - - - -		50.00
	E. H. Hyde, - - - - - -		440.00
	T. S. Gold, Secretary, salary, - -	$700 00	
	Traveling expenses, - -	255.60	
	Freight and express, - -	42.18	
	Postage, - - - -	69.59	

Telegrams, - - -	$3.90	
Stationery, - - -	4.24	
Cattle Commission, - -	2.75	
Connecticut Farmer, Adv., -	1.00	
Prof. Collier, expenses, - -	3.50	
Expenses at Newtown, - -	81.05	
R. J. Hinman, reporting, - -	20.00	
J. B. Olcott, lecture, - -	25.00	
E. H. Jenkins, lecture, - -	27.50	
Edward Norton, lecture, - -	27.00	
Prof. W. H. Brewer, lecture, -	26.25	
L. F. Scott, lecture, - -	26.00	
Dr. E. L. Sturtevant, lecture, -	31.33	
B. G. Northrop, lecture, - -	27.00	
B. G. Halsted, " - -	27.30	
J. M. Hubbard, " - -	25.00	
		$1,427.19
Balance in Treasury, - - -		322.37
		$3,302.99

Jan. 12, 1881, Received on account of Agricultural Statistics. Balance from Report of 1880, - - - - $425.00

PAID.

April 12,	P. M. Augur, - - - - - - -	25.00
	Wm. J. Jennings, - - - - - -	25.00
	David Williams, - - - - - -	25.00
Aug. 2,	The Case, Lockwood & Brainard Co., - -	318.50
Jan. 12, 1882,	W. H. Yeomans, by T. S. Gold, - - -	25.00
	Balance in Treasury, - - - - - -	6.50
		$425.00

NATHAN HART, *Treasurer.*

West Cornwall, Jan. 18, 1882.

INDEX.

STATE OF CONNECTICUT.

ANNUAL REPORT

OF

The Connecticut Agricultural

EXPERIMENT STATION

For 1881.

PRINTED BY ORDER OF THE LEGISLATURE.

NEW HAVEN:
TUTTLE, MOREHOUSE & TAYLOR, PRINTERS.
1882.

OFFICERS

OF

The Connecticut Agricultural Experiment Station,

1881.

STATE BOARD OF CONTROL.

	His Exc. HOBART B. BIGELOW, *President.*	*Ex-officio.*
	Hon. E. H. HYDE, Stafford, *Vice-President.*	Term expires, 1882.
	Prof. W. O. ATWATER, Middletown.	" 1882.
	T. S. GOLD, West Cornwall.	" 1883.
	EDWIN HOYT, New Canaan.	" 1883.
Executive Committee.	JAMES J. WEBB, Hamden.	" 1884.
Executive Committee.	W. H. BREWER, New Haven, *Sec'y and Treas.*	" 1884.
Executive Committee.	S. W. JOHNSON, New Haven, *Director.*	*Ex-officio.*

Chemists.

E. H. JENKINS, Ph.D.

H. P. ARMSBY, Ph.D., to September, 1881.

C. A. HUTCHINSON, B.S.

ANNOUNCEMENT.

The Connecticut Agricultural Experiment Station was established in accordance with an Act of the General Assembly, approved March 21, 1877, "for the purpose of promoting Agriculture by scientific investigation and experiment."

The Station is prepared to analyze and test fertilizers, cattle-food, seeds, soils, waters, milks, and other agricultural materials and products, to identify grasses. weeds, and useful or injurious insects, and to give information on the various subjects of Agricultural Science, for the use and advantage of the Citizens of Connecticut.

The Station makes analyses of Fertilizers, Seed-Tests, &c., &c. for the Citizens of Connecticut *without charge*, provided—

1. That the results are of use to the public and are free to publish.

2. That the samples are taken by *consumers* from stock now in the market, and in accordance with the Station instructions for sampling.

3. That the samples are fully described on the Station "Forms for Description."

All other work proper to the Experiment Station that can be used for the public benefit, will be made without charge. Work done for the use of individuals will be charged for at moderate rates. The Station will undertake no work, the results of which are not at its disposal to use or publish, if deemed advisable for the public good. See p. 17.

Samples of Commercial Fertilizers, Seeds, etc., will be examined in the order of their coming; but when many samples of one brand or kind are sent in, the Station will make a selection for analysis.

The results of each analysis or examination will be promptly communicated to the party sending the sample. Results that are of general interest will be sent simultaneously to all the newspapers of the State for publication, and will be summed up in the Annual Reports made to the Legislature.

The officers of the Station will take pains to obtain for analysis samples of all the commercial fertilizers sold in Connecticut; but the organized coöperation of the farmers is essential for the full and timely protection of their interests. Farmers' Clubs and like Associations can efficiently work with the Station for this purpose, by sending in samples early during each season of trade.

It is the wish of the Board of Control to make the Station as widely useful as its resources will admit. Every Connecticut citizen who is concerned in agriculture, whether farmer, manufacturer, or dealer, has the right to apply to the Station for any assistance that comes within its province to render, and the Station will respond to all applications as far as lies in its power.

☞ Instructions and Forms for taking samples, and Terms for testing Fertilizers, Seeds, etc., for private parties, sent on application.

☞ Parcels by Express, to receive attention, should be prepaid, and all communications should be directed, not to individual officers but simply to the—

AGRICULTURAL EXPERIMENT STATION,

P. O. Box, 945. NEW HAVEN, CONN.

LABORATORY AND OFFICE, (until June 30, 1882).

In East Wing of Sheffield Hall, Grove Street, head of College Street.

CONTENTS.

REPORT OF THE BOARD OF CONTROL.

To the General Assembly of the State of Connecticut:

GENTLEMEN:—The Board of Control of THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION herewith submits to your Honorable Body the Annual Reports of the Director and Treasurer made to this Board at its Annual Meeting held at the State House, in Hartford, January 17, 1882.

We beg leave to say that the work of the Station has gone on through the year witnout interruption. Professor Johnson, as Director, has been assisted the whole year by Dr. E. H. Jenkins and Mr. C. A. Hutchinson, and by Dr. H. P. Armsby, for eight months. Dr. Armsby left the Station September 1st, to take a position in the Storrs Agricultural School.

The Board of Control has held one meeting, and its Executive Committee eight meetings in the year.

The Sheffield Scientific School of Yale College, which has furnished accommodations free of expense, since the establishment of the Station in 1877, gave notice at the end of the fourth year of this arrangement that it would need its rooms for instruction at the end of the five years named in its original offer, which would be June 30, 1882. This necessitates that provision be made for the future accommodation of the Station, and your Honorable Body will be asked to make a special appropriation to furnish a place and facilities for its work.

The last Annual Report was bound and distributed as heretofore with the Report of the Board of Agriculture. By special resolution the Legislature called for 1250 extra copies, which were distributed in advance of the regular edition. These extra copies cost comparatively little (less than seven cents each), and the demand for them has been greater than the supply, and the Board suggests that your Honorable Body take similar action this year and order 2000 copies for separate distribution.

HOBART B. BIGELOW,
President.

WILLIAM H. BREWER,
Secretary.

REPORT OF THE TREASURER.

Wm. H. Brewer, *in account with The Connecticut Agricultural Experiment Station.*

Receipts.

Balance from account of 1880,	$132.56	
Laboratory Receipts,	303.15	
From State Treasurer, licenses for sale of Fertilizers,	725.00	
From State Treasurer, Annual Appropriation,	5,000.00	
		$6,160.71

Payments.

Salaries,	$3,706.50	
Laboratory Expenses,	1,217.85	
Stationery, Postage and Printing,	225.48	
Furniture and Repairs,	237.13	
Gas and Fuel,	142.16	
Traveling Expenses of the Board,	10.00	
Miscellaneous,	10.50	
Cash Balance on hand,	611.09	
		$6,160.71

There is due the Experiment Station fifty-three (53) dollars for Laboratory work done, and the outstanding bills, apparatus and material ordered from abroad, but not yet received, and liabilities of the Station are estimated to amount to six hundred and thirty (630) dollars.

The Station is in possession of office furniture, apparatus, appliances, laboratory stock, seed and plant collections, and other material estimated to be worth sixteen hundred (1600) dollars, that is, it would take fully that sum to replace them or procure their equivalent.

WM. H. BREWER,
Treasurer.

Audited, Hartford, Jan. 17, 1882.

T. S. Gold,
W. O. Atwater, } *Auditing Committee.*

REPORT OF THE DIRECTOR.

The year 1881 has given this Station abundant employment in the analysis of Fertilizers, of which 170 samples have been examined, including, so far as could be learned, nearly every brand of fertilizer sold in the State.

Of Feeding Stuffs 37 samples have been analyzed and most of this work has been done incidental to an investigation of the winter feed in use on some of our Dairy farms, made for the purpose of comparing the rations there employed with the German Standard.

The Station has analyzed 56 samples of milk, partly in the interest of one of our large creameries, partly as a contribution to a knowledge of Guernsey milk, and partly in reference to the quality of the milk supplied to cities.

Since the issue of the last Report, 15 samples of seeds have been tested. Other seed-examinations now in progress are not ready for publication.

Five examinations for poisons have been made. Of these three, viz., one on a well-water and two on parts of dead animals, gave negative results. An account of the other two cases is given further on.

A large amount of work has been done in the Station Laboratory with reference to the determination of "reverted" phosphoric acid, but the results are not ready to publish.

The other subjects that have been under investigation may be learned from subsequent pages or referred to by help of the preceding Table of Contents and the Index at the close of this Report.

Seventeen Station Bulletins have been issued during the year and sent to all the newspapers and to all the Farmers' Clubs and

Agricultural Societies in the State. These bulletins are all promptly printed in the CONNECTICUT FARMER, published weekly at Hartford. Many of them are copied into the agricultural journals of neighboring States.

In my last Report *the present resources of the Station* were thus described:

"In its present organization the locality of the Connecticut Agricultural Experiment Station consists of two apartments sixteen by thirty feet, besides an entrance hall, and a small closet, all loaned for its use. One of these larger rooms is its chemical laboratory, the other its office and writing room. Its property consists of the most essential chemical apparatus needed for analytical work and the simplest office furniture and requisites. It has no land and no place where any experiments on soils, plants or animals, under agricultural conditions, can be set up or carried out. The Station owns no books except its own manuscript records, a few copies of its printed Reports and a few volumes of agricultural journals and transactions received in way of exchange.

"That the Station thus lives in borrowed lodgings, without grounds or opportunities for agricultural experiments, is not the plan or desire of the Board of Control, but has been necessitated by the limited means at its disposal."

When the Station was organized in 1877, the Governing Board of the Sheffield Scientific School, as is known, offered apartments for its accommodation for a term of five years free of rent. The crowded condition of its Chemical Laboratory has obliged the Sheffield School to notify the Experiment Station that these rooms will be required for its own uses on and after July 1st, 1882.

This not unforeseen contingency compels the Station to consider where in the future it shall be located, and whether it shall remain, as it has been, a mere Chemical Laboratory, or shall be established on a broader and more appropriate basis, and be fairly equipped for all the various kinds of experimental work that properly belong to an Agricultural Experiment Station.

The wants of the Station.—What I submitted last year in reference to the wants of the Station at that time, applies with greater emphasis at this juncture and I can therefore scarcely omit to repeat from the Report for 1880 the following paragraphs:

"In its present shape the Station is quite strictly confined to those investigations which can be made in the chemical laboratory, but is debarred from any systematic or serviceable experimental study of the very numerous and most important questions which relate to the wants of soils, crops, or domestic animals, a study which would require land and the simpler appliances that are employed in practical agriculture.

"The analysis of Commercial Fertilizers, which so largely occupies the working force of the Station, accomplishes a single though highly useful purpose, viz: to enable the farmer to know the composition and approximate commercial value of the costly manures that are so largely consumed in our State.

"But what is equally important is to know the *agricultural value* of these fertilizers or their elements, and their economical adaptation to various soils, crops or circumstances. Numerous inquiries are constantly addressed to the Station relating to these topics, to which in many cases no satisfactory answer can be given. In most instances, however, suitably conducted practical experiments would make it possible to answer these inquiries more or less perfectly, and to make valuable additions to our store of knowledge. There are two methods of making such experiments. They may be carried out on a farming scale for a series of years, as has been done at a few places in Europe, notably by Mr. Lawes of England; but thus conducted, their expense is so great and so long a time must usually pass before the useful results appear, that this method is not open to the Experiment Station unless it were transferred to a farm, and provided with five or six times its present amount of funds. Another plan is to make experiments on a small scale in pots or boxes. This method has indeed some drawbacks, but very many advantages. It requires but little ground. By use of a greenhouse, in this sunny climate, experiments may be carried on nearly throughout the year, their number may be cheaply multiplied and results got in a comparatively short time. Furthermore, the influence of disturbing causes, excess or lack of rain or warmth, the ravages of birds and insects, may be more perfectly avoided. By this method a large number of experiments have been made and are constantly making in the European Stations and in this country. Prof. Storer at the Bussey Institution, Dr. McMurtrie at the Department of Agriculture, Washington, and the writer have obtained useful results by its means.

"To carry on such experiments as a part of Station work would require that the Station should have control of a plot of ground of one or several acres in extent, with unobstructed exposure to sun, and so enclosed as effectually to exclude all intrusion.

"Furthermore, there would be needed a suitable glass plant-house, with heating arrangements, water, etc., and a skillful gardener would have to be added to the working force of the Station.

"The seedsmen of our State are beginning to call upon the Station to test the vitality and purity of their seeds, and to do this at the proper time (in winter) and to the extent which is soon likely to be demanded, a special seed laboratory will be absolutely necessary.

"This experimental ground, furthermore, should be the site of the Station Laboratory, because the experiments to be conducted there would require more or less chemical work to be done in preparing for them and in elaborating their results, and would demand the constant oversight of the Director and his assistants throughout all their duration.

"The Station should also have lodgings for its gardener and for other responsible assistants within its enclosure, to insure the undisturbed progress of its investigations.

"The Station grounds with these buildings cannot be placed beyond the reach of illuminating gas and water-service pipes, without extreme inconvenience to its garden and laboratories. The Station should therefore be permanently located in some city suburb where it will also be readily accessible to the Post, Express and Telegraph Offices. The chemical laboratory of the Station ought to consist of a room somewhat larger than that now occupied, and should have adjoining a capacious store-room and a smaller furnace room. In connection with its office should be suitable accommodation for a considerable library. It would be extremely desirable also to have space for preserving and displaying specimens of objects having agricultural interest, which fall in the line of its investigations, viz: samples of the seeds of useful and injurious plants and a collection of such plants as might be useful for purposes of comparison and identification. The Station has already in its possession a small but valuable collection of seeds, and a pretty complete herbarium of the grasses and sedges of New England. Samples of rocks, soils, crude and native fertilizing materials and agricultural products of various kinds could readily be kept as an instructive exhibition, if but the place were provided.

" A plain brick building with the capacity of a large dwelling house, would give the Station good accommodation in all these respects.

" To carry on the Station thus equipped in a manner commensurate with the interests involved would require some increase of its funds, for several purposes.

1. To enlarge its laboratory outfit, which is barely sufficient for the analytical work it has had to do, but ought to be considerably extended for profitable working.

2. To establish a working reference library. The Station must be vitally defective unless those who labor in it can have ready and constant access to all the special books, journals and Reports which record the results of investigations in the Experiment Stations of other States and Countries.

3. The Station will need a larger fund for current expenses so soon as it begins to experiment in the field, garden and plant-house."

It is, I believe, universally believed by all who are capable of intelligent judgment, that the Experiment Station as now carried on has been of great service to our agriculture, and has saved many times its cost to the State of Connecticut in the single item of Commercial Fertilizers.

It is evident that a continuance of Station work is indispensable in order that our farmers may have the means of knowing with reasonable accuracy, what is offered in the fertilizer market, and what are fair prices for a costly class of goods whose commercial value can only be ascertained by chemical analysis.

But in fact the Experiment Station, if suitably equipped, can do a grander and vastly more profitable work for the State than by the analysis of Commercial Fertilizers.

The virgin soils of the Western Prairies are brought into pressing competition with our rugged and " exhausted " fields by the increasing facilities for cheap transportation, and by the eager industry of the army of immigrants which continually invades our country. During the last twelve months Europe has poured upon us nearly 700,000 men, women and children, mostly reared to habits of assiduous labor, and many of them accustomed to such desperate economies that they are easily able to live on what we commonly throw away.

To maintain our position as a State preëminent in all that has made New England civilization so powerful and beneficent in shaping the destinies of this Republic, it is of the first importance that our farms be developed and worked to their full capacity. This is essential to our manufacturing and commercial interests, for all forms of honest industry reach their highest successes when they are most intimately associated, and to the greatest degree mutually helpful.

That our farms can hold their own against those of the great West, and can in fact derive immense advantage from Western competition is not a matter for doubt.

To do this, however, intelligence must both hold and drive the plow. We must learn and use all the best methods of planting and harvesting, the best modes of making, saving, and applying home manures, the best systems of farm management, of tillage, rotation of crops, cattle feeding, handling of milk, that exist, or that can be devised which suit our circumstances.

In almost every direction in which the farmer prosecutes his search for more light, he is confronted by a darkness which for thousands of years has resisted the utmost efforts of those who have gone before him, and now equally resist his attempts to dispel. He has but one resource left, and that is science, and to judge from the brilliant successes which for the last twenty-five years have fairly crowded each other in our recollection, this resource is equal to the emergency. In fact, now that all other industries have recognized the potency of this means of advancement, the Eastern farmer must either make use of it in self-defence or be driven to the wall.

Science is from its nature peculiarly adapted to flourish among, and to make flourish a free and aspiring people. Science is not necessarily an aristocracy of intellect that condescends to dole out the crumbs of knowledge to the common herd, but is an organization of all available forces for the pursuit of knowledge.

The citizens of Connecticut are, separately, as mere individuals, nearly powerless to maintain peace, order, decency, education, justice, rights to property, or any of the fruits of civilization. But the citizens of Connecticut, organized by the machinery of town, county, State, and Federal Government, and by the institutions of education and religion, not only are able to possess their individual property, rights and enjoyments, but are able through legislation, yearly to attain a fuller measure of prosperity and happiness, as well as a higher capacity for enjoying these blessings; are able also to exercise a magnificent hospitality to the emigrating thousands of other countries, and to defend their firesides and their institutions against the armies of the world.

Just as each citizen of our State and Union, working in our governmental organization, is according to his talent and energy, a potent agent in civil progress, so each farmer and gardener, whether he labors with his own hands for daily bread or directs the labor of others by the toil of his brain, becomes a discoverer when he works under efficient scientific organization, and may have the satisfaction of finding his good ideas and his accurate observations recognized at their true value and usefully incorporated into the common fund of agricultural knowledge.

Science is ready to do for our farming industries, what it has done for our intellectual enjoyments. It is as able to trace the kinds, the sources, and to control the movements of plant-food, to investigate the workings of manure, the effects of tillage or rainfall, the traction of the plough, the rising of cream or any agricultural question, as to guide the ship at sea by magnet and sextant, to transmit messages from town to town or from continent to continent by telegraph or telephone.

But here again the results obtained must be proportioned to the efforts used. Before we can control the production of a crop we must learn in detail what are the exact conditions which, in the plan of nature, invariably work together, and are essential to vegetable growth. To prosecute such studies successfully, is now a comparatively simple matter, but it cannot be done without certain apparatus, and it cannot be done advantageously without various conveniences which are to be had by paying for them, but which cannot be realized by wishing for them. Out of nothing comes nothing.

The splendid successes of gas lighting, of the steam engine, the telegraph, the electric light, of the arts of spinning, weaving and dyeing, of glass and metal manufacture, and, in our own field, of the mowing and reaping machine, have cost long and anxious experimenting and heavy outlay for labor and materials. It cannot be otherwise in respect to most of the unsolved questions that we desire cleared up. In any direction where the investigator can see before him the reasonable possibility of reaching a result that will ensure large pecuniary reward, there is, generally speaking, no difficulty in securing from capitalists any requisite amount of funds for prosecuting investigations. Many of our rich corporations, whose money has been made by scientific investigations, are constantly assisting numberless projects which point with more or less promise to improvement in the processes they employ and to corresponding increase of their gains.

They are able to secure to themselves by patent or by secrecy, the fruit of their outlay. In agriculture, however, we want improvements in a multitude of details which can offer no considerable pecuniary reward to the inventor or discoverer; improvements, many of which in their nature are not patentable and which ought to be made of universal avail to every landholder without restriction or royalty. We know that these improvements and discoveries may be made or their impracticability demonstrated, and we earnestly wish somebody would do it and thus give us relief. But they are not realized, because for the most part they do not offer sufficient inducements to stimulate investigators to work them out. Men who have a genius for discovery labor for some more or less tangible reward, at least the means of comfortable living and enough besides to command books, apparatus, learned society, and the power of gratifying in all ways their passion for seeing, knowing and experimenting. Unless Agriculture can offer some of these inducements, she cannot expect the results to which they lead. Occasionally a man of wealth and scientific tastes like Boussingault in France, Lawes in England, and Valentine in New York, will work or aid work in this direction for the pleasure and the fame of it. Occasionally a College Professor may have energy enough to do something in this line besides carrying the burden of academic duty. But the Experiment Station is the institution that must ultimately be depended upon. The Farmers of Connecticut have wanted it and at their word the State has given it to them. If they want it enlarged, put upon a broader and more practical basis, enabled to do more work and a greater variety of work, they have but to decide upon a plan and submit it to the General Assembly, where it will be passed upon according to its merits.

The initiative taken in this matter by Connecticut has found response in other States. The New Jersey Agricultural Experiment Station was established by Act of Legislature in March, 1880, with an appropriation of $5,000. The Station was located at New Brunswick in connection with the State Agricultural College. On the College Farm provided for that institution some years ago at the expense of the State, the Experiment Station carried out several series of practical feeding trials to test the value of the German

Standard Rations, and to study the nutritive value of ensilage. These investigations* so completely demonstrated the utility of the Experiment Station, that the Legislature of 1881 voted to increase the Station income to $8,000. North Carolina lately has furnished her station with excellent accommodations at public expense. New York is just organizing a station at an outlay of $20,000 per annum.

FERTILIZERS.†

In respect to its terms, the Station makes *two classes* of analyses of fertilizers and fertilizing materials; the first for the benefit of farmers, gardeners and the public generally; the second for the private use of manufacturers and dealers. Analyses of the *first class* are made gratuitously, and the results are published as speedily and widely as possible for the guidance of purchasers and consumers. Those of the *second class* are charged for at moderate rates, and their results are not published in a way to interfere with their legitimate private use. The Station, however, distinctly reserves the liberty to use at discretion, for the public benefit, all results obtained in its Laboratory, and in no case will enter into any privacy that can work against the public good.

During 1881, one hundred and seventy (170) samples of fertilizers have been analyzed. Of these, 44 were examined for private parties, and the remainder, 126, for the general use of the citizens of the State.

The samples analyzed for the public benefit have been sent in from various quarters of the State, in most instances by actual purchasers and consumers, but in some instances by dealers or agents.

All the analyses of the first class are made on samples understood to have been taken in accordance with the printed instructions which the Station supplies to all applicants. Here follows a copy of these instructions.

* For the account of them see subsequent pages of this Report.

† The matter of this and of several subsequent pages, explanatory of the sampling and valuation of fertilizers, is copied with a few appropriate alterations from the Report for 1880.

THE CONNECTICUT
AGRICULTURAL EXPERIMENT STATION.

Instructions for Sampling Commercial Fertilizers.

The *Commercial Value* of a high priced Fertilizer can be estimated, if the amounts *per cent.* of its principal fertilizing elements are known. Chemical analysis of a small sample, so taken as to fairly represent a large lot, will show the composition of the lot. The subjoined instructions, if faithfully followed, will insure a fair sample. Especial care should be observed that the sample neither gains or loses *moisture* during the sampling or sending, as may easily happen in extremes of weather, or from even a short exposure to sun and wind, or from keeping in a poorly closed vessel.

1. Provide a tea cup, some large papers, and for each sample a glass fruit-can or tin box, holding about one quart, that can be tightly closed, all to be clean and dry.

2. Weigh separately at least three (3) average packages (barrels or bags) of the fertilizer, and enter these *actual weights* in the "Form for description of Sample."

3. Open the packages that have been weighed, and mix well together the contents of each, down to one-half its depth, emptying out upon a clean floor if needful, and crushing any soft, moist lumps in order to facilitate mixture, but leaving hard, dry lumps unbroken, so that the sample shall exhibit the texture and mechanical condition of the fertilizer.

4. Take out five (5) equal cupfulls from different parts of the mixed portions of each package. Pour them (15 in all) one over another upon a paper, intermix again thoroughly but quickly to avoid loss or gain of moisture, fill a can or box from this mixture, close tightly, *label plainly*, and send, charges prepaid, to

The Conn. Agricultural Experiment Station,
New Haven, Conn.

The foregoing instructions may be over-nice in some cases, but they are not intended to take the place of good sense on the part of those who are interested in learning the true composition of a fertilizer. Any method of operating that will yield a *fair sample* is good enough.

In case of a fine, uniform and moist or coherent article, a butter-tryer or a tin tube, like a dipper handle, put well down into the packages in a good number of places will give a fair sample with great ease. With dry, coarse articles, such as ground bone, there is likely to be a separation of coarse and fine parts on handling. Moist articles put up in bags or common barrels may become dry on the outside. It is in these cases absolutely necessary to mix thoroughly the coarse and fine, the dry and the moist portions before sampling. Otherwise the analysis will certainly misrepresent the article whose value it is intended to fix.

The quantity sent should not be too small. When the material is fine and uniform, and has been carefully sampled, a pint may be enough, but otherwise and especially in the case of ground bone, which must be mechanically analyzed, the sample should not be *less than one quart.*

It is also important that samples for analysis should be taken at the time when the fertilizer is purchased, and if they cannot be at once dispatched to the Station, they should be so preserved as to suffer no change. Moist fish, blood or cotton seed will soon decompose and lose ammonia, if bottled and kept in a warm place. Superphosphates containing much nitrogen will suffer reversion of their soluble phosphoric acid under similar circumstances. Most of the moist fertilizers will lose water unless tightly bottled, but some of the grades of potash salts will gather moisture from the air and become a slumpy mass if not thoroughly protected.

These changes in the composition of a sample not suitably preserved, must invalidate any conclusions from its analysis, and work serious injustice either to the manufacturer or to the consumer.

It doubtless often happens that a purchaser on laying in a stock of fertilizers, decides that he will not then trouble the Station to analyze the goods he has obtained, but will set aside samples which he can send for examination in case the crops report adversely as to their quality. It is always better to send all samples at once to the Station where they can be directly analyzed or so prepared that they shall keep without chemical change.

With the Instructions for Sampling, the Station furnishes a blank Form for Description of Samples, a copy of which is here given.

THE CONNECTICUT

AGRICULTURAL EXPERIMENT STATION,

NEW HAVEN, CONN.

FORM FOR DESCRIPTION OF SAMPLE.

Station No.---------- Rec'd at Station,---------------18

Each sample of Fertilizers sent for gratuitous analysis must be accompanied by one of these Forms, with the blanks *below* filled out fully and legibly.

The filled out Form, if wrapped up with the sample, will serve as a label.

Send with each sample a specimen of any printed circular, pamphlet, analysis, or statement that accompanies the fertilizer or is used in its sale.

Brand of Fertilizer,--------------------------------------

Name and address of Manufacturer,------------------------

Name and address of Dealer from whose stock this sample is taken,---

Date of taking this sample,-------------------------------

Selling price per ton or hundred, bag or barrel,--------------

Selling weight claimed for each package weighed,------------

Actual weight of packages opened,-------------------------

Here write a copy of any analysis or guaranteed composition that is fixed to the packages.

Signature and P. O. address of person taking and sending the sample.

On receipt of any sample of fertilizer from the open market, the filled out "Form for Description," which accompanies it is filed in the Station's Record of Analyses and remains there as a voucher for the authenticity of the sample and for the fact that it has been taken fairly, or, at least under suitable instructions. It is thus sought to insure that manufacturers and dealers shall not suffer from the publication of analyses made on material that does not correctly represent what they have put upon the market.

The "Form for Description" when properly filled out, also contains all the data of cost, weight, etc., of a fertilizer which are necessary for estimating, with help of the analysis, the commercial value of its fertilizing elements, and the fairness of its selling price. Neglect to give full particulars occasions the Station much trouble, and it is evident that want of accuracy in writing up the Description may work injustice to the manufacturers or dealers as well as mislead consumers. It is especially important that the *Brand* of a fertilizer and its *Selling price* should be correctly given. The price should be that actually charged by the dealer of whom it is bought, and if the article be purchased in New York or other distant market, that fact should be stated and the cost at the nearest point to the consumer, on rail or boat, should be reported also.

In all cases, when possible, *ton-prices* should be given, and if the sale of an article is only by smaller quantities, that fact should be distinctly mentioned.

When a sample of fertilizer has been analyzed, the results are entered on a printed form, which is filed in the Station Record of Analyses, facing the "Description of Sample" that was received with the fertilizer to which it pertains, and there remains for future reference.

A copy of the analysis is also immediately reported to the party that furnished the sample, the report being entered on one page of another printed form and facing a second printed page of "Explanations" intended to embody the principles and data upon which the valuation of fertilizers is based.

These Explanations are essential to a correct understanding of the analyses that are given on subsequent pages and are therefore reproduced here, as follows:

EXPLANATIONS OF FERTILIZER-ANALYSIS AND VALUATION.

Nitrogen is commercially the most valuable fertilizing element. It occurs in various forms or states. *Organic nitrogen* is the nitrogen of animal and vegetable matters generally, existing in the albumen and fibrin of meat and blood, in the uric acid of bird dung, in the urea and hippuric acid of urine, and in a number of other substances. Some forms of organic nitrogen, as that of blood and meat, are highly active as fertilizers; others, as that of hair and leather, are comparatively slow in their effect on vegetation unless these matters are reduced to a fine powder or chemically disintegrated. *Ammonia* and *nitric acid* are results of the decay of *organic nitrogen* in the soil and manure heap, and are the most active forms of Nitrogen. They occur in commerce—the former in sulphate of ammonia, the latter in nitrate of soda.

17 parts of ammonia, or 66 parts of pure sulphate of ammonia, contain 14 parts of nitrogen.

85 parts of pure nitrate of soda also contain 14 parts of nitrogen.

Soluble Phosphoric acid implies phosphoric acid or phosphates that are freely soluble in water. It is the characteristic ingredient of Superphosphates, in which it is produced by acting on "insoluble" or "reverted" phosphates with oil of vitriol. It is not only readily taken up by plants, but is distributed through the soil by rains. Once well incorporated with soil it shortly becomes reverted phosphoric acid.

Reverted (*reduced or precipitated*) *Phosphoric acid* strictly means phosphoric acid that was once freely soluble in water, but from chemical change has become insoluble in that liquid. It is freely taken up by a strong solution of ammonium citrate, which is therefore used in analysis to determine its quantity. "Reverted phosphoric acid" implies phosphates that are readily assimilated by crops, but generally have less value than soluble phosphoric acids, because they do not distribute freely by rain.

Insoluble Phosphoric acid implies various phosphates not freely soluble in water or ammonium citrate. In some cases the phosphoric acid is too insoluble to be rapidly available as plant food. This is true of South Carolina rock phosphate, of Navassa phosphate, and especially of Canada apatite. The phosphate of coarse raw bones is at first nearly insoluble in this sense, because of the animal matter of the bone which envelopes it, but when the latter decays in the soil, the phosphate remains in essentially the "reverted" form.

Potash signifies the substance known in chemistry as potassium oxide, which is the valuable fertilizing ingredient of "potashes" and "potash salts." It is most costly in the form of sulphate, and cheapest in the shape of muriate or chloride.

The Valuation of a Fertilizer signifies estimating its worth in money, or its trade-value; a value which, it should be remembered, is not *necessarily* proportional to its fertilizing effects in any special case.

Plaster, lime, stable manure and nearly all the less expensive fertilizers have variable prices, which bear no close relation to their chemical composition, but guanos, superphosphates and other fertilizers, for which $30 to $80 per ton are paid, depend chiefly for their trade-value on the three substances, *nitrogen*, *phosphoric acid* and *potash*, which are comparatively costly and steady in price. The money-value per pound of these ingredients is easily estimated from the market prices of the standard articles which furnish them to commerce.

The average Trade-values, or cost in market per pound, of the ordinarily occurring forms of nitrogen, phosphoric acid and potash, as found in the Connecticut and New York markets, and employed by the Station during 1881, have been as follows:

TRADE-VALUES FOR 1881.

	Cents per pound.
Nitrogen in nitrates,	26
" in ammonia salts,	22½
" in Peruvian Guano, fine steamed bone, dried and fine ground blood, meat and fish, superphosphates and special manures,	20
" in coarse or moist blood, meat or tankage, in cotton seed, linseed, and Castor Pomace,	16
" in fine ground bone, horn and wool dust,	15
" in fine medium bone,	14
" in medium bone,	13
" in coarse medium bone,	12
" in coarse bone, horn shavings, hair and fish scraps,	11
Phosphoric acid soluble in water,	12½
" " "reverted" and in Peruvian Guano,	9
" " insoluble, in fine bone and fish guano,	6
" " " in fine medium bone,	5½
" " " in medium bone,	5
" " " in coarse medium bone,	4½
" " " in coarse bone, bone ash and bone black,	4
" " " in fine ground rock phosphate,	3½
Potash in high grade sulphate,	7½
" in low grade sulphate and kainite,	5½
" in muriate or potassium chloride,	4½

These "trade-values" of the elements of fertilizers are not fixed, but vary with the state of the market, and are from time to time subject to revision. They are not exact to the cent or its fraction, because the same article sells cheaper at commercial or manufacturing centers than in country towns, cheaper in large lots than in small, cheaper for cash than on time. These values are high enough to do no injustice to the dealer, and properly interpreted, are accurate enough to serve the object of the consumer.

To Estimate the Value of a Fertilizer we multiply the per cent. of Nitrogen, etc., by the trade-value per pound, and that product by 20; we thus get the values per ton of the several ingredients, and adding them together we obtain the total estimated value per ton.

In case of *Ground bone*, the fineness of the sample is graded by sifting, and we separately compute the nitrogen value of each grade of bone which the sample contains, by multiplying the pounds of nitrogen per ton in the sample, by the per cent. of each grade, taking one one-hundredth of that product, multiplying it by the estimated value per pound of nitrogen in that grade, and taking this final product as the results in cents. Summing up the separate values of each grade, thus obtained, together with the values of each grade for phosphoric acid, similarly computed, the total is the estimated value of the sample of bone. For further particulars, see page 39.

The uses of the "Valuation" are, 1st, to show whether a given lot or brand of fertilizer is worth as a commodity of trade what it costs. If the selling price is no higher than the estimated value, the purchaser may be quite sure that the price is reasonable. If the selling price is but $2 to $3 per ton more than the estimated value, it may still be a fair price; but if the cost per ton is $5 or more over the estimated value, it would be well to look further. 2d, Comparisons of the estimated values and selling prices of a number of fertilizers will generally indicate fairly which is the best for the money. But the "estimated value" is not to be too literally construed, for analysis cannot always decide accurately what is the *form* of nitrogen, etc., while the mechanical condition of a fertilizer is an item whose influence cannot always be rightly expressed or appreciated.

The Agricultural value of a fertilizer is measured by the benefit received from its use, and depends upon its fertilizing effect, or crop-producing power. As a broad, general rule, it is true that

Peruvian guano, superphosphates, fish-scraps, dried blood, potash salts, plaster, etc., have a high agricultural value which is related to their trade-value, and to a degree determines the latter value. But the rule has many exceptions, and in particular instances the trade-value cannot always be expected to fix or even to indicate the agricultural value. Fertilizing effect depends largely upon soil, crop and weather, and as these vary from place to place and from year to year, it cannot be foretold or estimated except by the results of past experience, and then only in a general and probable manner.

For the above first-named purpose of valuation, the trade-values of the fertilizing elements which are employed in the computations should be as exact as possible, and should be frequently corrected to follow the changes of the market.

For the second-named use of valuation, frequent changes of the trade-values are disadvantageous, because two fertilizers cannot be compared as to their relative money-worth, when their valuations are estimated from different data.

Experience leads to the conclusion that the trade-values adopted at the beginning of a year should be adhered to as nearly as possible throughout the year, notice being taken of considerable changes in the market, in order that due allowance may be made therefor. It should be remembered that, in an Annual Report, the fluctuations in trade-value that may occur within the year cannot be accurately followed, and the comparisons of estimated values are mostly in retrospect.

Analyses and Valuations of Fertilizers.

The classification of the Fertilizers analyzed in the Station Laboratory from January 1st to Nov. 1st, 1881, is as follows:

9 plain (non-nitrogenous) superphosphates.
44 nitrogenous ("ammoniated") superphosphates and guanos.
24 special fertilizers, or "formulas."
18 bone manures.
11 dried blood and tankage.
14 fish manures.
1 tortoise shell saw dust.
7 castor pomace and cotton seed meal.
2 night soil and Pollard's night soil fertilizer.
11 potash salts.

2 nitrate of soda.
1 salt.
2 land plaster.
5 ashes.
1 refuse lime.
1 limestone.
2 marls (one styled " bird guano").
3 soap boilers' refuse.
1 mussel bed.
2 swamp muck.
9 miscellaneous, private.
———
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Plain (non-nitrogenous) Superphosphates.

These fertilizers are either prepared by treating bone black (calcined bones, see p. 67) or some high grade native phosphate with sulphuric acid, or are the result of a manufacturing process by which low grade phosphates, such as South Carolina rock, are concentrated. None of them contain any essential quantity of "bone" in the usually received and proper sense of that word, as is proved by the nearly total absence of nitrogen. Sample **554**, being designated "Dissolved Ground Bone," was analyzed for nitrogen and 0.21 per cent. of that element was found. All the samples made from bone black contain a similar quantity of nitrogen, but this nitrogen is of little or no fertilizing value.

Of the nine samples examined during 1881, seven are of excellent and nearly uniform quality, most of their phosphoric acid being soluble in water. Two are exceptional; of these, **634** is an excellent fertilizer containing a total of 19½ per cent. of phosphoric acid, of which 18¼ per cent. is available, although 8½ per cent. is not soluble in water. **554**, the only sample whose cost exceeds valuation, was not well prepared and contained 4.2 per cent. of insoluble phosphoric acid.

The average cost of soluble phosphoric acid, viz: 11.1 cents in the six best samples whose price is given, is well within the valuation, 12½ cents, that has been hitherto employed by the Station.

It is a fact that has been made conspicuous in former reports that soluble phosphoric acid is most cheaply and most certainly obtained in the high grade non-nitrogenous (not ammoniated) superphosphates and the increased attention given to that class of fertilizers during 1881 is encouraging evidence that consumers are studying the wants of their soils more carefully than has formerly been the custom.

Sample **635** is from one of the sets of fertilizers supplied for experimental purposes as suggested by Prof. Atwater. It is of unexceptionable quality for its purpose.

For Analyses, etc., see pp. 28 and 29.

Nitrogenous Superphosphates, Guanos,* etc.

Under this heading are reported the various commercial fertilizers, except so-called "special fertilizers" which have been analyzed at the Station, that contain, or are claimed to contain any considerable amount of phosphoric acid soluble in water, and also of nitrogen.

This list includes 16 "phosphates," and "superphosphates," variously designated, 8 "guanos" native and manufactured, 2 "Matfield Fertilizers," 2 "Mapes' Complete Manures," an "animal fertilizer," a "fish and potash" and a "bone dissolved in sulphuric acid," making a total of 31. "Thirteen other analyses of superphosphates have been made for private use. Of these fertilizers, 24 contain potash in smaller or larger quantity.

In the table they are arranged in the order of the excess of estimated value over cost or of cost over estimated value.

For Analyses, etc., see pp. 30, 31, 32 and 33.

The percentage of *chlorine* is an indication as to whether muriate of potash or kainite has been used in the manufacture. 35½ parts of chlorine in muriate of potash correspond to 47 of potash. High grade sulphate of potash is free or nearly free from chlorine.

The "comparison of different samples of the same (or similar) brand," see page 34, mostly explains itself. Dickenson's superphosphate, a new article, manifests much more fluctuation in composition and value than will probably appear when the manufacturing process becomes settled by experience.

Peruvian guano now varies in value unpleasantly. The ancient rich deposits it is said are quite exhausted. What comes into market is therefore presumably of inferior value. Rumor has it also that very inferior or adulterated shipments from England have been coming to this country for disposal, and consumers would do well not to purchase without guaranty of composition.

* For "The Bird Guano and Fertilizer" see page 58.

NON-NITROGENOUS SUPERPHOSPHATES.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
622	Pure Dissolved Bone, 15%.	H. J. Baker & Bro., New York.	Manufacturers.	J. J. Webb, Hamden.
623	Superphosphate of Lime, or Pure Dissolved Bone Phosphate.	Geo. B. Forrester, New York.	"	" "
615	Superphosphate. Export brand.	Mapes F. & P. G. Co., New York.	" Hartford Branch.	T. N. Bishop, Plainville.
578	English Phosphate.	Imported by H. J. Baker & Bro.	Wilson & Burr, Middletown.	J. M. Hubbard, Middletown.
592	Bone Superphosphate (Export).	Mapes F. & P. G. Co.	Manufacturers, Hartford Br'ch.	C. E. Bunce, Manchester.
634	Dissolved Bone Black.	Bowker Fertilizer Co., Boston and New York.	Henry D. Torrey, Putnam.	W. I. Bartholomew, Putnam.
663	Bone Superphosphate.	Mapes F. & P. G. Co.	Manufacturers, Hartford Br'ch.	Sampled by the Station.
554	Cooke's Dissolved Ground Bone.	Manufactured for E. F. Cooke by Bowker Fertilizer Co.	G. P. Jennings, Green's Farms.	Geo. P. Jennings.
635	Dissolved Bone Black.	Mapes F. & P. G. Co., New York.	Manufacturers, Hartford Br'ch.	W. I. Bartholomew, Putnam.

Non-Nitrogenous Superphosphates.

Station No.	Name.	Soluble Phos. Acid.	Reverted Phos. Acid.	Insoluble Phos. Acid.	Estimated value per ton.	Cost per ton.	Valuation exceeds cost.
622	H. J. Baker's Pure Dissolved Bone,	13.66	0.99	1.14	$37.30	$30.00	$7.30
623	G. B. Forrester's Superphosphate of Lime,	12.25	0.70	0.85	32.91	28.50	4.41
615	Mapes' Superphosphate (Export Brand),	13.51	1.66	.82	37.75	34.00	3.75
578	H. J. Baker's English Phosphate,	13.18	1.30	.90	36.37	33.00	3.37
592	Mapes' Bone Superphosphate (Export),	12.99	2.58	.55	37.76	36.00	1.76
634	Bowker's Dissolved Bone Black,	9.92	8.35	1.29	41.38	40.00	1.38
663	Mapes' Bone Superphosphate,	13.41	1.54	.70	37.14	36.00	1.14
554	Cooke's Dissolved Ground Bone,	7.40	2.01	4.20	*28.00	31.00	Cost exceeds valuation. 3.00
635	Mapes' Dissolved Bone Black,	14.18	.36	.51	36.71	----	Cost not known.
	Average, disregarding **634** and **554** as exceptional,	13.31	1.30	.78	$36.56	$32.91	

The average cost of soluble phosphoric acid, excluding **634** and **554**, is 11.1 cts. per lb.

* Including 0.21 per cent. Nitrogen, valued above at 84 cts., but probably not worth it.

Nitrogenous Superphosphates, Guanos, etc.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
662	Pure Fine Bone dissolved in Sulphuric Acid.	Mapes Formula & Peruvian Guano Co.	Mapes F. & P. G. Co., Hartford Branch.	Dr. E. H. Jenkins.
557	Bone Phosphate.	David Dickenson, Middle Haddam.	David Dickenson, Mid. Haddam.	D. Dickenson.
627	Superphosphate.	" " "	" " "	D. Dickenson.
577	Bone Phosphate.	" " "	" " "	H. L. Stewart, Middle Haddam.
558	Ammoniated Bone Phosphate.	" " "	" " "	D. Dickenson.
581	Phosphate.	Geo. H. Harris & Son, Eagleville.	G. H. Harris & Son.	G. H. H. & Son.
604	Peruvian Guano.	Hobson, Hurtado & Co., N. Y.	R. B. Bradley & Co., New Haven.	Experiment Station.
633	G. W. Miller's Raw Bone Phosphate.	G. W. Miller, Middlefield.		G. W. Miller.
586	E. Frank Coe's Phosphate.	E. F. Coe, N. Y.	Simon Banks, Southport.	G. P. Jennings, Southport.
576	Ammoniated Bone Phosphate.	David Dickenson, Middle Haddam.	David Dickenson, Mid. Haddam.	H. L. Stewart, Middle Haddam.
610	Superphosphate.	Lombard & Matthewson, Warrenville.	Buck & Durkee, Willimantic.	N. P. Perkins, Willimantic.
611	Darling's Animal Fertilizer.	L. B. Darling & Co., Pawtucket, R. I.	J. A. Lewis.	W. H. Barrows, Willimantic.
568	Soluble Nitrogenous Phosphate.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	C. E. Bunce, So. Manchester.
673	Special Phosphate.	G. W. Miles Co., Milford.	Geo. W. Miles Co.	J. W. Nettleton, Milford.
671	Bowker's Hill and Drill Phosphate.	Bowker Fertilizer Co., New York and Boston.	E. B. Clark, Orange.	" " "

NITROGENOUS SUPERPHOSPHATES, GUANOS, ETC.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and sent by
598	Mapes' Complete Manure for Heavy Soils.	Mapes Formula & Peruvian Guano Co.	Mapes F. & P. G. Co., Hartford Branch.	C. E. Bunce, South Manchester.
567	Pine Island Guano.	Quinnipiac Fertilizer Co., New London.	Olds & Whipple, Hartford.	" "
601	Soluble Nitrogenous Superphosphate.	Quinnipiac Fertilizer Co.	R. B. Bradley & Co., New Haven.	Experiment Station.
672	Ammoniated Bone Superphosphate.	Geo. W. Miles Co., Milford.	G. W. Miles Co.	J. W. Nettleton, Milford.
590	Ammoniated Bone Phosphate.	Rafferty & Williams, N. Y.	F. Ellsworth, Hartford.	C. E. Bunce.
603	Pine Island Guano.	Quinnipiac Fertilizer Co.	R. B. Bradley & Co., New Haven.	Experiment Station.
661	Soluble Pacific Guano.	Pacific Guano Co., Boston, Mass.	H. A. Stillman & Co., Hartford.	" "
602	Fish and Potash.	Quinnipiac Fertilizer Co.	R. B. Bradley & Co., New Haven.	" "
594	Mapes' Complete Manure.	Mapes Formula & Peruvian Guano Co., N. Y.	Mapes F. & P. G. Co.	C. E. Bunce.
556	Cooke's Blood Guano.	Bowker Fertilizer Co., for Ed. F. Cooke, N. Y. City.	Geo. P. Jennings, Southport.	G. P. Jennings.
565	Soluble Pacific Guano.	Pacific Guano Co., Boston, Mass.	H. A. Stillman & Co., Hartford.	C. E. Bunce.
550	No. 1. Peruvian Guano.		Seth Chapman, N. Y. City.	J. W. Hemingway, Plainville.
619	Matfield Fertilizer, No. 2.	Matfield Fertilizer Co., Boston.	Matfield Fertilizer Co.	T. S. Gold, West Cornwall.
589	No. 1. Standard Peruvian Guano.	Hobson, Hurtado & Co., N. Y.	F. Ellsworth, Hartford.	C. E. Bunce.
561	Mitchell's Standard Phosphate.		H. A. Stillman & Co., Hartford.	"

Nitrogenous Superphosphates, Guanos, etc.

Station No.	Name.	Nitrogen of Nitrates.	Nitrogen of Ammonia Salts.	Nitrogen of Organic Matters.	Soluble Phos. Acid.	Reverted Phos. Acid.	Insoluble Phos. Acid.	Potash.	Chlorine.	Estimated Value per ton.	Cost per ton.	Valuation exceeds Cost.
662	Mapes' Pure Fine Bone dissolved in Sulphuric Acid,	----	----	2.74	1.65	19.34	3.16	----	----	$53.69	$42.00	$11.69
557	Dickenson's Bone Phosphate,	----	----	3.23	7.87	7.92	3.11	0.15	----	50.71	40.00	10.71
627	" Superphosphate,	----	----	3.97	5.04	9.12	3.96	0.47	0.32	50.07	40.00	10.07
577	" Bone Phosphate,	----	----	3.38	4.57	8.88	4.73	----	----	46.61	40.00	6.61
558	" Ammoniated Bone Phosphate,	----	----	3.54	3.90	9.90	2.18	0 52	----	44.92	40.00	4.92
581	Harris' Phosphate,	----	----	2.93	4.88	7.07	2.72	----	----	39.91	36.00	3.91
604	Peruvian Guano,	----	----	6.28	3.32	7.03	11.44	2.77	3.04	62.29	60.00	2.29
												Cost exceeds Valuation.
633	G. W. Miller's Raw Bone Phosphate,	----	----	3.41	2.60	6.59	3.61	5.09	----	43.97	44.25	0.28
586	E. Frank Coe's Phosphate,	----	----	2.34	7.49	2.11	2.69	----	----	35.12	36.00	0.88
576	Dickenson's Ammoniated Bone Phosphate,	----	----	3.24	1.68	9.66	2.54	----	----	37.59	40.00	2.41
610	Lombard & Matthewson's Superphosphate,	----	----	2.91	2.27	7.42	5.70	----	----	37.51	40.00	2.49
611	Darling's Animal Fertilizer,	----	0.46	3.63	0.58	5.89	7.14	6.47	6.33	38.74	42.00	3.26
568	Quinnipiac Fertilizer Co's Soluble Nitrogenous Phosphate,	----	----	2.41	5.70	4.61	1.16	2.70	2.84	36.01	40.00	3.99
593	"A" Brand Mapes' Complete Manure,	0.42	0.32	1.56	3.40	7.53	2.27	3.25	3.18	37.55	42.00	4.45
673	G. W. Miles Co's Special Phosphate,	----	0.40	2 06	5.98	0.97	2.00	7.17	6.36	35.39	40.00	4.61
671	Bowker's Hill and Drill Phosphate,	----	----	2.40	5.40	2.16	4.60	2.49	2.02	34.75	40.00	5.25

Nitrogenous Superphosphates, Guanos, etc.

Station No.	Name.	Nitrogen of Nitrates.	Nitrogen of Ammonia Salts.	Nitrogen of Organic Matters.	Soluble Phos. Acid.	Reverted Phos. Acid.	Insoluble Phos. Acid.	Potash.	Chlorine.	Estimated Value per ton.	Cost per ton.	Cost exceeds Valuation.
598	Mapes' Complete Manure for Heavy Soils,	----	3.95	1.62	2.27	5.68	3.08	2.80	3.02	$46.37	$52.00	$5.63
567	Pine Island Guano,	----	----	4.20	5.34	1.93	0.52	2.94	1.08	38.65	45.00	6.35
601	Quinnipiac Fertilizer Co's Superphosphate,	----	---	2.88	1.22	7.80	2.35	1.72	1.70	32.98	40.00	7.02
672	G. W. Miles Co's Ammoniated Bone Superphosphate,	----	0.39	1.81	6.55	1.01	2.14	3.46	3.70	32.68	40.00	7.32
590	Rafferty & Williams' Ammoniated Bone Phosphate,	----	----	2.00	8.05	1.23	1.38	2.53	2.24	34.54	42.00	7.46
603	Pine Island Guano,	----	----	4.58	3.04	3.31	1.07	2.83	0.96	37.41	45.00	7.59
661	Soluble Pacific Guano,	0.62	----	1.74	7.29	1.52	3.42	1.76	1.76	36.83	45.00	8.17
602	Fish and Potash,	----	----	3.56	0.19	3.52	3.16	3.20	4.40	27.73	36.00	8.27
594	Mapes' Complete Manure for Sandy Soils,	1.27	2.99	1.10	1.44	4.38	2.01	6.68	7.54	44.36	53.00	8.64
556	Cooke's Blood Guano,	----	----	2.49	6.16	1.97	5.14	2.26	----	37.11	46.00	8.89
565	Soluble Pacific Guano,	----	----	2.61	5.90	1.36	4.05	2.28	2.45	35.36	45.00	9.64
550	No. 1. Peruvian Guano,	----	----	5.57	3.23	4.33	8.62	2.40	6.75	50.16	60.40†	10.24
619	Matfield Fertilizer, No. 2,	----	----	1.57	----	----	0.52	3.70	4.69	10.23	25.00‡	14.77
589	No. 1. Standard Peruvian Guano,	----	---	6.73	2.28	4.56	4.70	2.94	9.00	50.05	66.00	15.95
561	Mitchell's Standard Phosphate,	----	----	1.06	0.14	5.08	2.19	----	----	16.36	40.00	23.64
	Average of 31 samples,									39.21	43.32	

† In Plainville. ‡ In Boston.

COMPARISON OF DIFFERENT SAMPLES OF THE SAME (OR SIMILAR) BRAND OF SUPERPHOSPHATE, &c.

		Nitrogen.	Soluble Phos. Acid.	Revert. Phos. Acid.	Insol. Phos. Acid.	Potash.	Estim. Value.	Cost.
David Dickenson's Superphosphate,	**557**	3.23	7.87	7.92	3.11	0.15	$50.71	$40.00
	627	3.97	5.04	9.12	3.96	0.47	50 07	40.00
	577	3.38	4.57	8.88	4.73	-- -	46.61	40.00
	558	3.54	3.90	9.90	2.18	0.52	44.92	40.00
	576	3.24	1.68	9.66	2.54	----	37.59	40.00
Peruvian Guano,	**604**	6.28	3.32	7.03	11.44	2.77	62.29	60.00
	550	5.57	3.23	4.33	8.62	2.40	50.16	60.40
	589	6.73	2.28	4.56	4.70	2.94	50.05	66.00
Soluble Pacific Guano,	**661**	2.36*	7.29	1.52	3.42	1.76	36.83	45.00
	565	2.61	5.90	1.36	4.05	2.28	35.36	45.00
Quinnipiac Fertilizer Co's Superphosphate,	**568**	2.41	5.70	4.61	1.16	2.70	36.01	40.00
	601	2.88	1.22	7.80	2.35	1.72	32.98	40.00
Pine Island Guano,	**567**	4.20	5.34	1.93	0.52	2.94	38.65	45.00
	603	4.58	3.04	3.31	1.07	2.83	37.41	45.00
Mapes' Complete Manure, "A" Brand	**593**	2.30	3.40	7.53	2.27	3.25	37.55	42.00
Mapes' Complete Manure, For heavy soils	**598**	5.57	2.27	5.68	3.08	2.80	46.37	52.00
Mapes' Complete Manure, For light soils	**591**	5.36	1.44	4.38	2.01	6.68	44.36	53.00

* Including 0.62 in form of nitrates.

The more complete analysis of No. 1 Peruvian guano, sample **550**, is as follows:

Volatile and organic matters and water,	29.77
(Containing nitrogen 5.57.)	
Ash,	70.23
	100.00

The Ash consists of

Sand and matters insoluble in acid,	10.15
Oxide of Iron,	1.08
Lime,	13.58
Magnesia,	2.10
Potash,	2.40
Soda,	11.39
Phosphoric Acid,	16.18
Sulphuric Acid,	8.14
Chlorine,	6.75
	71.77
Deduct Oxygen equivalent to Chlorine,	1.54
	70.23

Peruvian Guano formerly used to contain not more than one to two per cent. each of soda, sulphuric acid, and chlorine. The above sample contains these bodies in much larger quantities, corresponding to about 13 per cent. of sulphate of soda and 11 per cent. of common salt. The presumption is therefore very strong that these cheap chemicals are now used to "extend" or adulterate the Guano.

The three "Mapes' Complete Manures" are distinct brands claiming different composition and selling by the manufacturers at different prices. Two of them are also included among the special manures, p. 36.

The average cost of these fertilizers, $43, exceeds the average estimated value, ($39.00), by $4.00 in round numbers. Last year the average cost of 21 samples was $39, and the average estimated value $36. Purchasers of Mitchell's Standard Phosphate have been paying a standard price for a very poor article, if sample **561** fairly represents the brand.

Special Fertilizers or Formulas.

Of this class 26 samples have been analyzed. Two of these, viz: **593** and **594**, have been also included among superphosphates, etc. A single one of all these samples has an estimated value far above its cost. The cost of a dozen of them comes within $4.00 of estimated value. The cost of the remaining 13 exceeds estimated value from $4.50 to $22.

There are very good reasons why the individual farmer should endeavor to adapt manures to his special crops. Where large tracts of land of uniform quality have been cropped and handled alike for years there is propriety in trying to compose a fertilizer specially applicable to that land or to different classes of crops on it; but for the farmers of Connecticut at large, whose crops and soils are as diverse in their needs as well can be, to suppose that it is possible to make fertilizers that have any universal adaptation to different crops is downright nonsense. That the "formulas" now offered to farmers are the roughest guess-work is capitally illustrated by the table on page 38. There it is seen, by comparing "the highest and lowest per cent.," that the four brands of "Corn Manure" that have been in the Connecticut market, range in content of nitrogen from 3.6 to 6.2 per cent., in "available" phosphoric acid from 2. to 11.4 per cent., and in potash from 4.6 to 14.6 per cent. Greater variety is found in the five kinds of

Special Fertilizers.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sent by
518	Potato Manure.	H. J. Baker & Bro., N. Y.	H. J. Baker & Bro.	S. C. Hardin, Glastonbury.
520	Turnip "	" " "	" " "	" " "
522	Wheat "	" " "	" " "	" " "
647	Corn "	G. B. Forrester, N. Y.	S. B. Wakeman, Saugatuck.	J. B. Nash, Saugatuck.
643	Oat "	" " "	" " "	" " "
519	Onion "	H. J. Baker & Bro.	H. J. Baker & Bro.	S. C. Hardin.
637	Corn "	G. B. Forrester.		M. S. Baldwin, Naugatuck.
588	Special Onion Manure.	" "	S. B. Wakeman.	G. P. Jennings, Green's Farms.
523	Cabbage Manure.	H. J. Baker & Bro.	H. J. Baker & Bro.	S. C. Hardin.
648	Strawberry "	G. B. Forrester.	S. B. Wakeman.	S. B. Wakeman.
521	Oat "	H. J. Baker & Bro.	H. J. Baker & Bro.	S. C. Hardin.
517	Tobacco "	" "	" " "	" "
665	" " Conn. Brand.	Mapes Formula and Peruvian Guano Co., N. Y. and Hartford.	Mapes F. & P.G. Co., Hartford Br.	E. H. Jenkins.
593	Turnips, Peas, Beans, Buckwheat. (Mapes Com. Manure, "A" Brand).	Mapes Formula and Peruvian Guano Co., N. Y. and Hartford.	" " "	C. E. Bunce.
587	Special Manure.	G. B. Forrester.	S. B. Wakeman.	G. P. Jennings.
646	Potato "	" "	" "	J. B. Nash.
649	Onion "	" "	" "	S. B. Wakeman.
597	Potato "	Mapes F. & P. G. Co.	Mapes F. & P. G. Co.	C. E. Bunce, So. Manchester.
596	Corn "	" "	" "	" " "
645	" " Stockbridge.	Bowker Fertilizer Co., N. Y.	Hubbell & Wakeman, Saugat'k.	J. B. Nash.
594	Early Vegetables, Onions, Hops. (Mapes Com. Man. for sandy soils).	Mapes F. & P. G. Co.	Mapes F. & P. G. Co.	C. E. Bunce.
650	Potato Manure, Stockbridge.	Bowker Fertilizer Co., N. Y.	Hubbell & Wakeman, Saugat'k.	J. B. Nash.
606	Grain " "	" " "	R. B. Bradley & Co., N. Haven.	Experiment Station.
620	Corn Fertilizer.	Matfield Fertilizer Co., Boston.	Matfield Fertilizer Co.	T. S. Gold, West Cornwall.
605	Potato Manure, Stockbridge.	Bowker Fertilizer Co.	R. B. Bradley & Co.	Experiment Station.
618	" Fertilizer.	Matfield Fertilizer Co.	Matfield Fertilizer Co.	T. S. Gold.

Special Fertilizers.

Station No.	Name.	Nitrogen of Nitrates.	Nitrog'n of Ammonia Salts.	Nitrog'n of Organic matters.	Total Nitrogen.	Soluble Phos. Acid.	Revert. Phos. Acid.	Insoluble Phos. Acid.	Potash.	Chlorine.	Estimated value per Ton.	Cost per Ton.	Valuation exceeds cost.
518	Potato Manure, Baker's	----	2.77	4.61	7.38	1 71	4.58	2.42	12.92	4 23	$60.54	$46.50	$14.04
520	Turnip " "	----	5.47	0.77	6.24	2.30	3.72	1.69	10.56	3.32	53.79	52.00	1.79
522	Wheat " "	----	4.66	1.55	6.21	4.15	1.96	1.17	5.93	1 93	49.00	47.50	1.50
647	Corn " Forrester's	----	4.58	----	4.58	6.62	1.33	0.37	6.63	2.79	49.94	49.00	0.94
643	Oat " "	----	4.79	----	4.79	4 95	1.04	0.33	8.61	3.29	49.13	49.00	0.13
													Cost exceeds Valuation.
519	Onion Manure, Baker's	----	4.08	0.94	5.02	2.30	3.91	1.39	9.55	2.75	47.08	47.50	0.42
637	Corn " Forrester's	----	5.25	0.25	5.50	4.90	0.74	0.44	8.67	----	46.54	47.50	1.04
588	Special Onion Manure, Forrester's	----	5.42	----	5.42	5.09	0.75	0.08	6.76	1.12	46.70	48.00*	1.30
523	Cabbage Manure, Baker's	----	4.35	0.77	5.12	1.56	3.97	1.18	10.01	3.61	46.14	48.00	1.86
648	Strawberry " Forrester's	----	3.20	0.23	3.43	6.31	0.77	0.21	6.45	0.66	42.42	44.50	2.08
521	Oat " Baker's	----	3.66	0.75	4.41	1.33	4.10	2.08	11.12	3.44	44.91	47.50	2.59
517	Tobacco " "	----	4.01	0.42	4.43	0.45	4.71	1.28	11.98	4.23	44.05	47.50	3.45
665	" " Conn. Brand, Mapes'	2.52	1.95	0.39	4.86	3.29	2.32	1.85	7.42	1.14	49.20	53.00	3.80
593	Turnips, Peas, Beans, Buckwheat (Mapes Complete Manure, "A" Brand.)	0.42	0.32	1.56	2.30	3.40	7.53	2.27	3.25	3.18	37.55	42.00	4.45
587	Special Manure, Forrester's	----	4.32	----	4.32	4.30	1.07	0.37	9.05	4.53	42.52	48.00*	5.48
646	Potato " "	----	3.38	----	3.38	4.88	0.56	0.28	9.50	0.66	43.10	49.00	5.90
619	Onion " "	----	5.06	----	5.06	3.98	0.50	0.42	6.30	0.42	43.57	49.50	5.93
597	Potato " Mapes'	1.32	1.50	0.59	3.41	4.62	5.64	1.22	5.00	4.72	43.63	50.00	6.37
596	Corn " "	0.62	2.21	0.80	3.63	2.30	7.14	2.60	5.67	6.14	43.19	50.00	6.81
645	" " Stockbridge	----	0.31	3.73	4 04	5.46	1.35	1.97	5.29	2.33	42.70	50.00	7.30
594	Early Vegetables, Onions and Hops (Mapes' Com. Manure for sandy soils.)	1.27	2.99	1.10	5.36	1.44	4.38	2.01	6.68	7.54	44.36	53.00	8.64
650	Potato Manure, Stockbridge	----	0.24	3.08	3.32	5.54	1.29	1.93	4.85	2.21	39.17	50.00	10.83
606	Grain " "	----	0.28	2.92	3.20	6.04	1.42	0.13	5.89	6.32	36.06	50.00	13.94
620	Corn Fertilizer, Matfield	----	---	4.82	4.82	1.32	1.63	0.63	5.28	5.52	31.02	45.00	13.98
605	Potato Manure, Stockbridge	---	0.29	2.72	3.01	6.26	0.54	0.13	4.93	5.60	33.76	50.00	16.24
618	" Fertilizer, Matfield	0.66	----	1.55	2.21	2.63	0.38	0.13	6.53	14.14	22.93	45.00	22.07

* At New York.

COMPARISON OF SPECIAL CORN, POTATO AND ONION MANURES.

Station No.	Name.	Year.	Nitrogen.	Phos. acid sol. and rev.	Potash.	Crop.
137	Stockbridge.	1878	5.9	5.4	6.6	Corn.
195	"	1878	6.2	3.8	7.0	
407	"	1880	4.7	6.0	6.8	
N. J.	"	1880	4.8	7.2	6.2	
476	Matfield.	1880	6.1	2.0	5.3	
620	"	1881	4.8	3.0	5.3	
379	Mapes.	1880	3.7	10.2	7.2	
N. J.	"	1880	4.0	11.4	4.6	
N. J.	"	1880	3.9	6.5	7.7	
596	"	1881	3.6	9.4	5.7	
300	Forrester.	1879	5.5	5.3	13.1	
421	"	1880	4.8	6.0	14.6	
643	"	1881	4.6	8.0	8·6	
637	"	1881	5.5	5.6	8.7	
	highest	per cent.	6.2	11.4	14.6	
	lowest	"	3.6	2.0	4.6	
146	Stockbridge.	1878	3.5	6.4	10.2	Potato.
260	"	1879	3.8	7.0	8.8	
409	"	1880	4.1	5.9	8.1	
417	"	1880	3.8	5.2	8.0	
Mass.*	"	1879	4.4	3.8	7.6	
650	"	1881	3 3	6.8	4.9	
605	"	1881	3.0	6.8	4.9	
116	Forrester.	1878	5.7	7.6	11.4	
282	"	1879	4.6	5.5	9.1	
304	"	1879	4.8	5.3	10.3	
420	"	1880	4.8	5.4	11.3	
646	"	1881	3.4	5.4	9.5	
128	Mapes.	1878	3.7	4.5	14.8	
376	"	1880	3.9	8.6	7.7	
597	"	1881	3.4	10.3	5.0	
618	Matfield.	1881	2.6	3.0	6.5	
518	Baker's.	1881	7.4	6.3	12.9	
	highest	per cent.	7.4	10.3	14.8	
	lowest	"	2.6	3.0	4.9	
258	Stockbridge.	1879	3.9	6.4	8.3	Onion.
363	"	1880	3.1	5.3	7.9	
259	Mapes.	1879	5.7	6.2	7.5	
594	"	1881	5.4	5.8	6.7	
301	Forrester.	1879	7.4	4.5	7.4	
416	"	1880	7.4	4.6	7.3	
588	"	1881	5.4	6.8	6.8	
619	"	1881	5 1	4.5	6.3	
519	Baker's.	1881	5.0	6.2	9.6	
	highest	per cent.	7.4	6.8	9.6	
	lowest	"	3.1	4.5	6.3	

"Potato Manure," nitrogen ranging from 2.6 to 7.4, phosphoric acid from 3. to 10.3, and potash from 4.9 to 14.8 per cent. The highest per cents. in the Corn and Potato Manures respectively, are but slightly different, and the same is true of the lowest per cents.

Bone Manures.

Method of Valuation.

The method adopted for the valuation of bone manures has been already outlined on page 20. Further details are here given, in part reproduced from former Reports.

Experience has led us to distinguish, for the purpose of valuation, five grades of ground bone, the proportions of which are found by a mechanical analysis, *i. e.*, by passing a weighed sample of the bone through a system of four sieves. These five grades have the dimensions, and during 1881, have had the trade-values below specified, viz:

Grade.	Dimensions.	1881. Estimated value per pound. Nitrogen.	Phos. Acid.
Fine,	smaller than one $\frac{1}{50}$ inch,	15 cts.	6 cts.
Fine medium,	between $\frac{1}{50}$ and $\frac{1}{25}$ inch,	14 "	$5\frac{1}{2}$ "
Medium,	" $\frac{1}{25}$ and $\frac{1}{12}$ inch,	13 "	5 "
Coarse medium,	" $\frac{1}{12}$ and $\frac{1}{6}$ inch,	12 "	$4\frac{1}{2}$ "
Coarse,	larger than $\frac{1}{6}$ inch,	11 "	$3\frac{1}{2}$ "

The chemical and mechanical analysis of a sample of ground bone being before us, we separately compute the nitrogen value of each grade of bone which the sample contains, by multiplying the pounds of nitrogen per ton in the sample by the per cent. of each grade, taking $\frac{1}{100}$th of that product, multiplying it by the estimated value per pound of nitrogen in that grade, and taking this final product as the result in cents. Summing up the separate values of each grade, thus obtained, together with the values of each grade for phosphoric acid, similarly computed, the total is the estimated value of the sample of bone.

The following may serve as an example of the valuation of a bone manure by this method. G. W. Miller's Pure Ground Bone, **632**, contained phosphoric acid 23.21 per cent. or 464.2 pounds per ton, and nitrogen 3.95 per cent. or 79 pounds per ton. By the mechanical analysis it showed:

42	per cent.	fine.
33	"	fine medium.
22	"	medium.
3	"	coarse medium.
0	"	coarse.

The calculations are as follows:

79 × 42 ÷ 100 × 15 =	$4.98
79 × 33 ÷ 100 × 14 =	3.64
79 × 22 ÷ 100 × 13 =	2.26
79 × 3 ÷ 100 × 12 =	.28
Estimated value of nitrogen=	$11.16
464.2 × 42 ÷ 100 × 6 =	$11.71
464.2 × 33 ÷ 100 × 5½ =	8.42
464.2 × 22 ÷ 100 × 5 =	5.11
464.2 × 3 ÷ 400 × 4½ =	.63
Estimated value of phosphoric acid=	$25.87
Total estimated value=	$37.03

This result agrees with the cost ($36.00) within $1.03.

When the sample of bone contains foreign matters introduced as preservatives, dryers or adulterants, such as salt, salt-cake, niter-cake, ground oyster-shells, spent lime, plaster, or soil, these must be taken account of in the mechanical analysis, especially since they would be likely, on sifting, to pass chiefly or entirely into the finer grades. Lister's Bone usually, and this year Rafferty & Williams' Bone, contain a considerable, or even a large, percentage of salt-cake; of sample 552, 48 per cent. passed the finest sieve, but the sample yielded to water 38 per cent. of soluble matter, chiefly salt-cake, which mostly passed the finer sieves. In such cases, the several grades as obtained by sifting must be separately examined and the amounts of foreign matter which they contain must be suitably taken into the account if an exact valuation is desired.

In some instances a further source of error in valuation may arise from the fact that the proportions of nitrogen and phosphoric acid are not the same in the finer and coarser portions of a sample, which contains no adulterants, properly speaking, but partly consists of meat, tendon, etc.

There is, however, a limit beyond which it is useless to attempt to refine the processes of valuation. When they become too complicated or costly they defeat the object which they should serve. It is sufficient that the errors of valuation are no greater than those which arise from unavoidable variations in different portions of the same lot of fertilizer, or in different lots of the same brand. A difference of two or three dollars between cost and estimated value cannot ordinarily demonstrate that either is out of the way.

Analyses of Bone Manures.

(See Tables on pp. 42 and 43.)

Of the eighteen samples of ground bone here reported, but four fall in value seriously below their cost. These four are Lister's Celebrated Ground Bone, and Rafferty & Williams' Bone Meal. These two articles contain large and variable quantities of moisture and salt-cake or sulphate of soda. (In **552** 12.2 per cent. water, and 38.3 soluble matters, mostly salt-cake; in **553** 7.3 per cent. water and 17.2 soluble matter; in **607**, 24 per cent. soluble matters.) Doubtless the nitrogen and phosphoric acid in these brands are more soluble and active than in raw bone, and this fact should enhance the estimated value. On the other hand, the pulverized salt-cake which passes the fine sieves by our mode of reckoning tends to increase the estimated value, so that the figures given for the latter are probably not far from correct.

On soils which need or are benefited by sulphates, the salt-cake in these articles has a value not to be overlooked. Perhaps they may sometimes be strikingly useful because of the presence of sulphate of soda, as might be expected on land in grass, where plaster operates well, but they may also often work injuriously from containing so much soluble salts, especially if applied with seed in the hill or drill.

"Peter Cooper's Pure Bone" contains so much less nitrogen than other brands of pure bone, because it has been boiled or steamed for the glue manufacture. The boiling has removed all the fat or grease, and also a good share of the peculiar animal matter of the bone (ossein) which dissolves in hot water as glue or gelatine, and which contains all the nitrogen. The residual bone pulverizes easily, and, by the loss of animal matter, is rendered relatively richer in phosphoric acid.

Some entertain the notion that grease in ground bone is a sign of goodness. This is true to a degree, since fresh raw bone is greasy, while old bones that have been exposed to the weather and bones which have been boiled or steamed are not greasy. It is again true that weathered bones and boiled bones are not so rich in nitrogen as fresh raw bones. On the other hand grease is not a fertilizer, and while the extraction of grease is accompanied

Bone Manures.

Station No.	Name or Brand.	Manufacturer.	Dealer.	Sampled and Sent by
666	Pure Bone Saw Dust.	G. W. Dickenson, Essex.	Chas. A. Sill, Saybrook.	T. S. Gold, West Cornwall.
658	Bone Turning Chips.	" " "	" " "	" " "
657	Ivory Dust.	" " "	" " "	" " "
519	Bone Saw Dust.	Holyoke Bone Co., Holyoke, Ms.	Holyoke Bone Co.	J. W. Hemingway, Plainville.
585	Peter Cooper's Pure Bone.	Peter Cooper, N. Y.	Simon Banks, Southport.	G. P. Jennings, Green's Farms.
632	Pure Ground Bone.	G. W. Miller, Middlefield.		G. W. Miller.
582	Bone. Sample No. 1.	G. H. Harris & Son. Eagleville.	G. H. Harris & Son.	G. H. H. & Son.
545	Quinnipiac Coarse Bone.	Quinnipiac Co., Wallingford.		J. W. Yale. Meriden.
677	Peck Brothers' Ground Bone.	Peck Brothers, Northfield.	G. P. Burnett, Bristol.	S. R. Gridley, Bristol.
581	Strictly Pure Ground Bone.	G. B. Forrester, New York City.	S. B. Wakeman, Saugatuck.	G. P. Jennings, Green's Farms.
555	Pure Ground Bone.	Stevens & Draper, Long Hill.	G. P. Jennings.	" " "
614	Ground Bone.	G. B. Forrester.		J. H. Robinson, Saugatuck.
569	Pure Bone Meal.	Mapes' Formula and Peruvian Guano Co., N. Y.	Mapes' F. & P. G. Co.	C. E. Bunce, So. Manchester.
583	Bone. Sample No. 2.	G. H. Harris & Son, Eagleville.	G. H. H. & Son.	G. H. H. & Son.
553	Celebrated Ground Bone.	Lister Bros., Newark. N. J.	Simon Banks, Southport.	G. P. Jennings.
670	Bone Meal.	Rafferty & Williams, N. Y.	S. A. Weldon & Son, Bristol.	S. R. Gridley, Bristol.
607	Celebrated Ground Bone.	Lister Bros., Newark.	R. B. Bradley & Co., N. Haven.	Experiment Station.
552	Commonwealth Bone Meal.	Rafferty & Williams, N. Y.	Rafferty & Williams.	Staples, Coley & Co., Westport.

Bone Manures.

Station No.	Name.	Nitrogen.	Phos. Acid.	Finer than $\frac{1}{50}$ inch.	Finer than $\frac{1}{25}$ inch.	Finer than $\frac{1}{12}$ inch.	Finer than $\frac{1}{6}$ inch.	Coarser than $\frac{1}{6}$ inch.	Estimated value per ton.	Cost per ton.	Valuation exceeds Cost.
666	G. W. Dickenson's Pure Bone Saw Dust	2.15	19.21	95.2	4.8	---	---	---	$29 40	$20.00	$9.40
658	G. W. Dickenson's Bone Turning Chips	3.73	25.97	27.6	29.0	27.4	12.8	3.2	37.83	30.00	7.83
657	G. W. Dickenson's Ivory Dust	3.38	26.86	52.0	20.5	18.5	9.0	---	39.54	35.00	4.54
549	Holyoke Co's Bone Saw Dust	3.72	25.67	75.8	19.6	4.6	---	---	41.00	37.00*	4.00
585	Peter Cooper's Pure Bone	1.40	29.92	51.0	15.0	13.0	15.0	6.0	36.48	35.00†	1.48
632	G. W. Miller's Pure Ground Bone	3.95	23.21	42.0	33.0	22.0	3.0	---	37.03	36.00	1.03
582	Harris' Bone. Sample No. 1	4.05	21.88	2.0	2.0	8.0	34.0	54.0	28.33	28.00	0.33
											Cost exceeds Valuation.
545	Quinnipiac Co's Coarse Bone	3.84	22.32	13.0	10.0	12.0	15.0	50.0	29.94	30.00	$0.06
677	Peck Bro's Ground Bone	4.32	21.89	7.2	13.9	17.2	33.4	28.3	31.24	32.00	0.76
584	Forrester's Strictly Pure Ground Bone	4.18	21.80	16.0	14.0	36.0	34.0	---	33.04	34.50	1.46
555	Stevens & Draper's Pure Ground Bone	4.09	21.03	15.0	25.0	30.0	30.0	---	32.41	34.00	1.59
614	Forrester's Ground Bone	4.01	20.95	27.0	27.0	35.0	11 0	---	33.41	35.00	1.59
569	Mapes' Pure Bone Meal	2.46	27.46	100.0	---	---	---	---	40.33	42.00	1.67
583	Harris' Bone. Sample No. 2	3.66	17.74	3.0	8.0	17.0	27.0	45.0	24.68	28.00	3.32
553	Lister's Celebrated Ground Bone	3.44	14.19	28.0	20.0	17.0	17.0	18.0	23.61	31.00	7.39
670	Rafferty & Williams' Bone Meal	1.68	14.36	52.0	20.0	14.0	14.0	---	20.67	32.00‡	11.33
607	Lister's Celebrated Ground Bone	3.02	9.54	31.0	19.0	14.0	17.0	19.0	17.80	30.00	12.20
552	Rafferty & Williams' Commonwealth Bone Meal	1.48	12.11	48.5	20 8	12.6	10.7	7.4	17.36	30.00§	12.64

* At Plainville; $35.00 at Holyoke. † In Southport on time; $33.00 in New York. ‡ At Bristol. § At New York.

by more or less loss of nitrogen, this loss is partly or perhaps fully compensated by the greater friability, porosity, and more ready decomposability of the boiled bone. The bones whose grease is gone, absorb water more readily, and therefore enter into putrefactive decay more quickly and feed vegetation more promptly than fresh raw bones. If grease in ground bone is too much relied on as a test of good quality, probably no long time will transpire before "pure bone" that has been boiled and possibly mixed with plaster and crushed oyster shells, will be greased in order to give it the semblance of genuineness.

Bones, slightly boiled to extract grease, probably are not injured for fertilizing use. Bones from which much gelatine has been removed are reduced in commercial value, but are still an excellent fertilizer when they are to be had at a fair price.

The first four articles in the table are perhaps not quite so much better than those below them as the valuation would indicate. In the bone saw dust which is prepared under water and dried for market, there is liable to be a large and variable quantity of moisture. The bone saw dust, turning chips and ivory dust, are all made from the most dense and close textured material, and for that reason would be slower in action than average bone of equal fineness.

On the whole, leaving out of consideration both of the exceptional extremes, the cost and estimated values of the bone manures agree as well as could be reasonably expected.

Dried Blood and Tankage.

Four samples of refuse from New Haven slaughter houses gave the subjoined results on analysis.

Station No.	Name.	Manufacturer.	Sampled and sent by
625	Dried Blood.	S. E. Merwin & Son, New Haven.	J. J. Webb, Hamden.
626	Dried Blood and Tankage.	Strong, Barnes, Hart & Co., New Haven.	" "
630	Dried Blood.	Sperry & Barnes, New Haven.	E. P. Augur, Middlefield.
631	" "	Strong, Barnes, Hart & Co., New Haven.	E. P. Augur, Middlefield.

Analyses.

	625	626	630	631
Nitrogen	6.81	7.03	6.93	8.06
Phosphoric Acid	9.58	6.16	7.32	3.80
Estimated Value per Ton	$38.74	$35.51	$36.50	$36.80
Cost per Ton	30.00	35.00	30.00	35.00
Valuation exceeds Cost	8.74	0.51	6.50	1.80

Six other samples of higher grade, made from blood and meat, or scrap (cracklings), and more thoroughly dried, were analyzed for private parties with results as follows:—

Station No.	Name.	Water.	Nitrogen.	Ammonia equiv. to Nitrogen.
529	Dried Blood	23.62	12.48	15.15
528	Ammonite	7.00	11.79	14.32
531	"	6.87	11.28	13.69
533	"	4.69	12 01	14.59
540	"	5.23	11.95	14.51
546	Azotin	11.84	12.03	14.40

Fish Manures.

Fish Scrap has been comparatively scarce in the retail market, most of the supply being consumed by manufacturers of super-phosphates. Below are given analyses of two samples taken from open market. The remaining twelve analyses were made for dealers, mostly on cargo samples, and are here quoted as a contribution to the statistics of this branch of Connecticut industry.

No. **566**, made by the Quinnipiac Fertilizer Co., New London, sold by Olds & Whipple, Hartford, was sampled by C. E. Bunce, South Manchester.

No. **600**, made by the Quinnipiac Fertilizer Co., sold by R. B. Bradley & Co., New Haven, was sampled by the Station.

Fish Scrap.

Station No.	Name.	Water.	Nitrogen.	Ammonia equiv. to Nitrogen.	Nitrogen in water-free Fish.	Phos. Acid.	Estimated Value per ton.	Cost per ton.
566	Dry Ground Fish,	-----	8.54	----	----	6.96	$42.51	$45.00*
600	" "	-----	6.17	----	----	5.32	31.06	45.00
512	Fish,	18.78	7.58	9.21	9.33			
514	"	45.58	4.79	5.82	8.80			
515	"	50.94	4.97	6.03	10.13			
591	"	39.35	----	----	----			
636	"	25.37	7.41	9.00	9.93			
639	"	-----	6.83	8.30	----	6.83		
641	"	14.42	9.29	11.28	10.85			
651	"	12.46	8.69	10.55	9.93			
653	"	17.84	7.01	8.51	8.53	6.53		
654	"	40.49	5.13	6.23	8.62	5.12		
534	"	15.00	7.41	9.00	8.72			
548	"	14.62	7.23	8.78	8.47			
	Average for 1881,	26.80	7.00	8.43	9.33			
	" 1880,	17.99	8.11	9.85	9.89			
	" 1879,	19.13	7.70	9.34	9.46			
	" 1878,	14.90	7.65	9.24	7.91			
	" 1877,	13.66	8.24	10.01	9.36			
	" 1875–6,	11.78	7.80	9.47	8.84			

Tortoise Shell Saw Dust.

551, Tortoise Shell Sawdust, made by F. S. Johnson, Plainville, Ct., sent by J. W. Hemingway, Plainville.

* Calculated from price per cwt.

ANALYSIS.

Nitrogen	14.72
Phosphoric Acid	trace
Estimated value per ton	$32.38
Cost per ton	30.00

This animal product has probably about the same value as horn and hair in a corresponding state of sub-division. Its nitrogen is reckoned at 11 cts. per lb. in the above valuation.

Castor Pomace and Cotton Seed Meal.

Castor Pomace.

No.	Made by	Sold by	Sent by
563	H. J. Baker & Bros., N. Y.	Buckland & Hardin, Glastonbury.	C. E. Bunce, So. Manchester.
564	" " "	Olds & Whipple, Hartford.	C. E. Bunce.
621	" " "	------------------	H. J. Baker & Bros.
660	" " "	------------------	H. Y. Castner & Bro., N. Y.

Cotton Seed Meal.

No.	Made by	Sold by	Sent by
579	B. G. Stanton, New London, Conn.	Coles & Weeks, Middletown.	J. M. Hubbard, Middletown.
580	?	Wilson & Burr, Middletown.	J. M. Hubbard, Middletown.
629	?	W. F. Fuller, Suffield.	H. H. Austin, Suffield.

Analyses.

	Castor Pomace.				Cotton Seed Meal.		
	563	**564**	**621**	**660**	**579***	**580**	**629**
Nitrogen,	5.08	5.47	4.43	4.74	3.56	6.01	6.80
Phos. Acid,	1.60	1.61	1.40	1.56	1.70	1.70	3.27
Potash,	1.12	0.99	1.07	0.97	1.57	1.20	2.00
Estimated value per ton,	$18.97	20.32	16.82	17.91	14.84	22.35	27.48
Cost per ton,	$25.00	25.00	-----	22.50	30.00	21.00	30.00

* No. **579** contains the almost worthless hulls.

The price of Castor Pomace has advanced since last year by $3–5 per ton. The composition remains about the same. In case of Cotton Seed Meal the price has not advanced, but an inferior article, **579** has been put upon the market. This grade of meal, which contains the black hulls, can be distinguished by close inspection from the better meal that is ground from decorticated cotton seed.

Night Soil.

543 received March 15th, from Wm. Burr, Fairfield.

This sample represents the material gathered from village privies during cold weather in the spring season. For comparison the analysis of a sample from a large quantity taken in the village of New Canaan in 1859 is given.

Chemical Analyses of Night Soil.

	Fairfield. 543	New Canaan.
Water,	53.06	66.74
Organic Matter,*	11.62	17.68
Sand, soil and coal ashes,	29.76	8.59
Potash,	.21	.65
Soda,	.26	
Lime,	.82	2.27
Magnesia,	.60	
Iron oxide and alumina,	1.79	2.69
Phosphoric acid,	1.41	1.38
Sulphuric acid,	.39	
Chlorine,	.08	
	100.00	100.00
*With Nitrogen,	.74	.87

No closer agreement could be expected in two samples of this material than is seen in the above analyses. The greater quantity of lime found in the New Canaan sample might have come from a sprinkling of oyster shells or the like. The large admixture of sand, soil and coal ashes is what can hardly be avoided.

The most valuable fertilizing elements of the night soil, viz: nitrogen, phosphoric acid and potash may be bought in other forms in the fertilizer market for 22½ cts., 9 cts. and 7 cts. per pound respectively. The highest commercial value of these ingredients in 100 pounds of night soil, **543,** is as follows:—

Nitrogen,	0.74 × 22½	cts.=	16.6 cts.
Potash,	0.21 × 7	" =	1.5 "
Phos. acid,	1.41 × 9	" =	12.7 "
Total			29.8 "

The other substances present do not materially add to the value, and the commercial worth of the night soil is not more than 30 cts. per 100 pounds, or $6.00 per ton, on the most favorable reckoning.

Pollard's Improved Night-Soil Fertilizer.

In the Station report for 1880 were given the analyses of two samples of "Concentrated Privy Guano," said to be manufactured by Pollard and Cook, of Providence. These samples were brought to the Station by a party who gave his name and address as F. C. Cook, 119 Ellsworth Avenue, New Haven. These samples had an estimated value of $129 per ton, and while flavored with night soil, were essentially mixtures of chemicals too costly for agricultural use. It was perfectly evident that "there was a mouse in the meal," and the question at once arose whether the Station should act as detective, or by giving rope possibly become hangman. It was decided to give rope; the analyses were mailed to the address given, and as stated in the last Report were made use of by Pollard in a swindling tour at the South.

During the present year Mr. F. C. Cook called upon the writer in company with several respectable citizens of New Haven, who appeared as his vouchers, and stated that he did not bring or send the samples of Privy Guano, and at the time they were sent knew nothing of them whatever. Mr. Cook further stated that he had negotiated with H. M. Pollard, and had bought of the same the right to make the "Patent Improved Night Soil Fertilizer," and also stated that it was his belief that it was Pollard in person who brought to the Station the samples of "Privy Guano," and used without authorization, his (Mr. Cook's) name upon the Station form for description of the samples.

Mr. Cook further wished to know whether the "Improved Night Soil Fertilizer," the patent right for manufacturing which had become his property, was worth manufacturing. If not he desired to have done with it. The patent directs to mix fresh night soil with burned plaster and various other ingredients, and

Mr. Cook having taken the trouble to prepare a quantity in the best manner, it has been submitted to analysis by the Station with the figures subjoined, the writer desiring to give full investigation to any scheme for utilizing materials that are going to waste.

The results of the analysis plainly demonstrate that night soil, at its best, is not rich enough to warrant manufacturing by the Pollard process, and show, what was indeed sufficiently evident without the analysis, that the Pollard Patent has no real value.

Analysis of Improved Night Soil Fertilizer.

544, made by F. C. Cook, New Haven, according to the specifications of the Pollard Patent.

Moisture,				15.70
Organic and Volatile Matters,*				14.80
Hydrated Sulphate of Lime, (same as unburned plaster or gypsum,)	containing	Water,	13.42	
		Sulphuric Acid,	29.81	64.10
		Lime,	20.87	
Lime as carbonate or phosphate,				.90
Magnesia " "				.29
Potash " "				.59
Soda " "				.73
Iron Oxide,				.83
Phosphoric Acid,				1.25
Chlorine,				trace
Sand,				.81
				100.00

* With Nitrogen, 1.19

The sample contains at least 95 per cent. of matters that have no fertilizing value with exception of the plaster, which is commercially worth $6 per ton, or 30 cts. per 100 lbs. The value of the other ingredients is nothing commercially except in case of

Potash	worth 7 cts. per lb.	=	4	cts. for	$\frac{6}{10}$ lb.	
Phosphoric Acid	" 9 "	=	11¼	"	1¼ "	and
Nitrogen	" 22½ "	=	27	"	1⅕ "	
Add for Plaster,			20	"	64 "	and
We have the *total value*,			62¼	cts. per 100 lbs.		

The commercial value per ton is accordingly $12.50, or, exclusive of plaster, $8.50, a sum insufficient to pay the cost of manufacturing and handling. If the manufacture were undertaken with the common run of privy night soil, the value would be $2–$3 less per ton, as appears from the valuation of sample **543**.

Potash Salts.

The muriates, with but two exceptions, are equal or superior to guarantee, and average 51 per cent. of potash, or 81 per cent. of muriate. The average cost of potash is $4.14 per 100 lbs., but the fluctuations of cost amount in the extreme to $1.06 per 100 lbs. The average cost is well within the Station valuation of 4½ cts.

The single sample of high grade sulphate cost within 15 cents of the estimated value. In kainite, potash has been held as high as in the 81 per cent. sulphate, kainite selling for $18 and $20 per ton, while the wholesale quotations in New York have ranged from $6.50 to $9.

Potash Salts.

Muriates.

Station No.	Importer.	Dealer.	Sampled by
560	Mapes Formula and Peruvian Guano Co., N. Y.	Mapes F. & P. G. Co.	C. E. Bunce, So. Manchester.
572	Bowker Fertilizer Co., N. Y.	Wilson & Burr, Middletown.	J. M. Hubbard, Middletown.
595	Mapes F. & P. G. Co.	Mapes F. & P. G. Co.	C. E. Bunce.
608	" " "	" " "	C. Fairchild, Middletown.
609		Wilson & Burr.	C. Fairchild, Middletown.
616	Mapes F. & P. G. Co.	Mapes F. & P. G. Co.	T. N. Bishop, Plainville.
624	H. J. Baker & Bro., N. Y.		J. J. Webb, Hamden.

Sulphate.

559	Mapes F. & P. G. Co.	Mapes F. & P. G. Co.	C. E. Bunce.

Kainite.

571	Rafferty & Williams, N. Y.	F. Ellsworth, Hartford.	C. E. Bunce.
659*			
664	Mapes F. & P. G. Co.	Mapes F. & P. G. Co.	E. H. Jenkins.

* Private analysis.

Potash Salts.—*Analyses, etc.*

	Muriates.							
	560	**572**	**595**	**608**	**609**	**616**	**624**	Average.
Potash (potassium oxide),	45.87	49.02	51.21	53.91	50.16	53.25	54.26	
Equivalent to puro muriate,	72.65	77.63	81.11	85.30	79.40	84.34	86.04	
Potash guaranteed or implied in brand,	50.50	50.5 to 53.7	----	50.50	50.50	53.00	52.50	
Muriate guaranteed,	80.00	80-85	----	80.00	80.00	84.00	83.00	
Cost per ton,	$42.00	45.00	42.00	38.00	42.50	42.00	44.00	
Estimated Value per ton,	$41.28	44.12	46.09	48.52	45.14	47.92	48.83	
Cost per 100 lbs. of potash,	$4.58	4.59	4.10	3.52	4.23	3.94	4.05	4.14

POTASH SALTS.—ANALYSES.

	Sulphate.	Kainite.		
	559	571	659	664
Potash (potassium oxide),	43.23	12.51	12.08	12.68
Equivalent to pure Sulphate,	79.95	23.20	-----	-----
Chlorine,	0.88	27.23	-----	26.08
Potash guaranteed or implied in brand,	43.81	11.90 to 14.06	-----	13.00
Sulphate guaranteed,	81.00	-----	-----	-----
Cost per ton,	$65.00	20.00	-----	18.00
Calculated value per ton,	$64.85	13.75	-----	13.95
Cost of Potash per 100 lbs.,	$7.52	8.00	-----	7.10

NITRATE OF SODA.

642. Nitrate of Soda, imported by The Mapes Formula & Peruvian Guano Co., New York and Hartford; sent by J. W. Hemingway, Plainville, Ct.

675. Cargo sample, analyzed for private parties.

Analyses.	642	675
Nitrate of Soda,	95.90	95.21
Moisture,	3.00	2.73
Salt,		1.19
Undetermined matters,	1.10	.87
	100.00	100.00
Nitrogen in nitrate,	15.79	15.68

Cost of **642** in New York, $12.75 per 300 lbs., or $4.25 per 100 lbs.

Cost of Nitrogen in **642** per lb., 26.9 cents.

The ruling *wholesale prices* in New York are $3.12 to $3.25 per 100 lbs. The latter corresponds to 21 cts. per lb. for Nitrogen.

SALT.

570. Salt, manufactured by the Onondaga Salt Co., Syracuse, N. Y.; sold by Bronson & Fitzgerald, Hartford; sampled by C. E. Bunce.

Pure Salt (Chloride of Sodium),	93.60
Moisture and impurities,	6.40
	100.00
Cost per ton,	$10.00

Land Plaster.

562. Plaster, manufactured by G. A. Loudon, Berlin, Ct., sold by Olds & Whipple, Hartford, and sent by C. E. Bunce, South Manchester, Ct.

628. Plaster, manufactured and sent by Peck Brothers, Northfield, Ct.

Analyses.

	562	628
Sand and insoluble matters,	2.50	2.95
Carbonates, etc., by difference,	1.93	1.01
Hydrated Sulphate of Lime (pure gypsum),	95.57	96.04
	100.00	100.00
Cost per ton,	$9.00	$7.50

Lime-Kiln Ashes.

494. Lime-kiln ashes from New York State.

507. Lime-kiln ashes from stock of Ralph Barber, Rockville. Sampled and sent by H. A. Slater, North Manchester.

542. "Ashes from factories in Canada." Sample sent February 10th, by George F. Chapin, Thompsonville, from J. Thayer, dealer, Boston, Mass.

Lime-kiln ashes are the mixture of wood ashes and lime, which comes from the fire places in lime kilns, where wood is used as fuel. **494** and **507** were sent to the Station as lime-kiln ashes, and doubtless are fair samples of their class.

	494	507	542
Sand and matters insoluble in acids,	} 10.23	2.75	} 4.84
Silica,		1.32	
Char,		4.98	2.98
Carbonic acid,	} 29.40*	24.81	7.05
Moisture expelled at 212°,		2.15	1.00
Combined Water,		4.64*	13.46*
Oxide of iron and alumina,	3.73	.22	.57
Lime,	50.53	53.85	67.42
Magnesia,	3.19	1.30	1.28
Potash,	1.74	1.94	.23
Soda,	.55	.73	.42
Phosphoric acid,	.63	1.31	.38
Sulphuric acid,	undet.	undet.	.37
	100.00	100.00	100.00
Cost per bushel,	?	20 cts.	

* Includes loss in analysis.

Analyses.

Sample **494** was analyzed for private use, and the Station has no information as to cost, etc.

Both **494** and **507** have a composition more nearly like that of leached ashes than anything of common occurrence with which they can be compared. From leached ashes they differ in containing little or no moisture, and about 20 per cent. more lime. They agree more closely with leached ashes in the proportion of alkalies, magnesia and phosphoric acid present, although their potash is more and their phosphoric acid less than leached ashes commonly contain. Of the lime, in sample **507**, about 31 per cent. exists united to the carbonic acid, making 56 per cent. of carbonate of lime; about 14 per cent. is united to water, forming 19 per cent. of slacked lime; and the remaining 8 per cent. is present as quick-lime. The sample contains, therefore, about 83 per cent. of lime and its carbonate and hydrate. These ashes are, in fact, unleached wood ashes mixed with four to six times their weight of partly slacked and carbonated lime. They must be used with caution, but if properly applied will no doubt prove a valuable fertilizer on some soils.

Sample **542** was offered at Thompsonville as "Canada ashes." In it the 7 per cent. of carbonic acid is united to 9 per cent. (in round numbers) of lime, making about 16 per cent. of carbonate of lime. The combined water is united to about 42 per cent. of the lime, making 55 per cent. of hydrate of lime (slacked lime) and the remainder of the lime—16 per cent.—exists as quick-lime. Accordingly the sample contains 87 per cent. of lime and its carbonate and hydrate. It contains also 9 per cent. of sand, char, oxide of iron and moisture, leaving 2.7 per cent. of magnesia, alkalies, phosphoric acid and sulphuric acid.

These "ashes from factories in Canada" are, in fact, lime, so slightly admixed with wood ashes, as not to differ essentially from oyster-shell lime in composition or value whether commercial or agricultural. The presence of so much caustic and slacked lime renders this sample very unlike ashes in its action on the soil. From their presence in such large quantity this material might occasion serious loss if applied to growing crops or to land ready to plant. The name is misleading and fraudulent, and evidently we have a material which will scarcely pay the farmers of Connecticut to transport from the "factories in Canada," or rather from Boston, where it is believed to have originated.

The weight of the struck bushel of **542** is about 55 lbs., its commercial value is not far from that of an equal weight of slacked oyster-shell or other cheap lime. The other samples must be reckoned at about the same commercial value. Their agricultural value must be estimated as that of lime, and not that of leached ashes.

Cotton Seed Ashes.

505 sample received from G. Balloch, dealer, 90 Broad street, New York.

Analysis.

Silica and sand,	12.55
Oxide of iron and alumina,	3.54
Lime,	7.52
Magnesia,	11.06
Potash (sol. in water, 17.18 per cent.),	29.40
Sulphuric acid,	2.27
Phosphoric acid (sol. in am. citrate, 5.13 per cent.),	17.72
Carbonic acid,	7.63
Chlorine,	.22
Char,	1.42
Water,	5.67
Combined water and loss,	1.05
	100.05
Deduct oxygen equivalent to chlorine,	.05
	100.00

This is an excellent fertilizer. Reckoning its potash at 4½ cts., and phosphoric acid at 6 cts., the sample has a value of $47.72 per ton. The analysis does not, however, fully establish the availability of these ingredients. Evidently some 12 per cent. of the potash is present in the form of silicate insoluble in water, and a considerable amount of phosphoric acid is of uncertain solubility. Mr. Balloch was unable to put any price on the ashes and they do not appear to have come into market to any noteworthy extent. Should they do so the Station will give them further investigation.

Leached Ashes.

652, Canada Ashes. Sampled and sent by Robert S. Cone, Moodus, from lot of 1,000 bushels purchased of James A. Bill, Lyme. Part of cargo (8,000 bushels) of barge A. P. Wright.

Analysis.

	652
Sand and matters insoluble in acid, Silica,	8.61
Char,	2.27
Carbonic acid.	23.42
Moisture, Combined water,	24.25
Oxide of iron and alumina,	1.49
Lime,	34.65
Magnesia,	2.68
Potash,	1.05
Soda,	.50
Phosphoric acid,	.88
Sulphuric acid,	.20
	100.00
Cost per bushel,	17 cts.

The sample accords well in composition with those formerly analyzed at this Station. The lime exists mostly as carbonate, and is therefore without injurious action on vegetation. This fertilizer appears to be very popular in Connecticut, the importations from Canada direct, during 1881, having amounted to about 250,000 bushels.

Refuse Lime from Beet Sugar Works.

516. This sample was sent in December, 1880, by Edgar Stoughton, Esq., of South Windsor, and came from the Franklin Beet Sugar works, in Massachusetts.

Analysis.

Moisture,	42.19
Carbonic acid, organic matter* and water,	23.99
Lime,	19.85
Potash,	.32
Phosphoric acid,	3.10
Undetermined matter,	10.55
	100.00
Estimated value, per ton,	$9.30
* With nitrogen,	.44

In Bulletin 51, dated Jan. 27, 1881, the lime in this sample was valued at $1.59. At the present advanced price of lime at New Haven it would be worth $2.38, which would bring the total value of **516** to $10.10 per ton. The Franklin Works are, however, suspended, and this refuse is not in the market.

"The Bird Guano and Fertilizer."

527. Sample received Jan. 26, from Samuel Hubbard, Hartford. Dealer, L. A. Bradley, 17 Colony street, West Meriden. "Selling price at factory, $30 per ton."

Composition.

Organic and volatile matter,*	5.37
Carbonate of lime,	56.10
Carbonate of magnesia,	2.38
Sand, silica and clay,	33.45
Oxide of iron with traces of alkalies, chlorine, sulphuric and phosphoric acid,	2.70
	100.00
*With nitrogen,	0.20

This quack fertilizer is an inferior quality of shell marl, said, in the accompanying circular, to be taken from the shores of Cayuga lake, in New York. It corresponds most nearly in composition and fertilizing value to leached ashes, is however rather inferior to ordinary leached ashes which cost from $4.50 to $7.50 per ton, according to the amount of transportation.

Analyses of Rocks.

655. Limestone. Sent by H. N. Bill, Willimantic.

Chemical Analysis.

	655.	A.	B.	C.
Lime,	20.28	29.32	5.69	.46
Magnesia,	.43	4.16	2.10	1.80
Potash,	.03	.29	.54	.47
Soda,	·30	.70	.67	.28
Oxide of iron and alumina,	1.89	3.28	8.89	7.75
Phosphoric acid,	trace	trace	.15	.10
Soluble in strong acids,	22.93	37.75	18.04	10.86
Silica and silicates insoluble in acids,	61.20	32.86	75.59	86.06
Carbonic acid (and loss on ignition),	16.47	29.39	6.37	*3.08
	100.60	100.00	100.00	100.00

* Water.

655 is said to be situated about two and a half miles from Willimantic and to occur in layers that in the aggregate amount to three feet in thickness. It burns and slacks like common limestone. It contains in round numbers, 40 per cent. of carbonates of lime and magnesia.

The sample analyzed was from a loose fragment believed by Mr. Bill to be identical with the rock of the ledge.

Very probably the impure lime obtained by burning this rock may be of great advantage if skillfully employed upon the contiguous farms.

The analyses **A, B** and **C** above given were made by Dr. Jenkins in 1873 and are copied from the writer's note books as a useful contribution to the knowledge of our agricultural raw materials.

A is the "Limestone" occurring in Woodbridge, a few miles west of New Haven. It was some years ago burned for making "hydraulic cement" or "water lime," but the manufacture was shortly abandoned. Portions of the rock which have long been exposed well illustrate the process of "weathering" whereby rocks are transformed into soil. In some cases the carbonates of lime and magnesia have been dissolved out for a depth of several inches, leaving the comparatively insoluble silica and silicates as a rough porous coating which is dark in color, owing to the conversion of the iron originally present in white carbonate or pale green silicate to the brown hydrated peroxide. This rock contains a large proportion of carbonates of lime and magnesia and one per cent. of alkalies, including 0·3 of potash.

B and **C** were samples of rock from the farm of David J. Stiles of Southbury. The former is a hard compact "Limestone," the latter a soft shale or slaty rock, easily broken up by action of the weather. These rocks are from or near the well-known locality where fossil fish have been found. They contain notable quantities of phosphoric acid and half a per cent. of potash. These rocks if pulverized would act as fertilizers on most poor soils, and under favorable circumstances some of them may perhaps yield a profit by such application. Soils which have been formed and are still forming by the decay of these rocks are, it is to be presumed, amply stocked with lime, magnesia, potash and phosphoric acid or such of these bodies as are abundantly indicated by the analyses. Investigation of the composition of our rocks may evidently furnish useful hints to the thoughtful agriculturist.

Soap Boilers' Refuse.

573. Scraps from rendering vat.
575. Liquid from rendering vat.
574. Lye from condenser.
The above were sent to Station by A. A. Hills, Greenville.

Analyses.

	573	575	574
Nitrogen	2.25	1.07	----
Phos. acid	0.51	0.22	----
Potash	----	----	2.40
Estimated value per ton	$7.81	$4.83	$2.16

The ton of **575** and **574** equals about 230 gallons or $7\frac{1}{3}$ bbls.

Mussel Bed.

617. From Maine; brought to Station by Wm. Romer, Jr., of Warren, R. I. A useful fertilizer but not one that will warrant much cost of transportation.

Water	29.10
Sand and insoluble	52.73
Organic matter *	2.20
Alumina and Oxide of Iron	4.55
Lime	4.15
Magnesia	.86
Potash	.30
Soda	.57
Sulphuric acid	.57
Phosphoric acid	.18
Carbonic acid, chlorine and loss,	4.69
	100.00

* Containing nitrogen 0.144.

This sample is more than four-fifths sand or clay and water. It contains about seven per cent. of carbonate of lime and one per cent. of carbonate of magnesia, which are commonly useful applications to New England soils. Of the more costly fertilizing elements—nitrogen, phosphoric acid and potash—it contains less than exist in stable manure of average quality.

Swamp Muck.

612. Swamp muck sent by N. P. Perkins, Willimantic. This muck was dug in November, 1880, lay in heaps in the field during the winter and until about the middle of May, when it was sent to the Station.

680. Swamp Muck from J. W. Nettleton, Milford.

The Fresh Muck contains:	**612**	**680**
Water	77.59	73.13
Organic matters *	15.65	14.64
Ash †	6.76	12.23
	100.00	100.00
* With Nitrogen	.41	.35
† With Sand and silicates	6.15	9.79
" Oxide of iron, alumina and phosphoric acid	.38	1.09
" Lime	.14	.19
" Soluble iron-salts	*trace*	*none*
" undetermined matter	.09	1.16
	6.76	12.23
The Dry (Water-free) Muck contains:		
Organic matters	69.82	54.46
Ash	30.18	45.54
Lime	.62	.65
Nitrogen	1.83	1.31
The Organic Matters contain:		
Nitrogen	2.62	2.40

These samples are quite similar in composition. Their *direct fertilizing value* is comparatively small, lying mainly in the small quantities of nitrogen and lime they contain. The nitrogen amounts to but 7 to 8 lbs. per ton of muck, about half as much as is usually found in stable manure. Of lime there is but 3 to 4 lbs. per ton. The nitrogen exists doubtless in a less active state than that of stable manure. As a "fertilizer" therefore, using that word in its strictest sense, muck of the quality of these samples has little value.

Mr. Perkins in forwarding samples wrote as follows: "The analysis of the swamp muck is of greater importance to us than that of phosphates, as we can have thousands of loads of the former for the drawing, while we must pay largely for the phosphates. I have no confidence in the muck except as an absorbent. Mr. Barrows mixes ashes with it and claims great results from its use. Mr. Lewis has to haul his more than a mile and hauls hundreds of loads, tips a load in a place, covers the ground all over and claims good results, and certainly he grows the finest vegetables I ever saw. In years past he has used great quantities of stable manure, ashes, etc. Mr. Barrows' and my muck beds are so handy we can haul an ox load each hour in the day."

Mr. Perkins' cultivable land in Pleasant Valley lies nearly level, and but slightly higher than the Muck Swamp into which it gradates. The soil consists largely of clay and silt washed from the surrounding hills, or brought in by the streams from distant higher lands. It appears to be mostly a deep, moist, fine-textured loam, and to have, for a New England soil, a more than usual stock of native fertility. It is a soil which needs nothing to help it retain moisture, which is not deficient in organic matter and which only requires small amounts of fertilizing applications with judicious tillage and rotation, and in the moister parts, deep drainage, to maintain it in a productive state. Such a soil is evidently not of the kind to be benefited by swamp muck. Some of Mr. Perkins' neighbors who work coarse-textured, hungry soils which let the water through them like a riddle, find that Swamp Muck is very useful to them. They, however, do not rely upon it as a direct source of plant food. They use with it "large quantities of stable manure, ashes, etc." The muck is just as valuable as an "amendment," to give to ground the texture and physical qualities of "loam" or of "garden soil" as stable manure is, and the stable manure, ashes, etc., serve to set up that "fermentation" or decomposition in Swamp Muck which renders its nitrogen of avail.

The use of Swamp Muck on grass land, or on tilled soil newly broken up from grass and therefore well stocked with humus, is of the nature of "carrying coals to Newcastle." In market gardening, where the continual tillage tends to the rapid removal of organic matter, muck may well take, more or less, the place of stable manure, according to its quality and cost.

The quality of Swamp Muck can be roughly inferred from the following considerations: When the swamp is a basin with a small outlet or none, when the "wash" that enters it comes copiously from good or rich soil, when the herbage that grows on it is tall and rank, when large quantities of forest leaves accumulate in it, we may safely assume that the muck will be relatively rich in plant-food. It is from such deposits that the muck has been obtained, which is reported to have nearly equaled stable manure in fertilizing effect. On the other hand, when the wash into the swamp is scanty and from coarse, poor soil, when the vegetation is mere moss or a spare growth of sedge, and when large volumes of water flow through it and leach out its soluble matters, then it would be strange if the muck had any considerable active fertilizing quality. It may, nevertheless, even then, be very serviceable for *amending* poor, coarse, sandy or gravelly soils, but the amending must be followed up by real "manure" of the appropriate kind.

Mr. Perkins says further: "Our muck beds are from two to ten feet deep. At the bottom of them we find stone that are quite white and remain so for many years. I can point out in our walls every stone that came from the muck." This interesting statement illustrates one of the modes in which swamp muck, as well as stable manure, green crops ploughed under and decaying vegetable matter, generally operate as *indirect fertilizers.* The white stones observed by Mr. Perkins, differ from those taken out of the arable land or those that originally strewed the surface of much of the higher land simply in one respect. The stones long weathered on or in the soil, are colored yellow or brown by compounds of iron, which are constant ingredients of nearly all our rocks. The stones dug out of the muck are white because these iron compounds have been dissolved away by the action of the acids which are developed in the decay of vegetable matter, and which are essential ingredients of Swamp Muck.

The productiveness of unmanured land is kept up by natural processes which liberate potash, phosphoric acid, lime, etc., from the stony matter or rock-dust of the soil. Living roots attack this rock-dust by the vegetable acids (oxalic acid) which they contain. Stable manure and swamp muck attack it by the humic acids which they contain and by the carbonic acid of which in their decay they are the constant and abundant sources. These and similar applications, which consist largely of humus or decaying vegetable matters, thus prepare for crops the nutriment of which the soil is the great storehouse, and manure the land by making its own supplies available.

Mr. Perkins also states in his letter: "I think it remarkable that we can raise the nicest and largest potato crops on our blackest, most mucky soil, and they never rot."

Since low damp situations are commonly favorable to the potato rot, this observation suggests that possibly the potato fungus is counteracted by some ingredient of this mucky land, and recalls the statement made by Prof. Cook, Director of the New Jersey Agricultural Experiment Station in the first Report of that Station (1880), p. 66, which is to the effect that the "cranberry scald," a disease due to a fungus, does not appear on certain marls and bogs which contain free acid or acid salts. It was at first thought that sulphate of iron (copperas) was the preventive, but experiments with that substance on various cranberry bogs during 1880, did not give conclusive resnlts. It is important that the experience of those who have raised potatoes on mucky land be made public, in order to guide investigation on this subject, should the facts warrant undertaking its study.

The sample of long weathered Swamp Muck sent by Mr. Perkins, contains a trace of soluble iron salts. These in minute quantities are not harmful to agricultural plants. When their amount increases beyond certain limits, they destroy our common crops. Bog vegetation, the cranberry included, tolerates them in greater quantities. It is possible that the potato may flourish when its juices contain enough iron-salts to destroy the fungus which causes the "rot." This fungus, as is well-known, may go into the ground with the seed potatoes, and may develop as an internal parasite within the growing potato plant, penetrating its stems and leaves, and finally so multiplying under favorable conditions—hot and moist weather—as to injure or destroy the crop.

It would first be necessary to establish beyond question, the fact that mucky soils or some mucky soils, furnish immunity from the potato rot under circumstances favorable to its development, in soils of ordinary character. The Station could coöperate in such an investigation if it had suitable grounds and the means for carrying on experiments in various soils and mixtures.

Sea-Weed.

In answer to inquiries as to the Commercial Value of Sea-weed and sea-weed ashes, I give below the results of analyses made by me or under my direction, in former years:* These analyses refer to the more or less well-dried material. When newly gathered the sea-weed contains from 70 to 90 per cent. of water.

* The analysis of Eel-grass was made in 1860, by my former pupil, William H. Bergen, Esq.

Analyses.

	1860	1862	1871
	Eel-grass.	Kelp.	Rock-weed.
Moisture,	17.75	9.81	11.01
Organic matter and loss in analysis,	64.90	71.41	69.10
Sand,	5.72	0.13	1.59
Lime,	2.73	1.40	1.10
Magnesia,	1.82	0.20	1.19
Oxide of Iron,	0.72	0.26	0.37
Soda,	1.14	1.64	2.22
Potash,	0.94	2.46	2.18
Chloride of Sodium (common salt),	2.73	5.93	4.14
Sulphuric acid,	0.54	6.19	6.82
Phosphoric acid,	1.01	0.57	0.28
	100.00	100.00	100.00
Nitrogen,	-----	1.77	1.20
Ammonia equivalent to Nitrogen,	-----	2.15	1.46

Sea-weed as ordinarily gathered is a mixture of various plants, and more or less animal matter, living and dead, adheres to it, so that there is considerable variety in the material and in its composition. Where sea-weed is thrown up in large quantities too remote from cultivated land to be of direct use as manure, it may be burned and the ashes transported to some distance with a profit. Sea-weed is, however, rather difficult to burn and the ashes are likely to be quite variable in character and value.

Reduction of Unground Bones. Bone Black.

The following questions were received and answered substantially as follows, through *The Connecticut Farmer:*

"What is the best way of rendering fresh bones available for land? Is it not practicable to dissolve them with sulphuric acid when there is no mill near at hand? How much acid is required per hundred pounds of bones, and what is the *modus operandi?* How is 'bone-black' prepared?

Answer.

It is not an easy matter to reduce fresh whole bones to a suitable form for use as a fertilizer. Treatment with sulphuric acid does not appear to be practicable. The acid, suitably diluted, acts energetically on bones at first and readily disintegrates them to a certain depth. Unless, however, a large of excess of acid be used the action soon becomes sluggish, because where the acid is in contact with the bone it forms sulphate of lime, itself being spent as an acid or solvent in the operation, and its place is taken by the bulky sulphate. Fresh acid must then be brought in contact with the bone by abundant stirring in order to renew and maintain the action. The pulpy sulphate of lime holds mechanically a large quantity of liquid and thus hinders the desired result. The excess of sulphuric acid rapidly absorbs moisture from the air and the final result is the solution of the bone or most of it at the expense of a wasteful excess of acid and the product requires mixture with something to take up the water and neutralize the excess of sulphuric acid.

These difficulties would not be so serious if suitable and cheap vessels could be had in which to carry on the process, for after the bones were disintegrated the sloppy mass could be dried and its excess of sulphuric acid utilized by admixture of South Carolina phosphate rock, or other similar material, which would be thereby converted into superphosphate.

On a very small scale cast-iron vessels could be employed. A pit lined with blue flag-stones or with hard bricks closely laid in common lime mortar (not cement), would be more suitable for large quantities. It would appear, however, that there is doubtful profit in undertaking to reduce whole bones by sulphuric acid on the small scale, especially since the use of this acid is attended by considerable risk to those inexperienced in handling it.

In Russia, Ilienkoff and Engelhardt claim to have successfully employed caustic potash for the conversion of bones into a pulverulent fertilizer.

Their method of reducing entire bones with caustic potash, or what amounts to the same thing, with *wood ashes and lime*, is described by Ilienkoff as follows:

"To 4,000 pounds of bone take 4,000 pounds of unleached wood ashes, 600 pounds of fresh-burned lime and 4,500 pounds of water. First slack the lime to a powder, mix it with the ashes, and placing a layer of bones in a suitable receptacle—a pit in the ground lined with boards, stone slabs or brick—cover them with the mixture; lay down more bones and cover and repeat this until half the bones, or 2,000 pounds are interstratified with the ashes and lime; then pour on 3,600 pounds of water, distributing it well, and let stand. From time to time add water to keep the mass moist. So soon as the bones have softened so that they can be crushed between the fingers to a soft soap-like mass, take the other 2,000 pounds of bones and stratify them in another pit with the contents of the first. When the whole is soft, shovel out to dry and finally mix with dry muck or loam (4,000 pounds), or enough to make it handle well."

I should suppose that this method might be advantageously modified somewhat as follows: Arrange a circular layer of bones closely laid on a bed, a foot thick of good loam, under shelter; wet them from a watering pot and sprinkle over them wood ashes enough to fill all the chinks. Then give a coating of gypsum; put upon that a few inches of muck or loam, adding all along as much water as will well moisten the earth and ashes but not more than the mass can easily absorb; then place another layer of bones with ashes, gypsum, loam or muck, and water as before, until the heap is built up several feet; finally, cover with loam and keep moist by adding water from time to time, but not enough to run away from the bed. When the bones are sufficiently softened, mix well together with the loam used as bed and cover, and with more if need be. This plan would require more time but perhaps would be as efficacious and more convenient than the process last described.

Instead of wood ashes a mixture of lime and some form of "potash salts" might be employed, but trials on a large scale would be needful to learn the proper proportions and mode of working.

A third method of disintegrating bones is to induce decomposition of the animal matter (ossein), by composting or interstratifying them with fermenting horse dung, and keeping the mass moist by covering with loam and adding occasionally urine or dung-heap liquor. As to the details of this method or the practicability of it, I can give no information.

Bone-black is prepared by heating bones in close pots or retorts until the animal matter is destroyed and most of it driven off as water, gases, "animal oil" and ammonia. What remains behind in the pots is the "bone-black." It consists of the phosphate of lime of the bones mixed with some ten per cent. of carbonate of lime and sand and six per cent. of carbon. The bone-black thus obtained is broken up for use in sugar refining. The refiners mostly employ it in a coarse, granular form. The dust which results from the granulation goes to the superphosphate manufacturers, and is one of the best materials for their use. When the granulated bone-black has been used in decolorizing a certain amount of sugar it loses its efficacy and is subjected to a red heat in close pots in order to restore (partially), its defecating power. After some repetitions of this process it becomes of no further use to the sugar refiner and goes to the fertilizer maker. This "spent bone-black" is less valuable than the refuse powder, above mentioned, because its phosphoric acid is reduced by five to ten per cent., and the carbonates considerably increased. The demand for bone-black on the part of fertilizer makers is so great that unwholesome stories are in circulation to the effect that inferior native phosphates, under false colors, i. e., suitably blackened, are in the market carrying the name and style of bone-black but in fact and with intent spurious, although not altogether worthless.

I will add here an estimate of the commercial value of the product that would result from the quantities of bones, wood-ashes, etc., used in Ilienkoff's process as above described:

4,000 pounds of average bones contain 4 per cent. or 160 pounds of nitrogen and 20 per cent. or 800 pounds of phosphoric acid.

4,000 pounds of average wood ashes, unleached, contain 8½ per cent. or 340 pounds of potash, and 2 per cent. or 80 pounds of phosphoric acid. The bones and ashes together contain—

160	pounds of nitrogen, worth, at 20 cents,	$32.00
880	" phosphoric acid, worth, at 9 cents,	79.20
340	" potash, worth, at 5½ cents,	18.70
		$129.70

Admitting that there is no loss of nitrogen and no loss or gain of water or of loam, etc., this value of $129.70 would belong to 13,100 pounds or 6½ tons of the finished bone compost. The value of one ton would accordingly be, in round numbers, $20.

Preparation of Bone Superphosphate.

In answer to repeated inquiries from various sources, the method of "dissolving" ground bone, i. e. of preparing a bone superphosphate by help of sulphuric acid—useful where soluble phosphoric acid and nitrogen are desired—is here given.

Most of the ground bone that comes into market contains a considerable, often a large, proportion of coarse fragments which remain in the soil for years before they become of avail to plants. The finest parts of ground bone are, on the other hand, adapted to feed crops at once. If ground bone be treated directly with sulphuric acid, the fine parts are promptly decomposed, but the coarse portions are but little acted on unless a large amount of acid and much time are consumed. Dr. Alexander Müller has proposed the following very rational method of treating ground bone, which is the best adapted for domestic use of any of the processes involving the use of the oil of vitriol.

Take 100 lbs. of ground bone such as contains 20 to 50 per cent., more or less, of material coarser than ½ inch, 25 lbs. of oil of vitriol of 66°, the strongest commercial acid, and six quarts of water.

Separate the bone by sifting into two, or if the proportion of coarse bone is large, into three parts, using sieves of $\frac{1}{16}$ inch and ⅛ inch mesh.

Mix the coarser part of the bone in a cast-iron or lead-lined vessel with the oil of vitriol. When the bone is thoroughly wet with the strong acid, add the water, stirring and mixing well. The addition of the water to the acid developes a large amount of heat which favors the action. Let stand, with occasional stirring, for twenty-four hours, or until the coarsest fragments of bone are quite soft; then, if three grades of bone are used, work in the next coarser portion of bone, and let stand another day or two until the acid has softened all the coarse bone, or has spent its action; and finally, dry off the mass by mixing well with the finest bone. In carrying out this process, the quantity of oil of vitriol can be varied somewhat—increased a few pounds if the bone has a large proportion of coarse fragments, or diminished if it is fine.

Stoeckhardt gives a somewhat different procedure, viz: "From a mixture of sifted wood or coal ashes and earth thrown upon a barn or shed floor form a circular wall, so as to enclose a pit capable of containing one hundred weight of ground bone; the surrounding wall of ashes may be rendered so firm as not to yield by being trodden down or beaten firm with a board.

Sift off the finer part of the bone and set it aside. Throw the coarser part into the cavity, and sprinkle it during continued stirring with three quarts of water until the whole is uniformly moistened; add gradually eleven pounds of oil of vitriol of 66°, the agitation with the shovel being continued. A brisk effervescence of the mass will ensue (from decomposition of the carbonate of lime in the bones), which will not, however, rise above the margin of the pit if the acid is poured on in separate small quantities. After twenty-four hours, sprinkle again with three quarts of water, add the same quantity of sulphuric acid as before, with the same brisk shoveling of the mass, and leave the substances to act for another twenty-four hours upon each other. Then intermix the fine bone previously sifted off, and finally shovel the ashes and earth of the pit into the decomposed bone until they are all uniformly mixed together."

"Available" Phosphoric Acid.

The current uses of the term "available" as applied to phosphoric acid have occasioned some confusion and may appropriately be noticed here.

In an *agricultural sense* available phosphoric acid is that which can be of use to vegetation. The three states of phosphoric acid which are distinguished in this report, viz: "soluble," i. e. freely dissolved in water, "reverted," or very slightly soluble in water, but freely dissolved in ammonium citrate, and "insoluble," which means not freely dissolved either by water or by ammonium citrate, are all more or less fully and rapidly available for the nutrition of crops. The least "available" of these three forms—the "insoluble"—is the form which in nature is chiefly accessible to plants, and is sufficient for the slow growth of prairie and forest, and under favorable conditions answers most of the purposes of agriculture. For immediate effect, on quick-growing crops, or on infertile soils, the soluble and reverted are desirable and advantageous.

Some chemists, in reporting the analyses of fertilizers, are in the habit of classing together "soluble" and "reverted" under the designation "available." In so doing they have various reasons, some of which are good. They assert or imply that the distinction between "soluble" and "reverted" is too fine-drawn for practical purposes; that in many cases "reverted" is as good or better for crops than "soluble;" that therefore it is useless to estimate them separately.

If the *cost* of soluble and reverted phosphoric acid were the same, there would be some good grounds for rejecting the distinction, but the cost is not the same, and the purchaser ought for that reason to know what he has to pay for. Again, in some cases, on mucky soils, soluble phosphoric acid in large doses appears to be a damage, while on others it is much more efficacious than reverted. From two distinct points of view then, that of commercial value or cost, and that of applicability to certain soils or crops, the consumer may require or may desire the distinction to be maintained.

Manufacturers who are not able or are not willing to give the purchasers of their "superphosphates" any considerable quantity of soluble phosphoric acid, are apt to be pleased with the term "available," which relieves them from a troublesome responsibility, since they can manufacture and furnish such "available" more cheaply and certainly than they can supply a constant proportion of soluble and of reverted.

On the other hand, manufacturers who make a "superphosphate" in the original and strict sense of this much-abused term, containing soluble phosphoric acid in large quantity, would be aggrieved if that quality of their product were ignored.

When consumers come to agree that reverted phosphoric acid is practically as good a fertilizing agent as soluble, and when manufacturers generally understand how to give the consumer his money's worth in reverted phosphoric acid, i. e. to give him more pounds corresponding to the less cost per pound, as compared with soluble, then it will be time to abolish the distinction which it now appears needful to maintain. No one should be more pleased with this simplification than the Experiment Station chemist whose labors would thus be materially lessened.

Review of the Fertilizer Market.

Organic Nitrogen in Dried Blood, Azotin* and Ammonite,* was quoted in New York *at wholesale* in May last at $21.25 to $21.87 per hundred lbs. In August the wholesale price advanced to $23.37, and in November and December to $24.30 per hundred. The retail cost of nitrogen in New Haven samples of low grade dried blood sent to the Station during May and June, ranged between 14 and 20 cents per lb. The retail cost of nitrogen in Blood and Azotin reported from the New Jersey Station Sept. 20th, varied from 22¼ to 28¾ cts. per lb., the average being nearly 24 cts.

In the two samples of Dry Ground Fish examined here in April and May, nitrogen cost 21½ and 31 cts. per lb. respectively. Four samples at the New Jersey Station gave, nitrogen for 18 to 21½ cts. The *wholesale price* of Fish Scrap has advanced since April from $36 to $40–42 per ton.

Castor Pomace has furnished nitrogen in our markets at 21 cts. In decorticated cotton seed meal it has cost 15 to 18 cts.—in cotton seed meal with hulls, 37 cts. per lb.

In really pure Ground Bone the average cost of nitrogen has not varied essentially from the Station values given on page 23, viz: from 11 to 15 cts. per lb., according to degree of fineness.

Nitrogen in Ammonia-salts has advanced in price and throughout the season has held at 24 to 26 cts. per lb., wholesale, the latter price ruling in New York at the close of 1881. No retail ammonia-salts have come to the Station during 1881. In four samples reported from the New Jersey Station in September, Nitrogen cost on the average 26 cts. The fact that the wholesale and retail prices of ammoniacal nitrogen have been quite the same, probably comes from the circumstance that the articles which give the retail cost were purchased before the advance. In 1882, nitrogen in ammonia-salts will probably retail at about 30 cts. per lb.

Nitrogen of Nitrates.—Nitrate of Soda has been largely imported during the year and has supplied nitrogen at about 21 cts. per lb., *wholesale.* The retail cost of nitrogen in the sample of nitrate analyzed here was 26.9 cts. The average retail cost in four samples examined in New Jersey was 26½ cts.

* Trade names for animal matter (meat scrap, cracklings), very dry and free from grease. For analyses see p. 45.

Soluble Phosphoric Acid.—The average retail cost of soluble phosphoric acid in seven samples of the best quality of plain superphosphate analyzed here during 1881, was 11.1 cts. per lb. Four samples gave the cost at the New Jersey Station at 11½ cts.

Phosphoric acid in really pure Ground Bone of the spring deliveries, has not, on the average, varied in cost from the Station valuations.

Insoluble Phosphoric Acid.—Charleston Rock, ground and delivered, has advanced *at wholesale* from $15 per ton in May and June to $16 in October, and to $17 in November. This advance is perhaps largely due to the increased demand during the manufacturing season, and it does not appear that phosphoric acid in any of its forms has cost the consumer more than during 1880.

Potash in Muriate has cost from $3.52 to $4.59 per 100 lbs. retail, in seven samples, the average having been $4.14; *in Sulphate*—one sample, the 100 lbs. cost $7.52; *in Kainite*—2 samples, the cost of potash per hundred was $8.00 and $7.10, but should not have been more than half these figures judging from the wholesale quotations, viz: $6.50–$9.00 per ton. See p. 51.

Notwithstanding the increased price of ammonia-salts and of the higher grades of blood and animal matters, the aggregate average cost of the several fertilizing elements in the Nitrogenous Superphosphates and Guanos, good and bad taken together, has during 1881, exceeded the Station valuation by only 9¾ per cent. as against 12 per cent. in 1880. The advance in cost of this class of goods over the cost in 1880, is also 9¾ per cent.

In "Special Manures" the fertilizing elements cost in the aggregate average, 8.8 per cent. above the Station valuation, as against 10.9 per cent. in 1880.

The growing demand for nitrogenous fertilizers naturally enhances the prices of the raw materials which enter into their composition and the prospect is that their cost will rather increase than diminish in the future, and it is probable that the Station will be obliged to advance considerably its valuations of the various forms of nitrogen for the year 1882. What ratings it will be proper to adopt for the coming year cannot be now determined.

POISONS.

Poison Mittens.

A leather mitten believed to have caused a painful eruption on the wrist and arm of the wearer, was sent to the Station from Dr. J. R. Sanford, of West Cornwall, through Dr. C. W. Chamberlain, Secretary of the State Board of Health. The back of the mitten was apparently sheepskin, dressed with the wool on, the wool was mostly dyed black, but numbers of the fibers were yellow, as if a yellow die had been first applied and afterwards a black. The palm of the mitten was lined with similar skin with the wool dyed yellow. The yellow dye is readily dissolved to some extent, both from the yellow and black wool-lining, by warm water, and is more freely taken up by dilute alkalies and acids. A careful examination makes very probable that the yellow dye is Martius' Yellow (Dinitronaphtol) a coal-tar product that is known to have an irritating action on the skin.

Cattle Poisoned by Blue or Mercurial Ointment.

A resident of this State has brought the following interesting case to the notice of the Station:

In December, 1880, the owner of some 30 head of cattle applied "blue ointment" to his animals for the destruction of lice. The ointment was purchased of a druggist and was mixed, melted and well worked together with more than an equal weight of unsalted lard or tallow. The diluted ointment was applied with the fingers to places least liable to be reached with the tongue and but once to each animal. The application was made by the proprietor himself who had in previous years repeatedly used blue ointment of full strength and without any bad results. The animals were, with exception of two milch cows, store cattle, steers and heifers coming 2 years old. Some of the heifers were with calf.

Seventeen head (Durham grades and common stock, except two Jersey grades,) were to all appearance uninjured by the application. Thirteen animals, including eight Jersey grades, were more or less seriously affected in consequence of using the ointment.

Nine or ten had fever attacks a few days after the ointment was used, with incessant panting and loss of appetite, from which they mostly recovered in two or three days. Nearly all the sick animals had chronic itching sores and eruptions, which, in most cases, appeared where the ointment was applied, and generally also elsewhere. In five or six cases, the inside of the hind legs were extensively excoriated. In several instances there was great swelling of the fore legs above the knee, with copious secretion at first of serum, and afterwards of purulent matter. In four cases the poisoning reached a fatal termination. Two of the animals that died had no eruption. One of them lived until May, and two others until July, 1881. The others have mostly recovered, but at least one of them still shows, after a twelve-month, traces of the effects of the mercurial poison.

Three questions were put to the Station respecting the ointment used:—

1. Is the sample blue ointment?

2. As compared with samples procured from other druggists, is this ointment of the usual strength and made in the usual way?

3. Has the ointment undergone any chemical change by age or otherwise?

To answer these questions, the sample (1) was compared with two others (2) and (3), obtained respectively at Klock's drug store and at Apothecaries' Hall, New Haven.

As is well known, blue ointment is usually prepared by rubbing together lard, a little suet, and metallic mercury (quicksilver), until the latter is no longer distinguishable by its silvery luster. Thus made, blue ointment is grease intimately mixed with metallic mercury in a state of extreme subdivision.

The results of the examinations are as follows:—

	(1)	(2)	(3)
Mercury soluble in ether,	1.80	trace.	trace.
Mercury soluble in hydrochloric acid,	.74	none.	trace.
Mercury insoluble both in ether and hydrochloric acid,	29.03	33.76	29.35
Total mercury,	31.57	33.76	29.35
Water (?) loss at 212°,	1.67	1.21	1.66
Fat by difference,	66.76	65.03	68.99
	100.00	100.00	100.00

The agreement in the quantities of fat and mercury in the three samples is as close as could be expected, and shows that the sample (1) contained the proper proportions of its ingredients. Careful testing demonstrated the absence of other poisonous metals, especially lead, and also proved that no corrosive sublimate was present. The ointment was warmed with ether in order to dissolve the fat and separate it from the metallic mercury. On evaporating the clear ether-solution, there was deposited in case of (1) a dark gray substance, which proved to contain mercury in no inconsiderable quantity. From the ether-solution there was obtained in each of the samples evidence of the presence of mercury, but in those purchased in New Haven the quantity of mercury was unweighable. Sample (1), however, yielded 1.8 per cent. of mercury soluble in ether, and existing probably as oleate, stearate or palmitate of that metal. After extracting the ointments (2) and (3) with ether there remained nearly pure metallic mercury, which, in case of (3), contained a trace of some mercury compound soluble in hydrochloric acid. On the contrary, the metallic mercury of (1) was mixed with a gray substance, which dissolved in hydrochloric acid and yielded 0.74 per cent. of mercury, reckoned as metal.

The ointment which caused the disastrous results contained, accordingly, 2½ per cent. of mercury, or one-twelfth of the whole, in a soluble and highly active state, and it is to this fact that its poisonous effects are doubtless to be attributed.

The analysis throws little light on the reason why the sample contained such a quantity of soluble mercury. Christison long ago observed that mercurial ointment may contain mercury in a soluble state. It is extremely probable that the use of rancid lard and long keeping occasioned the solution of the metal. In becoming rancid, fats undergo a decomposition which results in the formation of acids. Where mercury is long exposed to or agitated in contact with air, it is gradually, in part, converted into a black powder of mercurous oxide. This oxide readily dissolves in acids. Bärensprung asserts that this oxide is the active ingredient of mercurial ointment. He says, also, that its quantity increases with the age of the ointment, which, as is known, gradually becomes darker in color on keeping. A variety of circumstances are likely to influence the quality of blue ointment, and, plainly enough, it is sometimes a very dangerous remedy.

FODDER AND FEEDING STUFFS.

Thirty-seven samples of Feeding Stuffs have been analyzed, viz:

2 of sorghum seed.
1 of maize.
1 of corn and cob meal.
1 of oats.
3 of New Process linseed meal.
1 of cotton seed meal.
1 of brewers' grains.
2 of wheat bran.
2 of sugar feed.
2 of mangolds.
1 of turnips.
1 of sugar beet pulp.
1 of apple pomace.
5 of hay.
4 of maize fodder.
2 of ensilage.
7 of mixed provender.
—
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As in former Reports, I give here a few pages explanatory of the analyses of Fodder and Feeding Stuffs. The recent publication of Dr. Armsby's *Manual of Cattle Feeding*,* enables me to refer to that book for further information on these and other points connected with the composition and use of feeding stuffs.

It is chiefly owing to the investigations that have been carried on in the European Experiment Stations, that the chemical analysis of an article of cattle food may be usefully employed in fixing its nutritive value and place in the feeding-ration, and also in deciding how much the farmer can afford to pay for it, or at what price, and to what extent he can substitute it for other materials customarily used.

Full Tables of the Composition of Feeding Stuffs, of Feeding Standards, and concise directions for their use, together with

* Manual of Cattle Feeding, a Treatise on the Laws of Animal Nutrition and the Chemistry of Feeding Stuffs in their application to the Feeding of Animals. With Illustrations and an Appendix of useful Tables. By Henry P. Armsby, Chemist to the Connecticut Agricultural Experiment Station. New York: John Wiley & Sons, 15 Astor Place. 1880.

much other useful matter of a similar kind, will be found in *The Farmer's Annual Handbook for* 1882, by Drs. Armsby and Jenkins.*

In order to make our analyses of cattle feed directly useful, it is needful to adduce some of the results of the prolonged study of this subject made in other countries.

The following Table of the Composition, Digestible Nutritive Ingredients and Money Value of some of the most important Feeding Stuffs (page 81), is taken from the German of Dr. Emil Wolff, of the Agricultural Academy at Hohenheim, and represents the most recent and most trustworthy knowledge on these subjects.†

The *composition* of feeding stuffs, as here stated, is the *average* result of the numerous analyses that have been made within twenty-five years, mostly in the German Experiment Stations.

In his Manual, Dr. Armsby has adopted the Table of Kühn, who gives essentially the same averages as Wolff, and in addition shows the range of composition by stating the greatest and smallest per cent. of each ingredient.

The *quantities of digestible nutrients* are partly derived from actual feeding experiments, and are partly the result of calculation and comparison.

The percentage of the *three classes* of digestible matters, viz: *Albuminoids,‡ Carbhydrates§* and *Fat*, form the basis for calculating the money value of feeding stuffs. The values attached to them by Dr. Wolff are the following, the German mark being considered as equal to twenty-four cents, and the kilogram equal to 2.2 pounds avoirdupois.

1 pound of	digestible	albuminoids	is worth	$4\frac{1}{3}$	cents.
1 "	"	fat	"	$4\frac{1}{3}$	"
1 "	"	carbhydrates	"	$\frac{9}{10}$	"

These figures are intended to express the average *money values* of the respective food-elements in the German markets. Whether

* Published by D. Appleton & Co., New York.

† From "*Mentzel u. Lengerke's Kalender*," for 1882.

‡ The Albuminoids here include a proportion of *amides* whose quantity in feeding stuffs has very recently become a subject of investigation, and whose nutritive value is not yet fully understood.

§ The "nitrogen free extract" (N. fr. Extract) in grains, consists almost exclusively of carbhydrates, viz: starch, sugar, gum. and allied bodies; in grass and hay it includes, in addition, substances of whose properties we are ignorant, but which, so far as they are *digestible*, rank with the carbhydrates.

or not these values are absolutely those of our markets, they represent presumably the *relative* values of these elements approximately, and we may provisionally employ them for the purpose of comparing together our feeding stuffs in respect to money value.

These money or market values are to a degree independent of the feeding values. That is, if of two kinds of food, for example, Hungarian hay and malt sprouts, the one sums up a value of 66 cents, and the other a value of $1.31 per hundred, it does not follow that the latter is worth for all purposes of feeding twice as much as the former, but it is meant that when both are properly used, one is worth twice as much money as the other. In fertilizers we estimate the nitrogen of ammonia salts at 22½ cents per pound, and soluble phosphoric acid at 12½ cents, but this means simply that these are equitable market prices for these articles, not that nitrogen is worth twice as much as soluble phosphoric acid for making crops. In the future more exact valuations may be obtained from an extensive review of the resources of our markets, in connection with the results of analyses of the feed and fodder consumed on our farms.

The column headed "*nutritive ratio*" in the table on page 81, gives the proportion of digestible albuminoids to digestible carbhydrates inclusive of fat.* The albuminoids, which are represented in animal food by the casein or curd of milk, the white of egg and lean meat, and in vegetable food by the gluten of wheat (wheat gum), and other substances quite similar to milk-casein and egg-albumin, have a different physiological significance from the carbhydrates, which are fiber or cellulose, starch, the sugars, the gums, and similarly constituted matters.

The albuminoids may easily be made over by the animal into its own substance, i. e., into muscles, tendons, and the various working tissues and membranes which are necessary parts of the animal machine, because they are the same kind of materials, are, chemically speaking, of the same composition.

The carbhydrates, on the other hand, probably cannot serve at all for building up the muscles and other parts of the growing animal, and cannot restore the waste and wear of those parts of mature animals, because they are of a very different nature. They contain no nitrogen, an element which enters into all the

* Fat and carbhydrates have, it is believed, nearly the same nutritive function, and it is assumed that 1 part of fat equals 2.4 of carbhydrates.

animal tissues (albuminoids) to the extent of some fifteen per cent. of their dry matter.

The carbhydrates cannot restore the worn out muscles or membranes of the animal any more than coal can be made to renew the used-up packing, bolts, valves, flues and gearing of a steam-engine. The albuminoids are to the ox or the man what brass and iron are to the machine, the materials of construction and repair.

The carbhydrates are, furthermore, to the animal very much what coal and fuel are to the steam-engine. Their consumption generates the power which runs the mechanism. Their burning (oxidation) in the blood of animals produces the results of life just as the combustion of coal in the fire-place of the steam-engine produces the motion and power of that machine.

There is, however, this difference between the engine and the animal. The former may be stopped for repairs, the latter may run at a lower rate, but if it be stopped it cannot resume work. Hence the repairs of the animal must go on simultaneously with its wastes. Therefore, the material of which it is built must admit of constant replacement, and the dust and shreds of its wear and tear must admit of escape without impeding action. The animal body is as if an engine were fed with coal and water not only, but with iron, brass and all the materials for its repair, and also is as if the engine consumed its own worn out parts, voiding them as ashes or as gas and smoke. The albuminoids, or blood- and tissue-formers, are thus consumed in the animal, as well as the carbhydrates, or fuel proper. The fact that the albuminoids admit of consumption implies that when the carbhydrates or proper fuel are insufficient, they, the albuminoids, may themselves serve as fuel. Such is the case, in fact. But, nevertheless, the two classes of substances have distinct offices in animal nutrition, and experience has demonstrated, that for each special case of animal nutrition a special ratio of digestible albuminoids to digestible carbhydrates is the best and most economical, and, within certain limits, is necessary. This proportion we designate as the *nutritive ratio*, and these explanations make its significance evident.

To allow of directly comparing the money-value of feeding stuffs with some universally accepted standard, the last column of the table (page 81) gives a comparison with good average meadow hay taken as 1.

Average Composition, Digestibility and Money Value of Feeding Stuffs as given by Dr. Wolff for Germany for 1882, *except those in italics.*

	Water.	Ash.	Nitrogenous Matters, Albuminoids & Amides.	Fiber.	Nitrogen-free Extract.	Fat.	Digestible nutrients.			Nutritive Ratio 1:*	Value.	
							Albuminoids.	Carbhydrates including fiber.	Fat.		Dollars per 100 pounds.	Comparison with meadow hay = 1.
Meadow hay, poor	14.3	5.0	7.5	33.5	38.2	1.5	3.4	34.9	0.5	10.6	0.48	0.74
" " fair	14.3	5.4	9.2	29.2	39.7	2.0	4.6	36.4	0.6	8.3	0.55	0.86
" " average	14.3	6.2	9.7	26 3	41.4	2.5	5.4	41.0	1.0	8.0	.64	1.00
" " very good	15.0	7.0	11.7	21.9	41.6	2.8	7.4	41.7	1.3	6.1	.74	1.17
" " extra	16.0	7.7	13.5	19.3	40.4	3.0	9.2	42.8	1.5	5.1	0.84	1.32
Clover hay, average	16.0	5.3	12.3	26 0	38.2	2.2	7.0	38.1	1.2	5.9	0.69	1.08
" " best	16.5	7.0	15.3	22.2	35.8	3.2	10.7	37.6	2.1	4.0	0.88	1.39
Timothy hay	14.3	4.5	9.7	22.7	45.8	3.0	5.8	43.4	1.4	8.1	0.69	1.09
Hungarian hay	13.4	5.7	10.8	29.4	38.5	2.2	6.1	41.0	0.9	7.1	0.66	1.04
Rye straw	14.3	4.1	3.0	44.0	33.3	1.3	0.8	36.5	0.4	46.9	0.35	0.55
Oat "	14.3	4.0	4.0	39.5	36.2	2.0	1.4	40.1	0.7	29.9	0.44	0.69
Rich pasture grass	78.5	2.2	4.5	4.0	10.1	1.0	3.4	10.9	0.6	3.6	0.27	0.42
Average meadow grass, fresh	70.0	2.1	3.4	10.1	13.4	1.0	1.9	14.2	0.5	8.1	0.22	.36
Green maize, German	85.0	1.0	1.2	4.7	7.6	0.5	0.7	7.4	0.2	11.3	.10	.16
" *Mr. Webb*, 1874	86.0	0.8	0.8	4.8	7.3	0.3	0.6	8.3	0.2	14.4	.11	.17
Cured Maize Fodder, Mr. Webb	27.3	4.2	4.4	25.0	37.9	1.3	3.2	43.4	1.0	14.4	.57	.91
Potatoes	75.0	0.9	2.1	1.1	20.7	0.2	2.1	21.8	0.2	10.6	.29	.46
Carrots	85.0	0.9	1.4	1.7	10.8	0.2	1.4	12.5	0.2	9.3	.18	.28
Mangolds	88.0	0.8	1.1	0.9	9.1	0.1	1.1	10.0	0.1	9.3	.14	.22
Rutabagas	87.0	1.0	1.3	1.1	9.5	0.1	1.3	10.6	0.1	8.3	.15	.24
Turnips	92.0	0.7	1.1	0.8	5.3	0.1	1.1	6.1	0.1	5.8	.11	.16
Sugar beets	81.5	0.7	1.0	1.3	15.4	0.1	1.0	16.7	0.1	17.0	.19	.30
Maize, German	14.4	1.5	10.0	5.5	62.1	6.5	8.4	60.6	4.8	8.6	1.10	1.73
" *American*	14.4	1.5	10.7	2.0	66.5	4.9	9.0	63.3	3.7	8.0	1.12	1.75
Oats	14.3	2.7	12.0	9.3	55.7	6.0	9.0	43.3	4.7	6.1	.97	1.53
Rye	14.3	1.8	11.0	3.5	67.4	2.0	9.9	65.4	1.6	7.0	1.09	1.68
Barley	14.3	2.2	10.0	7.1	63.9	2.5	8.0	58.9	1.7	7.9	0.95	1.47
Peas	14.3	2.4	22.4	6.4	52.5	2.0	20.2	54.4	1.7	2.9	1.44	2.25
Field beans	14.5	3.1	25.5	9.4	45.9	1.6	23.0	50.2	1.4	2.3	1.51	2.36
Squashes	89.1	1.0	0.6	2.7	6.5	0.1	0.4	7.1	0.1	18.4	.08	.13
Malt sprouts	10.1	7.2	24.3	14.3	42.1	2.1	19.4	45.0	1.7	2.5	1.31	2.06
Wheat bran, coarse.	12.9	6.6	15.0	10.1	52.2	3.2	12.6	42.6	2.6	3.9	1.04	1.63
" fine	13.1	5.4	14.0	8.7	55.0	3.8	11.8	44.3	3.0	4.4	1.03	1.62
Middlings	11.5	3.0	13.9	4.8	63.5	3.3	10.8	54.0	2.9	5.7	1.07	1.68
Rye bran	12.5	5.2	14.5	5.7	58.6	4.5	12.2	46.2	3.6	4.5	1.10	1.72
Palm-nut cake	10.5	4.2	16.9	17.4	41-0	10.0	16.1	55.4	9.5	4.9	1.61	2.51
Cotton seed cake decorticated	11.2	7.6	38.8	9.2	19.5	13.7	31.0	18.3	12.3	1.6	2.05	3.22
Scrap, by Goodale's process	11.5	--	64.0	--	--	4.6	57.6	--	4.1	0.2	2.67	4.17
Fish-scrap, dry ground	11.7	--	51.5	--	--	8.1	46.4	--	6.2	0.3	2.28	3.56
Dried blood	12.0	4.1	80.8	--	2.6	0.5	54.1	2.6	0.5	--	2.39	3.76
Whey	92.6	0.7	1.0	--	5.1	0.6	1.0	5.1	0.6	6.6	.11	.18
Milk	87.5	0.7	3.2	--	5.0	3.6	3.2	5.0	3.6	4.4	.34	.53

* Nutritive ratios are read, 1 : 10.6, 1 : 8.3, etc. See page 79.

ANALYSIS OF FEEDING STUFFS.

The samples taken by Dr. Armsby are further noticed in his "Observations on the Feeding of Milch Cows," page 90. The analyses there given, with the exception of a number made on mixed fodders, are tabulated here for convenience of comparison and reference.

Sorghum Seed.

XC, Seed of Minnesota Early Amber Cane, from E. M. Dunn, Grafton, Mass.

XCII, Sorghum Seed, from E. D. Pratt, West Cornwall.

Composition.

	Air-dry.		Water-free.	
	XC.	XCII.	XC.	XCII.
Water.	15.04	16.76		
Ash,	1.73	2.17	2.04	2.60
Albuminoids or protein,	8.13	7.69	9.57	9.23
Crude fiber	1.94	3.21	2.28	3.85
Nitrogen-free extract	69.65	66.81	81.98	80.30
Fat,	3.51	3.36	4.13	4.02
	100.00	100.00	100.00	100.00

No determinations of the digestibility of sorghum seed have been reported. Its composition is quite similar to that of the ordinary cereal grains, and it is to be anticipated that it will prove equally digestible. In computing the following table, the averages of the digestion coefficients for all the cereals yet experimented on were used.

Probable amount of digestible nutrients in air-dry substance:

	XC.	XCII.
Albuminoids,	6.59	6.23
Carbhydrates,	62.47	60.26
Fat,	2.60	2.40
Nutritive ratio,	1:10.4	1:10.6
Estimated value,* per 100 lbs.,	$0.96	$0.92

* This estimated value is simply intended to furnish an approximately fair comparison between different feeding stuffs. See p. 78.

Grain and Meal.

CVI. Maize from farm of E. Norton, Farmington. Sampled by H. P. Armsby, April 1st, 1881.

XCIX. Corn and Cob Meal from farm of T. S. Gold, West Cornwall. Sample taken by H. P. Armsby, March 19th, 1881.

CIV. Oats from farm of E. Norton, Farmington. Sampled by H. P. Armsby, April 1st, 1881.

	Fresh.			Water-free.		
	CVI.	XCIX.	CIV.	CVI.	XCIX.	CIV.
Water,	18.16	20.99	13.48	----	----	----
Ash,	1.43	2.38	3.46	1.76	3.02	4.00
Protein,	9.60	8.18	9.38	11.73	10.35	10.83
Crude Fiber,	1.47	4.35	9.28	1.79	5.50	10.72
N. fr. extract,	64.95	60.44	59.52	79.36	76.50	68.81
Fat,	4.39	3.66	4.88	5.36	4.63	5.64
	100.00	100.00	100.00	100.00	100.00	100.00

Sugar Feed.

CI, Sugar Feed, private analysis.

CXXX, Sugar Feed. Sent Oct. 14th by J. J. Webb, Esq. Sold by D. B. Crittenden & Co., New Haven.

	CI.	CXXX.	Water-free. CI.	Water-free. CXXX.
Water,	6.57	10.40		
Ash,	3.22	.78	3.44	.87
Albuminoids or protein,	13.50	13.13	14.45	14.66
Crude fiber,	10.65	8.44	11.40	9.42
Nitrogen-free extract,	54.85	61.38	58.72	68.51
Fat,	11.21	5.87	11.99	6.54
	100.00	100.00	100.00	100.00

If we assume that the same coëfficients of digestibility apply to this substance as have been determined for maize meal, the digestible nutrients are, in CXXX,

Protein	10.37	per cent.
Fiber,	5.23	"
Nitrogen-free extract,	55.85	"
Fat,	4.99	"
Nutritive Ratio,	1:7	
Valuation,*	$1.17	per 100 lbs.
Cost,	$1.20	" " "

* Reckoned from the data used for comparison in former Reports which make the value of the best maize $1.10 and of wheat bran $1.04 per 100 lbs.

This "Sugar Feed" is a kiln-dried residue or waste from the manufacture of Glucose (or corn sugar) which is obtained by the action of acids on the starch of maize. It is in fact corn concentrated by removal of starch so that the protein is raised from 10 to 13 per cent., fiber from 2 to 9 per cent., while nitrogen-free extract (carbhydrates) is diminished from 68 to 58 per cent. CXXX contains but little more fat than average maize. In CI twice as much is present. Judged by these analyses alone Sugar Feed must be regarded as a valuable feeding stuff. It is rumored that dairymen find it objectionable for milk cows, and experience must be appealed to for positive information as to its merits.

New Process Linseed Meal.

XCI, From T. S. Gold, West Cornwall.

XCV, Sold by Smith, Northam & Robinson, Hartford, sent by E. Norton, Farmington.

XCVI, Sent by E. Norton.

	XCI.	XCV.	XCVI.	LXXV.
Water,	12.91	9.85	11.11	10.76
Ash,	6.08	5.67	5.61	6.71
Albuminoids or protein,	32.01	37.62	36.90	35.64
Fiber,	8.77	undet.	undet.	8.86
Nitrogen-free extract,	37.56	undet.	undet.	35.22
Fat,	2.67	4.87	5.89	2.81
	100.00			100.00

LXXV is the Station analysis of this excellent feeding stuff, made in 1879. The recent analyses show that the composition is fairly uniform. The estimated value of LXXV was $1.69 per hundred lbs. The cost was $1.50, which is also the present price.

Cotton Seed Meal.

CXXIX. Cotton Seed Meal. Sent by H. H. Austin from stock of W. F. Fuller, Suffield. The same as fertilizer **629**, p. 47. Cost, $30 per ton.

		Water-free.
Water,	9.06	----
Ash,	7.50	8.24
Protein,	42.50	46.75
Fiber,	4.24	4.66
N. fr. extract,	22.12	24.30
Fat,	14.58	16.05
	100.00	100.00

Bran and Brewers' Grains.

CIII. Wheat Bran from E. Norton, April 1st.

CXXI. Wheat Bran from F. R. Starr, April 8th.

CXIV. Brewers' Grains from J. J. Webb, April 5th.

The above were sampled by H. P. Armsby at the dates given from the material in use at the dairies of the above named parties.

	Fresh.			Water-free.		
	CIII.	CXXI.	CXIV.	CIII.	CXXI.	CXIV.
Water,	13.56	13.94	78.21	----	----	----
Ash,	6.15	5.52	1.36	7.11	6.41	6.29
Protein,	16.56	14.89	4.79	19.17	17.32	22.00
Fiber,	8.22	7.31	3.20	9.51	8.52	14.69
N. fr. extract,	51.56	55.95	11.65	59.63	65.07	53.40
Fat,	3.95	2.39	0.79	4.58	2.68	3.62
	100.00	100.00	100.00	100.00	100.00	100.00

Roots.

CXII. Mangolds raised by J. J. Webb, Hamden. Sampled April 5, 1881, by H. P. Armsby.

CXX. Mangolds, Golden-globe, from farm of F. R. Starr, Litchfield. Sampled by H. P. Armsby, April 8, 1881.

CXIII. Turnips raised by J. J. Webb. Sampled by H. P. Armsby, April 5, 1881.

	Fresh.			Water-free.		
	CXII.	CXX.	CXIII.	CXII.	CXX.	CXIII.
Water,	92.82	91.44	88.89	----	----	----
Ash,	.91	1.17	.71	12.65	13.64	6.36
Protein,	1.89	1.65	1.34	26.36	19.27	12.14
Fiber,	.76	.80	.86	10.54	9.28	7.76
N. fr. Ext.,	3.56	4.91	8.11	49.63	57.46	72.90
Fat,	.06	.03	.09	.82	.35	.84
	100.00	100.00	100.00	100.00	100.00	100.00

Sugar Beet Pulp.

XCIV. Sent by A. W. Cheever, Esq., Sheldonville, Mass., from the Franklin Beet Sugar Works.

	Fresh.	Water-free.
Water,	91.31	----
Ash,	.47	5.42
Albuminoids or Protein,	.94	10.84
Fiber,	2.13	24.48
Nitrogen-free extract,	5.11	58.86
Fat,	.04	.40
	100.00	100.00

This Pulp is perhaps the most watery and least concentrated cattle food of vegetable origin that is employed. Turnips even are a little better in composition. Whey alone, of all feeding stuffs, surpasses it in dilution. That it will bear but little cost of transportation or handling is evident.

Apple Pomace.

In January, Mr. J. H. Dickerman of Mt. Carmel, brought a sample of frozen fresh apple pomace to the Station, with the statement, that while horned cattle scarcely touched it, his horses and colts ate it with evident relish and benefit. The sample, No. XCVII, was analyzed with the following result. An analysis by Prof. F. H. Storer,* is given by way of comparison:

	XCVII.		XCVII. Water free.
Water,	72.62	77.21	
Ash,	0.81	.50	2.96
Albuminoids,	1.65	.98	6.03
Crude Fiber,	5.92	3.90	21.62
Nitrogen free extract,	17.03	15.71	62.19
Fat and wax,	1.97	1.70	7.20
	100.00	100.00	100.00

In respect to the quantities of the various food-elements the analysis shows that this pomace is superior to corn-fodder, and to turnips, mangolds and all of our root crops except the potato, and that it is but little inferior to the last named tuber.

* In his paper On the Fodder Value of Apples. Bulletin of the Bussey Institution, vol. i, p. 365.

The digestibility of the food-elements in the pomace is not known with certainty, but probably the nitrogen free-extract is nearly equivalent to the same amount of digestible carbhydrates (starch, sugar) and there can be little doubt that the pomace is, in nutritive quality, equal if not superior to the feeding stuffs above named, potatoes alone excepted.

This sample was from a press of more than ordinary power and therefore rather dryer than apple pomace commonly is. It is considerably richer in albuminoids and fiber than Prof. Storer's sample, which may probably be due to the greater proportion of seeds, cores, and skins contained in common cider apples over that found in the sound Baldwins from which his sample was obtained.

Prof. Storer in his paper, published in 1875, remarks: "It would be interesting to determine by actual trial whether a process of preservation which is largely employed in Europe for keeping a variety of soft and juicy materials might not be available for the preservation of pomace." He refers here to the "sour fodder" of the Germans, which is neither more nor less than a kind of "ensilage," and his suggestion is well worth considering.

Hay.

C. Timothy hay, farm of T. S. Gold, West Cornwall. Taken March 19, 1881.

CVIII. Low-meadow hay from farm of E. Norton, Farmington, April 1.

CXVIII. Hay fed (not raised), by F. R. Starr, Litchfield, April 8.

CVII. Uneaten portion of CVIII, April 1.

CXIX. Uneaten portion of CXVIII, April 8.

The above were sampled by Dr. Armsby at the dates given.

	C.	CVIII.	CXVIII.	CVII.	CXIX.
Water,	13.47	14.51	15.83	19.25	23.93
Ash,	3.86	5.84	4.21	5.04	3.70
Protein,	7.63	10.10	6.68	6.04	4.44
Fiber,	29.26	25.05	27.06	28.31	26.71
N. fr. Ext.,	43.48	42.45	44.74	39.65	40.08
Fat and Wax,	2.30	2.05	1.48	1.71	1.14
	100.00	100.00	100.00	100.00	100.00

	Water-free.				
	C.	CVIII.	CXVIII.	CVII.	CXIX.
Ash,	4.45	6.83	5.00	6.25	4.87
Protein,	8.82	11.82	7.93	7.48	5.84
Fiber,	33.83	29.31	32.15	35.07	35.11
N. fr. Ext.,	50.24	49.64	53.17	49.08	52.69
Fat and Wax,	2.66	2.40	1.75	2.12	1.49
	100.00	100.00	100.00	100.00	100.00

Mr. Gold's Timothy hay, like the sample from his farm, analyzed in 1879, is rather low in content of protein (albuminoids), and ranks as "inferior" compared with Wolff's standard. Dr. Armsby leaves us to infer that it was completely eaten, while of the low-meadow hay of Mr. Norton, which "analyzes better," some 12 per cent. was left uneaten in feeding. Of the still poorer hay fed by Mr. Starr (but not raised by him), about 7 per cent. was uneaten. The parts rejected by the cows, CVII and CXIX, are seen by the analyses to be much inferior in composition to the entire hay. The uneaten portions, as every farmer knows, consist chiefly of the coarse woody stems of grasses and of weeds. The analyses show that these contain more water by 5 to 8 per cent. than the entire hay, doubtless derived from the saliva and warm breath of the cows. Comparison of the analyses reckoned on dry matter shows a less content of protein by 2 to 4 per cent., and a correspondingly larger proportion of fiber in the uneaten hay.

For the composition of the eaten parts of these samples see pages 95 and 100.

Maize Fodder and Stover.

CX. Corn fodder, farm of E. Norton, Farmington.

CIX. Uneaten part of CX. April 1.

CXI. Stover (Corn stalks), farm of J. J. Webb, Hamden.

CXVI. Uneaten part of CXI. April 5.

The above were sampled at the dates given by Dr. Armsby.

					Water-free.			
	CX.	CIX.	CXI.	CXVI.	CX.	CIX.	CXI.	CXVI.
Water,	14.84	18.29	23.13	39.74	....	....	....	....
Ash,	4.47	4.14	4.34	4.24	5.26	5.06	5.65	7.04
Protein,	5.76	4.72	7.19	3.72	6.77	5.78	9.36	6.18
Fiber,	25.93	28.70	27.24	22.20	30.46	35.13	35.44	36.83
N. fr. Ext.,	47.55	42.77	36.45	29.28	55.77	52.35	47.41	48.59
Fat,	1.45	1.38	1.65	.82	1.74	1.68	2.14	1.36
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

Of Mr. Norton's Corn-fodder about 16 per cent., of Mr. Webb's Stover, 35 per cent., were left uneaten. The analyses show a striking difference between the composition of the entire fodder and the rejected portions. The latter, as in case of hay, and for the same reason, probably, are much more watery than the former, and less rich in protein.

In Dr. Armsby's paper, pages 95 and 98, will be found statements of the composition of the eaten portions of these maize fodders.

Ensilage.

XCVIII. Maize Ensilage, received Feb. 5th.
CXXIII. Cabbage Ensilage, received April 14th.
Both sent by B. C. Platt, of Suffield.

	XCVIII. Fresh.	CXXIII. Fresh.	XCVIII. Water-free.	CXXIII. Water-free.
Water,	82.09	87.61		
Ash,	1.04	4.16	5.84	33.59
Albuminoids,	1.27	1.19	7.07	9.64
Crude fiber,	5.76	1.59	32.15	12.84
Nitrogen free extract	9.50*	4.52	53.03†	36.43
Fat and wax,	0.34	0.93	1.91	7.50
	100.00	100.00	100.00	100.00

* Contained free acid 0.66 reckoned as acetic acid.
† " " 3.69 " "

Further information as to the composition and feeding value of Ensilage will be found in the New Jersey Station Bulletin on that subject, which is reprinted on subsequent pages.

OBSERVATIONS ON THE FEEDING OF MILCH COWS

AS PRACTICED IN CONNECTICUT.

By Professor H. P. Armsby, Ph.D.

The observations described in the following pages were made for the purpose of comparing the rations used by good farmers in this State with those which foreign, and especially German, experience and investigation have shown to be best adapted to the conditions prevailing in the countries where those investigations were made.

Owing to the comparatively limited time available for work of this sort, and the very considerable amount of analytical work involved, but four rations have been thus compared, and consequently these observations can only be considered as a beginning in this direction.

The farms visited were those of Secretary T. S. Gold, of West Cornwall, Edward Norton, Esq., of Farmington, J. J. Webb, Esq., of Hamden, and F. R. Starr, Esq., of Litchfield, and the thanks of the Station are due to these gentlemen for the interest they took in the investigations and the willingness with which they placed all possible facilities at the Station's disposal and contributed their own time and personal attention to the proper carrying out of the trials.

The method pursued at each place was substantially the same. A quantity of each fodder more than sufficient for a day's feeding was weighed out. From this amount the cows were fed exactly as usual, and by the same person. The amount of each fodder remaining after the day's feeding was weighed; any fodder left uneaten was also weighed, and from these data the amounts of the several feeding-stuffs actually consumed were found. Samples of the feeding-stuffs were also taken for analysis, and on the combined results of the weighings and analyses the calculations of the following pages are based.

The first farm visited was that of T. S. Gold, Esq., of West Cornwall (Cream Hill). The stock was nearly all Ayrshires and Ayrshire grades, and was fed chiefly for the milk, which was sent to New York. The feeding-stuffs used were hay, maize meal (ground with the cob), and "new process" linseed meal. The hay was mostly timothy and was cut June 30, 1880, cutting fully two tons per acre. Much hay is raised on the farm and it is the aim to feed as much of it as possible, using only what grain is necessary. The cows were fed hay and grain in the morning after milking, and hay at noon and night.

Two stables, containing together twenty-five cows in all stages of lactation, were selected for observation, and the fodder which they consumed was weighed for two consecutive days with the following results:

	1st Day.	2d Day.	Average.	Average per Head.
Hay eaten	549.00 lbs.	552.00 lbs.	550.50 lbs.	22.02 lbs.
Maize meal eaten	39.25	39.00	39.13	1.57
Linseed meal eaten	55.50	57 50	56.50	2.26

The close agreement of the results on the two days is, to a certain extent, a guarantee of their correctness, and is interesting as showing the uniformity in feeding attainable by practice.

In the above form, however, the ration cannot be readily compared with others in which different feeding-stuffs may have been used. The most practicable way in which to render it comparable with others is to estimate, as may be done with considerable accuracy from the chemical composition of the feeding-stuffs, the amounts of really nutritive (digestible) matters contained in the ration. The feeding-stuffs used were found to contain the following percentages of moisture:—

Hay	13.47 %
Maize meal	20.99
Linseed meal	12.91

The water-free substance of these feeding-stuffs had the following composition in 100 parts:—

	Ash. per cent.	Protein. per cent.	Crude fiber. per cent.	N. fr. Extract. per cent.	Fat. per cent.
Hay	4.45	8.82	33.83	50.24	2.66
Maize meal	3.02	10.35	5.50	76.50	4.63
Linseed meal	6.98	36.76	10.07	43.14	3.05

From these data we proceed to estimate the digestibility of the ingredients of these feeding-stuffs. The hay has approximately the same composition as the average of those designated by Wolff as "Inferior," particularly as regards protein and crude fiber, and since experience has shown that the digestibility of hay is largely determined by its chemical composition, we may assume this hay to have had the same digestibility as the average of Wolff's "Inferior," and say that about 52 per ct. of its protein and

49 per ct. of its fat were digested. The digestible carbhydrates we consider to be equal to the total amount of nitrogen-free extract, because experiment has shown that this is almost always the case with coarse fodder, within narrow limits. We conclude, then, that the *dry matter* of this sample of hay contained 52 per cent. of 8.82 per cent., or 4.59 per cent. of *digestible* protein, 49 per cent. of 2.66 per cent., or 1.30 per cent. of *digestible* fat, and 50.24 per cent. of *digestible* carbhydrates. That these numbers are not exact is sufficiently evident from the manner in which they are obtained. They are simply the best estimate of the digestibility of this particular sample which the results of numerous digestion experiments enable us to form.

In very much the same way we estimate the digestibility of the other feeding-stuffs used, except that there is less uncertainty involved, the digestibility of concentrated fodders having usually been found to vary less than that of coarse fodders. In the case of the maize meal the estimate is complicated by the presence of an indeterminate amount of cob. In twelve samples of maize examined at this Station in 1878,* the cob was found to amount on the average to about 20 per cent. of the weight of the corn. On this basis, and assuming the cob to be of average composition, it will be found that a separate estimate of the digestibility of corn and cob will yield a final result differing by less than 0.05 lb. per head from that obtained by applying the digestion coëfficients of maize directly to the cob-meal. We are therefore at liberty to pursue the latter and simpler course. Our digestion coëfficients, then, which express the percentage digestibility of the several ingredients of the feeding-stuffs are:

	Protein.	Crude Fiber.	N. fr. Extract.	Fat.
Hay,	52	--	--	49
Maize meal,	79	62	91	85
Linseed meal,	85	44	81	90

The dry matter of our feeding-stuffs, therefore, contains of digestible matters:

	Protein. per cent.	Carbhydrates, per cent.†	Fat, per cent.
Hay,	4.59	50.24	1.30
Maize meal,	8.18	73.03	3.93
Linseed meal,	31.25	39.37	2.75

* Report, 1878, p. 74.

† The digestible portions of the crude fiber and of the N. fr. extract, have the same composition and are added together as carbhydrates.

It is now a very simple matter to calculate the amounts of total dry matter, and of digestible protein, carbhydrates and fat, contained in the daily ration per head. We obtain the following results :

	Total dry matter. lbs.	Digestible.		
		Protein. lbs.	Carbhydrates. lbs.	Fat. lbs.
Hay ... .22.02 lbs.	19.05	0.87	9.57	0.25
Maize meal .... 1.57 "	1.24	0.10	0.91	0.05
Linseed meal... 2.26 "	1.97	0.62	0.78	0.05
Total.	22.26	1.59	11.26	0.35
Total per 1,000 lbs. live weight,	26.19	1.87	13.25	0.41
Wolff's standard,	24.00	2.50	12.50	0.40

The cows weighed by estimate 800–900 lbs. each, and hence the total of the above ration has been re-calculated to the basis of 1,000 pounds live-weight to render it comparable with the ration recommended by Wolff, which is placed below it. It will be noticed at once that the two differ considerably, but any remarks on this difference will be deferred until the remaining rations have been considered.

The average yield per day and head of the whole herd was about 6.3 quarts of milk.

The second farm which was visited was that of Mr. Edward Norton, of Farmington. Here the cows were mostly Guernseys and Jerseys. The milk is sold to the Farmington Creamery and hence care is taken to feed nothing which could injure the flavor of the butter. For this reason no oil-cake is used. The fodder of twenty-six cows, in all stages of lactation, was weighed. This included nearly all the cows in milk. The average weight of the animals was, by estimate, 925 pounds. The following feeding-stuffs were used:

Low meadow hay, cut in July, 1880. The cows had just been changed to this from better hay, and ate rather less than usual in consequence.

Corn fodder from northern corn, cut in September, 1880. Three bushels of seed per acre in drills 2½ feet apart.

Oats, maize meal, and wheat bran. The oats and maize are ground together in the proportions of ⅓ oats and ⅔ maize, and one bag of this mixture is added to two bags of bran, this being estimated to be about equal parts by weight. This mixture we will designate as "grain."

The order of feeding was grain followed by corn fodder in the morning, hay at noon, and grain followed by hay at night. The hay lay in the mangers over night.

The following weighings were made on two successive days:

	1st Day.	2d Day.	Average.	Av. per day and head.
Hay fed,	475.5 lbs.	472.5 lbs.	474.0 lbs.	18.23 lbs.
Hay left uneaten,	73.5	44.5	59.0	2.27
Hay eaten,	402.0	428.0	415.0	15.96
Corn fodder fed,	101.0 lbs.	95.0 lbs.	98.0 lbs.	3.77 lbs.
" left uneaten,	18.0	13.5	15.8	0.61
" eaten,	83.0	81.5	82.2	3.16
Grain eaten,	115.0 lbs.	116.0 lbs.	115.5 lbs.	4.44 lbs.

The fodders were found to contain the following amounts of moisture at the barn:

Hay,	14.51	per cent.
Hay left uneaten,	19.25	"
Corn fodder,	14.84	"
Corn fodder left uneaten,	18.29	"
Oats,	13.48	"
Maize,	18.16	"
Wheat bran,	13.56	"

Their dry matter had the following composition:

	Ash, Per cent.	Protein. Per cent.	Crude Fiber. Per cent.	N. fr. Extr. Per cent.	Fat. Per cent.
Hay,	6.83	11.82	29.31	49.64	2.40
Hay left uneaten,	6.25	7.48	35.07	49.08	2.12
Corn fodder,	5.26	6.77	30.46	55.77	1.74
Corn fodder left uneaten,	5.06	5.78	35.13	52.35	1.68
Oats.	4.00	10.83	10.72	68.81	5.64
Maize,	1.76	11.73	1.79	79.36	5.36
Wheat bran,	7.11	19.17	9.51	59.63	4.58

Analyses were also made of the mixed oats and maize, and of the mixed "grain" as fed. A comparison of these analyses showed that the mixed "grain" was composed of very nearly one part of oats, two parts of maize, and four parts of bran, by weight. If these proportions are taken as the basis of the calculation, the amount of non-nitrogenous matters contained in the 4.44 lbs. of "grain" fed, differs by less than 0.04 lbs. from that found when the actual composition of the "grain" is made the basis of the calculation, while the amount of protein differs less than 0.01 lb. We may, therefore, estimate without essential error that the 4.44 lbs. of "grain" fed were composed of

Oats,	0.63 lbs.
Maize,	1.27
Wheat bran,	2.54
	4.44

It will be noticed that analyses were made of the hay and corn fodder left uneaten and that these, as was to be expected, were of poorer quality than the original materials. It follows that the portions actually eaten were of correspondingly better quality, and it is the composition of these which must furnish us with the correct basis for our estimate of digestibility. The 18.23 pounds of hay fed per day and head contained 12.07 pounds of dry matter, and the 2.27 pounds left uneaten contained 1.75 pounds of dry matter. By subtracting the amounts of the several ingredients contained in the latter quantity from those contained in the former, we shall obtain the amounts contained in the 10.32 pounds of dry matter actually eaten, from which its percentage composition may readily be computed. The calculation is as follows:

	Dry matter of hay fed out. lbs.	Dry matter of hay uneaten. lbs.	Dry matter of hay eaten. (Difference.) lbs.	Percentage composition of dry matter of hay eaten.
Ash,	0.82	0.11	0.71	6.88
Protein,	1.43	0.13	1.30	12.60
Crude Fiber,	3.54	0.61	2.93	28.39
N. fr. extract,	5.99	0.86	5.13	49.71
Fat,	0.29	0.04	0.25	2.42
	12.07	1.75	10.32	100.00

Making a similar computation for the corn fodder we obtain the following results:—

	Dry matter of fodder fed out.	Dry matter of fodder uneaten.	Dry matter of fodder eaten. (By difference.)	Percentage composition of dry matter of fodder eaten.
	lbs.	lbs.	lbs.	per cent.
Ash	0.12	0.02	0.10	5.15
Protein	0.16	0.02	0.14	7.22
Crude fiber	0.72	0.15	0.57	29.38
N. fr. extract,	13.2	0.22	1.10	56.70
Fat	0.04	0.01	0.03	1.55
	2.36	0.42	1.94	100.00

The composition thus found differs somewhat from the composition of the hay and corn fodder as fed, and indicates a greater digestibility. The following digestion coefficients may be assumed to represent fairly the digestibility of the various feeding-stuffs here used. Those for the maize fodder are not those given under that head in the tables, but are the average coefficients for Wolff's "Inferior" meadow hay, with which this sample of corn fodder agrees approximately in composition. The only coefficients which we have for maize fodder are the results of but a single experiment on fodder of unusually excellent quality and hence are much too large for a sample of this sort.

Digestion coefficients.

	Protein.	Crude fiber.	N. fr. extract.	Fat.
Hay eaten	60	--	--	48
Corn fodder eaten	56	--	--	48
Oats	74	21	73	82
Maize	79	62	91	85
Wheat bran	88	20	80	80

The dry matter of our fodders, then, contains the following percentages of *digestible* nutrients :—

	Protein. per cent.	Carbhydrates. per cent.	Fat. per cent.
Hay eaten	7.56	49.71*	1.16
Corn fodder eaten	4.04	56.70*	0.74
Oats	8.01	52.48	4.62
Maize	9.27	73.33	4.56
Wheat bran	16.87	49.61	3.66

* Equal to total N. fr. extract.

The ration per day and head was, therefore, thus constituted :—

Eaten.		Total dry matter. lbs.	Digestible.		
			Protein. lbs.	Carbhydrates. lbs.	Fat. lbs.
Hay	15.96 lbs.	10.32	0.78	5.13	0.12
Corn fodder	3.16 "	1.94	0.08	1.10	0.01
Oats	0.63 "	0.55	0.04	0.29	0.03
Maize	1.27 "	1.04	0.10	0.76	0.05
Wheat bran	2.54 "	2.20	0.37	1.09	0.08
Total	23.56 "	16.05	1.37	8.37	0.29
Per 1,000 lbs. live weight,		17.35	1.48	9.05	0.31
Standard,		24.00	2.50	12.50	0.40

The average yield of milk per day and head by the whole herd for the week previous to these observations was 7.7 quarts.

The third farm visited was that of J. J. Webb, Esq., of Hamden. Six cows were selected by Mr. Webb as representing a fair average of his herd. Some of them were good milkers but not fresh. Their average weight was, by estimate, 925 pounds each.

The following feeding-stuffs were in use:

"Meal," a mixture of 200 parts wheat bran, 100 parts cotton seed meal, and 60 parts malt sprouts. Brewers' grains. Mangolds. Turnips. Hungarian hay and sheaf oats, cut. Stover, also cut.

The order of feeding was as follows:— In the morning brewers' grains, "meal," turnips, hay; at about 10 A. M., stover; at about 2.30 P. M., mangolds; at about 4 P. M., brewers' grains, "meal," stover. The stover lies in the mangers over night.

The following weights were obtained:

	1st Day.	2d Day.	Average.	Average per head.
Stover fed out	72.00 lbs.	61.75 lbs.	66.88 lbs.	11.15 lbs.
" uneaten	30.25	17.40	23.83	3.97
" eaten	41.75.	44.35	43.05	7.18
Hay eaten	35 00	31.75	33.38	5.56
"Meal" eaten	15.00	14.75	14.88	2.48
Brewers' grains eaten	121.75	112.00	116.88	19.48
Mangolds	79.50	88.50	84.00	14.00
Turnips	74.25	63.50	68.88	11.48

The analyses of the feeding-stuffs employed and of the uneaten stover gave the following results:—

Moisture.

Stover	23.13 per cent.
Stover uneaten	39.74 "
Hay	19.33 "
Brewers' grains	78.21 "
"Meal"	13.75 "
Mangolds	92.82 "
Turnips	88.89 "

Composition of Dry Matter.

	Ash. per cent.	Protein. per cent.	Crude fiber. per cent.	N. fr. extract. per cent.	Fat. per cent.
Stover	5.65	9.36	35.44	47.41	2.14
Stover uneaten	7.04	6.18	36.83	48.59	1.36
Hay	8.57	13.22	31.37	45.04	1.80
Brewers' grain	6.29	22.00	14.69	53.40	3.62
"Meal"	7.06	26.18	8.52	52.43	5.81
Mangolds	12.65	26.36	10.54	49.63	0.82
Turnips	6.36	12.14	7.76	72.90	0.84

The very large proportion of protein in the mangolds is noteworthy, and indicates that much of it belongs to nitrates, amides, and other non-albuminoid nitrogenous compounds.

Computing the percentage composition of the stover actually eaten we get the following results:—

	Dry matter of stover fed out. lbs.	Dry matter of stover uneaten. lbs.	Dry matter of stover eaten. (By difference.) lbs.	Percentage composition of dry matter of stover eaten.
Ash	0.44	0.15	0.29	5.21
Protein	0.72	0.13	0.59	10.59
Crude fiber	2.74	0.80	1.94	34.83
N. fr. extract	3.67	1.06	2.61	46.86
Fat	0.17	0.03	0.14	2.51
	7.74	2.17	5.57	100.00

No samples could be obtained of the bran, malt sprouts, or cotton seed meal used, and therefore the averages of the digestion coefficients of these substances are applied to the mixture of the three. The coefficients for malt sprouts are only estimates, no determinations of their digestibility having yet been made, and the same is true of those for brewers' grains. Those for cotton seed meal are results recently obtained by Wolff* in experiments on sheep, with "decorticated" cotton-seed meal, and are notably higher than those previously obtained with a sample which was not "decorticated."

Digestion Coefficients.

	Protein.	Crude fiber.	N. fr. extract.	Fat.
Hay	60	--	--	50
Stover	50	--	--	30
Brewers' grains,	85	--	--	80
Wheat bran	88	20	80	80
Cotton seed meal	85	0	95	88
Malt sprouts	80	--	--	80
Average for "meal"	84	10(?)	90	83

The roots are assumed to be entirely digestible and the digestible crude fiber and nitrogen-free extract of the brewers' grains and malt sprouts are assumed to equal the total nitrogen-free extract. On the basis of these coefficients, the dry matter of the fodders contained the following amounts of digestible matters:—

	Protein. per cent.	Carbhydrates. per cent.	Fat. per cent.
Hay	7.93	45.04	0.90
Stover eaten	5.29	46.86	0.75
Brewers' grains	18.70	53.40	2.90
"Meal"	21.99	48.04	4.82
Mangolds	26.36	60.17	0.82
Turnips	12.14	80.66	0.84

* Landw. Versuchs-Stationen, xxvii, 226.

The daily ration per head was, accordingly, thus constituted:—

	Dry matter. lbs.	Digestible.		
		Protein. lbs.	Carbhydrates. lbs.	Fat. lbs.
Hay .... 5.56 lbs.,	4.49	0.36	2.02	0.04
Stover .... 7.18 "	5.57	0.29	2.61	0.04
Brewers' grains 19.48 "	4.24	0.79	2.26	0.11
"Meal"....... 2.48 "	2.14	0.47	1.03	0.10
Mangolds... ..14.00 "	1.01	0.27	0.61	0.01
Turnips ....11.48 "	1.28	0.16	1.03	0.01
Total, ...	18.73	2.34	9.56	0.31
Total per 1,000 lbs. live weight, ...	19.25	2.53	10.34	0.34
Standard, ...	24.00	2.50	12.50	0.40

The average yield of milk per head on the two days of the experiment was 22.3 lbs. and 23.3 lbs. respectively, or an average of about 10.4 quarts per head for the two days.

The fourth farm visited was that of F. R. Starr, Esq., of Litchfield (Echo Farm). The stock is Jerseys and Jersey grades. Part of the milk is shipped directly to New York and the rest is made into butter on the premises.

Eight pure Jersey cows, not including the best milkers, were selected by Mr. Starr as fairly representing the average of his herd. They had been in milk for from one to eight months and were on full feed. Their average weight was 890 pounds. The cows being valuable, it is considered of the first importance to keep them in good condition for breeding, and hence it is intended to feed them only moderately.

At the time the farm was visited the supply of home grown hay was exhausted and hay was being bought, so that frequent changes in the quality of the hay fed were being made. Owing to this and other unavoidable circumstances the results obtained were less satisfactory than in the other cases and the weighings were continued only through one day.

The feeding-stuffs employed were hay, provender (equal weights of maize and oats), wheat bran, and mangolds. The order of feeding was:—In the morning, provender, bran and hay; at noon, hay; at 3 P. M., mangolds; at night, provender, bran and hay.

The following tables contain the results of the weighings and analyses made:—

	Total.	Per head.
Hay fed out	203.00 lbs.	25.38 lbs.
Hay uneaten	14.86	1.86
Hay eaten	188.14	23.52
Bran eaten	20.00	2.50
Provender eaten	37.50	4.69
Mangolds eaten	60.00	7.50

Moisture in Fodders.

Hay	15.83 per cent.
Hay uneaten	23.93
Bran	13.94
Provender	17.28
Mangolds	91.44

Composition of Dry Matter of Fodders.

	Ash. Per ct.	Protein. Per ct.	Crude fiber. Per ct.	N. fr. extr. Per ct.	Fat. Per ct.
Hay	5.00	7.93	32.15	53.17	1.75
Hay uneaten	4.87	5.84	35.11	52.69	1.49
Bran	6.41	17.32	8.52	65.07	2.68
Provender	2.46	11.25	5.23	76.99	4.07
Mangolds	13.64	19.27	9.28	57.46	0.35

Composition of Dry Matter of Hay Eaten.

	Dry matter of hay fed out. lbs.	Dry matter of hay uneaten. lbs.	Dry matter of hay eaten. lbs.	Percentage composition of dry matter of hay eaten.
Ash	0.85	0.07	0.78	4.96
Protein	1.36	0.08	1.28	8.14
Crude fiber	5.49	0.48	5.01	31.87
N. fr. extract	9.09	0.72	8.37	53.25
Fat	0.30	0.02	0.28	1.78
	17.09	1.37	15.72	100.00

Digestion Coëfficients.

	Protein.	Crude fiber.	N. fr. extract.	Fat.
Hay eaten	52	--	--	49
Maize	79	62	91	85
Oats	74	21	73	82
Average for provender	77	47	82	84
Bran	88	20	80	80

Percentage of Digestible Nutrients in Dry Matter.

	Protein.	Carbhydrates.	Fat.
Hay eaten	4.23	53.25	0.87
Provender	8.66	65.59	3.42
Bran	15.24	53.76	2.14
Mangolds	19.27	66.74	0.35

Daily Ration per Head.

	Dry matter. lbs.	Digestible.		
		Protein. lbs.	Carbhydrates. lbs.	Fat. lbs.
Hay .... 23.52 lbs.	15.72	0.66	8.37	0.14
Provender ...... 4.69 "	3.88	0.34	2.54	0.13
Bran .... 2.50 "	2.15	0.33	1.16	0.05
Mangolds ... .. 7.50 "	0.64	0.12	0.43	---
Total, ...	22.39	1.45	12.50	0.32
Total per 1,000 lbs. live weight, ...	25.16	1.63	14.04	0.36
Standard, ...	24.00	2.50	12.50	0.40

The average daily yield of milk per head for five days preceding these weighings was 24.74 lbs., equal to about 11.3 quarts.

In the foregoing pages we have sought to make as accurate a comparison as is possible under the circumstances of the rations in use on these four farms with that which German investigators have found to produce the best results. In every case we have found more or less difference and in all but one a very noticeable difference. For the sake of easy comparison the five rations are brought together in the following table:—

	Mr. Gold's Ration. lbs.	Mr. Norton's Ration. lbs.	Mr. Webb's Ration. lbs.	Mr. Starr's Ration. lbs.	Dr. Wolff's standard Ration. lbs.
Dry matter	26.19	17.35	19.25	25.16	24.00
Digestible protein	1.87	1.48	2.53	1.63	2.50
" carbhydrates.......	13.25	9.05	10.34	14.04	12.50
" fat	0.41	0.31	0.34	0.36	0.40
Total digestible matter	15.53	10.84	13.21	16.03	15.40
Nutritive ratio	1:7.6	1:6.7	1:4.4	1:9.1	1:5.4

One point to be remembered in comparing these rations is that Mr. Webb's and Mr. Starr's both contained roots. The very high percentage of nitrogen in these roots indicates that they contained large amounts either of nitrates or of the various amide-like bodies which have been found in relative abundance in mangolds. Consequently the numbers given under "protein" should be diminished somewhat to represent the true amount of this ingredient. The difference thus made, however, is so small comparatively as to have little effect on our conclusions.

The question now presents itself, which of these five rations is the best one, or are they all the best for their respective circumstances? Obviously no complete answer can be given to this question. We are not justified in concluding that the Connecticut rations are in so far incorrect as they differ from the German standard, nor on the other hand are we warranted in assuming without question that the Connecticut rations are the best that could be devised under the circumstances. The object of this paper being chiefly statistical, it is not proposed to enter into an elaborate discussion of this point, and still less to make any criticisms on the methods of feeding practiced, but there are certain fairly well established general principles concerning the feeding of milk cows which may throw some light on the subject.

In the first place, it may be remarked that Wolff's standard ration is unquestionably a good one, as has been shown by abundant experience in Germany and to some extent in this country. It is no theoretical deduction from chemical or physiological laws, but rests on the firm basis of actual trial on the farm.

In comparing the other rations with it, it is noticeable at once that, with one exception, they contain a much larger proportion of non-nitrogenous nutrients to nitrogenous (protein or albuminoids) than is the case with the standard, while in one case there is also as compared with the standard a decided deficiency in the amount of total digestible matter. It therefore seems reasonable to conclude that if, in Mr. Norton's ration, the *amount* of the several nutrients had been increased, without altering their proportions, the result would have been a larger yield of milk.* Furthermore, all experiments on milk-production have shown that the most milk is produced on a ration containing a large proportion of protein, and there can be no reasonable doubt that if the relative amount of protein in these rations had been increased and that of carbhydrates and fat decreased, so as to keep the total amount of digestible matters the same, more milk would have been produced. Of these conclusions we may feel very certain. Our figures, to be sure, rest on estimates of the digestibility of the feeding stuffs and in some cases of the live weights of the animals and therefore are not exact, but they are probably exact enough to show that in these rations with one exception the nutritive ratios, viz: 1 : 7.6, 1 : 6.7 and 1 : 9.1, are much wider than that adapted to the most abundant production of milk (1 : 5.4). In Mr. Webb's ration the nutritive ratio is narrower, viz: 1 : 4.4. We are therefore justified in regarding it as in the highest degree probable, if not certain, that a narrowing of the nutritive ratio in the three cases to that of the standard ration, by decreasing the

* i. e. If the animals were not too far advanced in lactation.

hay and increasing the bran or linseed meal, for example, would have resulted in an increased milk production, while, if the feed had been made even richer than the standard ration, still more milk might have been obtained.

But in practice the question to be solved is not what ration produces the most milk. If that were all, the problem before the feeder would be a comparatively simple one. The question is, what ration produces milk at the greatest profit, and the answer to this must obviously depend not only on the producing power of the ration, but on its cost, the price of the milk, the cost of labor, etc., and will be likely to be quite different under diverse circumstances. It is not difficult, however, to compute with a fair degree of accuracy whether, in any given case, an improvement of the ration by the addition of more protein is likely to be profitable.

As an example of the manner of making such a calculation, I have taken Mr. Gold's ration. At the time of these observations about 40 cows were being fed, and they averaged about 6 quarts of milk per day. Reducing Wolff's standard to the amounts called for by a cow weighing 850 pounds, the estimated weight of Mr. Gold's, we get

Total dry matter,	20.40 lbs.
Digestible protein,	2.13 "
" carbhydrates,	10.63 "
" fat,	0.34 "

If, now, in Mr. Gold's ration we replace four pounds of hay by one and three-fourths pounds of linseed meal, we get a ration corresponding very nearly to the standard, viz:

	Total Dry matter. lbs.	Digestible.		
		Protein. lbs.	Carbhydrates. lbs.	Fat. lbs.
Hay, 18 lbs.	15.58	0.72	7.83	0.20
Maize meal, 1.57 lbs.	1.24	0.10	0.91	0.05
Linseed meal, 4 lbs.	3.48	1.09	1.37	0.10
	20.30	1.91	10.11	0.35

If the hay saved by this method of feeding could have been sold at $13.13 per ton, it would have just paid for the extra linseed meal used at $30.00 per ton, leaving the extra yield of milk on the better ration as so much gained. Or, in case it was thought desirable to feed the hay on the farm, more cows could have been kept. Instead of 40 cows, 49 might have been kept on the same amount of hay, by purchasing extra corn meal and linseed meal. It is easy to calculate that the extra amounts thus required per day would be:—Of corn meal 14 pounds, and of linseed meal 106 pounds. At the rate of $1.50 per hundred for the corn meal and $30.00 per ton for the linseed meal, these would cost, together, $1.80. If we suppose that the cows yielded no more milk on this ration than on the old one, the 54 quarts of milk from the nine new cows would cost $1.80, or 3.3 cents per quart, plus the cost of the extra labor involved. If we suppose the yield of milk to have been increased to 7 quarts per day, then we obtain 103 quarts of milk more than before, at a cost for extra feed of $1.80, or at the rate of 1.7 cents per quart, plus the extra labor required.

Plainly, the results of such a calculation will vary with the prices of the feeding stuffs, while the question of gain or loss will depend also on the price which can be got for the milk, and would properly involve the value of the manure also. The above computation is simply intended to illustrate the principle on which such calculations can be made. It would be easy to make a similar computation for the other rations, and to estimate whether, under any given circumstances, better feeding would probably pay. Other elements, of course, might also enter into the calculation, such as the necessity of producing good butter in Mr. Norton's case, or considerations of the health of valuable cows, as in Mr. Starr's case.

Mr. Webb's ration differs from the others in containing nearly the amount of digestible protein called for by the standard, but less carbhydrates. The difference is not great, and several ingredients whose digestibility is doubtful enter into this ration, so that it would not be entirely safe to base positive conclusions on the results obtained. If our estimates represent accurately the quantities of digestible nutrients, it is probable that an increase of the digestible carbhydrates by two or three pounds would cause a somewhat greater flow of milk, or that as good a result could have been reached with less of the costly protein (albuminoids) and more of the cheap carbhydrates.

Another point worthy of notice in these rations is the amount of total dry matter. This, compared with the total digestible matter, shows us how much indigestible matter the animal had to work over to get the digestible nutrients. In the above rations the indigestible matter varies from 10.66 pounds to 6.04 pounds, and this means a corresponding difference in the internal work of digestion. A certain bulk of food is normally required by ruminating animals, but within reasonable limits, the less the amount of indigestible matters, the less energy is expended in digestion and the more is available for productive purposes, while the celebrated experiments of Miller on exclusive meal feeding seem to indicate that this saving by concentrated fodder may be temporarily made very large.

Still one more point remains to be briefly noticed. It may be said, as it is by some, that the results of foreign experimenters are good for their circumstances, but that it is doubtful if they apply to the quite different conditions prevailing here. If by this is meant that it is doubtful if the German standards will prove the most profitable under our conditions of climate, etc., the claim may perhaps be admitted. The point is one which can be settled only by numerous carefully conducted feeding trials, made by those who have had training in the art of experimenting and are familiar with the precautions necessary in such investigations. If, however, what is meant is that the general laws of animal nutrition as worked out by other observers do not apply to our conditions, we can only say that such a claim has a very slender basis in fact. In the case of milk production, for instance, there are some things that are settled beyond reasonable doubt. It has been established that the supply of protein in the food has a direct and striking influence on the amount of milk produced, and this is just as true in Connecticut as in Saxony. If the addition of protein to a ration like one of those given above produced a larger yield of milk on a Saxon farm, there is no obvious reason why the same result should not follow on a Connecticut farm. The increase might not be the same—probably it would not be—but neither our climate nor our cattle are so different from those of Europe as to give any reason for believing that the result would be any different in kind or largely different in degree. In one case the increase might be profitable, and in the other the reverse—that would depend on other considerations.

FEEDING EXPERIMENTS

On Milch Cows, with the use of Standard Rations, including Ensilage, made at the New Jersey Agricultural Experiment Station.

In previous Reports I have called attention to the Feeding Standards which the German Experiment Stations have elaborated by a large number of exact and laborious practical feeding trials. Early in 1881 the New Jersey Experiment Station published in its bulletins X and XI the results of some feeding experiments carried on under its immediate charge that fully confirm the estimate in which these feeding standards are held in Germany. These bulletins are so full of valuable information that, with consent of Dr. Cook, Director of the New Jersey Station, I reprint them for the benefit of Connecticut stock feeders.

An account of the Feeding Standards may be found in the Report of this Station for 1879, pp. 94–98; also in Dr. Armsby's *Manual of Cattle Feeding*, p. 368, and in Drs. Armsby and Jenkins' *Farmers' Annual* for 1882, p. 184.

"Bulletin X.

The object of this bulletin is to call the attention of the intelligent farmers of this State to a rational system of stock feeding. For illustration, a ration for milch cows has been computed, its cost estimated and its practical value shown by a feeding trial which has now lasted over fifty days.

A farmer feeding a good quality of clover hay will find that nearly thirty-five pounds per day will be necessary to maintain the flow of milk and prevent loss of flesh in a cow of about 1,000 lbs. live weight. Now according to an analysis recently made at the Station, thirty-five pounds of second growth clover hay from the College Farm contained:

4.6 lbs. Protein.
.9 lbs. Fat.
13.9 lbs. Starchy matter (Nitrogen-free extract*).
10.0 lbs. Woody " (Fiber).
1.7 lbs. Ash.
3.9 lbs. Water.

* See foot note, p. 78.

These constituents, however, are not all digestible. A chemical examination of the solid excrements of the cow would show that

1.85 lbs. Protein,
.40 lbs. Fat,
10.70 lbs. Woody and Starchy matter,

had passed through the animal undigested, and as far as nutrition is concerned, had been lost.

If now we subtract from the food eaten, the amount of indigestible matter found in the manure, we shall know how much digestible food there is in thirty-five pounds of clover hay. It will be found to be $2\frac{3}{4}$ lbs. protein, $\frac{1}{2}$ lb. fat and $13\frac{2}{10}$ lbs. starchy matter.

The cow then which consumes thirty-five pounds of clover hay daily, lives, increases perhaps a trifle in live-weight, and produces its milk from $2\frac{3}{4}$ lbs. protein, $\frac{1}{2}$lb. fat, and $13\frac{2}{10}$ lbs. starchy matter. German agricultural chemists have shown that an ordinary milch cow of 1,000 lbs. live weight does not require more than $2\frac{1}{2}$ lbs. digestible protein, $\frac{4}{10}$ lbs. digestible fat, and $12\frac{1}{2}$ lbs. digestible starchy matter daily, and German farmers have proved the correctness of these figures by years of practical experience. Of course, if a cow gives an unusual amount of milk, an unusual quantity of food will be necessary, if loss of live weight is to be avoided. In such cases the quantity of digestible matter can be increased to $2\frac{3}{4}$ lbs. of protein, $\frac{1}{2}$ lb. fat, and $13\frac{2}{10}$ lbs. starchy matter. It will rarely be found profitable, however, to feed more than this amount.

The farm should supply an abundance of digestible starchy matter in the form of fodder-corn, straw, chaff, turnips, etc. The digestible protein and fat can probably, in most cases, be bought at a lower price than the market value of that raised in New Jersey.

The following table will give an idea of the wide range of prices between farm products and such commercial articles as cotton-seed meal, oil cake, brewers' grains, etc.

100 lbs. of	Cost.	Contain of digestible Protein.	Fat.	Starch.*
Timothy Hay,	$1.00	3.02	1.37	48.58
Clover Hay,	.75	7.83	1.48	39.71
Corn Meal,	1.12	6.23	2.89	66.90
Brewers' Grains,	.25	4.73	1.50	14.29
Cotton Seed Meal,	1.30	33.00	10.89	12.62

* i. e., of *Carbhydrates;* see p. 78.

One hundred pounds of digestible protein, fat and starch, costs in

	Protein.	Fat.	Starch.
Timothy Hay,	$6.70	$6.70	$1.40
Clover Hay,	4.30	4.30	.90
Corn Meal,	4.90	4.90	1.00
Brewers' Grains,	2.80	2.80	.60
Cotton Seed Meal,	2.80	2.80	.60

The second table shows that digestible protein in Brewers' grains and cotton seed meal can be bought for about $2.75 per hundred pounds, while in corn meal it costs nearly $5.00 per hundred pounds, and in timothy hay $6.70 per hundred pounds. A farmer who can sell his Indian meal at $1.12 per hundred, will see that he is receiving five cents per pound for his protein, and can buy for his own use the same material for $2\frac{3}{4}$ cents per pound.

The point now to be explained is how to use cotton-seed meal in place of corn meal. By looking at the first table it will be seen that 100 lbs. of cotton seed meal contain 33 pounds of digestible protein; that we know is enough to last a cow over thirteen days; it contains too, fat enough to last twenty-one days, while the digestible starch in one hundred pounds is just enough for one day. To express the same idea in another way, we would need only eight pounds of the cotton seed meal to furnish the cow with the $2\frac{1}{2}$ pounds of protein, while the 8 pounds would give twice as much fat and only about $\frac{1}{12}$ as much starch as is necessary. We see then that the cotton-seed meal must be mixed with something which contains a large quantity of digestible starch, and a very small quantity of protein and fat. Wheat straw which contains in one hundred pounds only $\frac{8}{10}$ lbs. of digestible protein and $\frac{3}{10}$ lbs. of digestible fat, while it yields $37\frac{1}{2}$ lbs. of digestible starchy matters would seem to answer our purpose exactly. It would do exactly, if a cow were simply a milk machine, but a living creature is much more complicated than any machine can possibly be. One objection would be a difficulty to induce the animal to eat such a large amount of coarse fodder. Another would be a fact not yet mentioned, viz: the digestible food should be contained in a ration which when perfectly free from all traces of moisture, should not weigh more than from 24–28 pounds. If the food be mixed with a larger amount of indigestible matter, it is scarcely to be expected that it can be digested and assimilated. Now our ration of eight pounds of cotton-seed meal and thirty-three pounds of wheat straw would contain almost thirty-five pounds of dry matter, nearly ten pounds more than is allowable.

The ration fed to a herd of six mixed grade cows at the College Farm, has given perfect satisfaction; it was made up as follows, the calculation being for 1,000 lbs. live weight per day:

	Containing pounds of digestible		
	Protein.	Fat.	Starch.
6 lbs. Clover Hay,	0.47	.09	2.27
13 lbs. Wheat Straw,	0.11	.04	4.88
20 lbs. Brewers' Grains,	0.99	.33	2.86
20 lbs. Turnips,	0.26		2.06
2 lbs. Cotton Seed Meal,	0.66	.22	0.24
Total,	2.45	.65	12.31
The total dry matter was,		25.5 lbs.	

The total weight of the six cows, taken with all usual precautions, was 5,770 lbs. To find the amount of fodder and feed needed for the herd, we have therefore to multiply the weights, which, as above stated, are for 1,000 lbs., by 5.77; for example:

6 lbs. of Clover Hay,	× 5.77 = 34½	pounds.
13 lbs. Wheat Straw,	× 5.77 = 75	"
20 lbs. Brewers' Grains,	× 5.77 = 115	"
20 lbs. Turnips,	× 5.77 = 115	"
2 lbs. Cotton Seed Meal,	× 5.77 = 11½	"

The daily cost of the ration for 6 cows can now be easily computed:

35 lbs. Clover Hay, at $15 per ton,	=26 cents.
75 lbs. Wheat Straw, at $7 per ton,	=26 "
115 lbs. Brewers' Grains, at $5 per ton,	=29 "
115 lbs. Turnips, 10c. per bushel.	=19 "
11½ lbs. Cotton Seed Meal, at $26 per ton,	=15 "
	$1.15
Daily cost for each cow,	19 cents.

The straw was passed through a cutter and thoroughly mixed with the Brewers' Grains, Cotton Seed Meal and Turnips. The mixture was fed in equal portions morning and evening. The hay was fed at mid-day.

The cows were mixed grades taken from a herd of twenty-four head. They were milked twice daily—the milk of each cow being carefully weighed, and a sample of the mixed milk together with the record of the yield, sent each day to the Station by Mr. Theodore West, Farm Superintendent.

The following table gives a description of each cow and her total yield of milk:

Name of Cows,.	Strawberry.	Starface.	Daly.	Dominie.	Sutphen.	Camel.
Age of Cows,...	6 years.	6 years.	4 years.	7 years.	9 years.	7 years.
Weight of Cows,	965	1,000	825	917	880	1,220
Date of Calving,	Oct. 23, '80.	Oct. 10, '80.	June 12, '80.	July 15, '80.	Oct. 8, '80.	Apr. 15, '80.
Next Calf ex'd,.	Aug. 29, '81.	....	July 13, '81.	Aug. 1, '81.	....	Apr. 1, '81.

YIELD OF MILK.

	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.	lbs. oz.
From Nov. 16–Nov. 26—11 days,...	273.8	274	166	256	279.12	223.8
From Nov. 27–Dec. 7—11 days,....	292.8	261	185	259	272	218
From Dec. 8–Dec. 16—8 days.	199.8	185.8	147.12	190	199.8	160.4
Total yield for 30 days,............	765.8	720.8	498.12	705	751.4	601.12

The total yield for the entire herd is 4,042 lbs., 12 oz.

The weight of a quart of milk for practical purposes may be taken as two pounds. The total yield then for 30 days is 2,021 quarts, or 67.3 quarts daily, an average yield for each cow of over 11 quarts.

1. From the experiments it appears then that the cows have gained a little in flesh by being fed on this ration, and that their flow of milk has not diminished.

2. It is fairly proved that the ration saved directly 30 per cent. on the cost of a full ration of clover hay, and still more than this on one of clover and Indian meal.

3. The ration also saved indirectly by turning to profitable account the straw and coarse products which are ordinarily only used for manure.

4. The whole experiment shows that the live stock on a farm can be kept in good condition, and a much larger amount of its high priced products sold, than it is now the practice to sell, or that a greatly increased amount of live stock can be profitably kept while consuming all the food products.

The above is but a single example of the use of a computed ration. It was made for a special purpose; and there might have others calculated which would have been quite as economical.

GEORGE H. COOK, *Director.*

New Brunswick, N. J., Jan. 15, 1881."

"NEW JERSEY AGRICULTURAL EXPERIMENT STATION.

BULLETIN XI.—ENSILAGE.

In this bulletin we give the results of a feeding experiment with corn ensilage.

On November 16th four cows of native breed were taken from the herd at the College Farm, placed side by side in the same barn and for a term of ninety-one days were fed, exercised and milked at the same time.

During the first period of twenty-eight days a ration was divided among them, made up of twenty-two and one-half pounds of clover hay, forty-nine pounds of wheat straw, seventy-five pounds of brewers' grains, seventy-five pounds of turnips, and seven and one-half pounds of cotton seed meal. It was calculated to furnish daily to each 1,000 lbs. of live weight.

2.5 lbs. digestible protein.
0.5 lbs. digestible fat.
12.5 lbs. digestible carbhydrates.

This being according to German investigators the necessary amount of food.

For the second period of twenty-eight days no change was made in the ration fed cows Nos. I and II, while in that fed III and IV, 100 lbs. of ensilage was substituted for 40 lbs. of turnips; in other respects it remained the same as that fed during the first period; it furnished daily to each 1,000 lbs. of live weight

2.50 pounds digestible protein.
.90 pounds digestible fat.
14.90 pounds digestible carbhydrates.

This was fed in order to determine whether an increased amount of the heat-producing compounds, fat and starch, was rendered necessary by the severity of the weather. The additional food caused no increase in the yield of milk; cows I and II on the poorer ration gave during this period more milk than during the preceding.

Our intention thus far was to ascertain the quantity of food required to keep these cows up to their full yield of milk.

For the third period, of five weeks ending Feb. 17, Nos. I and II were fed the same as during the first and second periods; to III and IV an equal amount of digestible food was given daily, in 120 pounds of ensilage and five pounds of cotton seed meal per cow; it was eaten without waste and with apparent relish.

We tabulate below the yield of milk for 13 weeks. It must be remembered that during the first period all four cows received the same ration; that during the second and third periods cows I and II received the same as during the first; that cows III and IV were fed during the second period with an unusually rich ration, and during the third period with one made up of ensilage and cotton seed meal alone, containing however an amount of food equal to that fed during the first period.

	I. 7 yrs. old. Calved July 15. lbs.	II. 9 yrs. old. Calved Oct. 8. lbs.	III. 6 yrs. old. Calved Oct. 23. lbs.	IV. 6 yrs. old. Calved Oct. 10. lbs.
Average daily yield for 1st period, ----	23.5	25.1	25.6	24.1
" " " " 2d " ----	25.2	26.1	24.9	24.
" " " " 3d " ----	25.2	23.2	23.8	24.
" " " " 91 days, -----	24.6	24.8	24.8	24.

An opportunity is here offered to call attention to the fact that up to a certain point the yield of milk may be influenced by the quantity of digestible food, but beyond this point, which is determined by breed, time of calving and individual peculiarity, an increased amount of food fails to increase the yield of milk; ensilage can produce no more milk than any other fodder which contains an equal amount of food, a point well illustrated by the above table.

While the yield of milk and its per centage of butter cannot be increased at will, it is well known that its quality may be very materially influenced by the feeding. It is claimed for ensilage that it makes "Winter butter equal to June butter." A claim willingly admitted, butter made from the fodder being to our knowledge of unusually fine color and flavor.

The composition of ensilage is by no means constant, as the following table of analyses shows: soil, variety of corn, method of planting and cultivating, and above all the time of harvesting, exert a decided influence on its quality.

The samples furnished by Mr. Platt and Messrs. Whitman & Burrill had the characteristic vinous smell which indicated that they had been exposed to the air before reaching the laboratory—and probably an analysis of a perfect sample would have indicated a larger amount of nutritive matter. From personal observation at the silo we know that Mr. Platt's ensilage was as well preserved as any we have seen.

In this table the samples have been arranged with reference to their percentages of water and carbhydrates:

	Loss at 212° F. Pr. ct.	Protein. Pr. ct.	Fat. Pr. ct.	Fiber. Pr. ct.	Ash. Pr. ct.	Carbhydrates Pr. ct
Mr. Mills, Pompton, N. J.,	77.4	1.02	0.68	6.85	1.00	13.04
Mr. Morris, Oakland Manor, Md.,	78.51	.88	0.62	6.43	1.53	12.03
Buckley Bros., Port Jervis, N. Y.,	80.86	1.27	0.67	5.47	1.00	10.73
Coe Bros., West Meriden; Conn.,	82.10	1.21	0.71	5.34	1.02	9.62
College Farm, New Brunswick, N. J.,	83.52	.94	0.65	5.18	1.43	8.28
Mr. Platt, Suffield, Conn.,	83.56	1.06	0.73	5.76	.81	8.08
Whitman & Burrill, Little Falls, N. Y.,	83.54	1.06	0.50	5.85	1.40	7.65
James Lippincott, Mt. Holly, N. J.,	84.28	1.37	0.50	4.68	1.26	7.91
Dr. J. M. Bailey, Billerica, Mass.,	84.87	1.06	0.45	5.61	.98	7.03

The amount of ensilage to be used depends entirely upon its quality and upon the plans of the farmer.

Mr. Mills, for instance, could make up a full ration for a cow of 1,000 lbs. live weight, by feeding daily eighty pounds of his ensilage and five and one-half pounds of cotton seed meal; while at the College Farm with five pounds of cotton seed meal, one hundred and twenty pounds were necessary. In these rations nearly all the carbhydrates needed and a portion of the protein and fat are furnished at a very low price by the ensilage; the balance of the protein and fat is drawn from the cotton seed meal. If desirable, a much smaller quantity of ensilage could be used and the carbhydrates given in form of corn meal or any feed rich in these compounds; in ensilage they can be had, however, much cheaper than in any feed known to us at present. One thing must be considered: if the quality of the ensilage obliges the farmer to feed his cows more than eighty or ninety pounds daily per head, there is reason to fear that they will scour. The amounts fed by the above named gentlemen have varied from sixty-five to eighty pounds, and with these amounts no trouble whatever has been experienced. We therefore conclude that if the ensilage is of first-class quality, eighty pounds per day will furnish an animal with the full amount of carbhydrates; if it is of medium quality it will be safer to limit the amount to about ninety pounds, furnishing the rest of the carbhydrates in form of feed or straw.

From the above experiment we feel justified in concluding that milch cows can be safely fed large quantities of this fodder, and that it is a perfect substitute for hay. The question of expense we reserve for a future bulletin.

George H. Cook, *Director*.

New Brunswick, March 7, 1881."

AN ACT ESTABLISHING THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SECTION 1. That for the purpose of promoting agriculture by scientific investigation and experiments, an institution is hereby established, to be called and known as The Connecticut Agricultural Experiment Station.

SEC. 2. The management of this institution shall be committed to a Board of Control, to consist of eight members, one member to be selected by the State Board of Agriculture, one member by the State Agricultural Society, one member by the Governing Board of the Sheffield Scientific School at New Haven, and one member by the Board of Trustees of the Wesleyan University at Middletown, and two members to be appointed by the Governor of this State, with the advice and consent of the Senate. The Governor of the State, and the person appointed as hereinafter provided to be the Director of the Station, shall also be *ex officio* members of the Board of Control.

SEC. 3. After the appointment of the members of the Board of Control as aforesaid, said members shall meet and organize by the choice from among their number of a President, a Secretary, and a Treasurer, who shall be elected annually, and shall hold their respective offices one year, and until the choice of their successors. Five members of said Board shall constitute a quorum thereof for the transaction of business.

SEC. 4. Said Board shall meet annually after the first meeting thereof, on the third Tuesday in January in each year, at such place in the city of Hartford as may be designated by the President of said Board, and at such other times and places, upon the call of the President, as may be deemed necessary, and may fill vacancies which may occur in the officers of said Board.

SEC. 5. Said Board of Control shall locate and have the general management of the institution hereby established, and shall appoint a Director, who shall have the general management and oversight of the experiments and investigations which shall be necessary to accomplish the objects of said institution, and shall employ competent and suitable chemists and other persons necessary to the carrying on of the work of the Station. It shall have power to own such real and personal estate as may be necessary for carrying on its work, and to receive title to the same by deed, devise, or bequest. It shall expend all moneys appropriated by the State in the prosecution of the work for which said institution is established, and shall use for the same purpose the income from all funds and endowments which it may hereafter receive from other sources, and may sue and be sued, plead and be impleaded, in all courts, by the name of The Connecticut Agricultural Experiment Station. It shall make an annual report to the Legislature which shall not exceed two hundred printed pages, of which not exceeding three thousand copies shall be printed.

Sec. 6. The sum of five thousand dollars annually is hereby appropriated to said Connecticut Agricultural Experiment Station, which shall be paid in equal quarterly installments to the Treasurer of said Board of Control, upon the order of the Comptroller, who is hereby directed to draw his order for the same; and the Treasurer of said Board of Control shall be required, before entering upon the duties of his office, to give bond with surety to the Treasurer of the State of Connecticut in the sum of ten thousand dollars, for the faithful discharge of his duties as such Treasurer.

Sec. 7. Upon the death or resignation of any of the members of the Board of Control, the authority or institution by which such deceased member was originally appointed shall fill the vacancy so occasioned.

Sec. 8. Professor Samuel W. Johnson, of New Haven, is hereby empowered to appoint and call the first meeting of said Board of Control as soon as may be practicable after the appointment of the members thereof, and he shall notify all said members of the time and place of said meeting. Two of said members shall hold office for one year, two of them for two years, and two of them for three years; and at said first meeting they shall determine by lot which of said members shall hold office for one year, which for two years, and which for three years. All members of said Board thereafter chosen or appointed, except such as are appointed or chosen to fill vacancies in said Board, shall continue in office for the term of three years from the first day of July next succeeding such appointment.

Sec. 9. This act shall take effect from its passage.

Approved March 21, 1877.

AN ACT RELATING TO THE PRINTING OF THE REPORT OF THE STATE BOARD OF AGRICULTURE AND OF THE CONNECTICUT AGRICULTURAL EXPERIMENT STATION.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SEC. 1. The Comptroller shall annually cause to be printed, at the expense of the State, five thousand copies each of the report of the State Board of Agriculture and of the Connecticut Agricultural Experiment Station.

SEC. 2. All acts and parts of acts inconsistent herewith are hereby repealed.

Approved, March 19, 1879.

AN ACT CONCERNING COMMERCIAL FERTILIZERS.

Be it enacted by the Senate and House of Representatives in General Assembly convened:

SEC. 1. Every lot or package of commercial manure or fertilizer sold, offered, or exposed for sale, in this State, at a price of one-half cent or more a pound, shall be accompanied by a plainly-printed label or stencil mark on each package, which shall clearly and truly state its name or brand, its weight, the name and address of the manufacturer or seller, and its chemical composition, expressed in the terms and manner approved, and currently employed, by the Connecticut Agricultural Experiment Station. Every lot or package of commercial fertilizer or manure sold at a price less than one-half cent a pound shall be accompanied by a printed label, which shall give a correct general statement of its composition and ingredients.

SEC. 2. Every manufacturer or importer of commercial fertilizers or manures, excepting rock plaster or sulphate of lime, shall, before offering the same for sale in this State, procure a license from the Secretary of State, as manufacturer or importer of the same, and shall pay into the treasury of the State the sum of fifty dollars annually for one kind or brand of fertilizer or manure, and fifteen dollars for each other distinct kind or brand of fertilizer, and shall at the same time file with the Secretary of State, and also with the director of the Connecticut Agricultural Experiment Station, a statement of the names of his agents, and also the name or brand, and the composition of each fertilizer or manure, manufactured or imported by him for sale. Every manufacturer of fish guano, or fertilizers of which the principal ingredient is fish or fish-mass from which the oil has been extracted, shall, before manufacturing or heating the same, and within thirty-six hours from the time such fish or mass has been delivered to him, treat the same with sulphuric acid or other chemical, approved by the director of said experiment station, in such quantity as to arrest decomposition : *provided, however*, that in lieu of such treatment such manufacturers may provide a means for consuming all smoke and vapors arising from such fertilizers during the process of manufacture.

Sec. 3. Every person who shall bring into the State ashes for the purpose of sale shall, before offering the same for sale, procure a license from the Secretary of State, and shall pay therefor into the treasury of the State the sum of fifty dollars annually.

Sec. 4. All moneys collected by the State as license fees, as provided in sections two and three of this act, shall be appropriated to the support and maintenance of the Connecticut Agricultural Experiment Station, and shall be paid over to the Treasurer of said Station quarterly.

Sec. 5. Any person violating any provision of sections one, two, and three of this act shall be fined one hundred dollars for the first offense, and two hundred dollars for each subsequent violation.

Sec. 6. The director of the Connecticut Agricultural Experiment Station is hereby authorized, in person, or by deputy, to take samples for analysis from any lot or package of manure or fertilizer, which may be in the possession of any dealer.

Sec. 7. This act shall not apply to parties manufacturing fertilizers for their own private use, or in quantities of less than twenty-five tons per year; *provided*, the same is sold only to consumers and on the premises where manufactured.

Sec. 8. Title sixteen, chapter fifteen, sections fifteen and sixteen, and title twenty, chapter twelve, section five of the General Statutes are hereby repealed.

Sec. 9. This act shall take effect immediately.

Approved, April 14, 1881.

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