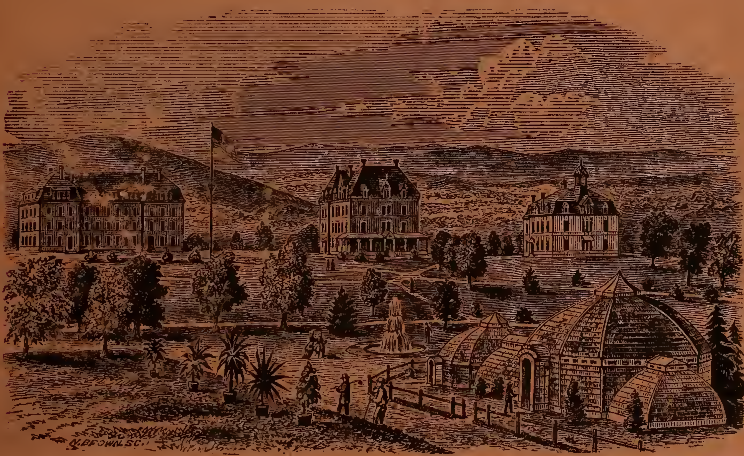
Twelfth Annual Report

of the

Massachusetts Agricultural College.



JANUARY, 1875.

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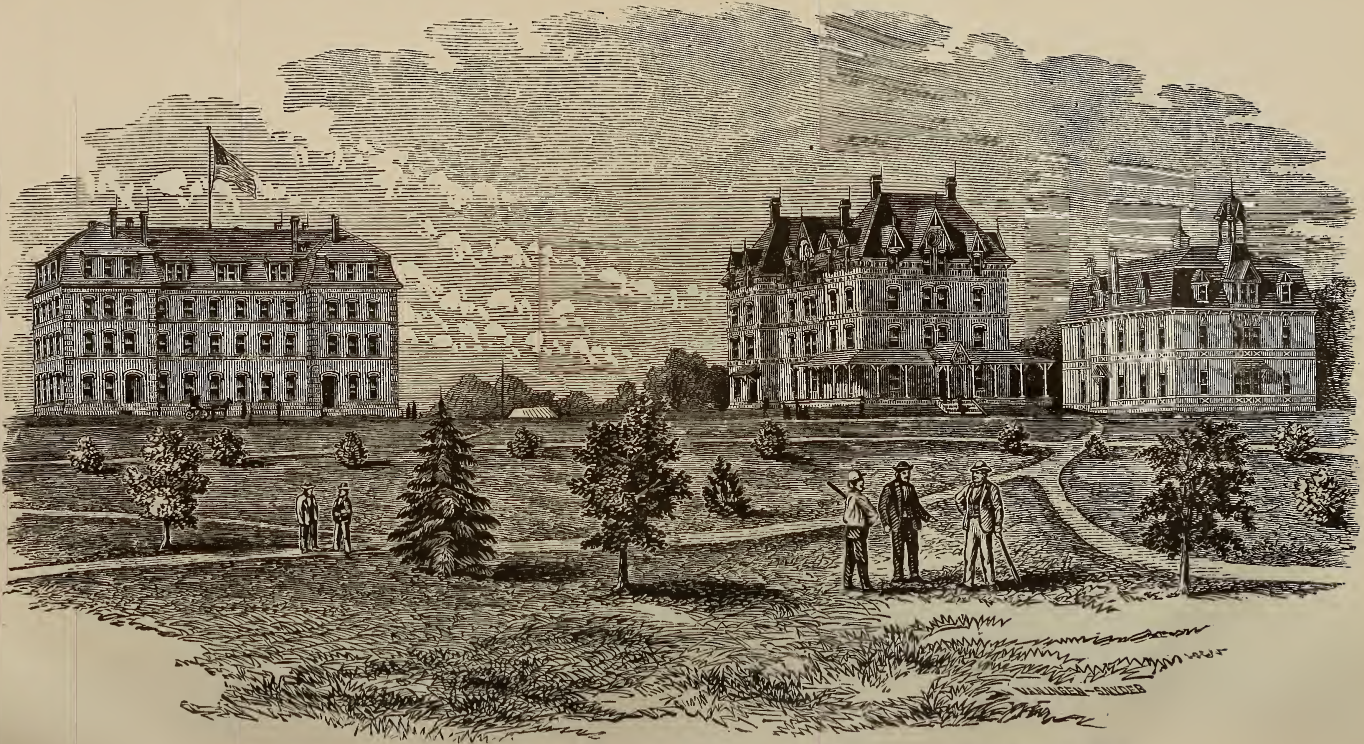


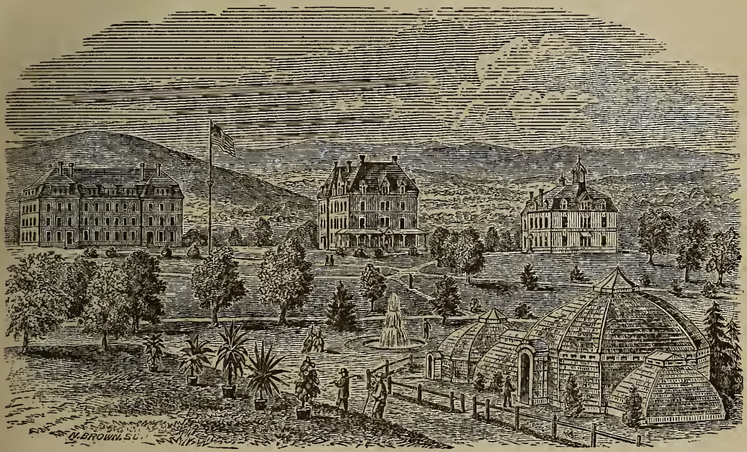
MASSACHUSETTS AGRICULTURAL COLLEGE.

SENATE...... ......No. 99.

TWELFTH ANNUAL REPORT

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.



JANUARY, 1875.

BOSTON:
WRIGHT & POTTER, STATE PRINTERS.
79 MILK STREET (CORNER OF FEDERAL).
1875.

Commonwealth of Massachusetts.

Executive Department, Boston, March 4, 1875.

To the Honorable Senate.

I have the honor herewith to transmit, for the information and use of the General Court, the last Annual Report of the Trustees of the Massachusetts Agricultural College, with accompanying documents.

WM. GASTON.

Commonwealth of Massachusetts.

AMHERST, February 20, 1875.

To His Excellency WILLIAM GASTON.

SIR :—I have the honor herewith to present to your Excellency and the Honorable Council the Twelfth Annual Report of the Massachusetts Agricultural College.

Very respectfully, your obedient servant,

W. S. CLARK.

INDEX.

ANNUAL REPORT.

To His Excellency the Governor and the Honorable Council.

The Trustees of the Massachusetts Agricultural College respectfully submit their Report for the year 1874.

A very thorough official investigation into the condition of the Agricultural Colleges, endowed by the Act which was approved and signed by President Abraham Lincoln, July second, 1862, has recently been completed by a congressional committee. The report of this committee contains a great amount of information in regard to these national schools of science in the several States, and the general results are stated as follows:—

"A considerable number of the colleges have done work which requires no apology; and a few of those earliest organized have already found time to take a high rank among the institutions of the land. The number of students in attendance upon these schools is already between three and four thousand, and they have furnished more than sixteen hundred graduates to the active occupations of life. They are generally gathering about themselves material appliances in the form of farms, stock, workshops, machinery, books and apparatus. More than two hundred teachers are engaged in the work of instruction. There is evidence of an honest purpose to make the studies pursued such in variety, in extent, and in value as shall meet the requirements of the law to which they are indebted for their endowment. Studies connected with agriculture and the mechanic arts are made prominent, if not paramount; and there is reason to believe that by this means the taste for these branches of knowledge has been considerably increased in the whole community. It must be added that the reports sent from these colleges reveal a certain fresh interest,—a spirit of youth, a new enthusiasm,—which, when intelligent and enduring, is one of the best prophecies of success. Strong evidence is afforded of the power of these institutions to establish sympathetic relations between themselves and the communities in which they are placed, in the fact that they have already received, in appropriations from States and in donations from counties, towns and private individuals, an amount almost equal in the aggregate to the whole bounty of the Government."

An examination of the statistics to be found in this report will furnish satisfactory proof that Massachusetts has no reason to be ashamed of the institutions which she has endowed with the proceeds of the national grant. In one respect, however, the policy of the Commonwealth differs remarkably, and most unhappily, from that of every other State. No provision has been made for free scholarships in her Agricultural College. Her normal schools are not only open to all her sons and daughters, without any charge for tuition, but excellent rooms and board are furnished for a nominal and very moderate charge.

Harvard College announces that "good scholars of high character but slender means are seldom or never obliged to leave college for want of money," and the same may be safely asserted in reference to the other colleges of the State.

It seems, therefore, most unreasonable that an institution founded by the government for the technical education of the people should be compelled to charge every student *one hundred dollars per annum* for tuition and room-rent, thereby excluding from it a large proportion of those who would most gladly avail themselves of its advantages. If the object in establishing such a college is to enlighten and elevate the farming community, and to improve and increase the agricultural products of the State, why should any one be debarred by high tuition from the fullest enjoyment of its privileges? It is earnestly hoped, by both trustees and faculty, that the legislature will not only appropriate the money necessary for the maintenance of the College in a flourishing condition, but also provide that indigent students, at least, who are residents of the Commonwealth, may enjoy free tuition.

To pay the small indebtedness, meet necessary current expenses for the year 1875, and make some desirable improvements, the College needs an appropriation of ten thousand dollars.

The importance of providing the means to defray the necessary expense of investigations and experiments for the advancement of pure science, especially of chemistry and animal and vegetable physiology, as well as for the improvement of agriculture in its various departments, has been repeatedly urged in former reports. The great number of institutions maintained in Europe for this special purpose, as well as the obvious advantages which must result from such action, would seem to be sufficient reasons for a legislative enactment requiring that such work should be constantly and systematically carried on at the State Agricultural College. Competent investigators ought to be found among the professors, and useful assistants among the students, especially in the post-graduate course; while most of the material appliances are already at hand in the fields, the barns, the plant-houses, and the scientific laboratories.

It is, however, indispensable, for the highest success of such an experiment station, that its officers have the means for purchasing such special apparatus as may be required, and for employing such labor as may at any time be absolutely demanded. They must also have the assurance that investigations may be continued through a series of years, without interruption or hindrance, since field experiments will otherwise be of comparatively little value.

Notwithstanding the want of funds and the abundance of other imperative duties, the officers of the College have not been idle in years past, but have enthusiastically and laboriously striven to accomplish what they could in this direction.

Professor Goessmann has won high commendation for himself and the College, and done a most valuable work for the agricultural interests of the whole country, by his very elaborate and satisfactory experiments in regard to the cultivation of the beet for the production of sugar. Though we still continue to practise the folly of sending to foreign countries one hundred millions of dollars in gold every year for an agricultural product which the farmers of France profitably raise for four cents per pound, and though we still in the West grow corn for ten cents per bushel on land that would yield easily a ton of sugar to the acre, we shall, before many years, adopt the wiser policy of nearly all the nations of con tinental Europe, and cease to import what we can economically grow upon our own soil. Then the College reports upon this subject, published in 1871, 1872 and 1874, will be duly appreciated.

Again, in 1873, Professor Goessmann prepared a valuable report on commercial fertilizers; and the result of the discussions thereby induced has been the enactment of a law for the regulation of the sale of these costly, but indispensable, aids to profitable farming. The object of the law, in the Professor's own words, is to compel the dealers in these articles "to state what they sell and to sell what they state." The very able reports made by him, as State Inspector of Fertilizers, to the Board of Agriculture, and printed in the "Agriculture of Massachusetts" for 1873–4 and 1874–5, have been pronounced by Hon. Marshall P. Wilder as worth more to the Commonwealth than all that has been expended for the maintenance of the board since its first organization.

An excellent paper upon commercial fertilizers will be found appended to this Report.

Professor Stockbridge has also been engaged, for some years, under many difficulties, in the prosecution of experiments relating to the application of special fertilizers in definite quantities to particular crops. The results are very encouraging, and an interesting preliminary report upon the subject is herewith presented.

Under the direction of the President, a great number of observations have been made during the years 1873 and 1874 upon the following subjects, viz.:—

First. The structure, composition and arrangement of the buds of hardy trees and shrubs. Specimens have been collected from one hundred and forty species, but the investigations are not yet finished.

Second. The percentage of water to be found in the wood and bark of the several parts of trees at different seasons of the year.

Third. The phenomena and causes of the flow of sap from wounds in trees when denuded of their foliage, as well as the flow from the stumps of woody and herbaceous plants when cut near the ground in summer. In connection with this subject an attempt has been made to determine what species flow, how rapidly and copiously, and under what circumstances.

Fourth. The pressure and suction exerted by the movements of the sap exuded from the detached roots of plants, or from the wood of trees at different elevations from the ground, as exhibited upon water or mercurial gauges or manometers.

Fifth. The structure and functions of the bark of exogenous trees, with special reference to the circulation of sap, the formation of wood, and the effects of girdling.

Sixth. The expansive force of growing vegetable tissue in a squash has been measured, and in connection with this experiment many interesting observations have been made concerning the structure and development of the squash plant.

The facts ascertained and recorded for the first time upon the above topics are several thousand in number, and have been presented to the State Board of Agriculture for publication in the Annual Report by Secretary Flint. A summary of the results, in the form of a lecture, is appended to this Report.

Valuable assistance has been cheerfully rendered by Professors Peabody, Stockbridge, Goessmann and Maynard, and by Messrs. Wakefield, Wellington, Penhallow, Knapp, Brooks, Hague, Dodge and Clark, members of the College.

A remark of Mr. Robert Manning, editor of the publications of the Massachusetts Horticultural Society, is perhaps worthy of record in this place. After being informed of the interesting results of the above-mentioned investigations, he said he did not know that it was necessary to maintain the Agricultural College in order to have these truths discovered, but they were unknown until after its establishment.

In addition to their regular duties as instructors, the President and Professors Stockbridge and Cressy, and Farm Superintendent Dillon have attended a large number of agricultural fairs, farmers' institutes, and the annual country meeting of the Board of Agriculture, and contributed by formal lectures and extempore remarks to the public exercises of these gatherings. It is an encouraging fact that the attendance on these meetings for the benefit of the agricultural community has been unusually large, and the interest manifested very decided.

At the close of the academic year, Professor Peabody resigned his position as professor of mathematics and physics, and Professor William B. Graves, of Marietta College, Ohio, was chosen as his successor. He is now engaged in preparing a report to the legislature on the proper width for the rims of wagon wheels, considered with reference both to the wear of the highways and the draught of loaded vehicles.

The condition of the farm and its management for the year will be learned from the accompanying report of Superintendent Dillon. Professor Maynard's will show what has been done in the horticultural department. The principal wants of this department are, glass structures for the propagation of bedding plants and for graperies and orchard houses, and the fund, so often mentioned, of fifty thousand dollars for the endowment of the Botanic Garden.

The Hills prizes for the best herbariums, prepared during the year by the members of the senior class, were awarded as follows, viz. :—The first prize, of fifteen dollars, to Thomas Russell Callender, of Northfield, and the second prize, of ten dollars, to William Penn Brooks, of South Scituate. The prize, of five dollars, for the best collection of woods, was obtained by Lauren Kellogg Lee, of Shrewsbury.

The public exercises of the fourth anniversary week began on Monday, July thirteenth, when the lower classes were examined in the studies of the term by the committee appointed by the State Board of Agriculture. The members of this committee were President P. A. Chadbourne, D.D., LL.D., of Williamstown; Joseph N. Sturtevant, Esq., of Framingham; and Edward P. Root, Esq., of Barre. These gentlemen visited the College several times during the year, and their report in regard to its condition and wants will be found in the "Agriculture of Massachusetts" for 1874–5.

The Farnsworth Prize Declamations occurred on Monday evening, in the military hall, where all the anniversary exercises were held. The successful competitors for the gold medals were Thomas Edwin Smith, of Chesterfield, from the sophomore class, and Joseph Wyman, of Arlington, from the freshman class. The silver medals were awarded to John

Elgin Williams, of Amherst, from the sophomore class, and to Walter Mason Dickinson, of Amherst, from the freshman class.

On Tuesday, July fourteenth, the forenoon was devoted to the oral examination of the graduating class in agriculture, for the Grinnell prizes, established by Hon. William Claflin. A large number of distinguished gentlemen were present, and abundant evidence given by the class of thorough training in this special department of the College. The examining committee, consisting of Gideon H. Allen, B.S., of North Conway, N. H., John M. Smith, Esq., of Sunderland, and J. N. Bagg, Esq., of West Springfield, awarded the first prize, of fifty dollars, to Edgar Howard Libby, of Ashland, and the second prize, of twenty dollars, to Edward Phelps Chandler, of Westborough.

The Peabody prize, of twenty dollars, for the best collection of insects, was also awarded to Mr. Libby.

In the afternoon of Tuesday, the usual address before the Social Union was delivered by President Chadbourne. His subject was "Physical Science as the Product and Promoter of Civilization," and his masterly treatment of it afforded the highest satisfaction to his hearers. The orator began by comparing the ancient civilizations and their results to the geological periods in the earth's history with the peculiar treasures deposited in each for the use of man. "This age of the earth, with its higher forms of life, is better than all former ones. It is the period for which these were but preparations; and their importance is measured alone by the material they have prepared for us. So the past civilizations have left something all through the ages that we can no more neglect than we can the mineral treasures of the earth. But the present civilization, more wide-spreading than all others, is to mold the destinies of the race while the world remains. Nothing better has gone before it to which we can appeal for an example and for guidance. The natural sciences are prominent among the elements of stability in this civilization, being important agencies in almost every system of education, as well as the procurers and fashioners of almost every material product which the varied wants of enlightened man demand. Physical science shows what man has done for himself, not what nature has done for him. Science does not advance man, but man advances science; and he does this most effectually when striving after a knowledge of the truth, without regard to its practical usefulness. The advance of science is always beyond the line of utility.

"As a promoter of civilization, the greatest triumph of science is the means it provides for intercourse among nations. It also widens the field for human habitation, and makes possible a more compact settlement of the earth. It is a wonderful indicator of man's power of thought, and the great preserver of all arts. But science cannot bring man up to the highest plane of mental and moral character. The guiding star to all permanent progress in this direction is found in the firmament of our moral and religious nature."

A large number of graduates were in attendance at the anniversary, and formally organized an association, to be known as the Associate Alumni of the Massachusetts Agricultural College; the object of which is declared to be, to promote in every proper way the interests of the College, to cultivate among the graduates a sentiment of mutual regard, and to foster and strengthen their attachment to their Alma Mater.

The forenoon of Wednesday, July fifteenth, was devoted to the inspection of the farm, stock and buildings, and the review of the battalion of Agricultural Cadets by His Honor Thomas Talbot, acting governor of the Commonwealth. Several members of the executive council, and many other distinguished visitors, were present to witness the evolutions of the battalion under the command of Professor Merrill, U. S. A.

In the afternoon, the usual graduating exercises were attended by a numerous audience, and eight theses pronounced by members of the graduating class, the valedictory addresses being delivered by Daniel Green Hitchcock, of Warren. The diplomas were then presented by His Honor Thomas Talbot, with a few appropriate remarks. He eulogized education, saying that an intelligent brain is the best partner for industrious hands. There is no short cut to a worthy life. Patience, integrity and hard work are the paths that lead to success. In conclusion, he spoke of the advantages and pleasures of rural life in contrast with the inconveniences and uncertainties of a business career in the crowded centres of manufactures and commerce.

In reviewing the history of the year 1874, the Trustees feel that it has been one of real and unusual prosperity for the institution under their charge. The officers and students have performed their duties with marked fidelity, and there has been no case of death or severe sickness among them. The general tone of the newspapers has been much more considerate and complimentary than heretofore, and the public opinion in regard to the value of the course of study and training at the College has evidently become more intelligent and more favorable.

The method of teaching adopted by the faculty is the one so much commended and so admirably practised by the lamented Agassiz, which leads the student to observe and investigate for himself, rather than to have implicit faith in text-books, without questioning or testing their statements. The educational influence of the numerous scientific investigations and experiments continually carried on by the professors, assisted by the students, cannot fail to be most beneficial, as well on account of the accurate and permanent character of the knowledge thus acquired, as of the stimulating and ennobling effect of such researches upon the minds and hearts of those engaged in them.

Respectfully submitted,

By order of the Trustees,

W. S. CLARK,

President.

AMHERST, January, 1875.

Figure 1.

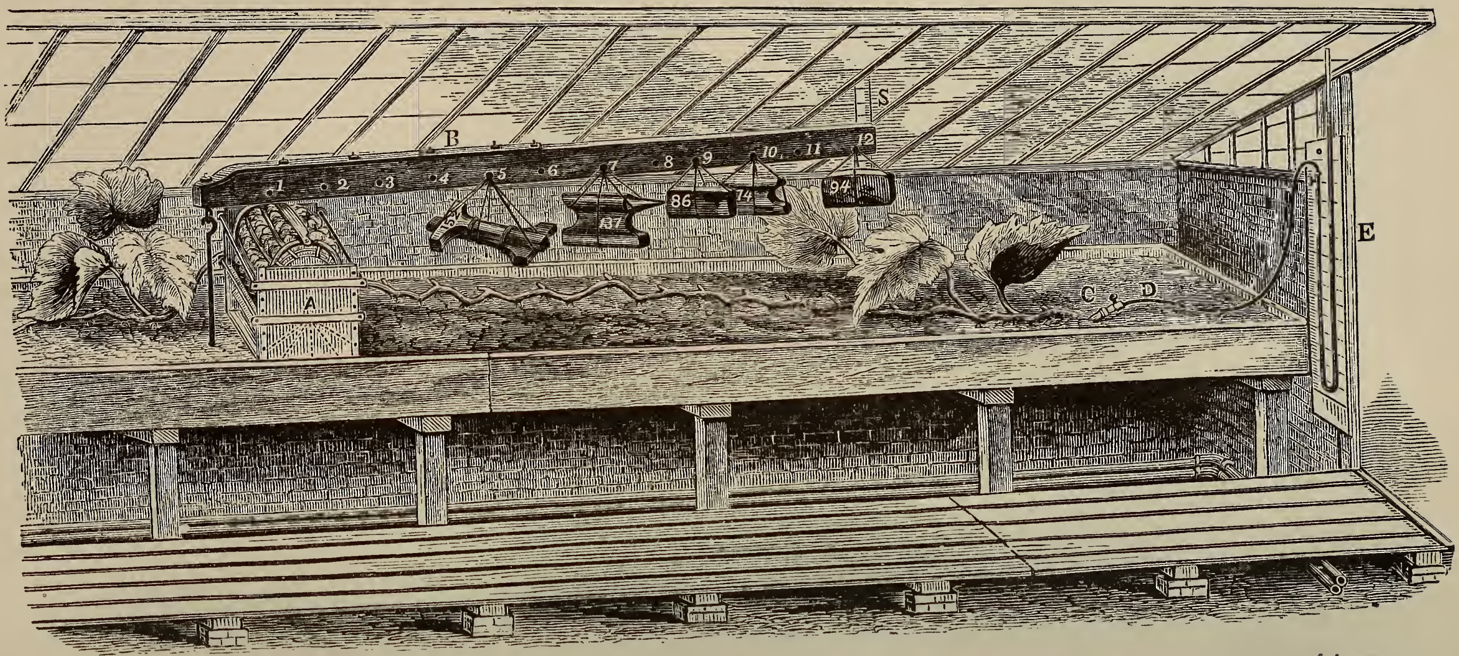


Fig. 1 exhibits the propagating pit with the squash in harness, and the squash-root of a second vine attached to a mercurial gauge to show the pressure of the sap.

A, the box in which the squash was placed.
B, the lever to support the weights.
C, the root from which the principal vine grew.
D, the root of the vine, which was cut off when eight weeks old and connected with a gauge.
E, mercurial gauge.
S, scale to indicate the variations in the position of the lever.

A LECTURE

ON

THE FLOW OF SAP AND THE POWER OF PLANT GROWTH,

Delivered before the New England Agricultural Institute, at Worcester, Mass., January 23, 1875.

By President W. S. CLARK, LL. D.

THE FLOW OF SAP AND THE POWER OF PLANT GROWTH.

The committee of arrangements for this Agricultural Institute, in selecting their speakers, seem to have had in mind the excellent motto of the Royal Agricultural Society of England,—"Practice with Science." You have already been entertained and instructed by gentlemen who possess both practical wisdom and scientific attainments, as well as the happy faculty of telling what they know in an interesting manner. It is, therefore, with hesitation that I presume to state a few facts concerning the phenomena of plant life which have come under my observation during the past year.

There are said to be persons whose desire for the acquisition of wealth is so excessive, that even in the presence of the majestic fall and the resounding and resistless flood of Niagara, they are principally occupied in calculating its value as a water-power. Such men cannot be expected to approve or appreciate any attempt at scientific research for the discovery of truth, except so far as they may be able to see money in it. They fail to perceive that every new fact learned is a step forward in the grand march of human progress.

It seems to have been the special mission of the lamented Agassiz to this utilitarian age and people to demonstrate the unspeakable worth of scientific pursuits. This great teacher, while devoting his life chiefly to the study of the most obscure and worthless of animals, was accustomed, upon occasions like this, to take the platform and awaken within the breast of every hearer the highest enthusiasm for pure science, and the heartiest admiration for himself as an interpreter of Nature. Though he has left his associates on the State Board of Agriculture no code of rules for their guidance, and though he has added little to what we call the practical knowledge of farmers, he has been, like the invisible steam within a mighty engine, the power to move us all. Let us preserve the impetus he has imparted, and by similar diligence and earnestness in the cultivation of those sciences which are inseparably connected with progress in agriculture, we may hope to command for our profession the respect of all intelligent men, and to accomplish much for its advancement.

When we consider that during the past year more than a million of dollars have been expended by the most enlightened nations in sending expeditions to distant parts of the earth to observe the transit of Venus, we may certainly hope that scientific investigations concerning things nearer home, and more directly connected with every-day life, will soon be appreciated and sustained better than they have been in the past.

Liebig, the illustrious leader in the application of chemistry to the improvement of soils and the production of desirable crops, has said that the scientific basis of agriculture embraces a knowledge of all the conditions of vegetable life; while Dr. Lindley, the distinguished botanist and editor of the "Gardeners' Chronicle and Agricultural Gazette," of London, has declared that good agriculture and horticulture are founded upon the laws of vegetable physiology.

The phenomena of plant life, therefore, afford a most appropriate field for investigation at an Agricultural College. During the last two years numerous experiments have been undertaken, and some thousands of observations made and recorded at Amherst, for the purpose of learning as much as possible in regard to the nature of the vital force in plants. Our inquiries have thus far been directed especially to the movements of the sap in the roots, wood and bark of trees, and to the facts concerning its flow from the maple and other species in the spring. Observations have also been made upon the peculiar structure and functions of the wood, bark and roots, and upon the mechanical power of growing vegetable tissue.

Your attention is invited this evening to a few of the more important results thus far attained, in the hope that they may not prove altogether uninteresting. The importance of these investigations would be more readily appreciated did time allow us to state some of the numerous, but exceedingly diverse and often absurd, hypotheses which have been advanced in reference to the circulation of sap in plants. Even during the past year, a course of lectures on the "Physiology of the Circulation in Plants, in the Lower Animals, and in Man," delivered before the Royal College of Surgeons in Edinburgh, has been published by Macmillan & Co., of London, in which it is announced that the sap of trees descends in autumn, and escapes from the roots into the earth. The author, after assuming this and other false premises, proceeds to invent a marvellous system of compound syphons, by means of which he accounts to his satisfaction for all the movements of sap. The name of this ingenious professor is J. Bell Pettigrew, M.D., F.R.S., F.R.S.E., F.R.C.P.E., etc., and ought to have weight, but unfortunately the facts are against him, and facts are said to be stubborn things.

The syphons of Dr. Pettigrew are as difficult to find and as useless as the spongioles which Mr. Herbert Spencer imagines to exist in the roots and in the leaves of trees. He assumes (falsely) that the upward and downward currents of sap move in the vessels of the wood, the spongioles of the leaves, which nobody else has seen, forcing the elaborated sap down through the very same capillary tubes up which the crude sap is supposed to be driven by the spongioles of the roots, whatever *they* may be.

The observations to be described will demonstrate that the metaphysical speculations even of talented men are of small value in the study of experimental science.

Let us first consider the phenomenon of bleeding, or the flow of sap, from plants.

The fungus called *Merulius lacrymans*, which causes the dry-rot in timber, owes its destructive influence to the fact that it is always moist, apparently from the exudation of water from the surface of the fibres of its mycelium. Water is said sometimes to drip from the leaves of the cabbage, the calla and many other plants, especially during warm nights, when exhalation of aqueous vapor from the stomates has ceased. The leaf of a species of caladium has a small pore at its tip, from which water drops so freely that half a pint has been collected from one leaf in a single night. This sort of bleeding, or weeping, seems to result from the excessive activity of the absorbent rootlets.

The pitchers of several species of *Nepenthes*, *Sarracenia*, etc., secrete from glands within them an aqueous fluid, which, however, seems to have some powerful properties, adapting it for the destruction and digestion of the insects which serve as food to these carnivorous plants.

A great variety of volatile oils, like turpentine and wood oil, of resins, like copal, mastic and colophony, of elastic resins, like caoutchouc and gutta-percha, of gums, like gum-arabic, and of sugars, like manna, are found in commerce, and are products either of decomposition or of secretion in the tissues of certain trees. Sometimes these peculiar substances, which are not known to be of any use to the trees producing them, exist in *all* the tissues, while in other cases they are confined chiefly either to the wood or the bark. The mode of extraction varies greatly in different countries.

Thus, on the island of Singapore, the gutta-percha tree has been exterminated by the destructive method adopted for the collection of this valuable substance. The trees, instead of being tapped and carefully preserved, were cut down to obtain the milky sap. Caoutchouc is now generally obtained by making incisions in the bark, or bark and sap-wood of the numerous species which furnish it. Gum-arabic exudes from natural cracks in the bark of several species of leguminous trees in dry, hot weather. Manna is procured by making short, horizontal incisions, one above the other, in the bark of a species of ash. Venetian turpentine is the product of the European larch. The mode of tapping it in the Tyrol is as follows:—A hole one inch in diameter is bored in the spring into the centre of the tree, inclining slightly upward from the bark. This is stopped with wood, and in autumn the plug is removed and the pitch collected. This process is repeated annually without any detriment to the tree. If, however, several holes be bored and the pitch allowed to flow through the warm season, as is done in Piedmont, the timber is said to be greatly injured.

The gathering of turpentine, or pine pitch, in our Southern States, is conducted in the following manner:—The turpentine flows from incisions made in the bark and sap-wood chiefly of the long-leaved pine. One man can attend to about three thousand trees through the year. The pitch is collected in cavities, called boxes, holding about three pints, which are cut with an ax, in the trunk, near the ground, during the winter. Above the boxes horizontal incisions an inch or two in depth are made, from time to time, so as to expose a fresh surface. The quantity of bark thus removed from above the box amounts to about a foot in height and the same in width each year, and the process is continued till the so-called chipping has extended as high as a man can reach, when a new box is cut on the opposite side of the tree. The flow begins about the middle of March and continues through the season of growth, being best in July and August. The boxes are emptied five or six times during the year, and the resin which forms on the exposed wood is scraped off from time to time. The total annual yield of three thousand trees is about seventy-five barrels of pitch, and twenty-five of scrapings.

Many herbaceous plants, when growing rapidly, will flow somewhat freely from the stump when cut down. Thus, if a stout stalk of corn or tobacco be cut near the ground, it will bleed for a few hours; and, if a pressure gauge be applied and the air excluded, the sap will exert a force sufficient to sustain a column of water from ten to twenty-five feet in height. The stump of a squash vine, about two months old, in the Durfee Plant-house, exuded its sap, last August, with a power equal to a column of water forty-eight and a half feet high, but the tender roots died at the end of three days, when the pressure ceased. [See Fig. 1.]

The *Jubaea spectabilis* of Chili is a palm tree, valuable on account of the very agreeable syrup obtained by the evaporation of its sap. This, however, is procured in a singular and wasteful manner. Trees fifty feet high are felled so that the top lies higher than the butt. The single bud, with the crown of leaves at the top, is then cut off, and the sap flows freely for several months from the upper end of the trunk, provided a fresh surface be exposed every day by removing a thin slice of the wood. Mr. Darwin says if the top lies lower than the butt, the sap will not flow, and that it runs best in the warmest days. The total flow from each trunk amounts to about ninety gallons, or seven hundred and twenty-five pounds, of sap. No satisfactory explanation of this curious phenomenon has been discovered.

In the warm regions of Asia, Africa and South America are found nearly one thousand species of palm trees, from many of which a sweet sap is obtained in large quantities. This is simply allowed to ferment, and drank as palm wine, or distilled for the production of a sort of brandy, or it is evaporated for the extraction of its sugar in the form of syrup, or of a dry powder. In the province of Bengal, in India, fifty thousand tons of palm sugar are produced annually. The total product of palm wine in the world greatly exceeds that of wine from the grape.

Instead of felling the trees, as in Chili, it is customary in some countries to make deep incisions into the top of the trunk, from which the sap flows during the cooler months of the year, the amount varying with the species. The common wild date tree of India, which attains a height of from thirty to forty feet, yields about two hundred pounds per annum of sap, containing some eight pounds of sugar, or four times the average yield of our sugar maples.

Palm wine, or toddy, is, however, usually obtained from the great branching flower stalks of the trees. From the axils of the immense leaves, or fronds, are developed huge buds, containing the inflorescence. Before these burst the stout spathe by which they are enveloped, they are carefully bound together and then beaten with sticks, to crush the flower buds and thus to cause the sap to flow freely from the tip of the main axis of the inflorescence, which attains a length of some feet. The process of beating the bud and removing a thin slice from the end is repeated daily so long as the bud lasts. There are often several of these flowing on the same tree at once, and upon some species they are constantly renewed and as constantly bled for two or three years, when the tree dies from exhaustion.

The *Agave Americana*, or century plant, upon reaching maturity, which it does in warm regions in about seven years, sends up a flower stalk which produces numerous branches and several thousand flowers, rising to the height of from twenty to forty feet. Near the cities and large towns of

Mexico, extensive plantations of this species are cultivated for the sweet sap which flows very abundantly into the cavity formed by cutting out the flower bud from the centre of the crown of massive leaves. This sap is produced for several months, until the plant is exhausted, and in the aggregate amounts to from twelve hundred to sixteen hundred pounds from each plant. It ferments rapidly and forms an acid, slightly intoxicating fluid, with an intolerable odor of carrion. It is called pulque, and is the favorite beverage of the Mexicans. Foreigners are also said to become accustomed to its peculiar taste and odor, and then to prefer it to claret. A powerful brandy is also distilled from the fermented sap.

At present we are unable to give any other explanation for the flow of sweet sap from the flower buds of palms and agaves than that these plants have been so constituted that they first accumulate a quantity of starch, which is stored up either in the leaves or the pith of the stems, and then, by a vital process, this starch is rapidly converted into sugar and transferred to the flower buds for their nourishment.

During the past two years, we have tested with reference to the flow of sap about sixty species of trees and shrubs growing in Amherst. These have been tapped at various times during the year, and most of them have been visited daily, about noon, for several weeks in the spring. Whenever sap has been seen to flow, the number of drops per minute has been recorded, or the entire flow for the day has been weighed. The results of these observations will be found in the annual report of the State Board of Agriculture for 1874–5.

Many trees, like the chestnut, the oak, the elm and the poplar, do not flow at all; others, like the buttonwood, the apple, the beech, the alder and the hickory, flow for a very short time, or in very moderate quantity; while others, like the birches, the maples, the ironwood and the grape, flow for a considerable time quite freely.

The grape is generally supposed to bleed more abundantly from wounds than any other woody plant, but there are several species which far surpass it in rapidity and quantity of flow, even though allowance be made for its size. The total amount of sap from a very large wild vine, during the past season, was eleven pounds and nine ounces, while a paper birch, fifteen inches in diameter, yielded sixty-three pounds in one day and fourteen hundred and eighty-six pounds in less than two months.

The second question for consideration relates to the time when plants bleed.

Herbaceous plants flow most copiously when in vigorous growth, if the stems be cut off so as to offer little resistance to the sap forced upwards by the active absorption which occurs as a vital process in the root hairs or minute rootlets.

Palms and agaves flow when about to blossom, and so far as we know, by reason of a vital process, connected with the period of inflorescence and fruiting. If the flower stalks were uninjured, the same transference of material would occur, and we should imagine we accounted for it by saying it goes to the place where it is wanted and used. But this is no reason for the continued flow from the wounded bud, the development of which has been stopped.

The bleeding of the grape, the apple and other trees, which occurs only in warm weather, must be attributed to the vital force of the absorbent surface of their roots, which awaken to new activity after their annual period of repose. The flow from such species is not of long duration, and ceases with the development of their foliage.

Certain species of trees, of which the sugar maple may be taken as the type, will bleed from wounds at any time between the fall of the leaves in autumn and the opening of the buds in spring, provided the weather is sufficiently cold to freeze the wood, which contains from forty to fifty per cent. of water, at all seasons of the year, and provided the temperature afterwards rises somewhat above the freezing point.

If a mercurial gauge be applied to the root of a grape vine, which is entirely separated from the vine itself, and lies buried in the earth just as it grew, it will, like all other roots in early spring, show suction; that is, the root will absorb the water from the gauge and draw the mercury towards itself. In May, however, the root will begin to exude sap into the gauge, and the pressure exerted by it will increase until about the last of the month, when it will be equal to a column of water from fifty to ninety or more feet in height.

A black birch root, treated in a similar manner during the past season, has shown a variation, between the greatest suction and the highest pressure, of one hundred and three feet of water.

If now we apply a gauge to the root of a sugar maple, we obtain most surprising results. This tree, which flows so freely, exhibits no pressure from root absorption. We must, therefore, seek some other cause for the flow of sap, which is often very abundant.

In order to learn the movements of the sap in a sugar maple, we attached, last March, five gauges to one tree in the following manner, viz. :—

Number one, to a detached root in its natural position in the ground.

Number two, to the end of the same root which was connected with the trunk of the tree.

Number three, to the sap-wood just beneath the bark and two feet from the ground.

Number four, to the centre of the tree, in the heart-wood, at the same level with number three.

Number five, to the sap-wood, twenty feet above number three, among the branches.

Observations were made three times daily for ten weeks, and the following remarkable results obtained, viz. :—

First. The detached root showed no pressure at any time.

Second. The gauge among the branches exhibited the greatest pressure, which was equal to more than fifty-two feet of water.

Third. The other gauges varied somewhat alike, but showed the most pressure when sap flowed most rapidly from other sugar maple trees.

Fourth. When the sap ceased running, as at night, the gauges began to exhibit suction from the reabsorption of the sap in them by the tree.

From these and other facts, it became evident that the flow of sap from the maple was in no sense a vital process, but purely physical. The hypothesis was therefore adopted that a hard frost separates the sap from the wood of certain trees, and that when the temperature rises it is gradually reabsorbed. If, however, the tree be tapped, so that the liberated sap can run out, then it will do so, flowing, as is the case in the maple, most copiously from above. The bleeding is a sort of leakage from the vessels of the wood; but this is evidently aided by the elastic force of the gases in the wood, which are compressed by the sap liberated, and which are further expanded by the increase of temperature which always accompanies a flow.

This hypothesis explains the variations of the gauges, and accounts for the singular fact that the upper one shows the most pressure, because the branches and twigs would of course be most quickly and powerfully affected by the heat of the sun and the temperature of the atmosphere. The pressure of the expanded gases within a tree, in its normal condition, would facilitate the process of reabsorption by the wood of the liberated sap. Their contraction by cold would also cause the cessation of the flow from a tree which was running, and produce the extraordinary phenomenon of suction, exhibited by the gauges at night.

An interesting demonstration of this theory was obtained by cutting branches, fifteen feet in length, from trees of sugar maple, white birch, hickory, buttonwood, chestnut and elm, when the temperature was below zero, and suspending them in the warm air of the Durfee Plant-house. The maple soon began to flow at the rate of twenty-four drops per minute, the buttonwood eleven drops, and the hickory exuded a little honey-sweet sap, precisely as in early spring; while the birch, the chestnut and the elm remained perfectly dry. A gauge was then attached to a maple limb, and exhibited the same phenomena when the limb was heated and cooled as were observed upon the trees in the open air last spring, in the alternations of day and night.

In regard to the causes which induce the absorption of water and soluble substances by the roots of living plants, it seems unfortunate that so much has been claimed for osmose in this connection. Boussingault has recently shown that roots containing sugar do not exude it when growing in water; while leaves and fruits, when immersed in this fluid, readily absorb it by an osmotic process, and part with their sugar. If the enormous absorption of water by the roots of birch trees, in spring, were accompanied by any corresponding exudation, it would appear easy to find some proof of it, which no one has yet detected. It is not possible to account for the fact, that when the sap is rising most rapidly, none will flow from a wound in the bark, even when it will run a stream from the outer layer of wood, if the circulation in the trunk is caused by osmose. There is fresh cellular tissue in the liber and some soluble material; but the bark remains comparatively dry till growth begins. After the cambium has become abundant, why should not all the crude sap press towards it and draw the elaborated material directly into the wood, instead of pushing its way against the force of gravity to the leaves, if osmose is so powerful an agent in the circulation? If this tendency to rush into the bark were to exist, there would be a much greater flow from places that are girdled than is now observed, and probably the bark itself would be ruptured by the pressure exerted, which would often be equal to more than thirty pounds to the square inch.

One of the most surprising facts to be noticed in examining the wood of any tree with well-developed foliage, is the entire absence of anything like free, or fluid, water. A freshly cut surface of the sap-wood is not even moist to the touch, and, if a tube be inserted into the trunk of such a tree, it will frequently absorb water with great avidity. On the sixth of June last, a half-inch tube, six feet in length, was attached to a stop-cock, inserted into the trunk of an elm, and the tube filled with water. The absorption was so rapid that the fluid disappeared in thirty minutes, and this was repeated several times the same day. Similar observations were made upon white oak, chestnut and buttonwood trees.

Now, this absorption was not osmotic, but apparently the result of imbibition, or the affinity of the cellulose of the woody fibre for the water. Is not this, then, the proper name for the force which carries up the crude sap?

The wood of growing trees, when cut from near the surface, though apparently dry, contains nearly fifty per cent. of water; and in the young twigs, with a living pith, the proportion is even greater.

There is good reason to believe that the sap in ordinary trees begins to move first in the buds, and that the first supply of water exhaled in the spring is derived from the sapwood. Branches of aspen and red maple, two feet in length, were cut on the twenty-sixth of last March, and placed in a warm room in an empty vase. The flower buds developed without any other water than what they could abstract from the wood; so that, on the fifth day, the staminate catkins of the aspen were four inches long and the pollen well developed. Branches which have been removed from apple trees in the spring are often covered with blossoms in a similar way, while lying on the ground. It is a well-established fact that the roots of most woody plants have no power at any season to force water to any considerable height when separated from their stems.

The roots of all plants, growing in ordinary soil, develop most freely and absorb most abundantly, when the earth is well drained and aërated. Thus we find that the crude sap imbibed by the root-hairs from the surface of the particles of the soil, seems to be taken up in a dry state,—that is, it is absorbed, molecule by molecule, and no liquid is visible, and carried in this form through all the cellulose membranes between the earth and the leaf by which it is to be digested or exhaled. We do not say this is literally true, but it accords very nearly with what is constantly to be seen. The circulation of the sap in a poplar tree is very dry, compared with that of the blood in any animal. Not a drop of sap or moisture will ever flow from the soft wood of an aspen, so far as we have observed. Nevertheless, it grows very freely and starts very early in the spring, and usually contains more than fifty per cent. of water.

That living cellulose has a peculiar and most powerful affinity for water is evident from the fact, discovered by De Vries, that when a shoot of an herbaceous plant with large leaves is cut, and the fresh surface allowed to come for a short time into contact with the air, it loses much of its absorbing power, and the leaves will wilt, even though it be placed in water. If, however, the section be made under water, so that the living tissue is not exposed to the air, its power of imbibition remains unimpaired, and the leaves do not wilt.

It appears, therefore, that much of the crude sap passes through the membranes of the sap-wood, or woody fibre, or cellular tissue of plants in an apparently solid form, combined with the cellulose, just as the water in dry slacked lime or a plaster cast is in a solid state. In all these cases, it may be obtained as a liquid by distillation at a temperature of 212° F. The cause of the motion is the removal of the water from the tissue at some point, by exhalation, by chemical combination, or by assimilation. Whenever any portion of the living cellulose has an insufficient amount of water to saturate its affinity, it imbibes an additional quantity, and this process is continued backward through the tissues to the earth or the source of supply.

The conducting power of the cellulose of sap-wood is very remarkable, as is seen in the fact, that whenever a limb of an apple or peach tree breaks down under its burden of fruit, it very rarely wilts or fails to ripen its crop. Those who have compared the area of a section of the trunk of a large tree with the area of a section of its branches at any point above, must have noticed that the relative amount of sap-wood rapidly increases as we ascend toward the top, and that the young twigs and small branches contain no other wood.

An elm in Amherst, famous for the beautiful symmetry of its form, and known as the Ayres elm, was carefully measured last summer by Professor Graves and the senior class of the College. The area of the sections of the branches twenty feet from the ground was more than twice as great as the area of a section of the trunk four feet from the earth, and the proportion of sap-wood was of course much greater.

An interesting experiment was undertaken at the Durfee Plant-house, to determine how small a proportion of sap-wood could conduct the necessary supply of sap to the foliage of a growing tree, and, also, whether the bark alone could transmit the requisite water to prevent the leaves from wilting. A plant of *Hibiscus splendens*, standing in the ground, and having three stems from the same root, was selected for trial. The plant was growing rapidly, and was prepared for the experiment as follows:—Two of the stems were tied firmly to stakes, and the third left undisturbed. The first specimen had all the bark removed from one inch of the stem, and then the wood was cut away until there remained only a small piece of the outside layer of sap-wood, which was one inch long, and seven-sixteenths of an inch in circumference. This exposed surface was immediately covered with grafting wax, to protect the tissues from the action of the air. The amount of stem remaining was just one eighty-fourth of the original, which was about four inches around. The healthy leaf surface was fully twenty-five hundred square inches, from both sides of which exhalation went on to some extent, making five thousand square inches of exhaling surface. The result was that the foliage remained perfectly fresh and vigorous for ten days, until, on the tenth of November, the specimen was cut for the museum. [See Fig. 2.]


Fig. 2.

The other stem was used to determine whether, by osmose or in any other way, the crude sap could ascend in the bark and supply the leaves with water. All the wood, and one-third of the bark, were removed from a portion one-half inch in length, the exposed tissues protected by wax, and the branches so pruned as to leave but five hundred square inches of leaf surface. The foliage drooped in a single hour, and never recovered. This experiment showed that the bark was altogether incompetent to transmit the requisite supply of crude sap to the parts above it, although it was thick and succulent and much greater in quantity, when compared with the exhaling surface, than the piece of sap-wood which showed such marvellous conducting power. If osmose were the cause of the ascent of sap, it would seem that the abundant parenchyma of the bark, intimately united as it is with the wood by the medullary rays, must freely transmit the amount required in this case. But the leaves wilted and perished as quickly as if the entire stem had been severed. [See Fig. 3.]

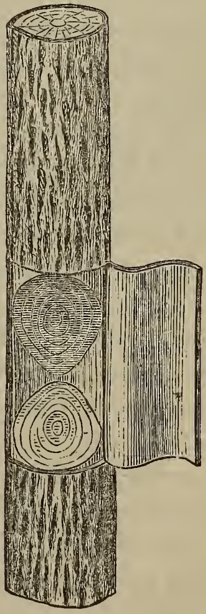


Fig 3.

Having thus demonstrated the fact that crude sap ascends chiefly in the sap-wood of exogenous trees, let us now consider a few facts which appear to prove that there is a counter movement of elaborated sap, which is, for the most part, confined to the bark.

It is well known that if a narrow ring of bark be removed from the trunk of a tree between the leaves and the roots, then the deposition of wood ceases below the girdled place, though above it the growth for the season ensuing will be quite normal. This proves beyond dispute that the wood cannot convey that portion of the elaborated sap which is essential to growth, and that it can be conducted only by the tissues of the bark, or the imperfectly developed tissues of the cambium, between it and the perfectly formed wood. Nevertheless, there is free communication in a transverse direction for the crude sap, and for some of the elaborated substances, between the wood and the bark, probably by means of the medullary rays which connect the two. Thus only can we account for the fact that the bark below a girdled place often remains alive long after the deposition of wood ceases, and also for the circumstance that starch and sugar, which must originally come from the leaves, are found either accumulated in the cells of certain stems and roots, or existing in the sap which flows or is expressed from their tissues.

If we shave off little by little the bark of a maple when the sap is flowing freely, we shall observe no exudation from any portion of the *liber* even, but, as soon as the whole of this is removed, the sap issues from every part of the surface of the exposed wood.

Again, those who work with mill logs tell us that in the spring the bark becomes soft and loose, precisely as if the tree were standing, at least in the case of some species. Sometimes logs and poles cut for fences will sprout and actually produce shoots with foliage, the sap of which must be derived from that which is stored up in the timber, and which must pass from the wood to the bark.

Mr. William F. Flint, of Richmond, New Hampshire, has sent us a piece of a red maple slab, which he found on moist ground under a pile of wood, and which threw out at the ends and sides a callous a quarter of an inch thick, precisely like an ordinary cutting of a grape vine. Here we have an instance of growth without either roots, buds or leaves, all the material for which must have been derived from the stick itself. [See Fig. 4.]

Fig. 4.

Similar to this in its character is the curious circumstance, not very unfrequent, of old potatoes resolving themselves into several smaller ones within the skin of the parent tuber, without any external appearance of vegetation. This is reported to have occurred in a vast number of tubers in a quantity of potatoes on board a vessel in the Arctic Ocean, where the low temperature probably exerted some influence in causing this peculiar mode of sprouting.

With the view of determining some facts concerning the functions of the bark in connection with the circulation of sap and the growth of wood, many experiments have been undertaken at the College, during the past two years, with some interesting results.

In order to learn whether the annual layer of wood upon trees is developed from the outside of the old wood or from the inside of the bark, the following plan was tried: Vigorous young trees of elm, willow and chestnut were selected, which were from two to three inches in diameter. On the thirtieth of May, before any deposition of organized tissue was visible, but when the bark was easily separated from the wood, a horizontal incision was made with a sharp knife around each stem, and immediately above this four vertical incisions, on the four quarters of the stem, about three inches in length. The four strips of bark were then carefully detached from the wood at their lower ends, and a piece of tinned copper, one inch wide and long enough to reach around the wood and overlap, was adjusted to the trunk. The bark was then replaced and covered tightly with cloth which had been dipped in melted grafting wax. The trees grew through the season as usual; and, after the fall of the leaves, the bandages were removed and the results observed. In all cases, the new wood (*b*) was found to have been deposited from the bark, and outside of the metallic band (*a*). [See Fig. 5.]

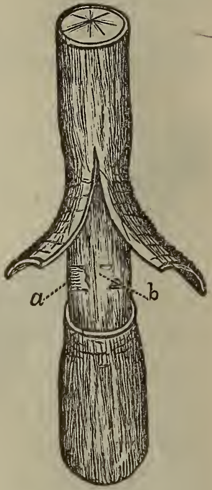


Fig. 5.

Examination under the microscope showed that the medullary rays were as numerous as in other portions of the layer of wood, and extended directly from the bark to the metal under it, thus proving that it did not flow down from above the band. [See Fig. 6.]

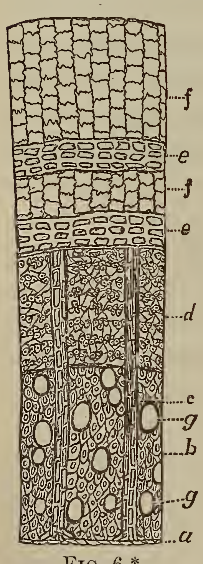


Fig. 6.*

This quite satisfactory result demonstrates that the elaborated material, formed in the leaves, descends in the bark, rather than in the wood of all exogenous trees.

Much information has also been obtained in regard to the effects of ringing or girdling the trunks and branches of trees by the removal of a band of bark, or of bark and sap-wood, from the entire circumference.

This has long been practised in new countries to kill the timber which the settler had not time to fell, but must destroy

* Figure 6 gives the microscopic structure of a horizontal section of the elm wood and bark directly over the metal. Next to the tin was a thin layer of parenchyma (*a*), connected to the inner layer of bark by medullary rays (*c*), which were as numerous as in the other parts of the new wood, and passed directly from the bark to the metal, whether examined in a horizontal or vertical section. The cork-cells (*f*), bast (*d*) and parenchyma (*e*) of the bark, and the woody fibre (*b*), ducts (*g*) and medullary rays (*c*) of the stem, are clearly visible in this section.

in order to obtain grass and other crops. The Chinese are said to produce curious dwarf fruit trees, by ringing a fruit-bearing branch and placing over the spot a flower pot filled with earth in which roots are developed, so that it may then be detached from the parent tree and cultivated independently. The Italians propagate the fig tree in a similar manner, and this process may be made very useful in securing the certain growth of a sporting branch of any woody plant, or of the branches of species with spongy or pithy wood, which will not root from cuttings.

It is a well-known fact that the ringing of the branch of a vine or tree will tend to increase the size of the fruit the following season, because the branch is thereby gorged with elaborated material for which there is no outlet, and some persons habitually adopt this mode of improving fruit, especially that of the grape.

In the town of Southborough, Mass., is an apple orchard of healthy trees, from twelve to sixteen inches in diameter, which were all girdled by the owner, Mr. Trowbridge Brigham, in the spring of 1870, for the purpose of inducing fruitfulness. The desired result is said to have been obtained, and the trees seem to have suffered no material injury, owing to the imperfect manner in which the operation was performed. At the time when the trees were in full blossom, a narrow belt of bark, usually less than an inch in width, was removed from the trunks, about two feet from the ground. This did not peel freely in all cases, and there were many crevices where it was retained. By means of these connecting links the communication between the leaves and roots was imperfectly preserved, and during the season new wood and bark were developed upon these places. In addition to this, in many cases, the new wood from the upper side of

Fig. 7.*

* Figure 7 shows how a branch of a wild grape vine, after being girdled, formed new wood from both above and below, and thus made a new passage for the downward flow of the sap. The wood developed from beneath the girdle was formed from sap elaborated in other branches.

the girdled spot was sufficiently abundant to reach across and form a connection with the living bark below. [See Fig. 7.]

Upon one of these trees was found a branch some four inches in diameter, which had been perfectly girdled in 1870, and, although no communication had existed between the bark of the branch and that of the trunk, it had grown every year till March, 1874, when it was cut. The buds upon it were poorly developed, but alive, while the ends of the branches were dead. It apparently could not have survived more than a year or two longer, and the reason was obvious upon making a longitudinal section through the girdled part. The limb was nearly horizontal, and the ring of bark removed was only

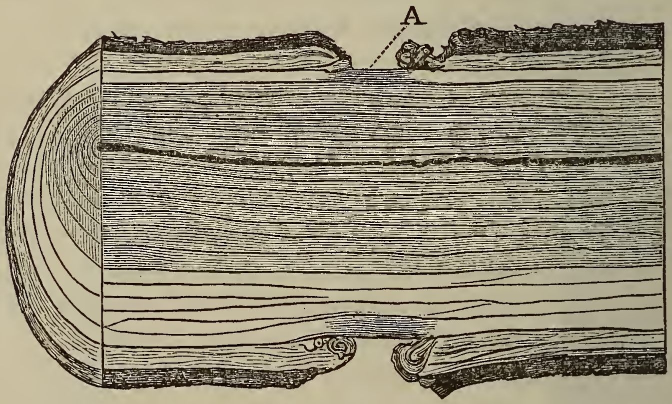


FIG. 8.

a few inches from the trunk. New layers had formed each year up to the denuded place, but the enlargement was more above this than below it. The material to form new wood and bark below came from the other parts of the tree, and yet, owing apparently to the poor circulation, was deficient in quantity. The crude sap, with some materials from other portions of the tree, ascended to the buds and leaves, and so an unhealthy growth was continued. An examination of the section of this branch explained the cause of its final failure. The wood beneath the girdled place, through which the sap must ascend, was gradually dying, and thus the channel of communication was constantly becoming more and more obstructed. On the whole, this mode of treating orchards cannot be recommended for general use. [See Fig. 8.]

In regard to the length of time during which a perfectly girdled tree may continue to live, we have obtained some facts worth recording.

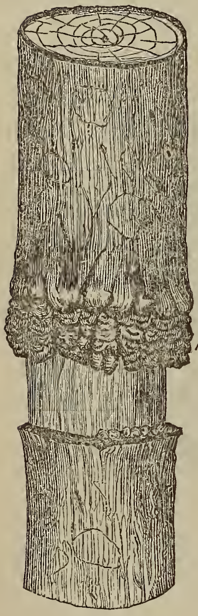
In India, it is necessary to girdle the teak trees the year before cutting them, in order to have them die and lose a portion of their sap by evaporation, since otherwise the logs will not float down the rivers to market. Removing a ring of bark is not sufficient to accomplish this result, and it is necessary to cut through all the sap-wood, so as to prevent the ascent of water to the leaves, or the trees will continue to live for years.

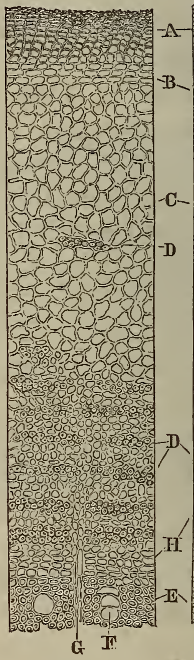
Mr. William F. Flint has communicated an interesting account of a beech tree, about eighteen inches in diameter, which grew in an open pasture in Richmond, New Hampshire. It was girdled, for the express purpose of killing it, in 1866, by chopping a gash two or three inches wide and nearly as deep entirely around the trunk near the ground. The next year it sent up sprouts from below the girdle, and formed a new layer over its entire surface. This was repeated in 1867; but in 1868 the bark and sprouts of the lower part died, and dead branches began to appear in the top. This process of decline continued, and, in 1873, but one of the large branches put forth its leaves, and, finally, on the ninth year, in 1874, it died utterly. This remarkable tenacity of life is doubtless due to the close, fine texture of the timber, and the fact that such beeches in open land have an unusual amount of sap-wood, and are hence called white beeches.

A red maple on the College farm, which was girdled in April, 1873, by cutting a channel in the sap-wood, two inches wide and one inch deep, bled most profusely, but grew as usual through the season. No wood, however, was formed below the girdle, and the bark died and separated from the wood. The roots, however, remained alive, and the tree has borne its usual amount of foliage during the summer of 1874, and formed its buds for the next year, and produced a new layer of wood above the girdle. Specimens have been collected for chemical and microscopic analysis of the roots and of the wood and bark above and below the girdle, in the hope that some light may be thrown upon the subject of sap circulation and the functions of the bark, whenever this work can be done.

On the third of June last, branches of the apple, pear, peach, crab-apple and grape, were girdled by removing a ring of bark one inch long. They grew well, and bore an abundance of fine fruit, as was expected.

At various times during the summer, a large number of





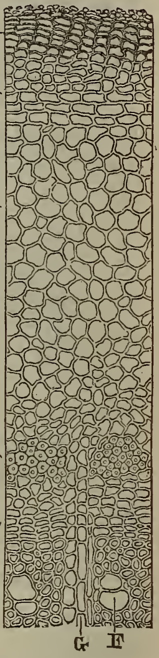


FIG. 9. FIG. 10. FIG. 11.* FIG. 12.†

small trees of the more common species were girdled. They all grew through the season as usual, except that they formed no wood below the girdle, after the bark was removed. The bark below the girdle, however, remained alive and healthy;

* Figure 11 shows the microscopic structure of the ordinary bark of a young red maple. A, periderm or cork. B, primary parenchyma. C, secondary parenchyma. D, bast fibres. E, woody fibre of trunk. F, vessels or ducts in wood. G, medullary rays connecting bark and wood. H, recent parenchyma of inner bark.

† Figure 12 shows the same elements in the newly-formed bark seen in Fig. 10, magnified 200 times.

but the place from which it was removed became dry and dead, except in a single instance.

The red maple, girdled June twenty-third, formed wood only on the upper side ; but the specimen girdled July twenty-first, formed a new layer of wood and bark upon the denuded surface. This was doubtless owing to the fact that a portion of the cambium was left on the wood sufficient to conduct the elaborated sap and form new tissues out of it. This tree, like the others, grew in the woods, where it was shaded from the direct rays of the sun. The new bark was of a reddish brown color, and very smooth, and consisted of a thin layer of periderm or cork, with parenchyma and bast, and closely resembled in its structure the ordinary bark of this species.

There is a popular notion that the bark of an apple tree, removed on the longest day of the year, will be renewed, and it is well known that occasionally such renewal of the bark of various species does occur. This may happen whenever there is deposited upon the old wood, enough of the new layer to conduct downward the elaborated sap and develop from the living parenchyma of the forming medullary rays a protecting layer of periderm. [See Figs. 9, 10, 11 and 12.]

It is not uncommon for the bark of the half-hardy weeping willow to be started by freezing and thawing from the wood. When this is the case, there sometimes forms a new layer of wood upon the detached bark, which is disconnected from the wood of the parent trunk. There is, also, sometimes formed a new layer of wood and periderm on the old wood under the shelter of the old bark, and roots often descend from the healthy portion of the trunk several feet beneath the loose bark to the ground, and as soon as they penetrate it enlarge rapidly. All these phenomena are readily explained by supposing that the liber or inner bark of the tree is torn asunder, a portion sometimes remaining attached to the wood sufficient to conduct the elaborated sap, and so form a new layer of wood with a layer of cork. The roots are developed from the uninjured portion under the protection of the old bark, and in their nature are precisely like roots from cuttings. The rupture of the medullary rays and the separation of the bark from the wood by the combined action of frost and sunshine is not uncommon in the apple and other cultivated trees.

If a severe frost separates the water from the wood as ice, and it then thaws and freezes again, before it can be reabsorbed, it would be likely to burst the bark or tissues in which it was accumulated. This usually results in one or more cracks through the bark on the southerly side of the tree, from which there is, in the case of the apple tree, commonly a slight flow of crude sap in the following April or May. The outside of the bark is blackened, and the detached portions die.

In the spring of 1874, a vertical crack three feet long was noticed on the south side of a vigorous young Gravenstein apple tree in Amherst, the trunk of which was about three inches in diameter. Upon examination it was found that the bark had not been separated from the thick layer of wood formed the previous year, but that this outside layer was entirely separated from the wood beneath. The bark being supplied with sap, ascending through this layer, remained sound, and the crack being filled with wax the tree grew equally well with others in its vicinity, which had sustained no injury. The new growth on the sides of the crack, being covered only with a thin, soft periderm, will doubtless readily unite, and there will soon remain no trace of the rupture. The separated layers of wood, however, will never be reunited, though the inner ones may conduct sap until converted into the nearly impervious heart-wood, which occupies the central portion of every trunk after it attains to any considerable size. At what age, if ever, the inner wood of exogens loses all power of conveying sap, and whether the sound heart of an old tree, which has never been exposed to the influences of the atmosphere, still retains life, are questions which have not yet been definitely answered. It is not easy to say wherein the vitality of any perfectly formed tissue, whether of the wood or bark, consists, since its cells have no power of enlargement or multiplication. The functions of the wood seem to be mainly, if not wholly, such as may be performed by dead material. The cellulose which has never been exposed to the air, may retain its peculiar affinity for water, which is evidently much greater before than after drying. The cells may serve as reservoirs of starch and other substances which may afterwards be imbibed by the living, growing or ripening tissues. The pith, which is alive in young branches so long as leaves are borne upon their wood, dies apparently with them. If growth is a characteristic of living tissue, then our trees may with some reason be considered annuals, since all their growth proceeds normally from their winter buds and completely envelopes every portion of the tissues of root, stem and branch previously formed, thus excluding them from the weather and preventing their decay while using them for a support and a source of supplies. However this may be, it is certain that the vitality of trees is concentrated in a remarkable manner upon their surfaces and the extremities of their roots and branches.

Among the observations made during the past season, not the least interesting were those relating to the natural grafting which is frequently to be seen in the forests, and which is particularly noticeable among roots. [See Fig. 13.] Time will not permit us to dwell upon this subject here; but the wonderful conducting power of woody tissue, and the surprising vitality of the bark, can be illustrated in no manner so clearly as by reference to the possibilities of the processes of budding and grafting which are so universally employed in the propagation of desirable varieties of trees. Two cases only can be mentioned. First, a compound tree can be produced, which shall have a plum root and stock, on which shall grow an apricot stock, and on this, a blood peach with red wood, on this a snow peach with white

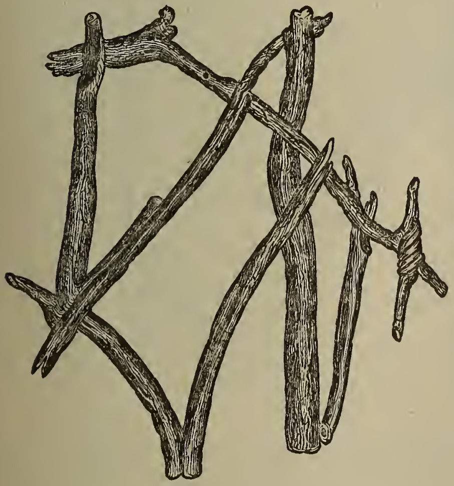


Fig. 13.*

* Figure 13 shows the grafted roots of a white pine stump, the points of union being very numerous.

wood, and on this, an almond with yellow wood. Thus we may have a tree with plum roots and almond foliage. But we can cause buds to be developed on all the five sorts of wood and bark which constitute the stem so as to have five kinds of leaves, flowers and fruits produced by means of the crude sap absorbed by the plum roots. This is plainly analogous to the raising of a child, a calf, a colt, a lamb, a white pig and a black pig on the same cow's milk. The specific life of each, and not its food, determines its size, form and character. [See Fig. 14.]

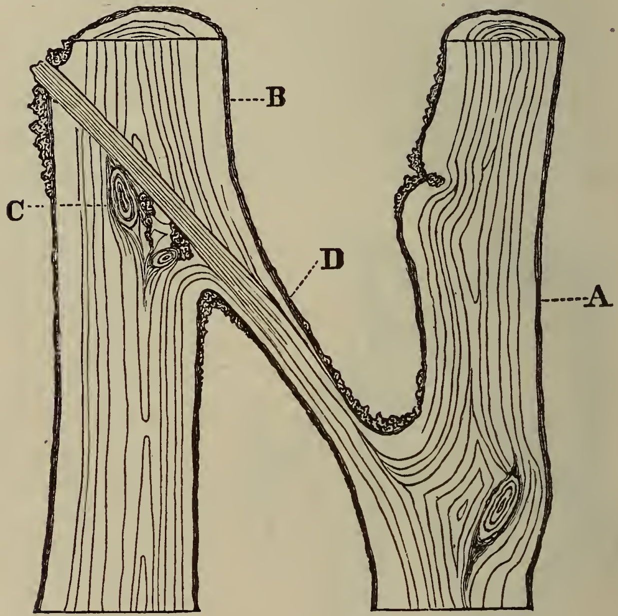


FIG. 14.*

To show still more impressively the peculiar power of the wood and bark to conduct the crude and elaborated saps in either direction, and to act either as roots or branches, as circumstances require, we will describe an experiment performed by a French gardener, M. Carillet, at Vincennes, in 1866 and 1867.

* Figure 14 illustrates the natural grafting of two trunks of white pine. A is the smaller trunk, a branch of which is seen to grow through the wood of the larger one The union of wood is perfect, and the elaborated sap from B has flowed so freely over the connecting branch, that A is larger below, and B is larger above the place of junction. C is the knot in the heart of B, formed of the base of the limb, in the axil of which D, the connecting branch, became fastened in the beginning of the operation

He selected two dwarf pear trees grafted on quince roots, which were from four to five feet high. One of these was carefully dug up in April, 1866, and fastened in an inverted position above the other. The leading shoots of the two trees were now flattened on one side with the knife and the two surfaces firmly bound together in the usual manner of splice-grafting. The two shoots grew together, and in the course of the summer following a few leaves appeared on the main stem of the inverted pear tree, and also on the main branches of the quince roots, which were entirely in the air, some eight or ten feet from the ground. The next spring, scions from four varieties of pear were set upon the four main branches of the quince roots, two of which lived and grew several inches. Meanwhile, the inverted pear tree bore two pears. Here, then, was a composite tree, consisting first of a root of quince, then a pear tree; upon this was an inverted pear tree, which had branches consisting of inverted quince roots which produced quince leaves; and these were surmounted by pear shoots of two unlike kinds. Upon such a specimen it would be difficult to comprehend the working of the imaginary syphons of Dr. Pettigrew, to which reference has been made. * * * * * * * *

But I am reminded that I have promised to tell the story of a squash in harness. The following considerations suggested the idea of experimenting with this plant:—

First. It is a well known fact that beans, acorns and other seeds often lift comparatively heavy masses of earth in forcing their way up to the light in the process of germination.

Secondly. We have all heard how common mushrooms have displaced flagging-stones, many years since in Basingstoke, and more recently in Worcester, England. In the latter case, only a few weeks ago, a gentleman noticing that a stone in the walk near his residence had been disturbed, went for the police, under the impression that burglars were preparing some plot against him. Upon turning up the stone, which weighed eighty pounds, the rogues were discovered in the shape of three giant mushrooms.

Thirdly. Bricks and stones are often displaced by the growth of the roots of shade trees in streets. Cellar and other walls are also frequently injured in a similar way.

Fourthly. There is a common belief that the growing roots of trees frequently rend asunder rocks, on which they stand, by penetrating and expanding within their crevices.

Having never heard of any attempt to measure the expansive force of a growing plant, we determined to experiment in this direction.

At first, we thought of trying the expansive force of some small, hard, green fruit, such as hickory nut or a pear, but the expansion was so slow and the attachment of the fruit to the tree so fragile, that this idea was abandoned. The *squash*, growing on the ground, with great rapidity, and to an enormous size, seemed on the whole the best fruit for the experiment.

Accordingly, seeds of the mammoth yellow Chili having been obtained from Mr. J. J. H. Gregory, of Marblehead, they were planted on the first of July, in one of the propagating pits of the Durfee Plant-house, where the temperature and moisture could be easily controlled. A rich bed of compost from a spent hot-bed was prepared, which was four feet wide, fifty feet long, and about six inches in depth. Here, under the fostering care of Professor Maynard, the seeds germinated, the vine grew vigorously, and the squash lifted in a most satisfactory manner.

Never before has the development of a squash been observed more critically or by a greater number of people. Many thousands of men, women and children from all classes of society, of various nationalities, and from all quarters of the earth, visited it.

Mr. D. P. Penhallow watched with it several days and nights, making hourly observations; Professor H. W. Parker was moved to write a poem about it; and Professor J. H. Seelye declared that he positively stood in awe of it.

Curious facts were noted in regard to all parts of the plant, but among the most surprising were those relating to the development of the roots. Growing under the most favorable circumstances, they attained a number and an aggregate length almost incredible. The primary root from the seed, after penetrating the earth about four inches, terminated abruptly and threw out adventitious branches in all directions. In order to obtain an accurate knowledge of their development, the entire bed occupied by them was saturated with water, and after fifteen hours, numerous holes were bored through the plank bottom, and the earth thus washed away. After many hours of most patient labor, the entire system of roots was cleaned and spread out on the floor of a large room where they were carefully measured. The main branches extended from twelve to fifteen feet, and their total length, including all subdivisions, was more than two thousand feet.

At every node or joint of the vine was also produced a root. One of these nodal roots was washed out and found to be four feet long and to have four hundred and eighty branches, averaging with their branchlets a length of thirty inches, making a total of more than twelve hundred feet. As there were seventy nodal roots, there must have been more than fifteen miles in length on the entire vine. There were certainly more than eighty thousand feet, and of these fifty thousand feet must have been produced at the rate of one thousand feet or more per day.

Now it has been said that corn may be heard to grow in a still, warm night, and it has been proved that a root of corn will elongate one inch in fifteen minutes. But here are twelve thousand inches of increase in twenty-four hours. What lively times in the soil where such vital force is at work! The wonder is that we do not hear the building of these roots as it goes on.

But in addition to the movements caused by the increase of the roots among the particles of the soil, we should remember that solution, chemical affinity, diffusion and capillarity, as well as the absorption of the feeding rootlets, are incessantly at work beneath the surface of the silent earth.

With what amazement should we behold the development of a crop upon a fertile field, if we could but see with our eyes the things which are known to transpire!

The flowers of the squash are arranged in regular succession, one at each node. A female flower is usually succeeded by four males, so that squashes would be produced at every fifth node, if all should set, which, however, never happens. The impregnation of the ovules within the ovary of the female flower requires the deposition of pollen grains from the

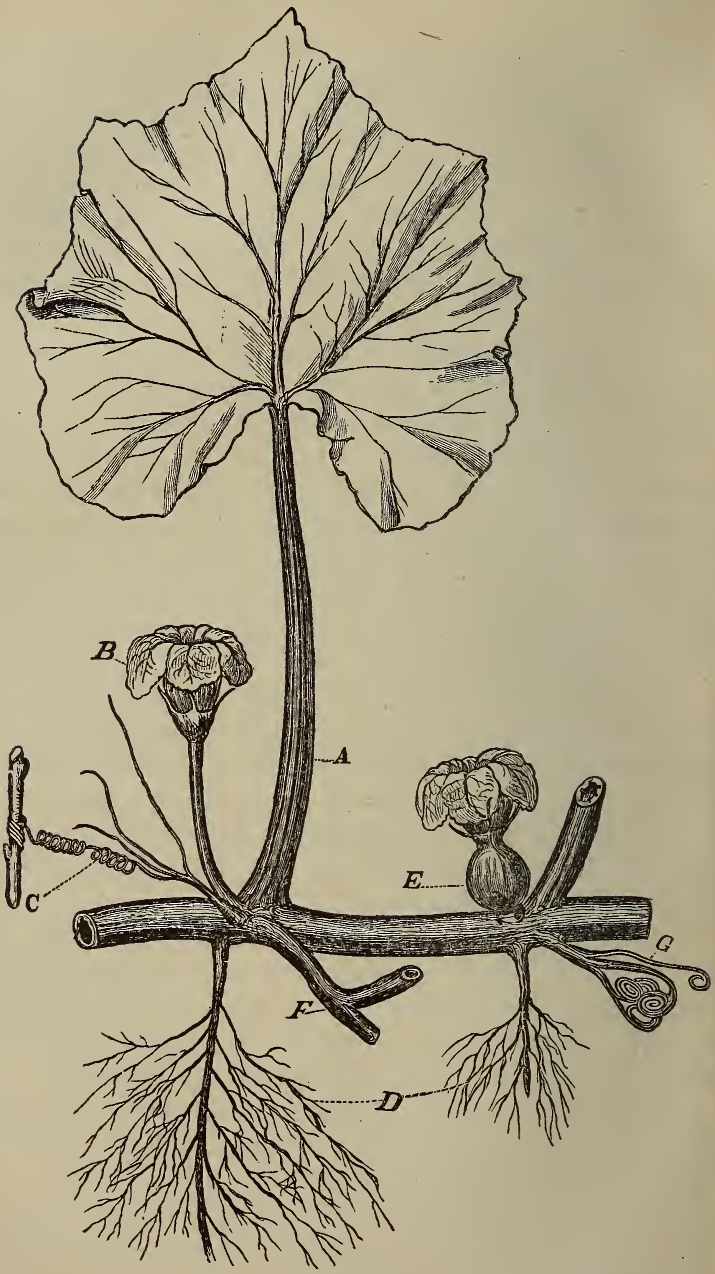


FIG. 15.

Represents two nodes of the squash vine. A, is the petiole of a leaf showing vertical striæ. B, a staminate flower on a long peduncle. C, a branching tendril exhibiting the mode of attachment to a support, and the double reversed spiral of the portion between the support and the base of the tendril, by which all the branches of a tendril are made to bear their share of the strain, if they secure an attachment; and by which also great elasticity is given to the tendril, and the liability of rupture largely diminished. D, nodal roots. E, a pistillate flower with a short peduncle. F, a lateral branch of the vine. G, a tendril which, having failed in finding a support, has coiled upon itself and turned back towards the older portion of the vine.

anther cells of the male flower upon the stigma of the former under favorable circumstances. The stigmatic surface must be in a proper condition to retain and develop the pollen, which must also be in a perfect state. Bright, warm weather will doubtless aid in the process, though much remains to be observed in regard to it. The pollen grains of the squash are large and rough, and of a spherical form, and consist of an outer and an inner coating of membrane filled with a protoplasmic fluid. In the outer coating is a minute orifice, through which, when moistened by the saccharine secretion of the stigma, the inner coating protrudes as a microscopic structureless tube which pushes its way into the tissues of the style and ovary until it reaches the embryo sac of an ovule, which may then become a perfect seed. This contract of the pollen tubes with the ovules is essential to the setting of every squash. The transfer of the pollen grains to the stigmas is usually accomplished by insects, which fly from flower to flower in pursuit of food. It may also be done artificially, and there is reason to believe that the crop of squashes, melons and cucumbers might often be largely increased by attention to this matter in out-door cultivation. When grown under glass, fertilization must always be effected by artificial means. [See Fig. 15.]

The pistillate, or female flower, on the twenty-first node of our growing vine, was carefully impregnated with pollen on the first of August last. The young squash immediately began to enlarge, and on the fifteenth of the same month, measured twenty-two inches in circumference; on the sixteenth, twenty-four inches, and on the seventeenth, twenty-seven. Though the rind of the young fruit was very soft, it was now determined to confine it in such a way as to test its expansive power. In doing this, great care was taken to preserve the health and soundness of every part of the squash, and to expose at least one-half of its surface to the air and the light.

The apparatus for testing its growing force consisted of a frame or bed of seven inch boards, one foot long. These were arranged in a radial manner like the spokes on the lower half of a wheel, their inner edges being turned towards the central axis. These pieces were held firmly in place by two end-boards twelve inches square, to the lower half of which they were secured by nails and iron rods. A hemi-ellipsoidal cavity, about five inches deep in the centre, and eight inches long, was cut from the inner edges of the seven boards, and in this the squash was carefully deposited, the stem and vine being properly protected by blocks of wood from injury by compression. Over the squash was placed a semi-cylindrical harness or basket of strap iron, firmly rivetted together. The meshes between the bands, which crossed each other at right angles, were about an inch and a half square. The harness was twelve inches long and the same in width, so that when placed over the squash it just filled the space between the end-boards. Upon the top of the harness, and parallel with the axis of the cylinder and the squash, was fastened a bar of iron with a knife-edge to serve as the fulcrum of a lever for the support of the weights by which the expansive force was to be measured. At first, an iron bar, one inch square, was used for a lever; then a larger bar of steel, then a lever of chestnut plank, then one of seasoned white oak plank, and, finally, one of chestnut, five by six inches and nine feet long; but even this required to be strengthened by a plate of iron, four inches wide by half an inch thick and five feet in length. The fulcrum for the lever was also renewed from time to time, as the weight was increased. [See Fig. 1.] The following table shows the weight of iron lifted by the squash in the course of its development:—

August	21st, .	60	pounds.	Sept.	14th, .	1,300	pounds.
	22d, .	69	"		15th, .	1,400	"
	23d, .	91	"		27th, .	1,700	"
	24th, .	162	"		30th, .	2,015	"
	25th, .	225	"	October	3d, .	2,115	"
	26th, .	277	"		12th, .	2,500	"
	27th, .	356	"		18th, .	3,120	"
	31st, .	500	"		24th, .	4,120	"
Sept.	11th, .	1,100	"		31st, .	5,000	"
	13th, .	1,200	"				

The last weight was not clearly raised, though it was carried ten days, on account of the failure of the harness irons, which bent at the corners under the enormous pressure of two and a half tons, and consequently broke through the rind of the squash. It was not feasible to remove the harness and substitute for it a stouter one, on account of its being imbedded in the substance of the squash, which grew up through the meshes of the harness, forming protuberances an inch and a half high and overlying the iron bands. When, on the seventh of November, the harness was removed, in order to take a plaster-cast of the squash, it was necessary to cut the straps with a cold-chisel, sometimes into several pieces, and draw them out endways. The growing squash adapted itself to whatever space it could find as readily as if it had been a mass of caoutchouc, nor did it ever show the slightest tendency to crack, except in the epidermis. This would often open in minute seams, from which a turbid mucilaginous fluid exuded. In the morning, drops of this would frequently bedew the protuberances, like drops of perspiration. In the sunshine, these dried up, and fell off as minute globules, resembling gum-arabic.

The lifting power was greatest after midnight, when the growth of the vine and exhalation from the leaves was least.

The material out of which the squash was formed, was elaborated in the leaves during the daytime and transferred through the vine to the stem. Through this it was imbibed by the living, growing cells of the squash, which were constantly multiplying by subdivision until their number was many billions, notwithstanding the enormous pressure under which they were forced to develop. This growth was possible only because life, being a molecular force, exerted its almost irresistible power over an enormous surface of cell membrane.

Scarcely less astonishing than the mechanical force exhibited, was the ability of the tissues of the squash to resist chemical changes and the attacks of mold where the rind was injured by bruises or cuts. Whenever fresh-growing cells were exposed to the action of the air, they immediately began to form a regular periderm of cork, precisely resembling in appearance and structure that produced upon the cork oak, the elm and other trees.

The form of the squash can hardly be described, but may be seen in the drawings, which show the end and the upper side. The weight was forty-seven pounds and a quarter, and, when opened, the rind was found to be about three inches thick, and unusually hard and compact. The internal cavity corresponded in form to the exterior, but was very small, and nearly filled with fibrous tissue, and plump and apparently perfect seeds in about the normal number. [See Figs. 16, 17.]

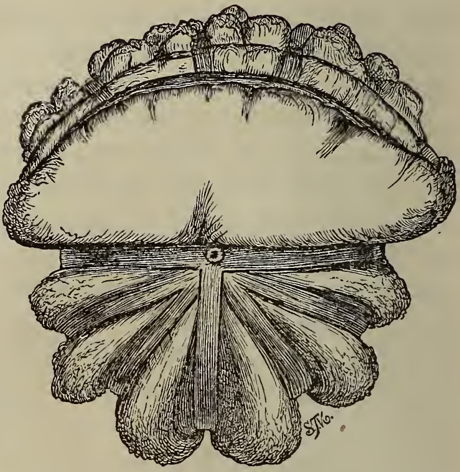


FIG. 16.

The frequent displacement of flagging-stones, and the damage often done to brick and concrete pavements and stone walls by the roots of shade trees, considered in connection with the wonderful expansive power of the squash in harness, made it evident that growing roots of firm wood must be capable of exerting, under suitable conditions, a tremendous mechanical force. Upon searching the fields for examples of trees standing upon naked rocks or ridges covered with only a shallow soil, many interesting specimens were readily discovered to demonstrate this fact.

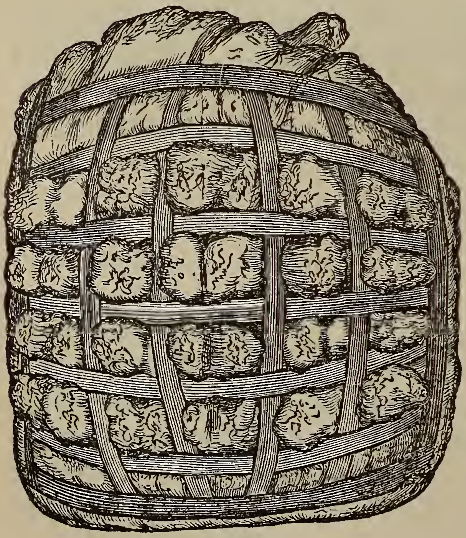


FIG. 17.

In South Hadley, Massachusetts, a sugar maple was found which had grown upon a horizontal bed of red sandstone. The tree stood upon the naked rock, over which its roots extended a few feet in three directions into the soil. One root had pushed its way under a slab of the rock, which measured more than twenty-four cubic feet, and must have weighed nearly two tons. In the course of twenty years or more, this root had developed to such a size as to raise the slab

Fig. 18.

entirely from the bed rock and from the earth, so that it rested wholly upon the wood.

Upon examining the tree, it was evident that as it stood upon horizontal roots which rested on solid rock and had a diameter of nearly a foot, and as they had grown by an annual deposition of wood entirely around them, and as the heart, now several inches from the rock, must once have rested on it, and as the rock could not have been depressed, therefore the tree had been lifted every year by the growing wood of the outside layer. Another tree of paper birch having been found growing in a similar manner, one of the horizontal roots was sawed through, and the centre of the heart was seen to have been elevated seven inches since the tree was a seedling.

Now it is clearly demonstated that the power of vegetable growth can lift a tree, and that it must do so whenever the bed of the roots cannot be depressed, It is evident, also, that old trees on a clay hardpan, or any other unyielding subsoil, must be thrown up by the process of growth. Every person is familiar with the fact that large trees usually have the appearance of having been raised, and their roots are often bare for considerable distances around the trunk. [See Fig. 18.]

This lifting of the tree from its bed would seem to be advantageous to it, by tightening the roots so as to hold it firmly in place, notwithstanding the possible elongation of their woody fibre by the excessive strains to which they are subjected during violent storms. This method of securing the tree in place would be still further improved by the constant enlargement of the roots by the annual deposition of a layer of wood, and the consequent filling of any space formed in the soil by the movement of the roots, caused by the swaying of the tree in the wind.

This slight annual elevation of trees, by the increase in diameter of their horizontal roots, furnishes an explanation for the differences of opinion in regard to the question, whether a given point on the trunk of a tree is raised in the process of its growth. While it has been demonstrated by Prof. Asa Gray that two points in a vertical line on the trunk of a tree will not separate as it enlarges, it seems equally clear that both of them may be quite perceptibly elevated in the course of time.

It has been stated, on good authority, that at Walton Hall, in England, a millstone was to be seen, in 1863, in the centre of which was growing a filbert tree, which had completely filled the hole in the stone, and actually raised it from the ground. The tree was said to have been produced from a nut which was known to have germinated in 1812. The above story has been declared false, because, as asserted, the tree could not have exerted any lifting power upon the stone. It is, however, not difficult to see that it may be true, and is even probable.

Yet it should be remembered that the amount of elevation, in any case where it occurs from the increase in the size of the horizontal roots, must depend upon the character of the material on which they rest, and can never exceed one-half the diameter of the largest ones. When, therefore, a writer asserts, as has recently happened, that during a visit to Washington Irving, at Sunnyside, he carved his name upon the bark of a tree beneath which he was sitting in conversation with the illustrious author, and that many years after he went to the place, and, with much difficulty, discovered the identical inscription high up among the branches, far above his reach, it may be safely inferred that the number and exaltation of his feelings interfered slightly with the correct action of his intellectual faculties.

It is evident, in conclusion, that we have much yet to learn about plant life, and that it is very unwise to attempt to explain all its phenomena by a few general statements.

Life has been well styled the loftiest subject of philosophy, but let us not forget that the only way to a sound philosophy is through a knowledge of the truth, and that this is to be obtained in completeness only by laborious and intelligent investigation.

Let not the slowness nor the difficulty of progress in real knowledge discourage us, however, but rather awaken in us a higher reverence for Him who has created the wondrous frame of Nature, and set it before us as a means of calling out our highest faculties, and of leading us

"Through Nature, up to Nature's God."

Let the impatient student recollect that all the problems of science will not be solved till the end of time, since generations yet unborn will need, as they will certainly have, abundant material for the exercise of their minds, and the awakening of their desires to comprehend the mysteries of creation. But the more difficult the achievement, the more glorious and joyous is the accomplishment.

"Let us, then, be up and doing,
With a heart for any fate,
Still achieving, still pursuing,
Learn to labor and to wait."

REPORT

ON

AGRICULTURAL EXPERIMENTS.

By Professor LEVI STOCKBRIDGE.

AGRICULTURAL EXPERIMENTS.

During the past year, the duties which have been required of students in this department of the College have been faithfully and promptly discharged. The young men have apparently taken a deeper interest in the exercises of the classroom than in former years, to which result the Grinnell prizes for the best oral and written examination on graduation day have unmistakably contributed much. As usual, the students have participated in all the practical operations of the farm, taking an active part in its ordinary cultivation, and performing nearly all the labor in improving the slope between the Plant-house and brook, by underdraining. With much interest and zeal, they have aided in making the materials and in carrying on the experiments with fertilizers, noting accurately the condition of the crops during their growth, and recording the final results. Although I feel confident that this department is in a good degree accomplishing the objects for which it was instituted, yet I believe its popularity and usefulness would be greatly enhanced if its wants, as detailed by me in the Tenth Annual Report, could be supplied.

The "experiments upon feeding crops with special fertilizers in a purely chemical form," to which you allude in your last annual report to the Trustees, have been continued during the past summer, and with results which apparently indicate the possibility that there is a better method of producing crops than any which is now generally pursued. For many years the felt want of intelligent Massachusetts farmers has been "more manure," and at prices which would justify its purchase. In our State, the market demand for farm-crops, in such form that but a small part of them could be retained and changed to yard-manure, has been gradually lessening the home accumulations of this material; and its sale-value in our towns and cities has precluded the profit of its purchase for ordinary crops. To supply this deficiency, recourse has been had to manufactured commercial fertilizers; but whether there is good reason for it or not, there is a general distrust of their reliability and efficiency, which has prevented their purchase to such an extent as is desirable. Frequent demands have been made that experiments should be tried here with these compounds, on an extensive scale, to determine what kinds were the most valuable, and what they were worth, that the farming community might have some guide in their purchases, and be protected from imposition.

For the double purpose of quieting this popular demand, and of accustoming students to observe nature for the acquisition of facts, such experiments have been tried every year, since 1867,—both with fertilizers bought in the market and those which have been sent here for the purpose by manufacturers. But the idea has never for a moment been entertained that such experiments could determine any fundamental principles in feeding plants, or be of the least practical use as a guide to farm improvement or profit. Therefore, while a record has been kept of results, no public report of the same has been made. To learn and prove the absolute law of nature in this regard, the wiser course seemed to be to discard all mixtures and compounds made by others, and test the feeding choice of plants by the use of known elements prepared in the laboratory, but which, if they should be found valuable, could be purchased by farmers in any desired quantity.

Messrs. Lawes and Gilbert, at Rothamsted, England, had proved incontestably that plants could be grown by the use of certain substances, known as chemical elements; in fact, that those elements, uncombined, were more efficacious than when used in the form of yard-manure; yet the result of trial led them to believe that the most effective elements in increasing the product of certain species of plants were not those found in maximum quantities in their structure, and that there was no specific relation between the quantity of the elements applied and the yield of the crop.

M. George Ville, at Vincennes, France, had succeeded in producing fine crops, without yard-manure, by using the elements of which all plants are composed, and, as the crop on the same land was changed, applying as a manure the substance which was the predominating element of the new plant.

These experimenters, in selecting the substances to be used, relied to a great extent on the supposed fact that some elements existed in the soil in great abundance, while others were deficient, and strove to find by trial what was wanting, that the same might be supplied. For our purpose, and considering the condition of a large part of our Massachusetts soils, a more rational and philosophical method seemed to be to discard all conditions of soil, except such as were purely physical, and direct attention exclusively to the plant, its composition and choice of food. It was believed that for all practical purposes we had absolute knowledge of the composition of plants, of the relative proportions of the different elements which they choose, and the form or condition in which the elements of plant food must exist to enable its vital forces to appropriate them. At the same time, the possibility remained that the average of our soils might contain some of the elements in such abundance, or that the forces of nature might develop them with such rapidity that the farmer might be relieved from the expense of supplying them as direct food. This was thought to be an economical matter of much importance, the fact in relation to which might materially simplify the application of the principle, and was therefore the first to be learned.

Accordingly, in the spring of 1869, soils were taken from various localities on the College farm, and from several adjoining farms, for experiment. Care was taken to avoid all soils which were very fertile, or in a high state of cultivation, and to select those of poor quality, or nearly sterile. The soils were placed in pots in the Plant-house, and in them were placed the seeds of our various agricultural plants. As these commenced to grow, they were fed from time to time with the chemical elements which they were known to contain, and in an absolutely soluble condition. The e'ements were occasionally varied and sometimes compounded in such proportions as they had been found to exhibit in the several varieties. The experiments were continued under these conditions, during the years 1869 and 1870; but in 1871, the soils were placed in large boxes in the open air, and the same method was pursued through that and the following year of 1872.

The first fact which appeared to be unmistakably taught by these experiments, was that for the plants and soils used, and for one, two, three or four crops of the same plant on the same soil, the only substances the farmer must supply were nitrogen, potash and phosphoric acid; and second, that there was a marked relation between the quantity of the crop produced and of the elements applied, if these elements were mixed in such proportion as they exhibit in the *entire* plant which was being fed. Accepting these two facts provisionally as a natural law, I commenced experimenting in the open field, in 1873, on soils in a reduced state of fertility, or quite sterile, which experiments have been continued through the season of 1874. These trials have been made on the College farm, on the farms adjoining, and in the adjacent towns of Hadley and Sunderland. Soils of various characteristics and conditions have been used, and in plots of twenty, forty, eighty, and one hundred and sixty square rods. The crops fed have been wheat, rye, corn, oats, potatoes, grass and tobacco.

Dr. C. A. Goessmann, professor of chemistry in the College, and State inspector of fertilizers, has cheerfully coöperated and rendered invaluable aid in the experiments by testing the substances used for feeding purposes, so that I have known with certainty what elements were used, and what their condition of solubility. In all cases, before applying the food or planting the crop, a written statement was prepared of the kind and quantity of the elements to be used, and the estimated yield of the crop, and in no single case has there been a failure of anticipated results which could not be traced with perfect certainty to other causes than the food applied. Causes such as the winter killing of wheat, an under-estimate of the natural proportion of straw to grain, and the per cent. of potash in one of its salts.

In different experiments, fifty, sixty-five, eighty-five, and one hundred and four bushels of Indian corn have been produced per acre, two hundred and twenty-five bushels of potatoes, thirty of rye, sixty of oats, and nineteen hundred and fifty pounds of tobacco leaf; or, twenty-five, fifty and eighty bushels of corn, twenty of rye, one hundred and fifty of potatoes, and fifteen hundred pounds of tobacco leaf per acre more than the natural yield of the soil; which yield has in all cases been determined by planting an equal plot of each crop, the plants on which received no artificial food. It has been an observed fact in the results that the plants thus artificially fed are measurably independent of the ordinary variations of the seasons and meteorological conditions of the atmosphere. The results of the open field experiments of 1873 and 1874 are almost identical. But the two seasons have been very unlike, and there has been an equal variation in the general crop returns of the State. June, July and August of 1873 (the three active months for the growth of our crops) were extremely dry, the rainfall being but 7.987 inches. These three months in 1874 were the reverse, the rainfall being 19.340 inches, or an excess of 11.353 inches in the latter year. The two years were nearly equally unlike in the average temperature of those months, that of 1873 being 68.596°, and that of 1874, 66.306°, the former being two degrees warmer than the latter. There was nearly or quite as much variation in the humidity of the air, pressure of vapor, and mean height of the barometer.

At this early period in these investigations, I will not venture an opinion of what may be the final result to soils cropped for many successive years by this process. It may possibly be found necessary to use other elements besides those already named, to secure maximum crops. But the crops of the second year on the plots which were artificially manured and which had no manure the second year, have invariably yielded double the amount of the yield of the unmanured plots, and very nearly as much as land by their side which had a heavy dressing of yard-manure the previous year; but the clover on the latter is looking better at the present time than on the artificially manured plots.

There are good scientific reasons for believing, that if all the elements supplied are consumed by the crop it is intended to feed, yet for a limited period, at least, the soil will be improved and left with an increased percentage of plant food as the result of the process. This fact is indicated by the result, but it needs substantiating by long-continued trial. In these experiments, quantities of food and crops have been based exclusively on the per cent. of nitrogen, potash and phosphoric acid; but these elements have been used in the form of sulphates of ammonia and potash, and superphosphate manufactured in the laboratory from bone charcoal and sulphuric acid. As an absolute fact, therefore, the mixture contains other mineral elements than the two named; but as the search is primarily after practical facts, and as it is difficult for the farmer to obtain the leading elements in a more convenient form, it has not been deemed best to exclude them, or to make critical inquiry respecting their influence.

If my future experiments in the direction now being pursued shall coincide with those already made to such an extent as to justify the adoption of the method in general farm operations, it will result in materially decreasing the cost of producing crops on our depleted soils; enable the farmer to sow any crop, or any amount of crops, regardless of the soil; make him at the same time (if he so choose) independent of all manufacturers, of what are now known as commercial fertilizers, for he can purchase the elements in any market and himself make the mechanical mixture,—the only safeguard needed being the guarantee of the importer or the manufacturer that the substances are in fact and form what they are represented. But it is yet too early to draw conclusions, as to what is to be the final result of these experiments. The indications are very clear and decided at this point of the investigation; but it is necessary that they should be extended and continued, and many side-issues examined, before a complete and final report shall be made.

The great controversy of 1850 and 1855, between Dr. Liebig, M. Bousingault, Lawes and Gilbert, and Mr. Way, respecting the relative value of certain chemical elements in promoting the growth of plants, though of the utmost scientific importance, was, and could be, of little practical value, because at that day the elements were not found in market in sufficient quantities, or at prices which would justify their use as fertilizers in the ordinary production of crops. But since the discovery of the practically exhaustless beds of phosphatic nodules in South Carolina, the potash deposits of Germany, the extensive manufacture of sulphate of ammonia as a waste product in the distillation of coal for illuminating gas, and the opportunity to increase its manufacture almost indefinitely, the needed elements can be obtained in any required quantity, in a cheaper and more efficient form than in that of yard-manure; provided, the government will adjust its tariff rates in the interest of agriculture on those articles needed in the production of plants.

In the experiments alluded to, these elements have been the ones used, and regard has been had to their content in the whole plant, for the composition of stalks, straw and grain, and tops and tubers are very dissimilar. For the production of twenty-five bushels of Indian corn and its average natural proportion of stalks, there have been used thirty-five pounds of nitrogen, thirty-seven pounds of potash and fifteen pounds of phosphoric acid. To produce one hundred bushels of potatoes, and their average natural proportion of tops, use has been made of twenty-five pounds of nitrogen, thirty-nine pounds of potash and twelve pounds of phosphoric acid.

These quantities are given as examples of the detail of the experiments; but the elements are estimated in a pure and absolutely soluble condition. To obtain them, it is necessary to take some one of their compounds, and use it in such quantities as is required to get the requisite amount of the element. As an illustration, take the quantities of the elements used in the corn example. If the nitrogen is bought in the form of sulphate of ammonia, which is guaranteed to contain twenty per cent of actual nitrogen, as many hundred pounds of the compound will be required as twenty times is contained in thirty-five, the amount of nitrogen required. The potash being procured in the form of sulphate of potash, guaranteed to contain thirty per cent of actual potash, as many hundred pounds of the compound will be required as thirty is contained times in thirty-seven, the quantity of potash required. By the same method, the requisite quantity of phosphoric acid is obtained in the form of a superphosphate, simple and without a mixture of any other element, and estimated on its known per cent of soluble acid.

In closing this Report, I desire to reiterate my statement previously made, that I am recording the actual results of these experiments in the past, and will not venture a prediction for the future, for there are some important crops with which no experiments have been made, and others require continued trial, but I here give in detail the result of one case, which may, it is hoped, be an indication of future possibilities.

In 1874, a measured acre of land was taken on a farm near the College, of cold, inert soil, and so nearly sterile that it produced no plants but coarse weeds. The last attempts to crop it were in 1869 and 1871. The crops were first corn and then potatoes, neither of which were produced in quantity sufficient to pay for harvesting, and the potatoes were not harvested. I caused the land to be as thoroughly fitted by plowing and cultivating as the inert, cloddy nature of the soil would permit. The chemicals were applied and harrowed in, and it was planted to corn on the 29th of May, the rows running north and south, four feet apart, and hills three feet eight inches. The land was most persistently and thoroughly cultivated and hoed during the season to improve, if possible, the natural physical condition of the land, and overcome the injurious effects of cold, rainy weather. Notwithstanding the unfavorableness of the season, the crop grew finely, constantly presented a dark green, healthy, vigorous appearance, and continued so until late in the season. The crop ripened beautifully, was sound and fine, and yielded by weight 62 bushels of corn and 4,300 pounds of stalks.

PAPER

ON

COMMERCIAL FERTILIZERS.

By Professor C. A. GOESSMANN, Ph. D.

COMMERCIAL FERTILIZERS.

In the report for 1873, I discussed the peculiar position which commercial concentrated fertilizers occupy in a rational system of cultivating farm lands, and urged their judicious application in connection with barn-yard manure. To protect the interests of farmers and honest dealers, a law for the regulation of the trade in fertilizers has since been passed by the legislature, which requires a statement to accompany all packages of commercial fertilizers, which gives the guaranteed percentage of phosphoric acid, potassium oxide and nitrogen contained in them. Having acted as State Inspector of Fertilizers during the past two years, I propose now to present an abstract of my official reports to the State Board of Agriculture.*

The first of these reports consists mainly of statements regarding the present conditions of the resources of some of the most prominent substances which serve either directly as special manure, or enter into the manufacture of our commercial fertilizers. In the second report, I tried to determine, by a series of analyses of specimens collected from dealers, the present condition of the trade in these articles, and to describe more in detail the kind of fertilizers farmers ought to buy. I have earnestly endeavored, on all occasions, to promote a desirable understanding between dealers and farmers, in regard to their mutual interests.

German Potash Salts.

The main bulk of these substances thus far imported has been of the lower grades. Their percentage of potassium oxide, in our section of the country, has rarely exceeded from

* See "Agriculture of Massachusetts," by Hon. C. L. Flint, for 1873 and 1874.

eight to nine per cent.; in some exceptional cases only, it was noticed as high as from eighteen to nineteen per cent. It is a matter of particular regret that our importers have been apparently guided in their selection entirely by the question of first cost. Engaged as we are with a first trial of these salts upon our lands, it is quite obvious, that articles of a reliable and definite character should be at first applied in order to ascertain as soon as possible their true merits.

The higher grades of these fertilizers being the result of a more careful process of manufacture, which aims at the exclusion of admixtures of an objectionable character, as chlorides of sodium and magnesium, are the safer articles; they are also as a general rule the cheapest potash compounds, on account of reduced expenses for freight.

Past experience in other countries has demonstrated clearly that *the form* in which the potassium is present, whether as potassium chloride or as potassium sulphate, as well as the *peculiar nature* of the compounds, which usually accompany the potassium in its original state, modify to a considerable extent their action on various crops and upon different kinds of soil. Whether potash fertilizers are useful for agricultural purposes, has never seriously been questioned, since we have learned by careful investigation that potassium is one of the essential or indispensable articles of plant food. The main point which our farmers have to consider, when contemplating the use of the German potash salts, lies in the question, what particular kind would be most efficient in each case. As none of our former potash fertilizers, like wood-ash, nitre, etc., can be properly compared, as far as composition and their peculiar mode of action is concerned, with the German or Stassfurt potash salts, it seems but prudent to turn the experience of others to account.

Leading agriculturists of Europe indorse unanimously the sulphate of potassium as being the safest compound, without regard to the kind of crop, particularly as far as the quality of some industrial crops, as tobacco, sugar-beets, etc., are concerned. Upon wet lands alone is its application considered unprofitable, and the chloride of potassium proposed as the more suitable article. The latter is also highly recommended for all kinds of forage crops and grain crops. To apply it in connection with some soluble phosphate insures in the latter case a good result.

The commercial muriate of potash, which contains usually eighty per cent. of chloride of potassium (fifty per cent. of potassium oxide), on account of its low price as compared with the more concentrated sulphates of potassa, is one of the most economical potash fertilizers which farmers may safely use in an ordinary mixed system of general farming. In the case of tobacco and other industrial crops, none but the higher grades of salts containing sulphate of potassa should be used. Both kinds ought always to be mixed with three or four times their volume of earth before being applied.

Peruvian Guano.

The sources of this valuable fertilizer, judging from a recent publication of P. Galvez (the Peruvian Ambassador in London, 1872–1873) are more numerous than usually represented. From forty to forty-five different localities are mentioned as being capable of supplying still, for many years, the market at the present rate of demand. The prospects respecting the *quality* of our future supply seem to be less satisfactory. The well-known difference in the composition of the Peruvian guano from the Chincha Islands, of an earlier period, and our present supply from the Guanape Islands, demonstrates plainly the possibility of serious variations in the commercial and agricultural value of the material from different deposits. The comparatively limited extent of many of the still existing guano deposits, designed for exportation, cannot but tend to increase our risks. A number of lately published analyses by Prof. Voelcker, of genuine samples from Ananillos, Punta de Lobos and Pabellon de Pica, confirm this opinion. The guanos from these three localities varied in a remarkable degree, not only as far as the different deposits are concerned, but also as to the different layers of one and the same deposit. The various samples were, of course, quite valuable fertilizers, yet their agricultural value differed so widely, that their commercial value ought to be regulated by their composition.

The reputation of a good Peruvian guano as a valuable special fertilizer is so well established, that farther indorsements seem to be unnecessary; yet it is well to bear in mind that this result is greatly due to its former uniform and good quality. The variations in the composition of the Peruvian guano have attracted of late more attention. They have been rendered also more conspicuous in those countries where the trade in fertilizers has been subjected to an intelligent supervision by agricultural chemists.

In speaking of serious variation being noticed in the composition of Peruvian guano, I do not refer merely to fraudulent adulterations practised on a genuine article, but in particular to genuine but inferior ones. The one-price system of the Peruvian government becomes, under these circumstances, quite objectionable, and it is but proper on the part of its numerous customers to ask the adoption of a more satisfactory manner of selling guano. Nothing short of selling it by standard analysis, with a guarantee of the commercial value represented in the former, ought to satisfy the farmers. The difficulty rests at present, as far as I am informed, rather with the Peruvian government, than with their agents. The European contractors of that government do not hesitate to acknowledge that the attitude assumed by the Peruvian government towards its customers is anything but mutually satisfactory. They have yielded to the just demands of the public, and have recently introduced a process which enables them to prepare a uniform article from the raw imported guano.

The process, which is patented by Messrs. Ohlendorff & Co., consists in treating the crude guano with concentrated sulphuric acid. In consequence of this treatment, most of the phosphoric acid is rendered soluble, and the ammonia changed into sulphate of ammonia, and thereby protected against evaporation. The product is known by the name of "dissolved guano," and it is sold with a guarantee of the specified percentage of soluble phosphoric acid and active ammonia.

To obtain some more definite idea about the general chemical and physical properties of "dissolved Peruvian guano," I secured a sample for examination from Messrs. Ohlendorff & Co., of Hamburg, Germany, during the last year. An analysis of that sample showed that it contained from eight to nine per cent of phosphoric acid, soluble in water, eight per cent of active ammonia, and two per cent of potassium oxide. Its mechanical condition was excellent, and it formed a brown, pulverent mass, fit for immediate application. The analytical results proved that the "dissolved Peruvian guano" may claim a foremost position among our commercial, nitrogenous, phosphatic fertilizers. An addition of from ten to fifteen per cent of sulphate of potassa, in the form of the higher grades of German potash salts, cannot fail to increase its efficiency as a valuable fertilizer in market-gardening, and in all cases where a speedy action is of particular importance. It can be used in a liquid form, as a solution in water.

Animal Dust.

This fertilizer is prepared from the blood, the meat scraps and part of the bones obtained in slaughter-houses. The manufacture has engaged of late considerable attention, on account of the introduction of large abattoirs near our commercial centres along the Atlantic coast. Meat scraps and bones are first subjected to a rendering process, to secure the fat; the refuse mass obtained thereby is subsequently dried by steam in Hagel's drier, and ground. The blood is either added to the rendered mass before drying, or it is dried by itself, and subsequently mixed in after having been pulverized. The mixture when finished for sale consists of a coarse powder, of a reddish gray color, and has a peculiar, yet not very offensive, odor. The abstraction of the fat from the meat and the bones before they are worked into fertilizers is not only good economy, but it tends to hasten their disintegration and subsequent solution in water under the influence of carbonic acid.

Bones differ mainly in regard to the relative proportion of cartilage (a nitrogenous matter) and of neutral phosphate of lime. The harder bones are usually separated for the manufacture of buttons and of bone-black; the smaller and softer bones are turned into fertilizers. After having passed through the rendering process, they count in the manufacture of this fertilizer mainly as the source of phosphoric acid, for their nitrogenous constituent has been dissolved and subsequently lost in the extraction of the fat.

It matters very little which of our domesticated animals furnish the meat scraps,—cattle, sheep or hogs. The fresh meat of these animals contains from 72 per cent to 79.3 per cent of water, and, on an average, 3.35 per cent of nitrogen; whilst dry meat consists of from 14.30 to 15.72 per cent of nitrogen, provided, in the latter case, that the fat has been previously separated. The blood of these animals amounts to about one-tenth of their entire weight, and is in all of them of a similar composition. Fresh blood contains on an average seventy-eight parts of water and twenty-two parts of dry substance. Its average percentage of nitrogen amounts to 3.7 per cent. Dry blood contains 16.8 per cent of nitrogen.

The main task for all manufacturers of fertilizers, from butchers' refuse, as previously described, consists in the production of a uniform article, as far as its chemical composition and mechanical condition is concerned. Manufacturers of fertilizers ought to bear in mind, that the articles they offer for sale have not only a certain commercial, but also a peculiar agricultural, value; and that the latter is independent of the former, for the two are determined by a quite different standard. The agricultural value depends on its crop-producing quality, and is determined by the judicious application by the farmer. A shovelful of lime may do more good, under certain circumstances, than several times its weight of the more costly dried blood. The commercial value depends here, as elsewhere, on the relation of demand and supply in the general market, and is controlled by competition. The commercial value of a fertilizer is not necessarily altered by a change in the relative proportion of its constituents; its agricultural value always is; for each of its constituents, as potassa, phosphoric acid, nitrogen, etc., has a function of its own. They are, it is true, equally indispensable for plant growth, yet they cannot substitute each other. The most important information the farmer needs, to secure to himself the full agricultural value of any commercial fertilizer offered for sale, consists in knowing the exact kind, the amount, and the chemical and physical condition of the essential articles of plant food it contains. Without this information, a rational system of manuring becomes impossible. Commercial fertilizers are too expensive to be used without a careful consideration whether they will bring speedy returns or not. The surest way to establish a reputation for a well-prepared fertilizer, which contains one or more of the essential articles of plant food, next to a reasonable price, is to furnish it of a uniform composition. Reliable standard fertilizers are needed in the interests of a rational system of manuring and of a good economy.

Meat scraps, blood and bones ought to be mixed, therefore, with a view of definite proportions; and the fertilizer should be dried by a moderate heat, so as to contain not more than ten per cent. of moisture. The first precaution secures uniform composition, and thus a definite agricultural value; the latter tends to keep the animal matter in an unimpaired state of preservation while it is kept in store. Animal dust may serve, like fish guano, as a substitute for Peruvian guano, provided its content of nitrogen does not fall below six per cent. It acts, however, slower than Peruvian guano, and ought to be carefully composted for several months before it is applied. To use it in connection with potash compounds, increases, no doubt, in many cases, its efficiency.

Mineral Phosphates.

Many new deposits of mineral phosphates have been of late brought to our knowledge. Some of them are very extensive, and promise to furnish an ample supply of phosphoric acid for agricultural purposes for future years. Most noteworthy among them are those of Central Russia, Western Germany, Southern France, Canada and South Carolina. Our home supply, previous to the discovery of the two latter localities, has been for many years obtained from the Jarvis, Sombrero, Baker and Navassa Islands. The latter island, in common with the Charleston, S. C., deposit, furnish at present our main supply. Both kinds are principally used for the manufacture of superphosphates. The South Carolina phosphate occurs largely along the sea-shore and beneath the shallow water of rivers in the vicinity of Charleston. The Ashley and Cooper rivers are noted for their rich phosphates. The deposits are very extensive. The State charges a tax of one dollar on every ton of phosphates taken from the river beds. The composition of the material from different localities has been found to vary from 20 per cent to 60 per cent of bone phosphate, or from 9 per cent to 27 per cent of insoluble phosphoric acid. Samples containing from 24.5 per cent to 26.6 per cent of phosphoric acid (or from 54 per cent to 56 per cent of bone phosphate), from 5 per cent to 10 per cent of carbonate of lime, several per cent of oxide of iron, besides some clay and sand, have been sold at eight dollars and a half for 2,240 pounds. The same material has been offered at New York at from eleven and a half to twelve dollars per ton. The expenses for grinding are usually from one and a half to two dollars per ton.

The Navassa phosphate, which has been sold in our markets since 1856, occurs in large quantities upon Navassa, a small coral island about thirty-three miles south-west of Hayti. The sample which served for my analysis consisted partly of pieces several inches long and wide, and partly of granular masses of various sizes and of different degrees of hardness. Both kinds varied in color from white to reddish brown. Numerous analyses show its percentage of phosphoric acid to be from 32 per cent to 36 per cent, or from 70 per cent to 78 per cent of bone phosphate. I obtained the following results :—

Loss by calcination,	9.60
Sand and clay,	2.70
Phosphoric acid,	34.09
Lime,	37.67
Sesquioxide of iron and alumina,	12.99

This article in a finely-ground state sells at Baltimore for seventeen and a half dollars per 2,240 pounds, and at New York for eighteen dollars. The low price of these mineral phosphates (about two and a half cents per pound of phosphoric acid) deserves the attention of farmers who aim at an enriching of the soil. These phosphates act, of course, slowly, under ordinary circumstances; yet, more recent experience confirms the opinion that they pay well, if applied in a finely-ground form, and with a due consideration of the causes which favor their solubility. As carbonic acid aids powerfully in the disintegration and final solution of all bone phosphates, it is but reasonable to assume that satisfactory results may be obtained by incorporating daily a certain amount of finely-ground phosphate from South Carolina, Sombrero, or Navassa, etc., in barn-yard manure; or by composting it with horse-manure during the summer season for autumn demand; or applying it in the fall upon soil rich in humus, or upon moist meadows and pasture lands. In a favorable mechanical condition they are apparently in no less suitable form for assimilation than a large portion of the phosphates in a cultivated soil. The low price enables the farmer to stock his exhausted lands again with an essential article of plant food. We are too much given to the habit of judging the agricultural and commercial value of a fertilizer by the crop which we chance to get the first year, and leave thus out of consideration that the real value of any fertilizer depends frequently, to a large degree, on the condition in which the lands are left after the crop has been removed. A rational system of farming always aims at improving the land under cultivation by a judicious system of rotation and of manuring. Merely restoring to the soil what the last crop has carried off, may work satisfactorily in the case of land in a *high state of cultivation*, yet it can never secure the highest results possible in such exhausted lands as constitute the greater portion of our farms.

Superphosphates and Ammoniated Superphosphates.

This class of compounds represents the largest portion of our American commercial fertilizers. The phosphoric acid which they contain is, as a general rule, obtained either from raw or boiled bones, from the waste of bone-black, or from two or three mineral phosphates. It is stated by good authority that nearly four-fifths of all our superphosphates are made from the South Carolina and Navassa Island phosphates. The use of these phosphates for the manufacture of superphosphates, as far as the amount of sulphuric acid required is concerned, is somewhat expensive, from the fact that they frequently also contain from ten to fifteen per cent of sesquioxide of iron and alumina, besides from two to five, and more, per cent of carbonate of lime. To secure in cases like these the entire amount of phosphoric acid in a soluble form, requires, therefore, a larger quantity of sulphuric acid than the decomposition of the bone phosphate alone would consume, which increases the cost of the phosphoric acid produced. Some otherwise very valuable mineral phosphates, as, for instance, Sombrero guano, have proved, for this reason, unprofitable for the manufacture of superphosphates.

Another very serious difficulty in the application of some mineral phosphates, arises from the fact that it often becomes impracticable to use an amount of sulphuric acid sufficient to convert all the oxides of iron and alumina and carbonate of lime present into sulphates, and also the entire amount of bone phosphate into soluble phosphoric acid; *i.e.*, monocalcic phosphate. Unfavorable physical and chemical conditions, such as coarseness of the material, etc., interfere, in many instances, with a speedy reaction of the sulphuric acid, which tends to leave, for some time at least, a part of the latter in an uncombined state. Superphosphates, rich in sulphates of alumina and iron, are hygroscopic, and, consequently, troublesome to handle. An addition of a small quantity of hydrochloric acid has, in some instances, proved very useful in counteracting the last-mentioned tendency. To escape these inconveniences, less sulphuric acid is frequently used than is needed to render the entire amount of phosphoric acid present soluble. Undecomposed bone phosphate, uncombined oxides of iron and alumina are thus of common occurrence in superphosphates but recently manufactured. As these substances act quite injuriously in the course of time on the soluble phosphoric acid, by changing it into a less valuable form, so-called "reduced phosphoric acid" or bicalcic phosphate, it becomes quite evident that the cheaper kind of two commercial mineral phosphates, which contains an equal percentage of bone phosphate, may prove in the end not to be the most economical material to work into superphosphates.

To derive the full benefit of the comparative cheapness of most mineral phosphates in the manufacture of superphosphates, requires considerable skill in mechanical appliances and some familiarity with chemistry. Large establishments for the manufacture of standard superphosphates can make no better investment than to put their factories under the supervision of a good chemist, and, what is equally essential, give him a fair chance to do his best. In our present mode of managing the fertilizer business, it is but natural that our superphosphates, although frequently manufactured from the same raw materials, are of very uncertain composition, of a low grade, and of quite unequal commercial value. Coarsely ground mineral phosphates, in their original state, are almost worthless in a concentrated commercial fertilizer. As bones yield in much larger degree to the dissolving action of the carbonic acid in the soil, we prefer superphosphates made from bones, to those manufactured from mineral phosphates, in case they contain equal amounts of insoluble phosphoric acid. In regard to the soluble phosphoric acid, of course it is of no consequence from what source it has been procured,—bones or mineral phosphates. The best protection for farmers, as a general rule, is to refuse to buy superphosphates which contain from two to three per cent. of insoluble phosphoric acid, at a rate which applies properly only to first-class articles.

The so-called ammoniated superphosphates receive only in exceptional cases their nitrogen in the form of ammonia compounds. In the majority of cases the nitrogen is added in the form of some nitrogenous animal matter, as ground bones, Peruvian guano, fish pulp, meat scraps, blood, refuse material from glue factories, hair, horn, ground leather, etc. Also Chili saltpetre, and potash saltpetre, sometimes furnish the nitrogen in commercial manures. Our dealers have not yet been seriously asked to recognize the great difference which exists between nitrogen in the form of ammonia compounds, guano, meat, blood, fish; and that in the form of hair, horn, woollen refuse, leather scraps, etc., although in the latter case, it is hardly worth one-half the amount of that in the former. As the new law for the regulation of the trade in fertilizers proposes to protect the farmer in his just claims, he ought to assist in its enforcement, by refusing to buy of dealers who do not comply strictly with its requirements, and give with every package an intelligent statement respecting the chemical composition and real agricultural and commercial value of the articles they offer for sale.

SYNOPSIS OF LECTURE

ON

THE DENTITION OF DOMESTIC ANIMALS,

DELIVERED AT THE MEETING OF THE STATE BOARD OF AGRICULTURE, AT WESTFIELD, MASS., DECEMBER 3, 1874.

BY PROFESSOR NOAH CRESSY, M. D.

DENTITION OF DOMESTIC ANIMALS.

The teeth belong to the digestive system; and though firm, hard substances, and even implanted in the maxillary bones, yet they are no part of the osseous skeleton. They are developed from the mucous membrane along the walls of the anterior portion of the alimentary canal, and thus serve as the mechanical agents in the division and the trituration of the food. The teeth are therefore adapted in the carnivorous animals for seizing and tearing flesh; while in the herbivora, there is a modified form of the same, to suit the changed condition of the creature in nature. In fact, almost every conceivable gradation of purpose may be served by these important organs in the economy of the different orders, genera and species of mammals.

In the walrus or sea-cow, we find a pair of tusks developed to such an extent that they are used as organs of locomotion when the creature is basking upon the shore; and the fossil dinotherium of the tertiary epoch evidently used a similar pair of the front teeth on the lower jaw as a means of anchorage.

The beaver, like the carpenter with his tools, diligently applies his gnawing teeth to the wood, and thus prepares and by the same means transports his building material for his dam.

The elephant and the musk-deer have well-developed teeth, that are employed as organs of defence, while the hyena and the dog show their glistening ivory when in rage, and use the same as weapons of combat. But nowhere is the secondary use of the teeth more evidently displayed than in man, where they not only contribute to beauty, but to his inimitable power of speech.

Hence the teeth are important in a zoölogical point of view, and greatly aid in the classification of animals. So intimate are the relations of these organs to the general economy and habits of an individual, that the naturalist is often enabled to determine the position of a fossil creature in the scale of being by the teeth alone; and not unfrequently these are the only relics to be found to mark the existence of some huge monster, whose bony skeleton perhaps may have smouldered away to dust.

The teeth are composed of three distinct anatomical elements,—the dentine, the enamel, and the crusta petrosa. The first was so named by Professor Richard Owen, of London, in 1835. It forms the bulk of the tooth, and is very firm and solid. Hence it has been called the bone of the tooth. A modified form of it, as seen in the tusks of the elephant, is called *ivory*. It is made up of a series of minute tubes and cells, with earthy particles interposed. The dentine of the higher mammals is unvascular, but its nutrition is carried on by means of these tubes connecting with the pulp.

The enamel is the hardest snbstance in the animal body, and consists of earthy matter deposited in an organized matrix. The enamel forms a perfect sheath around the dentine, except on the lower portion of the root. In man and the carnivorous animals it permanently covers the crown, but in the herbivora, where the teeth are long and gradually wear away, it soon becomes denuded. Here it takes on a new form, being folded upon itself, and in the grinding teeth it presents a peculiar appearance, interspersed with dentine. In the front teeth of the horse it forms a deep cavity, as seen in figure 2, and is known as the infundibulum.

The crusta petrosa is a hard, bone-like substance, which covers that portion of the tooth within the jaw. In its structure and manner of growth it resembles the osseous tissue more than either of the other dental elements. It varies greatly in thickness on different teeth and on different parts of the same tooth. It is the thickest at the end of the fang; and where it covers the enamel it appears like a thin layer of cement, which name also has been applied to it by various authors. It fills the bottom of the infundibula, and forms an oval island in the sack of the enamel, which is well illustrated in comparing figures 2 and 3. As the teeth wear away, the nerve begins to recede from the crown, and its cavity is filled with cement. This makes the "dental star," as shown in figure 4.

There is great variety in the form and number of teeth among our domesticated and wild animals, and we are therefore led to inquire what relation one kind of dentition has to another. Zoölogists and palæontologists are agreed that the typical set of mammalian teeth is forty-four. This corresponds with the number found in the fossil skull of the dotherium, as shown in figure 1. Professor Owen and other naturalists claim that the hog is the only creature now in existence that has a complete set. But there is evidently some mistake about the dentition of the *Suidæ*, as I shall endeavor to show at another time.

Anatomists have divided the teeth into certain series, as follows: the first three in front on each side are called from their shape, incisors; the next one is the canine; then comes the four premolars; and lastly the three molars, as here represented.

Incisors, $\frac{3}{3}\times\frac{3}{3}$; canine, $\frac{1}{1}\times\frac{1}{1}$; premolars, $\frac{4}{4}\times\frac{4}{4}$; molars, $\frac{3}{3}\times\frac{3}{3}=44$. This formula shows the teeth to be equally divided above and below and upon the right and left side. But all animals do not possess this number. Man has only thirty-two, and in comparing them with the typical set, we discover that the outer incisors in both jaws are lost; the canines are in place, and so are the molars; but of the four premolars only two are present, and these are known as the bicuspids. In the horse and ruminants we find the molars and three of the premolars present, and not unfrequently the first milk molar in a rudimentary form, which may be called a supernumerary. This is always present as a germ in each jaw, as will be seen in the formulæ for the deciduous teeth of the horse and ox.

Incisors, $\frac{3}{3}\times\frac{3}{3}$; canines, $\frac{1}{1}\times\frac{1}{1}$; molars, $\frac{4}{4}\times\frac{4}{4}=32$.

This peculiar denticle is known among horse jockeys as the "wolf-tooth," and special pains are usually taken to remove it at an early date, lest it cause blindness or some other ophthalmic trouble. Such practice, based on imaginary pathology, cannot be too strongly denounced by every anatomist in the land. The occasional presence of this diminutive tooth with the permanent set only illustrates the law of reversion, and should be looked upon in a zoölogical, rather than in a pathological, point of view. It is curious that the farriers of the county, who have almost invariably, they claim, found this to be so very troublesome in the horse, have not stopped to inquire whether similar diseases did not exist among the ruminants, where these wolf-teeth are quite as prevalent.

Prof. Joseph Leidy, M. D., of Philadelphia, has found, in his palæontological researches concerning the extinct mammalian fauna of Dakota and Nebraska, that the *Anchitheridæ* (a large family of solipeds, now found fossil in the Mauvaises Terres) had six large molar teeth on each side of both jaws, besides a small premolar, as in the horse. Hence, the wolf-tooth becomes an interesting relic in the study of natural history. And the various diseases of the eye, supposed to be caused by this little nerveless tooth, must have prevailed throughout a long geological period when there were no veterinarians to attend to the sanitary condition of these afflicted animals, if such they were, from the possession of this offending tooth.

In the bovines, the number of teeth is reduced to thirty-two, inasmuch as there are no incisors nor canines in the upper jaw in the second dentition. Yet germs of these teeth are in place, though not developed in the first set.

The canines appear in the musk-deer and in the caribou, and the outer incisors also occur in the camel.

As the milk-teeth are gradually replaced by those of the permanent set, at different intervals in different species of animals, we are enabled to determine the comparative age of a creature in its early years, if we know the order of its dentition. And the teeth which are of the most importance to the practical observer are the incisors and the canines on the lower jaw.

The colt has the six incisors well developed and in position at one year of age. The infundibula or "the marks," seen at figure 2 in the crown of the front teeth, are well defined. But at two years of age these cavities have become nearly, if not quite, worn out; and, if a colt at this age is very large and well developed, it may be taken for a horse much older, by one not experienced in such dental examinations. But any one with half an eye, though deceived in regard to the *marks*, can see that the creature is still a colt.

At three years of age, the central nippers are replaced by the permanent teeth, which are much wider and more bulky than the remaining ones of the milk set. The lateral nippers come at four, and the permanent corner nippers appear when the horse is five years old, and seldom or never before that time.

This is an important age to observe the condition of the mouth; for not unfrequently a large four-year-old colt is offered for sale as a five-year-old horse, for family use, and one not familiar with the order of dental development would be deceived and "sold" by a sharp horse jockey. Before you pay any money for a horse represented to be five years old, see that the milk-nippers, which are very small compared with the other front teeth, have been replaced by the "horse-teeth," so called.

The canine or "bridle-teeth," though always present as a germ, are usually not very much developed in the mare, and therefore of no importance to decide this question, but in the horse they are much more prominent at five, than a year previous. There are but few cases, I fancy, of horses absolutely five years old, that have not shed their corner milk-teeth. But if the matter is pressed, call for an authentic record in all such disputed cases.

At six years of age, the "marks" in the first incisors have usually disappeared, and at seven, the same change has occurred in the lateral nippers, and repeated in the corner teeth at eight. Thus, when a horse is going on nine years old, all the "marks" have usually disappeared from the lower front teeth. From this age onward, the teeth become thinner in their lateral diameter, as also much shorter. At figure 3, is seen the left middle incisor at about twelve years of age; and at figure 4, the same tooth from the jaw of a horse twenty-seven years of age and represented in full at figure 12, which is actually drawn from nature. I know the history of this horse: it belonged to the late Michael Griffin, of Middletown, Conn., and I obtained this specimen with my own hand, from the carcass. You will see that this old horse's tooth is much shorter than the one at twelve years of age, and not half as wide. Thus you will find a serial gradation in the length and width of the lower incisors, from eight to extreme old age. The older the horse, the shorter the teeth, even though they show longer above the gum than in a younger animal.

From the foregoing it will be seen that the first pair of permanent incisors occur in the colt at three years of age, and the others at intervals of one year. The "marks" disappear according to the same law. But in the ox we have another order of dentition. Here, the first pair of the second set occur at two, and the others, including the canines, which thus make eight front teeth, at intervals of six months. To verify this, I have watched the dental development of the thoroughbred stock at the College barn, and have had Professor S. T. Maynard sketch the following figures from living animals, that may be examined at any time by all who are interested in this branch of inquiry.

"Yucatan," a Shorthorn heifer, is now two years old, and has the first pair of permanent teeth up and well developed. (See figure 5.)

Another heifer of the Shorthorn breed, "Bella Wilfer," now two years and a half old, has four incisors, as shown in figure 6.

"Grand Duke," one of the Jersey bulls, had the six incisors well developed last fall, when three years of age, as seen in figure 7.

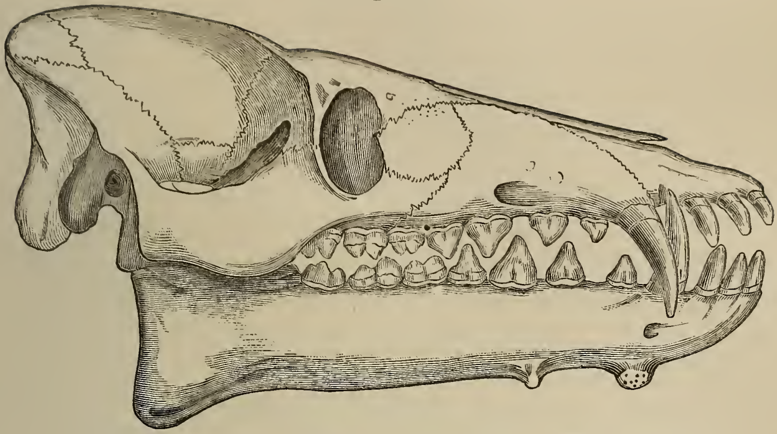
The Ayrshire bull, "Lord Ronald," has now a full mouth at three and a half years old. (See figure 8.)

These all occur in the regular order of dentition, but there is occasionally a slight variation. "Fourth Highland Chief," a bull of the Holstein breed, is a little tardy in his dental development, according to this rule. He will not have a full mouth until four years of age, as seen in figure 9.

The teeth grow smaller as the creature advances in years. This is well illustrated by comparing the appearance of the jaw of old "Beauty" (figure 10) with any of the other figures. There are at times very early developments of the teeth, when the jaw-bones are not large enough to contain them. This causes great irregularity in the position of the milk set, as is well shown in figure 11. When this is the case, the permanent teeth usually follow in rapid succession, and if crowded, one should be removed to prevent its being broken off at an early age, in the act of grazing.

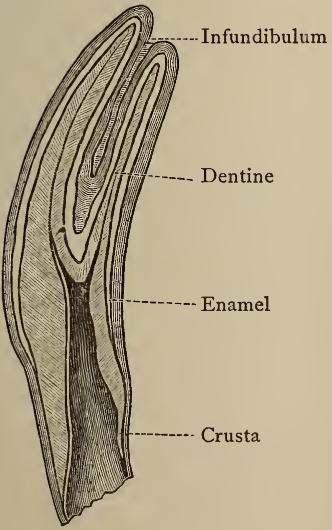
Sheep have the same number of teeth as cattle, and the appearance of the jaw is very similar, but the order of dentition is in accordance with another law, peculiar to every species. The first pair of permanent incisors appear at one year of age, and the rest follow at an interval of nine months, with slight variations for exceptional cases. This will make the next two appear at one year and nine months; the third pair at two and a half, and a full mouth at three years and three months.

Fig. 1.



SKULL OF ELOTHERIUM MORTONI. (After Leidy.)

Fig. 2.

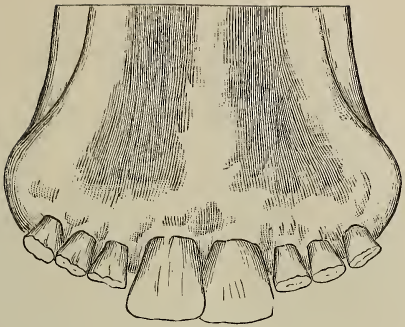


Section of Incisor of Horse.

Fig. 4.

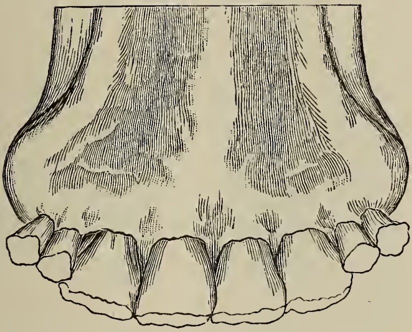
Fig. 3.

No. 5.



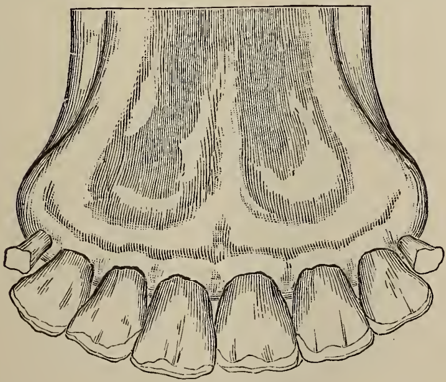
YUCATAN, (Shorthorn,) 2 years old, March 19, 1875.

No. 6.



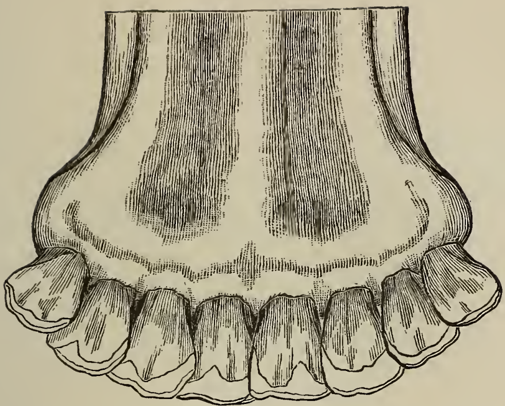
BELLA WILFER, (Shorthorn,) 2½ years old, March 20, 1875.

No. 7.



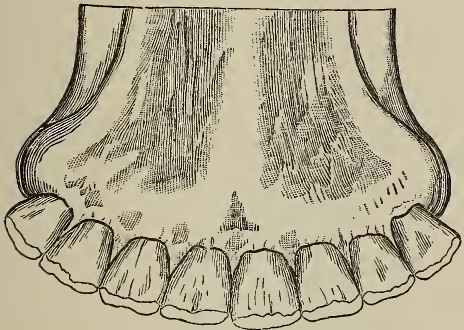
GRAND DUKE, (Jersey,) 3 years old, Sept. 24, 1874.

Fig. 8.



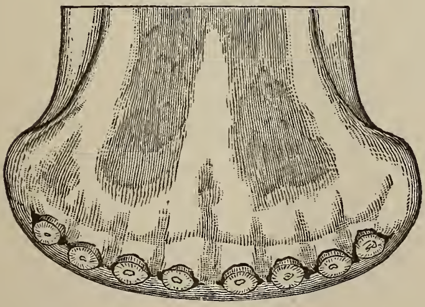
LORD RONALD, (Ayrshire,) 3½ years old, March 26, 1875.

Fig. 9.



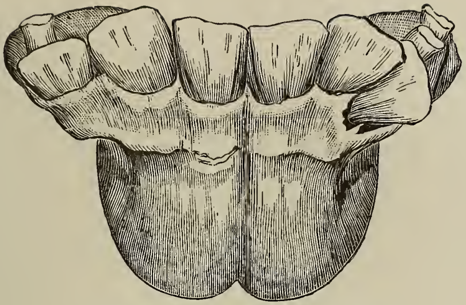
FOURTH HIGHLAND CHIEF, (Holstein,) 4 years old, May 15, 1875.

Fig. 10.



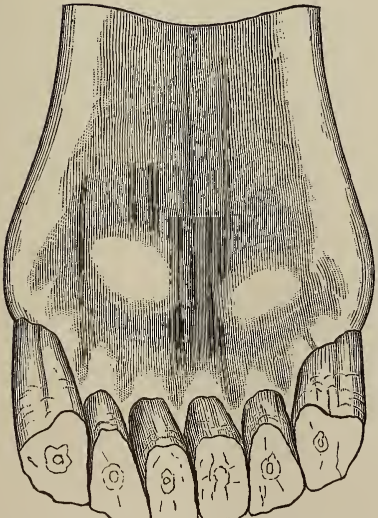
BEAUTY, No. 8, (Ayrshire,) 21 years old.

Fig. 11.



Irregular Dentition of Cow.

Fig. 12.



Lower Incisors of Horse, 27 years old.

REPORT

ON

HORTICULTURAL DEPARTMENT.

By Professor S. T. MAYNARD, B. S.

HORTICULTURAL DEPARTMENT.

The plants in the Durfee Plant-house are generally in a very good condition; but owing to the many duties which devolve upon the gardener and the need of skilled labor to assist him, he finds it very difficult to keep everything in the neat and flourishing condition desirable in a house of this kind.

Many of the plants have been injured by a beetle belonging to the curculio family, which appears in large numbers in July and August. It feeds upon the foliage of nearly all kinds of greenhouse plants; even the thick, hard leaf of the camellia is not free from its attacks. It continues to feed until December and January, when it lays its eggs and dies. The larva feeds upon the roots of the plants, doing quite as much injury beneath the soil as the perfect beetle does above. It is about one-fourth of an inch long, of a grayish brown color, with a white spot upon the outer edge of its wing-covers. It is, undoubtedly, a foreign species, and may have been imported with some of our plants.

During the past two years the lower woodwork of the plant-house has received one coat of paint, and the entire frame should be painted both inside and out as soon as possible. The walk in the octagonal room has been relaid, and those in the other rooms need renewing.

The grounds around the plant-house and botanic museum have been laid out in beds and borders, and many ornamental trees and shrubs planted the past season.

The vineyard has made a good growth, and the wood fully matured. Early in the season it promised a heavy crop of fruit; but about the first of July a fungus appeared which rendered it a perfect failure. This fungus or mildew was found upon the stem of the berry, and in some cases upon the leaf, in July, but no trace of it could be found upon the berry itself until nearly a month later. Its effect was to check the growth of the fruit, to cause it to color prematurely, but to remain hard, and finally shrivel on the vine. In some cases the entire bunch was affected; in others, only a few berries.

This fungus appeared identical with the common oidium or mildew which destroys the foliage of the foreign and thin-leaved varieties of the grape. Its ravages were confined to the fruit of the Concord, Israella and Agawam, and to the foliage of the Delaware, Iona and Wilder.

The orchard consists of two hundred and sixty-three trees, including one hundred and forty pear, seventy peach, twenty-five apple, fifteen plum and thirteen cherry trees, all of which have made a good growth the past season. Of the peach trees, forty were planted last spring; the others are older, and a few bore fruit. Sixty pear trees of the Buffum variety have been grafted with fifteen of the leading sorts.

The nursery contains a good stock of ornamental trees and shrubs and a large number of fruit stocks, which do good service in instructing students in the art of budding and grafting.

There are at present no small fruits, except the grape, growing in the horticultural department, but a few plants of the more important varicties were obtained last spring and propagated for planting the coming season.

Owing to the limited market in this vicinity, no great profit would result from their extensive cultivation; but while there is so much confusion in regard to the names of varieties of both large and small fruits, and while instruction cannot be given with profit upon their cultivation without practical illustration, all the leading kinds should be grown under their correct names.

The grove east of the plant-house has been laid out for the Massachusetts garden. A drive, and numerous walks, have been cut and gravelled, and the ground cleared and graded.

A green crop has been plowed in on the lot, previously subsoiled for the pinetum.

On the piece of land north of the botanic museum have been grown eighty-five varieties of potatoes. The seed was received in May, one tuber of each kind. On account of the time required to prepare molds and make casts of each, which were colored and placed in the museum, they were not planted until the first week in July. They were cut in pieces of from one to three eyes, two to five pieces, placed in four and five inch pots, in a good rich soil, and set in the propagating pit. Here they remained about one week, when they were planted in moderately rich soil, in the open ground.

The accompanying table gives the results :—

VARIETIES.	Weight of seed in ounces and drams.		No. of eyes.	No. of hills.	Produce, pounds and ounces.		Condit'n of vines, Sept. 28, 1874.	Average size.
Andes,	4	16	14	4	11	6	8	2
Black Mercer,	3	4	18	5	14	8	8	2
Bismarck,	3	6	28	11	27		8	2
Breezees Prolific,	3	12	10	3	14	4	7	2
Brownite,	4	4	10	3	5	14	10	2
Calico,	4	4	18	5	9	14	2	2
California,	7	5	28	6	11	12	1	1
Carmelite,	2	8	22	6	9	6	10	2
Caroline,	2	11	21	9	18	4	4	2
Cusco White,	–		21	6	8	8	10	2
Climax,	3	13	18	4	16	2	8	1
Conover,	1	14	11	3	5	6	9	2
Copper Mine,	1	10	13	4	13	4	8	1
Croton,	2	6	8	4	3	2	10	2
Crown Prince,	1	11	15	5	13	10	9	2
Drew's Prolific,	3	9	10	3	12	10	7	1
Dover,	5	6	15	–	–		–	–
Dykeman,	3	7	13	5	4	4	10	2
Dyrite,	2	4	10	5	10	6	3	1
Extra Early Vermont,	5	2	15	7	24	4	10	1
Early Rose,	4	2	18	7	24	8	10	1
Early Mohawk,	4	5	12	4	10	12	10	1
Early Queen,	2	14	10	3	5		10	2
Early Sebec,	3	10	14	5	3	6	10	2
English Kidney,	5	2	27	–	–		–	–
Excelsior,	2	15	11	5	16	8	7	1
Fenian,	2	6	18	4	1	15	10	3
Forfarshire Red,	1	4	10	4	8	2	8	1
Fox Seedling,		14	11	3	4	15	8	2
Garnet Chili,	3	12	18	4	11	12	5	1
Girard,	3	5	19	5	5	14	10	2
Gleason,	3	14	17	7	9	14	8	1
Glenida,		15	10	3	4	6	10	2
Goodrich,	4	10	20	6	24		5	1
Gravelot,	3	10	21	4	4	6	10	3

VARIETIES.	Weight of seed in ounces and drams.		No. of eyes.	No. of hills.	Produce, pounds and ounces.		Condit'n of vines, Sept. 28, 1874.	Average size.
Gregory,	0	13	9	3	4	4	10	2
Hanson,	5	7	14	4	10	6	5	2
Hexamer,	2	6	9	3	9	14	4	2
Holbrook,	2	6	13	10	–		4	3
Howe's White Rose,	10	6	16	3	16	4	4	2
Jackson's White,	2	4	23	7	13		9	2
Ketcham,	1	3	12	5	3	2	10	2
King of the Earlies,	4	2	11	3	3		10	2
Lady Finger,	1	12	19	5	1	14	9	3
Late Rose (Campbell's),	5	3	22	6	26	12	4	2
Late Rose (Thornburn's),	5	9	20	10	43	10	8	1
Leather Coat,	3	14	22	–		14	–	3
London White,	1	6	8	–	2	6	–	1
Mareopac,	2	5	10	4	8	2	10	2
McMahon,	5		19	8	14	14	4	2
Monitor,	1	5	11	5	15		5	1
Mt. Gilead,	3	4	24	5	9	10	10	2
New Hampshire,	2	3	9	–	1	6	–	2
No Blow,	2	4	7	3	23		5	1
Orono,	1	8	12	5	3	10	10	2
Peachblow (white),	4		14	4	8	14	2	2
" (red),	2		11	–	2	6	–	1
" (white-eyed),	1	12	10	2	4	8	2	2
Peerless,	8	14	15	5	13	6	6	2
Peerless Seedling,	2	7	19	5	14	8	6	1
Penn's Search-warrant,	3		19	4	7		4	1
Pink-eyed Rusty-coat,	1	7	20	–		6	–	3
Prince Albert,	4		28	8	15		8	1
Putnam,	3	6	25	5	9	8	5	1
Samaritan,	1	14	10	3	3		9	2
Sedan,	5	2	15	5	8	2	9	2
Skerry Blue,	2	3	13	4	7		1	2
Snowball,	1	12	19	10	18	6	6	2
Standard,	5	15	23	7	15	2	2	2
State of Maine,	2	12	22	5	11	2	8	2
Strawberry,	1	6	7	3	7	14	8	1
Vandervere,	7	7	26	4	12	6	8	1
Western Reserve,	4	14	15	6	12	6	10	2
White Chili,	1	10	9	5	9	10	1	1
" Mercer,	3	10	17	4	10	12	9	1
" Sprout,	5		20	9	12	10	5	2
Willard,	3	2	13	3	8	6	10	1
Young's White Rose,	3	10	16	5	24		8	1
No. 14,	3		11	4	7	10	10	2
23,	7	2	19	4	29	4	4	2
26,	4		22	8	26		9	2
29,	2		12	3	8	14	10	2
31,	3	8	20	5	12	6	6	2
35,	3	12	21	6	5	8	10	2
37,	5	13	13	5	6	12	4	2

Ten, in column five, indicates the vines in perfect condition, and one, that all were dead at the time of digging. One, in column six, means large; two, medium; three, small.

Four pounds of No. 23 were received and treated the same as the others; yielded about four bushels. All the potatoes were dug September 28.

A large amount of work has been done by students in this department, and more faithful or interested assistance could not be desired; but the limited time they have to work each day renders their labor unprofitable. The benefit to the students themselves may in a measure compensate for this inconvenience and loss.

Besides attending to the regular duties as gardener, instruction has been given to the junior class in fruit-culture during the fall term, and in floriculture the first four weeks of the winter term. The same class have performed their class work in this department, and received what instruction could be given in the practice of horticulture in its various branches.

The senior class received during the fall term instruction in the art of fruit modelling and painting, and in the study and use of the microscope during the winter term.

Many models of fruits and vegetables have been added to the collection, and it is hoped that by obtaining specimens from their original localities, correct representations of all the valuable varieties will soon be placed in the museum.

REPORT

OF

FARM SUPERINTENDENT,

JOHN C. DILLON, Esq.

THE FARM AND THE STOCK.

During the months of January, February and March, the men and teams were employed in drawing loam and sand to the yards and cellars, in gravelling the roads, in felling, trimming and getting to the mill and delivering chestnut and pine timber, in moving stumps, plowing, subsoiling and grading for the horticultural department, and, when they could be spared, in drawing railroad ties from Pelham to Northampton.

The land west of the boarding-house, and also one acre north of the new barn, on which field fodder and sweet corn and sugar beets were raised last year, was plowed the last week in April, and sown the fourth of May with excelsior oats, at the rate of two bushels of seed per acre, and yielded a very large crop of grain and straw, which were secured in fine order. Clover, timothy and redtop were also sown with the oats, and made a fine catch.

In my last year's report, I made the following statement: "Soon after haying, we plowed about twelve acres of land lying east of the brook and intersected by the county road, and have since sown it with rye." "This land is rough, cold, springy, weedy and barren, and it has never yielded crops worth harvesting." "At the same time I know of no land that will better repay the cost of improvement, and it is proposed to drain, grade and cultivate it, as and when means and opportunity permit."

The rye on this plot being almost entirely winter-killed, we worked about five acres of it in May, with the Holbrook cultivator, crossed with the Nishwitz harrow, and sowed it with oats, using three bushels of seed per acre, and sowing about five hundred pounds of Brighton fertilizer to the acre, which we harrowed in with the grain. We afterwards sowed ten pounds of clover seed per acre, and rolled it in. By these means we obtained a very large crop of fodder oats, which we secured in fine order, and about the handsomest stand of clover I ever saw. After haying, we top-dressed this with compost from the yard, and sowed timothy and red-top; and we have thus got this troublesome piece into a condition to yield profitable returns for two or three years, when it can be taken in hand and more effectually reclaimed.

Three acres more of the land sown to rye last year was plowed and planted to corn. The rye, on five of the remaining eight acres, was so severely injured by the freezing and thawing of the wet, springy surface, that it was purposed to plow it in and plant fodder corn; but it was impossible to get on the land, and what little rye was left made a vigorous growth, and, in proportion to the number of stalks, yielded an excellent crop. The other three acres, being on dry land, made a satisfactory growth, and yielded a good crop of rye and straw.

The land selected for planting with corn was the worst portion of the tract thus described by Professor Stockbridge in 1868. "The mow lands first demand attention, because they are contiguous to the highway, and at present wet, rough and unproductive. The fields of this division slope towards the brook, which has a rapid fall. They are all surcharged with water, whieh breaks out in springs in many places, running over the surface, making the soil cold and barren, and inducing the growth of coarse and undesirable grasses."

To cultivate corn on such land as this, in the wettest season ever known, and in plain view of a critical public, required all the pluck and perseverance at my command.

After repeated preparations, necessitated by repeated pouring rains, the corn was planted from the thirtieth of May to the sixteenth of June; and though its growth in the months of June and July was very slow, yet, thanks to the unusually warm and favorable fall, the corn ripened well; and, except on about half an acre, where the plants were literally drowned, we harvested a good crop of corn and stover. An acre near the buildings was planted with small yellow corn, and furnished an excellent illustration of the method of planting and cultivating by the German beet-machinery, as described in former reports.

The potatoes for the main crop were planted on land adjoining, and of the same character as the corn land above described. Like the corn, they were more or less affected by the unfavorable conditions of the land and season, but by careful and persistent cultivation we obtained a fair crop; and, contrary to my expectations, the quality of the potatoes is remarkably good.

About the first of May, we plowed in a liberal dressing of stable manure on an acre and a quarter of land where we raised millet last year, harrowed with Nishwitz and cross-harrowed with Thomas's harrow, and planted with sugar-beets. To the wetness of the season and the springy nature of the land, I attribute the fact that the crop was a partial failure. I therefore filled the vacancies on one-fourth of the piece by transplanting, and plowed in the remaining three-fourths and sowed it, June twenty-fourth to July second, with Swedish turnips. The beets and turnips were planted in rows eighteen inches apart, and twice cultivated with the German beet-machinery, and twice hand-hoed, the plants being thinned to about ten inches apart in the rows; and November fifth to tenth we harvested four tons of beets and twenty tons of Swedish turnips.

The grass crop was a full average one, and by the help of improved machinery was secured in fine condition, in spite of the unusually catching weather.

The strawberries, raspberries and blackberries all yielded abundantly, and attracted much attention and admiration from visitors to the College.

The vegetable garden was manured at the rate of ten cords to the acre, plowed, harrowed, and handed over to Prof. Stockbridge. Under his direction, the planting, cultivating and harvesting were performed by the students, as class work, and good crops of various kinds of garden vegetables were raised and secured.

The nursery, young orchards and the vineyard have also been supplied with manure, and kept thoroughly cultivated, and several plots have been prepared and cultivated, under the direction of Prof. Stockbridge, for experiments, which he will probably detail in his report.

Before this year, the greater portion of the available labor, outside of what was necessary for putting in, cultivating and securing the crops, and teaming for the College, has been expended in making roads and bridges, removing stumps and stones, levelling mounds and hillocks, filling up bog-holes and gullies, and other work of the kind, which added little to the productive value of the farm, and after its completion was little thought of except by those who were capable of appreciating the difference wrought by each successive year in the appearance of the estate. Much of this work still remains to be done; but it is an encouraging fact that each year the result of a given amount of labor is more apparent, and we are now enabled to undertake and accomplish works of sufficient difficulty and extent to free us from the accusation of being "forever doing nothing."

In his report of 1868, already referred to, Prof. Stockbridge says: "The pasture lands on the river, which bounds the estate on the west, have the best soil on the farm; but much of it is saturated with water, and covered with brush, and should be improved immediately."

The need of improvement, so apparent at that time, has steadily increased; but, as the pasture was remote from general observation, its claims have had to yield to the pressing necessity of putting the land about the buildings into presentable shape.

Now, however, a public road has been opened through this part of the farm, cutting off a considerable slice of the driest land; and the unusual moisture of the past spring and early summer, so aggravated the general sourness of the herbage, and the difficulty of reaching the isolated knolls where a sweeter vegetation obtained, that the larger cattle showed unmistakably that the supply of nutritious feed was not in a proper proportion to the labor of getting it. Clearly the task of improvement could no longer be deferred.

The general character of the pasture was that of a low, marshy plain, lying at the foot of the slope behind the College, and kept wet and sour by the surface and spring water which was either pouring or oozing into it from the adjoining upland. This water, after thoroughly saturating the soil, and filling the slough-holes and reservoirs, meandered leisurely among rushes and alders till, after an astonishing number of convolutions, it found its way to the brook at the extreme west of the farm. Most of the land was covered with dog-roses, alders, fruitless huckleberry bushes, swamp laurels, ferns, thistles, and sapling pines from one foot to ten feet high; and, of course, the removal of these was the first step in the process of improvement. Then, to get rid of the surplus water, we ran a tile-drain along the foot of the slope, tapping the springs, and by means of two larger drains converging into one, we carried the water thus collected to a point at the lower end of the piece inclosed for improvement, whence, in due time, it can be carried on to the river. The drain was laid in a very dry time, but at once began to discharge a gallon a minute, and is now pouring out a stream which nearly fills the three-inch pipe.

We plowed all the land about seven inches deep, using only two horses on each plow, but paying especial attention to keeping the shares and coulters of the plows sharp; and having a man to follow with a fork, to lay up any sods which might fall back, and to clear the furrow for the next bout. After plowing, we harrowed thoroughly both ways with the Nishwitz harrow, sowed on five cwt. to the acre of a commercial superphosphate, harrowed with the Thomas's smoothing harrow, sowed a mixture of herdsgrass, redtop, orchard grass, and fowl-meadow, and rolled with a heavy roller, and there is now a flattering promise of a good crop of hay next summer. The surface is still somewhat lumpy and uneven; but after sowing clover-seed in the spring, it is intended to roll the piece again, and it is expected that this will leave it in fair condition for the mowing-machine, tedder and horse-rake. After a heavy rain, I carefully marked the course of the surface-water, and afterwards provided for its rapid escape by deepening, clearing out, and connecting the dead furrows, and making a few cuttings through the hillocks which had heretofore set back the water, and rendered it difficult to tell in which direction the outlet really was.

The land inclosed for improvement amounts to twenty-five acres. Of this, thirteen are already laid down; about five acres are plowed, and it is proposed to manure this, and also the remaining seven, which are drained, but otherwise unimproved, and sow both with oats and grass-seed next spring. As the seeded, the plowed and the wild portions of the piece are all of the same general character, and an equal proportion of the expense of drainage is chargeable to each, it is proposed to consider the whole piece as reclaimed, and to state the cost of the different operations as it will probably stand after the first of May, 1875.

Pasture Swamp—To Massachusetts Agricultural College.

Dr.

August, 1874, to May, 1875.—To cutting, mowing and burning brush, 25 acres, at $5 per acre,	$125 00
To plowing (two men and a boy, and two horses) 33 days, at $7.75 per day,	255 75
To harrowing five days with Nishwitz,	25 00
To 6¼ tons superphosphate, at $45 per ton,	281 25
To sowing,	5 25
To harrowing with Thomas's,	12 50
To 12 acres oats (30 bushels),	21 00
To sowing oats,	1 50
To grass-seed (clover, 250 lbs.),	25 00
To timothy, 6¼ bushels,	25 00
To fowl-meadow, 2 bushels,	9 00
To orchard grass, 3 bushels,	14 00
To sowing grass-seed,	3 50
To rolling,	12 50
To 1,600 three-inch sole tile, at $38.70 per M,	62 92
To 1,445 two-inch sole tile, at $24.50 per M,	35 40
To drawing tile from depot and delivering,	5 00
To digging, laying and covering 2,000 rods of drain, 3 to 5 feet deep, at 65 cents per rod,	130 00
To 50 pounds tarred paper,	2 00
	$1,051 57

Cr.

By 25 acres of excellent land, adjoining the highway, and convenient to College and town, before of little value, now worth for farming purposes $200 per acre,	$5,000 00

Besides reclaiming this piece of pasture, we have accomplished a very desirable improvement in filling up the zigzag channel along which the brook flowed before its course was straightened by Professor Stockbridge and the students in 1872, and in plowing the swale and grading the bluffs between the south culvert and the wooden bridge. The expense of this operation, charging a man and two horses at $4, and a man and bull and tip-cart at $2.50 per day, amounted to $182 ; and, considering the improved appearance of this very prominent feature in the approach to the College, and the fact that three acres are changed from a nearly worthless swamp to smooth and productive land, the outlay cannot be regarded as extravagant or unprofitable.

We have also blasted and removed the rocks, scraped the mounds into the slough-holes, and otherwise graded and levelled the piece between the greenhouse and the county road ; and as the students, under the direction of Professor Stockbridge, have made good progress in thoroughly draining it, it is hoped that this piece will soon be an ornament, instead of a reproach, to the College.

The banks around the new barn have been graded, covered with loam, top-dressed and seeded down ; elms and maples have been obtained and set out in place of those which have died, and numerous evergreens have been procured from the woods and pastures and set out in the nursery, and in clumps at different points on the farm. Considerable care and labor have also been expended in improving, gravelling and keeping in repair the four miles of roads on the estate.

Four hundred loads of compost from the yards have been carted out and spread on the mowing, and loam and other materials have been furnished as a basis for next year's supply. The plan proposed in my last report, for the storage of loam in the barn, and its use for bedding, has been carried out, and works admirably. Loam is carted into the barns, and dumped through a scuttle into a pen at the east end of the cow-stable, where it is kept dry and free from frost, and seven wheelbarrow loads in summer, and fourteen (about half a cord) in winter, are daily used to bed the stock, and absorb the liquids and gases of the manure.

List of Crops cultivated on the College Farm during the year 1874.

CROPS.	Area. Acres.	Area. Rods.	Yield.
Oats,	10	32	506 bushels oats, and estimated 10 tons straw.
Fodder (oats),	4	80	7 tons fodder.
Rye (springy land),	5	00	25 bushels.
" (dry land),	3	00	88 bushels.
Potatoes (manured),	2	40	320 bushels large, 135 bushels small.
" (unmanured),	2	00	360 bushels large, 50 bushels small.
Corn,	8	00	350 bushels.
Sugar-beets and ruta-baga,	1	43	4 tons of beets, and 20 tons of turnips.
Small fruits,	1	48	610 boxes.
Vegetable garden,	1	13	A variety of vegetables.
Nursery,	1	12	– –
Young orchard,	3	00	– –
Vineyard,	2	00	– –
Arboretum,	3	00	– –
Pasture reseeded,	13	00	– –
" plowed,	5	00	– –
Swale plowed and graded,	3	00	– –
Total area in tillage,	70	14	– –
" in mowing,	124	55	190 tons of hay.
" in pastures,	108	47	– –
" in woods and roads,	80	64	– –
	383	20	

Among the labors, outside of farm work proper, and the improvement and beautifying of the estate, which devolve on the Farm Superintendent, and the men and teams in his employ, are the attendance on visitors, and the answering of inquiries, oral and written, about the agricultural department; the examining and reporting on implements and machines left for trial; the transporting of freight and baggage to and from the depot; the drawing and delivering of two hundred and fifty tons of coal to the different departments of the College; the removal of ashes and other refuse; the digging up and relaying water-pipes from the laboratory to Professor Graves's house and the boarding-house; the cleaning of the numerous vaults, wells, and cisterns on the estate; the supply of loam and absorbents where needed; and, generally, the furnishing of men and teams for any and all purposes ordered by the proper authority, and necessary for the welfare, progress and prosperity of the several departments of the College.

Stock.

The stock, which was quite particularly described in my last report, has been thrifty, prosperous and productive, especially of bull calves.

Shorthorns.

The Shorthorns comprise one bull and fifteen females. The bull "Roan Regent" is a handsome, thrifty animal, and at fifteen months old weighed 1,080 pounds. His pedigree, below, shows about three-fourths of the Bates-Stevenson blood ("Duchess," "Princess" and "Oxford"), the remaining fourth being derived from the famous tribes of the brothers Colling, Coates, Booth, Sir C. Knightley and Earl Spencer. His immediate ancestors have all been animals of high individual excellence, well and favorably known in this section, the cows being especially remarkable for their milking qualities.

"Roan Regent," bred by H. S. Porter, Hatfield, Massachusetts, the property of the Massachusetts Agricultural College, Amherst, Massachusetts. Roan, calved September 25th, 1873, got by "Roan Duke" (10,783), out of "Red Rose" by "Autocrat, 2d" (5,335). "Jenny," by "Brother Jonathan, 2d" (2,570). "Dorothy, 3d," by "Princess Leopold" (869). "Dorothy," by "East Windsor" (56). "Red Romp," by "Agate" (2). "Romp," by "Enchanter" (3,729). "Rachel," by "Washington" (1,566), imported "Pansy," by "Blaize" (76). "Primrose," by "Charles" (27), by "Blyth Comet" (85), by "Prince" (521), by "Patriot" (486), &c.

Notes.—"Roan Duke" (10,783), by "6th Duke of Thorndale" (4,752), out of "Ada, 2d," by "4th Hiawatha" (2,970), &c.

"Autocrat, 2d" (5,335), by "Marmion" (1,843), [he by "Duke of Gloster" (11,382), out of "Zoe," by "5th Duke of York" (10,168),] out of "Tube Rose, 3d," by "3d Duke of Cambridge" (5,941), &c.

"Brother Jonathan, 2d" (2,570), by "Friar John"

(12,905), out of imported "Bianca," by "Minstrel" (11,818), &c.

"Prince Leopold" (869), by "Meteor" (104), [he by "Duke of Wellington" (3,654), out of "Duchess," by "Duke of Northumberland" (3,647), gr. dam by "Belvedere" (1,706), &c.] out of "Flora," by "Imperial" (2,151), &c.

"Fourth Hiawatha" (2,970), by "Kirkleavington" (11,640), [he by "Duke of Wellington" (3,654), out of "Lady Barrington, 3d," by "Cleveland" (3,407). "Lady Barrington, 2d," by "Belvedere" (1,706), &c.], out of "Yarico, 4th," by "Prince Leopold" (869), &c.

The cows are handsome, thrifty animals. Tracing their lineage through the most famous herds of America and England, and having been bred and kept for dairy purposes, they retain the milking properties, as well as the symmetry and disposition to fatten when dry, for which the earlier Short-horns were famous.

The Ayrshires

comprise three bulls and thirteen cows and heifers, all excellent representatives of this hardy and valuable breed.

The Jerseys

consist of one bull and three females. The latter possess, in a high degree, the deer-like beauty and butter-making faculties for which the breed is celebrated.

The Brittanies.

These consist of a bull, "Merlin," bred on the farm; a cow, "Pauline," bred by Hon. C. L. Flint, and presented by William Knowlton, Esq., of Upton; and a bull-calf, "Arthur," presented by Mr. Whittle, of the McLean Asylum, Somerville, Mass., and are excellent specimens of this beautiful and every way estimable little breed.

The Dutch or Holsteins

are represented by a bull, "Fourth Highland Chief" (14), bred and presented by Winthrop W. Chenery, Esq., of Belmont; and a heifer, "Midwould, 19th," also bred by Mr.

Chenery, and purchased for the College in 1873; both excellent representatives of this very ancient and honorable race of dairy cattle.

Swine.

The College has now twelve swine, four of each of the three breeds,—Chester White, Berkshire and Essex.

Sheep.

The sheep consist of a Cotswold buck, of extraordinary size and quality, bred and presented to the College by R. W. Cameron, Esq., of Clifton, Staten Island, N. Y.; and four Cotswold ewes, from the imported flocks of Messrs. Cameron and D. F. Appleton, of Ipswich, and one buck lamb, bred on the farm.

Poultry.

The poultry-houses are well supplied with first-rate specimens of Games, Gold-spangled Polands, Silver-spangled Hamburghs, and White and Partridge Cochins, and in the yards are fine Bronze Turkeys, Rouen Ducks and Pea Fowl.

Pigeons and Rabbits.

In the pigeon-loft are superior specimens of ten distinct breeds, besides as many sub-varieties, and in a spare pigpen is a colony of English lop-eared rabbits.

The poultry, pigeons and rabbits have been prosperous and productive, and, besides being objects of much interest to students and visitors, have served to illustrate and settle doctrines and questions relating to the laws of similarity and variation, atavism, relative influence of parents, in-and-in breeding and crossing, the effects of domestication, and the tendency of animals to recur to feral instincts, especially in the concealment and protection of their young, and other interesting subjects connected with the study of animal physiology, psychology and natural history generally.

The cattle were exhibited at the Hampshire cattle-show at Amherst, but were not allowed to compete for premiums, the society agreeing to furnish the students and faculty free tickets instead.

At the exhibition of the Hampshire, Franklin and Hampden Society, at Northampton, we showed four animals, and were awarded two first and one second premium.

The impression is becoming very general that the College ought not to compete for premiums; and out of deference to this feeling, and in consideration of the fact that their stock is always on exhibition, it does not seem desirable that the College should carry the stock to the fairs, except occasionally, as a grateful testimony to societies which have shown their interest by endowing one or more scholarships.

The buildings have been fully described in former reports, and no important alteration has been made in them during the past year. By the increased productiveness of the farm, they are now filled to their utmost capacity, and, with continued progress, an enlargement, or a resort to the European system of stacking, will soon be necessary.

The teams consist of six excellent farm horses and five bulls. The Jersey and Ayrshire bulls have been in the yoke nearly every day since the ground settled last spring, and "Belvedere" and "Fourth Highland Chief" have done considerable work in the tip-cart and the roller and on the harrow. "Fourth Chief," especially, is a whole team. He was three years old in May last, and weighs 2,400 pounds. We work him in collar and harness, drive him with reins, and in many places where horses would not work at all, he will walk with a full load across the furrows as if he were drawing an empty cart on a turnpike road.

As the students can only work in the intervals of their studies, four intelligent, reliable men are employed to drive the teams, and, with an old man and a boy, constitute the regular working force on the farm. In harvest, and when called upon to undertake extensive improvements, such other help is employed as is necessary.

As heretofore, the work about the barns has all been performed by students, and it gives me great pleasure to testify to the uniform manliness, courtesy and intelligent interest they have exhibited. Their skill and diligence are best shown by their works, which have earned for them most gratifying compliments from visitors, and have assisted very materially in the success of the agricultural department. In the summer we commence work at five, and in the winter at six o'clock, A. M., and the milking, cleaning, carding, cutting roots and fodder, cooking and feeding are performed, and the barn all cleaned up ready for the inspection of visitors, before the College exercises commence. The cattle are again let out, the stables cleaned, and the cattle put up again, milked and fed, between four and six o'clock, P. M., in the winter, and between five and seven, in the summer. In addition to this, many of the students have diligently assisted me whenever their studies would permit, in surveying, levelling and planning work, in cutting brush, draining and building fences, in haying and harvesting, and farm-work generally.

As class work, under the direction of Professors Stockbridge and Maynard, they have done a very large amount of labor in planting, cultivating and harvesting the crops, in draining, in landscape gardening, and otherwise improving the estate, which I presume those gentlemen will particularly report.

Summary.

In reviewing the experience of the past year, I submit that our circumstances during the spring and early summer were perplexing and discouraging in a remarkable degree; that by diligence and perseverance, we overcame our difficulties as far as it was possible to do so, and obtained good average crops; and that we have gratefully and zealously availed ourselves of the favorable weather of the fall to secure the crops, and to improve the appearance, productiveness and value of the farm, both as an investment, and as a necessary and important part of the educational apparatus of the College.

I forward herewith a detailed statement of receipts and expenses. A considerable saving of expense, and a proportionate increase in money returns, might have been obtained, if it had been possible or desirable for me to have devoted my time and thought more exclusively to these objects; but it is claimed that, considering the difficulties of the soil and season, the increase in the value of the farm and stock, the many objects to which the farm and teams have been subservient, that the management has been reasonably judicious, and has been prompted by a careful regard to the permanent prosperity of the farm and the institution generally.

In concluding this Report, I would distinctly disclaim the intention of practising or justifying any extravagant or unprofitable outlay, or the neglect of careful economy in every detail of farm management; but it has seemed to me that a certain standard of excellence in the condition and appearance of the farm, the buildings and the stock is demanded, both for the character of the College and the permanent utility and profitableness of the farm; and this standard I have diligently sought to attain as quickly and economically as possible. By the growth of the yearlings and two-year-olds, the farm, in another year, will be well stocked with breeding animals of pure breeds, high individual character and practical merit, which it will be in a position to support in the best possible condition, without any outlay whatever for grain or fertilizers, and will then yield a satisfactory and constantly increasing profit on the capital invested in it, besides fulfilling the important offices of instruction and example which are properly expected of it.

The following is a list of the thoroughbred stock belonging to the College:—

Shorthorns.

Bull.—"Roan Regent." *Cows.*—"Yarico, 57th," "Bella Donna," "Peachbud, 8th," "Aurora, 4th," "Emma, 3d," "Autumn Lily," "Wistaria," "Lilian," "Bella Wilfer," "Yucatan," "Estella," "Mabel," "Isabelle," "Yucatella" and "Beatrice."

The pedigrees of all these animals are recorded in the "American Shorthorn Herd-book."

Ayrshires.

Bulls.—"Lord Ronald," "Bonnie Doon," "Roy of Aldivalloch." *Cows.*—"Beauty, 8th," "Lulie" (1,500), "Rosa" (1,780), "Beauty" (870), "Emily, 4th," "Beauty, 11th," "Beauty, 12th," "Leilah," "Little Emily," "Beauty, 13th," "Beauty, 14th," "Emmeline."

These animals have all perfect pedigrees, and either are recorded or will be recorded in the next volume of the "Ayrshire Herd-book."

Jerseys.

Bull.—"Grand Duke" (408). *Cows.*—"Hattie" (977), "Lady Essex" (1,059), "Success" (1,254).

All recorded in the "American Jersey Herd-book."

Brittanies.

Bulls.—"Merlin," "Arthur." *Cow.*—"Pauline."

Dutch or Holstein.

Bull.—"Fourth Highland Chief" (4). *Cow.*—"Midwould, 19th."

Sheep.

One Cotswold ram, four Cotswold ewes, one Cotswold buck lamb.

Swine.

Four Chester Whites, four Berkshires, four Essex.

Poultry.

One hundred Games; twenty Cochins; ten Gold-spangled Polands; ten Silver-spangled Hamburghs; nine Bronze turkeys; six Rouen ducks; sixty pigeons; viz., Carriers, Pouters, Tumblers, Fantails, Jacobins, Nuns, Archangels, Turbits, Trumpeters, Quakers, Blue-rocks.

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OF

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1874.

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GRADUATES OF 1874.*

Benedict, John Mitchell,	Bethel, Conn.
Blanchard, William Henry,	Putney, Vt.
Chandler, Edward Phelps,	Westborough.
Curtis, Wolfred Fletcher,	Westminster.
Hitchcock, Daniel Green,	Warren.
Hobbs, John Alden,	Northampton, N. H.
Libby, Edgar Howard,	Ashland.
Lyman, Henry,	Middlefield, Conn.
Montague, Arthur Huntington,	South Hadley.
Phelps, Henry Lyman,	Southampton.
Smith, Frank Stockbridge,	Springfield.
Woodman, Edward Eastman,	Danvers.
Zeller, Harrie McKeen,	Hagerstown, Md.
Total,	13.

SENIOR CLASS.

Barrett, Joseph Francis,	Barre.
Barri, John Atherton,	Cambridgeport.
Bragg, Everett Burt,	Amherst.
Brooks, William Penn,	South Scituate.
Bunker, Madison,	Nantucket.
Callender, Thomas Russell,	Northfield.
Campbell, Frederick George,	W. Westminster, Vt.
Clark, Xenos Young,	Amherst.
Clay, Jabez William,	Westminster, Vt.
Dodge, George Rufus,	Hamilton.
Hague, Henry,	Lonsdale, R. I.
Harwood, Peter Mirick,	Barre.
Knapp, Walter Haydn,	Boston.
Lee, Lauren Kellogg,	Shrewsbury.
Miles, George Melville,	Westminster.
Otis, Harry Preston,	Northampton.
Peabody, Cecil Hobart,	Amherst.

* The annual report being made in January, necessarily includes parts of two academic years, and the catalogue gives the names of such students as have been connected with the College during any portion of the year 1874.

Rice, Frank Henry,	Barre.
Southwick, Andre Arnold,	Mendon.
Winchester, John Frost,	Peabody.
Total,	20.

JUNIOR CLASS.

Bagley, David Appleton,	Winchendon.
Chickering, Darius Otis,	Enfield.
Deuel, Charles Frederick,	Amherst.
Graves, Louis Bertrand,	South Ashfield.
Guild, George William May,	New York City.
Hawley, Joseph Mather,	Salem, N. Y.
Ladd, Thomas Henry,	Watertown.
Lawton, Charles Follen,	New Bedford.
Mann, George Hewins,	Sharon.
Martin, William Edson,	Hadley.
McConnel, George Washington,	Lonsdale, R. I.
McLeod, William Alexander,	Lonsdale, R. I.
Naito, Saitaro,	Chiyoshiu, Japan.
Parker, George Lowell,	Dorchester.
Porter, William Henry,	Hatfield.
Rogers, Mulford Thacher,	Watertown.
Root, Joseph Edward,	Barre.
Sears, John Milton,	Ashfield.
Taft, Cyrus Appleton,	Whitinsville.
Urner, George Peter,	Elizabeth, N. J.
Wetmore, Howard Graham,	New York City.
Williams, John Elgin,	South Amherst.
Total,	22.

SOPHOMORE CLASS.

Bellamy, John,	Boston.
Benson, David Henry,	Bridgewater.
Brewer, Charles,	Pelham.
Clark, Atherton,	Amherst.
Dickinson, Walter Mason,	Amherst.
Goodrich, Wilbur Francis,	East Cambridge.
Hibbard, Joseph Robinson,	Chester, Vt.
Moore, Frank Lester,	Framingham.

Nye, George Everett,	Sandwich.
Paige, Harrie Cruse,	Tarrytown, N. Y.
Palmer, Frank Waldo,	Amherst.
Parker, Henry Fitch,	Amherst.
Phelps, Charles Herbert,	South Framingham.
Pixley, Martin Shaw,	West Hawley.
Porto, Raymundo,	Para, Brazil.
Southmayd, John Edwards.	Middletown, Conn.
Southworth, Charles Heyward,	Springfield.
Urner, Frank Gordon,	Elizabeth, N. J.
Wilson, Alvin Robert,	South Hadley.
Wuyesugi, Tall Katuyoshi,	Tokeio, Japan.
Wyman, Joseph,	Arlington.
Total,	21.

FRESHMAN CLASS.

Allen, Matthew Joseph,	Marion.
Baker, David Erastus,	Franklin.
Boutwell, Willie Levi,	Leverett.
Brigham, Arthur Amber,	Marlborough.
Carneiro, Manuel Dias,	Rio de Janeiro, Brazil.
Choate, Edward Carlile,	Cambridge.
Coburn, Charles Francis,	Lowell.
Collum, George Newell,	Hartford, Conn.
Cooley, Silas Rose,	North Hadley.
Foote, Sandford Dwight,	Springfield.
Hall, Josiah Newhall,	Revere.
Howe, Charles Sumner,	Ayer Junction.
Hubbard, Henry Francis,	New Rochelle, N. Y.
Humphrey, George Eddy,	Rochester.
Hunt, John Franklin,	Sunderland.
Loomis, Francis Eugene,	North Amherst.
Lovell, Charles Otto,	Amherst.
Morey, Guy,	Lowell.
Nims, Luther,	Woodlawn, N. C.
Spofford, Amos Little,	Georgetown.
Stockbridge, Horace Edward,	Amherst.
Taylor, Henry Morgan,	Boston.
Tuckerman, Frederick,	Boston.
Washburn, Hosea,	Bridgewater.
Total,	24.

SELECT CLASS.

Auger, Charles Parmelee,	Middletown, Conn.
Ball, Gilman Kimball,	Holyoke.
Barstow, William Hale,	Haverhill, N. H.
Bond, Henry,	Ware.
Darling, Ira C.,	Pawtucket, R. I.
Davis, George Williams,	West Stafford, Conn.
Goss, Frank Washington,	Lancaster.
Gunn, Willie Bradford,	Sunderland.
Holmes, Harry Hawley,	Greenwich, N. Y.
Howe, Waldo Vernon,	Framingham.
Jackson, Henry Stranahan,	Orange, N. J.
Kendall, Hiram,	Watertown.
Mildeberger, Victor,	New York City.
Mills, James Kellogg, Jr.,	Springfield.
Parker, George Amos,	Gardner.
Platt, William Davenport,	Baltimore, Md.
Potter, William Stiles,	La Fayette, Ind.
Smith, Thomas Edwin,	Chesterfield.
Walker, James B.,	Springfield.
Total,	19.

RESIDENT GRADUATES.

Penhallow, B. S., David Pearce,	Portsmouth, N. H.
Wellington, B. S., Charles,	Amherst.
Total,	2.

SUMMARY.

Graduates of 1874,	13
Resident Graduates,	2
Seniors,	20
Juniors,	22
Sophomores,	21
Freshmen,	24
Select,	19
Total,	121

COURSE OF STUDY AND TRAINING.

Freshman Year.

First Term.—Chemical Physics, 5 hours each week; Human Anatomy, Physiology and Hygiene, 3 hours; Algebra, 5 hours; English, 2 hours; Agriculture, 3 hours; Declamation, 1 hour; Free-hand Drawing, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term.—Inorganic Chemistry, 4 hours; Human Anatomy, Physiology and Hygiene, 3 hours; Geometry, 5 hours; Agriculture, 4 hours; English, 2 hours; Elocution, 1 hour; Free-hand Drawing, 4 hours; Military Drill, 4 hours.

Third Term.—Organic and Practical Chemistry, 8 hours; Geometry, 4 hours; French, 5 hours; Elocution, 1 hour; Agriculture, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Sophomore Year.

First Term.—Agricultural and Analytical Chemistry, 8 hours each week; Analytical Geometry, 4 hours; French, 5 hours; Agriculture, 2 hours; Declamation, 1 hour; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term.—Quantitative Chemical Analysis, 7 hours; Trigonometry, 5 hours; French, 4 hours; Agriculture, 4 hours; Declamation, 1 hour; Military Drill, 4 hours.

Third Term.—Zoölogy, 5 hours; Surveying, 5 hours; Agriculture, 2 hours; English, 3 hours; Declamation, 1 hour; Drawing, 4 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Junior Year.

First Term.—German, 5 hours each week; Mechanics, 5 hours; Entomology and Zoölogy, 3 hours; Market Gardening, 2 hours; Levelling and Drawing, 5 hours; Military Drill, 3 hours; Manual Labor, 6 hours.

Second Term.—German, 4 hours; Physics, 5 hours; Botany, 4 hours; Microscopy, 2 hours; Drawing, 4 hours; Agricultural Debate, 1 hour; Military Drill, 4 hours.

Third Term.—German, 4 hours; Astronomy, 4 hours; Botany, 4 hours; Topographical Surveying, 4 hours; Stock and Dairy Farming, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Senior Year.

First Term.—English Literature, 4 hours each week; Botany, 2 hours; Veterinary Science, 3 hours; Book-keeping, 2 hours; Roads and Railroads, 5 hours; Drawing, 2 hours; Original Declamation, 1 hour; Military Drill, 3 hours.

Second Term.—English Literature, 4 hours; Mental Science, 4 hours; Arboriculture, 2 hours; Veterinary Science, 3 hours; Drawing, 4 hours; Military Drill, 4 hours.

Third Term.—Veterinary Science, 3 hours; Geology, 3 hours; Landscape Gardening, 2 hours; Rural Law, 1 hour; Lectures on English Language, 2 hours; Agricultural Review, 4 hours; Military Drill, 4 hours.

Instruction is largely given by lectures and practical exercises, but the following text-books are recommended for recitation or reference.

Botany and Horticulture.

Gray's Lessons, Manual, and Botanical Text-book.
Masters' Henfrey's Elementary Course of Botany.
Berkeley's Introduction to Cryptogamic Botany.
Cooke's Microscopic Fungi.
Carpenter's The Microscope and its Revelations.
Flint's Grasses and Forage Plants.
Downing's Fruits and Fruit-Trees of America.
Thomas' American Fruit Culturist.
Strong's Grape Culture.
Henderson's Practical Floriculture.
Fuller's Forest Tree Culturist.
Hoope's Book of Evergreens.
Williams' Choice Stove and Greenhouse Plants.
Helmsley's Hand-book of Hardy Trees, Shrubs and Herbaceous Plants.
Loudon's Cyclopædia of Plants.
Lindley and Moore's Treasury of Botany.
Kemp's Landscape Gardening.
Downing's Landscape Gardening.

Agriculture.

Johnson's How Crops Grow.
Johnson's How Crops Feed.

Pendleton's Scientific Agriculture.
Hyde's Lowell Lectures on Agriculture.
Liebig's Natural Laws of Husbandry.
French's Farm Drainage.
Flint's Milch Cows and Dairy Farming.
Sturtevant's The Dairy Cow — Ayrshire.
Waring's Handy-book of Husbandry.
Henderson's Gardening for Profit.
Donaldson's British Agriculture.
Morton's Cyclopædia of Agriculture.
Low's Domesticated Animals.
Flint's Reports on the Agriculture of Massachusetts.
Agricultural Gazette and Gardeners' Chronicle, London.

Chemistry and Geology.

Watt's Fownes' Manual of Elementary Chemistry.
Sibson's Agricultural Chemistry.
Caldwell's Agricultural Chemical Analysis.
Nason's Woehler's Chemical Analysis.
Wills' Analytical Chemistry.
Johnson's Fresenius' Qualitative and Quantitative Analysis.
Liebig's Ernährung der Pflanzen.
Wolff's Landwirthschaftliche Analyse.
Hoffmann's Ackerbau Chemie.
Watt's Chemical Dictionary.
Dana's Mineralogy.
Hitchcock's Geology.
Dana's Text-book and Manual of Geology.

Veterinary Science and Zoölogy.

Fleming's Chauveau's Comparative Anatomy of Domesticated Animals.
Dalton's Human Physiology.
Cleland's Animal Physiology.
Williams' Principles of Veterinary Surgery.
Williams' Principles of Veterinary Medicine.
Gamgee's On Horse-shoeing and Lameness.
Gamgee's Domestic Animals in Health and Disease.
Armitage's Clater's Cattle Doctor.
Youatt's Treatises on the Domestic Animals.
Blaine's Veterinary Art.
Morton's Manual of Pharmacy.
Wood and Bache's United States Dispensatory.
Harbison's Elementary Zoölogy.

Lankester's Advanced Zoölogy.
Packard's Guide to the Study of Insects.
Harris' Insects Injurious to Vegetation.
Westwood's Principles of Classification of Insects.
Baird's Mammals of North America.
Murray's Geographical Distribution of Mammals.
Samuels' Birds of New England.
Cobbold's Entozoa.
Denney's Parasitic Insects.
Moquin-Tondon's Manual of Medical Zoölogy.

Mathematics, Physics, and Civil Engineering.

Olney's Algebra, Geometry, and Trigonometry.
Gillespie's Surveying.
Gillespie's Roads and Railroads.
Atkinson's Ganot's Physics.
Peabody's Astronomy.
Loomis' Meteorology.

Military Science and Tactics.

Upton's Tactics for Infantry.
Artillery Tactics for U. S. Army.
Mahan's Field Fortifications.
Halleck's International and Military Law.
Regulations of U. S. Army.
History of the War of the Rebellion.

English, French and German.

Hart's Composition.
Fowler's English Grammar.
Shaw's Complete Manual of English Literature.
Chambers' Cyclopædia of English Literature.
Morley's English Writers.
Taine's History of English Literature.
Languillier and Monsanto's French Grammar.
Spier and Surenne's French Dictionary.
Glaubensklee's German Grammar.
Adler's German Dictionary.

The French and German books for translation are changed every year, selections being made from recent literary and scientific publications.

Mental, Moral and Social Science.

Haven's Mental Science.
Hickok's Empirical Psychology.

Porter's Elements of Intellectual Science.
Seelye's Schwegler's History of Philosophy.
Haven's Moral Philosophy.
Hickok's Moral Science.
Hopkins' Law of Love and Love as Law.
Chadbourne's Natural Theology.
Walker's Science of Wealth.
Perry's Political Economy.
Carey's Principles of Social Science.
Stirling's Bastiat's Harmonies of Political Economy.

CALENDAR FOR 1875.

The third term of the collegiate year begins March 25th, and continues till June 23d.

The first term begins August 26th, and continues till the Wednesday before Thanksgiving.

The second term begins December 16th, and continues till March 15th, 1876.

There will be an examination of candidates for admission to the College, at the Botanic Museum, at 9 A. M., Tuesday, June 22d, and also on Thursday, August 26th.

The Farnsworth Prize Declamations take place Monday evening, June 21st.

The public examination of the graduating class for the Grinnell Prize for excellence in Agriculture, and the examination of the other classes in the studies of the term, will take place on Tuesday forenoon, June 22d.

The Address and Poem before the Literary Societies will be delivered on Tuesday afternoon.

The exercises of Graduation Day occur June 23d.

There will be a session of the State Board of Agriculture at the College, June 22d and 23d.

ADMISSION.

Candidates for admission to the Freshman Class are examined, orally and in writing, upon the following subjects: English Grammar, Geography, Arithmetic, Algebra through simple equations, and the History of the United States.

Candidates for higher standing are examined as above and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the College until he is fifteen years of age, and every student is required to furnish a certificate of good character, from his late pastor or teacher, and to give security for the prompt payment of term bills. Tuition and room-rent must be paid in advance, at the beginning of each term, and bills for board, fuel, etc., at the end of every term.

The regular examinations for admission are held at the Botanic Museum, at 9 o'clock, A. M., on Tuesday, June 22d, and on Thursday, August 26th; but candidates may be examined and admitted at any other time in the year.

Further information may be obtained from President W. S. Clark, Amherst, Mass.

EXPENSES.

Tuition, ...	$25 00 per term.
Room-rent, ...	$5 00 to 10 00 "
Board, ...	3 50 per week.
Expenses of Chemical Laboratory to Students of Practical Chemistry, . . .	10 00 per term,
Public and private damages, including value of chemical apparatus, destroyed or injured, ...	at cost.
Annual expenses, including books, . .	$300 00 to $350 00

REMARKS.

The regular course of study occupies four years, and those who complete it receive the degree of Bachelor of Science, the diploma being signed by the Governor of Massachusetts, who is president of the corporation.

The Trustees of the College have recently entered into the following agreement with the corporation of Boston University, viz.:—

Proposed Articles of Agreement between the Trustees of the Massachusetts Agricultural College and the Trustees of Boston University.

I. The College on its part agrees:—

1. That matriculants in Boston University desiring to pursue any regular or special course of instruction presented in the Massachu-

setts Agricultural College shall be at liberty to do so on the same terms and conditions as other persons, and on completing the course to the satisfaction of the authorities of both institutions, shall be entitled to take their appropriate degree, either at the hands of the College, or from the University, or both, as they may prefer.

II. The University on its part agrees :—

1. That so long as this agreement is found satisfactory, it will refrain from organizing an independent College of Agriculture, and will give its cordial support and influence to the building up of the Massachusetts Agricultural College.

2. It will, by its annual circulars and official correspondence, publicly and privately, recommend those seeking an agricultural education to resort for it to the Massachusetts Agricultural College, and will publish in connection with its annual catalogue such statements of the advantages of the College as may be agreed upon by the Presidents of the two institutions.

III. Both parties further agree :—

1. That to promote a good understanding, each corporation, whenever it may desire, shall have the privilege of representing its interests by a duly accredited officer or committee in the business meetings of the other.

2. That either party to this agreement shall have power to terminate it, at the close of any scholastic year, by giving notice of such desire and intent one year previously.

Under this arrangement, all students who desire it may become members of the University and receive its diploma in addition to that of the College.

The instruction in the languages is intended to qualify the graduates to write and speak English with correctness and effect, and to translate German and French with facility. The scientific course is as thorough and practical as possible, and every science is taught with constant reference to its application to agriculture and the wants of the farmer.

The instruction in agriculture and horticulture includes every branch of farming and gardening which is practised in Massachusetts, and is both theoretical and practical. Each topic is discussed thoroughly in the lecture-room, and again in the plant-house or field, where every student is obliged to labor. The amount of required work, however, is limited to six hours per week, in order that it may not interfere with study. Students are allowed to do additional work, provided they maintain the necessary rank as scholars. All labor is paid at the rate of ten to twenty cents per hour, according to its value.

Indigent students are allowed to do such work as may offer about the College and farm buildings, or in the field, but it is hardly possible for one to earn more than from $50 to $100 per annum besides performing other duties. So far as is consistent with circumstances, students will be permitted to select such varieties of labor as they may for special reasons desire to engage in.

The State Board of Agriculture unanimously voted at their last annual meeting that every Agricultural Society receiving the bounty of the Commonwealth be urged to maintain at least one scholarship at the College, and to secure the attendance of one or more students. The Trustees also voted at their annual meeting to authorize the Executive Committee to remit the tuition of such worthy students as were unable to pay it.

Those who pursue a select course attend recitations and lectures with the regular classes; but those properly qualified, who desire special instruction in chemistry, civil engineering, veterinary science, agriculture or horticulture, may make private arrangements with the officers having charge of these departments.

An expenditure of from $10 to $50 is necessary to provide furniture, which may be purchased at reasonable rates, either new or second-hand. At the beginning of the second term of attendance, every student is required to provide himself with the full uniform prescribed for the battalion of Agricultural Cadets.

On Sundays, students are expected to attend the chapel service and Bible class, which are conducted by the Professor of Moral Science. While the Bible is made the basis of all religious instruction, everything of a denominational character is as far as practicable avoided.

Students may, upon the written request of their parents or guardians, be excused from these exercises to attend services in one of the churches of the town, but, for obvious reasons, it is very undesirable that such requests be made.

REGULATIONS.

1. Students are specially forbidden to combine together for the purpose of absenting themselves from any required exercise, or violating any known regulation of the College.

2. The roll shall be called five minutes after the ringing of the bell for each exercise of the College by the officer in charge, unless a monitor be employed, and students who do not answer to their names shall be marked absent, provided that any student coming in after his name has been called shall be marked tardy. Two tardinesses shall be reckoned as one absence.

3. Absence from a single exercise may be allowed or excused by the officer in charge of the same; but permission to be absent from several exercises must be obtained from the general excusing officer or from the president. In such cases, the officer excusing will furnish a certificate of excuse, which shall state the precise time for which absence is permitted, and which shall be a satisfactory reason for absence from all exercises occurring within the time specified.

4. Absence without permission obtained beforehand will not be excused by any member of the faculty, except on the presentation of a satisfactory excuse written upon the prescribed blank form. Excuses must be rendered to the officer in charge of the exercise from which the student was absent; except that when the absence may include two or more days, the excuse may be rendered to the president, whose approval shall be deemed sufficient for all absences specified therein. Excuses must be rendered promptly; no officer will be expected to receive an excuse after one week has elapsed from the end of the absence, if there has been an opportunity for presentation. Excuses deemed satisfactory will be returned to the student with the indorsement of the approving officer. Excuses deemed insufficient will be retained and referred to the faculty for their decision.

5. For every absence for which no excuse may be offered, or, if offered, shall be deemed insufficient by the faculty, the absentee shall be charged with a fine of one dollar upon the treasurer's accounts, and no student may enter upon the duties of a term, or receive an honorable discharge, certificate of attendance, or diploma, until all fines previously incurred are paid.

6. Whenever the aggregate number of unexcused absences in all departments reaches five, the student so delinquent shall be informed of the fact. When the number of such absences reaches eight, the parent or guardian of the student shall be informed of his delinquency; and when ten such delinquencies are justly recorded against any student, his connection with the College may be terminated.

7. Students are forbidden to absent themselves without excuse from the regular examinations, to give up any study without permission from the president, or to remove from one room to another without authority from the officer in charge of the dormitory buildings.

8. The record of deportment, scholarship and attendance will be carefully kept; and, whenever the average rank of a student for any term falls below fifty, he will not be allowed to remain a member of the College, except by a special vote of the faculty. Admission to the College and promotion from class to class, as well as to graduation, are granted only by vote of the faculty.

9. Students are required to abstain from everything injurious to the buildings and other property of the College, and in all respects to be gentlemen.

10. Students will not be excused from regular duty to engage in boating.

BOOKS, APPARATUS, AND SPECIMENS IN NATURAL HISTORY.

The library of the College contains about 1,500 volumes. Among them are several valuable sets of cyclopædias, magazines and newspapers, reports of agricultural societies and state boards of agriculture, and many standard works on agriculture and horticulture. There are many useful works of reference in chemistry, botany, surveying and drawing. The larger part of the books has been presented to the institution by private individuals.

The faculty and students also have the privilege of drawing books from the excellent library of Amherst College, which contains nearly 30,000 volumes.

The state cabinet of specimens, illustrating the geology and natural history of Massachusetts, has been removed from Boston to the College, and is of much value for purposes of instruction.

The Knowlton herbarium contains more than 10,000 species of named botanical specimens, besides a large number of duplicates. The botanic museum is supplied with many interesting and useful specimens of seeds, woods and fruit models. There is also a set of diagrams illustrating structural and systematic botany, including about 3,000 figures.

About 1,000 species and varieties of plants are cultivated in the Durfee Plant-house, affording much pleasure and information to students of both Colleges.

The very extensive, and in many respects unsurpassed, collections in geology, mineralogy, natural history, ethnology and art, belonging to Amherst College, are accessible to members of the Agricultural College.

The chemical, engineering and military departments of the Agricultural College are well furnished.

The armory contains two brass pieces of artillery, fifty sabres, and one hundred and fifty breech-loading rifles.

FARNSWORTH RHETORICAL MEDALS.

Isaac D. Farnsworth, Esq., of Boston, has generously provided a fund of $1,500, the income of which is to be used for the purchase of gold and silver medals, to be annually awarded, under the direction of the College faculty, for excellence in declamation.

GRINNELL AGRICULTURAL PRIZES.

Hon. William Claflin, of Boston, has given the sum of $1,000 to establish a fund for the endowment of a first prize of $50, and a second prize of $20, to be called the Grinnell Agricultural Prizes, in honor of George B. Grinnell, Esq., of New York. These prizes are to be paid in cash to those two members of the graduating class who may pass the best oral and written examination in Theoretical and Practical Agriculture.

HILLS BOTANICAL PRIZES.

For the best herbarium, collected by a member of the class of 1876, a prize of $15 is offered, and for the second best, a prize of $10; also a prize of $5 for the best collection of woods.

FINANCIAL STATEMENT,

JANUARY 1, 1875.

REAL ESTATE.

College Farm and Quarry,	$37,500 00
South College,	36,000 00
North College,	36,000 00
College Hall,	30,000 00
South Boarding-house,	8,000 00
North Boarding-house,	8,000 00
Durfee Plant-house,	12,000 00
Botanic Museum,	5,000 00
South Barn,	14,500 00
Farm-house,	4,000 00
Four Dwellings and Barns purchased with the estate,	9,000 00
Total Real Estate,	$200,000 00

FARM STATEMENT.

Value of Live-stock,	$11,560 00
of Vehicles and Implements,	2,840 00
of Produce on hand,	5,736 00
	$20,136 00
Total credits of Farm, including property inventoried Jan. 1, 1875, credit for labor performed in grading, etc., and receipts from sales of live-stock and produce,	24,553 00
Total debits of Farm, including property inventoried Jan. 1, 1875, and all expenditures for live-stock, labor, implements, repairs, seeds, fertilizers, etc.,	24,286 60

FUND FOR MAINTENANCE OF THE COLLEGE,

In Charge of the State Treasurer.

Agricultural College Fund.

Cash balance on hand, January 1, 1875,		$10,000 00
Present investments:—		
City of Salem bonds,	$55,000 00	
of Lynn bonds,	25,000 00	
of Chelsea notes,	25,000 00	
of Fall River notes,	50,000 00	
Town of Milford bonds,	14,200 00	
of Plymouth notes,	6,724 65	
of Brighton notes,	10,000 00	
of West Roxbury notes,	70,000 00	
of Westborough notes,	12,000 00	
of Lee notes,	4,142 75	
County of Hampden notes,	50,000 00	
		322,067 40
Massachusetts Troy & Greenfield Railroad bonds,	$8,000 00	
Massachusetts Bounty Loan bonds,	16,000 00	
		24,000 00
State of Maine bonds,		4,000 00
Total Fund,		$360,067 40

Two-thirds of the income of this fund is by law paid to the treasurer of the College, and one-third to the treasurer of the Institute of Technology.

The Hills Fund of $10,000, for the maintenance of the Botanic Garden, is in charge of the College treasurer, and at present yields an income of $500.

To this sum should be added the receipts of tuition and room-rent, amounting to $100 per annum for each scholar, and the receipts from the sale of the products of the farm and garden.

Dr. MASSACHUSETTS AGRICULTURAL COLLEGE *in account with* NATHAN DURFEE, *Treasurer.* Cr.

1874.			**1874.**		
Jan. 1,	To balance,	$2,875 06		By Salaries,	$20,395 83
	Income Hills Fund,	500 00		Board of Students,	3,801 97
	State Endowment Fund,	15,701 75		Expenses Hills Fund,	509 04
	State Appropriation,	18,000 00		Contingent account,	7,910 21
	Bequest of Mary Robinson,	1,000 00		Botanical account,	473 96
	I. D. Farnsworth, Esq.,	90 00		Farm account,	4,222 24
	Hon. William Claflin,	1,000 00		Interest account,	444 02
	Receipts from Students,	8,810 05		Prize account,	187 00
	from Farm Superintendent,	1,487 54		Claflin Prize Fund, invested,	1,000 00
	from Gardener,	549 20		Indebtedness of 1873, paid,	8,845 47
	from bills payable,	3,500 00	Dec. 31,	By balance,	5,723 86
		$53,513 60			$53,513 60

Respectfully submitted,

NATHAN DURFEE, *Treasurer.*

I have examined the Treasurer's accounts and find them correctly stated and accompanied by the proper vouchers.

HENRY COLT, *Auditor.*

SUMMARY OF METEOROLOGICAL OBSERVATIONS

For the Year 1874,

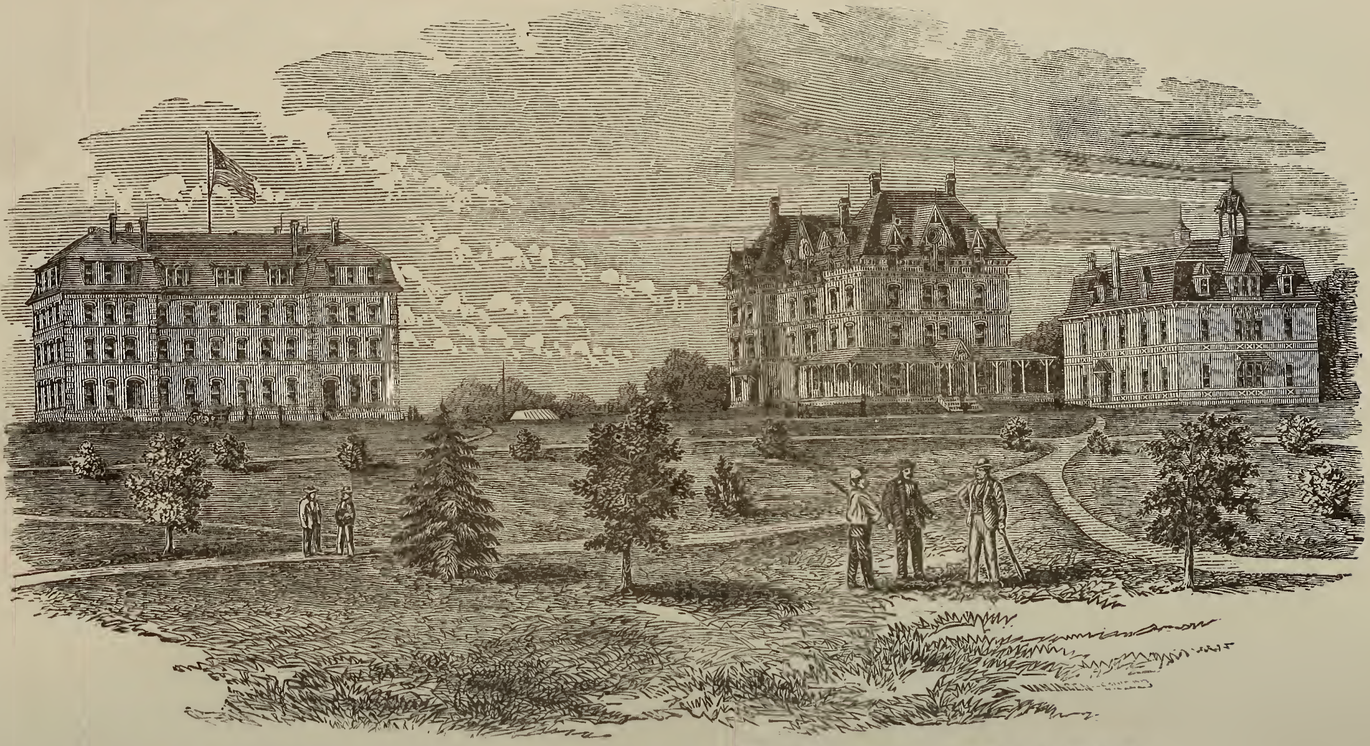
TAKEN AT AMHERST, MASS.,

By Professor E. S SNELL, LL.D., of Amherst College.

Latitude, 42° 22′ 17″. Longitude, 72° 34′ 30″. Elevation above the sea level, 267 feet.

SUMMARY OF METEOROLOGICAL OBSERVATIONS FOR 1874.

MONTHS.	THERMOMETER IN THE OPEN AIR.			RAIN AND SNOW.		CLOUDS.	WINDS. PER CENT. OF TIME AND FORCE.				BAROMETER. BAROMETER HEIGHT REDUCED TO FREEZING POINT.			FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.		
	Maximum.	Minimum.	Mean.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches	Mean per cent of sky.	Northwest.	Southwest.	Southeast.	Northeast.	Maximum.	Minimum.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
January, . .	52.0	1.2	58.15	5.461	12.5	59	49	21	19	11	30.312	29.280	29.843	.376	.023	.134	100	33	75
February, . .	49.3	-5.0	24.48	2.185	15.5	49	73	9	8	10	30.453	29.233	29.847	.293	.027	.110	100	45	72
March, . .	57.2	9.7	32.96	1.348	5.5	48	70	14	9	7	30.175	29.155	29.644	.405	.039	.132	98	28	63
April, . .	63.0	18.7	38.32	6.028	11.5	56	47	20	17	16	30.263	29.034	29.727	.392	.045	.158	100	23	67
May, . .	86.0	39.0	56.52	5.224	–	45	41	7	32	7	30.205	29.233	29.656	.728	.097	.304	98	25	64
June, . .	93.0	51.3	66.18	5.059	–	58	40	18	22	20	29.985	29.242	29.672	.956	.214	.491	99	34	74
July, . .	90.0	58.0	67.16	11.579	–	49	22	27	41	10	29.973	29.496	29.734	.839	.378	.580	100	42	79
August, . .	84.0	46.3	65.58	2.689	–	36	36	12	36	16	30.025	29.357	29.740	.823	.288	.492	100	34	61
September, . .	85.8	39.0	62.03	1.818	–	50	46	14	32	8	30.076	29.076	29.819	.691	.218	.437	100	37	79
October, . .	66.0	28.5	47.60	1.845	–	45	53	18	21	8	30.241	29.313	29.804	.442	.132	.265	100	38	75
November, . .	60.0	16.0	36.21	3.536	7.5	43	57	15	23	5	30.337	28.807	29.822	.388	.053	.157	100	25	70
December, . .	49.0	0.0	29.29	1.168	4.0	50	60	14	21	5	30.372	29.369	29.843	.272	.024	.122	100	37	69
YEAR, . .	93.0	-5.0	46.21	47.940	56.5	50	50	17	23	10	30.453	28.807	29.763	.956	.023	.282	100	23	71



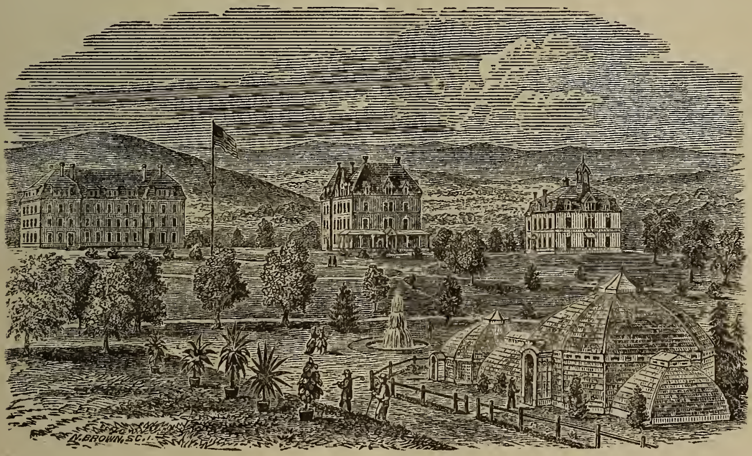
MASSACHUSETTS AGRICULTURAL COLLEGE.

SENATE...... ......No. 45.

THIRTEENTH ANNUAL REPORT

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.



JANUARY, 1876.

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1876.

Commonwealth of Massachusetts.

AMHERST, Jan. 13, 1876.

To His Excellency ALEXANDER H. RICE.

SIR :—I have the honor herewith to present to Your Excellency and the Honorable Council the Thirteenth Annual Report of the Massachusetts Agricultural College.

Very respectfully,
Your obedient servant,

W. S. CLARK.

INDEX.

ANNUAL REPORT.

To His Excellency the Governor and the Honorable Council:

The Trustees of the Massachusetts Agricultural College, in accordance with the requirements of the statutes of the Commonwealth, respectfully offer the following Report concerning the Institution under their charge.

As no appropriation was granted by the legislature, and no gifts of considerable value were received during the year 1875, no important improvements to the estate nor additions to the buildings or means of instruction have been made. The income from the fund and the receipts from tuition charges have been barely sufficient to pay the salaries of the officers, so that the necessary expense of insurance, repairs, sweeping, lighting and heating, as well as keeping roads, grounds and water-works in good order, has been met, as in years past, by borrowing. The accumulated debt of the College now amounts to $20,000, and must increase at the rate of several thousand dollars per annum so long as the present course of instruction is continued without adequate provision for the payment of current expenses. That the system of study and training now in operation is in most respects the best possible for an agricultural college of the first class, such as Massachusetts ought to maintain, is generally conceded. It is, however, obviously impracticable for the Trustees to preserve the Institution in its present form without the required funds. In order that the absolute necessity of immediate and efficient action, as well as the magnitude of the interests involved, may be clearly comprehended and fully appreciated, it seems proper to give a complete account of the amount of money which has been devoted to this grand and reasonably successful enterprise, and to name the sources from which the funds have been derived, and the objects for which they have been expended.

Historical Statement.

The Massachusetts Agricultural College was incorporated as a State Institution in 1863, and endowed with funds received from the United States. In accepting the gift of 360,000 acres of land by the Act of April 18, 1863, the State contracted to maintain forever at least one college, "where the leading object shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life."

On the 25th of May, 1864, the Trustees by a unanimous vote located the College in Amherst, the town having pledged itself to pay the sum of $75,000 for the erection of buildings, and to furnish for a reasonable price a satisfactory tract of land for the uses of the Institution. In the October following, the present estate of the College was purchased from six different parties. The cost of the land and buildings at that time amounted to about $43,000, the total area being 383½ acres.

The State has further contracted with the United States, that "No portion of the fund derived from the land grant, nor the interest thereon, shall be applied directly nor indirectly, under any pretence whatever, to the purchase, erection, preservation or repair of any building or buildings."

The total expenditure for the erection of new buildings has been more than $150,000, and in this respect the College is well furnished. The total cost of the real estate, including buildings and permanent improvements, and excluding insurance and repairs, has been not less than $225,000. The personal property, consisting of books, specimens, apparatus and furniture, may be moderately valued at $30,000, and the farm-stock, vehicles, implements and produce, at $10,000 more. Thus the total property of the College may be fairly estimated as worth for its purposes the sum of $265,000.

The cash funds for all objects and from all sources now amount to $253,500. This magnificent sum of $518,500, therefore, represents the present value for educational uses of the Massachusetts Agricultural College to the Commonwealth.

In order to furnish all the information which might seem desirable in regard to the receipts and expenditures from 1863 to 1876, the assistant treasurer, George Montague, Esq., has been requested to transcribe them from the books of the treasurer, and arrange them in a convenient form for reference. These tables will be found appended to this Report. The accounts of the College are kept with great exactness, and carefully audited.

What the College has Accomplished.

Eight years is a brief period in the life of an institution, and especially of one which, from its novel and peculiar character, has been forced to struggle for its very existence against the prejudices of the ignorant and the jealousy of the educated among its opponents, and has often in times of need found its nominal friends greatly lacking in hopefulness, courage and enthusiasm. Another practical difficulty in the way of the rapid development of such a college, lies in the impossibility of educating the people to a correct apprehension of the real objects and methods of the course of instruction, so long as the newspapers continually scatter broadcast disparaging and false statements concerning it. Again, there are many students who are prevented from attendance by erroneous ideas regarding the compulsory manual labor and military drill which are wisely required by the laws of both the State and the national government. But nothing has so severely checked the growth of the Massachusetts College as the high rate of tuition and the total want of means so abundantly provided in other colleges for the pecuniary assistance of worthy but indigent students. Is it not surprising that Massachusetts, with all her renown for wealth, intelligence and liberality, should stand alone among all the States of the Union in the bad preëminence of refusing free education to those of her youth who desire to enjoy the privileges of her Agricultural College? If the Institution could be more intimately connected with the educational system of the

Commonwealth by the establishment of a free scholarship in every representative district which should be open to competition among the best scholars in all the public schools, then the people would feel its influence for good, and the State would enjoy a most ample return for the money expended in its establishment and maintenance. Is it better that the half-million dollars already invested in the College should educate two hundred students in continuous succession, or that its organization be destroyed and its educational power reduced to insignificance for the want of a few thousand dollars of annual income? This is the question which the legislature should answer by their action in this centennial year.

The work of the College, however, has not been, even in the years of its infancy, without some importance, nor is the reputation it has achieved by honest effort discreditable to its Massachusetts name.

The total number of students admitted on examination is 398, of whom 95 have completed the four years' course, and received the degree of bachelor of science. It is a noteworthy fact, that nearly all who enter the College become desirous of graduation. There is also a steadily increasing tendency to return after obtaining a degree, for post-graduate study. The number of post-graduates in attendance the past term was six, all of whom devoted themselves to chemistry, four of them pursuing botany in addition, and one, veterinary science.

At this point, every reader wishes an immediate and definite reply to the question, "How many of your graduates are farmers?" This may be answered fairly in several ways. It can be said, for instance, that there are as many as intended to be farmers when they entered college, which proves that they have not been educated away from farm life. Again, it is true, that nearly all would prefer agriculture as a business, provided they could command the requisite capital with which to buy, stock and run a good farm, which shows that those who engage in some other occupation, where they can earn more than they can as mere farm laborers, are men of sound judgment. Several have returned to the old homestead, and are working with their fathers, bringing light and comfort to the families favored with their presence.

Some are managing farms for others, which is a most difficult thing for a young graduate without business experience to do in a manner satisfactory to his employer, especially when the latter is a man who has made a fortune in some other occupation, and has small knowledge himself of practical agriculture. Others are engaged in the cultivation of fruits, or flowers, or in the manufacture or sale of fertilizers, or in editing agricultural papers, or as agricultural engineers, or architects, or landscape gardeners. About one-half the entire number of alumni are believed to be occupied more or less directly with agriculture, as above stated.

But the remainder are by no means to be regarded as having been educated in vain at the Agricultural College. Their light cannot be hid, and their influence will be felt for good to agriculture wherever they reside. They are intelligently interested in all that pertains to progress in farming and gardening; and when they are sent to the general court, as many of them are sure to be, they will stand up and vindicate the claims of their alma mater, to the respect and support of the Commonwealth. Among the occupations by which they propose to earn an honest living, may be enumerated the law, medicine, the veterinary art, pharmacy, teaching, civil engineering, trade, transportation, and various mechanic arts.

All those individuals who have insisted that the College was a failure because any of its graduates ever thought of engaging, even temporarily, in any other business than farming, are requested to read and remember that clause of its charter which is quoted on a preceding page, and which declares the object of its foundation to be, not solely nor chiefly the education of farmers, notwithstanding the agricultural part of its name, but "to promote the liberal and practical education of the industrial classes in the *several* pursuits and professions of life."

While large demands are necessarily made upon the time and strength of the College officers, in consequence of the limited number of the faculty and the practical character of the instruction, yet they have accomplished every year since their organization, an amount of useful labor for the advancement of science, the improvement of agriculture, and the enlightenment of the public which is by no means insignificant, and compares favorably with what has been done in a similar direction at any other institution. It has indeed been asserted by very high authorities, that the results of the investigations at the College upon the cultivation of the sugar-beet as a profitable farm crop in Massachusetts, upon the agricultural and commercial value of fertilizers and the proper regulation of their manufacture, upon the circulation of sap and other phenomena of plant life, and upon the economical and certain production of crops by the use of definite prescribed quantities of plant food, were in each case sufficiently valuable to the State to justify the foundation and liberal support of the Institution.

The Botanical Department.

The interest in the study and collection of plants under the direction of President Clark, has been very decided. This has resulted in part from the stimulating effect of the investigations concerning the phenomena of plant life which have been going on during the last three years, and in part from the publication of a catalogue of plants growing within thirty miles of the College, as well as from the meetings of the Botanical Association of the Connecticut Valley. Prof. E. Tuckerman, LL. D., of Amherst, prepared this catalogue, with the aid of Mr. C. C. Frost, of Brattleboro', Vt., and generously printed it at his own expense. It contains the names and, in the case of rare species, the localities of all the flowering and flowerless plants of this region, so far as known, with the exception of the fresh-water *Algæ*.

The competition for the Hills prizes by the class of 1876 was more spirited than ever before, and the number of species collected and mounted was, in some cases, remarkably large, while the individual specimens were often nearly perfect. The committee of award consisted of Prof. C. S. Sargent, of Brookline, and Rev. H. G. Jesup, of Amherst, and after a careful examination of the best three herbaria, they decided to give the first prize of fifteen dollars to Joseph Mather Hawley, of Salem, N. Y., and the second prize of ten dollars to George Hewins Mann, of Sharon, Mass. The prize of five dollars for the best collection of specimens of wood, was awarded to George Lowell Parker, of Boston, who collected during the year 1875, eighty-five species of wood, and prepared a fine herbarium, containing seven hundred and forty-four species of plants, including about eighty species of *Lichenes.* He also had the good fortune to discover on the perpendicular cliffs of Rattlesnake Gutter, in Leverett, a locality of *Umbilicaria Dillenii* of very unusual size and fertility. One specimen measured fourteen inches by eleven, and was attached to the rock by a single slender stalk, a peculiarity from which the generic name is derived. Some of the specimens were of most venerable appearance, and covered over with perfect fruit, which is exceedingly rare on this species.

Four graduates have continued their botanical studies at the College, using as a text-book the admirable treatise of Professor Julius Sachs upon the morphology and physiology of plants.

Mr. D. P. Penhallow has made a great number of interesting observations upon the habits of growing plants, and done some excellent work upon the Knowlton herbarium.

In this connection, it may not be improper to mention the fact, that the extended account of the investigations in this department, published in the last volume of the "Agriculture of Massachusetts," was deemed of sufficient interest to warrant the republication of six thousand copies for gratuitous distribution by the State Pomological Society of Michigan.

The Durfee Plant House and the adjoining grounds have been well kept during the year, under the faithful and intelligent supervision of Prof. S. T. Maynard. He reports that the house now contains between seven and eight thousand plants, of fifteen hundred species and varieties, of which twenty-three hundred are either growing in the ground or in pots or boxes more than five inches in diameter. Twenty thousand bedding plants were propagated last season, and of these, fifteen thousand were set in the beds and borders of the College estate, and elicited much commendation from the numerous visitors who saw them. The sales of flowers and plants during the year amounted to $758.32, and about one-third of the grapes from the vineyard were sold for $265.16, the remainder having been destroyed by frost.

There are now standing in the nursery more than six thousand fruit and ornamental trees, embracing a large number of species. The vineyard contains about two thousand vines of thirty-two different sorts. In the orchard are thrifty trees of the best varieties of apples, pears, plums, cherries and peaches.

Considerable progress has been made in preparing the ground for the garden of Massachusetts plants, and a very tasteful arrangement of beds for hardy herbaceous perennials has been laid out and planted north of the propagating pits.

Prof. C. S. Sargent, Director of the Arnold Arboretum in Boston, has manifested great interest in the advancement of this department of the College, and has furnished without any charge some thousands of specimens, including several hundred species of trees, shrubs and herbaceous plants, many of which were not obtainable elsewhere. Appended to this Report is a list of his gifts.

A portion of the income of the Hills fund has been expended in the purchase of specimens for the Botanic museum, and of valuable books adapted to the wants of the department.

The President is still hopefully waiting for the fund of $50,000 for the endowment of the botanic garden, and for the graperies and the orchard and propagating houses, which are indispensable to a proper system of horticultural education and training at the College.

Officers and Students.

The conduct of the students has been most exemplary, and their attention to duty worthy of high praise. Cases of discipline have been of rare occurrence, and in every instance during the past year reproof and punishment have resulted in the improvement of those who received them. About twenty, mostly in the upper classes, have matriculated in the Boston University, and will thus become on graduation alumni of both Institutions. The desire for a higher course of study is quite manifest, and several seniors are pursuing Latin with the intention of obtaining by examination the degree of bachelor of philosophy from the University.

Professor Stockbridge has given the theoretical and practical instruction in agriculture, and his classes have taken a lively interest in his numerous experiments, upon which they have performed a portion of their manual labor. Appended to this Report is the Professor's statement concerning his discoveries in regard to the most economical mode of feeding plants. These experiments, continued through several years, have awakened a new interest in the subject of growing remunerative crops upon worn-out soils, especially in localities where barn-yard manure is not obtainable. It appears also to be demonstrated, that chemical manures may be very profitably used to supply deficiencies in the quantity or quality of stable-manure, the value which varies so greatly according to the nature and the food of the animals producing it, and the subsequent treatment to which it is subjected. If one-half of the apparent results shall be substantiated by the future' experience of the farmers of the country, then the money expended upon the College will yield a larger rate of interest than any other investment which the State has ever made. For the continuation of his investigations, the Professor ought to have $1,000 per annum for ten years.

The annual paper from Professor Goessmann is herewith presented, and will be found full of instruction. There can be no doubt that the excellent law regulating the sale of commercial fertilizers, under the official inspection of the Professor, has already accomplished most valuable results, and quite revolutionized the mode of their manufacture. As all packages are now required to have the guaranteed composition attached to them, it has become necessary for manufacturers, not only to use some intelligent skill in their processes, but also to sell their articles for a price approximating at least their real commercial value. The principle of the law has compelled the agents of the Peruvian government to rectify their guano, and prepare it of a uniform standard. So that now a rectified guano is sold at sixty dollars per ton, which by the guaranteed analysis is worth seventy, and is doubtless a better article than the average of the crude guano which has heretofore been furnished for eighty dollars per ton.

Is it too much to ask, that some credit be allowed the College for its work in this direction? To assert that the present law will actually add to the agricultural products of the State a net value of more than $100,000 per annum, is but a moderate estimate of its beneficent effects. Under its influence the farmer will purchase more and better fertilizers, and his crops will be of higher quality, more abundant, and more profitable. Yet there are those who seem to prefer "ignorance, our common curse," to accurate knowledge, and declare the College to be an "elephant" for which the State has no use.

The importance to the Commonwealth of utilizing the salt marshes along the coast for agricultural purposes, as has been done so successfully in many other countries, is too obvious to require comment. The valuable reports upon the composition of the soil and beach sand at Marshfield, and the chemical changes occurring as the result of diking, which have been prepared by Dr. Goessmann for the Board of Agriculture, will undoubtedly result in the reclamation within a short time of large tracts of a similar character with those under experiment at Green Harbor. Some useful information upon this matter will be found in the Professor's paper appended to this Report.

Following this is a brief statement of some inquiries concerning the physiological effect of special chemical fertilizers upon the quality of fruits. This investigation is one of great promise, and may enable us to modify at will the relative proportions of acid, sugar and ether in our apples, pears and grapes, and thereby, not only to produce practically new varieties of superior quality and market value, but possibly to cultivate with great advantage many sorts which, though highly esteemed in other countries, have not hitherto succeeded with us.

The only change among officers of instruction the past year occurred in the military department by the expiration of the three years for which Lieut. A. H. Merrill was detailed, and the consequent appointment by President Grant of Lieut. C. A. L. Totten, as professor of military science and tactics.

The battalion of cadets was left by Prof. Merrill in an admirable condition as to drill and discipline, and his urgent recommendation in favor of a complete dress uniform was adopted by the College immediately after his departure in March. The work of the department was undertaken with hearty enthusiasm by Prof. Totten, and his success has been remarkable. If the State will furnish the means required to educate two hundred students continuously, without any charge for tuition, there will graduate from the College every year a large class of young men thoroughly educated and trained to serve as officers or soldiers in the militia. No intelligent person who will read the report of the Professor on this department, and then come and see what he is really accomplishing, will hesitate to admit that it is impossible for the State to apply money for the promotion of military training more wisely than to furnish annually the small sum necessary to the support of the College in its present form and efficiency.

Professor Cressy has maintained a good degree of interest in the veterinary department, and has lectured on topics of great importance to farmers and the general public in many towns of Massachusetts, Connecticut, Vermont and New Hampshire.

The most urgent want of this department, is money for the purchase of materials for preserving specimens, especially of morbid anatomy, and for the preparation and exhibition of a collection of comparative osteology.

Professors Goodell, Parker and Graves, and Farm Superintendent Dillon, have discharged, with fidelity and success, the duties of their respective departments. The report of the latter shows what crops have been cultivated, and the general character of his work. The farm is in the main well stocked and equipped, and must hereafter cease to be a burden upon the treasury.

Anniversary Exercises.

The public exercises of the fifth anniversary week began on Monday, June 21, with the examinations of the three lower classes in the studies of the term. The examining committee appointed by the Board of Agriculture, consisted of Professor C. S. Sargent, of Brookline; Hon. E. H. Bennett, LL. D., of Taunton, and H. S. Goodale, Esq., of Mt. Washington. All of these gentlemen manifested much interest in the performance of their duties as Visitors of the College throughout the year, and their report, presented to the Board of Agriculture at its annual meeting, will be found in the "Agriculture of Massachusetts" for 1875, by Secretary Flint.

The Farnsworth Prize Declamations occurred on Monday evening, and were honored by the presence, for the first time, of the founder, Isaac D. Farnsworth, Esq., of Boston. The successful competitors for the gold medals were Atherton Clark, of Amherst, from the sophomore class, and Charles Francis Coburn, of Lowell, from the freshman class. The silver medals were awarded to David Henry Benson, of Bridgewater, from the sophomore class, and David Erastus Baker, of Franklin, from the freshman class. The following gentlemen kindly served as judges on the occasion; viz., Professor H. H. Neill, of Amherst College; Rev. J. L. Jenkins, of Amherst, and Rev. E. P. Dyer, of Shrewsbury.

The examination before the Board of Agriculture for the Grinnell prizes, founded by Hon. William Claflin, of Newton, was held Tuesday forenoon, June 22. Col. Eliphalet Stone, of Dedham, Major Jonathan Ladd, of Lowell, and Hon. Allen W. Dodge, of Hamilton, constituted the committee of award. There were fourteen competitors, and the exercises were of an instructive and interesting character. Printed lists of twenty-three agricultural topics, were placed in the hands of the committee and each student was allowed seven minutes in which to discuss the one assigned him, and to answer such pertinent inquiries as any person present might make. Besides this oral examination, a written one had been previously held, the papers from which were also submitted to the committee of award. The first prize of fifty dollars in money was given to Jabez William Clay, of Westminster, Vt., and the second prize of thirty dollars to Andre Arnold Southwick, of Mendon, Mass.

While the committee were quite unanimous in their decisions, still they felt that many of the unsuccessful competitors had done exceedingly well, and deeply regretted their inability to do more than to express their great satisfaction at the evidence given by all the young men of thorough training in the theory and practice of agriculture. They were, however, entirely relieved of their trouble when the large-hearted chairman, Col. Stone, handed sixty dollars to Prof. Stockbridge, with the request that it be divided equally among the twelve for whom there were no other prizes. The effect of the Grinnell prizes in stimulating the graduating class to review their course in agriculture with thoroughness and enthusiasm, has been very marked ever since their establishment.

Tuesday afternoon was devoted to the literary exercises before the Social Union, consisting of an address by President W. F. Warren, D. D., LL. D., of Boston University, and a humorous agricultural poem by H. S. Goodale, Esq., of Mt. Washington, Mass.

Address of President Warren.

After some pleasant allusions to the years of his early life, which were passed on a farm within sight of the College, he announced as his theme, "Weather Probabilities of American Agriculture."

Two conditions of society were declared to be unfavorable to a prosperous agriculture, both of which are usually encountered by the farming population in the history of every people. The first of these conditions exists where other forms of industry are so undeveloped or depressed, that the tillers of the soil are the only class rightfully possessing, as the sole producers of wealth, abundant and unfailing supplies. All other classes must subsist on this property of the farmers, and having nothing to give in exchange for it, they seize it by force. This state of anarchy and violence leads to feudalism, when the farmer submits to the exactions of his chieftain for the sake of protection from indiscriminate robbery. In the enjoyment of this security, improvement in agriculture becomes possible.

The second unfavorable condition occurs later in the life of nations, and is seen where the farming community is regarded as less respectable or less fortunate than the other classes of society. In the progress of civilization there comes a time when the plain countryman looks with envy upon the comfort and elegance of city homes. As he walks through the marts of trade, and sees the products of every clime, the fruits of every industry, the triumphs of every art, his own simple, monotonous life in the hills seems meagre, poverty-stricken, unsatisfying in every respect. How can he resist the temptation to send his boy down to the city to get an education, or a trade, or some business position, that will make him in due time a happy citizen, if not a millionaire?

Referring to American agriculture, the orator said it had never experienced the untoward influence of the first unfavorable condition, because the early colonists came from civilized communities, bringing with them not only plows, hoes, and sickles, but also the lathe, the loom and the printing-press. The various occupations and professions of our people thus developed simultaneously with mutual benefit to all.

Having thus escaped the first danger to the interests of our agriculture, have we any reason to hope we may be delivered from the second? Are the deep, strong, unconscious drifts of American life tending to diminish the desirableness of the farmer's calling as compared with other industrial pursuits? If they are, and if no corrective agencies can be brought in, American agriculture has seen its best day. It is doomed to become more and more servile and ignoble, and not all the eulogies which anniversary orators and poets can lavish upon it can save it!

In our American society, we may discover some peculiar characteristics which inspire hope concerning the maintenance and the improvement of our rural life. Let us glance at a few of them for the reassurance of our faith in a better future.

First, we may consider the ennobling effect upon the individual among the masses of the people of the American system of church polity. Whoever would have religious privileges, knows the State will not, as in other countries, provide them. Whoever wishes his children brought up in a Christian way, and with Christian associates, must put his hand in his own pocket and summon his neighbors to do the same, that the church may be built and the ordinances of religion provided for. The members of all classes in society must be ready to give time and money and thought and prayer to keep up the Christian life and organization. Never have the agricultural communities of the Old World enjoyed such uplifting stimulation as this, and the broadening, liberalizing influence exerted upon our people by this religious responsibility and work is beyond all computation.

A second great defence of our farmers against the belittling tendency of the division of labor and the depressing influence of caste, may be found in the political freedom and power of every American citizen, however humble his occupation or limited his abilities. The universal ballot necessitates intelligence, quickens ambition, calls out discussion, grinds all class distinctions to powder. Wherever it exists, the progress of industrial organization can never wholly mechanize men.

Another defence lies in the unprecedented mobility of our population. It is very common to deplore the restlessness with which the young men of New England yearn to see the great world; but you cannot lessen it without imbruting their active minds, and deadening their quick imaginations. The impulse cannot be suppressed; true wisdom will teach us to train and utilize it. The reason why this passion for roving in search of knowledge, wealth and power, hitherto unattainable on the farm, is so strong in our young men as compared with farmers' sons of history, is found in part at least in our system of general education. The true remedy for this unrest consists, not in lessening the intelligence which has given it birth, but must be sought in a direction exactly opposite. The magnet which draws away from farm life can be made to draw with equal strength towards it. This is the grand experiment which our age is trying. One hundred years ago, this very year, it began in Europe; with us it dates back hardly a generation. The experiment is higher agricultural education; its highest organ and instrument the nationally endowed agricultural college.

The benefits of this new educational movement are already great, and are destined to be greater. Apart from the direct improvements which it has wrought in practical agriculture, it has wonderfully diversified the resources and opportunities of the calling. It has opened up new and honorable careers to youthful ambition, thus retaining in sympathy and active coöperation with the profession thousands who otherwise must have been lost to it. Time was when the young man whom genius and taste predestined to a teacher's career, was necessarily carried away from living fellowship with his old friends and kindred on the farm. Now he can follow the bent of his aptitude, and still identify himself more closely with country life and agricultural progress than had he followed the plow life-long upon his native hillsides. Once the youth born for eminence as an original investigator of nature found no position, where the call and pressure would be constant to utilize the fruits of his experiments and studies in the elevation and improvement of the earth-tilling art: now how great the need of just such men to ground the art on scientific methods, and train the new generation of farmers! Once the grand career of authorship carried its aspirants, of necessity, to spheres of life and thought removed by long intervals from agricultural sympathy; now no field of literature offers more tempting tasks or compensations than the agricultural. So in the direction of mechanical invention and appliance, in the direction of biological investigation, in the direction of breed-studies and breed-improvement, in the direction of new forms of agricultural manufacture and agricultural commerce, numberless new opportunities and employments have been opened which all go to diversify, to enrich, and to render attractive the farm life once so monotonous.

And one grand, beneficent function of the Agricultural College is the introduction of its students to all these inviting and useful careers before exposure to diverting or competing influences.

Let us, then, be thankful that education no longer consigns a man to one of the trinity of the so-called learned professions. The world has come to see that if trained intellect has elevated and ennobled three callings, it can elevate and ennoble all callings, notably that one which seems fundamental to every other.

Altogether, then, the "Weather Probabilities of American Agriculture" are far from discouraging. The law of Old World society is not the law of ours. With a free church to arouse and develop spiritual manhood; a universal ballot, training all to statesmanship; a mobile population, precluding all local and vocational crystallization; and last of all, an educational system, adapted so to broaden and heighten the calling as to make room in it for the kingliest of men,—there seems no reason to doubt that in America the farmer's vocation is destined to steady improvement and increased honor.

Graduation Day.

The forenoon of Wednesday, June 23, was devoted to the inspection of the farm, stock and buildings, and the review of the battalion of Agricultural Cadets by His Excellency Governor Gaston. The usual artillery salute upon his arrival brought together on the parade-ground a large number of distinguished visitors, including His Honor H. G. Knight, members of the Executive Council, the Legislature, and Board of Agriculture, as well as a multitude of other friends and patrons of the College.

The appearance and evolutions of the cadets, under the command of Professor Totten, U. S. A., elicited much praise from the spectators. The new West Point uniforms were especially admired, and imparted to the battalion a fine military style.

At the annual meeting of the Associate Alumni, Mr. W. H. Bowker, of Boston, was elected president, and Prof. S. T. Maynard, of Amherst, corresponding secretary.

In the afternoon the usual graduating exercises were attended in the military hall by a numerous audience. Eight theses were pronounced by members of the senior class, the valedictory addresses being delivered by William Penn Brooks, of South Scituate.

The public exercises of the anniversary were concluded by the presentation of the diplomas to those candidates for the degree of bachelor of science who had been recommended by the faculty and approved by the Trustees.

His Excellency William Gaston, President of the College Corporation, conferred the degrees and made the following address :—

Gentlemen of the Graduating Class :

Your labors in these academic halls are now completed; the labors of preparation are over, and the real and earnest duties and work of life have begun. You are now about stepping on the threshold of active life to meet its cares and its toils, its struggles and its responsibilities. No man's life can be a series of continued triumphs. In all your struggles, with the use of your best energies, you must meet with alternating success and defeat, and every well-met struggle will give you strength for future conflicts; and if you meet all the difficulties which surround your paths in the spirit of generous and earnest manhood, ultimate success must await you all.

Gentlemen, you have especially been taught the science of agriculture; the farms of New England have for more than two centuries, under the providence of God, yielded to the severe labors of man the fruits of the earth. But these have not been the best results of New England farming; these homes, surrounded by the influences of the church and school-house, have sent forth men who have been leaders in the armies of civilization and peace. Of these men I trust you will become worthy and equal successors. I trust that you will carry the banners which they have borne in triumph into the fields that are yet to be subdued by the forces of religion, of learning and of civilization.

Permit me, gentlemen, in the language of another, to bid you "go forth fearlessly and resolutely to the warfare of life, and may the blessings of Providence guide you aright amidst its various perils. Temptations will assail you; shake them off like dewdrops from the lion's mane. Dangers will beset you; encounter them without dismay." And finally, gentlemen, when the fight waxes hottest, when the whole head is sick and the whole heart faint, and all things else shall seem to fail, then raise your eyes aloft and behold emblazoned on the azure field of the firmament that wondrous banner which the first Christian emperor saw, or thought he saw, in the midst of battle beaming gloriously upon him through the surrounding clouds, the banner of religion, and read upon it, as he did, in letters as bright as the flashes of the forked lightning, the assurance of success: "By this, conquer."

Respectfully submitted,

By order of the Trustees,

W. S. CLARK, *President.*

AMHERST, January, 1876.

REPORT

ON

EXPERIMENTS IN FEEDING PLANTS.

By Prof. LEVI STOCKBRIDGE.

EXPERIMENTS IN FEEDING PLANTS.

In my last annual report I called attention to a series of experiments in feeding plants which had been carried on for some years by me, and to the results and teachings of the same. Those experiments have been continued during the year 1875, and much time and labor expended to verify and correct our opinion, if need be, of the law of natural proportions between the different parts or organs of plants, that we might be guided by exact data in our attempts to apply the law of plant nutrition. The publication of that report attracted so much attention, and elicited such extended inquiry concerning this whole matter, as to its facts, principles and practice, that it is deemed necessary to give in the present report a detailed statement, not only of the experiments, but of the law of plant nutrition, our mode of applying it in practice, and its indication of the correct system and rules of producing crops in general agriculture. Such statement I shall attempt to make in the following pages, avoiding a repetition of my former report, except where it is necessary to make the present intelligible.

Experiments of 1875.

We have tried experiments the past year with Indian corn, potatoes, oats, grass, field beans, turnips, garden crops, and tobacco. The results throughout the series are nearly identical with those of 1874 and 1873. The plots of land planted to potatoes and oats, manured and unmanured, were the same used for that purpose in 1874. With oats, a sufficient quantity of my compound for oats was applied to produce 50 bushels of grain per acre and its natural proportion of straw more than the yield of the soil without manure, and the grain sown the 28th of April. The crop was harvested the 25th of

August, and, after drying, was threshed and weighed, and the yield of grain found to be, on the unmanured plot, 15 bushels per acre, and on the manured plot 60 bushels, or five bushels less than the anticipated quantity.

A sufficient amount of my mixture for potatoes was applied to one plot to make 100 bushels of tubers and their natural proportion of stalks per acre more than the natural product of the land. Peerless potatoes were planted the twenty-fifth day of May, and harvested the 9th of October. The yield on the unmanured plot was 128 bushels per acre; of these, 40 bushels were good marketable potatoes, and 80 bushels were small, unripe, and not fit for table use. The manured plot yielded 289½ bushels, of which 59 bushels were small, and 230 bushels fit for the table. The increased yield on the manured plot was 151½ bushels, or 51½ bushels more than the anticipated quantity.

I applied a sufficient quantity of the materials for corn to produce 50 bushels of grain per acre and its natural proportion of stover more than the yield of the soil unmanured, and planted the plot the 24th of May, with a variety known locally as the Comins corn. It was harvested the 25th of October, and, after being dried, the yield was found to be, on the unmanured plot, $25\frac{1}{9}$ bushels per acre of inferior, poorly filled corn. The manured plot yielded 74 bushels of fully developed, perfect corn, or $1\frac{8}{9}$ bushels less than the anticipated quantity.

The experiment with the hay crop was tried on a piece of old and badly bound turf, and the fertilizer was applied in the spring. A supposed sufficient quantity was used to produce one ton of hay per acre more than the natural yield of the land. The grass was cut twice, first on the 10th of July and again on the 12th of September. The yields of both crops on the unmanured plot was 1,800 pounds per acre. The manured plot yielded 3,750 pounds per acre, or 1,950 more than the manured, it being 50 pounds less than the expected amount.

In the experiment with field beans, the proper quantity of the mixture for beans was used to produce 20 bushels per acre and the natural proportion of straw more than the yield of the soil without manure. The variety planted was the common white oblong bean. The crop was planted the 20th of May, and harvested the 1st of September. The yield on the unmanured plot was four bushels per acre. On the manured plot it was 25 bushels per acre, or one bushel more than the quantity stated.

Experiments by Others.

In the above experiments, the soil used was the same kind described in my last report, and was in plots of one-eighth or one-fourth of an acre. But to obviate any objections which might be urged against the practical value of experiments tried on such small areas, and with so much care and attention, two pieces of comparatively waste land were secured outside the college farm to experiment with corn on a larger scale and in a more indefinite way. One of the plots contained 154 square rods, and the other 193 rods. To these plots, which were in bad physical condition, I applied the proper material for corn sufficient to produce 50 bushels of grain and the natural proportion of stover per acre, disregarding the natural yield of the land, and with no unmanured plots. The smaller plot yielded 94 bushels of corn, or 98 bushels per acre. The larger one gave 90 bushels of corn, or within a fraction of 75 bushels per acre. Thus the result of using this material as a manure in the method of ordinary agricultural operations, varies little, if at all, from the results in the more carefully conducted experiments. If, however, the above given case does not substantiate the fact, there are other evidences in abundance of its truth. The publication of my first report on these experiments produced great inquiry for detailed practical information respecting them, for the purpose of trying or of adopting this method of manuring. The information sought was given, and during the season I have found, partly by observation, but principally by general report, that many farmers in this and other States had been induced by the information to procure the fertilizer and apply it to their crops. In the aggregate, several hundred acres must have been treated in this way. I have had opportunity to see but few of the crops grown, yet thinking it important to know something of the results obtained, as it was in fact a part of this series of experiments, I communicated with several gentlemen in different sections, and asked for the favor of a report. Many such have been received, and below, in as succinct a manner as possible, I give a few of them, which are practically like all the rest.

Mr. H. C. Comins, President of the Hampshire County Agricultural Society, and a resident of Hadley, states, that, according to directions, he procured enough of materials to make 50 bushels of corn, and applied it to a measured acre of very good land, but which had not been manured or ploughed for six years. No other manure was used. He harvested 93 bushels of corn from the acre.

Hon. A. C. Parsons, of Northfield, writes that he procured $30 worth of the articles recommended for corn, and applied them to an acre of land that was little better than a sand-bank, and had previously borne nothing. Through the season the corn on this land looked and grew better than the corn on his best land where he ploughed in a heavy green sward and applied 40 bushels of unleached ashes per acre. The yield was 103 bushels of ears.

F. J. Stockbridge, of the same town, replies as follows: He procured in New York, as directed, the materials for one acre of tobacco, at 1,500 pounds per acre; for three acres of corn, at 50 bushels per acre; and for one-half an acre of potatoes, at 100 bushels per acre; intending in each case to produce that quantity more than the natural yield of the soil. Having thoroughly pulverized and mixed the substances on his barn floor, he applied that for tobacco on average land. The crop on it was better through the season, and worth more at harvest time, than the rest of his crop which grew beside it and was well manured with yard-manure. The crop was on the poles, and not weighed at the time of the report. The materials for corn were used on poor, plain land, that would not bear anything without manure. The yield on the three acres was 167 bushels of corn, or about 55 bushels per acre. The compound for potatoes was used on poorer land (if possible) than that for corn, but the half-acre produced 65 bushels of large, smooth, excellent potatoes.

Mr. H. L. Phelps, of Southampton, replies that he procured and applied the materials recommended for grass. The land had not been ploughed for 20 years, or manured for three years. He used enough to make two tons of hay per acre more than the natural yield, and he harvested $3\frac{1}{2}$ tons.

Hon. Hinsdale Smith, of Springfield, writes that he purchased in New York, as directed, the substances in sufficient quantity to grow 50 bushels of corn per acre on 20 acres. It was all used, one-half of the land being stiff clay and quite rough, and the remainder good corn land. The crop on the clay was light, on the other land very heavy. He harvested 45 bushels per acre for the 20 acres. He thinks the experiment a success, and has ploughed 30 acres of better land this fall on which to repeat the trial next year.

Mr. E. F. Bowditch, of Framingham, says he procured and applied the materials for corn to produce 75 bushels per acre on 12 acres. The committee who examined the field, and tested portions of it, estimated the yield at 115 bushels per acre. His own estimate was 90 bushels per acre, at a cost of 40 cents per bushel, and he intends to plant 30 acres in the same manner next year.

Mr. E. H. Judd, of South Hadley, obtained the materials and compounded them for potatoes, but by mistake used *muriate* instead of *sulphate* of potassa. The land was sandy loam, in fine condition. The yield was large, not less than 400 bushels per acre of fine-appearing potatoes, but their cooking quality was quite inferior.

Failures.

So far as direct reports have been received, or as rumor tells, farmers trying this method of feeding plants have been more than pleased with the results obtained, except in two cases, which they consider absolute failures. As these cases are suggestive and instructive, I report them. The experiments were in the towns of South Hadley and Westfield, and as the facts in all their general and minute details are exactly alike, the report of one is that of both.

C. F. Fowler, Esq., of Westfield, says he procured the materials and compounded them for potatoes, in quantity sufficient for 100 bushels per acre in addition to the natural yield of the land. The application was made to one acre of land, *the soil of which was coarse sand with an open gravelly subsoil.* The potatoes started finely and made a good growth of tops early in the season, but at harvest time few tubers were found, and only 40 bushels were taken from the acre.

To these two experiments I shall again allude before closing this report, but passing over these for the present, it does not appear extravagant to say that the entire series on the college farm, on adjoining lands, and in the various localities named, are identical in result, and that there is nothing in this method of feeding plants so intricate, or requiring so much intelligence and skill, that it cannot be successfully practised by the average farmer. These experiments were not originated for the purpose of substantiating any previously conceived notions or theories of plant nutrition, or method of feeding plants, but in the earnest hope of discovering some method by which the supposed laws of nutrition could be made practically beneficial in the production of crops, supply in a measure the great deficiency of barn-yard manure, and restore fertility to our worn-out fields, with other substances than *that* as the leading material. They have now been continued for seven consecutive years, and I trust are not without practical and valuable results, some of which I did not anticipate at the outset, and would hardly have believed to be within the range of possibility. In order that these or similar results may be attained by all the farmers of the State, it is now necessary that a more complete elucidation should be made of the general facts and principles, as well as of the minute practical details, of this method of feeding plants. But the experiments are by no means completed. There are many directions in which investigation should yet be made, but more particularly in search of economical results, and it is my intention to continue them in the future.

Data by which the Formulas have been Prepared.

To prepare a formula containing the natural nutritive elements of a given variety of plant, it is absolutely necessary to know the substances which have entered into the composition of that plant when it is perfectly mature, healthy, having been supplied with its natural food in sufficient quantity; and not only this, but to know the composition of its different parts or organs, for they are very unlike during growth and in maturity. That this composition may be intelligible to practical men, the technical terms of chemical analysis must be changed to those they understand; as, for instance, a certain number of bushels of wheat contain so many pounds of potash or lime, and the relative proportions between the different parts or organs of mature, well-fed plants, must be known. I have secured the former by taking an average of all reliable chemical analyses of our farm crops, and changing them to the form indicated, and the latter by averaging the results of many trials, of selected plants which gave indication of being in the above required condition. Below I give these ascertained proportions between the tops and roots or tubers of our root crops, and the roots, straw and grain of our cereal crops.

100	bushs.	of potatoes,	at 60 lbs.	℔ bush.,	require	360 lbs. tops,	air-dried.
100	"	of onions,	at 52 lbs.	"	"	153 lbs. "	"
100	"	of Swede turnips,	at 60 lbs.	"	"	175 lbs. "	"
20	"	of field beans,	at 60 lbs.	"	"	725 lbs. straw,	"
25	"	of oats,	at 32 lbs.	"	"	1,700 lbs. "	"
25	"	of buckwheat,	at 48 lbs.	"	"	1,550 lbs. "	"
20	"	of winter rye,	at 56 lbs.	"	"	2,300 lbs. "	"
25	"	of wheat,	at 60 lbs.	"	"	3,400 lbs. "	"
50	"	of Indian corn,	at 56 lbs.	"	"	4,100 lbs. of roots, stalks and cob,	air-dried.
100	"	of flat or English turnips,	at 60 lbs.	℔ bush.,	require	600 lbs. of tops,	air-dried.

The formulas on which the materials found in the composition of plants have been compounded for the experiments, are based on the above indicated analyses and proportions, and are given below. But their striking peculiarity of expression, which must have been apparent in the record of the experiments, I will explain before closing this report.

Potatoes.

To produce 100 bushels of potatoes per acre and their natural proportion of tops more than the natural product of the land, and for other quantities in like proportion, use—

Nitrogen,	21 lbs.	in the form of	Sulph. ammonia, 24 ℔ ct. dry salt, 105 lbs.
Potash,	34 lbs.		" potash 35 ℔ ct. dry salt, 225 lbs.
Phosphoric acid,	11 lbs.		Superphosphate, 13 ℔ c. soluble acid, 85 lbs.

Field Beans.

To produce 20 bushels of field beans and their natural proportion of straw, pods, etc., more than the natural product of the land, and for other quantities in like proportion, use

Nitrogen,	53 ℔s.	in the form of	Sulph. ammonia, 24 ℘ ct. dry salt, 265 ℔s.
Potash,	33 ℔s.		" potash, 35 ℘ ct. dry salt, 198 ℔s.
Phosphoric acid,	20 ℔s.		Superphosphate, 13 ℘ ct. sol. acid, 160 ℔s.

Buckwheat.

To produce 25 bushels of buckwheat and its natural proportion of straw per acre more than the natural yield of the land, and for other quantities in like proportion, use

Nitrogen,	37 ℔s.	in the form of	Sulph. ammonia, 24 ℘ ct. dry salt, 185 ℔s.
Potash,	50 ℔s.		Muriate potash, 80 ℘ ct. dry salt, 100 ℔s.
Phosphoric acid,	15 ℔s.		Superphosphate, 13 ℘ ct. sol. acid, 105 ℔s.

Mixed Hay.

To produce one ton of hay more than the natural produce of the land per acre, and in like proportion for other quantities, use

Nitrogen,	36 ℔s.	in the form of	Sulph. ammonia, 24 ℘ ct. dry salt, 180 ℔s.
Potash,	31 ℔s.		Muriate potash, 80 ℘ ct. dry salt, 70 ℔s.
Phosphoric acid,	12 ℔s.		Superphosphate, 13 ℘ ct. sol. acid, 95 ℔s.

Red Clover.

To produce one ton of clover per acre more than the natural yield of the soil, use

Nitrogen,	43 ℔s.	in the form of	Sulph. ammonia, 24 ℘ ct. dry salt, 215 ℔s.
Potash,	40 ℔s.		Muriate potash, 80 ℘ ct. dry salt, 80 ℔s.
Phosphoric acid,	11 ℔s.		Superphosphate, 13 ℘ ct. sol. acid, 85 ℔s.

Timothy Hay.

To produce one ton of timothy hay per acre more than the natural yield of the land, use

Nitrogen,	24 ℔s.	in the form of	Sulph. ammonia, 24 ℘ ct. dry salt, 120 ℔s.
Potash,	27 ℔s.		Muriate potash, 80 ℘ ct. dry salt, 54 ℔s.
Phosphoric acid,	10 ℔s.		Superphosphate, 13 ℘ ct. sol. acid, 80 ℔s.

Fodder Corn.

To produce Indian corn fodder, two tons per acre more than the natural yield of the soil, and in like proportion for other quantities, use

Nitrogen,	20 lbs.	in the form of	Sulph. ammonia, 24 ⅌ ct. dry salt,	100 lbs.
Potash,	66 lbs.		Muriate potash, 80 ⅌ ct. dry salt,	132 lbs.
Phosphoric acid,	16 lbs.		Superphosphate, 13 ⅌ ct. sol. acid,	128 lbs.

Oats.

To produce 25 bushels of oats and the natural proportion of straw per acre more than the natural yield of the land, and in like proportion for other quantities, use

Nitrogen,	23 lbs.	in the form of	Sulph. ammonia, 24 ⅌ ct. dry salt,	115 lbs.
Potash,	20 lbs.		Muriate potash, 80 ⅌ ct. dry salt,	40 lbs.
Phosphoric acid,	12 lbs.		Superphosphate, 13 ⅌ ct. sol. acid,	90 lbs.

Winter Rye.

To produce 20 bushels of winter rye and the natural proportion of straw per acre more than the natural product of the soil, and in like proportion for other quantities, use

Nitrogen,	25 lbs.	in the form of	Sulph. ammonia, 24 ⅌ ct. dry salt,	125 lbs.
Potash,	24 lbs.		Muriate potash, 80 ⅌ ct. dry salt,	48 lbs.
Phosphoric acid,	16 lbs.		Superphosphate, 13 ⅌ ct. sol. acid,	128 lbs.

Rye Straw.

To produce rye straw as a market crop, without the grain, and to obtain two tons per acre more than the natural yield of the land, and in like proportion for other quantities, use

Nitrogen,	10 lbs.	in the form of	Sulph. ammonia, 24 ⅌ ct. dry salt,	50 lbs.
Potash,	31 lbs.		Muriate potash, 80 ⅌ ct. dry salt,	62 lbs.
Phosphoric acid,	8 lbs.		Superphosphate, 13 ⅌ ct. sol. acid,	64 lbs.

Beets.

To produce 100 bushels of beets and their tops on a given area of land more than its natural yield, use

Nitrogen,	11 lbs.	in the form of	Sulph. ammonia, 24 ⅌ ct. dry salt,	55 lbs.
Potash,	25 lbs.		" potash, 35 ⅌ ct. dry salt,	155 lbs.
Phosphoric acid,	6 lbs.		Superphosphate, 13 ⅌ ct. sol. acid,	50 lbs.

Cabbage.

To produce one ton of green cabbage on a given area of land more than its natural yield, and in like proportion for other quantities, use

Nitrogen,	28 lbs.	in the form of	Sulph. ammonia, 24 ⅌ ct. dry salt,	140 lbs.
Potash,	12 lbs.		" potash, 35 ⅌ ct. dry salt,	75 lbs.
Phosphoric acid,	4 lbs.		Superphosphate, 13 ⅌ ct. sol. acid,	32 lbs.

The yield of cabbage on well manured land averages not far from 35,000 pounds per acre.

Indian Corn.

To produce 50 bushels of the grain and its natural proportion of stover to the acre more than the natural yield of the soil, and in like proportion for other quantities, use

Nitrogen,	64 lbs.	in the form of	Sulph. ammonia, 24 ℔ ct. dry salt, 320 lbs.
Potash,	77 lbs.		Muriate potash, 80 ℔ ct. dry salt, 154 lbs.
Phosphoric acid,	31 lbs.		Superphosphate, 13 ℔ ct. sol. acid, 248 lbs.

Wheat.

To produce 25 bushels of wheat and the natural proportion of straw per acre more than the natural yield of the land, and in like proportion for other quantities, use

Nitrogen,	41 lbs.	in the form of	Sulph. ammonia, 24 ℔ ct. dry salt, 205 lbs.
Potash,	24 lbs.		Muriate potash, 80 ℔ ct. dry salt, 48 lbs.
Phosphoric acid,	20 lbs.		Superphosphate, 13 ℔ ct. sol. acid, 160 lbs.

Swede Turnips, or Ruta-bagas.

To produce 100 bushels of turnips and their tops more than the natural yield of a given area of land, and in like proportion for other quantities, use

Nitrogen,	11 lbs.	in the form of	Sulph. ammonia, 24 ℔ ct. dry salt, 55 lbs.
Potash,	18 lbs.		" potash, 35 ℔ ct. dry salt, 118 lbs.
Phosphoric acid,	8 lbs.		Superphosphate, 13 ℔ ct. sol. acid, 63 lbs.

Onions.

To produce 100 bushels of onions and their natural proportion of tops on a given area of land more than its natural yield, and in like proportion for other quantities, use

Nitrogen,	11 lbs.	in the form of	Sulph. ammonia, 24 ℔ ct. dry salt, 55 lbs.
Potash,	9 lbs.		" potash, 35 ℔ ct. dry salt, 54 lbs.
Phosphoric acid,	4 lbs.		Superphosphate, 13 ℔ ct. sol. acid, 32 lbs.

Tobacco.

To produce 1,500 pounds of the dried leaf of Connecticut seed-leaf tobacco, with its natural proportion of stalks, more than the natural yield of the land, use

Nitrogen,	119 lbs.	in the form of	Sulph. ammonia, 24 ⅌ ct. dry salt,	595 lbs.
Potash,	172 lbs.		" potash, 35 ⅌ ct. dry salt,	1,075 lbs.
Phosphoric acid,	16 lbs.		Superphosphate, 13 ⅌ ct. sol. acid,	125 lbs.
Lime,	160 lbs.		Sulphate lime, 79 ⅌ ct. dry salt,	500 lbs.
Magnesia,	38 lbs.		" magnesia, 16 ⅌ ct. dry salt,	475 lbs.

The above formulas differ slightly from the one adapted to the tobacco of the South.

Form in which to obtain the Materials.

I have generally used the substances named in the form seen in the formulas, but this is not strictly essential. If used in the form of a salt, as above, it must be neutral. The nitrogen may be obtained from any substance containing it in ready availability and known quantity. The cheapest form in which suitable potash can be obtained is probably that of the muriate, and in this form it is adapted to the grass and grain crops, especially on moist, retentive land. But it is not suitable for tobacco, beans, and the root crops, injuring the burning qualities of the former, and the starch content of the latter, as will be seen by referring to the experiment of E. H. Judd, of South Hadley, as given in this report, where by mistake it was used, producing a very large yield of potatoes of inferior quality for table use. For these crops it should be in the form of sulphate. The per cents. of the elements in the compounds used in preparing the formulas as above, may not always be easily ascertained. But this is immaterial. The quantity of superphosphate to be used is based solely on its content of soluble acid, no regard being paid to any insoluble which it may contain, and all the compounds are better in a soluble state and immediately available. But care should be taken to avoid the mistake of Mr. Fowler, of Westfield, whose experiment with potatoes was a total failure, because, being in a soluble condition and applied to "*a coarse sand with a gravel subsoil*," the rains washed the elements away before they could afford the crop much nutriment. If Mr. Fowler had composted his materials with loam, he would probably have secured a crop.

How to Prepare the Materials.

The combining of the materials for use is simply a mechanical mixture. The lumps in them may be crushed on a floor or some other convenient place, and the whole intimately and thoroughly mixed with a shovel. But a much better and more efficient method is to have them ground together in a suitable mill.

Manner of Applying.

As a rule, this, like all other easily decomposed manures, should be thoroughly mingled with the surface-soil on tillage land. All that is to be applied to a given plot may be put on at one sowing, before the crop is planted, and then cultivated or harrowed in; or one-half may be applied at that time and the remainder later in the season, and cultivated and hoed in. I use the former method, but in either case due care should be taken that the substance does not come in contact with any planted seed, or the foliage of plants. When small quantities are used for hoed crops, the rows may be furrowed and the materials *strewed* in the furrow, but in no case should they be "dropped in the hill," even if deeply covered before the crop is planted. For lands permanently in grass, it should be sown on the surface as evenly as possible, and in the fall, before the ground is frozen. But very satisfactory results follow when applied in the spring, or for a second crop immediately after the first has been cut.

Yield of Crop corresponding with the Quantity Applied.

Allusion has already been made to the curious form of statement of the formulas. It is similar to one which might be made by a mechanic, that to cover the side of a building 30 feet long and 15 feet high it will require 450 square feet of boards. It would perhaps be preposterous to say, from our limited data, that the statement of the formulas in results can compare in exactness with that of the mechanic; but a few facts in the form of figures will show that in a few years it might approximate it very closely. In presenting this, I leave out of the account the reports of experiments tried by others, where they have generally given results in excess,—because in most of them there is an element of uncertainty about the natural yield of their land,—and take only my own trials, where the yield of equal plots, manured and unmanured, and the quantity and condition of the elements, are positively known. I take only such as have been tried more than one year.

Indian Corn.

PLOT.	Excess.	Deficiency.
	Bushels.	Bushels.
1873. Plot No. 1, ...	4.9	–
" No. 2, ...	5.0	–
" No. 3, ...	15.0	–
" No. 4, ...	4.1	–
1874. Plot No. 1, ...	–	0.75
" No. 2, ...	–	4.00
1875. Plot No 1, ...	–	1,10
" No. 2, ...	5.0	–
Result of three years, ...	34	5.85

Potatoes.

1873. Plot No. 1, ...	10	–
1874. Plot No. 1, ...	–	7
1875. Plot No. 1, ...	51	–
" No. 2, ...	5	–
Result of three years, ...	66	7

Oats.

1874. Plot No. 1, ...	–	10
" No. 2, ...	–	8
1875. Plot No. 1, ...	–	5
Result of two years, ...	–	23

The table shows that during three years, and on fifteen different plots, with three crops where all the elements of success have been supposed to be secured, the excesses of the statement of expected results have been 100 bushels, and the deficiencies 35.85 bushels, or the *excesses* exceed the *deficiencies* by 64.15

bushels. A discrepancy exists, though, on the right side for the farmer, but its cause can be determined with certainty only by continued experiment and investigation. In the case of the mechanic, if he, by mistake in calculation, procured 500 feet of boards to side the given building, instead of 450 feet, he would have a surplus for other work of the same kind; or if his careless or ignorant workmen did not have due regard to the manner of cutting and putting on the boards, there would be a deficiency in the covering. And this element of uncertain results operates with us in precisely the same way and to a greater extent. Supplying the plant with food is one thing; preparation and tillage of the soil, so that its organs can freely perform their functions, is a very different one, but all-important in the result.

Result of Physical Condition of Soil.

The physical condition of the soil, important as it is, may be considered as under the perfect control of the farmer, and should be first attended to, for unless it is, an experiment in feeding plants cannot be relied on to prove or disprove a fact in this direction. The experiment of Hon. Hinsdale Smith, of Springfield, is a case in point; on his ten acres of rough clay land "the crop was light"; on the soil in good condition, "very heavy." So far as the nutrition of the crop was concerned, there was no reason why that on the former should not have been as good as on the latter, and it probably would have been had it been dried and brought into a good pulverulent condition. Proper physical state of soil is therefore essential, in order that a fertilizer may have its due effect, and that there be no loss on either manure or labor.

Influence of the Variability of Seasons on Crops.

Farmers quite generally, if not universally, entertain the opinion (and act in accordance therewith) that whatever may be their *method* of manuring, or the liberality with which they supply manure, yet there is no certainty, or approximate certainty, of results. In their opinion, the "weather" overrules and controls all else. Not those sudden and great elemental changes which bring the untimely, killing frost, or the destroying drought, but those ordinary variations of seasons, which, by some supposed mysterious influence, augment or depreciate the average yield of crops. To acknowledge this as a fact is to admit that success in agriculture is controlled by the element of chance and accident, and not of principle and law, and that it is therefore a business in which no wise man would engage. In a recent lecture before the State Board of Agriculture, Rev. W. H. H. Murray expressed the opinion that "as a commercial business, that business is a failure which cannot with certainty predict its results." The expression has in it the elements of truth, and applies with as much force to the making of crops as to any other pursuit. But before concluding that chance and uncertainty are inseparably connected with agriculture, or control its results, it would be well to know the elemental influences which retard or accelerate the production of plant-nutriment, and whether we can ameliorate or control that influence when it is adverse to our interests. Plants are not nourished by the soil or the manures we mingle with it *as such*, but by certain substances contained in soils and manures after they have been freed from those compounds by chemical change. On an undecomposed soil, in the presence of undecomposed manures, the plant waits or starves for nutrition until the "weather" develops it. If now the season is cold and wet, and the interspaces of the soil closed with water, so that the air, with its warming influence to give vigor to roots; with its carbonic acid, ammonia, oxygen and ozone to hasten decomposition, cannot penetrate it; or if by severe drought, water in sufficient quantity for the same purpose is not present, we have just the condition of weather and results of which the farmers complain, though it is such that if absolute plant-food were present, the plant would grow on unimpeded by the influence. Cannot the farmer to a great extent manure his lands with plant-food, rather than the raw, coarse, undecomposed compounds more generally used? If he can and does not, he should cease complaining, and acknowledge that his ordinary "weather" crops are the result of his omission. His course of action should be controlled by the rule that only decomposed fertilizers, whether stable-manures or the substances used in these experiments, feed plants.

Effect of these Manures on Succeeding Crops.

But admitting that the use of the substances named as manures may very largely increase the crop to which they are applied, admitting that their use materially removes the element of chance, the cultivator propounds the questions: "Is not this done at the expense of the soil? Will not that be left sterile?" Thus far our experiments answer these questions decidedly in the negative, or rather they show that the soil is left in better condition than it was before being cropped by this method.

A plot manured in 1873 produced 85 bushels of corn per acre; without any other application it produced a large crop of oats in 1874, and a good crop of clover in 1875. A plot treated in the same way in 1874 produced 104 bushels of corn per acre. The normal capacity of the land at that time, as proved by a crop on an unmanured plot, was 34 bushels per acre. This manured plot was planted again with corn in 1875, without manure, and its yield was 64 bushels per acre, or 30 bushels per acre as the second result of the manure applied in 1874. Another plot manured and planted to corn in 1874 produced 62 bushels of corn per acre; the same plot manured with the same quantity of material and planted to corn in 1875, yielded 78 bushels per acre, an increase of 16 bushels per acre, which can only be accounted for on the supposition of the influence of the application made in 1874.

Lasting Manures.

Though the question seems to be answered with precision, that this method of manuring does not injure the soil, yet the farmer prefers a "lasting manure." Allusion was made to this fact in our last report, but as there has been no apparent change in this respect, I refer to it again. The farmer wants a "lasting manure." For what? Is it for his interest to use such? We are treating of the nutrition of plants, not of the general care and manipulation of the soil. Plant-food, whether in the form of yard manure or of chemical elements, is costly material. If the farmer has that of either kind which has cost him $50, or which has in it the nutrition for 50 bushels of corn, it is certainly better for him, so far as both principal and interest on the cost are concerned, as well as in the items of labor, that that cost should be returned to one crop rather than to incur the expense of tilling his land and harvesting three crops to obtain it. It is clear that he cannot afford to use a lasting manure at a high price. If, however, he can obtain certain cheap materials, as the nodules from Charleston Basin, simply ground, muck, and some kinds of lime, which, when applied to the soil, slowly and gradually decompose and indirectly fertilize it, he can afford to use them.

Cost of this Manner of Manuring.

The cost of growing crops by this method is one of much consequence, and should receive our attention. Assuming the cultivator has exhausted his home resources of fertilization, and yet has land that ought to be producing useful and valuable crops, can he, as a matter of profit, afford to purchase the substances named, and use them for that purpose? To answer this question, I take it in its simplest form, as the one in which it will be most readily understood. The substances used are to some extent commercial commodities, and subject to slight variation in price, which, however, is much more likely to depreciate than to be enhanced. But taking the price paid for materials used in experiments in 1875, the cost at the farm was 41 cents for the amount to produce a bushel of corn.

The value of a bushel of corn,	$0 75
Value of the 90 pounds of stover produced with it, at $8 per ton,	36
Total value of corn and stover,	$1 11
Cost of fertilizer,	41
Value of crop above cost of fertilizer,	$0 70

The cost of the materials for a bushel of potatoes is nine cents; with potatoes at 50 cents per bushel at the farm, the value of the crop is 41 cents per bushel more than the cost o the fertilizer. But there is another aspect to the case, and it is shown in the experimental plot which contained 154 rods of land and produced 94 bushels of corn.

Cost of fertilizer used on plot,		$20 50
94 bushels of corn at 75 cents,	$70 50	
4 tons stover at $8,	32 00	
Total value of crop,		102 50
Value of crop more than cost of fertilizer,		$82.00

That is, in this, which is an actual case, we have $82 to pay for the labor, interest and taxes, and this it should be noticed is without allowing for any improvement to the land, the advantage of which may be received in future crops. The gain here is in the natural yield of the land, which should be estimated in all cases; for the farmer, as a rule, should till no land the natural product of which will not pay its own taxes and for the labor bestowed upon it. In general practice, the profits may be more or less than in the case cited, but the prospect of profit by this method is full of encouragement. The two points always to be kept clear and distinct by actual accounts, are the profits and loss on the natural yield of land as compared with the cost of labor in tillage, interest and taxes, and the increased yield caused by the application of fertilizers compared with their first cost and their manipulation.

Where to Obtain the Materials.

The chemical compounds used in these experiments are not in common use, and are but l ttle known in agricultural communities; but since the discovery of the Stassfurt deposits and the increased importation and manufacture of sulphate of ammonia, they are obtainable in all our commercial centres. Though all traders in chemicals can supply them, it is better for the farmer to deal with those who import or keep them in large quantities for manurial purposes. As a necessary measure to prevent imposition in the manufacture and sale of these fertilizers, and to secure to the farmer the materials in suitable form and purity and correctly compounded according to the principles given, I have applied for and received a United States patent, covering the right to manufacture and sell fertilizers prepared according to these formulas. Under the authority of this patent, I have given to Mr. W. H. Bowker, a graduate of the College, and a dealer in this kind of merchandise, at No. 43 Chatham Street, Boston, the privilege, for one year, of compounding and selling them. He will also sell the materials, proportioned according to the formulas, without mixing them, in such quantity as shall suit the wants of purchasers, and I am quite certain he will honestly execute the trust reposed in him. The success of our early experiments, which led to our final result, is largely due to the assistance and coöperation of Dr. Goessmann, the chemist of the College, in testing the materials obtained, giving his opinion of the form in which they should be used, and in ascertaining the composition of the varieties of plants to be experimented with. The law of Massachusetts regulating the sale of fertilizers requires the guaranteed composition to be given on every package of all articles sold for more than $15 per ton.

Principles of Plant-Nutrition.

It remains to inquire whether the results which have been obtained are fortuitous and accidental, and therefore not reliable as guides in future and general practice, or whether they are the result of compliance with the principles of natural laws, will therefore endure, and should correct our present methods of practice. Whatever may be said of their application to practice, investigations of the basic principles of plant-nutrition are not new to us, or this country. Some of the ablest scientific investigators of England, France and Germany, under royal and imperial patronage, and with every possible advantage which abundant time and unlimited means could give, have employed many years in experimenting, investigating and studying it. Though later in this field of examination, the scientists of America have not forgotten or overlooked it, but, without government patronage or assistance, have, according to their individual means, performed much useful and important work. As a result of these investigations, the belief of men in relation to this subject has been in a transition state for nearly forty years, and these changes have been accepted only after long controversy and the most searching and acute investigation, oft repeated. The theory that for the nutrition of the plant there should be in the soil large supplies of matter of organic origin was disproved when it was found that many soils were very fertile with only two or three per cent of organic matter in their composition, while others were sterile with from ten to thirty per cent. The theory that the mineral elements were soonest exhausted from the soil by the production of plants, and therefore for permanent success the farmer need only supply the displaced minerals; and its antagonistic theory, that nitrogen, volatile and naturally in small quantity, was most quickly lost or consumed, and should receive the first attention, were in due time both displaced by the discovery that it was essential the farmer should supply both for the continued production of plants on the same land. The theory was promulgated that as a guide in feeding plants the soil should be chemically analyzed, and when thus its composition was known, deficient elements could be added to make that composition correspond with that of the plant it was desired to produce. But when it was discovered that the plant, though a more acute, observing and precise chemist than any human manipulator, might starve for want of substances which the destroying acids of the chemist proved to be quite abundant in the soil, and that, if it were a scientific fact it could not be availed of in general agriculture, it passed from the beliefs of men. As the result of inaccurate observations, other theories have been advocated and believed only to be discarded by the discovery of the certain fact bearing on the case. But pressed on by the vital importance of the case, inquiry has continued, fact after fact has been discovered, proved and admitted, until at the present time, with the exception of one or two points of minor importance, there is general accord among investigators respecting the principles of plant-nutrition, and the following is a concise statement of the same.

For the nourishment of the plant, both organic and inorganic matter are indispensable. So far as the *plant* is concerned, one class of matter is of no more importance than the other. All of the organic elements (carbon, oxygen, hydrogen and nitrogen) are absolutely necessary as the food of plants. So far as the *plant* is concerned, neither of these elements is of greater importance than another. A plant cannot be produced if either is absent. So far as the cultivator is concerned, that element which nature provides in least quantity in an available condition, and which the plant requires from him in largest proportional quantity, is of the greatest importance, and that is nitrogen.

The oxygen and hydrogen which the plant requires for food, are abundantly provided by nature. With its leaves and roots immersed in air and water, it can and *will* provide itself with those elements, without care or thought on the part of the farmer. Its required carbon is provided by the carbonic acid in the air and soil; the supply in nature is exhaustless, and the plant has the natural power to gather all it needs. Nitrogen it obtains from the ammonia and nitric acid of the soil and air, and *perhaps* from the elemental nitrogen of the atmosphere and the chemical combination of the elements of ammonia within its structure. But the supply is not equal to the demand, and the farmer must make up the deficiency. For food, and so far as the *plant* is concerned, each of the nine chemical elements taken into its composition are of equal importance; and the maximum crop, which will be the natural product of a given area of soil, will be determined by the minimum available quantity of either of the elements. The composition of the plant is the result, not of accident, but of design; and if it is produced in a normal and healthy state, one of the elements of its food cannot be substituted for another. Some of these elements are in most soils in large proportional quantity, and naturally become available with sufficient rapidity to meet the wants of the plant. The content of some in the plant is large compared with their available quantity in the soil, and by continued plant-production, there is of them, ere-long, a deficient supply. The substances in most soils in large quantity, when compared with the food-want of the plant, and in an available condition, are lime, soda, magnesia, sulphur, chlorine, silica and sulphuric acid; while those contained in most soils in small quantity in available form compared with the wants of the plant, are potash and phosphoric acid. These are soonest exhausted, and if cropping be continued, must be artificially supplied.

Plants are not new creations of matter, but reorganizations of material previously existing in soil and air which is held in various compound forms, and cannot be obtained by the plant until by the influence of chemical forces and root-action those compounds are transmuted into other forms and become solvent in the water of the air and soil. An intelligent analysis and examination of these principles will show that the experiments are entirely in accord with them, their result, what might have been predicted, and that they may safely be adopted as permanent rules of practice. Admitting this to be a fact, the conclusion may and has been drawn that your manure is a useless thing; that the farmer has "only to scratch his land, throw on the chemical stuff and harvest his 100 bushels of corn to the acre." But such and all kindred conclusions, whether urged in good faith or in derision, are utterly erroneous. All the principles and need of tillage, the necessity of securing the proper physical condition of soil, will yet remain. Barn-yard manure in general culture will still be king. For it is, and will continue to be, an unavoidable waste product incident to many necessary branches of farming,—a waste product of every form of dairying; a waste product of growing and fattening beef, pork or mutton; and a waste caused by the necessity of keeping teams to work our farms as well as to perform general transportation. It would be the acme of ignorance and thriftlessness not to preserve, husband and use this, and all the wastes of our slaughtering establishments; of all our horn, hoof, bone, hide and glue establishments; of all our woolen manufactories; of all our fisheries; and of the sewerage and cesspools of country, town and city. But after all this has been saved and utilized by application to our farms, a vast field will be left for the profitable employment of chemical manures, and the world is asking for the increased products.

The fair and legitimate conclusions which may be drawn from the principles as illustrated by the experiments are: That barn-yard manure, valuable as it is, is not the best material, or in the best form, in which to obtain the food of plants, if that is to be purchased at its ordinary market price. Because it is crude, coarse, undecomposed, heavy in consequence of its large content of water, which make the cost of transportation and application very large. Because it is not so readily available to nourish the plant, and does not produce such certain and immediate results as when the elements of nutrition are applied in a chemical form. The organic mass of yard manure is highly beneficial in the soil, by increasing its absorbing and retaining quality for water and the gases of the soil and atmosphere, and perhaps a developer and diffuser of certain mineral elements; but these ends can all be obtained more cheaply with muck and loam, as well as by the roots remaining in the soil and the turning in of green crops, while other and better substances are being used as plant-food. It is not the best manure for special crops, because if all the elements it contained were available, they are not often proportioned according to the feeding want of the plant we are producing; and in order to obtain the needed supply of the minimum element it contains, we must make application of the mass in such large quantities as to result in great loss of the unused elements which are in excess. And the conclusion is, that true economy forbids the general use of yard manure except in connection with certain known mineral elements, according to the known food-want of the plant to be produced. Manure in its fertilizing properties is quite equal to that of the crops of which it is a waste; therefore, as an example, if it is the waste of English or clover hay and Indian corn, it cannot be adapted to the growth of potatoes and tobacco, which are potash plants, and in composition unlike the hay and grain. Therefore, if small quantities of manure with some form of *potash* in sufficiently large amount to make the composition like the plant to be produced are applied, it is better and cheaper than to supply a large amount of manure to obtain the needed potash. It is also a fair conclusion, that to maintain or to increase the fertility of our farms it is not absolutely necessary or even desirable to keep any kind of stock simply or mainly to consume our crops, that they may be returned for fertilizing purposes.

Finally, if there is no great mistake in the principles and results, the conclusion must be drawn, that they solve one of the great agricultural problems of our time; a problem the solution of which has caused the greatest anxiety in all the densely populated countries of the globe, and one which has been a source of much apprehension here. In all the older States of the Union, our cities, both in number and population, have increased with unparalleled rapidity. The civic population increases faster than the rural, the consumers of food faster than the producers. From all the rural districts enormous streams of soil products, in the form of vegetables, grains, meat and raw material for manufacture, are pouring into these centres. These are the choice elements of the soil, the waste of which would maintain its producing power; but owing to our wasteful systems of sewerage, it is all, or nearly all, lost, and as a result these States have seen their agricultural lands producing less and less per acre of all our important crops, until millions of acres, once productive, have become so sterile that their crops will not pay the cost of their cultivation. The people of Massachusetts annually consume the products of 500,000 head of cattle more than are fed upon our territory, and our bread is much of it grown on fields 2,000 miles westward. All this because the food products of the people taken from the soil are not in any form returned to it. This cause has seemed a necessity,—one whose results could not be avoided, if we must depend on the waste products of our crops to support the producing powers of the soil. But chemical manures may supply the deficiency. They will produce plants of choicest qualities, and in luxuriant abundance. With profit to the cultivator they may be the means of covering our hillsides, valleys and plains with beautiful, bountiful crops of grass and grain, and at the same time restore their exhausted acres to permanent, pristine fertility.

REPORT

ON

WORK IN CHEMICAL DEPARTMENT.

By Prof. C. A. GOESSMANN, Ph. D.

REPORT OF CHEMICAL DEPARTMENT.

Besides various analytical incidental inquiries, the following subjects have engaged my particular attention during the past year:—

1. The extent and nature of some of our resources of material suitable for the manufacture of fertilizers; and the quality of the latter offered in our markets for sale.

2. Some of the chemical changes going on at present in the soil of the reclaimed marshes at Marshfield, Plymouth County, Mass.

3. The effect of some special articles of plant-food on the fruit of various cultivated and wild grape-vines.

In the following pages, I take the liberty of presenting a brief statement of the ideas which have guided me in my inquiries, and also some of the results obtained, leaving the details to future special reports.

I. Commercial Fertilizers.

The past year has been an eventful one in the history of the trade in fertilizers; much progress has been made towards the adoption of a sounder and more uniform basis in its business transactions. The sale by chemical analysis has been more generally introduced, whilst the prices of many leading brands have been reduced from 20 to 25 per cent. and more. A commendable effort on the part of many manufacturers could be noticed, to learn the particular wants of the farmers, and to improve the quality of their articles in order to satisfy the increasingly intelligent demands of their customers. Many farmers have adopted a more judicious course in selecting their fertilizers. The cheapness of the various brands of standard fertilizers is already more generally determined, as it ought to be, not merely by their relative price per ton, but by the peculiar condition and the relative amount of phosphoric acid, potassa and nitrogen they contain. The recognition of a proper distinction between the agricultural and the commercial value of any materials used for manuring purposes, has secured better chances to obtain them at their real market value, and has thus advanced a more satisfactory relation between dealers and consumers.

In making these remarks, I do not intend to state that there are no inferior articles now offered for sale; for they will be sold as long as farmers will rather listen to the indorsements of irresponsible parties regarding the results they obtained, instead of considering carefully their own situation and wants, and of rendering themselves as far as practicable familiar with the properties of a good quality of the particular fertilizer they propose to use. It has been the aim of the writer to treat upon these points in his official annual reports as State inspector of fertilizers as far as circumstances allowed. He felt quite confident, when urging the propriety of adopting some judicious law for the regulation of the trade in commercial fertilizers (January, 1873), that a proper supervision of this important branch of industry, accompanied by a periodical official discussion of the mutual relations and interests both of the manufacturers and dealers in fertilizers and the farmers, would also furnish a very efficient means of communicating to the former the wants of the latter. At the same time he believed a numerous class of practical farmers might be induced to listen to the exposition of the rational principles of modern agriculture, by introducing practical illustrations which demonstrate their bearing on the pecuniary interests involved in farming, who scarcely would feel disposed to appreciate a concise yet abstract enumeration of the principles which control the success of their industry. It is gratifying to be able, even at this early date, to assert, judging from the numerous communications received, and from the character of the inquiries made, that the fertilizer law will prove indirectly a valuable promoter of higher agricultural education, especially among those farmers who for obvious reasons cannot enjoy the advantages of agricultural educational institutions and scientific agricultural literature.

During the past year from fifty to sixty chemical analyses of various kinds of fertilizers have been made, partly in reference to certain resources of fertilizers, and partly in connection with the inspection of fertilizers offered for sale.

Potash Fertilizers.

The supply of the better grades of these salts has been less than the demand, though the general character of the qualities sold has been more satisfactory than in previous years. There is a fair prospect that with the coming spring a direct agency from the Douglas-Hall mines, in Prussia, will be established in New York City, which proposes to sell only in large lots and at factory rates to dealers. Parties connected with the enterprise have asked my opinion regarding the particular qualities desirable for our wants. I am informed that only high grades, both of sulphate and muriate of potash, will be imported. I have taken occasion to analyze a sample of the crude material, carnallite, which serves mainly for the manufacture of the Stassfurt potash fertilizers, and found it an excellent article of its kind. Prof. F. Bischoff, of Prussia, one of the most noted investigators and historians of the mining enterprise at the Stassfurt saline deposits, speaks highly of the quality of potash compounds found at the Douglas mines at Western Egeln. It seems but reasonable to assume that by ordinary care valuable potash fertilizers may be expected from these new mines and factories.

Peruvian Guano.

The trade in this fertilizer has at last been based on a chemical analysis, with a guaranty of the represented composition. The New York general consignees of the Peruvian government have adopted the course recommended in my last year's report. A rectified soluble Peruvian guano, with a guaranty of ten per cent. of soluble phosphoric acid, ten per cent. of ammonia (actual and potential), and two per cent. of potassium oxide, at a price of $60 per ton of 2,000 pounds, has been put into the market. The chemical composition, and the valuable form of the essential constituents, cannot fail to secure a liberal patronage for this new fertilizer, which is also one of the cheapest at present offered for sale. There will be, henceforth, two distinct forms of genuine Peruvian guanos in our markets; namely, *raw genuine Peruvian guano*, and *rectified genuine Peruvian guano*. The latter is expected to replace the former in a very satisfactory way. The raw Peruvian guano is offered at a reduced price,—2,240 pounds gross weight, at the depot, at $60 instead of $80, the price per ton in former years. The well-deserved universal indorsement of good Peruvian guano, and the quite reasonable charge per ton of both the raw and the rectified soluble guano, with guaranty of definite composition, with abundant resources to supply an increased demand, cannot but exert a beneficial influence on the entire fertilizer trade, by stimulating exertion on the part of dealers in ammoniated superphosphates to meet with success a more exacting competition. The days of the successful manufacture of old-fashioned low-grade superphosphates seem about to terminate. How soon this may be brought about depends, however, largely on the judicious selection of fertilizers on the part of the farmer.

Fish Fertilizers.

The commercial value of these articles depends largely on their relative percentage of moisture. There is a remarkable variation, not unfrequently sufficient to affect their general character seriously. Their mechanical condition, as a general rule, is more or less objectionable, being quite frequently so coarse as to prevent their speedy action. The rendering process is but little studied in reference to its peculiar effect on the fish refuse, particularly as far as it affects the amount of nitrogen left behind, and seems in all its main features to be somewhat primitive. A more general practice to manufacture a fish guano of a definite composition and a fine mechanical condition, is still a matter quite desirable in the interests of the future prosperity of this business. I have visited some of the chief localities of the fish-rendering industry during the past year, to study the current modes of operation, and collect suitable material for chemical examinations, in order to learn from experiment on reliable material what composition might be expected from a good fish guano obtained from the refuse of our menhaden fish-rendering works under their present management. I found by analysis, ten per cent. of moisture, from eight to eight and five-tenths per cent. of nitrogen, and from eight to eight and five-tenths per cent. of phosphoric acid. An article of this kind, well ground, would be worth in our markets, even at the present reduced prices, from $40 to $45 per ton. A well-prepared fish guano is one of our most valuable home-made fertilizers, being fully equal to the best animal dust, and is one of the very best substitutes for Peruvian guano. Our resources are apparently but slightly taxed, for the main bulk of fish refuse turned to account is still derived from one branch of fisheries,—the menhaden fish-rendering works. The refuse of the cod-fisheries and whale-fisheries of Northern Europe send tens of thousands of tons of superior fish guano into the markets of Central Europe. May we not ask why our resources of a similar character are permitted to go to waste?

II. Observations on the Soils of the Reclaimed Salt Marshes of Green Harbor.

The history and description of these marsh lands in connection with a short sketch of some successful attempts to cultivate the reclaimed salt marshes of Europe, have already been given in a previous report to the State Board of Agriculture, under whose direction my investigation has been made. For the past two years my attention has been directed towards the following important points :—

First. The general character of the soil in the above-mentioned locality, with reference to its physical and chemical properties, and its available sources of plant-food for future cultivation.

Secondly. The influence of a gradual removal of the strong saline water of the ocean, and its replacement by the fresh water from a creek, which passes through the diked lands on the spontaneous local vegetation, as well as on various crops which, as first attempts of a systematic cultivation, have been tried of late in different sections of the reclaimed marsh lands.

To ascertain the amount of available mineral plant-food in the soil, several samples of the latter were taken from different sections of the marshes, by cutting slices of it, three inches wide and six inches long, to a depth of two feet. Each sample was thoroughly mixed, then slightly calcined, and subsequently for several days treated at ordinary temperature with diluted hydrochloric acid, having a specific gravity of from 1.10 to 1.12. From 1,000 parts of the calcined soil were thus subtracted the following number of parts of the substances named :—

	I.	II.
Phosphoric acid, ...	3.900	3.700
Potassium oxide, ...	9.463	11.500
Calcium oxide, ...	6.588	8.200
Magnesium oxide, ...	5.080	3.200
Sesquioxide of iron, ...	20.000	67.000
Alumina, ...	62.200	86.000
Sodium oxide,.	24.200	29.150

Sample I. was taken in the upper portion of the marshes, and Sample II. from the central or middle section.

Tests for chlorine and sulphuric acid were not made, on account of the worthless results in the case of a calcined material like the above. The composition of the soil left no doubt about the fact that its latent resources are well qualified, under suitable condition, to support, in case of a judicious selection of crops, a remunerative farm industry. Considering it of interest to know whether the accumulated beach-sand in the vicinity of the reclaimed lands might profitably serve as suitable material for filling in, leveling, etc., if needed during their preparation fcr cultivation, I tested a sample, and found it yielding readily from one to two per cent. of lime and magnesia. A more detailed analysis of the beach-sand in that locality will be made as soon as time permits, for to know its entire composition is of particular interest, as it has entered largely into the formation of the soil in the marshes. Extensive ditching during the past year has confirmed my last year's predictions, that future observation would show that the level surface of the meadows is due more to the accumulation of vegetable residual matter of successive periods of growth, than to a uniform level of the soil, and also that the latter will be found to vary in regard to its chemical and physical condition in different sections of the marshes, as well as in its various layers. The materials of the several strata of the soil were observed to vary, here and there, in the same locality, in size and color; quite prominent appeared the occasional local accumulations of oxide of iron. The more or less permeable nature of the successive soil deposits has evidently largely controlled the removal of the saline waters, and is one of the principal causes of sudden changes in the character of the vegetation within a limited area.

As the quality of the water which permeates the soil affects most decidedly the quality of the vegetation it produces, tests have been made from time to time to ascertain the soluble constituents of the drainage waters of the marshes. The following results regarding the percentage of chlorine give some approximate idea of the amount of change which has taken place since the diking of the meadows. The amount of chlorine in 100 parts of water tested was found to be as follows, viz.:—

I.	II.	III.	IV.	V.
1.9407	1.7020	2.3195	0.1386	0.8282

No. I. represents the amount of chlorine contained in 100 parts of water of the Atlantic Ocean (Kerl).

No. II. refers to a sample of water taken from a hole dug for that purpose, from three to four feet deep, in the month of June, 1874.

No. III. refers to a sample taken in June, 1874, from the lower section of the marshes, showing unmistakable signs of stagnation, and thus *increased concentration* of the saline water of the soil.

No. IV. refers to water taken July, 1875, from a drain-ditch in the central portion of the marshes.

No. V. refers to water taken from the creek soon after some damage had been done to the sluice-gate, allowing an access of salt water.

These results need no further comment; they show that the freshening process is going on steadily, and that nothing but local stagnation can hereafter render success uncertain as long as the dike with its sluice-gate is kept in satisfactory working order.

The changes which the natural or spontaneous local vegetation has exhibited, wherever good drainage has been secured, is quite remarkable. Sedges and rushes have continually receded, and a variety of more valuable plants have taken their place. Sea spear-grass (*Glyceria maritima*, *Wahl.*) has spontaneously taken the place of samphire (*Salicornia herbacea*). Timothy (*Phleum pratense*, *L.*) and redtop (*Agrostis vulgaris*, *With.*) have since been successfully raised. Many other farm crops have been tried and gave satisfactory results. The experience of the past year, although somewhat marred by the ravages of grasshoppers, has only encouraged confidence in the ultimate success of the enterprise. To improve the chances of a speedy consummation of that result, it is desirable that a good general system of drainage for the entire area of the reclaimed marshes should be soon decided upon; and that the plow should be effectually used wherever the accumulated vegetable matter beneath the old sod becomes spongy in consequence of its present rapid decay, a condition which tends to destroy that uniform compactness of the soil which is so essential for the profitable cultivation of all farm crops.

III. On the Physiological Effects of some Special Articles of Plant-Food on the Quality of the Fruit of Certain Wild and Cultivated Grape-Vines.

The subsequent communication, being for obvious reasons of a merely preliminary character, consists mainly of a series of analytical results regarding the ash constituents of different parts of the Concord grape-vine during various stages of its growth. The investigation has been going on for several years, as far as its preparatory work is concerned, and is still confined to an inquiry into the normal relative amounts and the peculiar distribution of the mineral constituents in the important organs of this variety of grape-vine during different periods of its annual development. The information thereby obtained is designed to serve as a basis for experiments, which are to some extent already inaugurated, *to ascertain in case alterations in regard to the quality of the fruit should be noticed in consequcnce of a treatment of the vines with certain special articles of plant-food, whether they are really due to the introduction or increase of any particular mineral element or combination of mineral elements*, or must be ascribed to season, location, etc. It is a well-known fact that the absolute amount of the mineral constituents of plants of the same variety of one and the same species may differ widely, yet as a rule this does not necessarily alter the general character of the plants; whilst a change in the relative proportions of their various ash constituents rarely has been noticed without having affected the quantity of some of their organic constituents, as starch, sugar, etc.

Successful cultivation of some of our most important industrial crops furnishes unmistakable illustrations pointing towards the existence of influences like those proposed for a strictly analytical inquiry. Although I might cite in support of my proposition many well-indorsed observations of others, I prefer for the present to refer to my own experiments upon the College farm, in 1873, regarding the effect of different fertilizers upon plants raised from the same seed on the same piece of land. The amount of sugar in the beet-roots raised from my own seed under the influence of different fertilizing agents, was noticed to differ from 9.42 to 14.32 per cent. To produce similar results on our various cultivated fruits is no doubt a subject worthy of serious attention. The circumstances which favor ordinarily the increase of sugar in the fruits, improve frequently also the formation of the aromatic principles peculiar to the species.

I have selected the grape-vine for my observations because it furnishes an abundance of material for examination; and among our cultivated grape-vines I have chosen the Concord grape as being a hardy, not overcultivated variety, and thus in all probability more inclined to respond to a special treatment. Besides the Concord grape-vine, a few wild vines (*Vitis Labrusca, L.* and *Vitis riparia, Michaux*) are on trial.

The experimental field is at the upper end of the College vineyard, and is divided into two plots by several rows of grape-vines, which are left without any fertilizer. One division is treated with a composition of superphosphate of lime and potash saltpetre, and the other with high grade sulphate of potassa and kieserite or oxide sulphate of magnesia; this treatment has been continued for two seasons, beginning in the spring of 1874. Mr. D. P. Penhallow, a graduate of the College, being peculiarly well qualified for the task, at my solicitation, has observed closely with me all the noticeable changes. He presented the following report at the end of the last season, which I add here without any comment:—

"During the entire season the growth of the vines was so uniform, and the changes in their development so gradual, that at no time when observations were taken could anything more than ordinary vigorous development be noticed. All the vines exhibit a strong and healthy growth, for which the season was particularly favorable. During the early part of August mildew made its appearance on a few vines, but did not spread to any extent, the affection seeming to be strictly local, remaining in that part of the vineyard which was farthest from the shelter of the woods on the north. The vines under special treatment did not suffer at all from any form of fungus, though the season, especially in August, was warm and damp, and particularly favorable for the growth of all kinds of fungi. Three of the wild grape-vines produced fruit for the first time, though only a small quantity. Two resembled the Concord in all external characteristics, though the pulp was much more solid, and quite acid in taste (*Vitis Labrusca, L.*) The third bearing vine resembled the Delaware; the size of the fruit, however, was much larger, and it had a strong aromatic taste. (*Vitis riparia*, Michaux.) The berries were sweet, the pulp firm, the skin quite thin. The fruit of the Concord grape-vine which had been treated with special fertilizers had a remarkably thin skin, the pulp was less firm than usual, and the entire berry had apparently a more delicate taste. At the close of the season the effect of the fertilizers was quite apparent in the comparative growth of the vines. The branches were longer, the leaves were larger and of a deep green color as compared with the unfertilized vines. Many of these were very seriously affected at that period by phylloxera, which spread quite generally when the change of season began to destroy the leaves. The following analytical results are stated here for future reference:—

"I. One-year-old wood of Concord grape-vine, air-dry, contained in 100 parts, 2.069 per cent. of ash. (Penhallow.)

"II. Older wood of the same plant, air-dry, contained in 100 parts, 2.419 per cent. of ash. (Penhallow.)

"One hundred parts of these ashes contained the following relative amounts of the substances named:—

	I.	II.
Silica,	23.840—	22.285
Sesquioxide of iron,	8.530—	6.415
Oxide of potassium,	22.565—	15.210
of sodium,	?	?
of calcium,	9.740—	6.765
of magnesium,	4.280	4.546
Phosphoric acid,	14.065	5.226

"III. One hundred parts of air-dry seeds of the Concord grape left 3.07 parts of ash constituents, which contained (C. A. Goessmann),—

Silica,	0.009
Oxide of calcium,	0.738
of magnesium,	0.093
of potassium,	0.206
of sodium,	?
Phosphoric acid,	0.528

"IV. One hundred parts of air-dry stems of the Concord grape left 4.688 parts ash, which contained (C. A. Goessmann),—

Silica,	0.098
Oxide of calcium,	0.947
of magnesium,	0.396
of potassium,	0.980
of sodium,	?
Phosphoric acid,	0.832

"V. One hundred parts of the ash of air-dry skins of the Concord grape contained (C. A. Goessmann),—

Silica,	0.012
Oxide of iron,	0.008
of calcium,	0.574
of magnesium,	0.088
of potassium,	0.077
Phosphoric acid,	0.245

"VI. One hundred parts of ashes of fermented grape-juice of the Concord grape contained (C. A. Goessmann),—

Silica,	2.247
Oxide of potassium,	40.686
of sodium,	1.933
of calcium,	6.849
of magnesium,	6.238
of iron,	0.569
Phosphoric acid,	9.169

"VII. Tests for the percentage of grape sugar in the juice of the following varieties of grapes raised in the College vineyard (D. P. Penhallow, B. S.):—

1875.	Sept. 14.	Wild grape No. 2,	9.65	per cent.
	14.	Wild grape No. 3,	11.52	"
	15.	Wild grape No. 4,	4.15	"
	24.	Concord grape (not fertilized),	10.0	"
	24	Delaware grape,	12.96	"

REPORT

ON THE

MILITARY DEPARTMENT.

BY PROF. CHAS. A. L. TOTTEN, 1ST LT. 4TH ART., U. S. A.

MILITARY DEPARTMENT.

President W. S. Clark.

Sir :—I have the honor to submit the following Report :—

On the 11th of March, 1875, I was ordered to relieve 1st Lieut. A. H. Merrill, U. S. Army, who was on detached duty as professor of military science and tactics at this Institution. At the beginning of the summer term, March 25, I entered upon my present duties, receiving at his hands the battalion of cadets in a state of excellent drill and discipline, and the last senior class well grounded in the principles of field fortification. Since then the military duties have been actively carried out, both upon the drill-ground and in the recitation-room, and, I am gratified to state, with a marked show of growing interest, evincing a general and real appreciation of the true object of the military department. It is especially pleasing to make a satisfactory report of work accomplished, because it has been my constant aim to impress upon the students that it was not only a patriotic duty in return for government patronage, but a matter of education particularly important to the farming community as the final owners and protectors of the soil. Our country is not warlike in the aggressive sense, and our "peace military policy" is barely sufficient to keep the art of war alive within our borders. The colleges endowed by the land grant of 1862 are a part of this policy, and as such are peculiarly responsible for the honest fulfillment of the military requirements of that Act. The real value of a military education is a *fact* of history, and sooner or later has been recognized by every great nation. Congress has appreciated this, and has still further increased the facilities for such an education, by establishing certain free military professorships, one of which this

Institution enjoys. That a college, by an honest and determined policy, may do much towards the furtherance of military education, is certainly exemplified here. The time consumed by drills and tactical instruction is not only no loss to other departments, but does not much exceed that devoted by our neighbor, Amherst College, to gymnastics. Nor does it interfere with student-life so much as militia duties do with ordinary avocations.

The past year has been an important one to the military department in very many respects. The students have been kept quite busy, and by working with a will, have accomplished most satisfactory results. They have been called upon to appear in public several times as a military organization; once they were reviewed by His Excellency the Governor; they have once acted as an escort of honor, and twice they have had their tactical proficiency severely tested at special drills, before boards of visitors and military men of note; nor have they failed at these ordeals to acquit themselves with well-merited honor.

The aid rendered by a very efficient senior class in the transmission of elementary military knowledge to under-classes, has been very great. All of the responsible and important offices of the battalion are held by seniors, and the self-discipline and experience thence naturally derived is not only a means of realizing the object of the department, but as a matter of individual education is equally valuable. Four members of this class have been appointed to staff positions as assistant instructors in ordnance, signalling, artillery and infantry, respectively, thereby considerably lightening the labor of the professor, and enabling double the quantity of work to be accomplished.

The importance of adopting a complete uniform was clearly set forth in the last report of my predecessor. By authority of the trustees, choice was made of one similar in all respects to that worn by cadets at West Point, and, as predicted, its neat military appearance has increased tenfold the former interest in the tactical branch of the department.

Not alone, however, in the matters of organization, drill, and mere uniform, has the interest of the department been studied, but even more carefully in the higher branch of military science. An advanced course has been instituted, and confined exclusively to the senior class. This class is not only most fitted for its reception, but the least calculated to underrate its real importance. The instruction is carried on by text-books, lectures, familiar conversations and readings, and original essays from the students, and has for its object fully to cover the salients of the art of war in its modern aspects. The time allotted is regarded as ample, and the hearty coöperation of the two senior classes that have come under my charge fully justifies its being set aside for this purpose.

In addition to the regular course, gratuitous instruction is offered by the department to such student or students as desire to pursue any special military study, or to go deeper into any subject than the limited course will allow. Taking advantage of this privilege, a class is now forming to commence fencing during the winter term. Under the same privilege a volunteer class of some thirty was formed during the past term to study military signalling, and has now become quite proficient therein. A very full set of all the necessary equipments has been kindly furnished from Washington by the signal department, and it is hoped, during the summer term, to take advantage of the proximity of Mounts Tom, Holyoke and Toby for establishing temporary practice stations.

In order to give a more comprehensive idea of the method and scope of the instruction imparted, I append herewith a full schedule of the regular course of military science and tactics. It should not be regarded as merely a proposed plan, but one actually working, and at all times open to thorough examination and inspection. It is the object and intention of this department to send out with confidence every year young men well fitted to receive commissions either from the State or general government,—men who for four years have been carefully drilled in all military ceremonies and tactical manœuvres, have passed consecutively through the various grades of company and regimental formation, who have been subjected to discipline and understand the art of command, and who, moreover, are well instructed in all the main features of higher military science. During the past year, through the kindness of the chiefs of the various branches of the war and navy departments, some very valuable military books, papers and reports have been procured, forming the nucleus of a military library. The College is likewise indebted to Major Mordecai, professor of ordnance and gunnery at West Point, for very full and carefully arranged collections of samples of gunpowder and its various ingredients, and of fuses. The institution stands greatly in need of a suitable military cabinet. The substantial aid with which instruction would be thereby supplemented, is as self-evident as its present lack is annoying. A practical one only is important,—one well stocked with the various arms, shot, shell, cartridges, and other munitions of war, now in use. This could be furnished from the state arsenal with little trouble or expense, and under the provisions of existing law.

An efficient fire organization has been recently formed under the supervision of this department, and fire drills regularly instituted as a part of its term routine. Its equipment consists of Babcock's fire-extinguishers, Johnson's force-pumps, hooks, ladders and buckets. The value of well-drilled preparation for this emergency cannot but suggest its own importance.

Signalling having met with such favor among the students, I would respectfully suggest that overtures be made to the department at Washington for the purpose of establishing a regular weather station at this College. Considering the close relation of the signal department to the agricultural interests of the country, and the importance of accurate weather and storm reports to an institution of such character as ours, and also the central position of the College in a farming district so important as the Valley of the Connecticut, the very general utility of such an establishment would undoubtedly be quickly perceived.

Target-practice has been a part of the practical military course during the past year, and has led to the establishment of a rifle association among the students upon Creedmoor principles. It has a private fund sufficient to procure all the essentials, and a very fair five-hundred-yard range upon the College property. Such an association is particularly worthy of encouragement from its innocence, its health-promoting tendency, and the wide-spread repute of the rifle as an American weapon.

Considerable enthusiasm has been prevalent during the year on the subject of a mortar battery, the earthwork of which the students unanimously volunteered to build, provided the mortars could be procured. The trustees have given a site for the battery, but thus far the department has been unable to procure the guns. We have already drawn the full armament to which the College is entitled from the general government; but I trust the mortars may yet be obtained through the good offices of the State.

During the fall term the seniors were instructed, under the care of this department, in the subject of roads and railroads,—important alike to the military and agricultural interests of the country. Provision has also been made to bring the entire College, in the winter term, under its instruction in right-line, mechanical, and freehand drawing.

The military interests represented by this and similarly constituted colleges is constantly becoming a subject of more general regard. Its growth is worthy of note, and leading journals have lately been bold in advocating more generous patronage and support. The "Ploughman," representing agricultural interests, has set forth its practical value and importance; and the "Army and Navy Journal," from a military stand-point, is particularly friendly. The latter urges the yearly commissioning in the regular army of a proficient graduate from each of these military colleges, and confidently says, "The time is rapidly approaching when such will be the law of the land." The wisdom of establishing an inducement such as this, the zeal with which it would certainly inspire the students, and the justness of opening in this manner the high positions of a republican army, such as ours, to the people it protects, could not fail to be productive of great military benefit to the entire country.

Military Department — Regular Course of Drill and Instruction.

Tactics.

The instruction given under this head is obligatory upon all students, unless specially excused by proper authority on account of physical disability. They are required to conform to and obey all orders and regulations emanating from the headquarters of the military department, and to recognize such officers as are appointed from their own number for the purpose of military administration and drill. At the beginning of the second term of attendance every student is required to be provided with the full uniform prescribed for the Corps of Agricultural Cadets. A battalion of four companies, with a staff and permanent commissioned and non-commissioned officers, is the basis of military organization. The West Point method, so far as practicable at a college, is followed both in the matter of tactical instruction and military administration. The routine of company and battalion office-work is adhered to closely, making the department self-sustaining, and forming a valuable item of practical instruction. Special attention is paid to the rules of military etiquette, and to an impartial enforcement of the necessary discipline. The junior and sophomore classes are united for instruction in artillery tactics, being officered and equipped as a light battery. Drills amount to three or four per week, as directed in the catalogue, and are by class or college, according to their nature. Every Saturday morning the Commandant makes a thorough military inspection of the College. At this time the students are required to be in their rooms, for whose neat and orderly appearance they are held responsible. The armory contains a section of a light battery—" Napoleon guns "—with limbers, caissons, and all necessary equipments, a six-pounder, with limber and equipments, seventy-five sabres, twenty officer's swords and regalia, one hundred and fifty breech-loading rifles, Springfield cadet model, with a complete infantry outfit, and several accurate target rifles of Spencer, Remington and Henry manufacture. Students are held strictly accountable for the proper use and care of the arms and other public property issued to them, and in all cases of neglect, injury or loss, will be charged accordingly. The instruction is given theoretically in the recitation-room as well as practically upon the drill-ground, and embraces the following subjects :—

Infantry Tactics.—The schools of the soldier, squad, company and battalion; the manual of arms and of the sword; bayonet exercise, skirmish, drill and target practice; military ceremonies; organization of infantry; marches, camping and field service.

Artillery Tactics.—The schools of the soldier, gun detachment, section, and battery dismounted. The manuals of the piece and sabre; the sabre exercise; the mechanical manœuvres; organization of artillery, pieces, carriages and ammunition; marches and camping; pointing, ranges and field service.

Special instruction is gratuitously offered to volunteer classes in any military exercises, such as signalling, the use of the broadsword or fencing, the only requisite being real interest and sufficient numbers to insure practical results.

Military Science.

Instruction in this higher branch is given exclusively to seniors, and forms a part of their regular curriculum. It is open, however, like other courses at the institution, to such special students as may desire it. It extends over an entire year, and though more or less theoretical, still, wherever possible, is put to practical test and exemplification. The class meets the professor twice a week for an exercise of an hour's duration in the recitation-room, field or laboratory. The course is arranged as follows :—

Fall Term.—This term is devoted to the study of certain carefully selected text-books. These are supplemented by copious explanations, and their scope is amplified by special lectures wherever they are deemed incomplete or behind the times. The plan and profile of a bastioned frontwork, accurately constructed on a given scale, is required of each student, and the entire class is practically instructed in the field in the elementary operations of military engineering, such as plotting, profiling, throwing up and revetting an earthwork, and the construction of fascines, hurdles, gabions, obstructions, etc. An excursion is likewise made during this term to the national armory at Springfield, in connection with the study of breech-loaders and the manufacture of small arms.

Winter Term.—The text-books are completed, and infantry and artillery tactics theoretically reviewed. This term is principally devoted to a critical reading and familiar discussion of the constitution of the United States, the army regulations, the articles of war, militia and volunteer laws of the State and general government, enlistments, draftings, and such other important military subjects as every citizen should understand. The seniors are excused, by special orders, from certain armory drills, and the time so gained devoted to practical instruction in the military laboratory, such as the manufacture of cartridges, handling, filling and strapping shells, and the construction of military fireworks.

Summer Term.—This term is devoted entirely to lectures, the subjects being comprised under the following general headings: Modern ordnance and gunnery; military law, custom and practice; military history, embracing campaigns and battles; ancient and modern systems of warfare; and the critical study of some of the great generals of the past and present.

The entire course is kept closely reviewed, and terminates with a public examination.

In connection with the advanced course, two military essays are required from each senior. Those of the first set are due at the close of the fall term; they are written upon various military topics, and are read by their writers before the entire College in lieu of certain drills during the winter term. A single topic is discussed in the second set, and the best essayist thereon receives the military prize.

Text-Books.

Lippitt's Tactical Use of the Three Arms.
Lippitt's Treatise on Intrenchments.
Lippitt's Field Service in Time of War.
Lippitt's Special Operations of War.
Welcker's Military Lessons.
Upton's Infantry Tactics.
United States Artillery Tactics.

Books of Reference.

Kent's Commentaries.
Benet's Courts-Martial.
Holt's Digest of Opinions.
Halleck's International Law.
Regulations of United States Army.
United States Ordnance Manual.
General and State Militia and Volunteer Laws.
Scott's Military History.
Histories of Revolution, War of 1812, Mexican War, and Rebellion.
Public Documents and Reports of Military and Naval Departments.

Military Prize.

Prof. C. A. L. Totten offers a prize of twenty-five dollars for the best military essay from the senior class. Essays forming a part of the military instruction, all members of the class will be required to write. The award will be made each year during Lieut. Totten's connection with the College by a board of army officers chosen for that purpose.

Subject for Class of 1876.

"The Military Future of America."

REPORT

OF

JOHN C. DILLON, Esq.,

FARM SUPERINTENDENT.

REPORT.

List of Crops cultivated on the College Farm during the year 1875.

CROPS.	Area. Acres.	Area. Rods.	Yield.
Corn,	13	00	776 bushels.
Potatoes,	17	27	2,950 bushels.
Squash,	1	80	14 tons.
Oats,	6	00	13 tons Being very heavy, they lodged, and were mown for fodder.
Rye,	3	00	21 bushels; 22 cwt. straw.
Small fruits,	1	08	450 quarts.
Vegetable garden,	1	13	A variety of vegetables.
Experimental plots,	2	00	A variety of grains and vegetables grown by Profs. Stockbridge and Maynard, for testing the merits of varieties and the effects of special fertilizers.
Nursery,	1	12	
Young orchard,	3	00	
Vineyard,	2	00	
Arboretum,	2	00	
Total area in tillage,	52	140	
" in mowing,	141	149	143 tons of hay.
" in pastures,	108	47	
" in woods and roads,	80	64	
	383	80	

Two acres and a half of land have been thoroughly under-drained by the students, under the direction of Prof. Stockbridge. Six acres of bushy pasture have been plowed and planted, and twelve acres have been cut over and prepared for burning and plowing next year. The twelve acres of pasture swamp reclaimed last year yielded eleven tons of hay; this plot was seeded with clover last spring and top-dressed in the fall, and is good for two tons to the acre next year. A hundred and thirty-one rods of post and board fence have been built, and some 30,000 feet of pine and chestnut timber have been got out for repairs and alterations to the buildings.

A large amount of work has been performed in grading and getting out rocks, in obtaining and setting out shade-trees, making and keeping in repair roads, sidewalks, bridges and culverts, and in trucking, teaming and job-work for the different departments of the College.

The stock has been thrifty and productive. A few animals which fell short of a high standard of excellence have been slaughtered, or disposed of, with full notice of all defects; while others, of pure descent and unimpeachable character, have been sold for remunerative prices.

Great attention has been paid to the saving, extending and preparation of manure, while far less than usual has been spent for commercial fertilizers.

The outlay for this purpose was confined to $20 worth of dry fish, a favorite fertilizer in this section, and $20 worth of chemical materials, bought separately and mixed, and applied according to Prof. Stockbridge's formulas.

While it is only fair to say that the chemical fertilizers gave much the best return both in corn and potatoes, I feel it my duty to express my conviction that the College, as well as farmers generally, can profitably expend a liberal sum in husbanding and making the most of their home resources before buying commercial fertilizers, however scientifically compounded and honestly made.

I have furnished to the assistant treasurer, each month, a detailed statement of my cash receipts and expenditures, and also of all bills due to and by the farm.

The following is a synopsis :—

1875.	Receipts.	Expenditures.	Bills due.	Bills payable.
April, . . .	$363 64	$122 48	$298 95	$245 19
May, . . .	508 13	320 95	362 57	593 83
June, . . .	203 96	64 19	155 67	381 80
July, . . .	112 70	50 04	168 48	580 54
August, . .	43 30	19 20	146 08	661 70
September, . .	112 04	62 65	203 30	499 02
October, . .	167 54	107 24	212 58	471 36
November, . .	284 74	143 62	189 38	352 82
December, . .	92 12	81 86	150 00	870 00
	$1,888 17	$972 23	$1,887 01	$4,656 26

This leaves a balance of $1,853.31 against the farm; but as we have most of the year's crop on hand, and have to sell a number of animals to make room for calves and young stock which are coming along, I have reasonable hope of putting the balance on the right side before the end of my financial year.

I have made my report short, for several reasons: first, because my time is very fully occupied with the numerous and imperative duties of my office; secondly, because I am reluctant to occupy space which is needed for the reports of those gentlemen who, with greater ability and culture, have more time for thought, research and deduction.

The following is a list of the thoroughbred stock belonging to the College :—

Shorthorns.

Bulls.—"Baron of Grass Hill," "Bashaw," "Beauclerc." *Cows.*—"Yarico, 57th," "Bella Donna," "Peachbud, 8th," "Aurora, 4th," "Emma, 3d," "Wistaria," "Lilian," "Bella Wilfer," "Yucatan," "Estella," "Mabel," "Isabelle," "Yucatilla," "Beatrice," "Red Star," "Lilac," and "Blossom."

The pedigrees of all these animals are recorded in the "American Shorthorn Herd-book."

Ayrshires.

Bulls.—"Lord Ronald," "Roy of Aldivalloch," and "Pict of Picts." *Cows.*—"Lulie" (1,500), "Rosa" (1,780), "Emily, 4th," "Beauty, 12th," "Leilah," "Little Emily," "Beauty, 13th," "Beauty, 14th," "Emmeline," "Jennie," "Amelia," "Lydia," "Beauty, 15th."

These animals have all perfect pedigrees, and are recorded, or will be recorded, in the "Ayrshire Herd-book."

Jerseys.

Bull.—"Reformer." *Cows.*—"Hattie" (977), "Lady Essex" (1,059), "Success" (1,254).

The cows are all recorded in the "American Jersey Herd-book," and the bull is eligible for record in the A. J. C. C. Herd Record.

Brittanies.

Bulls.—"Merlin," "Arthur." *Cow.*—"Pauline."

Dutch, or Holsteins.

Bulls.—"Fourth Highland Chief" and a bull-calf. *Cow.*—"Midwould, 19th."

Sheep.

One Cotswold ram, four Cotswold ewes, three Cotswold buck lambs, three Cotswold ewe lambs.

Swine.

Three Yorkshires, four Berkshires, one Essex, one Chester White, eighteen grades.

Poultry.

Twenty Games; ten Cochins; twelve White Leghorns; four Gray Dorkings; eighteen Bronze Turkeys; sixty Pigeons; viz., Carriers, Pouters, Tumblers, Fantails, Jacobins, Nuns, Archangels, Turbits, Trumpeters, Quakers, and Blue-rocks.

CATALOGUE

OF

TREES, SHRUBS AND HERBACEOUS PLANTS

RECEIVED FROM

PROF. C. S. SARGENT, Director of the Arnold Arboretum,
BOSTON, MASS.

TREES AND SHRUBS.

Abies Douglasii.
Abies Englemanni.
Abies Menziesii.
Abies Mertensiana.
Abies Nordmanniana.
Acer glabrum.
Acer rubrum.
Æsculus flava.
Æsculus flava, var. purpurascens.
Æsculus glabra.
Akebia quinata.
Alnus glutinosa.
Alnus incana.
Alnus serrulata.
Ampelopsis Vietchii.
Asimena triloba.
Berberis Canadensis.
Berberis petiolaris.
Berberis Sinensis.
Berberis vulgaris, var. purpurea.
Betula alba, var. populifolia.
Betula lenta.
Biota orientalis.
Caragana frutescens.
Carpinus Americana.
Carya alba.
Carya macrocarpa.
Carya porcina.
Carya tomentosa.
Cedrus Atlanticus.
Celtis australis, var. crassulifolia.
Celtis occidentalis.
Cephalanthus occidentalis.
Colutea arborea.
Colutea arborescens.
Colutea arborescens, var. involuta.
Colutea cruenta.
Cornus florida.
Cornus paniculata.
Cornus stolonifera.
Cratægus coccinea.
Cratægus melanocarpa.
Cratægus Oxycanthus, var. sticta.
Cratægus pyracantha.
Cratægus pyrifolia.
Cratægus tomentosa, var. mollis.
Cupressus macrocarpa.
Cytisus alpina.
Cytisus capitata.
Euonymus atropurpureus.
Fraxinus Americana.
Gleditschia ferox.
Gleditschia triacantha.
Gymnocladus Canadensis.
Hydrangea arborescens.
Hypericum proliferum.
Ilex verticillata.
Jamesia Americana.
Koelreuteria paniculata.
Laburnum alpinum.
Laburnum alpinum, var. fragrans.
Laburnum vulgare, var. Adami.
Laburnum vulgare, var. involutum.
Larix leptolepis.
Libocedrus decurrens.
Liquidamber styracifolia.
Lonicera cœrulea.
Lonicera flava.
Magnolia glauca.
Negundo aceroides.
Philadelphus Gordonianus.
Philadelphus grandiflorus.
Pinus hirta.
Pinus inops.
Pinus monticola.
Pinus ponderosa.
Pinus resinosa.
Pinus rigida.
Pinus Tœda.
Prunus Americana.

Prunus Virginiana.
Ptelea trifoliata.
Pterocarpus fraxinifolius.
Pyrus coronaria.
Pyrus floribunda.
Pyrus parviflora.
Quercus alba.
Quercus aquatica.
Quercus bicolor.
Quercus cinerea.
Quercus coccinea.
Quercus coccinea, var. tinctoria.
Quercus ilicifolia.
Quercus macrocarpa.
Quercus macrocarpa, var. hybrida.
Quercus palustris.
Quercus pendula.
Quercus Prinos.
Quercus Rober, var. pedunculata.
Quercus rubra.
Rhamnus catharticus.
Rhamnus Frangula.
Rhus excisa.
Rubus deliciosus.
Sambucus nigra, var. virescens.
Sambucus pubens.
Spirea ariæfolia.
Spirea Aruncus.
Spirea Ballardi.
Spirea carpinæfolia.
Spirea grandiflora.
Spirea Indica.
Spirea Nobleana.
Spirea opulifolia.
Spirea salicifolia.
Spirea triloba.
Staphylea trifolia.
Ulmus montana.
Ulmus racemosa.
Viburnum Opulus.
Vitis cordifolia, var. riparia.
Xanthoxylum Americanum.
Yucca filamentosa.

Hardy Herbaceous and Annual Plants.

Abutilon Indicum.
Aconitum lycoctonum.
Aconitum lycoctonum, var. ochrantum.
Aconitum lycoctonum, var. pallidum.
Adenostoma fasciculata.
Agave Virginiana.
Agrostemma cœli-rosa.
Agrostemma coronaria.
Amarantus hypochondriacus.
Anagallis platyphylla.
Anemone Japonica, fl. alba.
Anthemis Triumfelti.
Aquilegia chrysantha.
Aquilegia glandulosa, var. bicolor.
Aquilegia hybrida.
Aquilegia viscosa.
Arabis turrita.
Arbutus Menziesii.
Arenaria foeniculata.
Arenaria graminifolia.
Arenaria plantaginea.
Aster tardiflora.
Astinella grandiflora.
Astragalus bicolor.
Astragalus galegiformis.
Astragalus uliginosus.
Atriplex hastata.
Atriplex hortensis.
Atropa Belladonna.
Audibertia coronaria.
Avena Ludoviciana.
Avena occidentalis.
Baptisia australis.
Bellis annua.
Betonica grandiflora.
Bidens leucantha.
Boltonia latisquama.
Calliandra compressa.
Campanula latifolia.
Campanula media.
Campanula persicæfolia.
Campanula persicæfolia, fl. pl.
Campanula thyrsoides.
Ceanothus rigidus.
Cheiranthus Cheiri.
Cirsium eryophorum.
Cleome spinosa.
Cnicus Pareyi.
Collinsia bicolor.
Collinsia grandiflora.
Coreopsis Drummondi.
Crambe Hispanica.
Cuphea lanceolata.
Cuphea purpurea.
Cuphea viscosissima.

Dactylis Hispanica.
Datura atroviolacea.
Delphinium cheilanthum.
Delphinium grandiflorum, var. Sinense.
Delphinium nudicaule.
Delphinium triste.
Desmodium Canadense.
Dianthus deltoides.
Digitalis purpurea.
Diplacus glutinosus.
Draba Aizoon.
Draba frigida.
Draba tridentata.
Epilobium alpinum.
Eriogonum racemosum.
Eriogonum umbellatum.
Erodium ciculanum.
Fedia corniculata.
Ferula Tingitana.
Festuca gigantea.
Fragaria Indica.
Gaura biennis.
Gaura grandiflora.
Genista tinctoria.
Geranium affine.
Geranium dissectum.
Geranium macrorhizum.
Gilia aggregata.
Gilia floccosa.
Helianthus petiolaris.
Helianthus rubescens.
Henckelia cylindrica.
Hibiscus tiliaefolia.
Hieracium aurantiacum.
Hordeum hexastichon.
Hordeum jubatum.
Horkelia Californica.
Iris aurea.
Iris Goldenstadtii, var. cœrulescens.
Iris lævigata.
Iris setosa.
Iris Siberica, var. hermatophylla.
Iris stenopetala.
Ivisia Pickeringii.
Lathyrus hirsuta.
Lathyrus maritima.
Lavatera plebeia.
Leonotis ovata.
Lewisia rediviva.
Lilium tenuifolium.
Lilium tigrinum, fl. pl.
Lilium tigrinum, var. splendens.
Limnanthes Douglasii.
Linum grandiflorum.
Linum perenne.
Lotus edulis.
Lupinus arboreus.
Lychnis alpina.
Lychnis chalcedonica.
Lychnis fulgens.
Lychnis splendens.
Malva fragrans.
Malva moschata.
Matricaria inodora.
Melananthera hastata.
Mesembryanthemum acinaciforme.
Mesembryanthemum aureum.
Mesembryanthemum candens.
Mesembryanthemum caulescens.
Mesembryanthemum cordifolium.
Mesembryanthemum depressum.
Mesembryanthemum edule.
Mesembryanthemum emarginatum.
Mesembryanthemum felinum.
Mesembryanthemum glaucum.
Mesembryanthemum heteropetalum.
Mesembryanthemum incarnatum.
Mesembryanthemum multiflorum.
Mesembryanthemum muricatum.
Mesembryanthemum musculinum.
Mesembryanthemum pomerideanum.
Mesembryanthemum rhomboideum.
Mesembryanthemum serrulatum.
Mesembryanthemum spectabile.
Mesembryanthemum tenuifolium.
Mesembryanthemum umbelliferum.
Mesembryanthemum uncinatum.
Mikania scandens.
Mirabilis Jalapa.
Mirabilis longiflora.
Mulgedium plumosum.
Myosotis sylvatica, fl. pl.
Nicotiana acuminata.
Nicotiana cerinthoides.
Nicotiana paniculata.
Nicotiana rustica.
Nigella Damascena.
Œnothera triloba.
Onopordon Arabicum.
Orobus tuberosus.
Orobus tuberosus, var. tenuifolius.
Panicum colonum.
Panicum Crus-Galli.
Panicum glaucum.
Papaver alpinum.

Papaver bracteatum.
Papaver nudicaule.
Papaver orientale.
Papaver somniferum.
Paronychia Baldwini.
Pentstemon breviformis.
Pentstemon cœrulea.
Pentstemon confertus.
Pentstemon cordifolius.
Pentstemon cyananthus.
Pentstemon deustus.
Pentstemon heterophyllus.
Pentstemon Palmeri.
Pentstemon spectabilis.
Petunia nyctaginiflora.
Plantago acanthophylla.
Polanisia graveolens.
Polemonium cœruleum.
Portulaca mucronata.
Primula Japonica.
Primula villosa.
Reseda inodora.
Reseda undata.
Rhagadiolus stellatus.
Rumex orientalis.
Rumex Patientia.
Rumex sanguisorbifolius.
Rumex Wrightii.
Salsola fragrans.
Salvia acaulis.
Salvia carnea.
Salvia Horminum.
Salvia lanata.
Salvia officinalis.
Salvia pratensis.
Saxifraga flagellaris.
Saxifraga rotundifolia, var. hastata.
Scabiosa alpina.
Schivereckia podolica.
Schizanthus pinnatus.
Scrophularia peregrina.
Scutellaria Bolanderi.
Sedum Aizoon.
Sedum Kamtschaticum.
Sempervivum tectorum.
Silene compacta, var. orientalis.
Silene fruticosa.
Silene muscipula.
Soja gracilis.
Solanum aculeatissimum.
Solanum Æthiopicum.
Solanum gracile.
Solanum multiflorum.
Solanum ricinifolium.
Solanum Warscewiczii.
Spiræa digitata, var. tomentosa.
Statice Tormentilla.
Streptanthus cordatus.
Symphyandra pendula.
Tagetes erecta.
Thermopsis fabacea.
Thermopsis mollis.
Trifolium Pannonicum.
Tritoma MacOweni.
Tritoma Uvaria.
Umbilicus Sewizena.
Valeriana eriocarpa.
Verbascum phlemoides.
Verbena officinalis.
Verbena venosa.
Veronica fruticosa.
Veronica gentianoides.
Veronica saxatilis.
Veronica urticæfolia.
Veronica Virginiana.
Veronica Virginiana, var. Japonica.
Vesicaria utriculosa.
Vicia villosa.
Viola Altaica.
Viola lutea.
Viola Nuttalli.
Viola pedata, var. bicolor.
Yucca Whipplei.
Zinnia verticillata.

Greenhouse Plants.

Acacia juniperiana.
Adenocarpus Telonensis.
Aloe ferox, var. minor.
Aloe retusa.
Aloe rubro-lineata.
Anemone picta.
Anemone Pulsatilla.
Anthemis nobilis.
Anthyllis Barba-Jovis.
Areca rubra.
Asclepias speciosa.
Aster alpina.
Benthamia fragifera.
Bignonia Capensis.
Bignonia capreolata.
Calycotoma spinosa.

Cassia corymbosa.
Celsia betonicæfolia.
Cereus gigantea.
Cestrum elegans.
Cestrum Parqui.
Chamæpeuce Casabonæ.
Chamærops hystrix.
Chilopsis linearis.
Chlorophytum Sternbergianum.
Cistus albidus.
Cistus laxus.
Cistus Monspeliensis.
Cistus salviæfolius.
Coronilla glauca.
Corypha australis.
Cotyledon bracteata.
Cotyledon Californica.
Cotyledon coccinea.
Cotyledon farinacea.
Cotyledon fulgens.
Cotyledon orbiculata.
Cotyledon stolonifera.
Dioscorea Batatas.
Echeveria atropurpurea.
Echeveria hybrida.
Echeveria metallica.
Echeveria nuda.
Echeveria retusa, var. splendens.
Eucalyptus concolor.
Eucalyptus coriacea.
Eucalyptus globulus.
Eucalyptus goniocalyx.
Eucalyptus stricta.
Goldfussia Parryi.
Graptophyllum hortense.
Hardenbergia Comptoniana.
Helenium grandiflorum.
Hemerocallis graminea.
Hemerocallis Middendorffiana.
Hibiscus tricolor.
Howarthia expansa.
Impatiens Hookeri.
Indigofera Anil.
Indigofera coronillifolia.
Ipomopsis rosea.
Ipomopsis superba.
Jasminum revolutum.
Jatropha Curcas.
Jubaea spectabilis.
Kalanchoe crenata.
Lespedeza violacea.
Lilium pulchellum.
Linum flavum.
Lophospermum grandiflorum.
Mammillaria Brockii.
Manihot utilissima.
Mesembryanthemum brevicaule.
Mesembryanthemum intonsum.
Mesembryanthemum Salmii.
Mesembryanthemum vaginatum.
Musa superba.
Orobus atropurpureus.
Pandanus Javanicus.
Phœnix dactylifera.
Phœnix sylvestris.
Pimpinella Anisum.
Pistacia Lentiscus.
Plumbago rosea.
Pyrethrum speciosum.
Rhyncospermum jasminoides.
Rochea falcata.
Rudbeckia Californica.
Sabal Mexicana.
Sabal Palmetto.
Stenosiphonium virgatum.
Strobilanthes reticulata.
Symphyandra Warreni.
Thladiantha dubia.
Vinca rosea alba.

CATALOGUE

OF

TRUSTEES, OVERSEERS, FACULTY AND STUDENTS.

1875.

TRUSTEES, OVERSEERS, FACULTY AND STUDENTS.

BOARD OF OVERSEERS.

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Instructor in Book-keeping.

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JOHN C. DILLON, Esq., Farm Superintendent.

GRADUATES OF 1875.*

Barrett, Joseph Francis, ...	Barre.
Barri, John Atherton, ...	Cambridgeport.
Bragg, Everett Burt, ...	Amherst.
Brooks, William Penn, ...	South Scituate.
Bunker, Madison, ...	Nantucket.
Callender, Thomas Russell, . . .	Northfield.
Campbell, Frederick George, . . .	West Westminster, Vt.
Clay, Jabez William, ...	Westminster, Vt.
Dodge, George Rufus, ...	Hamilton.
Hague, Henry, ...	Lonsdale, R. I.
Harwood, Peter Mirick, ...	Barre.
Knapp, Walter Haydn, ...	Boston.
Lee, Lauren Kellogg, ...	Shrewsbury.
Miles, George Melville, ...	Westminster.
Otis, Harry Preston, ...	Northampton.
Rice, Frank Henry, ...	Barre.
Southwick, Andre Arnold, . . .	Mendon.
Winchester, John Frost, ...	Peabody.
Total, ...	18.

SENIOR CLASS.

Bagley, David Appleton, ...	Winchendon.
Bellamy, John, ...	Boston.
Chickering, Darius Otis (Boston University),	Enfield.
Deuel, Charles Frederick (Boston Univ.),	Amherst.
Guild, George William May, . . .	New York City.
Hawley, Joseph Mather (Boston Univ.), .	Salem, N. Y.
Kendall, Hiram, ...	Watertown.
Ladd, Thomas Henry (Boston Univ.), .	Watertown.
Mann, George Hewins (Boston Univ.), .	Sharon.
Martin, William Edson, ...	Hadley,
McConnel, Charles Washington, . .	Lonsdale, R. I.
McLeod, William Alexander (Boston Univ.),	Lonsdale, R. I.
Parker, George Amos (Boston Univ.), .	Gardner.

* The annual report being made in January necessarily includes parts of two academic years, and the catalogue gives the names of such students as have been connected with the College during any portion of the year 1875.

Parker, George Lowell (Boston Univ.), .	Dorchester.
Phelps, Charles Herbert (Boston Univ.),	South Framingham.
Porter, William Henry, ...	Hatfield.
Potter, William Stiles, ...	La Fayette, Ind.
Root, Joseph Edward (Boston Univ.), .	Barre.
Sears, John Milton (Boston Univ.), .	Ashfield.
Smith, Thomas Edwin, ...	Chesterfield.
Taft, Cyrus Appleton (Boston Univ.), .	Whitinsville.
Urner, George Peter, ...	Elizabeth, N. J.
Wetmore, Howard Graham (Bost. Univ.),	New York City.
Williams, John Elgin (Boston Univ.), .	South Amherst.
Total, ...	24.

JUNIOR CLASS.

Benson, David Henry, ...	Bridgewater.
Brewer, Charles, ...	Pelham.
Clark, Atherton (Boston University), .	Amherst.
Dickinson, Walter Mason, . . .	Amherst.
Hibbard, Joseph Robinson (Boston Univ.),	Chester, Vt.
Nye, George Everett, ...	Sandwich.
Paige, Harrie Cruse, ...	Tarrytown, N. Y.
Parker, Henry Fitch, ...	Amherst.
Porto, Raymundo, ...	Para, Brazil.
Southmayd, John Edwards (Boston Univ.),	Middletown, Conn.
Urner, Frank Gordon, ...	Elizabeth, N. J.
Wuyesugi, Tall Katuyoshi (Boston Univ.),	Tokeio, Japan.
Wyman, Joseph, ...	Arlington.
Total, ...	13.

SOPHOMORE CLASS.

Baker, David Erastus, ...	Franklin.
Boutwell, Willie Levi, ...	Leverett.
Brigham, Arthur Amber, ...	Marlborough.
Choate, Edward Carlile, ...	Cambridge.
Coburn, Charles Francis, ...	Lowell.
Cooley, Silas Rose, ...	North Hadley.
Foot, Sandford Dwight, ...	Springfield.
Hall, Josiah Newhall, ...	Revere.
Howe, Charles Sumner, ...	Ayer Junction.
Hubbard, Henry Francis, . . .	New Rochelle, N. Y.

Humphrey, George Eddy, . . .	Rochester.
Hunt, John Franklin, ...	Sunderland.
Koch, Henry Gustave Heath (Boston Univ.),	New York City.
Lovell, Charles Otto (Boston Univ.), .	Amherst.
Morey, Guy, ...	Lowell.
Nimms, Luther, ...	Woodlawn, N. C.
Spofford, Amos Little, ...	Georgetown.
Stockbridge, Horace Edward, . . .	Amherst.
Tuckerman, Frederick, ...	Boston.
Washburn, Hosea, ...	Bridgewater.
Total, ...	20.

FRESHMAN CLASS.

Baker, Martin, ...	Marshfield.
Bass, Edward Little, ...	West Randolph, Vt.
Campbell, Charles Henry, . . .	West Westminster, Vt.
Chittenden, Edgar Davis, . . .	Sunderland.
Cook, Roland Chittenden, . . .	Guilford, Conn.
Dickinson, Richard Storrs, . . .	Amherst.
Green, Samuel Bowdlear, ...	Boston.
Howard, Joseph Clark, ...	West Bridgewater.
Hunt, Elisha Hubbard, ...	Sunderland.
Lincoln, Joseph Gardner, . . .	Woburn.
Lyman, Charles Elihu, ...	Middlefield, Conn.
Osgood, Frederick Huntington, . .	Cambridge.
Palmer, Coddington Billings, . . .	Easthampton.
Sherman, Walter Alden, ...	Lowell.
Smith, George Parmenter, . . .	Sunderland.
Swan, Roscoe Willard, ...	Framingham.
Wadley, George Dole, ...	Bolingbroke, Ga.
Waldron, Hiram Edmund Baylies, . .	Rochester.
Total, ...	18.

SELECT CLASS.

Auger, Charles Parmelee, . . .	Middlefield, Conn.
Carey, Charles Brown, ...	Cincinnati, Ohio.
Carneiro, Manuel Dias, ...	Rio de Janeiro, Brazil.
Carvallo, William, ...	Santiago, Chili.
Collum, George Newell, ...	Hartford, Conn.
Damon, William Frederick, . . .	Honolulu, S. I.

Goss, Frank Washington, . . .	Lancaster.
Gunn, Willie Bradford, ...	Sunderland.
Howe, Waldo Vernon, ...	Framingham.
Loomis, Francis Eugene, ...	North Amherst.
Mills, James Kellogg (Boston University),	Springfield.
Thurston, Louise Mellicent, . . .	Lynn.
Total, ...	12.

RESIDENT GRADUATES.

Bragg, B. S., Everett Burt, . . .	Amherst.
Brooks, B. S., William Penn, . . .	South Scituate.
Libby, B. S., Edgar Howard (Boston Univ.),	Amherst.
Penhallow, B. S., David Pearce, . .	Portsmouth, N. H.
Wellington, B. S., Charles, . . .	Amherst.
Winchester, B. S., John Frost, . .	Peabody.
Total, ...	6.

SUMMARY.

Graduates of 1875, ...	18
Resident Graduates, ...	6
Seniors, ...	24
Juniors, ...	13
Sophomores, ...	20
Freshmen, ...	18
Select, ...	12
Total, ...	111

COURSE OF STUDY AND TRAINING.

Freshman Year.

First Term.—Chemical Physics, 5 hours each week; Human Anatomy, Physiology and Hygiene, 3 hours; Algebra, 5 hours; English, 2 hours; Agriculture, 3 hours; Declamation, 1 hour; Freehand Drawing, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term.—Inorganic Chemistry, 4 hours; Animal Physiology, 3 hours; Geometry, 5 hours; Agriculture, 4 hours; English, 2 hours; Elocution, 1 hour; Freehand Drawing, 4 hours; Military Drill, 3 hours.

Third Term.—Organic and Practical Chemistry, 8 hours; Geometry, 4 hours; French, 5 hours; Elocution, 1 hour; Agriculture, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Sophomore Year.

First Term.—Agricultural and Analytical Chemistry, 8 hours each week; Analytical Geometry, 4 hours; French, 5 hours; Agriculture, 2 hours; Declamation, 1 hour; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term.—Quantitative Chemical Analysis, 7 hours; Trigonometry, 5 hours; French, 4 hours; Agriculture, 4 hours; Declamation, 1 hour; Military Drill, 3 hours.

Third Term.—Zoölogy, 5 hours; Surveying, 5 hours; Agriculture, 2 hours; English, 3 hours; Declamation, 1 hour; Drawing, 4 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Junior Year.

First Term.—German, 5 hours each week; Mechanics, 5 hours; Entomology and Zoölogy, 3 hours; Market Gardening, 2 hours; Levelling and Drawing, 5 hours; Military Drill, 3 hours; Manual Labor, 6 hours.

Second Term.—German, 4 hours; Physics, 5 hours; Botany, 3 hours; Floriculture, 2 hours; Drawing, 4 hours; Agricultural Debate, 1 hour; Military Drill, 3 hours.

Third Term.—German, 4 hours; Astronomy, 4 hours; Botany, 4 hours; Topographical Surveying, 4 hours; Stock and Dairy Farming, 2 hours; Military Drill, 4 hours; Manual Labor, 3 hours.

Senior Year.

First Term.—English Literature, 4 hours each week; Botany, 2 hours; Veterinary Science, 3 hours; Book-keeping, 2 hours; Roads and Railroads, 3 hours; Military Science, 2 hours; Original Declamation, 1 hour; Military Drill, 3 hours.

Second Term.—English Literature, 4 hours; Theses, 1 hour; Mental Science, 4 hours; Agriculture, 2 hours; Veterinary Science, 3 hours; Military Science, 2 hours; Microscopy, 4 hours; Military Drill, 3 hours.

Third Term.—Veterinary Science, 3 hours; Military Science, 2 hours; Geology, 3 hours; Landscape Gardening, 2 hours; Rural Law, 1 hour; Lectures on English Language, 2 hours; Agricultural Review, 4 hours; Military Drill, 4 hours.

LIST OF BOOKS.

Instruction is largely given by lectures and practical exercises, but the following text-books are recommended for recitation or reference:—

Botany and Horticulture.

Gray's Lessons, Manual, and Botanical Text-book.
Sachs' Text-book of Botany, Morphological and Physiological.
Masters' Henfrey's Elementary Course of Botany.
Berkeley's Introduction to Cryptogamic Botany.
Cooke's Microscopic Fungi.
Carpenter's The Microscope and its Revelations.
Flint's Grasses and Forage Plants.
Downing's Fruits and Fruit Trees of America.
Thomas's American Fruit Culturist.
Hoope's Book of Evergreens.
Strong's Grape Culture.
Henderson's Practical Floriculture.
Fuller's Forest Tree Culturist.
Williams's Choice Stove and Greenhouse Plants.
Helmsley's Hand-book of Hardy Trees, Shrubs and Herbaceous Plants.
Loudon's Cyclopædia of Plants.
Loudon's Cyclopædia of Gardening.
Lindley and Moore's Treasury of Botany.
Kemp's Landscape Gardening.
Downing's Landscape Gardening.

Agriculture.

Johnson's How Crops Grow.
Johnson's How Crops Feed.
Pendleton's Scientific Agriculture.
Hyde's Lowell Lectures on Agriculture.
Liebig's Natural Laws of Husbandry.
French's Farm Drainage.
Flint's Milch Cows and Dairy Farming.
Sturtevant's The Dairy Cow — Ayrshire.
Waring's Handy-book of Husbandry.
Henderson's Gardening for Profit.
Donaldson's British Agriculture.
Morton's Cyclopædia of Agriculture.
Low's Domesticated Animals.
Flint's Reports on the Agriculture of Massachusetts.
Agricultural Gazette and Gardeners' Chronicle, London.

Chemistry and Geology.

Watt's Fownes' Manual of Elementary Chemistry.
Sibson's Agricultural Chemistry.
Caldwell's Agricultural Chemical Analysis.
Nason's Woehler's Chemical Analysis.
Will's Analytical Chemistry.
Johnson's Fresenius' Qualitative and Quantitative Analysis.
Liebig's Ernährung der Pflanzen.
Wolff's Landwirthschaftliche Analyse.
Hoffman's Ackerbau Chemie.
Watt's Chemical Dictionary.
Dana's Mineralogy.
Hitchcock's Geology.
Dana's Text-book and Manual of Geology.

Veterinary Science and Zoölogy.

Fleming's Chauveau's Comparative Anatomy of Domesticated Animals.
Dalton's Human Physiology.
Cleland's Animal Physiology.
Williams's Principles of Veterinary Surgery.
Principles of Veterinary Medicine.
Gamgee's On Horseshoeing and Lameness.
On Domestic Animals in Health and Disease.
Armitage's Clater's Cattle Doctor.

Youatt's Treatises on the Domestic Animals.
Blaine's Veterinary Art.
Morton's Manual of Pharmacy.
Wood and Bache's United States Dispensatory.
Harbison's Elementary Zoölogy.
Lankester's Advanced Zoölogy.
Packard's Guide to the Study of Insects.
Harris's Insects Injurious to Vegetation.
Westwood's Principles of Classification of Insects.
Baird's Mammals of North America.
Murray's Geographical Distribution of Mammals.
Samuels' Birds of New England.
Cobbold's Entozoa.
Denney's Parasitic Insects.
Moquin-Tondon's Manual of Medical Zoölogy.

Mathematics, Physics and Civil Engineering.

Olney's Algebra, Geometry and Trigonometry.
Gillespie's Surveying.
 Roads and Railroads.
Everett's Deschanel's Natural Philosophy.
Atkinson's Ganot's Physics.
Peabody's Astronomy.
Loomis' Meteorology.

English, French and German.

Hart's Composition.
Fowler's English Grammar.
Shaw's Complete Manual of English Literature.
Chambers's Cyclopædia of English Literature.
Morley's English Writers.
Taine's History of English Literature.
Languillier and Monsanto's French Grammar.
Spier and Surenne's French Dictionary.
Glaubensklee's German Grammar.
Adler's German Dictionary.

The French and German books for translation are changed every year, selections being made from recent literary and scientific publications.

Mental, Moral and Social Science.

Haven's Mental Science.
Hickok's Empirical Psychology.
Porter's Elements of Intellectual Science.

Seelye's Schwegler's History of Philosophy.
Haven's Moral Philosophy.
Hickok's Moral Science.
Hopkins's Law of Love and Love as Law.
Chadbourne's Natural Theology.
Walker's Science of Wealth.
Perry's Political Economy.
Carey's Principles of Social Science.
Stirling's Bastiat's Harmonies of Political Economy.

CALENDAR FOR 1876.

The third term of the collegiate year begins March 23d, and continues till June 21st.

The first term begins August 24th, and continues till the Wednesday before Thanksgiving.

The second term begins December 14th, and continues till March 14th, 1877.

There will be an examination of candidates for admission to the College, at the Botanic Museum, at 9 A. M., Tuesday, June 20th, and also on Thursday, August 24th.

The Farnsworth Prize Declamations take place Monday evening, June 19th.

The public examination of the graduating class for the Grinnell prize for excellence in Agriculture, and the examination of the other classes in the studies of the term, will take place on Tuesday forenoon, June 20th.

The Address before the Literary Societies will be delivered Tuesday afternoon.

The exercises of Graduation Day occur June 21st.

ADMISSION.

Candidates for admission to the Freshman Class are examined, orally and in writing, upon the following subjects: English Grammar, Geography, Arithmetic, Algebra through simple equations, and the History of the United States.

Candidates for higher standing are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the College until he is fifteen years of age, and every student is required to furnish a certificate of good character, from his late pastor or teacher, and to give security for the prompt payment of term bills. Tuition and room-rent must be paid in advance, at the beginning of each term, and bills for board, fuel, etc., at the end of every term.

The regular examinations for admission are held at the Botanic Museum, at 9 o'clock A. M., on Tuesday, June 20th, and on Thursday, August 24th; but candidates may be examined and admitted at any other time in the year.

Further information may be obtained of President W. S. Clark, Amherst, Mass.

EXPENSES.

Tuition, ...	$25 00 per term.
Room-rent, ...	$5 00 to 10 00 "
Board, ...	3 50 per week.
Expenses of Chemical Laboratory to Students of Practical Chemistry, . . .	10 00 per term.
Public and private damages, including value of chemical apparatus destroyed or injured, .	at cost.
Annual expenses, including books, . . .	$300 00 to 350 00

REMARKS.

The regular course of study occupies four years, and those who complete it receive the degree of Bachelor of Science, the diploma being signed by the Governor of Massachusetts, who is president of the corporation.

The trustees of the College have entered into the following agreement with the corporation of Boston University, viz.:—

ARTICLES OF AGREEMENT BETWEEN THE TRUSTEES OF THE MASSACHUSETTS AGRICULTURAL COLLEGE AND THE TRUSTEES OF BOSTON UNIVERSITY.

I. The College on its part agrees:—

1. That matriculants in Boston University desiring to pursue any regular or special course of study presented in the Massachusetts Agricultural College, shall be at liberty to do so on the same terms and conditions as other persons, and on completing the course to the satisfaction of the authorities of both Institutions, shall be

entitled to take their appropriate degrees, either at the hands of the College, or from the University, or both, as they may prefer.

II. The University on its part agrees :—

1. That so long as this agreement may be found satisfactory, it will refrain from organizing an independent College of Agriculture, and will give its cordial support and influence to the building up of the Massachusetts Agricultural College.

2. It will, by its annual circulars and official correspondence, publicly and privately, recommend those seeking an agricultural education to resort for it to the Massachusetts Agricultural College, and will publish in connection with its annual catalogue such statements of the advantages of the College as may be agreed upon by the Presidents of the two Institutions.

III. Both parties further agree :—

1. That to promote a good understanding, each corporation, whenever it may desire, shall have the privilege of representing its interests by a duly accredited officer or committee in the business meetings of the other.

2. That either party to this agreement shall have power to terminate it, at the close of any scholastic year, by giving notice of such desire and intent one year previously.

Under this arrangement, all students who desire it, may become members of the University and receive its diploma in addition to that of the College.

The instruction in the languages is intended to qualify the graduates to write and speak English with correctness and effect, and to translate German and French with facility. The scientific course is as thorough and practical as possible, and every science is taught with constant reference to its application to agriculture and the wants of the farmer.

The instruction in agriculture and horticulture includes every branch of farming and gardening which is practised in Massachusetts, and is both theoretical and practical. Each topic is discussed thoroughly in the lecture-room, and again in the plant-house or field, where every student is obliged to labor. The amount of required work, however, is limited to six hours per week, in order that it may not interfere with study. Students are allowed to do additional work, provided they maintain the necessary rank as scholars. All labor is paid at the rate of ten cents per hour.

Indigent students are allowed to do such work as may offer about the College and farm buildings or in the field, but it is hardly possible for one to earn more than from $50 to $100 per annum besides performing other duties. So far as is consistent with circumstances, students will be permitted to select such varieties of labor as they may for special reasons desire to engage in.

The State Board of Agriculture unanimously voted at their annual meeting in 1875, that every agricultural society receiving the bounty of the Commonwealth be urged to maintain at least one scholarship at the College, and to secure the attendance of one or more students. The Trustees have also voted to authorize the executive committee to remit the tuition of such worthy students as were unable to pay it.

Those who pursue a select course attend recitations and lectures with the regular classes; but those properly qualified, who desire special instruction in botany, chemistry, civil engineering, veterinary science, agriculture or horticulture, may make private arrangements with the officers having charge of these departments.

An expenditure of from $10 to $50 is necessary to provide furniture, which may be purchased at reasonable rates, either new or second-hand. At the beginning of the seeond term of attendance, each student is required to provide himself with the full uniform prescribed for the battalion of Agricultural Cadets, the cost of which is about $30.

On Sundays, students are expected to attend the chapel service and Bible-class, which are conducted by the Professor of Moral Science. While the Bible is made the basis of all religious instruction, everything of a denominational character is, as far as practicable, avoided.

Students may, upon the written request of their parents or guardians, be excused from these exercises to attend services in one of the churches of the town, but, for obvious reasons, it is very undesirable that such requests be made.

POST-GRADUATE COURSE.

Graduates of colleges and scientific schools may become candidates for the degree of Doctor of Science, or Doctor of Philosophy, from the College or from the University, and pursue their studies under the direction of President Clark in Botany, Professor Goessmann in Chemistry, or other members of the faculty in their respective departments.

REGULATIONS.

1. Students are specially forbidden to combine together for the purpose of absenting themselves from any required exercise, or violating any known regulation of the College.

2. The roll shall be called five minutes after the ringing of the bell for each exercise of the College by the officer in charge, unless a monitor be employed, and students who do not answer to their names shall be marked absent, provided that any student coming in after his name has been called shall be marked tardy. Two tardinesses shall be reckoned as one absence.

3. Absence from a single exercise may be allowed or excused by the officer in charge of the same, but permission to be absent from several exercises must be obtained from the general excusing officer or from the president. In such cases, the officer excusing will furnish a certificate of excuse, which shall state the precise time for which absence is permitted, and which shall be a satisfactory reason for absence from all exercises occurring within the time specified.

4. Absence without permission obtained beforehand will not be excused by any member of the faculty except on the presentation of a satisfactory excuse written upon the prescribed blank form. Excuses must be rendered to the officer in charge of the exercise from which the student was absent; except that when the absence may include two or more days, the excuse may be rendered to the president, whose approval shall be deemed sufficient for all absences specified therein. Excuses must be rendered promptly; no officer will be expected to receive an excuse after one week has elapsed from the end of the absence, if there has been an opportunity for presentation. Excuses deemed satisfactory will be returned to the student with the indorsement of the approving officer. Excuses deemed insufficient will be retained and referred to the faculty for their decision.

5. For every absence for which no excuse may be offered, or, if offered, shall be deemed insufficient by the faculty, the absentee shall be charged with a fine of one dollar upon the treasurer's accounts, and no student may enter upon the duties of a term, or receive an honorable discharge, certificate of attendance, or diploma, until all fines previously incurred are paid.

6. Whenever the aggregate number of unexcused absences in all departments reaches five, the student so delinquent shall be informed of the fact. When the number of such absences reaches eight, the parent or guardian of the student shall be informed of his

delinquency; and when ten such delinquencies are justly recorded against any student, his connection wiih the College may be terminated.

7. Students are forbidden to absent themselves without excuse from the regular examinations; to give up any study without permission from the president, or to remove from one room to another without authority from the officer in charge of the dormitory buildings.

8. The record of deportment, scholarship and attendance will be carefully kept, and whenever the average rank of a student for any term falls below fifty, he will not be allowed to remain a member of the College, except by a special vote of the faculty. Admission to the College and promotion from class to class, as well as to graduation, are granted only by vote of the faculty.

9. Students are required to abstain from everything injurious to the buildings and other property of the College, and in all respects to conduct themselves with propriety.

10. Students will not be excused from regular duty to engage in boating.

BOOKS, APPARATUS, AND SPECIMENS IN NATURAL HISTORY.

The library of the College contains about 1,500 volumes. Among them are several valuable sets of cyclopædias, magazines and newspapers, reports of the agricultural societies and state boards of agriculture, and many standard works on agriculture and horticulture. There are many useful works of reference in chemistry, botany, surveying and drawing. The larger part of the books has been presented to the Institution by private individuals.

The faculty and students also have the privilege of drawing books from the excellent library of Amherst College, which contains over 30,000 volumes.

The state cabinet of specimens, illustrating the geology and natural history of Massachusetts, has been removed from Boston to the College, and is of much value for purposes of instruction.

The Knowlton herbarium contains more than 10,000 species of named botanical specimens, besides a large number of duplicates. The botanic museum is supplied with many interesting and useful specimens of seeds, woods and fruit models. There is also a set of diagrams illustrating structural and systematic botany, including about 3,000 figures.

About 1,500 species and varieties of plants are cultivated in the Durfee Plant-house, affording much pleasure and information to students of both Colleges.

The very extensive and, in some respects, unsurpassed collections in geology, mineralogy, natural history, ethnology and art, belonging to Amherst College, are accessible to members of the Agricultural College.

The chemical, engineering and military departments of the Agricultural College are well furnished.

The class in microscopy have the use of seven of Tolles' best compound microscopes, with objectives from four inches to one-eighth of an inch in focal distance, and a variety of eye-pieces.

PRIZES.

Farnsworth Rhetorical Medals.

Isaac D. Farnsworth, Esq., of Boston, has generously provided a fund of $1,500, which is to be used for the purchase of gold and silver medals, to be annually awarded, under the direction of the College faculty, for excellence in declamation.

Grinnell Agricultural Prizes.

Hon. William Claflin, of Boston, has given the sum of $1,000 for the endowment of a first prize of $50, and a second prize of $30, to be called the Grinnell Agricultural Prizes, in honor of George B. Grinnell, Esq., of New York. These prizes are to be paid in cash to those two members of the graduating class who may pass the best oral and written examination in Theoretical and Practical Agriculture.

Hills Botanical Prizes.

For the best herbarium, collected by a member of the class of 1877, a prize of $15 is offered, and for the second best, a prize of $10; also a prize of $5 for the best collection of woods.

Totten Military Prize.

For the best essay by a member of the senior class on such topic as may be assigned, a prize of $25. Subject for 1876, "The Military Future of America."

Hampshire Prizes.

The Hampshire Agricultural Society offers two prizes of $30 and $20 each to those two students from within the limits of the society who shall make the greatest improvement in scholarship during their Freshman year.

Scholarships.

Miss Mary Robinson, of Medfield, Mass., has given a fund of $1,000 to endow the Robinson scholarship, the income of which is assigned upon the recommendation of the faculty to the aid of one worthy indigent student.

The Trustees of the Massachusetts Society for Promoting Agriculture pay annually the sum of $300, which is assigned by the faculty to the payment of the tuition of four worthy indigent students who intend to engage in agricultural pursuits after graduation.

The Essex Agricultural Society pays $50 per annum to one student from within its limits.

The Harvest Club of the Connecticut Valley pays the tuition of one student selected by them.

FINANCIAL STATEMENT,

JANUARY 1, 1876.

REAL ESTATE.

College Farm and Quarry,	$37,500 00
North College,	36,000 00
South College,	36,000 00
College Hall,	30,000 00
South Boarding-house,	8,000 00
North Boarding-house,	8,000 00
Durfee Plant-house,	12,000 00
Botanic Museum,	5,000 00
South Barn,	14,500 00
Farm-house,	4,000 00
Four Dwellings and Barns purchased with the Estate,	9,000 00
Total Real Estate,	$200,000 00

FARM STATEMENT.

Value of Live-stock,	$12,500 00
of Vehicles and Implements,	2,840 00
Produce on hand,	5,300 00
	$20,640 00

Total credits of farm, including property inventoried Jan. 1, 1876, credit for labor performed in grading, etc., and receipts from sales of live-stock and produce,	26,623 60
Total debits of farm, including property inventoried Jan. 1, 1875, and all expenditures for live-stock, labor, implements, repairs, seeds, fertilizers, etc.,	26,317 54

FUND FOR MAINTENANCE OF THE COLLEGE,

In Charge of the State Treasurer.

Agricultural College Fund.

Cash balance on hand January 1, 1876,		$10,000 00
Present investments:—		
City of Salem bonds,	$55,000 00	
Lynn bonds,	25,000 00	
Chelsea note,	25,000 00	
Fall River note,	50,000 00	
Town of Milford bonds,	14,200 00	
Plymouth note,	6,724 65	
Brighton note,	10,000 00	
West Roxbury notes,	60,000 00	
Westborough notes,	12,000 00	
Lee note,	4,142 75	
Somerset note,	10,000 00	
County of Hampden note,	50,000 00	
		322,067 40
Massachusetts, Troy and Greenfield Railroad bonds,	$8,000 00	
Massachusetts Bounty Loan bonds,	16,000 00	
		24,000 00
State of Maine bonds,		4,000 00
Total Fund,		$360,067 40

Two-thirds of the income of this fund is by law paid to the treasurer of the College, and one-third to the treasurer of the Institute of Technology.

The Hills Fund of $10,000, for the maintenance of the Botanic Garden, is in charge of the College treasurer, and at present yields an income of $500.

To this sum should be added the receipts of tuition and room-rent, amounting to $100 per annum for each scholar, and the receipts from the sale of the products of the farm and garden.

Summary Statement of all Appropriations and Donations in money to the Massachusetts Agricultural College, not including the Endowment Fund.

$10,000 00	1864,	From State, for aid in founding College.
10,000 00	1865,	" " " "
75,000 00	1867,	From town of Amherst and Friends, to erect the first buildings.
10,000 00	1867,	From Dr. Nathan Durfee, a donation for the erection of the plant-house.
10,000 00	1867,	From L. M. and H. F. Hills, a fund, the income to be used for botanical department.
50,000 00	1868,	From State, for building and expenses.
50,000 00	1869,	" " " "
25,000 00	1870,	" " " "
2,000 00	1870,	From William Knowlton, Esq., for herbarium in Botanic Museum.
500 00	1870,	From Hon. Albert Fearing, for books.
50,000 00	1871,	From State, for building and expenses.
3,751 00	'68–'74,	From Agricultural Societies and Individuals, for scholarships to aid indigent students.
1,000 00	1873,	From Hon. William Claflin, for the Grinnell Agricultural Prize Fund.
1,500 00	1873,	From I. D. Farnsworth, Esq., for the Farnsworth Rhetorical Prize Fund.
1,000 00	1874,	From Miss Mary Robinson, bequest for Scholarship Fund.
18,000 00	1874,	From State, for current expenses of College.
$317,751 00	-	

Summary Statement of all Income and Receipts on account of the Massachusetts Agricultural College, from its Incorporation in 1863, to January 1, 1876.

	1864-5-6.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.
Balance,	-	-	$4,485 83	-	-	-	-	-	-	-
Income from Agricultural College Fund,	-	$10,930 00	8,908 10	$9,035 52	$4,839 82	$12,364 22	$15,083 07	$14,982 91	$15,701 75	$15,459 00
State Appropriations,	$20,000 00	-	50,000 00	50,000 00	25,000 00	50,000 00	-	-	18,000 00	-
Received for 1-10 Land Scrip,	29,778 40	-	-	-	-	-	-	-	-	-
Dr. Nathan Durfee, for plant-house,	-	10,000 00	-	-	-	-	-	-	-	-
Town of Amherst and Friends,	-	60,156 67	-	-	-	-	-	-	-	-
Farm Account,	-	2,030 22	2,204 16	1,840 06	3,004 78	633 01	873 50	2,107 69	1,487 54	1,637 12
Amherst College and Friends,	-	-	12,343 33	-	2,500 00	-	-	-	-	-
Income of Hills Fund,	-	-	500 00	500 00	500 00	500 00	500 00	500 00	500 00	500 00
Bills Payable,	-	-	11,000 00	-	-	-	-	10,460 00	3,500 00	4,000 00
Term Bills,	-	-	7,620 87	11,554 38	13,204 56	12,932 65	10,386 02	9,395 51	9,892 92	13,107 28
Botanical Department,	-	-	107 28	-	-	106 69	724 95	580 59	549 20	955 80
Contingent Fund,	-	-	-	119 10	281 78	153 88	-	90 59	190 60	9 84
Interest on Deposits,	-	-	-	-	-	-	390 00	-	140 00	-
Insurance,	-	-	-	-	-	-	1,501 63	-	-	-
Bequest of Miss Mary Robinson,	-	-	-	-	-	-	-	-	1,000 00	-
I. D. Farnsworth, Esq., for Rhetorical Prizes,	-	-	-	-	-	-	-	-	90 00	100 00
Hon. William Claflin, for Grinnell Prize Fund,	-	-	-	-	-	-	-	-	1,000 00	-
Income of Grinnell Prize Fund,	-	-	-	-	-	-	-	-	100 00	80 00
	$49,778 40	$83,116 89	$97,169 57	$73,049 06	$49,330 94	$76,690 45	$29,459 17	$38,117 29	$52,152 01	$35,849 04

Summary Statement of all Payments and Expenditures on account of the Massachusetts Agricultural College, from its Incorporation in 1863, to January 1, 1876.

	1864-5-6.	1867.	1868.	1869.	1870.	1871.	1872.	1873.	1874.	1875.
Salaries,	-	$9,250 00	$5,250 00	$12,459 72	$16,389 92	$15,016 67	$17,705 00	$19,540 89	$19,995 83	$18,272 50
Land and Buildings,	$32,499 50	-	6,000 00	7,000 00	-	-	-	-	-	-
Building Fund,	-	53,290 94	51,352 15	31,419 71	11,006 29	3,711 45	-	-	-	-
Current Expenses,	8,955 26	17,824 93	9,686 23	13,640 96	6,102 51	13,184 02	9,656 29	6,556 49	12,755 16	6,866 96
Farm Expenses,	-	11,074 66	3,467 71	6,253 18	6,116 77	6,337 83	7,313 54	4,548 55	4,222 24	3,495 00
Bills Payable,	-	-	-	-	-	11,000 00	-	-	3,960 00	-
Interest,	-	-	365 67	1,379 20	1,138 31	385 00	-	371 16	684 02	1,079 92
Income of Hills Fund,	-	-	450 92	281 44	30 00	269 97	916 42	725 73	509 04	252 04
Term Bill Expenses,	-	-	1,394 83	4,644 62	4,519 61	3,155 59	2,031 13	2,315 12	1,263 99	3,142 83
Board of Students,	-	-	4,447 36	5,672 27	4,746 61	6,833 55	4,249 51	4,281 82	3,851 97	4,773 27
Botanical Department,	-	-	-	65 86	121 66	607 90	364 38	274 75	473 96	1,117 35
Extra Instruction,	-	-	-	-	1,893 25	1,445 00	846 00	-	400 00	664 38
Investment of Grinnell Prize Fund,	-	-	-	-	-	-	-	-	1,000 00	-
Grinnell Agricultural Prizes,	-	-	-	-	-	-	-	-	117 00	70 00
Farnsworth Rhetorical Prizes,	-	-	-	-	-	-	-	-	70 00	117 00
	$41,454 76	$91,440 53	$82,414 77	$82,816 96	$52,064 93	$61,946 98	$43,082 27	$38,614 51	$49,303 21	$39,851 25

Summary Statement of all Income and Receipts and all Payments and Expenditures on account of the Massachusetts Agricultural College, from its Incorporation in 1863, to January 1, 1876.

Income and Receipts.		Payments and Expenditures.	
Balance, January 1, 1868,	$4,485 83	Salaries,	$133,880 53
From Income of Agricultural College Fund,	107,304 39	Land and Buildings,	45,499 50
State Appropriations,	213,000 00	Building Fund Account,	150,780 54
One-tenth Land Scrip for purchase of Farm,	29,778 40	Current Expense Account,	105,228 81
Dr. Nathan Durfee, for Plant-house,	10,000 00	Farm Account,*	52,829 48
Town of Amherst and Friends,	75,000 00	Bills Payable,	14,960 00
Farm Account,	15,818 08	Interest,	5,403 18
Income of Hills Fund,	4,000 00	Income of Hills Fund expended,	3,435 56
Bills Payable,	28,960 00	Term Bill Account,	22,467 72
Term Bill Account,	88,093 19	Board of Students,	38,856 36
Botanical Department,	3,024 51	Botanical Department,	3,025 86
Contingent Fund,	845 79	Extra Instruction and Lectures,	5,248 63
Interest on Deposits,	530 00	Grinnell Prize Fund Investment,	1,000 00
Insurance,	1,501 63	Income of Grinnell Prize Fund,	187 00
Bequest of Miss Mary Robinson,	1,000 00	Farnsworth Prize Fund,	187 00
I. D. Farnsworth, Income of Prize Fund,	190 00		
Hon. Wm. Claflin, for Grinnell Prize Fund,	1,180 00		$582,990 17
		Balance, January 1, 1876,	1,721 65
	$584,711 82		$584,711 82

* A large proportion of the farm expenses, as here given, was paid for the labor of men and teams in grading, building and repairing roads, hauling stone, and similar work, and is not properly chargeable to the farm as such.

DR. NATHAN DURFEE, TREASURER, *in account with* MASSACHUSETTS AGRICULTURAL COLLEGE. CR.

1875.		
Jan. 1	To Balance,	$5,723 86
	Income Hills Fund,	500 00
	State Endowment Fund,	15,459 00
	Farnsworth Prize Fund,	100 00
	Grinnell Prize Fund,	80 00
	Receipts from Students,	9,964 45
	Farm Superintendent,	1,637 12
	Gardener,	955 80
	Bills Payable,	4,000 00
		$38,420 23

1875.		
	By Salaries,	$18,272 50
	Board of Students,	4,773 27
	Expenses Hills Fund,	252 04
	Contingent Account,	4,784 85
	Botanical Account,	1,117 35
	Farm Account,	2,930 93
	Interest Account,	1,078 30
	Prize Account,	187 00
	Laboratory Account,	664 38
	Mary Robinson Fund, invest'd,	1,000 00
	Indebtedness of 1874 paid,	2,637 96
Dec. 31	Balance,	721 65
		$38,420 23

Respectfully submitted.

NATHAN DURFEE, *Treasurer.*

I have examined the Treasurer's accounts, and find them correctly stated, and accompanied by the proper vouchers.

HENRY COLT, *Auditor.*

SUMMARY OF METEOROLOGICAL OBSERVATIONS

For the Year 1875.

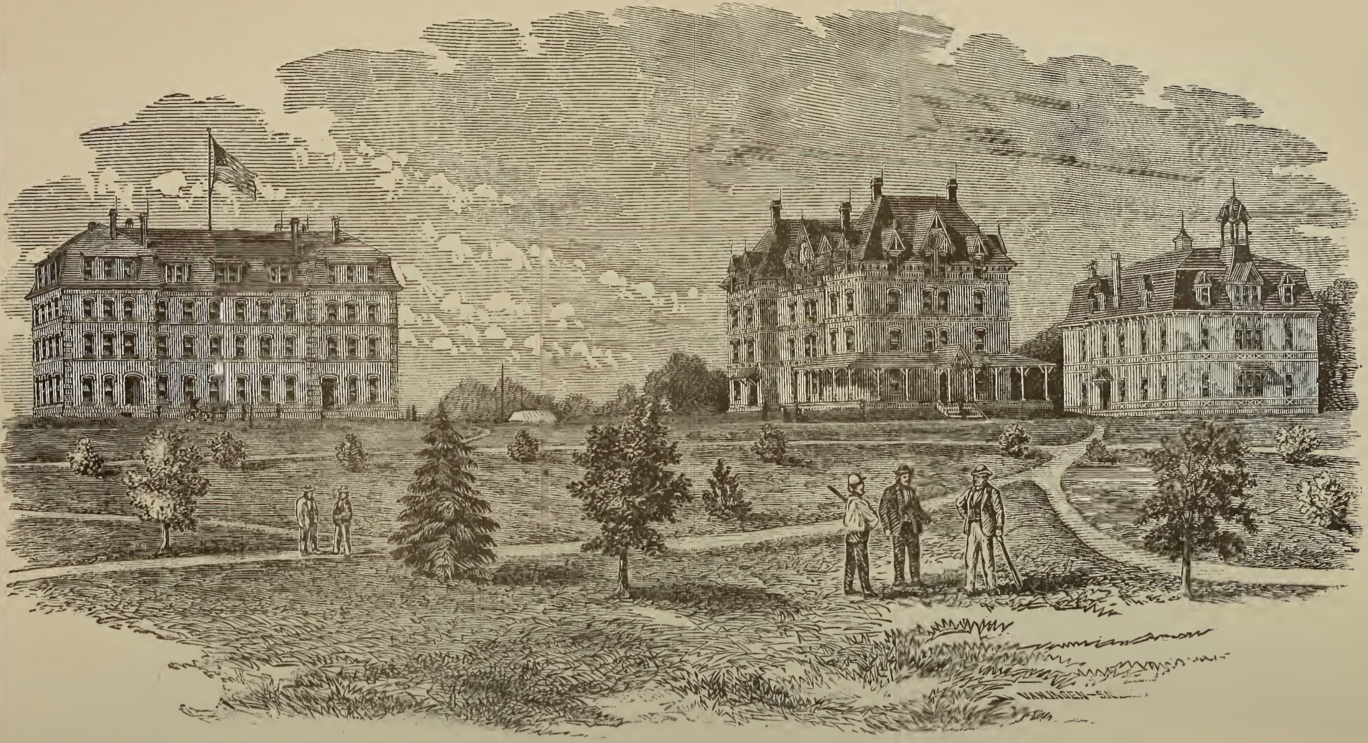
TAKEN AT AMHERST, MASS.,

By Prof. E. S. SNELL, LL. D., of Amherst College,

Latitude, 42° 22′ 17″. Longitude, 72° 34′ 30″. Elevation above the sea level, 267 feet.

SUMMARY OF METEOROLOGICAL OBSERVATIONS FOR 1875.

MONTHS.	THERMOMETER IN THE OPEN AIR.			RAIN AND SNOW.		CLOUDS.	WINDS. PER CENT. OF TIME AND FORCE.				BAROMETER. BAROMETER HEIGHT REDUCED TO FREEZING POINT.			FORCE OR PRESSURE OF VAPOR, IN INCHES.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.		
	Maximum.	Minimum.	Mean.	Am't of rain or melted snow in gauge, inches.	Depth of snow, inches	Mean per cent of sky.	Northwest.	Southwest.	Southeast.	Northeast.	Maximum.	Minimum.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
January, . .	35.5	-8.2	16.73	2.896	23.0	46	65	3	14	18	30.327	29.271	29.865	.140	.019	.070	100	40	69
February, . .	50.0	-4.0	17.53	3.620	11.0	39	68	11	18	3	30.203	28.996	29.745	.334	.018	.085	100	39	69
March, . .	51.0	0.0	27.79	4.200	31.5	52	55	8	18	19	30.251	29.291	29.797	.222	.030	.115	100	35	72
April, . . .	63.0	22.5	40.80	3.329	14.5	47	59	8	21	12	30.166	29.253	29.660	.348	.063	.154	96	23	61
May, . . .	84.7	39.8	57.14	2.188	-	43	41	21	24	14	30.030	29.215	29.666	.599	.078	.267	96	19	57
June, . . .	89.0	48.5	65.84	2.888	-	44	33	26	33	8	29.977	29.430	29.721	.866	.217	.462	97	28	72
July, . . .	91.5	53.8	69.30	8.149	-	42	33	23	35	9	29.989	29.461	29.696	.874	.293	.540	00	37	76
August, . .	84.8	52.0	68.94	6.165	-	54	28	10	56	6	30.077	29.499	29.783	.829	.316	.589	100	45	84
September, . .	84.7	32.5	57.27	4.649	-	40	46	23	20	11	30.174	29.300	29.732	.755	.160	.381	100	37	77
October, . .	70.3	26.0	47.90	3.887	-	55	50	19	23	8	30.201	29.071	29.694	.510	.123	.258	97	24	75
November, . .	56.2	-1.0	33.11	3.974	1.0	46	70	9	12	9	30.421	29.201	29.767	.353	.023	.137	98	25	69
December, . .	55.0	-9.0	28.26	1.032	6.0	67	65	11	19	5	30.391	28.923	29.679	.255	.015	.119	97	26	70
YEAR, . .	91.5	-9.0	44.22	46.977	87.0	48	51	14	25	10	30.421	28.923	29.734	.874	.015	.265	100	19	71



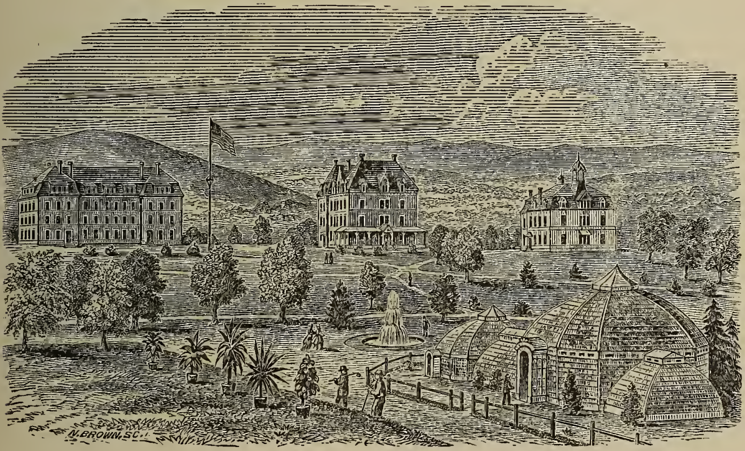
MASSACHUSETTS AGRICULTURAL COLLEGE.

SENATE...... ......No. 45.

FOURTEENTH ANNUAL REPORT

OF THE

Massachusetts Agricultural College.



January, 1877.

BOSTON:
ALBERT J. WRIGHT, STATE PRINTER,
79 Milk Street (corner of Federal).
1877.

Commonwealth of Massachusetts.

State Board of Agriculture, Secretary's Office,
State House, Boston, Feb. 19, 1877.

To His Excellency Alexander H. Rice.

Sir:—I have the honor to present to your Excellency and the Honorable Council the Fourteenth Annual Report of the Trustees of the Massachusetts Agricultural College.

Very respectfully,
Your obedient servant,

CHARLES L. FLINT,
Sec'y of the Board of Trustees.

Commonwealth of Massachusetts.

EXECUTIVE DEPARTMENT,
BOSTON, February 19, 1877.

To the Honorable Senate:

I have the honor herewith to transmit, for the information and use of the General Court, the last Annual Report of the Trustees of the Massachusetts Agricultural College, with accompanying documents.

ALEXANDER H. RICE.

ANNUAL REPORT.

To His Excellency the Governor and the Honorable Council:

The Trustees of the Massachusetts Agricultural College respectfully submit their Report for the year 1876.

It is gratifying to be able to state that the College has paid all its expenses for the past year, and that the debt which it had at the outset has not been increased. The income for the year may be briefly stated as follows:—

From State Endowment Fund,	$15,178 66
Appropriation by Legislature,	5,000 00
Term bills,	5,500 00
	$25,678 66

The expenses have been,—

For Salaries and instruction,	$19,032 50
Repairs, etc.,	5,079 35
Interest,	822 80
	$24,934 65

The income of the fund, with the addition of the high charge of $100 a year for tuition and room-rent, it will thus be seen, is inadequate to meet the necessary expenses of the institution and to maintain its efficiency. The Trustees are unable to see how the expenses can be reduced to a much lower figure than they have been during the past year, without seriously crippling the usefulness of the College, and they are reluctantly compelled to ask the Legislature for an appropriation of $5,000 to meet the deficiency of income for the present year.

The salaries paid, which constitute the large item of expense, are already far smaller than are usually paid in the High and Grammar Schools of our large cities. Boston, for example, pays the head masters of its High Schools $4,000 a year; the masters of its public Grammar Schools $3,200 a year, and even its sub-masters $2,600, while the salaries of our professors, men of high culture and capable of doing the best of work, are only $2,250. Any reduction of those salaries, it is evident, would be unjust, and would work great hardship. We could not pay less and expect to secure the services of accomplished men to fill those responsible positions. The College is indeed fortunate in having secured so able a corps of instructors, when similar positions in other fields of labor command so much more liberal rewards, and in having been able to retain so thoroughly strong and able a faculty on such a pittance as we are compelled to offer. They are all men devoted to their work, and they deserve the entire confidence, coöperation and sympathy of the community.

It is believed to be impracticable, moreover, to reduce the teaching force of the College below its present limits. One professorship has been vacated by the action of the Trustees during the past year, for the express purpose of keeping the expenses within the income; but this reduction has its limits, and to carry it further would be to cripple the efficiency and injure the reputation of the institution, for it is to be considered that the studies pursued must be such, in variety, in extent, and in value, as shall meet, in good faith, the requirements of the Act of Congress, to which we are indebted for the original endowment. In accepting the grant, the State obligated itself to fulfil its conditions, and it is presumed that it meant to do it honorably, and without any mental reservation of a compliance with the letter, and not with the spirit, of the gift. The spirit of the Act of Congress implies something more than the maintenance of a mere manual labor school. We must give a broader and more generous culture. We must do something to educate the mind as well as the hand, and make intelligent men and good citizens of our graduates, who are to go out into the world where they will be compared with the graduates of other institutions, whose leading idea is culture based on the classics. The fundamental idea of the course at the Agricultural College, is based on training in the natural sciences, and it is claimed that they constitute a better preparation for the work of practical life than mere classical culture; but it is obvious that some literary training must go along parallel with the scientific course, or our graduates would leave us very ill prepared to meet with those whose preparation had been more elaborate. The students of most other colleges have several years of preliminary training as a requisite for admission. They are required to come up to a high standard before they are allowed to enter upon their college course. Our students, on the other hand, come from the farms and the common schools, and it is obviously impossible to expect or to require so elaborate and extended a preparation as a condition of admission. Hence, there is an imperative necessity for a reasonable degree of general training and instruction in studies other than those directly connected with agricultural sciences.

It is practically impossible, also, to increase the income to be derived from tuition and room-rent, except by an increase in the number of students. These items are already far too high. We know of no similar Agricultural College in the country where they are so high, and in most of them the tuition is absolutely free. It is incredible that the State should proceed to establish an institution for the benefit of a particular class of its citizens, and then fix the cost of the enjoyment of the facilities offered at a price which practically excludes a large proportion of the very class which it was designed to instruct.

The Trustees, in the management of the College, have no personal ends to subserve. They have not sought the responsibility which has been placed upon them. They are not paid for their time or their services. They have regarded themselves as merely the agents of the Commonwealth, charged with certain duties which they desire conscientiously to fulfil, to carry out the intentions of the law under which they act, and to maintain an institution which shall be an honor and a credit to the Commonwealth and the country. They appeal, therefore, with confidence to the Legislature, to take measures which shall place the College on a stronger basis of future growth and prosperity.

The Trustees are of the opinion that a "Labor Fund," or else a comprehensive system of scholarships, should be established for the benefit of the institution. Either would have the effect to give it a large number of students, and thus provide the means for enlarging its sphere of usefulness, and render it entirely independent of the state treasury. Suppose we had a labor fund of $50,000 or $100,000, the income of which could be used to pay a fair and liberal compensation for the labor of students. We have plenty of work on the farm, in the plant-houses, and about the buildings, but little or no money to pay for it. The labor which would be, to a certain extent, educational, would, at the same time, enable the student to pay his way, preserving a certain degree of manly independence of feeling, and increasing the income of the College by the payment of a reasonable charge for tuition.

The scholarships established and maintained by some of the agricultural societies have enabled several young men to avail themselves of the ample facilities for an education which the College offers, men who could not have remained there without this assistance. Such scholarships have thus done great good, but their number is too limited to meet the wants of the institution. How shall their number be increased? The Trustees hesitate to apply to the Legislature for a sum at all adequate to meet the case, while application to individuals would certainly be a slow and hopeless effort. There seems to be no method so just, so simple, and so little burdensome to the state treasury and to the public, as to set apart a certain percentage of the surplus of what is commonly known as the "Dog Fund." The small fraction of fifteen per cent. of this surplus would be sufficient to establish a scholarship in every representative district in the State, or something over two hundred in all. It would infuse vitality into the College, and render it wholly independent of the state treasury. Such scholarships should be awarded on a fair competitive examination, and thus they would operate as a stimulus to exertion throughout all the public schools of the State, since they would become a reward for faithfulness and proficiency in study, and secure a more direct connection of the College with our public school system.

The Trustees recommend this course with all the more confidence from the fact that the "Dog Fund," as it is called, had its origin in the State Board of Agriculture, without whose earnest and persistent efforts it would never have been formed. That a small percentage of the unused surplus of the fund accruing from licenses should be set apart for encouraging agricultural education, seems but just and equitable.

It ought to be kept in mind that the benefits to be derived from the College, not only from the education to be imparted there, but especially from the investigations which have been undertaken and which are carried on there, will eventually accrue to every man, woman and child in the Commonwealth, and that it is for the interest of all that it should be sustained and strengthened, and that its possibilities for good should be developed to the utmost. The plan suggested for establishing a labor fund, or for organizing a system of free scholarships, seems to be the most feasible, and the least burdensome to the public, of any that can be devised.

The great want of Massachusetts agriculture of the present day is a series of accurate, careful and scientific experiments, extending over a sufficient period of time to determine positively and authoritatively the vast number of questions that are constantly coming up in the experience of every farmer and every gardener who cultivates the soil. There is a vague notion among the people that this is the work of the Agricultural College, and that it is the peculiar duty of that institution to arrange and carry on a broad system of investigation and experiment, as if it had no other work to do, and with all the appliances which an adequate plan of experiment implies.

The College has never refused, nor is it at all inclined to refuse, to meet the wants of the farming community in this direction. It should be borne in mind, however, that experiments, to be of any value, require not only great time and ability, but a liberal expenditure of money, and that the Trustees have absolutely no money at their disposal for this purpose. All that has been done there, by way of experiment, and it is by no means inconsiderable or unimportant, has been the voluntary contribution of time and labor on the part of men who are already overworked in the routine duties of instruction, for which they are but too poorly paid. Neither the Trustees nor the community can have any just claim upon them for the extra time demanded, or the sleepless vigilance required, to conduct any series of accurate experiments to a successful and satisfactory conclusion.

Could the college farm, or a portion of it, be recognized and established as an experiment station, and provided with the requisite means, it would go far to meet a great and growing public want, and do more real good for the agriculture of the present and the future of the Commonwealth than any other agency. Experiment stations are recognized as a necessity, and sustained as such, by the most enlightened governments in the world. A very large part of the progress and development of German agriculture, during the last quarter of a century, is due directly to the liberal support of experiment stations. They form a conspicuous feature of the comprehensive system adopted by the government for the development of the agricultural resources of the empire. The results have abundantly justified their organization, and placed the farming of Europe in the front rank among the industries of all civilized nations.

In 1851, fully a quarter of a century ago, the first experiment station was founded at Moeckern, in Saxony, and it soon proved to be so useful, and secured the confidence of the common people to such an extent, that the idea soon spread through Germany and into other countries, till, in 1868, there were no less than 28 stations in full and successful operation, and now the number is increased to 62, sustained largely by governments, but with the coöperation of individuals and agricultural societies. They have proved themselves of immense service, and are rapidly increasing in number and efficiency, while at the same time the agricultural colleges and schools are more numerous and better sustained than they are in this country.

But an experiment station costs money. The Trustees of the Agricultural College have not the means to organize it without the aid of the Legislature. The French government, always studious of the interests of the people and its own financial strength, sent a thoroughly competent man, M. Grandeau, to visit and study the experiment stations of Germany, and he reported to the French Minister of Agriculture that a useful station could be started for $6,000, and that it would cost about $3,000 a year to maintain it. The expenses of the Prussian stations vary from $800 to $4,000 a year, according to the completeness with which they are organized and equipped, and the number of scientific men employed. They would cost more in this country, but the cost will depend very much upon the amount and kind of work required of them.

The work of an experiment station requires not only land sufficient for field operations, but especially chemical and physiological laboratories. All these appliances are at hand at the Massachusetts Agricultural College, and it would involve little additional outlay on the part of the State or the College to organize a station on the most thorough basis. The quantity of land required for experimental purposes is not large. A portion of the college farm could be set apart for these objects without material detriment to the interests of the institution, while the laboratories would furnish immediate facilities for scientific investigation.

Every farmer recognizes the fact that most field experiments, to be of any great general and permanent value, require to be carried on through a series of years, and that they require great expense. But that they pay, and pay abundantly, for the outlay, is now universally recognized by farmers throughout Germany, who contribute largely and cheerfully for their support, in the form of small fees for analyses. It may be stated, also, that the work of the German stations has become thoroughly systematized by the division of labor, each one taking some special line of investigation, and leaving other specialties to other stations. The station mentioned as having been first founded at Moeckern, for instance, now confines itself chiefly to studies and experiments in the nutrition of animals, and some of the stables on the farm are set apart for the cattle required. Other stations are confined specially to experiments in fertilizers and the nutrition of plants, to animal and vegetable chemistry and physiology. Agricultural research, the discovery of new truth and the test of older theories, is the work of them all, to be sure; but the field is so vast that experience has dictated the economy of division of labor. And so it may be argued that we need numerous stations in various parts of the Commonwealth, and it is true; but we shall never have a system of such invaluable institutions unless we make a beginning in the establishment of one, and true economy would dictate its location in connection with the Agricultural College, where the requisite scientific appliances are already at hand.

Now, the practical point is, that such a labor fund as we have suggested would serve a most admirable purpose in carrying out this very object. The income of such a fund could be directed to the payment of the labor and time of students who would be capable, under competent scientific direction, of conducting experiments in a satisfactory manner, while, at the same time, their work would be educational in its character and of invaluable service to the agricultural community. The time cannot be far distant when the system of agricultural experiment stations, which has been found so valuable and so serviceable in Europe, will be recognized and adopted here. When it does come, it will do more than anything else to promote the rapid development of the resources of the Commonwealth.

The efficiency of the College has been maintained during the past year, and instruction has been given as usual in the various classes, with the exception of the department of veterinary science, which was discontinued for want of funds, on the 1st of July last. It is hoped that instruction in this important branch will be furnished by way of a course of lectures at least, as soon as the College has the requisite means.

The Board of Trustees are called upon to announce the decease of Dr. Nathan Durfee of Fall River, who was identified with the College from its origin, and one of its most liberal individual patrons. Dr. Durfee had given generously, not only of his means, but of his time and thought, to promote the growth and prosperity of the institution, and had served for several years as its treasurer, having resigned the office on account of bodily infirmities only a few months previous to his death. On that occasion the Board unanimously—

Voted, That the thanks of this Board are due, and are hereby tendered, to Dr. Nathan Durfee, late Treasurer of the Massachusetts

Agricultural College, for his services during its existence, especially for the generous aid and interest he has ever manifested in its behalf.

Anniversary Week.

By vote of the Trustees, this has been changed from July to June, and commenced with rhetorical exercises on Monday the 20th. The Farnsworth prizes, for excellence in this department, were awarded to David E. Baker (gold medal), and Horace E. Stockbridge (silver medal), of the class of '78; and to Joseph G. Lincoln (gold medal), and Lockwood Myrick (silver medal), of '79. The examination of the graduating class in agriculture, for the Grinnell prizes, occurred on Tuesday the 21st, and was largely attended by citizens interested in this department. The examination was well sustained by the class, and, in some cases, was of superior excellence. The first prize of $50 was awarded to George A. Parker, and the second prize of $20 to John M. Sears. The address before the College Literary Societies, in the afternoon of the same day, was delivered by the Rev. Dr. C. F. Allen, of the Maine State College, and was a pleasing and forcible presentation of the nature and high mission of the new education, with some pertinent suggestions concerning the benefit to be derived from certain auxiliaries to the college curriculum, especially from reading, and the cultivation of the social nature. The degree of Bachelor of Science was conferred upon twenty-four graduates by the College, and the same degree was bestowed upon twenty-one of this number by the Boston University. Two others of the class are matriculants of the University and candidates for the degree of Bachelor of Philosophy. It is hoped that the advantages and responsibilities connected with membership in the body of the University Alumni will, in after-life, exert a stimulating and beneficial influence on all who enjoy the honor. His Excellency Governor Rice, in presenting the diplomas, addressed the class as follows:—

"Gentlemen:—I shall attempt little more than to congratulate you upon the successful completion of the course of study and practice prescribed by the College. The institution is peculiar, has its special design, and fills a want not otherwise or not so well provided for. In the division of labor consequent upon the increase of population, the discoveries of science and their application to the useful arts, special education seems to have become necessary; and, altogether, this may seem to be required less in respect to agriculture than to the various branches of technical industry. Yet all the interests of society are so intimately related, that the advancement of one necessitates a corresponding development of all the rest. As agriculture lies at the basis of civilization, it must have that measure of care which shall keep its supplies inexhaustible. And, although farming has been sometimes deemed the simplest of pursuits, experience and observation show that it is as greatly enhanced by intelligence as is any other avocation. The generous soils of the Western States, the ease with which they are worked, and the small cost of fertilization, and the grand scale upon which operations may there be conducted, present persuasive inducements to the young and the enterprising to leave the older States and go West to embark in the pursuit of agriculture under those favorable conditions. Perhaps it is in this point of view that the study and practice of our agricultural college may appear to great advantage, by teaching how to overcome natural deficiencies of soil by scientific and artificial means, and thus, also, how to preserve an approximate equilibrium of interest even in agriculture between these widely separated localities. For, while the one of them may be, and is, better adapted to some branches of this industry, and especially to those whose products look to exportation for a market, the other offers profitable remuneration for other products adapted more especially to home consumption. I am told that no branch of farming has been more profitable, in proportion to the capital invested and the labor expended, than such as is carried on in localities near our cities and large towns, which furnish a ready and constant market and immediate returns to the producer. With better knowledge of the elements and combination of soils, and of the appliances of chemical agencies and skill in their treatment, the nature of the original and sterile formations may be so changed as to become new and productive; and the use of new tools and machinery, and the judicious selection and distribution of crops admit of so wide a range, that agriculture is seen to be as progressive as any of the mechanic arts, and by similar means and influences. Moreover, the increased and constantly cheapening facilities of communication are daily bringing every acre of the Commonwealth nearer to points of consumption, and thus it seems not extravagant to hope that the wealth and prosperity of the State will increase from the growth of intelligent farming, in a degree not disproportionate to that which flows from her manufactures or commerce.

"The value of agriculture, in the moral and social influence which it is capable of giving to society, is inestimable. Standing, as it were, apart from the fret and strife of mercantile pursuits, and free from the hazards which sweep off the earnings of a life-time in a single year of disaster, free from that fearful brain-wear which sends so many of our business men to early graves or to premature imbecility, and free, also, from that absorption in the pursuit of gain which is liable to subordinate the tenderest and noblest attributes of human nature, agriculture offers a rational and more tranquil life, a closer communion with nature in her simplicity and in her diviner revelations, and that healthy physical development which, with a cultivated mind, furnishes the brightest promise and the best condition of happiness. Nor is knowledge, in any of its departments, limited in value to that specific application. Knowledge is to be regarded as a means, rather than an end—as an instrument, rather than as a consummation. Cicero says that all the arts are linked together by a common bond, and so a well-cultivated mind is an elastic force, capable of universal application.

"In closing your connection with the College, young gentlemen, and turning your backs upon these familiar scenes, almost necessarily endeared to you by tender and enduring associations, let me exhort you to step into your places in the world with high aims and manly confidence. Success will depend somewhat upon opportunity, but much more upon character and determination. It is not given in the economy of Providence that all men shall become great, but all may become honorable and useful; and these qualities in the final account are of the greatest value. Be content to begin somewhere. Make your opportunity, if none is presented; utilize the gifts and advantages which this institution has bestowed upon you, and follow from these beginnings to more liberal attainments, with the assurance that every addition to your knowledge will increase your facilities and ensure your success.

"One of the wisest of counsellors has said: 'If any young man has embarked his life in the pursuit of knowledge, let him love her with a vehement love, with a love coeval with his life; let him not be intimidated by her cheerless beginnings, by the darkness out of which she springs, by the difficulties which hover about her, by the wretched habitation in which she dwells, by the want and sorrow which sometimes journey in her train. But let him follow her as an angel that will guard him, as the genius of his life. She will bring him out at last into the light of day, and exhibit him to the world, comprehensive in acquirements, fertile in resources, rich in imagination, strong in reasoning, prudent and capable above his fellows in all the relations and all the affairs of life.' Commending the hope and encouragement which these sentences contain to your cordial reception, I bid you God-speed in the new career which this day opens before you. Add to your intellectual culture, industry, sobriety, purity, and godliness, and, whatever else you may find in your experience, you will find that wisdom's ways are indeed the ways of pleasantness, and that all her paths are peace."

For the details of the work upon the farm and in the several departments of instruction, reference is respectfully made to the statements of the various professors which accompany this Report.

By order of the Board of Trustees,

CHARLES L. FLINT, *Secretary.*

BOSTON, February 19, 1877.

AGRICULTURAL DEPARTMENT.

To the Trustees of the Agricultural College.

GENTLEMEN:—It affords me pleasure to be able to report of the agricultural department of the institution, that though meagrely equipped, and in want of many things required for its greatest usefulness and final success, yet, during the past year, the system of instruction and assigned routine of duty have been successfully maintained, and with the cheerful coöperation of the students. The reduction in the price paid to students for their labor, from fifteen to ten cents per hour, and the employment of them as little as possible beyond their regular required labor, though it has saved the College some expense, has had a discouraging influence upon those who were largely dependent on this labor for support while remaining at the College. It has made it very difficult for them to continue their course, and, in many instances, has prevented such students from entering the institution. In its extremity the College is undoubtedly employing all the labor it can pay for, and at as high a rate of wages as it can or would be justified in paying. But that the institution, or its agricultural department, may accomplish the design of its organization, it appears to be imperative that at a very early day some scheme should be devised and put in operation, which will give students abundant labor at remunerative wages, or that the cost of tuition and room-rent should be materially diminished. The series of experiments in feeding plants with chemical substances, of which a detailed account was given in the last report, has been continued the past season, and a new series upon sixteen different plots of land has been instituted, to see if the gathering of nitrogen by the plant is governed by natural law, and can be reduced to a rule of practice. The results of the experiments have been recorded, but they are not (especially the latter) sufficiently decisive to justify report at this date.

LEVI STOCKBRIDGE,
Professor of Agriculture.

BOTANIC DEPARTMENT.

To the Board of Trustees of Massachusetts Agricultural College.

Gentlemen:—I have the honor of reporting the following upon the condition of the Botanic Department.

During the winter of 1876 the senior class received instruction in the study and use of the microscope, as directed. The junior class was instructed in the various branches of horticulture, by lectures, during this term, and in the summer and fall terms by the practical application of the principles laid down in the lectures, at class-work.

Since the departure of President Clark, exercises in botany have been conducted according to directions, finishing the summer term with instruction to both the senior and junior classes in structural and systematic botany and plant analysis. During the fall term the senior class received instruction in systematic botany and analysis.

The collection of plants in the Durfee plant-house has been kept in good condition, and many additions made. Owing to the growth of many of the specimen plants, the house has become so crowded as to necessitate the removal or destruction of some of the more common ones, to make room for the more valuable. This increased growth must limit, more and more each year, the amount of space that can be devoted to the growth of plants for the trade. The house is very much in need of repairs, and, unless painted, the woodwork will decay very rapidly.

The stock of bedding-plants on hand was never as large at this season of the year as at present. The nursery is well stocked with ornamental trees and shrubs, many of which are now in the best condition for transplanting. A large number of fruit-tree seedlings has been grown the past season, of which a fine lot of peach seedlings were successfully budded about the first of September. Many more seeds of fruit and ornamental trees were planted before the freezing of the ground in the fall.

The fruit-trees in the young orchard have made a good growth, and many varieties have been added the past season.

The vineyard has not made as good growth as could be desired, owing to the drought and the want of fertilizer. The vines have been very free from disease, but the phylloxera, or grape-vine aphis, so destructive to the vineyards of Europe, has made its appearance. Upon careful examination the root form was found upon the roots of every variety (about thirty) in the vineyard. The leaf form was found upon the foliage of but three or four varieties, such as the Clinton, Agawam, etc.

Of the small fruits, a few plants of a large number of varieties were purchased in the spring, which will be propagated for sale and experiment.

The amount received from the sale of plants the past season, notwithstanding the hard times, has been somewhat larger than ever before, and if it be deemed advisable for this department to compete with the trade, it can be still further increased by the use of more hot-beds and cold frames.

We are laboring under a great disadvantage in the trade department, in that our markets are so far away, and there being no direct railroad communication with any of them. We need, very much, one horse at least, independent of the farm teams, to carry our plants to the adjoining towns during the spring trade.

I desire to call attention to the fact that we are cultivating a large number of species and varieties of fruit and ornamental trees, shrubs, small fruits, and herbaceous plants for experiment and future use, and bedding-plants for the decoration of the grounds around the green-house, farm-house, and other college buildings, from which no return whatever is received, and which require a liberal use of manure for their successful growth.

No provision is made for this expense, except that the farm furnishes the fertilizing material, which is paid for from the funds of the botanic department. I would therefore respectfully ask that one hundred and fifty dollars ($150) be allowed the department the coming year for fertilizers.

Very respectfully submitted.

S. T. MAYNARD.

AMHERST, January 18, 1877.

MENTAL, MORAL, AND SOCIAL SCIENCE DEPARTMENT.

To the Secretary of the Board of Trustees.

SIR :—The Department of Mental and Moral Science regards the Agricultural College as designed not so much to "make men farmers," as to make farmers men, in every sense ; or, more precisely, to raise up a highly educated class in all pursuits of the productive sort. But the physical sciences crowd so hard in such an institution, that only one term, namely, in the senior year, can be given to mental and moral philosophy.

My labor has been, therefore, chiefly in other departments, not otherwise provided for,—for the most part in that of rhetoric and elocution. I have had charge of the exercises in English composition and in declamation, which are required of all the classes every term, except during a portion of the junior year ; and I have also had the seniors one term in a text-book of rhetoric. The teaching of elocution has been largely by the method of private drill ; and this, with the special drill for public occasions, as well as the painstaking criticism of essays, has consumed much uncounted time. The system adopted and carried out more fully the past year, has shown its results in the degree of excellence that marked our speakers on two occasions of the last commencement week.

Besides these studies, I have had one term each in geology (twenty-four lectures), physical geography, and physiology ; also one term in the theory of landscape gardening, as a system involving the study of nature and of art.

The chaplaincy, formerly attached to my duties, was given up at the close of the last summer term, in consideration of increased work, as above indicated. In respect to the students, who now attend whatever village church each may select, it is hoped that Sunday services will be less a college task, and will have a more inspiring social element.

Respectfully submitted.

H. W. PARKER.

REPORT OF FARM SUPERINTENDENT.

SIR:—I have the honor of submitting the following report: My duties as farm superintendent at the Massachusetts Agricultural College commenced April 1, 1876. My appointment to this department took place about three weeks prior to this date, consequently time for perfecting plans for the coming season's work was very limited; but with the kind assistance of the executive committee and Professor Stockbridge, the work has been accomplished in quite as satisfactory a manner as could be expected. I believe, without an exception, every crop was put in at the proper time.

Crops Grown.—In every instance I am unable to give the exact number of acres devoted to each crop, as I did not have time to make a survey before winter closed in. Of corn, there was about sixteen acres, and the yield was 1,800 baskets of ears. The crop of potatoes was small, on account of the excessive drought, and upon two acres a little over 200 bushels, marketable size, were harvested. Five acres were devoted to turnips, and instead of 4,000 bushels, which the land would have produced easily but for the dry weather, only 2,500 bushels were harvested. About twelve acres were devoted to oats, and 450 bushels of very nice grain were harvested. A small piece of early cabbage paid a very handsome profit, and, were it not for our distance from market, I can but believe this crop would be very remunerative. The late cabbages furnished many tons of excellent fodder, but were otherwise an unprofitable crop. The hay crop, which, in my opinion, is by far the most profitable for us to grow here, amounted to 115 tons; and the same area which produced this amount could easily be made to produce more than 350 tons of first-class English hay.

Some improvements have been made upon the land. A large amount of grading each side of the brook, near the ravine, was accomplished in August. A ditch, eight feet wide and three feet deep, was dug previous to the grading, to allow of the free passage of water. Two of my men and myself dug this in about three days' time, much to my astonishment and gratification, as I thought it would be a long job before we commenced. A large amount of excellent material for manure was obtained from this source. Another improvement was the ploughing and partial underdraining of the piece south-west from the old farm-house. The oldest farmers about here say it has never been ploughed before within their recollection.

From some cause unknown to myself, the land, the foundation of all our success in agriculture, shows only too plainly the great lack of manure, cultivation, and underdraining. I have used every available means for the increase of the manure-supply, and think that by April 1st there must be 1,000 loads of excellent manure in the barn cellar. Since June 20th none has been removed, and an average of fifty loads of loam a month has been used ever since in the stables. I trust that hereafter not a piece will be seeded without first receiving a liberal dressing of some good fertilizer.

A matter which may seem of minor importance, I beg leave to mention at this point, and it is in regard to the teamsters, teams, machines, and implements. Whoever superintends the farm must labor under a great disadvantage as long as the present arrangement exists. During the busiest part of the season, there was not a morning for six weeks that I did not go to the buildings at the north end of the farm before seven o'clock to inform my teamsters of their work for the day, thus saving them and their heavy teams the trouble of coming to me for their orders. From April 1 to December 1, not once did the teamsters drive to my house to know what they were to do for the day, and the result has been a greater saving of time, say nothing of the wear of the teams, than one can imagine.

I am obliged to hire most of my help at a disadvantage, on account of not being able to board them, and this is more clearly shown during vacation than at any other time. It is well known that there is a large number of cows to be milked at all seasons of the year, and during vacation, this work, which can be economically done by students in term time, must be attended to by others. The past season I have done a good share of this work myself, but many times I found it practically impossible to attend to it. To come to the point, the head teamster should have a house, connected with which should be a good convenient horse-barn and room for tools and machines, near the residence of the superintendent. This arrangement would enable one to give directions with ease at any minute; machines and implements could then be easily looked after, and, best of all, help could be hired in such a way that their services would be available morning and evening, when they are needed as much as at any time during the day. The old barns at the north end could be economically used for storing hay.

A much-needed addition is a suitable team for use at the plant-house during the busy time in the spring. Many times I have neglected the business of the farm for the sake of accommodating this department with a team, and as the business is rapidly increasing, much more team-work will be required.

The amount of butter made since April 1st is 1,600 pounds, a trifling amount, to be sure, when compared with what might be produced could the cows have the best of feed the year round.

The stock, as a rule, has been very thrifty, and disease has not troubled in any form. The herd consists of the following animals:—

Shorthorns.—Bulls: Baron of Grass Hill, and Roger. Cows and heifers: Belladonna and calf, Estella and calf, Peach Bud, 8th, Aurora, 4th, and calf, Isabella and calf, Yucatan and calf, Mabel, Yucatella, Bella Wilfer, Fairy Belle, 3d, Rosa Belle, Geraldine, Zenobia, Belle Amie, Barbara. Total, 21.

Ayrshires.—Bulls: Pict of Picts, Earl of Windham. Cows and heifers: Flora and calf, Prudence, Lulie, Jennie, Rosa, Beauty, 12th, Leilah and calf, Amelia, Little Emily, Emeline, Beauty, 13th, Cora, Hortense, Sarah Alice, Geneviève. Total, 20.

The calf Geraldine, dropped April 27, 1876, weighed, January 22, 1877, 652 pounds. This, of course, is not a remarkable weight for an animal that has been crowded, but for common fare I call it extra. She is a fine animal, to say the least. Some of the cows show well as milkers. Belladonna, Aurora, 4th, and Isabella have given, respectively, 23, 20, and 17 quarts per day. These are Shorthorns. Leilah and Jennie, two months after calving, Flora and Beauty, 13th, eight months after calving, are giving, respectively, 20, 17, 18, and 10 quarts per day. These are Ayrshires.

Dutch.—One cow, one bull. Total, 2.

Brittany.—One cow, one bull, and calf. Total, 3.

Jerseys.—One bull, one cow, two yearlings. Total, 4.

Total number of herd, 50.

Swine.—One Berkshire boar, one Berkshire sow, and five Berkshire pigs—7. One Yorkshire boar, two sows, grades. One Chester boar, one Chester sow, and three Chester pigs—5. Eight grades for fattening. Total, 23.

Horses, 6; sheep, 8.

Light Brahmas, Plymouth Rocks, Partridge Cochins, White Leghorns, and a variety of mixed fowls make up the poultry department.

The Executive Committee, ever ready to furnish means for reasonable improvements, ordered the erection of a building for the better accommodation of the dairy, and this has been most successfully completed. It contains a set of empire pans, four in number, each being large enough for the milk of fifty cows. The interior arrangement was most admirably completed by Mr. Lee, of the firm of Dickinson & Lee, Amherst, Mass.

A new engine-house has been erected, and a fine new engine, the gift of Hon. William Knowlton of Upton, Mass., furnishes power for cutting fodder, roots, and steam for cooking. A most desirable addition would be a grist mill and threshing-machine. It will cost $150 this year to do the grinding. Water has been introduced into the barn. The farm buildings have received a good coat of paint, and, by the generosity of Mr. Knowlton, the barn received a second coat.

It would be an injustice to close this Report without alluding to the promptness and good behavior of my help, and especially the teamsters, who have been ever ready, early and late; also, my brother, who has conducted the dairy in a most satisfactory manner. The students have rendered valuable assistance in the various departments.

I am indebted to John C. Dillon, Esq., my predecessor, for valuable assistance.

Respectfully submitted.

A. A. SOUTHWICK.

PHYSICS AND CIVIL ENGINEERING DEPARTMENT.

To the Trustees of the Massachusetts Agricultural College.

Gentlemen:—During the past year instruction has been given in the various branches of mathematics, as prescribed in the curriculum of study, with a single exception. By special order of the President, the subject of surveying is deferred to the third term of the present year. In astronomy, the class has made use of the opportunities afforded by the Amherst College observatory. The subject of physics has been taught by text-book and experimental lectures combined.

The interest exhibited by the students has been commendable, and their progress unusually good. Could the standard for admission to college be raised, a more extended and satisfactory course in both pure and applied mathematics would be possible. It would be better if the subjects attended to during freshman year were mastered in the lower schools.

The department of engineering is well furnished. That of physics is less fortunate. Its equipment stands quite in contrast with all the other departments of the College.

The apparatus which we have covers the subjects of mechanics, electricity, and magnetism. But it is not complete as far as it goes. The most expensive instruments have been purchased, and hence a small sum of money would be sufficient to make it complete.

There is *no* apparatus to illustrate the principles of *sound* and *light*. I would, therefore; recommend that one hundred dollars ($100) per annum be appropriated for the purpose of keeping in repair the apparatus which we have and purchasing such instruments as are needed to supply deficiencies.

I would also urge the importance of an early consideration of the question of completing the equipment of the department. The present condition of the apparatus renders it very difficult to give a systematic and well-rounded course of instruction in physics.

It should also be borne in mind that after the appropriation is made and the orders given, at least two years must elapse before the orders will be filled. This for the reason that most of the apparatus must be purchased abroad, and that manufacturers are never in a hurry.

Respectfully submitted.

WM. B. GRAVES.

AMHERST, January 17, 1877.

THE CHEMICAL DEPARTMENT.

The regular instruction in the various branches of theoretical and experimental chemistry, as prescribed in the course of studies for the freshman and the sophomore classes, have been given during the past year as in previous ones. The attendance of both classes has been regular, and their progress, on the whole, satisfactory. Several students of the advanced classes, besides five graduates of the College, have availed themselves of the opportunities offered by me to continue their studies in practical agricultural chemistry.

Besides my regular class duties, considerable time and attention have been devoted to analytical inquiries of various descriptions, which in part already have been published in a leading agricultural paper of this State. Among those not yet presented are the following investigations of a more general interest to agriculturists :—

1. The chemical examination of from sixty to seventy substances used for fertilizing purposes ; particular pains have been taken to study the character of waste products of various branches of home industry, with reference to their commercial and agricultural value.

2. Observations regarding the progress of the productiveness of the reclaimed salt-marshes at Marshfield.

3. Analytical inquiries into certain prominent alterations in the chemical composition, during their growth, of grapes, apples, and pears.

Each of these subjects will be duly reported in detail shortly, as a mere abstract of the work must fail to convey a satisfactory idea regarding the results thus far obtained.

Submitted very respectfully.

C. A. GOESSMANN,

Professor of Chemistry in the Massachusetts Agricultural College.

AMHERST, January 16, 1877.

THE MILITARY DEPARTMENT.

To the Secretary of the Trustees of the Massachusetts Agricultural College.

SIR :—I have the honor to submit the following report :—

The progress in the military department during the past year has been satisfactory. The small number of students now in College naturally limits this department in its endeavor to realize all its possibilities ; but the scope of instruction, as published last year, has been increased rather than curtailed (and this without the employment of any extra time), and the students seem to realize more fully the importance of the training placed in their reach by the government.

The armament of the College has been considerably augmented during the past year. In the spring term (1876) two 8-inch mortars, with their platforms and equipments, and some forty 8-inch mortar shells were received from the Ordnance Department. Mortar drill and firing practice has thus been added to the practical course, and assigned to the junior class.

During the fall term (1876), with the assistance of the senior class, the plan of a mortar battery, to be called "The Centennial Battery," was laid out upon the site granted for that purpose by the Trustees, and the work of its erection heartily undertaken by the entire College. Considerable assistance was afforded by the farm superintendent with ploughs, scoops, and horses, and the work pushed to half completion before the arrival of winter caused it to be suspended. It will be resumed early in the spring, and made ready for the reception of its armament as soon as possible. The College also stands indebted to the Ordnance Department for a considerable supply of ammunition for the 12-pound battery and small arms. It is earnestly recommended that the Trustees appropriate the small sum of fifty dollars ($50) for the erection of a suitable *magazine*, of small capacity, to contain such stock of ammunition as may from time to time be received and accumulate on hand.

The cabinet referred to in my last report has received some additions during the year. It is a fair beginning towards a military museum, and may be made one of the most practical as well as interesting collections at the College. The military library has also increased somewhat in size through the gratuity of various bureaus of the War Department at Washington.

This department has for some time had in view a special diploma, to be given to such graduating students as have shown marked proficiency and interest in military matters. The plans are now complete, the designs being a suitable combination of those found upon the state and regular commissions, and it is expected to strike them off in time for the present seniors. The attainment of such a certificate will not only be an additional incentive to earnest application on the part of the student, but the possession of such a paper is certainly the right of each deserving one, as an evidence of special fitness, entitling him to more than ordinary consideration should his services be needed by his State or country.

During the fall term, there was held at Chester, Penn., the first congress of army officers, serving as professors of military science and tactics at American colleges. The Massachusetts Agricultural College was duly represented, and the subject of military education earnestly canvassed. The convention elicited considerable interest, and is to be followed in time by others. The thirty infant military schools now included in this association have an important future, and it is gratifying to see that military journals, which a year ago first noticed them, are growing more and more earnest in their support. Our government cannot afford to overlook the thirty-five hundred young men that are now yearly fitting to officer her *future armies*.

The introduction of military essays into the senior course has been very successful, and has increased very much the scope of the instruction. The prize essay of the last class, on the subject of "The Military Future of America," was written by Cadet William A. McLeod of Lonsdale, R. I.

The subject for the present senior class is "The Military Resources of America."

The department still continues to have charge of the instruction in the subjects of roads and railroads, and drawing. These subjects are military as well as agricultural, and fittingly come under its care. The seniors are now receiving instruction in topographical drawing, with a special view to farm and military maps; the juniors and sophomores are engaged in instrumental drawing, while the freshman course is in freehand and sketching.

A good-sized volunteer class is being instructed in the fencing exercise, and all the classes will be drilled in target practice during the year over the college range.

Two very interesting series of experiments have been conducted by this department during the year. The one has had for its study a new artillery powder, manufactured on the accelerating and compensating principle; the other has resulted in the invention of a new shell for signal purposes and ornamental fireworks, and which has received the name of the "*College case*," in honor of this institution. I reserve for some future communication the discussion of these two subjects.

I am, sir, very respectfully,
Your obedient servant,

C. A. L. TOTTEN, *U. S. A.*,
Professor of Military Science and Tactics.

CATALOGUE

OF

TRUSTEES, OVERSEERS, FACULTY, AND STUDENTS.

1876.

TRUSTEES, OVERSEERS, FACULTY, AND STUDENTS.

BOARD OF TRUSTEES.

MEMBERS EX OFFICIIS.

HIS EXCELLENCY ALEXANDER H. RICE.
WILLIAM S. CLARK, LL. D., *President of the College.*
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CHARLES L. FLINT, *Secretary of the Board of Agriculture.*

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HENRY L. WHITING,	CAMBRIDGE.
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DANIEL NEEDHAM,	GROTON.
WILLIAM KNOWLTON,	UPTON.
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WILLIAM S. CLARK, Ph. D., LL. D.,
President and Professor of Botany and Horticulture.

LEVI STOCKBRIDGE,
Professor of Agriculture.

HENRY H. GOODELL, M. A.,
Professor of Modern Languages.

CHARLES A. GOESSMANN, Ph. D.,
Professor of Chemistry.

HENRY W. PARKER, M. A.,
Professor of Mental, Moral, and Social Science.

WILLIAM B. GRAVES, M. A.,
Professor of Physics and Civil Engineering.

First Lieut. C. A. L. TOTTEN, Fourth Artillery, U. S. A.,
Professor of Military Science and Tactics.

A. S. PACKARD, Jr., M. D. (State Entomologist),
Lecturer on Useful and Injurious Insects.

M. FAYETTE DICKINSON, Jr.,
Lecturer on Rural Law.

GEORGE MONTAGUE,
Instructor in Book-keeping.

SAMUEL T. MAYNARD, B. S.,
Gardener and Assistant Professor of Horticulture.

A. A. SOUTHWICK, B. S., Farm Superintendent.

GRADUATES OF 1876.*

Bagley, David Appleton, ...	Winchendon.
Bellamy, John, ...	Boston.
Chickering, Darius Otis (Boston Univ.), .	Enfield.
Deuel, Charles Frederick (Boston Univ.),	Amherst.
Guild, George William May (Boston Univ.),	New York City.
Hawley, Joseph Mather (Boston Univ.), .	Salem, N. Y.
Kendall, Hiram (Boston University), .	Watertown.
Ladd, Thomas Henry (Boston Univ.), .	Watertown.
Mann, George Hewins (Boston Univ.), .	Sharon.
Martin, William Edson (Boston Univ.), .	Hadley.
McConnel, Charles Washington (Boston University), ...	Lonsdale, R. I.
McLeod, William Alexander (Boston University), ...	Lonsdale, R. I.
Parker, George Amos (Boston Univ.), .	Gardner.
Parker, George Lowell (Boston Univ.), .	Dorchester.
Phelps, Charles Herbert (Boston Univ.), .	South Framingham.
Porter, William Henry (Boston Univ.), .	Hatfield.
Potter, William Stiles (Boston Univ.), .	LaFayette, Ind.
Root, Joseph Edward (Boston Univ.), .	Barre.
Sears, John Milton (Boston University), .	Ashfield.
Smith, Thomas Edwin, ...	Chesterfield.
Taft, Cyrus Appleton (Boston Univ.), .	Whitinsville.
Urner, George Peter (Boston Univ.), .	Elizabeth, N. J.
Wetmore, Howard Graham (Boston University), ...	New York City.
Williams, John Elgin (Boston Univ.), .	South Amherst.
Total, ...	24.

SENIOR CLASS.

Benson, David Henry (Boston Univ.), .	Bridgewater.
Brewer, Charles (Boston University), .	Pelham.
Clark, Atherton (Boston University), .	Amherst.

* The annual report being made in January necessarily includes part of two academic years, and the catalogue gives the names of such students as have been connected with the College during any portion of the year 1876.

Hibbard, Joseph Robinson (Boston University), ...	Vergennes, Vt.
Howe, Waldo Vernon (Boston Univ.), .	Framingham.
Nye, George Everett, ...	Sandwich.
Paige, Harrie Cruse, ...	Tarrytown, N. Y.
Parker, Henry Fitch, ...	Amherst.
Porto, Raymundo Martins da Silva, . .	Para, Brazil.
Southmayd, John Edwards (Boston University), ...	Middletown, Ct.
Wuyesugi, Tall Katuyoshi (Boston Univ.),	Tokeio, Japan.
Wyman, Joseph (Boston University), .	Arlington.
Total, ...	12.

JUNIOR CLASS.

Baker, David Erastus, ...	Franklin.
Boutwell, Willie Levi, ...	Leverett.
Brigham, Arthur Amber, ...	Marlborough.
Choate, Edward Carlisle (Boston Univ.), .	Cambridge.
Coburn, Charles Francis, ...	Lowell.
Foote, Sandford Dwight (Boston Univ.), .	Springfield.
Hall, Josiah Newhall, ...	Revere.
Hubbard, Henry Francis (Boston Univer.),	New Rochelle, N. Y.
Humphrey, George Eddy, . . .	Rochester.
Hunt, John Franklin, ...	Amherst.
Koch, Henry Gustave Heath (Boston University), ...	New York City.
Lovell, Charles Otto (Boston University),	Amherst.
Morey, Guy, ...	Lowell.
Spofford, Amos Little, ...	Georgetown.
Stockbridge, Horace Edward (Boston University), ...	Amherst.
Tuckerman, Frederick (Boston Univer.), .	Boston.
Washburn, John Hosea, ...	Bridgewater.
Total, ...	17.

SOPHOMORE CLASS.

Baker Martin,*	Marshfield.
Campbell, Charles Henry, . . .	West Westminster, Vt.
Dickinson, Richard Storrs, . . .	Amherst.

* Died March 10, 1876.

Green, Samuel Bowdler, ...	Chelsea.
Howard, Joseph Clark, ...	West Bridgewater.
Hunt, Elisha Hubbard, ...	Sunderland.
Knox, Reuben, ...	New York City.
Lincoln, Joseph Gardner, . . .	Woburn.
Myrick, Lockwood, ...	Concord.
Osgood, Frederick Huntington, . .	Cambridge.
Palmer, Coddington Billings, . . .	Easthampton.
Sherman, Walter Alden, ...	Lowell.
Smith, George Parmenter, . . .	Sunderland.
Swan, Roscoe Westley, ...	Framingham.
Waldron, Hiram Edmund Baylies, . .	Rochester.
Total, ...	15.

FRESHMAN CLASS.

Atwood, Horace Ward (Boston Univ.), .	Orange.
Bristol, Edwin Frank, ...	Harwinton, Ct.
Carey, Willis Washburn, ...	Fishkill, N. Y.
Endicott, George, ...	New York City.
Fowler, Alvan Luther, ...	Westfield.
Hall, Alfred Sigourney, ...	Revere.
Mattocks, Euao Edward, ...	Lyndon Centre, Vt.
McQueen, Charles Manjie, . . .	Longmeadow.
Parker, William Colverd, ...	Wakefield.
Pease, Charles Truman, ...	Bridgeton, Me.
Ripley, George Arms, ...	Worcester.
Stewart, William Clark, ...	Stillwater, Minn.
Stone, Almon Humphrey, . . .	Phillipston.
Townsley, Herbert Milton, . . .	De Kalb, N. Y.
Warner, William Edward, . . .	Newton.
Wing, Edgar Russell, ...	Needham.
Wood, Lewis, ...	West Upton.
Zabriskie, Frank Hunter, ...	New York City.
Total, ...	18.

SELECT CLASS.

Augur, Charles Parmelee, . . .	Middlefield, Ct.
Bass, Edward Little, ...	West Randolph, Vt.
Carey, Charles Brown, ...	Cincinnati, O.

Carneiro, Manuel Dias,	Rio de Janeiro, Brazil.
Carvallo, William,	Santiago, Chili.
Chittenden, Edgar Davis,	Sunderland.
Collum, George Newell,	Hartford, Ct.
Cook, Rolland Chittenden,	Guilford, Ct.
Damon, William Frederick,	Honolulu, S. I.
Goodale, Edwin Titus,	Boston.
Heighway, Sheridan Culbertson,	Cincinnati, O.
Howe, Charles Sumner,	Ayer Junction.
Lyman, Charles Elihu,	Middlefield, Ct.
Mills, James Kellogg (Boston Univer.),	Springfield.
Pierce, William Arthur,	Boston.
Plaza, Enguerrando,	Arauco, Chili.
Richardson, Benjamin Parker,	Boston.
Wadley, George Dole,	Bolingbrook, Ga.
Total,	18.

RESIDENT GRADUATES.

Bragg, B. S., Everett Burt,	Amherst.
Brooks, B. S., William Penn,	South Scituate.
Kendall, B. S., Hiram,	Watertown.
Libby, B. S., Edgar Howard (Boston University),	Boston.
Penhallow, B. S., David Pearce,	Portsmouth, N. H.
Winchester, B. S., John Frost,	Peabody.
Total,	6.

SUMMARY.

Graduates of 1876,	24
Resident graduates,	6
Seniors,	12
Juniors,	17
Sophomores,	15
Freshmen,	18
Select,	18
Total,	110

DR. GEORGE MONTAGUE, TREASURER, *in account with* MASSACHUSETTS AGRICULTURAL COLLEGE. CR.

1876			1876.		
Jan. 1	To balance,	$721 65		By Salaries,	$19,032 50
	Income Hills Fund,	500 00		Expenses Hills Fund,	416 43
	State Endowment Fund,	15,178 66		Contingent account,	5,079 35
	State appropriation,	5,000 00		Botanical account,	915 39
	Farnsworth Prize Fund,	100 00		Farm account,	3,102 56
	Grinnell Prize Fund,	80 00		Interest account,	822 80
	Receipts from students,	6,286 26		Prize account,	170 00
	from Farm Superintendent,	1,722 64		Laboratory account,	1,127 89
	from Gardener,	1,089 41		Indebtedness paid,	20,000 00
	from bills payable,	20,690 42	Dec. 31	Balance,	702 12
		$51,369 04			$51,369 04

Respectfully submitted.

GEORGE MONTAGUE, *Treasurer.*

I have examined the Treasurer's accounts, and find them correctly stated, and accompanied by the proper vouchers.

HENRY COLT, *Auditor.*

COURSE OF STUDY AND TRAINING.

Freshman Year.

First Term.—Chemical Physics, 5 hours each week; Human Anatomy, Physiology and Hygiene, 3 hours; Algebra, 5 hours; English, 2 hours; Agriculture, 3 hours; Declamation, 1 hour; Freehand Drawing, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term.—Inorganic Chemistry, 4 hours; Animal Physiology, 3 hours; Geometry, 5 hours; Agriculture, 4 hours; English, 2 hours; Elocution, 1 hour; Freehand Drawing, 4 hours; Military Drill, 3 hours.

Third Term.—Organic and Practical Chemistry, 8 hours; Geometry, 4 hours; French, 5 hours; Elocution, 1 hour; Agriculture, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Sophomore Year.

First Term.—Agricultural and Analytical Chemistry, 8 hours each week; Analytical Geometry, 4 hours; French, 5 hours; Agriculture, 2 hours; Declamation, 1 hour; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term.—Quantitative Chemical Analysis, 7 hours; Trigonometry, 5 hours; French, 4 hours; Agriculture, 4 hours; Declamation, 1 hour; Military Drill, 3 hours.

Third Term.—Zoölogy, 5 hours; Surveying, 5 hours; Agriculture, 2 hours; English, 3 hours; Declamation, 1 hour; Drawing, 4 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

Junior Year.

First Term.—German, 5 hours each week; Mechanics, 5 hours; Entomology and Zoölogy, 3 hours; Market Gardening, 2 hours; Levelling and Drawing, 5 hours; Military Drill, 3 hours; Manual Labor, 6 hours.

Second Term.—German, 4 hours; Physics, 5 hours; Botany, 3 hours; Floriculture, 2 hours; Drawing, 4 hours; Agricultural Debate, 1 hour; Military Drill, 3 hours.

Third Term.—German, 4 hours; Astronomy, 4 hours; Botany, 4 hours; Topographical Surveying, 4 hours; Stock and Dairy Farming, 2 hours; Military Drill, 4 hours; Manual Labor, 3 hours.

Senior Year.

First Term.—English Literature, 4 hours each week; Botany, 2 hours; Veterinary Science, 3 hours; Book-keeping, 2 hours; Roads and Railroads, 3 hours; Military Science, 2 hours; Original Declamation, 1 hour; Military Drill, 3 hours.

Second Term.—English Literature, 4 hours; Theses, 1 hour; Mental Science, 4 hours; Agriculture, 2 hours; Veterinary Science, 3 hours; Military Science, 2 hours; Microscopy, 4 hours; Military Drill, 3 hours.

Third Term.—Veterinary Science, 3 hours; Military Science, 2 hours; Geology, 3 hours; Landscape Gardening, 2 hours; Rural Law, 1 hour; Lectures on English Language, 2 hours; Agricultural Review, 4 hours; Military Drill, 4 hours.

LIST OF BOOKS.

Instruction is largely given by lectures and practical exercises, but the following text-books are recommended for recitation or reference:—

Botany and Horticulture.

Gray's Lessons, Manual, and Botanical Text-book.
Sachs' Text-book of Botany, Morphological and Physiological.
Masters' Henfrey's Elementary Course of Botany.
Berkeley's Introduction to Cryptogamic Botany.
Cooke's Microscopic Fungi.
Carpenter's The Microscope and its Revelations.
Flint's Grasses and Forage Plants.
Downing's Fruits and Fruit Trees of America.
Thomas's American Fruit Culturist.
Hoope's Book of Evergreens.
Strong's Grape Culture.
Henderson's Practical Floriculture.
Fuller's Forest Tree Culturist.
Williams's Choice Stove and Greenhouse Plants.
Helmsley's Hand-book of Hardy Trees, Shrubs and Herbaceous Plants.
Loudon's Cyclopædia of Plants.
Loudon's Cyclopædia of Gardening.
Lindley and Moore's Treasury of Botany.
Kemp's Landscape Gardening.
Downing's Landscape Gardening.

Agriculture.

Johnson's How Crops Grow.
Johnson's How Crops Feed.
Pendleton's Scientific Agriculture.
Hyde's Lowell Lectures on Agriculture.
Liebig's Natural Laws of Husbandry.
French's Farm Drainage.
Flint's Milch Cows and Dairy Farming.
Sturtevant's The Dairy Cow — Ayrshire.
Waring's Handy-book of Husbandry.
Henderson's Gardening for Profit.
Donaldson's British Agriculture.
Morton's Cyclopædia of Agriculture.
Low's Domesticated Animals.
Flint's Reports on the Agriculture of Massachusetts.
Agricultural Gazette and Gardeners' Chronicle, London.

Chemistry and Geology.

Watt's Fownes' Manual of Elementary Chemistry.
Sibson's Agricultural Chemistry.
Caldwell's Agricultural Chemical Analysis.
Nason's Woehler's Chemical Analysis.
Will's Analytical Chemistry.
Johnson's Fresenius' Qualitative and Quantitative Analysis.
Liebig's Ernährung der Pflanzen.
Wolff's Landwirthschaftliche Analyse.
Hoffman's Ackerbau Chemie.
Watt's Chemical Dictionary.
Dana's Mineralogy.
Hitchcock's Geology.
Dana's Text-book and Manual of Geology.

Veterinary Science and Zoölogy.

Fleming's Chauveau's Comparative Anatomy of Domesticated Animals.
Dalton's Human Physiology.
Cleland's Animal Physiology.
Williams's Principles of Veterinary Surgery.
Principles of Veterinary Medicine.
Gamgee's On Horseshoeing and Lameness.
On Domestic Animals in Health and Disease.
Armitage's Clater's Cattle Doctor.

Youatt's Treatises on the Domestic Animals.
Blaine's Veterinary Art.
Morton's Manual of Pharmacy.
Wood and Bache's United States Dispensatory.
Harbison's Elementary Zoölogy.
Lankester's Advanced Zoölogy.
Packard's Guide to the Study of Insects.
Harris's Insects Injurious to Vegetation.
Westwood's Principles of Classification of Insects.
Baird's Mammals of North America.
Murray's Geographical Distribution of Mammals.
Samuels' Birds of New England.
Cobbold's Entozoa.
Denney's Parasitic Insects.
Moquin-Tondon's Manual of Medical Zoölogy.

Mathematics, Physics and Civil Engineering.

Olney's Algebra, Geometry and Trigonometry.
Gillespie's Surveying.
Roads and Railroads.
Everett's Deschanel's Natural Philosophy.
Atkinson's Ganot's Physics.
Peabody's Astronomy.
Loomis' Meteorology.

English, French and German.

Hart's Composition.
Fowler's English Grammar.
Shaw's Complete Manual of English Literature.
Chambers's Cyclopædia of English Literature.
Morley's English Writers.
Taine's History of English Literature.
Languillier and Monsanto's French Grammar.
Spiers and Surenne's French Dictionary.
Glaubensklee's German Grammar.
Adler's German Dictionary.

The French and German books for translation are changed every year, selections being made from recent literary and scientific publications.

Mental, Moral and Social Science.

Haven's Mental Science.
Hickok's Empirical Psychology.
Porter's Elements of Intellectual Science.

Seelye's Schwegler's History of Philosophy.
Haven's Moral Philosophy.
Hickok's Moral Science.
Hopkins's Law of Love and Love as Law.
Chadbourne's Natural Theology.
Walker's Science of Wealth.
Perry's Political Economy.
Cárey's Principles of Social Science.
Stirling's Bastiat's Harmonies of Political Economy.

CALENDAR FOR 1877.

The third term of the collegiate year begins March 22d, and continues till June 20th.

The first term begins August 23d, and continues till the Wednesday before Thanksgiving.

The second term begins December 13th, and continues till March 13th, 1878.

There will be an examination of candidates for admission to the College, at the Botanic Museum, at 9 A. M., Tuesday, June 19th, and also on Thursday, August 23d.

The Farnsworth Prize Declamations take place Monday evening, June 18th.

The public examination of the graduating class for the Grinnell prize for excellence in agriculture, and the examination of the other classes in the studies of the term, will take place on Tuesday forenoon, June 19th.

The Address before the Literary Societies will be delivered Tuesday afternoon.

The exercises of Graduation Day occur June 20th.

ADMISSION.

Candidates for admission to the Freshman Class are examined, orally and in writing, upon the following subjects: English Grammar, Geography, Arithmetic, Algebra through simple equations, and the History of the United States.

Candidates for higher standing are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the College until he is fifteen years of age, and every student is required to furnish a certificate of good character, from his late pastor or teacher, and to give security for the prompt payment of term bills. Tuition and room-rent must be paid in advance, at the beginning of each term, and bills for board, fuel, etc., at the end of every term.

The regular examinations for admission are held at the Botanic Museum, at 9 o'clock, A. M., on Tuesday, June 19th, and on Thursday, August 23d; but candidates may be examined and admitted at any other time in the year.

Further information may be obtained of President W. S. Clark, Amherst, Mass.

EXPENSES.

Tuition, ...	$25 00 per term.
Room-rent, ... $5 00 to 10 00	"
Board, ...	3 50 per week.
Expenses of Chemical Laboratory to Students of Practical Chemistry, . . .	10 00 per term.
Public and private damages, including value of chemical apparatus destroyed or injured, .	at cost.
Annual expenses, including books, . .	$300 00 to 350 00

REMARKS.

The regular course of study occupies four years, and those who complete it receive the degree of Bachelor of Science, the diploma being signed by the Governor of Massachusetts, who is president of the corporation.

POST-GRADUATE COURSE.

Graduates of colleges and scientific schools may become candidates for the degree of Doctor of Science, or Doctor of Philosophy, from the College or from the University, and pursue their studies under the direction of President Clark in Botany, Professor Goessmann in Chemistry, or other members of the faculty in their respective departments.

REGULATIONS.

1. Students are specially forbidden to combine together for the purpose of exempting themselves from any required exercise, or violating any known regulation of the College.

2. The roll shall be called five minutes after the ringing of the bell for each exercise of the College by the officer in charge, unless a monitor be employed, and students who do not answer to their names shall be marked absent, provided that any student coming in after his name has been called shall be marked tardy. Two tardinesses shall be reckoned as one absence.

3. Absence from a single exercise may be allowed or excused by the officer in charge of the same, but permission to be absent from several exercises must be obtained from the general excusing officer or from the president. In such cases, the officer excusing will furnish a certificate of excuse, which shall state the precise time for which absence is permitted, and which shall be a satisfactory reason for absence from all exercises occurring within the time specified.

4. Absence without permission obtained beforehand will not be excused by any member of the faculty except on the presentation of a satisfactory excuse written upon the prescribed blank form. Excuses must be rendered to the officer in charge of the exercise from which the student was absent; except that when the absence may include two or more days, the excuse may be rendered to the president, whose approval shall be deemed sufficient for all absences specified therein. Excuses must be rendered promptly; no officer will be expected to receive an excuse after one week has elapsed from the end of the absence, if there has been an opportunity for presentation. Excuses deemed satisfactory will be returned to the student with the indorsement of the approving officer. Excuses deemed insufficient will be retained and referred to the faculty for their decision.

5. For every absence for which no excuse may be offered, or, if offered, shall be deemed insufficient to the faculty, the absentee shall be charged with a fine of one dollar upon the treasurer's accounts, and no student may enter upon the duties of a term, or receive an honorable discharge, certificate of attendance, or diploma, until all fines previously incurred are paid.

6. Whenever the aggregate number of unexcused absences in all departments reaches five, the student so disqualified shall be informed of the fact. When the number of such absences reaches eight, the parent or guardian of the student shall be informed of his delinquency; and when ten such delinquencies are justly recorded against any student, his connection with the College may be terminated.

7. Students are forbidden to absent themselves without excuse from the regular examinations; to give up any study without permission from the president, or to remove from one room to another

without authority from the officer in charge of the dormitory buildings.

8. The record of deportment, scholarship and attendance will be carefully kept, and whenever the average rank of a student for any term falls below fifty, he will not be allowed to remain a member of the College, except by a special vote of the faculty. Admission to the College and promotion from class to class, as well as to graduation are granted only by vote of the faculty.

9. Students are required to abstain from anything injurious to the buildings and other property of the College, and in all respects to conduct themselves with propriety.

10. Students will not be excused from regular duty to engage in boating.

BOOKS, APPARATUS, AND SPECIMENS IN NATURAL HISTORY.

The library of the College contains about 1,500 volumes. Among them are several valuable sets of cyclopædias, magazines and newspapers, reports of the agricultural societies and state boards of agriculture, and many standard works on agriculture and horticulture. There are many useful works of reference in chemistry, botany, surveying and drawing. The larger part of the books has been presented to the institution by private individuals.

The faculty and students also have the privilege of drawing books from the excellent library of Amherst College, which contains over 30,000 volumes.

The state cabinet of specimens, illustrating the geology and natural history of Massachusetts, has been removed from Boston to the College, and is of much value for purposes of instruction.

The Knowlton herbarium contains more than 10,000 species of named botanical specimens, besides a large number of duplicates. The botanic museum is supplied with many interesting and useful specimens of seeds, woods and fruit models. There is also a set of diagrams illustrating structural and systematic botany, including about 3,000 figures.

About 1,500 species and varieties of plants are cultivated in the Durfee Plant-house, affording much pleasure and information to students of both Colleges.

The very extensive and, in some respects, unsurpassed collections in geology, mineralogy, natural history, ethnology and art, belonging to Amherst College, are accessible to members of the Agricultural College.

The chemical, engineering and military departments of the Agricultural College are well furnished.

The class in microscopy have the use of seven of Tolles' best compound microscopes, with objectives from four inches to one-eighth of an inch in focal distance, and a variety of eye-pieces.

PRIZES.

Farnsworth Rhetorical Medals.

Isaac D. Farnsworth, Esq., of Boston has generously provided a fund of $1,500, which is to be used for the purchase of gold and silver medals, to be annually awarded, under the direction of the College faculty, for excellence in declamation.

Grinnell Agricultural Prizes.

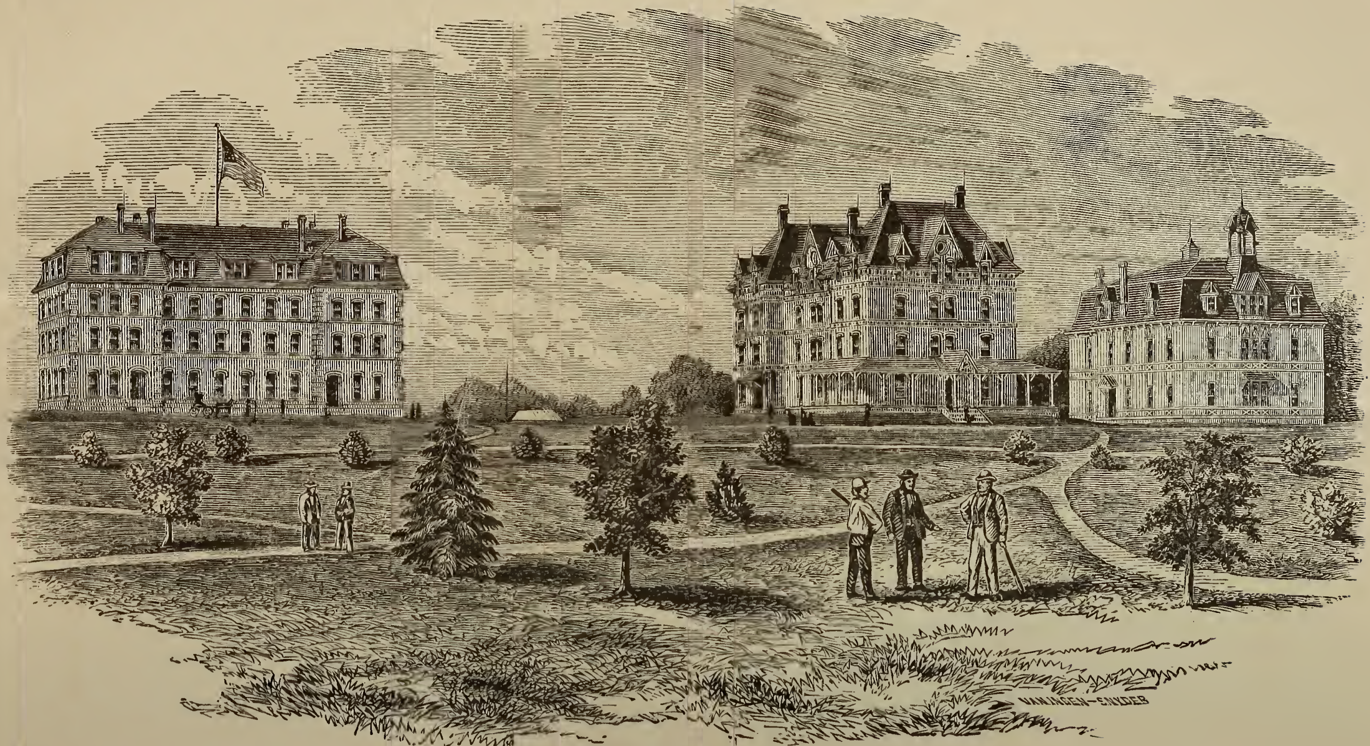
Hon. William Claflin of Boston has given the sum of $1,000 for the endowment of a first prize of $50, and a second prize of $30, to be called the Grinnell Agricultural Prizes, in honor of George B. Grinnell, Esq., of New York. These prizes are to be paid in cash to those two members of the graduating class who may pass the best oral and written examination in Theoretical and Practical Agriculture.

Hills Botanical Prizes.

For the best herbarium, collected by a member of the class of 1877, a prize of $15 is offered, and for the second best, a prize of $10; also a prize of $5 for the best collection of woods.

Totten Military Prize.

For the best essay by a member of the senior class on such topic as may be assigned, a prize of $25. Subject for 1877, "The Military Resources of America."



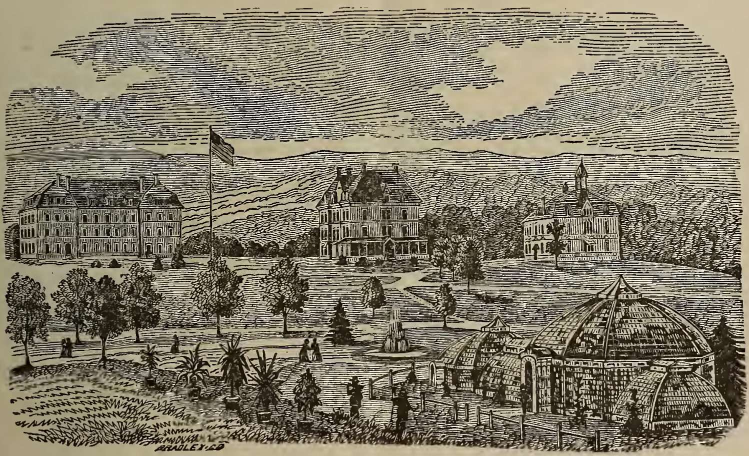
MASSACHUSETTS AGRICULTURAL COLLEGE.

SENATE...... ......No. 100.

FIFTEENTH ANNUAL REPORT

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.



JANUARY, 1878.

BOSTON:
Rand, Avery, & Co., Printers to the Commonwealth,
117 FRANKLIN STREET.
1878.

Commonwealth of Massachusetts.

AMHERST, Jan. 30, 1878.

To His Excellency ALEXANDER H. RICE.

Sir, — I have the honor herewith to present to your Excellency and the Honorable Council the Fifteenth Annual Report of the Massachusetts Agricultural College.

Very respectfully,

Your obedient servant,

W. S. CLARK, *President.*

Commonwealth of Massachusetts.

Executive Department,
Boston, Feb. 7, 1878.

To the Honorable the Senate:—

I have the honor herewith to present, for the consideration of the General Court, the Fifteenth Annual Report of the Massachusetts Agricultural College.

ALEXANDER H. RICE.

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ANNUAL REPORT.

To His Excellency the Governor and the Honorable Council:—

The Trustees of the Massachusetts Agricultural College respectfully submit their Fifteenth Annual Report:—

The experience of the year 1877 has not differed materially from that of preceding years. The objects for which the College was established have been kept steadily in view by the officers in charge, and such improvements made as the means at their disposal would allow. The appropriation of the last legislature was barely sufficient to defray ordinary expenses; and it has been only through the liberality of an individual member of the Board that certain indispensable repairs have been made, and a new propagating house for the botanical department built, without increasing the indebtedness of the corporation. The same generous friend, Hon. William Knowlton, has also kindly indorsed the notes of the treasurer during the past three years, and thus enabled him to maintain the credit of the College.

Justice demands that this debt of twenty thousand dollars, which has gradually accumulated through the failure of successive legislatures to provide the necessary funds for the current expenses of the institution, should be paid at once by an appropriation.

It is also necessary, unless radical changes of management are adopted, that the sum of five thousand dollars be provided to meet the deficit in the income for the ensuing year. The plan of organization, the course of instruction, and the method of agricultural experiments and scientific investigations which are now in operation at the College, are the results of much discussion, extensive observation, and large experience. They are also, in the main, quite satisfactory to all intelligent persons who are acquainted with them; and the principal objection to the College arises from the fact that money is required for its proper maintenance. Again and again have different legislatures visited the beautiful estate in Amherst belonging to the Commonwealth; and after seeing the faculty and students, with their books, specimens, and apparatus, the costly and commodious buildings, the fine live-stock in the barns, and the interesting contents of the plant-house, they have always voted the indispensable funds. But it is a very difficult and expensive undertaking to exhibit thus the whole Institution to the legislature, to explain in detail all its arrangements, and to answer fully all the misstatements and captious criticisms of those who, for any reason, choose to oppose the needed appropriations. This annual education of the great majority of the general court is rendered still more arduous by the fact that the people of Massachusetts are chiefly engaged in other occupations than agriculture, and therefore feel but little interest in its advancement; while the farmers, as a class, are so conservative as to have but a very moderate appreciation of the advantages to be derived from their College.

On the other hand, there are many reasons for encouragement. The possible utility of agricultural education is no longer questioned, and the importance of technical schools is now generally admitted; many honest opponents of such institutions having been converted, within a few years, into sincere and helpful friends.

It is easy to demonstrate that the College, with its scientific professors, its excellent farm, live-stock, and machines, its museums, library, laboratories, and plant-houses, may not only furnish a thorough scientific and practical education to such as desire it, but may also accomplish a vast amount of good by the careful trial of new implements, seeds, fertilizers, and methods, and by original investigations upon the great problems of agriculture and horticulture. The analysis and inspection of fertilizers which is constantly going on under the direction of Professor Goessmann is worth more to the farmers of the State than the entire expense of carrying on the College; and the experiments of Professor Stockbridge, upon the use of chemical fertilizers where stable-manure cannot be advantageously applied on account of the cost, have shown how the agricultural products of Massachusetts may be very largely increased, with a fair prospect of a reasonable profit. As every improvement in agriculture adds directly to the welfare of the people, not only in our own State, but wherever it may be adopted; and as the question for consideration by the legislature is, not whether there shall be a State College at Amherst, but whether the Massachusetts Agricultural College shall be so maintained as to accomplish worthily the objects of its establishment, — there seems to be no sufficient ground for the refusal of the small annual appropriation required. Is it wise for the legislature to break up the successful system of instruction and training which is now in operation as the result of fifteen years of experiment? Can the Commonwealth afford to lose a large part of the benefits which should be derived from an investment of more than half a million dollars in an institution for scientific and practical education, by neglecting to defray its necessary current expenses? If the very moderate sum of five thousand dollars per annum be furnished, the College can go on with its four-years' course of instruction, and, while receiving students of rather limited attainments, may send forth graduates deserving the name of educated men. It can also perform a great amount of most important work as an experimental station, and gradually bring its farm and gardens into such a condition of excellence as to be models for the imitation of both its students and the public generally.

The only way in which the cost of carrying on the College can be reduced materially is to shorten the course to three years, and raise the standard of admission to a point which would make it necessary for students to spend a year or two in some preparatory school of a high grade. By this change, the services of one professor might be dispensed with: but the diminution in the number of students would probably reduce the income from tuition to a considerable extent; so that the net gain would be slight. As the salaries of the officers are now ten per cent less than those paid by Amherst College, it is not practicable to economize largely in this direction.

The obligation of the State to sustain the College is very clear, and the pecuniary advantage of doing so is equally obvious. The Trustees, therefore, earnestly appeal to the legislature for that material aid which the best interests of the Institution under their charge, and the good name of Massachusetts, seem to them to demand.

SAPPORO AGRICULTURAL COLLEGE.

At the beginning of the year 1876 the Trustees were called to perform a most unexpected, but most important, duty in connection with agricultural education. The Japanese Government having determined to establish an agricultural college, and having selected the Massachusetts College as a model, very naturally looked to its faculty and graduates for advice and assistance. His Excellency Yoshida Kiyonari, Japanese minister at Washington, was especially desirous of procuring the services of President Clark, if only for a single year, to aid in locating, organizing, and starting the new institution. Accordingly, the Trustees, by a unanimous vote, granted him leave of absence from May 15, 1876, to Sept. 1, 1877; at which time he resumed his duties at Amherst.

The first professors selected for the Japanese college were William Wheeler of the class of 1871, David P. Penhallow of the class of 1873, and William P. Brooks, valedictorian in 1875. These gentlemen have proved themselves eminently qualified for the duties assigned them, and have given entire satisfaction to both the officers of the governnent and their Japanese pupils.

The college is located at Sapporo, the capital of Hokkaido, in latitude 43° N., in the valley of the great river Ishcari. The soil of the college farm is a fine black loam, underlaid with beds of yellow loam and gravel, and is admirably suited for tillage. The climate here is delightful, and especially favorable for vegetation. The ground is rarely frozen in winter, but covered with abundance of snow during four or five months. The summers are bright and warm, with plentiful rains; and autumnal frosts hardly appear before the snow. The following crops were successfully cultivated on the farm in 1876; viz., rice, wheat, barley, maize, oats, millet, Timothy, clover, beans, pease, Chinese indigo, hemp, flax, potatoes, sweet-potatoes, beets, turnips, field-radishes, carrots, cabbages, tomatoes, egg-plant, ginseng, white and paper mulberries, and a great variety of American and foreign fruit-trees and useful and ornamental plants. The farming of the past season has produced very satisfactory results. Professor Brooks reports that he has raised, among other things, two thousand bushels of excellent corn, two thousand bushels of Early Rose potatoes, one hundred and twenty tons of hay, and more sugar-beets, turnips, and carrots than he can store in his root cellar.

The college farm consists of two hundred and fifty acres, one hundred of which are devoted to pasture, and fifty to timber. The barn is one hundred by fifty feet, with one L sixty by thirty feet, and another forty by thirty feet, and a cellar one hundred by fifty feet, and ten feet deep. The farm is supplied with imported stock, and agricultural machines and implements of all sorts. At Sapporo excellent labor costs twenty cents per day, and the annual allowance for ordinary farm expenses is $15,350; while Massachusetts often fails to make any provision for the working-expenses of her College farm of nearly four hundred acres, though labor here costs five times as much.

It is a very interesting fact, that, in 1876, there were three model and experimental farms in Japan, under the charge of Japanese officers who had been educated at the Massachusetts College.

One of these farms, near Hakodate, contains five thousand acres, and is under the direction of Mr. Youchi, who has under him eleven officers, and nearly one hundred permanent laborers. He is allowed forty thousand dollars annually for his ordinary expenses, and gives away to the farmers of the province, or sells to them at a nominal price, a large part of the products of his farm. He raises annually ten thousand grafted fruit-trees and a million or more forest-trees for planting. He has an admirable plantation of Chinese mulberries, containing one hundred thousand trees for growing silk, and about one thousand sheep for the production of wool. Fine horses, neat-cattle, and swine also receive careful attention, many valuable animals having been imported from the United States.

The government farms for the improvement of agriculture in the province of Hokkaido, with a population of less than two hundred thousand, are sustained at an annual cost of more than a hundred thousand dollars, besides the maintenance of the new agricultural college, which requires thirty thousand dollars per annum. Is it too much for Massachusetts to appropriate five thousand dollars a year for the support of her single College and its farm?

The Japanese Government has contracted with a Californian of large experience to introduce eighty thousand sheep into one district on the island of Nippon, and has already enclosed six thousand acres of land for a stock farm. The wild prairie soil is being broken up, and cultivated grasses and forage plants being introduced, while suitable barns, sheds, and offices are in process of construction. During the year 1877 the sum of twenty-five thousand dollars was expended in Kentucky and California in the purchase of Thoroughbred and Norman horses, well-bred asses, and Shorthorn and Jersey cattle, for this single farm.

This establishment is designed not only to increase the supply, and improve the quality, of the valuable domestic animals of the empire, but also to serve as a practical school of agriculture for a large number of young men who perform the necessary labor, under the direction and instruction of American superintendents.

Among the many interesting and valuable results to be achieved by the Massachusetts professors at Hokkaido is the discovery of new and useful plants, and their introduction into the United States. Seeds of about thirty species of desirable trees, shrubs, woody climbers, and herbaceous plants, were collected in the autumn of 1877, and forwarded by President Clark to the Arnold Arboretum in Boston, where they are now growing. Among these are two specially worthy of notice, — the one for its fine foliage and flowers, and the other for its vigorous growth, its beautiful leaves and blossoms, and its excellent fruit. The first is called *Schizophragma hydrangeoides*, and is a woody climber, attaching itself to the trunks and branches of trees by aerial rootlets, and often clothing them from the ground to their tops with a mass of verdure, upon the outside of which, in midsummer, appear large cymes of white flowers. The main stem of this species is often found with a diameter of six inches, and doubtless frequently attains the age of more than one hundred years, as specimens have been collected which had a diameter of more than eleven inches. The largest stems are almost always hollow; and the entire bark is separated from the wood every year by a thin layer of cork, as in the grapevine. All persons who are familiar with the admirable qualities of the *Hydrangea paniculata*, which is abundant in the same forests on the island of Yezo, will be interested to know that this closely-allied climber has been introduced into our country.

The second species is called *Actinidia polygama*, and belongs to the same family with the tea and the camellia. It is a twining plant, sending out shoots from ten to twenty feet in length in a single season, and rapidly reaching the summits of the highest trees. The stem grows to a great size, and assumes the most grotesque forms. Sometimes a single vine will coil itself with surprising regularity about the trunk of a forest-tree, like a huge anaconda; and, again, two or more branches will twist about each other, forming an immense living cable, ten or twelve inches in diameter, and often rising from the earth to branches fifty feet above it without any apparent aid. The wood of this species is remarkably soft and porous, resembling that of the grape, and is often used by the Ainos for the manufacture of shallow dishes, which are usually ornamented with sculpturings. The large ducts of this wood are filled with innumerable microscopic needles of calcium oxalate. The younger vines and branches form an excellent substitute for ropes, especially when steamed in their own sap, and twisted while hot. This is ingeniously done by the Japanese by coiling the vines, and laying them upon fires of wood so arranged as to heat without burning them.

The inflorescence and foliage are handsome; the flowers being white, and arranged in loose racemes several inches long. The fruit, however, is worthy of special attention, it being edible, and highly esteemed by both bears and men. The clusters of ripe berries resemble somewhat those of the Malaga grape in size, form, and color; but the seeds are luckily very minute, though numerous. The flavor of the kokuwa, as the Japanese call it, is quite peculiar, but agreeable to most persons, especially after it has been slightly touched by the frost. The pulp is soft, juicy, and sweet, with a slight astringency, but scarcely any acidity, when fully ripe. It is very healthy; and large quantities are eaten by the people, both in the fresh state, and preserved in sugar. In passing through the forests, the bark of the large trees whose tops are covered with this vine is frequently seen to be scratched by the sharp claws of the bears, which are very fond of this as of other sweet fruits.

If this species should prove to be hardy in Massachusetts, of which there can be little doubt, it will not only be a most valuable ornamental plant, but the fruit will be worth cultivation even in its present wild state. If, however, it should prove as susceptible of improvement as our native grape has done, it will certainly become a most delicious addition to our list of fruits for the dessert and for cooking. An attempt has been made at Sapporo to manufacture kokuwa-wine; but it is hardly likely to prove a formidable rival to that from the grape. In Japan, however, it has only to compete with saki, or rice-wine, which it may easily surpass in every respect. The wild grape of Yezo is a most luxuriant vine, attaining a diameter of ten to twelve inches; but the fruit is utterly worthless, being very sour, and consisting chiefly of seeds. The enterprise of the Japanese is well illustrated in the fact that thirty thousand Concord vines and one hundred thousand American fruit-trees of all sorts were planted at and around Sapporo in the spring of 1877, all of which had been grown from imported stock on a government farm seven hundred miles distant.

WANTS OF THE MASSACHUSETTS COLLEGE.

The apparent indifference of recent legislatures, as well as of wealthy citizens of the State, in reference to the welfare of its Agricultural College, contrasts strangely with the enthusiastic and enterprising spirit of the "Yankees of the East." Nevertheless, the Trustees are unable and unwilling to believe that the present condition of affairs can long continue, and confidently expect that the funds will soon be furnished from some source, not only to render the College very useful in its present form and condition, but also to greatly enlarge and improve it.

The farm during the past year has been under the charge of Superintendent Southwick, whose report is appended to this, and shows what he has accomplished. Though he has had no money for carrying on a farm of nearly four hundred acres, except in the form of temporary loans, and though even a portion of his moderate salary has been the gift of a member of the Executive Committee, he has labored courageously and faithfully. He has raised some good crops, made some permanent improvements, and kept the estate in fair condition. It is, however, most unfortunate, both for his own reputation and that of the College, that he should be compelled to work with such limited means.

It is also a great defect in the equipment of the agricultural department, that a much larger number of sheep, dairy cows, ox and horse teams, and machines for economizing labor, are not provided as means for instructing the students in practical farming. While the idea that the farm ought to pay expenses seems very plausible, yet it cannot be put into practice without ignoring, to a very large extent, the special objects for which the College was established, and for which the farm has, by act of the legislature, been connected with it. Hitherto, the theoretical instruction in agriculture and horticulture in the lecture-room has been tolerably satisfactory, notwithstanding the great want of diagrams, models, specimens, implements, and machines for illustration. Those students who have been brought up on well-managed farms, and have acquired skill in manual labor, have been able to improve their time in the culture and discipline of their minds, and in the getting of valuable scientific and agricultural information. But the opportunities afforded to young men who have seen nothing of farm-life before entering College have never yet been what they ought to be. A large part of the operations on the College farm should be for purposes of experiment and instruction, without any special reference to immediate profit; and, until suitable provision is made for such management, the Institution cannot properly accomplish its mission.

The horticultural department has been well managed the past year by Professor Maynard, whose report will give the details of his efforts and the results achieved. There is much reason to expect great improvement in the practical instruction and profitable working of this department under the new arrangements which have recently been made.

Mr. John W. Clark, a graduate of the College, after spend-ing some years in extensive nurseries in the West, has returned, and associated himself with Professor Maynard in such a way as will largely increase the business of the department in raising and selling seeds, bedding, vegetable, and hardy herbaceous plants, and fruit and ornamental shrubs and trees. The erection of a new propagating-house will enable instructive and profitable work to be carried on in winter, and do much to render the department self-sustaining.

The Hills Fund of ten thousand dollars, which was generously subscribed some years ago by Messrs. L. M. and H. F. Hills, for the promotion of botanical science, has, during the year, been paid into the treasury. It is hoped this may be so invested as to produce a somewhat larger income than heretofore, and that important practical results may be attained by the investigations which may be prosecuted under the stimulus and assistance afforded by it. Similar funds would prove exceedingly valuable in connection with the departments of agriculture and chemistry. Mr. J. B. Lawes of Rothamsted in England, after maintaining and conducting in the most admirable manner an experimental station at his own expense for more than thirty years, has recently given the establishment, with a cash endowment of five hundred thousand dollars, into the charge of trustees, to be carried on in perpetuity. Who will imitate his noble example so far as to enable a similar work to be successfully inaugurated at Amherst?

A generous friend, who evidently appreciates the importance of such a station, has communicated to the Trustees, through Professor Stockbridge, his willingness to pay into the College treasury the sum of one thousand dollars to defray the expenses of agricultural experiments to be carried on upon the College farm during the year 1878. Though one year is a very limited period in which to accomplish results of the most valuable sort, yet it affords ample time and opportunity to begin operations, and demonstrate the necessity of a permanent fund for this purpose. The Trustees have, therefore, gladly accepted the proffered money, and appointed a committee, with full power to determine what shall be undertaken, to see that the work is properly done, and to report upon the results of their investigations. This committee consists of President Clark, Professors Goessmann and Stockbridge, Hon. Richard Goodman, and Secretary Flint.

It has been decided to plant two acres of land, near the north-east corner of the College estate, with forest-trees the coming spring. Among the species which have been tried, the European larch and the Scotch pine have seemed to be the most promising. The white-ash and hickory have not been tested, but are deemed specially worthy of trial.

The recent extraordinary development of the beet-sugar industry in Europe urges with renewed force upon our attention the probable advantages of its introduction into Massachusetts. The farmers of the Connecticut Valley, since the successful experiments with the sugar-beet were made at the College in the years 1870 and 1871, have found the tobacco-crop becoming less and less profitable, and would now gladly engage in some new agricultural enterprise. During the past year Professor Goessmann procured seed from Germany, and furnished it to several parties who desired to raise an experimental crop; and he has kindly determined for them the percentage of sugar in the different lots of beets. Nothing new has been discovered by these experiments; but the extreme differences of size and quality show, that, for the best results, the well-established rules of culture must be observed. The only practical obstacle in the way of producing all our sugar upon our own soil lies in the first cost of a factory. For the most economical working of the beet-roots, it is necessary to use not less than fifty tons *per diem;* and, as the sugar must be refined in the process of manufacture, the requisite apparatus is costly. A well-equipped beet-sugar factory would require for the plant and the working capital about one hundred thousand dollars, but, under judicious management, would, in all probability, prove a good investment.

It is proposed to raise on the College farm the ensuing season an acre of a new sorghum, which ripens well in Minnesota, two hundred miles north of Amherst. It is called the "Early Amber Cane," and produces one hundred and sixty gallons of excellent syrup per acre. From the syrup a good quality of sugar may be obtained, a gallon yielding from five to seven pounds. As the cane simply requires crushing between iron rollers, and the juice may be evaporated in open pans, just like maple-sap, no costly factory is needed. It seems, therefore, altogether likely that a beginning may be made in the home-production of sugar from sorghum of this new northern variety. The transition from this crop to the more profitable sugar-beet will then be comparatively easy.

Mr. Seth H. Kenney of Morristown, Rice County, Minn., a former resident of Amherst, has kindly furnished much valuable information upon this subject, and has generously given the College seed sufficient to plant an experimental acre. So promising does this new variety of sorghum appear, that the commissioner of agriculture at Washington has bought five thousand pounds of the seed for gratuitous distribution.

The chemical department of the College has been skilfully and economically managed by Dr. Goessmann, who has not only given the usual instruction, but also done a large amount of important work as State inspector of fertilizers, and chemist to the Board of Agriculture. The results of his official labors will be found in the Report of Secretary Flint.

It will be seen, by reference to the course of study, that a long-desired change has been made, by which the time assigned to practical chemistry has been somewhat increased, and transferred from freshman and sophomore years to junior and senior years.

Appended to this Report will be found a valuable paper by Professor Goessmann, giving the results of his experiments upon the relation of the ash constituents of plants to the growth of the organs of vegetation, and the quality and ripening of fruits.

In the department of physics there is great need of additional apparatus; and it is very desirable to have a laboratory where students can learn by practice the structure and use of the apparatus and machines by which the great forces of nature are measured, observed, and illustrated. Formerly the extensive and costly apparatus of Amherst College was available for the instruction of the agricultural students; but, since the decease of Professor Snell, it has not been practicable to continue this plan. It has become, therefore, very important for the College to procure as soon as possible at least three thousand dollars' worth of apparatus for the illustration especially of electricity, optics, and acoustics.

It would contribute immensely to the proper development of the College, if a suitable building were erected to accommodate the departments of physics and civil engineering, agriculture and natural history. Such an edifice, for which an admirable plan has been prepared, should contain a large room for the agricultural museum, and a lecture-room adjoining; a large room for the State collections in natural history, which are now in danger of destruction by fire in the south dormitory; and a lecture-room and laboratory for the professor of physics, with ample accommodations for apparatus. In the upper portion of the same building should be apartments for the College library and reading-room, and a spacious hall for public exercises.

Money is also greatly needed for the constant increase of the collections, and especially for the enlargement of the library. While, within suitable restrictions, the College can, doubtless, always enjoy the benefits of the valuable library and collections of Amherst College, it must be obvious to all, that for the books, specimens, and apparatus which are required for daily use, it should be independently furnished.

The foregoing statement of the deficiencies of the College is made, not with the expectation that they will at once be supplied either by individual, legislative, or congressional munificence, but in the hope that a knowledge of them may awaken sympathy in some quarters, and induce the friends of the Institution to rally with unwonted enthusiasm for its help.

Professor Totten's Report states clearly what has been attempted and accomplished in the military department during the past year. Considering the difficulties which have been experienced in other colleges in the maintenance of a thorough system of discipline and instruction in this department, his complete success and decided popularity are quite remarkable. As he has shown very decided ability as an officer and teacher during his detail at the College, it would be very agreeable to have him again assigned to duty at Amherst,

A course of lectures upon veterinary science and practice has been provided for the present senior class, and it is hoped the funds of the College may allow instruction upon this very important subject to be given every year. The lecturer for the class of 1878 is Dr. Charles P. Lyman of Springfield, Mass.

ANNIVERSARY EXERCISES.

The first public exercise of anniversary week occurred on Monday evening, June 18, and consisted of the Farnsworth Prize Declamations, which were honored by the presence of the founder. The judges were Hon. C. L. Flint of Boston, and Messrs. G. L. Smith and E. E. Webster of Amherst. The gold medals were awarded to Lockwood Myrick of the sophomore class, and Edgar R. Wing of the freshman class; and the silver medals to Roscoe W. Swan, sophomore, and Alvan L. Fowler, freshman.

The examination of the graduating class for the Grinnell Prizes, for excellence in agriculture, occurred in the forenoon of Tuesday, June 19; and the committee were President P. A. Chadbourne of Williams College, and Messrs. E. A. Ellsworth of Barre, and H. C. Comins of Hadley. The successful competitors were David H. Benson and John E. Southmayd, between whom the first prize, of fifty dollars, was divided, and Atherton Clark, who received the second prize, of thirty dollars.

The committee of award for the Hills Prizes, for the best collection of dried plants, were Professors H. G. Jesup of Dartmouth College, Edward Hitchcock of Amherst College, and S. T. Maynard of the Agricultural College. The first prize, of fifteen dollars, was given to Atherton Clark, whose herbarium was the largest ever collected by a student in the College, and contained eleven hundred and twenty-five species admirably mounted, named, and catalogued. The second prize, of ten dollars, was awarded to John E. Southmayd.

The Totten Military Prize, of twenty-five dollars, was bestowed upon David H. Benson for the best essay upon the subject assigned; viz., "The Military Resources of America."

The military parade in the forenoon of Graduation Day, June 20, was largely attended, and very interesting and satisfactory. In the absence of his Excellency the Governor, the battalion was reviewed by Ex-Gov. William B. Washburn. The diplomas for special excellence in this department were bestowed upon Atherton Clark, John E. Southmayd, David H. Benson, James K. Mills, Joseph Wyman, and George E. Nye.

The theses of the graduating class were delivered in the afternoon, in Amherst-College Hall; and the valedictory addresses were given by David H. Benson, who also had the honor of representing the College at the commencement exercises of Boston University.

The diplomas of the University, in the absence of President Warren, were presented to matriculants by Secretary Flint.

His Honor Lieut.-Gov. Knight closed the exercises with appropriate remarks, and bestowed upon each member of the graduating class the diploma of the College, in the name of the Commonwealth.

Respectfully submitted by order of the Trustees,

W. S. Clark, *President.*

Amherst, January, 1878.

MILITARY DEPARTMENT.

President W. S. Clark.

Sir,—I have the honor to submit the following Report:—

The work upon the centennial battery has been pushed, until it is now very near completion. It has been turfed and graded upon the inside, and one wing is already finished. It received its armament in time for the commencement exercises last June; and "the actual throwing of shell upon that occasion, from real mortars in a regular earthwork," added great interest to the military exercises of the day. This battery now constitutes one of the most noticeable features upon the College-grounds, has afforded eminently practical instruction in earthwork to the students who built it, will greatly facilitate the instruction of future classes, and, as a lasting monument of genuine enthusiasm, will certainly elicit the admiration of all who visit it.

The grading of the drill-ground early in the autumn has greatly improved its general appearance, and fitness for tactical manœuvre, and has thrown into greater relief the battery situated just beyond.

Through the kindness of the Adjutant-General of the State, large additions have been lately made to the collection in the military museum, and one hundred and sixty knapsacks furnished for purposes of camping and instruction. The usual supply of service ammunition for the twelve-pounders and small-arms was received at the beginning of the year from the ordnance department at Washington; and an additional supply of friction primers, and ammunition for the eight-inch mortars, has since been promised from the same source. This large amount of ammunition is now stored in the new and substantial service magazine built during the year from the appropriation of the Trustees for that purpose. This magazine is situated just in rear of the mortar battery, and is connected with it by a suitable trench, which serves both as a covered way and a drain.

Since the last report, several important changes have been effected in the uniform of the College. The West-Point cadet suit is still the regulation for full dress, but is now obtained from the contractors, Devlin & Co., at the very noticeable reduction of some seven dollars from the original cost. At the instance of a petition, originated, and signed almost unanimously, by the students, a neat blouse has been adopted for undress purposes. It is made of cadet gray, to match the pants and cap; and is modelled upon the blouse lately worn by regular army officers, with braid and slashes. This blouse has been contracted for by Devlin & Co., and already furnished to about forty cadets, at the low price of eleven dollars and fifty cents. Made out of a material so famous for its iron wear, it will certainly effect a great saving to the students, while, from its neat military appearance, it cannot fail to strengthen their *esprit de corps*. While adopting the blouse, the regular cadet overcoat and fatigue-cap ornament were also recognized "as uniform" by the department, and will be furnished by Devlin & Co. at twenty-one dollars and one dollar respectively. Of course it is not made obligatory upon cadets to procure any but the regular full-dress uniform, though the prospects are, that, in a few years, the blouse and cap ornament will be almost universally adopted.

The special military diploma, for some time contemplated by the department, was struck off from appropriate plates in time for issue to the last graduating class. The undertaking was entirely a private one; but no expense was spared to make a handsome document. It is surmounted by the design found upon the state-militia commission, has for its foot-piece one very similar to that found upon that of the regular army, reads somewhat like the West-Point diploma, and recommends its holder to a commissioned rank in the regular army of the United States, or in the militia of any of the several States. Though offered to and within the reach of all, it is to be given, under the official control of the professor of military science and tactics, only to such as attain to genuine military merit. It is intended for a prize, and as an incentive to military proficiency, and is already recognized by the students as having a decided intrinsic value. Six members of the class of '77 received the distinction; and, in order to extend the benefit to previous classes, the former heads of this department were communicated with, and from them six members of each of these classes also received proper recommendations. Two-thirds of those thus recommended have since applied for the paper, and now hold it as valuable evidence of special fitness to serve their country in the future. The expenses of engraving, printing, &c., have now been fully cleared; and, as all future sales will be a source of net income, I have the honor to present the plates and surplus diplomas now on hand to the College, for the purpose of perpetuating the prize known as the "Totten Military Prize." This prize is open to all members of the graduating class, and to such specials in their last year as may pursue the course in military science, and give satisfactory evidence of their tactical proficiency. The military essay for which this prize is offered has now become a feature in the course, and two classes have already competed for it. The prize essay of the last class, on the subject of "The Military Resources of America," was written by cadet First Lieut. and Adjutant D. H. Benson of Bridgewater. The subject for the present senior class is "The American Military Problem."

The usual excursion was made during the year to the national armory at Springfield, when opportunity was also afforded to visit the large pistol factory of Smith and Wesson, situated at the same place.

During the summer vacation an excursion was made to West Point with such members of the present senior class as found it convenient to attend. Parts of three days were enjoyably spent in examining the matters of interest collected at this famous institution; and every facility was courteously afforded by the commandant, Gen. Niel, to investigate and study the system of discipline and administration of the corps of cadets. This excursion, besides being very instructive and entertaining, enabled the department to take an entirely novel step in the instruction of new cadets. Upon the beginning of the present year the West-Point method was adopted; and three seniors, two of whom had seen the system in actual work, were detailed out over the new class, and not relieved from their entire charge until they were ready to be admitted to the battalion. This event occurred fully a month earlier than ever before, and has, in every respect, justified the innovation.

Three days in October were devoted by the faculty to an excursion for scientific purposes, and the enterprise placed under the charge of this department as to discipline and organization. It was organized, therefore, as a military expedition, and was entered into enthusiastically by the students, by whom all the arrangements were carried out, and without any drawbacks to their full realization. The thanks of the department are due to Mr. Bentley, superintendent of the N. L. N. Railroad, and to Mr. John H. Graves of Springfield, for the use of the depot, grounds, and picnic conveniences at Mount Toby station; all of which greatly added to the success of the encampment. It will be impossible to describe the expedition at length. But camp life and routine in all their details were grasped and put into actual practice by men who had never before experienced it, and this in an astonishingly short time. Discipline was perfect, interest unflagging, health excellent; and the battalion never before marched back to its quarters more conscious of the *military possibilities* that lie within its system of instruction than it did from Camp William Knowlton. It is the general desire of the students, and earnestly indorsed by this department, that such an encampment become a permanent feature in the College curriculum.

It was intended to inaugurate during the present year in this department a series of experiments in clearing land of stumps and rocks by means of the higher explosives. This important undertaking has been unavoidably delayed; but such steps have already been taken as will enable my successor to easily prosecute it. It is a subject that promises valuable results to the farming community, and nowhere could it be more properly studied than at this Institution.

The experiments carried on last year by this department in explosives have since been fully described and published in pamphlet form. These experiments had for their object the determination of the chemical, mechanical, and practical feasibility of "building up" grains, cakes, or masses out of two or more explosives, or out of the same explosive in varying conditions, in such a manner that these explosives should be *successively* ignited, but only by the actual combustion of the several layers down to them. A most important possibility is thus held out of utilizing even the fiercest of modern explosives for artillery purposes, — an undertaking but lately given up in despair by almost the whole world, but only after the expenditure of millions by both Austria and England. This new method, however, proposes to protect large grains of gun-cotton, picrate, or other explosive, by enveloping them in exterior jackets of ordinary gunpowder, and thus to retard their explosion until the powder, by its regular combustion down to them, has performed its important task of starting the inert projectile into rapid velocity. An accelerating powder of unlimited force is thus within the range of promise, and one which from its scientific construction will exert only a minimum strain upon the arm in which it is used. Considerable interest in the matter has now been excited in military circles; and the Franklin Institute, representing a high class of scientific thinkers, almost immediately republished, by permission, the entire article in its journal. It will, therefore, be unnecessary to discuss these experiments in this report. From the very nature, however, of such a subject, it is clear that vast means, delicate instruments, and special students, are necessary to carry to their legitimate ends experiments of so much importance. Such facilities are possessed only by governments; and, as the matter is of special value only for war-purposes, it ought certainly to enlist their attention.

The department continues in charge of the instruction in topography, levelling, road maintenance and construction, and drawing. These are all important studies for the scientific farmer, and, it is trusted, will some day receive enough consideration to constitute, with kindred subjects, a separate department of "Practical Agricultural Engineering." A few hundred dollars could hardly be spent more judiciously than in procuring specimens of the various road-coverings, models, drawings, and specifications of the different orders of city, town, and country roads, bridges, &c., and in establishing a suitable cabinet in connection with a class-room particularly devoted to these topics.

Before another catalogue is published, the detail of the present incumbent will have expired: he therefore takes the present occasion to acknowledge officially the firm and honest support that this department has always received at the hands of yourself and the faculty. The few cases of discipline that have arisen during his term of office have all received prompt notice; and such of them as have been of an aggravated character have been specialized with such summary consideration as should always characterize a military administration. The College, to a recognized extent, is a military one by the requirements both of the state and the national statutes; and its policy in regard to this department is considered to be both generous and just. This is especially true in view of the glaring shortcomings of many other institutions, which, though similarly bound to support a military department, are utterly devoid of even the principles of its inception. So long as discipline remains intact, drills and uniforms compulsory, military rank a matter of merit, and a course in military science forms a part of the regular curriculum, so long will this College be specially deserving of the highest esteem of military authorities, and a detail to its chair of military science and tactics be an honor to the officer fortunate enough to obtain it.

Words can scarcely be found in which fairly to appreciate the important part taken by the students themselves in building up a department whose promises are yet so distant. The record of the past three years is their best reward at present, while perhaps the future may have higher ones in store. Their interest has steadily increased, and thus achievements have been possible, that, without it, would never have been even conceived.

America is just beginning to realize the absolute value of more general military education. It is the least expensive preparation for the future she can make, but one whose ultimate value is to be computed only in *unspilt blood*, — treasure far more priceless than all the other vast expenditures of peaceful preparation for possible war.

Very respectfully your obedient servant,

C. A. L. Totten,
1*st Lieut.* 4*th Art.*, *U. S. A.*

HORTICULTURAL DEPARTMENT.

President W. S. Clark.

Sir, — I have the honor of making the following Report upon the condition of the Horticultural Department: —

It will be seen by the Treasurer's Report that the income from this department has been larger this season than ever before.

The orchard has been kept in a good state of cultivation, and many of the pear-trees give promise of fruit another year. The peach-trees have made a good growth, are free from disease, and have produced this season about twenty-five bushels of fine peaches. The trees have, each year, been pruned back to keep them in a compact form, and all borers have been carefully destroyed. The varieties found most valuable are Crawford's Early, Crawford's Late, Old Mixon, Stump the World, and Morris's White.

The vineyard has yielded a good crop of grapes of fine quality; but the bunches were small, owing, in part, to exhaustion of the soil, and in part to the injury done by the phylloxera, which has been found upon the roots of every variety.

The experiments made during the summer, of girdling the vines to hasten the ripening of the fruit, promise to be of some value, and will be continued.

From the hot-beds and cold-frames have been sold, the past season, seventy-five thousand cabbage-plants, lettuce, cucumbers, and tomatoes, to the value of a hundred and fifteen dollars, besides small plants of various kinds. Upon half an acre of land west of the peach-orchard were grown about two tons of fine Hubbard squashes; and from half an acre north of the Botanic Museum were grown over fifty bushels of ears of pop-corn.

A little over an acre and a half of land was planted with strawberries last spring, which have done well, except in some places where injured by the larvæ of the May beetle. Should the next season be favorable, we hope for quite an increase in our income from this source.

Arrangements have been made for the establishment of a trade nursery in connection with this department. Mr. J. W. Clark, a graduate of the College, who will have charge of this work, has made a beginning by putting in about twelve thousand cuttings of the more choice varieties of evergreen trees, and planting seeds of apple, pear, peach, plum, cherry, and many ornamental and timber trees, such as ash, maple, beech, hickory, &c. Also a large lot of green cuttings of the most desirable hardy shrubs were rooted early in the season, and placed in boxes for the winter. About two acres of land north of the plant-house, and the same amount on the south, have been ploughed and subsoiled to fit it for planting with trees. The extra expense attending the establishment of this department has rendered it necessary for us to exceed our income to a small amount. This, we feel confident, we can cancel by our increased sales the coming spring.

To facilitate work, and extend our operations, a new glass house has been built, one hundred feet long by seventeen feet wide. The funds for the purchase of material were generously loaned us by Hon. William Knowlton. All the work, with the exception of putting in the water-pipes and making and putting up the smoke-pipe, has been done without the aid of mechanics. Many of the students have assisted us in this work, having done nearly all of the painting, and all the glazing.

The Durfee Plant House has been painted outside with two coats of paint, put on by students, which adds very much to its beauty. The new boiler, put in last winter by the liberality of Hon. William Knowlton, has worked admirably, with a saving of much labor, and nearly ten tons of coal per annum. Many species and varieties of tender plants have been added to the collection by purchase or exchange; and many new sorts of hardy trees and shrubs have been procured in the same way, or grown from seeds.

Around the orchard and vineyard has been planted a hedge of blackberries of the Kittatinny variety, to prevent trespassers from passing through when grapes and other fruits are ripening. It is hoped, that, by good cultivation, we may be able to make an impenetrable hedge, and get fruit enough from it to pay the cost. Among the trees in the pear-orchard have been planted many of the leading varieties of blackberries and raspberries, which will give some fruit the coming season.

To the orchard and vineyard has been applied a chemical fertilizer, containing, with every hundred pounds of potash, fifty pounds of phosphoric acid, and twenty-five pounds of nitrogen.

For the success of the plans made for the work of this department, the sale of the plants grown, and the proper cultivation of the crops, it seems absolutely necessary for us to have the use of a good horse and express-wagon in addition to what may be done by the farm-teams.

The students who have been under my charge the past season have been very faithful in the discharge of their duties both in the class-room and at manual labor.

The success of our plant trade the past season has been largely due to Mr. Charles H. Maynard, who was chiefly responsible for it.

Respectfully submitted,

S. T. MAYNARD,
Gardener, and Ass't Prof. of Horticulture.

FARM DEPARTMENT.

President W. S. Clark.

Sir, — I have the honor to submit this my Second Annual Report as superintendent of the College farm.

Prosperity has accompanied the management another year. The farm account shows a good increase of revenue. It is also gratifying to know that more cash has been paid into the treasury than in any previous year since the establishment of the Institution.

I have to thank the Executive Committee and officers of the College for their hearty support.

CROPS.

Sixteen acres of corn produced between two and three thousand baskets of ears; three acres of potatoes, about three hundred bushels of marketable size; one acre of rutabagas, eight hundred bushels; two acres of sugar-beets, twelve hundred bushels; one acre of carrots, ten tons; four acres of spring wheat, one hundred bushels; two acres of rye, thirty-seven bushels; and ninety acres of mowing, one hundred and twenty-five tons of hay.

The corn-crop was excellent, and, but for the heavy rains of early summer, would have been much heavier. One field was so muddy at harvest-time, that it was actually unsafe to go upon it with horse-teams. The potato-crop was, every thing considered, very good. The turnips grew upon land that I mentioned in my last report as lying south-west from the old farm-house, and which was never before ploughed. This piece was manured with the "odds and ends;" in other words, with any fertilizing material that could be scraped together about the place. The crop suffered from excess of water while growing, and we fairly had to wade while harvesting it. The beet-crop was good, the roots being of fair size and excellent quality. This crop suffered also from excess of water while growing. The carrots were reasonably satisfactory, though the dry weather of August and September seemed to entirely stop their growth.

The wheat-crop was a grand success, the grain being unusually plump, and weighing, at the present time, sixty-one pounds to the bushel. One grain-dealer says it is seldom that such a lot of wheat can be found in the market. It is selling readily for a dollar and a half per bushel. It was manured with Stockbridge fertilizer; and a better catch of grass I never saw. I would advise sowing a much larger piece the coming season. The rye-crop would have been much heavier but for the poor seed sown.

During the past fall I was fortunate enough to put in fifteen acres of rye, my object being to get grain enough from this crop to feed the hogs.

Our conveniences for securing grain-crops are very meagre, to say the least, the old-fashioned grain-cradle being employed in harvesting; whereas a good reaping-machine should be used, for the twofold purpose of securing our crops quickly, and also to show the students, and especially visitors from abroad, that we propose to be foremost in the use of all modern appliances in our agriculture. We also greatly need a threshing-machine and a grist-mill, as we have an engine in the barn that would furnish ample power for running the same.

STOCK.

The stock consists of forty head of cattle, of which seventeen are Shorthorns, seventeen Ayrshires, four Jerseys, and two Brittanies. The horses are six in number.

SWINE.

Of swine there are seven Berkshire sows, two Chester sows, eleven pigs for fattening, two fat hogs, and one small boar. My sales of pigs and hogs amount to six hundred and sixty-seven dollars, and my outlay for additions to the stock has been forty-three dollars. The Berkshire swine of the College are of very superior quality. I am rather pleased to say that not an animal has been lost by sickness or accident thus far, although this is my second year.

I am experimenting, to some extent, to determine practically the cost of keeping, and the produce of, the various breeds of cattle; the results of which will be published at an early day.

I have purchased, at my own expense, a "Cooley creamer," for use in the dairy; and, thus far, very satisfactory results have been obtained.

No grain has been bought the past year for the cattle; but three hundred bushels of corn have been purchased for the horses and hogs.

During the fall we succeeded in breaking up about fifteen acres of the pasture-land; and, for the purpose of thoroughly eradicating the brush, it is proposed to plant it for a year or two. We also ploughed and seeded about five acres in front of the old farm-house; but this is so covered with water, that I have fears for the success of the operation. There remains now only one piece near this latter, which is in sight of the public travel, that has never been ploughed; and, although it is a sort of mud-hole, I would advise ploughing and seeding it the coming season, as even this will improve the general appearance much.

Two new model Buckeye mowers and an improved American tedder have been added to the list of machines to take the place of old ones worn out.

Considerable work has been done for the botanical department in the way of grading, ploughing, and subsoiling; and the public roads on the estate have been kept in repair.

During the fall I built a corn-crib of old rails and boards, fifty-four feet long, ten feet high, and four feet wide. I did all the work myself: so there was no expense, except for nails. The corn keeps perfectly in this rude receptacle.

The coming year I advise the growing of clover for the pasturage of swine.

Very respectfully submitted,

A. A. Southwick, *Farm Sup't.*

CATALOGUE OF THOROUGHBRED STOCK.

Shorthorns.

Baron of Grass Hill, 18,965.

Estella.
Belladonna.
Aurora, 4th.
Isabella.
Yucatan.

Mabel.
Yucatella.
Bella Wilfer.
Rosabelle.
Geraldine.
Zenobia.

Belle Amie.
Barbara.
Gertrude.
Lucille.
Gwendolyn.

Ayrshires.

Earl of Windham.

Flora.
Lydia.
Lulie.
Beauty 13th.
Jennie.

Leilah.
Amelia.
Cora.
Maid of Lorn.
Sarah Alice.

Dorothea.
Clytie.
Myra.
Psyche.
2 bull calves.

Jerseys.

Bull, Gift of O. B. Hadwen, Esq.

Dolly.
Daisy.

Dove.
Dimple.

Brittanies.

Pauline.

Mysie.

CONTRIBUTION

TO THE

CHEMISTRY OF THE AMERICAN GRAPE-VINE.

BY

PROFESSOR C. A. GOESSMANN.

CONTRIBUTION TO THE CHEMISTRY OF THE AMERICAN GRAPE-VINE.

By Professor C. A. Goessmann.

The question, whether a systematic and rational manuring of our fruit-bearing plants is essential for the continued production of good crops, engages of late, deservedly, our increased attention. It seems but reasonable to assume, that the same practice which has been recognized as indispensable for success in general agriculture ought to apply with equal force to the operations in fruit-culture, and horticulture in general. Modern rational agriculture bases its claim of superior progress, as compared with preceding periods, on the recognition and application of the principle, that it is essential for the continued success of its industry to return to the soil those substances which the crops abstract. It has been one of the principal occupations of numerous scientific investigators of agricultural problems, during the past thirty years, to prove the existence of these relations, and to study how to comply best with their requirements in an economical manner. Most of our common farm-crops have received, from the beginning, an undivided and careful attention: their composition has been ascertained, and their action on the soil thereby established. In many instances their peculiar mode of growth has been studied, to learn in what form the various manures are best applied in cases of different kinds of soil. Nobody familiar with the results of the investigations of late years can fail to notice their extraordinary influence on the progress of agricultural practice. The same statement cannot be made with reference to fruit-culture and horticulture. Experiment-stations for the benefit of these branches of agriculture are but few, and these, in the majority of instances, of a very recent date. Superior skill and intelligence have been largely engaged in the promotion of their interests from an exclusively botanical stand-point; while the peculiar intricacy of the subject, the growing of plants with a view of producing crops with reference to a certain quality rather than to mere quantity, may account, to some extent at least, for the comparatively limited practical interest, which, until of late, most horticulturists have manifested in trying chemistry as an assistant in their industry.

There is no scarcity of valuable observations regarding an exceptionally good success in producing fruits by the aid of various kinds of fertilizers; yet it is no less well recognized, that but little satisfactory explanation can be given as to the particular relations which exist between the composition or the quality of the fruit, and certain constituents and the condition of the fertilizer used. The chemical composition of the majority of fruits is but imperfectly known. The question, whether the ash-constituents of the fruit bear more than a mere incidental relation to the quality, is still largely a matter of conjecture, which derives its main support from the fact, that the ash-constituents of a few of our cultivated varieties — for instance, in the case of the strawberry — have been found widely differing, in regard to quantity and to quality, from those found in the wild forms from which they have originated. No important inferences have thus far been drawn from these observations.

Numerous careful inquiries into the composition of many of our farm-crops have shown that the total amount of the mineral or ash-constituents of one and the same variety of plant may vary widely in different specimens, when raised upon different soils, or under otherwise varying conditions of cultivation.

Experimental observation has thus far failed to prove the existence of any definite numerical relation between the total quantity of the essential mineral or ash-constituents, and of the entire dry organic matter of plants. We have learned that certain, and, comparatively speaking, but a few mineral elements are essential for the complete development of plants; yet we have only very vague notions regarding their peculiar mode of action in the process of vegetable growth. While we are ignorant, thus, of the peculiar mode in which these mineral constituents assist in the formation of organic matter, we have noticed, in the case of some of our most important industrial farm-crops, that a more or less liberal supply of certain essential articles of plant-food, as potassa, nitrogen, &c., quite frequently exerts a remarkable influence on the general character of the quality of the crops resulting, as far as the relative proportion of some of their proximate organic constituents, as albuminoids, starch, or sugar, is concerned. Even the peculiar form in which potassa, &c., have been applied, is known to exert, in many instances, a decided influence on the larger or smaller production of one or the other organic constituents of plants. The recent history concerning the safest modes of raising industrial crops of a superior quality for the purpose they shall serve, deserves, in my opinion, the serious attention of fruit-culturists in particular.

Judging from our past experience in general farm-management, it seems proper to assume that much benefit may be secured to fruit-culture and horticulture by studying the relations which exist between the composition of the soil and the ash-constituents of the fruits grown upon it. A rational system of manuring the fruit-bearing plants requires that kind of information for its foundation. It is quite certain that the practice of restoring to the soil, in suitable form and in due time, those constituents which the fruits abstract, cannot but contribute towards large crops by stimulating a vigorous condition of the entire plant. A strong, healthy plant is quite naturally better qualified to overcome interior local disorders, and to resist more successfully external injurious influences, than feeble specimens. Considering the previously expressed views worthy of serious attention, I have, of late, instituted a series of field-experiments with grape-vines, for the purpose of testing the action of certain special fertilizers on their productiveness, as far as quantity and quality of the grapes are concerned, and to ascertain whether a favorable change in their quality is accompanied with a definite alteration in the relative proportion of their mineral or ash constituents. I selected, for reasons already stated in previous communications,[1] the fruits of a cultivated and of a wild native variety of grape-vine; namely, the

Concord Grape and the Wild Purple Grape
(*Vitis Labrusca, L.*).

A due appreciation of the expected results rendered it quite advisable to study previously some of the more prominent features in the growth of these grapes, without any application of manure. As but little has been published regarding the chemical composition of our native grapes, I propose to describe at a future time some observations made in that connection, which, in my opinion, are of a more general interest from a scientific as well as a practical stand-point. My particular thanks are due to Professor S. T. Maynard, and to Messrs. E. B. Bragg and W. P. Brooks (graduates of the College, of the class of 1875), for very efficient assistance rendered in the progress of the investigations. Professor Maynard has taken a very active interest in the field-work; and Messrs. Brooks and Bragg have very satisfactorily carried out, under my direction, most of the analytical work.

[1] See Thirteenth Annual Report of the Massachusetts Agricultural College, p. 60; and also the Massachusetts Ploughman of June 24, 1877.

On the Growth and Composition of Grapes.

The examination was confined, in the majority of cases, to the berries and the juice of the grapes. The former were tested for the amount of water they lost at 100° C., and the total dry matter they left behind at that temperature. The juice of the grapes, obtained after crushing by means of a hand-press, was examined for its specific gravity, its percentage of grape-sugar, and its free acid. The sugar was determined by Fehling's mode, after the juice had been treated with an equal volume of a solution of basic acetate of lead, of the same concentration as that usually applied for the defecation of the juice of sugar-beet roots. The amount of free acid was determined with a solution of pure carbonate of soda, containing one gramme of calcined soda in one hundred cubic centimeters of the solution, and the test finished by finally raising the temperature to near the boiling-point. The examination of both berries and juice was repeated in various important stages of the development of the grapes. Ash-analyses have also been carried out as far as time has thus far permitted; yet, as only a small number of the analyses of the ashes of the berries have been finished, a more detailed discussion of the results obtained has to be deferred to some future suitable occasion. The relative amount of acid has been reported for the present, only to secure more exact quantitative statements after the nature of the acid has been more thoroughly studied.

Concord Grape. (Not fertilized.)

Date.	Specific gravity.	Temperature Centigrade.	Moisture lost at 100°–110° Centigrade.	Percentage of dry matter at 100°–110° Centigrade.	Percentage of grape-sugar in the juice.	Percentage of sugar in solid dry matter.	Amount in cu. cent. of soda solution to neutralize 100 parts juice.
1876.							
July 17	1.0175	31°	91.70	8.30	0.645	7.77	
" 20	1.0150	31°	91.90	8.10	0.625	7.72	216
Aug. 2	1.0200	25°	90.06	9.94	0.938	9.44	249
" 16	1.0250	28°	89.12	10.88	2.000	18.38	229
" 30	1.0500	25°	84.42	15.58	8.62	55.33	120
Sept. 13	1.0670	23°	82.52	17.48	13.89	79.46	55
" 4	1.0700	18°	80.18	19.82	16.13	81.38	49.2

Purple Wild Grape. (Near Adams's Pond.)

July 19	1.020	31°	91.00	9.00	0.714	7.93	204
Aug. 4	1.020	28°	87.75	12.25	1.10	8.98	249
" 16	1.025	28°	87.52	12.48	2.00	16.03	233
" 30	1.050	26°	83.42	16.58	6.50	39.81	147.6

White Variety of Wild Grape. (Near the purple grape.)

Date.	Specific Gravity.	Temperature Centigrade.	Moisture lost at 100°–110° Centigrade.	Percentage of dry matter at 100°–110° Centigrade.	Percentage of grape-sugar in the juice.	Percentage of sugar in solid dry matter.	Amount in cu. cent. of soda solution to neutralize 100 parts juice.
Aug. 31	1.050	26°	83.52	16.48	9.26	56.18	98

The juice of the Concord grape collected on the 17th of June, as above stated, was watery, and of a yellowish-green color: it turned purple by heating, with a slight excess of either ammonia or potassa, showing that the coloring-matter, which is characteristic of the ripe grape, is already, in some concealed form, present at a very early stage of its growth. The wild purple grape, in a similar condition of growth, showed the same property, with the exception that its juice was of a viscid character, and its color of a deeper tint when rendered alkaline. The color peculiar to these grapes makes its first appearance in the stems of the berries, and passes then rapidly on to the outer tissues of the skin. During the season of 1876, this change became first noticeable about the middle of August; and on the 30th of the month the color had already increased to such an extent, that a solution of basic acetate of lead produced a light purple-blue precipitate, similar in color to a freshly precipitated hydrate of chromium oxide. It will be noticed from the above tabular statement, that with the middle of August began a remarkable change in the growth of the grape. The free acid became most prominent in the juice about the first week in August, sank to less than one-half of its quantity towards the close of that month, and amounted, at the beginning of October, to one-fifth only of the largest quantity noticed in August. The sugar began to increase in the juice about the same time, when the free acid had reached its highest amount, and when the chlorophyl began to suffer a transformation of its green color into a purple pigment: its increase was, however, in a much larger ratio than the decrease of the free acid. A test of the entire berry for free acid, made on the 20th of July, but one week before the highest percentage was observed in the juice, showed that all the free acid noticed at that period in the berries was in solution in the juice; while repeated tests made with entire berries, and also with their juice, after the free acid in the latter had considerably fallen off, proved the presence of a larger amount of free acid in the berries than in the juice, which demonstrated the fact that the smaller quantity of free acid found in the juice of the grapes at a more advanced state of growth is due, in part at least, to the circumstance that the acid has partly formed quite insoluble acid combinations with potassa and with lime, which are largely distributed, in a crystalline form, through the cellular mass, and thereby cause a less acid re-action of the juice. In consideration of these observations, it seems but reasonable to conclude that Liebig's view, which assumes a conversion of the acid of the grapes in the latter stages of their growth into grape-sugar, does not agree with our present information. Dr. Neubauer, in his interesting investigation of German grapes, comes to similar conclusions. He favors, besides, the opinion that a periodical increased access of potassa and lime into the fruit causes the mentioned alterations at the stated stage of development. I shall return to this subject when discussing the relation of the ash-constituents in different stages of growth to the periodical changes in the composition of the fruit. A careful test made with the sap of grape-vines, taken in the month of May, from an incision in the vine made about from four to five feet above the ground, proved the absence of both cane and grape-sugar in that liquid. Comparing the above reported results of the comparative tests carried out with the juice of the wild purple grape and that of its cultivated offspring, it becomes at once noticeable, that, as far as the present investigation has been extended, their main difference, from a chemical stand-point, consists in changes regarding the quantity of sugar, the amount of total soluble matter, and the intensity of color. The acid, it seems, has not been affected. The sugar increases during the last period of ripening but little, and apparently partly from concentration of the juice by loss of moisture. Once removed from the grape-vine, the grapes lose moisture quite rapidly at ordinary temperature, yet at different rates, as may be seen from the following statement: —

Percentage of moisture lost.	Concord.	Agawam.	Israella.	Delaware.
Within eight days . .	9.97	10.80	11.74	8.75
" two weeks . .	9.97	17.76	11.74	14.41
" three weeks. .	20.53	24.89	27.54	19.87
" four weeks . .	26.75	31.12	35.62	24.52

The aromatic principles become more prominent at the close of the ripening process; in all probability, in consequence of a reaction of the albuminoids on the grape-sugar. They consist usually of combinations of alcohols with fatty volatile acids (compound ethers).

On the Composition of Various Kinds of Cultivated Ripe Grapes.

The subsequent statements comprise the observations of 1876 and 1877: the specimens which served for tests — with the exception of the Catawba, the Isabella, the Eumelan, the first-named Hartford Prolific, and the wild varieties — came from the College vineyard, and were as nearly as possible of the same degree of ripeness.

Hartford Prolific.

(Obtained through the kindness of H. Kendall, Esq., Providence, R.I.)

Date.	Specific gravity.	Temperature Centigrade.	Moisture lost at 100°–110° Centigrade.	Percentage of dry matter at 100°–110° Centigrade.	Percentage of grape-sugar in the juice.	Percentage of sugar in solid dry matter.	Amount in cu. cent. of soda solution to neutralize 100 parts juice.
1876. Sept. 5	1.06	22°	82.61	17.39	13.89	79.87	88.8
Ives's Seedling.							
Sept. 6	1.07	26°	79.85	20.15	15.15	75.14	88.6
Iona.							
Sept. 7	1.08	21°	75.44	24.56	15.15	61.68	144
Iona. (Mildewed.)							
Sept. 7	1.045	26°	85.59	15.41	6.25	40.56	204.4
Agawam.							
Sept. 11	1.075	20°	79.21	20.79	17.24	82.92	94.8
Wilder.							
Sept. 11	1.064	20°	83.47	16.53	13.67	82.69	56

Date.	Specific gravity.	Temperature Centigrade.	Moisture lost at 100°–100° Centigrade.	Percentage of dry matter at 100°–110 Centigrade.	Percentage of grape-sugar in the juice.	Percentage of sugar in solid dry matter.	Amount in cu. cent. of soda solution to neutralize 100 parts juice.
Delaware.							
Sept. 12	1.08	24°	76.51	23.47	17.86	76.09	74
Charter Oak.							
Sept. 12	1.08	24°	84.02	15.98	8.77	54.94	168.3
Israella.							
Sept. 16	1.075	23°	80.33	19.67	9 20	46.77	89.8
Bent's Seedling.							
Sept. 20	1.08	21°	78.35	20.65	16.13	78.11	181.8
Adirondack.							
Sept. 20	1.065	21°	84.89	15.11	13.17	87.16	68
Catawba. (From New York.)							
Oct. 16	1.08	13°	76.55	23.45	17.39	74.16	82
Wilder.							
1877. Sept. 11	1.065	23°	83.59	16.41	15.15	92.32	60
Charter Oak.							
Sept. 12	1.055	23°	83.78	16.22	9.80	60.42	96

Concord.

Date.	Specific Gravity.	Temperature Centigrade.	Moisture lost at 100°–110° Centigrade.	Percentage of dry matter at 100°–110° Centigrade.	Percentage of grape-sugar in the juice.	Percentage of sugar in solid dry matter.	Amount in cu. cent. of soda solution to neutralize 100 parts juice.
Sept. 13	1.065	24°	84.10	15.90	13.16	82.76	102
" 26	1.075	24°	80.66	19.34	15.43	79.78	70.8

Eumelan.

Sept. 24	1.065	16°	80.38	19.62	13.16	67.07	73

Wild White Grape. (Ripe, yet not shrivelled.)

Sept. 5	1.050	22°	84.43	15.57	7.20	46.24	140.8
		(Specimen much shrivelled.)					
" 20	1.060	16°	79.98	20.02	10.00	49.95	130

Wild Purple Grape. (Near Adams's Pond; was shrivelled.)

Sept. 20	1.045	16°	83.69	16.69	8.22	49.25	104

The different kinds of grapes above mentioned behave, in many instances, quite remarkably unlike each other in regard to the action of their juice towards basic acetate of lead. The latter produces in every case a voluminous, colored precipitate; yet these colors seem to result from the presence of several distinctly different pigments in the grapes, peculiar, in all probability, to the wild native varieties from which our cultivated ones have been produced. This re-action may prove of practical use as an aid in tracing the relationship to each other of the different varieties of grapes under cultivation. Dr. G. Engelmann, in his excellent description of the true American grape-vines, incidentally states that some growers consider the Delaware and the Clinton as derived from the same wild variety Riverside grape (*Vitis riparia*, Mich.): which appears doubtful, judging from the re-action with basic acetate of lead; for the juice of the Delaware grape gives a cream-colored precipitate; while that of the Clinton produces a bluish-green colored one, indicating quite different pigments in these varieties. As this peculiarity of the different kinds of grapes may be of interest to some cultivators, I will state some of my results in this direction. The re-actions are all made with ripe grapes, if not otherwise stated.

Purple Wild Grape. Hartford Prolific. Concord. Wilder. Ives's Seedling. Israella. Isabella. Clinton.	From light purple and bluish-green to slate-color.
White Wild Grape. Iona. Delaware. Charter Oak. Eumelan. Agawam.	From bright sulphur-yellow to cream-color.

Whether the various tints of the precipitates are due to the combination of the two extremes, dark purple and light sulphur-yellow, or to the result of a peculiar physiological process in the different varieties, is a question which only more detailed inquiries can decide.

Influence of Girdling the Vines on the Growth and Composition of Grapes.

The current statements regarding the effects of girdling grape-vines on the quality of the grapes growing on such plants are quite contradictory. To obtain some more definite idea concerning this practice, a series of experiments were planned, and, with the kind assistance of Professor S. T. Maynard, carried out, during the past season. The vines were girdled during the first week of August, — about the time when the berries of the Concord grape had reached the point when the free acid had attained its highest development, and the grape-sugar had begun slowly to increase. Entire vines, as well as large branches, served for the trial. Two incisions, from one-eighth to one-fourth of an inch apart, were made through the bark and the cambium-layer, and the mass between these cuts, down to the wood, carefully removed. A decided difference in the degree of growth of the grapes began soon to be noticeable, and to manifest itself during the entire season, until the grapes on the girdled branches had just reached their ripeness. The tests made at this point with both the grapes of the girdled and of the ungirdled branches, grown upon the same vine, showed quite a remarkable difference in the general quality of the entire grape and in their relative degrees of development. In some instances, it can be safely said that the girdled branches were from two to three weeks in advance of the ungirdled ones. A careful comparison of the previously described rate of growth of the Concord grape can serve as a proof of this statement. Some of the subsequently described analytical results do not as decidedly prove the great difference, because the tests were carried out a few days later than they ought to have been, which gave a good chance for the grapes from the ungirdled branches to gain time on the grapes from the girdled branches, which, being ripe, had reached a period of but very slow change in composition. The analytical statements below, concerning the Concord grape, show, also, that a ripe grape does not improve when kept too long on the vine. The sugar decreases apparently, and the acid increases (most likely on account of the formation of some acetic acid); the taste becomes, by degrees, more indifferent. The girdled vines did not show the slightest difference when compared, at the close of the season, with the ungirdled. The place where the bark had been removed was grown over. The plants which served for the experiments will be watched during the coming season, to learn whether any serious after-influence may show itself. It is also intended to find out what effect girdling will exert on grapes and juice when carried out at other periods of their growth.

Results of girdling Grape-Vines.

Hartford Prolific. (Branch not girdled.)

Date.	Specific gravity of juice of berries.	Temperature Centigrade.	Moisture lost at 100°–110° Centigrade.	Percentage of dry matter at 100°–110° Centigrade.	Percentage of grape-sugar in the juice.	Percentage of sugar in solid dry matter.	Amount in cu. cent. of soda solution to neutralize 100 parts juice.
1877. Sept. 3	1.045	19°	87.15	12.85	8.77	68.25	111.4
			Girdled Branch.				
" 3	1.065	19°	82.82	17.18	12.50	72.76	100
			Wilder. (Branch not girdled.)				
Sept. 3	1.055	19°	84.59	15.41	10.42	67.62	108.2
			Girdled Branch.				
" 3	1.075	19°	82.76	17.24	14.70	85.26	88.4

Delaware. (Branch not girdled.)

Date.	Specific gravity of juice of berries.	Temperature Centigrade.	Moisture lost at 100°–110° Centigrade.	Percentage of dry matter at 100°–110° Centigrade.	Percentage of grape-sugar in the juice.	Percentage of sugar in solid dry matter.	Amount in cu. cent. of soda solution to neutralize 100 parts juice.
Sept. 4	1.065	19°	84.25	15.75	11.76	74.66	101.2
			Girdled	Branch.			
" 4	1.075	19°	80.86	19.14	15.15	79.16	94.4

Agawam. (Branch not girdled.)

Sept. 4	1.060	19°	83.40	16.60	11.37	68.48	128.2
			Girdled	Branch.			
" 4	1 075	19°	81.55	18.45	16.13	87.42	114.8

Iona. (Not girdled.)

Sept. 6	1.0625	22°	80.37	19.63	13.51	68.31	131.4
			Girdled	Branch.			
" 6	1.085	22°	78.52	21.48	15.63	72.76	125.6

Concord. (Branch not girdled.)

Sept. 6	1.045	22°	86.54	13.46	7.46	55.42	182.4
			Girdled	Branch.			
" 6	1.070	22°	82.47	17.53	13.88	79.18	102.8
			Branch not	girdled.			
" 26	1.065	22°	82.37	17.63	13.70	78.27	86
			Girdled	Branch.			
" 26	1.080	22°	75.53	24.47	19.61	80.13	76.8
			Branch not	girdled.			
Oct. 5	1.075	12°	79.08	20.92	17.86	85.37	42
			Girdled	Branch.			
" 5	1.085	12°			17 50		54

On the Mineral Constituents of the Concord and the Wild Purple Grape-Vines.

In a previous report (1876) I have already stated the ash-analyses of several parts of the Concord grape; namely, that of the seeds, of the stems, and of the skins of the grapes, of the young and old woods, besides that of the fresh and fermented grape-juice. In the present communication I propose to add the following analytical results: —

I. — Analysis of the young branches, with their tendrils and blossoms, of the Concord vine.

II. — Analyses of the berries, without their stems, of the Concord vine, in different stages of their growth.

III. — Analyses of the berries of the Concord grape raised with the assistance of a special fertilizer, and of those raised without any fertilizer, upon the same field.

IV. — Analyses of the berries of the Wild Purple grape, without stems, grown in the woods near Adams's Pond, and of those transplanted from that locality to the College vineyard, and there treated with the same fertilizer as the Concord grape-vine mentioned above in No. 3.

As the investigation is still going on, it is thought best to defer a detailed discussion of these quite interesting results to a future occasion, when the work pointed out in the introduction may be considered more satisfactorily accomplished. As the peculiarity of the season must, quite naturally, be considered an important agency in controlling the results of growth, it is most desirable that certain tests should be repeated for several years, to impart more reliability to the conclusion drawn from all facts and circumstances which bear on the question under discussion.

Thus far, the results obtained with one fertilizer only have been examined. This fertilizer, which I have called No. 1 in my experiments, contains one pound of nitrogen in the form of nitric acid to three pounds and a half of potassium oxide in the form of potassium nitrate, and two pounds and a quarter of soluble phosphoric acid prepared from bone-black waste. The amount per acre is compounded of one hundred and eighty pounds of potash nitre, and four hundred and fifty pounds of a superphosphate containing twelve per cent of soluble phosphoric acid. In the analysis to obtain a material of exact comparative value, I converted the carefully prepared ash-constituents into sulphates, subsequently determined the sulphuric acid, and calculated in the remaining saline matter the various constituents for one hundred parts. The silicic acid has not yet, in every case, been controlled by a re-solution, and is therefore included with the incidental insoluble matter under that name.

I.—Young branches, with tendrils and blossoms, of the Concord grape-vine, collected on the 15th of June, 1876:—

Moisture lost at 100°–110° Centigrade	80.80 per cent.
Dry matter	19.20 "

One hundred parts of their ash contained—

Potassium oxide	24.7102 per cent.
Sodium oxide	.9442 "
Calcium oxide	40.5302 "
Magnesium oxide	10.6611 "
Ferric oxide	1.0773 "
Phosphoric acid	17.1590 "
Matter insoluble in dilute hydro-chloric acid . .	4.9180 "
	100.0000

II.—Berries of Concord, without stems, and not fertilized:—

(a) Berries collected on the 17th of July, 1876.
(b) Berries collected on the 18th of August, 1876.
(c) Berries collected on the 13th of September, 1876.

	(a)	(b)	(c)
Potassium oxide . . .	47.34	51.14	57.15
Sodium oxide	1.13	3.19	4.17
Calcium oxide . . .	24.21	16.20	11.30
Magnesium oxide . . .	4.76	6.38	3.10
Ferric oxide	.75	.65	.40
Phosphoric acid . . .	21.38	20.77	12.47
Insoluble matter . . .	.43	1.67	11.41

III.—Berries of the Concord grape, without stems, raised upon the ground, *fertilized* as stated above, and collected on the 3d of October, 1877:—

Potassium oxide	64.65 per cent.
Sodium oxide	1.42 "
Calcium oxide	9.13 "
Magnesium oxide	3.63 "
Ferric oxide	.50 "
Phosphoric acid	14.87 "
Insoluble matter	5.80 "

IV. — Berries, without stems, of the Wild Purple grape: —

(**a**) Berries collected on the 13th of September, 1876, from a wild vine near Adams's Pond.

(**b**) Berries collected on the 20th of September, 1876, transplanted to the College grounds, and fertilized as stated above.

	(a)	(b)
Potassium oxide	50.93	62.65
Sodium oxide	.15	.85
Calcium oxide	22.23	14.24
Magnesium oxide	5.59	3.92
Ferric oxide	.79	.53
Phosphoric acid	17.40	13.18
Insoluble matter	2.93	4.62

Effects of Cultivation and Fertilization on the Composition of Some Wild Varitiees of Grapes.

Analyses of Wild White and Purple grapes: —

(**a**) Berries of Wild White grape, without stems, from near Adams's Pond, collected on the 20th of September, 1877. (Dead ripe.)

(**b**) Berries of Wild White grape, without stems, from College vineyard, treated with fertilizer No. 1. Collected 20th of September, 1877. (Dead ripe.)

(**c**) Berries, without stems, of Wild Purple grape, from Adams's Pond. Collected 20th of September, 1877. (Dead ripe.)

(**d**) Berries, without stems, of Wild Purple grape, treated with the above stated fertilizer. Collected 20th of September, 1877. (Dead ripe.)

Specific Gravity.	Temperature Centigrade.	Moisture lost at 100°-110° Centigrade.	Percentage of dry matter at 100°-110° Centigrade.	Percentage of grape-sugar in the juice.	Percentage of sugar in solid dry matter.	Amount in cu. cent. of soda solution to neutralize 100 parts juice.
			(a)			
1.060	16°	79.98	20.02	10	49.95	130
			(b)			
		78.35	21.65	14.29	65	65
			(c)			
1.045	16°	83.31	16.69	8.22	49.25	104
			(d)			
1.065	16°	80.45	19.55	13.67	69.92	121.6

These analyses show very decidedly the influence of mere cultivation on wild varieties. Further investigations in this direction are in progress.

CATALOGUE

OF

TRUSTEES, OVERSEERS, FACULTY, AND STUDENTS.

1877.

TRUSTEES, OVERSEERS, FACULTY, AND STUDENTS.

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Gardener, and Assistant Professor of Horticulture.

A. A. SOUTHWICK, B.S., FARM SUPERINTENDENT.

Graduates of 1877.[1]

Benson, David Henry (Boston Univ.) .	Bridgewater.
Brewer, Charles (Boston University) .	Pelham.
Clark, Atherton (Boston University) .	Amherst.
Hibbard, Joseph Robinson (Boston University)	Vergennes, Vt.
Howe, Waldo Vernon (Boston Univ.) .	Framingham.
Nye, George Everett	Sandwich.
Parker, Henry Fitch	Amherst.
Porto, Raymundo, Martins da Silva (Boston University)	Para, Brazil.
Southmayd, John Edwards (Boston University)	Middletown, Conn.
Wyman Joseph (Boston University) .	Arlington.
Total	10

Senior Class.

Baker, David Erastus	Franklin.
Boutwell, Willie Levi (Boston Univ.) .	Leverett.
Brigham, Arthur Amber . . .	Marlborough.
Choate, Edward Carlisle (Boston Univ.)	Cambridge.
Coburn, Charles Francis (Boston Univ.)	Lowell.
Foote, Sandford Dwight (Boston Univ.)	Springfield.
Hall, Josiah Newhall (Boston Univ.) .	Revere.
Howe, Charles Sumner (Boston Univ.) .	Boston.
Hubbard Henry Francis (Boston Univ.)	New Rochelle, N.Y.
Hunt, John Franklin	Amherst.
Koch, Henry Gustave Heath (Boston University)	New-York City.
Lovell, Charles Otto (Boston Univ.) .	Amherst.
Lyman, Charles Elihu (Boston Univ.) .	Middlefield, Conn.
Myrick, Lockwood	Concord.
Osgood, Frederick Huntington (Boston University)	Cambridge.
Spofford, Amos Little (Boston Univ.) .	Georgetown.
Stockbridge Horace Edward (Boston University)	Amherst.

[1] The Annual Report, being made in January, necessarily includes parts of two academic years; and the catalogue gives the names of such students as have been connected with the College during any portion of the year 1877.

Tuckerman, Frederick (Boston Univ.)	Boston.
Washburn, John Hosea (Boston Univ.)	Bridgewater.
Woodbury, Rufus Putnam	Norwalk, Conn.
Total	20

Junior Class.

Campbell, Charles Henry	West Westminster, Vt.
Dickinson, Richard Storrs	Amherst.
Green, Samuel Bowdler	Chelsea.
Howard, Joseph Clark	West Bridgewater.
Hunt, Elisha Hubbard	Sunderland.
Knox, Reuben	New-York City.
*Lincoln, Joseph Gardner	Woburn.
Sherman, Walter Alden	Lowell.
Smith, George Parmenter	Sunderland.
Swan, Roscoe Westley	Framingham.
Vaill, William Henry	Enfield.
Waldron, Hiram Edmund Baylies	Rochester.
Total	12

Sophomore Class.

Atwood, Horace Ward (Boston Univ.)	Orange.
Endicott, George	New-York City.
Fowler, Alvan Luther	Westfield.
Hall, Alfred Sigourney	Revere.
McQueen, Charles Manjie	Longmeadow.
Parker, William Colverd	Wakefield.
Pease, Charles Truman	Bridgeton, Me.
Ripley, George Arms	Worcester.
Stewart, William Clark	Stillwater, Minn.
Stone, Almon Humphrey	Phillipston.
Wing, Edgar Russell	Needham.
Wood, Lewis	West Upton.
Total	12

Freshman Class.

Brooks, William Cummings	Boston.
Clark, Wallace Valentine	Amherst.

* Died Jan. 22, 1877.

Courtney, Matthew	Amherst.
Fairfield, Frank Hamilton	Waltham.
Flint, Charles Lewis, jun.,	Boston.
Gladwin, Frederick Eugene	East Haddam, Conn.
Hall, Albert Oliver	Chelsea.
Hills, Joseph Lawrence	Boston.
Hobbs, John Folsom	North Hampton, N.H.
Howe, Elmer Dwight	Marlborough.
Howe, Winslow Brigham	Marlborough.
Lee, William Gilbert	Amherst.
McKenna, James Peter	Amherst.
Perry, Alfred Dwight	Worcester.
Peters, Austin	Boston.
Rudolph, Charles	Amherst.
Sattler, Herman Charles	Baltimore, Md.
Smith, Benjamin Salter	New-York City.
Smith, John Leland	Barre.
Whitaker, Arthur	Needham.
Wilcox, Henry	Honolulu, S.I.
Wood, Wilbur	West Upton.
Young, Charles Elisha	Amherst.
Total	23

Select Class.

Bissell, Charles Humphrey	East Windsor, Conn.
Bristol, Frank Edwin	Harwinton, Conn.
Buoncore, Lewis	Wayland.
Carneiro, Manuel Dias	Rio de Janeiro, Brazil.
Chittenden, Edgar Davis	Sunderland.
Cook, Rolland Chittenden	Guilford, Conn.
Goodale, Edwin Titus	Boston.
Hawley, Amasa Stetson	Hadley.
Heighway, Sheridan Culbertson	Cincinnati, O.
Kenfield, Charles Robert	Amherst.
Mattocks, Euao Edward	Lyndon Centre, Vt.
Mills, James Kellogg (Boston Univ.)	Springfield.
Pierce William Arthur	Boston.
Richardson, Benjamin Parker	Boston.
Townsley, Herbert Milton	De Kalb, N.Y.
Warner, William Edward	Newton.
Zabriskie Frank Hunter	New-York City.
Total	17

Resident Graduates.

Benson, B. S., David Henry (Boston University)	Bridgewater.
Bragg, B. S., Everett Burt . . .	Amherst.
Lovell, B. A., Henry Lyman . . .	Amherst.
Porto B. S., Raymundo Martins da Silva (Boston University)	Para, Brazil.
Total	4

Summary.

Graduates of 1877	10
Resident Graduates	4
Seniors	20
Juniors	12
Sophomores	12
Freshmen	23
Select	17
Total	98

GRADUATES.

Allen, Gideon H., '71, Leavenworth, Kan., Agent, Adams Ex. Co.
Bagley, David A., '76, Winchendon, Medical Student.
Barrett, Joseph F., '75, Boston, Dealer in Fertilizers.
Barri, John A., '75, Northfield, Farmer.
Bassett, Andrew L., '71, New-York City, Clerk, Vermont C. R.R. & Steamship Co.
Bell, Burleigh C., '72, Bakersfield, Cal., Druggist.
Bellamy, John, '76, Brookline, Farmer.
Benedict, John M., '74, Springfield, Dealer in Produce.
Benson, David H., '77, Amherst, Post-Graduate, Agr. College.
Birnie, William P., '71, Springfield, Conductor on Railroad.
Bowker, William H., '71, Boston, Manufacturer and Importer of Fertilizers.
Blanchard, William H., '74, Putney, Vt., Farmer.
Bragg, Everett B., '75, Amherst, Post-Graduate, Agr. College.
Brett, William F., '72, Fall River, Merchant.
Brewer, Charles, '77, Pelham, Farmer.
Brooks, William P., '75, Sapporo, Japan, Professor of Agriculture, and Farm Superintendent, Agricultural College.
Bunker, Madison, '75, New-York City, Dealer in Fertilizers.
Callender, Thomas R., '75, Athol, Horticulturist.
Campbell, Frederick G., '75, West Westminster, Vt., Farmer.
Caswell, Lilley B., '71, Athol, Civil Engineer.
Chandler, Edward P., '74, Abilene, Kan., Farmer.
Chickering, Darius O., '76, Enfield, Farmer.
Clark, Atherton, '77, Amherst, Farmer.
Clark, John W., '72, Amherst, Nurseryman, Agricultural College.
Clark, Xenos Y., '78, San Francisco, Cal., Teacher.
Clay, Jabez W., '75, Westminster, Vt., Farmer.
Cowles, Frank C., '72, Hadley, Farmer.
Cowles, Homer L., '71, Amherst, Farmer.
Curtis, Wolfred F., '74, Westminster, Farmer.
Cutter, John C., '72, Warren, Physician.
Deuel, Charles F., '76, Amherst, Druggist.
Dodge, George R., '75, Boston, Dealer in Fertilizers.

Dyer, Edward N., '72, North Weymouth, Teacher.
Easterbrook, Isaac H., '72, Diamond Hill, R.I., Farmer.
Eldred, Frederick C., '73, New-York City, Insurance Agent.
Ellsworth, Emory A., '71, Northampton, Farmer.
Fisher, Jabez F., '71, Fitchburg, Clerk, Fitchburg R.R.
Fisk, Edward R., '72, Philadelphia, Penn., Salesman.
Flagg, Charles O., '72, Diamond Hill, R.I., Farmer.
Fuller, George E., '72, Greenfield, Civil Engineer.
Grover, Richard B., '72, Andover, Theological Student.
Guild, George W. M., '76, Lawrence, Merchant.
Hague, Henry, '75, Lonsdale, R.I., Minister.
Harwood, Peter N., '75, Barre, Farmer.
Hawley, Frank W., '71, Springfield, Butcher.
Hawley, Joseph M., '76, Berlin, Wis., Banking Clerk.
Herrick, Frederick St. C., '71, Methuen, Farmer.
Hibbard, Joseph R., '77, Chester, Vt., Farmer.
Hitchcock, Daniel G., '74, Warren, Merchant.
Hobbs, John A., '74, Bloomington, Neb., Farmer.
Holmes, Lemuel LeB., '72, Mattapoisett, Lawyer.
Howe, Waldo V., '77, Framingham, Manufacturer.
Kendall, Hiram, '76, Providence, R.I., Chemist.
Kimball, Francis E., '72, Worcester, Clerk, W. B. & G. R.R.
Knapp, Walter H., '75 South Orange, Horticulturist.
Ladd, Thomas H., '76, Boston, Student of Mechanics.
Lee, Lauren K., '75, Perth, N.Y., Farmer.
Leland, Walter S., '73, Sherborn, Farmer.
Leonard, George, '71, Springfield, Lawyer.
Libby, Edgar H., '74, Boston, Editor Scientific Farmer.
Livermore, Russell W., '72, Toledo, O., Lawyer.
Lyman, Asahel H., '73, Westhampton, Physician.
Lyman, Henry, '74, Middlefield, Conn., Farmer.
Lyman, Robert W., '71, Northampton, Civil Engineer.
Mackie, George, '72, Attleborough, Physician.
Mann, George H., '76, Sharon, Manufacturer.
Martin, William E., '76, Ann Arbor, Mich., Law Student.
Maynard, Samuel T., '72, Amherst, Assistant Professor Horticulture, Agricultural College.
McConnell, Charles W., '76, Philadelphia, Penn., Student, Dental College.
McLeod, William A., '76, Boston, Law Student, Boston University.
Miles, George M., '75, Tongue River, Mont., Chief Clerk, United-States Army, Quartermaster's Department.
Mills, George W., '73, Medford, Physician.
Minor, John B., '73, New Britain, Conn., Clerk, Union Mfg. Co.

Montague, Arthur H., '74, South Hadley, Farmer.
Morey, Herbert E., '73, Europe, Travelling.
Morse, James H., '71, Salem, Civil Engineer.
Nichols, Lewis A., '71, Chelsea, Civil Engineer.
Norcross, Arthur D., '71, Monson, Farmer.
Nye, George E., '77, Sandwich, Farmer.
Otis, Harry P., '75, Leeds, Manufacturer.
Page, Joel B., '71, Conway, Farmer.
Parker, Henry F., '77, Whitinsville, Machinist.
Parker, George A., '76, Poughkeepsie, N.Y., Gardener, Vassar College.
Parker, George L., '76, Boston, Florist.
Peabody, William R., '72, Atchison, Kan., General Agent, A. T. & S. F. R.R.
Penhallow, David P., '73, Sapporo, Japan, Professor of Chemistry and Botany, Agricultural College.
Phelps, Charles H., '76, South Framingham, Farmer.
Phelps, Henry L., '74, Southampton, Farmer.
Porter, William H., '76, Hatfield, Farmer.
Porto, Raymundo M. da S., '77, Para, Brazil, Planter.
Potter, William S., '76, La Fayette, Ind., Grain Broker.
Renshaw, James B., '73, Oberlin, O., Theological Student.
Richmond, Samuel H., '71, Boston, Professor of Penmanship, French's Business College.
Rice, Frank H., '75, Chicago, Ill, Farmer.
Root, Joseph E., '76, Barre, Teacher.
Russell, William D., '71, Turner's Falls, Chemist.
Salisbury, Frank B., '72, Diamond Fields, South Africa, Clerk.
Sears, John M., '76, Ashfield, Teacher.
Shaw, Elliot D., '72, Chicopee, Gardener.
Simpson, Henry B., '73, Centreville, Md., Farmer.
Smead, Edwin, '71, Baltimore, Md., Coal Merchant.
Smith, Frank S., '74, Springfield, Lumber Dealer.
Smith, Thomas E., '76, Kendallville, Ind., Professor of Elocution.
Snow, George H., '72, Leominster, Farmer.
Somers, Frederick M., '72, Kansas City, Mo., Editor.
Southmayd, John E., '77, Cottonsham, Ga., Farmer.
Southwick, Andre A., '75, Amherst, Farm Superintendent, Agr. Coll.
Sparrow, Lewis A., '71, Boston, Chemist.
Strickland, George P., '71, Amesbury, Civil Engineer.
Taft, Cyrus A., '76, Whitinsville, Machinist.
Thompson, Edgar E., '71, Brockton, Druggist.
Thompson, Samuel C., '72, Natick, Civil Engineer.

Tucker, George H., '71, West Springfield, Penn., Civil Engineer.
Urner, George P., '76, Woodbridge, N.J., Farmer.
Wakefield, Albert T., '73, Peoria, Ill, Physician.
Ware, Willard C., '71, Boston, Clothier.
Warner, Seth S., '73, Northampton, Dealer in Fertilizers.
Webb, James H., '73, New Haven, Conn., Attorney-at-Law.
Wellington, Charles, '73, Wash., D.C., Chemist, U. S. Ag. Dept.
Wells, Henry, '72, Rochester, N.Y., Clerk.
Wetmore, Howard G., '76, New-York City, Student of Medicine.
Wheeler, William, '71, Sapporo, Japan, Prof. of Math., Agr. Coll.
Whitney, Frank Le P., '71, Boston, Florist.
Whitney, William C., '72, Boston, Architect.
Williams, John E., '76, Amherst, Editor.
Winchester, John F., '75, New-York City, Student of Veterinary, A. V. College.
Wood, Frank W., '73, Providence, R.I., Civil Engineer.
Woodman, Edward E., '74, Jersey City, N.J., Florist.
Wyman, Joseph, '77, Arlington, Farmer.
Zeller, Harrie McK., '74, Hagerstown, Md., Farmer.

Total 130

COURSE OF STUDY AND TRAINING.

FRESHMAN YEAR.

First Term. — Chemistry, 5 hours each week; Human Anatomy, Physiology, and Hygiene, 3 hours; Algebra, 5 hours; English, 2 hours; Agriculture, 2 hours; Declamation, 1 hour; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term. — Inorganic Chemistry, 2 hours; Botany, 3 hours; Geometry, 5 hours; Agriculture, 3 hours; English, 2 hours; Elocution, 1 hour; Freehand Drawing, 3 hours; Military Drill, 3 hours.

Third Term. — Systematic Botany, 4 hours; Geometry, 4 hours; French, 5 hours; Elocution, 2 hours; Agriculture, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

SOPHOMORE YEAR.

First Term. — Systematic Botany, 3 hours each week; Geometry, 4 hours; French, 5 hours; English, 1 hour; Agriculture, 2 hours; Declamation, 1 hour; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term. — Geology, 3 hours; Trigonometry, 5 hours; French, 4 hours; English, 1 hour; Agriculture, 3 hours; Declamation, 1 hour; Drawing, 3 hours; Military Drill, 3 hours.

Third Term. — Zoölogy, 5 hours; Surveying, 5 hours; Agriculture, 2 hours; English, 3 hours; Declamation, 1 hour; Levelling, 3 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

JUNIOR YEAR.

First Term. — German, 5 hours each week; Mechanics, 5 hours; Entomology, 2 hours; Market-Gardening, 2 hours; Horticulture, 2 hours; Military Drill, 3 hours; Manual Labor, 6 hours.

Second Term. — German, 4 hours; Physics, 5 hours; Practical Chemistry, 9 hours; Drawing, 3 hours; Agricultural Debate, 1 hour; Declamation, 1 hour; Military Drill, 3 hours.

Third Term. — German, 4 hours; Astronomy, 4 hours; Practical Chemistry, 9 hours; Declamation, 1 hour; Stock and Dairy Farming, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

SENIOR YEAR.

First Term. — English Literature, 4 hours each week; Practical Chemistry, 7 hours; Book-keeping, 2 hours; Roads and Railroads, 3 hours; Military Science, 2 hours; Original Declamation, 1 hour; Military Drill, 3 hours.

Second Term. — English Literature, 4 hours; Theses, 1 hour; Mental Science, 4 hours; Agriculture, 2 hours; Veterinary Science, 3 hours; Military Science, 2 hours; Microscopy, 4 hours; Military Drill, 3 hours.

Third Term. — Veterinary Science, 2 hours; Military Science, 2 hours; Botany, 3 hours; Landscape-Gardening, 2 hours; Rural Law, 1 hour; Lectures on English Language, 2 hours; Theses, 1 hour; Agricultural Review, 4 hours; Military Drill, 4 hours.

LIST OF BOOKS.

Instruction is largely given by lectures and practical exercises; but the following text-books are recommended for recitation or reference: —

BOTANY AND HORTICULTURE.

Gray's Lessons, Manual and Botanical Text-Book.
Sachs' Text-Book of Botany, Morphological and Physiological.
Masters' Henfrey's Elementary Course of Botany.
Berkeley's Introduction to Cryptogamic Botany.
Cooke's Microscopic Fungi.
Carpenter's The Microscope and its Revelations.
Flint's Grasses and Forage-Plants.
Downing's Fruits and Fruit-Trees of America.
Thomas's American Fruit-Culturist.
Hoope's Book of Evergreens.
Strong's Grape-Culture.
Henderson's Practical Floriculture.
Fuller's Forest-Tree Culturist.
Williams's Choice Stove and Greenhouse Plants.
Helmsley's Hand-Book of Hardy Trees, Shrubs, and Herbaceous Plants.
Loudon's Cyclopædia of Plants.
Loudon's Cyclopædia of Gardening.
Lindley and Moore's Treasury of Botany.
Kemp's Landscape-Gardening.
Downing's Landscape-Gardening.

AGRICULTURE.

Johnson's How Crops Grow.
Johnson's How Crops Feed.
Pendleton's Scientific Agriculture.
Hyde's Lowell Lectures on Agriculture.
Liebig's Natural Laws of Husbandry.
French's Farm Drainage.
Flint's Milch Cows and Dairy Farming.
Sturtevant's The Dairy Cow, — Ayrshire.
Waring's Handy-Book of Husbandry.
Henderson's Gardening for Profit.
Donaldson's British Agriculture.
Morton's Cyclopædia of Agriculture.
Low's Domesticated Animals.
Flint's Reports on the Agriculture of Massachusetts.
Agricultural Gazette and Gardener's Chronicle, London.

CHEMISTRY AND GEOLOGY.

Watt's Fownes's Manual of Elementary Chemistry.
Sibson's Agricultural Chemistry.
Caldwell's Agricultural Chemical Analysis.
Nason's Woehler's Chemical Analysis.
Will's Analytical Chemistry.
Johnson's Fresenius' Qualitative and Quantitative Analysis.
Liebig's Ernährung der Pflanzen.
Wolff's Landwirthschaftliche Analyse.
Hoffman's Ackerbau Chemie.
Watt's Chemical Dictionary.
Dana's Mineralogy.
Hitchcock's Geology.
Dana's Text-Book and Manual of Geology.

VETERINARY SCIENCE AND ZOÖLOGY.

Fleming's Chauveau's Comparative Anatomy of Domesticated Animals.
Dalton's Human Physiology.
Cleland's Animal Physiology.
Williams's Principles of Veterinary Surgery.
Williams's Principles of Veterinary Medicine.
Gamgee's On Horse-shoeing and Lameness.
Gamgee's On Domestic Animals in Health and Disease.
Armitage's Clater's Cattle Doctor.
Youatt's Treatises on the Domestic Animals.

Blaine's Veterinary Art.
Morton's Manual of Pharmacy.
Wood and Bache's United-States Dispensatory.
Harbison's Elementary Zoölogy.
Lankester's Advanced Zoölogy.
Packard's Guide to the Study of Insects.
Harris's Insects Injurious to Vegetation.
Westwood's Principles of Classification of Insects.
Baird's Mammals of North America.
Murray's Geographical Distribution of Mammals.
Samuels's Birds of New England.
Cobbold's Entozoa.
Denney's Parasitic Insects.
Moquin-Tandon's Manual of Medical Zoölogy.

MATHEMATICS, PHYSICS, AND CIVIL ENGINEERING.

Murray's Algebra.
Loomis's Geometry and Trigonometry.
Gillespie's Surveying.
Gilmore's Roads and Railroads.
Hill's Stewart's Natural Philosophy.
Everett's Deschanel's Natural Philosophy.
Atkinson's Ganot's Physics.
Peabody's Astronomy.
Loomis's Meteorology.

ENGLISH, FRENCH, AND GERMAN.

Hart's Composition.
Fowler's English Grammar.
Shaw's Complete Manual of English Literature.
Chambers's Cyclopædia of English Literature.
Morley's English Writers.
Taine's History of English Literature.
Languiller and Monsanto's French Grammar.
Spiers and Surenne's French Dictionary.
Glaubensklee's German Grammar.
Adler's German Dictionary.

The French and German books for translation are changed every year, selections being made from recent literary and scientific publications.

MENTAL, MORAL, AND SOCIAL SCIENCE.

Haven's Mental Science.
Hickok's Empirical Psychology.

Porter's Elements of Intellectual Science.
Seelye's Schwegler's History of Philosophy.
Hickok's Moral Science.
Haven's Moral Philosophy.
Hopkins's Law of Love, and Love as Law.
Chadbourne's Natural Theology.
Walker's Science of Wealth.
Perry's Political Economy.
Carey's Principles of Social Science.
Stirling's Bastiat's Harmonies of Political Economy.

MILITARY SCIENCE.

Lippitt's Tactical Use of the Three Arms.
Lippitt's Treatise on Intrenchments.
Lippitt's Field Service in Time of War.
Lippitt's Special Operations of War.
Welcker's Military Lessons.
Upton's Infantry Tactics.
United-States Artillery Tactics.
Kent's Commentaries.
Benet's Courts-Martial.
Holt's Digest of Opinions.
Halleck's International Law.
Regulations of United-States Army.
United-States Ordnance Manual.
General and State Militia and Volunteer Laws.
Scott's Military History.
Histories of Revolution, War of 1812, Mexican War, and Rebellion.
Public Documents, and Reports of Naval and Military Departments.

CALENDAR FOR 1878.

The third term of the collegiate year begins March 28, and continues till June 26.

The first term begins Aug. 29, and continues till Nov. 26.

The second term begins Dec. 12, and continues till March 12, 1879.

There will be an examination of candidates for admission to the College, at the Botanic Museum, at nine A.M., Tuesday, June 25, and also on Thursday, Aug. 29.

The Farnsworth Prize Declamations take place Monday evening, June 24.

The public examination of the graduating class for the Grinnell prize for excellence in agriculture, and the examination of the other classes in the studies of the term, will take place on Tuesday forenoon, June 25.

The exercises of Graduation Day occur June 26.

ADMISSION.

Candidates for admission to the Freshman Class are examined, orally and in writing, upon the following subjects: English Grammar, Geography, Arithmetic, Algebra through simple equations, and the History of the United States.

Candidates for higher standing are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the College until he is fifteen years of age; and every student is required to furnish a certificate of good character from his late pastor or teacher, and to give security for the prompt payment of term-bills. Tuition and room-rent must be paid in advance at the beginning of each term, and bills for board, fuel, &c., at the end of every term.

The regular examinations for admission are held at the Botanic Museum, at nine o'clock, A.M., Tuesday, June 25, and on Thursday, Aug. 29; but candidates may be examined and admitted at any other time in the year.

Further information may be obtained of President W. S. Clark, Amherst, Mass.

EXPENSES.

Tuition	$25 00	per term.
Room-rent	$5 00 to 10 00	"
Board	3 50	per week.
Expenses of chemical laboratory to students of practical chemistry	10 00	per term.
Public and private damages, including value of chemical apparatus destroyed or injured,	at cost.	
Annual expenses, including books . .	$300 00 to 350 00	

REMARKS.

The regular course of study occupies four years; and those who complete it receive the degree of Bachelor of Science, the diploma being signed by the Governor of Massachusetts, who is president of the corporation.

Regular students of the College may also, on application, become members of Boston University, and upon graduation receive its diploma in addition to that of the College, thereby becoming entitled to all the privileges of its alumni.

The instruction in the languages is intended to qualify the graduates to write and speak English with correctness and effect, and to translate German and French with facility. The scientific course is as thorough and practical as possible; and every science is taught with constant reference to its application to agriculture and the wants of the farmer.

The instruction in agriculture and horticulture includes every branch of farming and gardening which is practised in Massachusetts, and is both theoretical and practical. Each topic is discussed thoroughly in the lecture-room, and again in the plant-house or field, where every student is obliged to labor. The amount of required work, however, is limited to six hours per week, in order that it may not interfere with study. Students are allowed to do additional work, provided they maintain the necessary rank as scholars. All labor is paid at the rate of twelve and one-half cents per hour.

Indigent students are allowed to do such work as may offer about the College and farm buildings, or in the field; but it is hardly possible for one to earn more than from fifty to one hundred dollars per annum besides performing other duties. So far as is consistent with circumstances, students will be permitted to select such varieties of labor as they may for special reasons desire to engage in.

Those who pursue a select course attend recitations and lectures with the regular classes; but those properly qualified, who desire special instruction in botany, chemistry, civil engineering, veterinary science, agriculture, or horticulture, may make private arrangements with the officers having charge of these departments.

An expenditure of from ten to fifty dollars is necessary to provide furniture, which may be purchased at reasonable rates, either new or second-hand. At the beginning of the second term of attendance each student is required to provide himself with the full uniform prescribed for the battalion of Agricultural Cadets, the cost of which is about thirty dollars.

On Sundays students are required to attend church in the forenoon, and invited to join a class for the study of the Bible in the afternoon. They will be permitted to select their place of attendance from among the churches in the town, of the following denominations; viz., Baptist, Congregational, Episcopalian, Methodist, and Roman-Catholic.

POST-GRADUATE COURSE.

Graduates of colleges and scientific schools may become candidates for the degree of Doctor of Science, or Doctor of Philosophy, from the College or from the University, and pursue their studies under the direction of President Clark in botany, Professor Goessmann in chemistry, or other members of the Faculty in their respective departments.

BOOKS, APPARATUS, AND SPECIMENS IN NATURAL HISTORY.

The Library of the College contains about fifteen hundred volumes. Among them are several valuable sets of cyclopædias, magazines and newspapers, reports of agricultural societies and state boards of agriculture, and many standard works on agriculture and horticulture. There are also many useful works of reference in chemistry, botany, surveying, and drawing. The larger part of the books has been presented to the Institution by private individuals.

The faculty and students also have the privilege of drawing books from the excellent library of Amherst College, which contains over thirty thousand volumes.

The State Cabinet of specimens, illustrating the geology and natural history of Massachusetts, has been removed from Boston to the College, and is of much value for purposes of instruction.

The Knowlton Herbarium contains more than ten thousand species of named botanical specimens, besides a large number of duplicates. The Botanic Museum is supplied with many interesting and useful specimens of seeds, woods, and fruit-models. There is also a set of diagrams illustrating structural and systematic botany, including about three thousand figures.

About fifteen hundred species and varieties of plants are cultivated in the Durfee Plant House, affording much pleasure and information to students of both colleges.

The very extensive, and in some respects unsurpassed, collections in geology, mineralogy and natural history, ethnology and art, belonging to Amherst College, are accessible to members of the Agricultural College.

The chemical, engineering, and military departments of the Agricultural College are well furnished.

The class in microscopy have the use of seven of Tolles's best compound microscopes, with objectives from four inches to one-eighth of an inch in focal distance, and a variety of eye-pieces.

PRIZES.

FARNSWORTH RHETORICAL MEDALS.

Isaac D. Farnsworth, Esq., of Boston has generously provided a fund of fifteen hundred dollars, which is to be used for the purchase of gold and silver medals, to be annually awarded, under the direction of the College Faculty, for excellence in Declamation.

GRINNELL AGRICULTURAL PRIZES.

Hon. William Claflin of Boston has given the sum of one thousand dollars for the endowment of a first prize of fifty dollars, and a second prize of thirty dollars, to be called the Grinnell Agricultural Prizes, in honor of George B. Grinnell, Esq., of New York. These prizes are to be paid in cash to those two members of the graduating class who may pass the best oral and written examination in Theoretical and Practical Agriculture.

HILLS BOTANICAL PRIZES.

For the best Herbarium collected by a member of the class of 1878, a prize of fifteen dollars is offered, and, for the second best, a prize of ten dollars; also a prize of five dollars for the best collection of Woods.

TOTTEN MILITARY PRIZE.

For the best Essay by a member of the Senior class on such topic as may be assigned, a prize of twenty-five dollars is offered. Subject for 1878, "The American Military Problem."

REGULATIONS.

I. — Students are specially forbidden to combine together for the purpose of absenting themselves from any required exercise, or violating any known regulation of the College.

II. — The roll shall be called five minutes after the ringing of the bell for each exercise of the College, by the officer in charge, unless a monitor be employed; and students who do not answer to their names shall be marked absent, provided that any student coming in after his name has been called shall be marked tardy. Two tardinesses shall be reckoned as one absence.

III. — Absence from a single exercise may be allowed or excused by the officer in charge of the same, if requested beforehand; but permission to be absent from several exercises must be obtained in advance from the general excusing officer, or from the president.

In such cases the officer excusing will furnish a certificate of excuse, which shall state the precise time for which absence is permitted, and which shall be a satisfactory reason for absence from all exercises occurring within the time specified.

IV. — Excuses for all absences, whether with permission obtained beforehand or not, must be submitted to the excusing committee. They must be rendered promptly within one week from the date of absence; and those deemed unsatisfactory will be returned to the student with the indorsement of the committee.

V. — Whenever the aggregate number of unexcused absences in all departments reaches five, the student so delinquent shall be informed of the fact. When the number of such absences reaches eight, the parent or guardian of the student shall be informed of his delinquency; and, when ten such delinquencies are justly recorded against any student, his connection with the College may be terminated.

VI. — Students are forbidden to absent themselves without excuse from the regular examinations, to give up any study without permission from the president, or to remove from one room to another without authority from the officer in charge of the dormitory buildings; and no student shall be permitted to make such change until he has procured from the inspecting officer a written statement that the room about to be vacated is in perfect order.

VII. — Students shall be required to attend the church of their selection regularly on Sunday morning, and report in writing to the excusing officer, during the ensuing week, whether they attended or not.

VIII. — The record of deportment, scholarship, and attendance, will be carefully kept; and, whenever the average rank of a student falls below fifty, he will not be allowed to remain a member of the College, except by a special vote of the faculty. Admission to the College, and promotion from class to class, as well as to graduation, are granted only by vote of the Faculty.

IX. — Students are required to abstain from any thing injurious to the buildings and other property of the College, and in all respects to conduct themselves with propriety.

SIZE OF ROOMS.

For the information of those desiring to carpet their rooms, the following measurements are given. In the south dormitory the main corner-rooms are fifteen by eighteen feet, and the adjoining bedrooms eight by twelve feet. The inside rooms are fourteen by fifteen feet, and the bedrooms eight by eight feet. In the north dormitory the corner-rooms are fourteen by fifteen feet, and the annexed bedrooms eight by ten feet; while the inside rooms are thirteen feet and a half by fourteen feet and a half, and the bedrooms eight by eight feet.

SCHOLARSHIPS.

The Massachusetts Society for Promoting Agriculture pays annually into the treasury of the College the sum of three hundred dollars, which is assigned by the Faculty to the payment of the tuition of four worthy indigent students who intend to engage in agricultural pursuits after graduation.

The income of the Robinson Fund of one thousand dollars, the bequest of Miss Mary Robinson of Medfield, is assigned by the Faculty to such indigent student as they may deem most worthy.

The Trustees voted, in January, 1878, to establish one free scholarship for each of the eleven congressional districts of the State. Applications for such scholarships should be made to the representative from the district to which the applicant belongs. The selection for these scholarships will be determined as each member of Congress may prefer; but, where several applications are sent in from the same district, a competitive examination would seem to be desirable. Applicants should be good scholars, of vigorous constitution; and should enter College with the intention of remaining through the course, and then engaging in some pursuit connected with agriculture. To every such student the cash value of a scholarship is three hundred dollars.

FINANCIAL STATEMENT, Jan. 1, 1878.

REAL ESTATE.

College Farm and Quarry	$37,500 00
North College	36,000 00
South College	36,000 00
College Hall	30,000 00
South Boarding-House	8,000 00
North Boarding-House	8,000 00
Durfee Plant-House	12,000 00
Botanic Museum	5,000 00
South Barn	14,500 00
Farm-House	4,000 00
Four Dwellings and Barns purchased with the Estate,	9,000 00
Total Real Estate	$200,000 00

FARM STATEMENT.

Value of Live-Stock	$5,872 00
Vehicles and Implements	1,243 55
Produce on Hand	1,921 00

FUND FOR MAINTENANCE OF THE COLLEGE, IN CHARGE OF THE STATE TREASURER.

Agricultural College Fund.

Cash balance on hand Jan. 5, 1878		$10,000 00
Present investments : —		
City of Cambridge Note	$75,000 00	
Lynn Bonds	25,000 00	
Chelsea Note	25,000 00	
Fall-River Note	50,000 00	
Town of Milford Bonds	14,200 00	
Plymouth Note	6,724 65	
Brighton Note	10,000 00	
Amounts carried forward	$205,924 65	$10,000 00

Amounts brought forward . .	$205,924 65	$10,000 00
West-Roxbury Notes . .	40,000 00	
Westborough Notes . .	12,000 00	
Lee Note	4,142 75	
Somerset Note . . .	10,000 00	
County of Hampden Note . . .	50,000 00	
		322,067 40
Massachusetts, Troy, and Greenfield Railroad bonds . . .	$8,000 00	
Massachusetts Bounty Loan Bonds .	16,000 00	
		24,000 00
State of Maine Bonds . . .		4,000 00
Total Fund		$360,067 40

Two-thirds of the income of this fund is by law paid to the Treasurer of the College, and one-third to the Treasurer of the Institute of Technology.

The Hills Fund of ten thousand dollars, for the maintenance of the Botanic Garden, is in charge of the College Treasurer.

To this sum should be added the receipts for tuition and room-rent, amounting to one hundred dollars per annum for each scholar, and the receipts from the sale of the products of the farm and garden.

DR. GEORGE MONTAGUE, TREASURER, *in Account with* MASSACHUSETTS AGRICULTURAL COLLEGE. CR.

1877.				1877.		
Jan. 1.	To balance		$702 12		By Salaries	$16,350 00
	Income of Hills Fund		1,045 83		Expenses of Hills Fund account	240 97
	State Endowment Fund		14,985 47		Contingent account	3,919 61
	State appropriation	$2,500.00			Botanical account	2,103 75
	State appropriation for students' labor	1,165.90			Farm account	3,669 80
			3,665 90		Interest account	1,636 24
	Prize Funds		180 00		Prize account	170 00
	Receipts from students		5,075 48		Laboratory account	400 75
	from Farm Superintendent		2,073 76		Bills payable, note paid	20,000 00
	from Botanical account		2,066 02		Students' bills, paid from Labor Fund	1,165 90
	Bills payable, Note at Greenfield Savings Bank		20,000 00	Dec. 31.	Balance	1,137 56
	Note at Amherst Bank		1,000 00			
			$50,794 58			$50,794 58

Respectfully submitted,

GEORGE MONTAGUE, *Treasurer.*

I have examined the Treasurer's accounts, and find them correctly stated, and accompanied by the proper vouchers,

HENRY COLT, *Auditor.*

SUMMARY

OF

METEOROLOGICAL OBSERVATIONS FOR THE YEARS

1876 AND 1877,

TAKEN AT AMHERST, MASS., BY MISS SABRA C. SNELL.

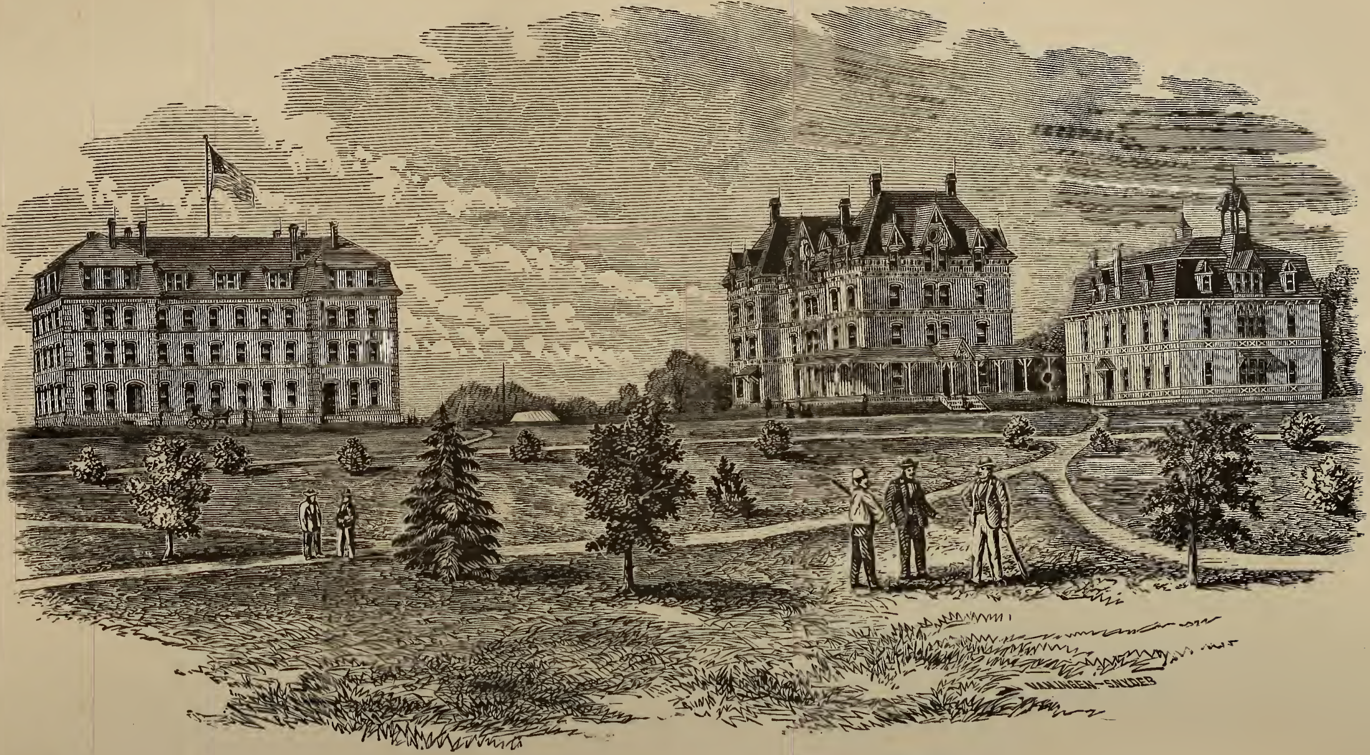
LATITUDE, 42° 22′ 17″. LONGITUDE, 72° 34′ 30″. ELEVATION ABOVE THE SEA LEVEL, 267 FEET.

SUMMARY OF METEOROLOGICAL OBSERVATIONS FOR THE YEAR 1876.

	Thermometer in open air.			Am't of Rain and Melted Snow.	Depth of Snow.	Clouds.	Winds. Per cent of time and force.				Barometer.			Force of Vapor.			Humidity.		
	Max.	Min.	Mean.				N.W.	S.W.	S.E.	N.E.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
January .	63.0	2.8	29.85	2.305	5.5	5.2	59	19	15	7	30.271	29.135	29.783	.422	.030	.134	98	26	72
February .	52.0	–1.0	26.36	5.526	20.0	5.0	61	15	14	10	30.629	28.621	29.789	.254	.015	.103	95	30	68
March .	59.0	4.5	31.60	7.104	15.0	4.9	64	14	14	8	30.157	28.953	29.699	.347	.034	.129	100	37	67
April .	53.3	28.0	43.60	3.105	3.0	5.5	63	12	12	13	30.105	29.227	29.662	.514	.067	.174	96	15	60
May .	86.0	39.0	57.52	3.956	–	4.5	41	20	25	14	30.145	29.387	29.734	.680	.119	.319	96	28	65
June .	87.7	47.0	70.61	3.867	–	5.5	31	25	42	2	29.992	29.381	29.713	.870	.308	.564	97	36	72
July .	95.0	52.5	74.19	4.836	–	4.5	35	23	31	11	29.995	29.507	29.703	.911	.308	.585	97	33	71
August .	90.0	49.0	70.59	0.272	–	3.4	38	10	51	1	30.042	29.486	29.821	.860	.194	.525	97	32	72
September .	90.0	41.2	59.10	3.705	–	5.1	42	12	23	23	30.139	29.313	29.725	.686	.152	.371	98	28	75
October .	71.1	23.0	45.50	1.118	–	4.7	57	21	19	3	30.072	29.244	29.670	.630	.102	.232	100	28	72
November .	71.7	18.9	40.50	2.488	–	5.8	51	19	9	21	30.122	29.239	29.683	.659	.000	.213	100	0	76
December .	42.0	–1.0	19.70	3.217	30.5	5.7	70	15	8	7	30.320	28.824	29.659	.195	.000	.080	100	0	69
Year .	95.0	–1.0	47.42	41.499	74.0	5.0	51	17	22	10	30.629	28.621	29.720	.911	.000	.286	100	0	70

SUMMARY OF METEOROLOGICAL OBSERVATIONS FOR THE YEAR 1877.

	THERMOMETER. IN OPEN AIR.			Am't of Rain and Melted Snow.	Depth of Snow.	Clouds.	WINDS. PER CENT OF TIME AND FORCE.				BAROMETER.			FORCE OF VAPOR.			HUMIDITY.		
	Max.	Min.	Mean.				N.W.	S.W.	S.E.	N.E.	Max,	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
January .	43.0	–3.0	20.05	2.517	9.5	4.8	64	20	12	4	30.254	28.896	29.793	.217	.018	.083	100	42	68
February .	50.0	8.5	30.78	0.360	0.5	3.4	60	11	20	9	30.125	29.306	29.718	.216	.032	.116	95	37	65
March .	52.8	10.0	33.30	6.973	6 0	5.8	63	13	17	7	30.167	28.833	29.682	.378	.043	.144	100	33	69
April . .	75.8	32.5	47.80	2.452	–	5.2	58	5	33	4	30.125	29.209	29.705	.479	.071	.183	99	15	57
May . .	84.5	40.0	58.50	1.925	–	4.5	44	34	14	8	30.034	29.172	29.665	.643	.092	.302	99	16	61
June . .	88.0	54.7	67.77	4.587	–	5.1	36	30	31	3	30.033	29.370	29.708	.760	.190	.497	100	20	76
July . .	89.1	58.1	71.13	6.470	–	5.0	33	26	35	6	29.962	29.411	29.674	.819	.343	.577	99	38	79
August .	87.4	54.8	71.35	2.790	–	4.9	40	23	30	7	29.965	29.448	29.666	.938	.371	.614	99	41	81
September .	85.7	39.0	63.31	0 912	–	4.1	39	29	27	5	30.018	29.435	29.792	.770	.197	.454	100	35	77
October .	75.4	25.3	50.50	6.985	–	5.6	34	17	35	14	30.178	29.264	29.764	.780	.084	.219	100	36	81
November .	66.8	19.4	41.92	5.435	0.5	5 5	49	17	26	8	30.307	29 093	29.823	.571	.083	.214	98	36	75
December .	55.2	13 0	33.09	1 023	0.5	2.8	59	20	17	4	30.345	29.170	29.857	.320	.000	.136	100	0	67
Year . .	89.1	–3.0	49.12	42.417	17.0	4.7	48	20	25	6	30.345	28.833	29.737	.938	.000	.295	100	0	71



MASSACHUSETTS AGRICULTURAL COLLEGE, AMHERST, MASS.

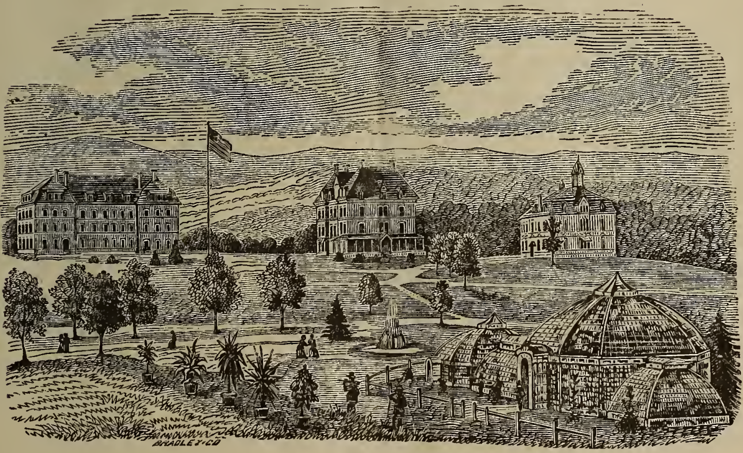
SENATE..... .....No. 100.

SIXTEENTH ANNUAL REPORT

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

JANUARY, 1879.



BOSTON:
Rand, Avery, & Co., Printers to the Commonwealth,
117 Franklin Street.
1879.

Commonwealth of Massachusetts.

AMHERST, Jan. 30, 1879.

To His Excellency Thomas Talbot.

SIR, — I have the honor herewith to present to Your Excellency and the Honorable Council the Sixteenth Annual Report of the Massachusetts Agricultural College.

Very respectfully,

Your obedient servant,

W. S. CLARK, *President.*

Commonwealth of Massachusetts.

EXECUTIVE DEPARTMENT,
BOSTON, Feb. 5, 1879.

To the Honorable the Senate.

I have the honor herewith to present for the consideration of the General Court the Sixteenth Annual Report of the Massachusetts Agricultural College.

THOMAS TALBOT.

INDEX.

ANNUAL REPORT.

To His Excellency the Governor and the Honorable Council.

The Trustees of the Massachusetts Agricultural College respectfully submit their Sixteenth Annual Report.

The year 1878 has been the most successful in the history of the institution. The number of students has been very large and their conduct excellent. All the dormitory rooms have been occupied; and the boarding-house has been able to furnish satisfactory board for two dollars and a half per week. The average annual number of students for the past eleven years is one hundred and eleven, and the number last year was one hundred and sixty-two. The average yearly number of graduates during the past eight years is nineteen; but the last class numbered twenty-one. The total number of alumni is now one hundred and fifty, a catalogue of whom, with their present occupations and addresses, is appended to this report. In addition to these there have been admitted to the College three hundred and sixty-five students who have taken a partial course of less than four years, a large proportion of whom came to the institution especially for instruction in agriculture, and are now believed to be applying their knowledge of the art to practice. The total number admitted on examination or diploma since the College was opened in 1867 is six hundred and thirty-seven. Of the alumni, forty-one are now engaged in practical farming or gardening, and sixteen are indirectly connected with agricultural affairs. In general intelligence upon all matters pertaining to agriculture and horticulture, every graduate of the College will compare favorably, not only with the alumni of any other educational institution, but also with the most successful and best-informed farmers of the Commonwealth.

The Trustees believe that the theoretical and practical education afforded by the College has been equal at least to that given at any other agricultural college of the country, and that in agriculture it has fully met the requirements of the charter granted by the Legislature of 1863. In order that the public may understand the origin and objects of the College, and the obligation of the State in regard to it, the laws of the United States and of Massachusetts by which it was endowed and incorporated are herewith printed for reference, and may be found on pp. 22–26.

The following facts are worthy the consideration of every fair-minded and honorable citizen of the good old Commonwealth whose name the College bears. First, Massachusetts has accepted from the United States three hundred and sixty thousand acres of land, from the town of Amherst seventy-five thousand dollars, and from individuals a large additional sum, and entered into a formal contract with the aforesaid parties to maintain in Amherst a college which shall not be inferior in its plan of organization to the existing State institution.

Secondly, the plan of organization and course of study have been established by law, and have been found satisfactory in practice, not only at home, but in Japan, where a similar college has been organized, and is now in successful operation. Whatever has been imperfect and objectionable in the working of the College has resulted rather from the want of adequate funds than from any inherent defects of the system adopted. The great uncertainty with regard to legislative appropriations has been a constant hinderance to the judicious and economical management and development of the College; but the Trustees, with the Governor of the Commonwealth as their presiding officer, claim to have done, in the main, as well as circumstances would allow.

Thirdly, the popular sentiment in favor of agricultural education and of scientific inquiry for the improvement of farming has steadily increased since the College was opened. This is demonstrated by the fact that more than four hundred young men applied for information about the College in the months of July and August last; and one-quarter of them appeared for admission to the freshmen class, while the majority of the others were deterred only by want of means to defray the expenses of the course. This result of offering free tuition refutes completely the assertion that there is no demand for agricultural education. If the college were properly supported, and thrown open, without charge for tuition, to the young men of Massachusetts, it would be crowded with superior students, and become exceedingly popular.

Fourthly, the military department of the College, — required, officered, and equipped by the General Government, — not only affords admirable facilities for valuable discipline to every student, but also educates, far more thoroughly than any militia system can, a large number of young men to serve as officers or soldiers in case of need. This feature of the course of study and training is far more important than is generally supposed and has from the first received most careful attention, and been eminently successful. No wiser expenditure for military purposes can be made by the State than to grant the small sum needed for the proper maintenance of the College.

Fifthly, the College has been and should be an experimental station for the trial and investigation of whatever promises to be of value in agriculture. The hearty recognition of the value of the scientific work done in years past by the faculty and students of the institution, by the lamented Agassiz and other scientists, has been a source of great encouragement to the president and professors, who have patiently endured much abuse from the newspapers, especially those of the cities.

Sixthly, the members of the Board of Agriculture are overseers of the College, and by their examining committees have regularly visited it, and reported upon its condition, adding such friendly criticism as they thought might be useful. The Trustees have endeavored, so far as their means would allow, to be guided by the suggestions offered. They have honestly and courageously striven to render the institution worthy the name given it by the Legislature of 1863, and, notwithstanding the unpopularity of the word "agricultural," they have not asked to have it stricken out, as has been done in Ohio[1] and Pennsylvania. They believe the

[1] The Ohio Agricultural and Mechanical College has been organized and re-organized by the Legislature four times; and in 1878 it was named the Ohio State University, and graduated its first class of six. It has real estate and appliances worth half a million dollars, and a cash income from the State treasury of thirty thousand dollars.

most difficult portion of the task assigned them has been accomplished, and that the College, substantially in its present form, is worthy of confidence and support, and that the people will not allow it to be reduced to insignificance for want of a small amount of money.

Seventhly, the financial condition of the College demands immediate attention and wise action on the part of the Legislature. Year after year the annual deficit has been reported, and repeated petitions for needed appropriations have been made. The committee on agriculture have granted hearings, and visited the College, and always reported favorably; but the handful of farmers, even when well informed themselves, have often been unable to secure the passage of their bill. The debt, to the accumulation of which no Legislature has objected, now amounts to thirty-two thousand dollars, and should be paid as soon as practicable. The Trustees, as unpaid agents of the Commonwealth, have done the best they could to carry on the College according to the plan prescribed by the statutes; and, when the necessary funds were not furnished them, they have been compelled to borrow the required amount. It would have been both unwise and unlawful for them to have modified the system of education without the approval of the Legislature. If, after due consideration, the General Court shall decide that the College is better than Massachusetts can afford to maintain for the education of her sons, then a new institution upon an inferior plan should be organized. A reference to the summary statement of all expenditures on account of the College, which may be found on p. 108, shows that the total cost of this grand experiment in agricultural education and improvement has been not less than one million dollars. More than one-quarter of this sum has been invested in land, buildings, apparatus, furniture, live-stock, and other appliances for the use of the several departments of the College. The Agricultural Fund in the State treasury, the income of which is applied for the payment of salaries, is two hundred and forty thousand dollars. In addition to this there are in the College treasury ten thousand dollars, constituting the Hills Fund (given by Messrs. L. M. and H. F. Hills), the Grinnell Prize Fund of one thousand dollars (the gift of Hon. William Claflin), and the Mary Robinson Scholarship Fund, of the same amount. A bequest of one thousand dollars has been made by Mr. Whiting Street of Northampton, who died during the past year; but the money has not yet been received by the treasurer. Thus it appears that the present resources of the College amount to half a million dollars, and that a cash income of not less than thirteen thousand dollars may be relied upon, without any regard to the receipts from tuition, room-rent, or sales of produce or live-stock.

Although every other State in the Union offers free tuition to its students in agriculture, the Trustees of the Massachusetts College have felt obliged in years past to charge seventy-five dollars per annum for tuition only, or three hundred dollars for the full course. This sum, added to the cost of room-rent, uniform, books, and board, was more than the farmers have felt able or willing to pay, especially during a period of financial depression. As the number of students consequently was diminished, the opponents of the institution loudly proclaimed that the experiment was a failure, and that there was no demand for agricultural education. With a view of testing this matter, the Trustees voted to establish a free scholarship in each of the eleven congressional districts of the State, and also to allow each of the alumni to nominate one student for a free scholarship for four years, provided he should enter the freshman class of 1878. The result has already been mentioned, and demonstrates the fact that the number of students would be limited only by the capacity of the buildings, if the College were placed in the same relation to the public as the State normal schools, the high schools, and the other agricultural colleges of the country.

The good name and the best interests of the Commonwealth imperatively require that the results of sixteen years of hard labor and large expense in organizing the College, now in successful operation, should receive candid and intelligent consideration from the Legislature. Certainly the wealthiest State in the Union cannot plead inability as an excuse for violating a plain contract to maintain "at least one such college" as is described in the first section of the act of incorporation. The Legislature of 1863 formally accepted the offer of the United States, with all its conditions, and then instructed the Trustees to demand seventy-five thousand dollars as the price of the advantages to be derived from the location and perpetual maintenance of such a college in any town which would also furnish a suitable farm for a reasonable sum. Amherst was one of four towns to bid for the institution, and was selected by the Trustees, with the approval of the Governor and Council, as, on the whole, offering the most eligible site and the most favorable conditions. She paid her money on demand, and now very properly expects Massachusetts to fulfil her part of the agreement. Again: the Trustees established eleven free congressional scholarships in January last, and gave due information of the same to the Legislature in their Fifteenth Annual Report. No objection having been made to their mode of carrying on the College by any Legislature, they deemed it for the best good of all concerned to offer to the alumni additional scholarships as before mentioned. There are consequently now about one hundred students at the College who have been promised free tuition for four years by the accredited agents of the State. It is clearly impossible to carry out this contract in its letter and spirit without the favorable action of the Legislature.

In view of the foregoing statements, the Trustees respectfully ask that a thorough inspection of the College be undertaken by the joint committees on education, agriculture, and military affairs, or by a special committee, and that such provision be made for the payment of the existing debt, and the future maintenance of the institution, as, after due consideration, may be deemed wise. They further recommend that the College be required to give free tuition to students from Massachusetts, as they believe its usefulness would be largely increased, and its standard of discipline and scholarship elevated, by such a policy. They also express the opinion that ample funds for the maintenance of the College may be secured, without any increase of taxation, by a careful re-adjustment of the usual appropriations for agricultural improvements.

THE MASSACHUSETTS EXPERIMENTAL STATION.

Notwithstanding the want of both time and money for such purposes, the faculty of the College have in years past undertaken a great variety of important investigations, and, as required by the statute, have published many of them in the annual reports. Aside from the valuable educational work of the officers, there can be no doubt that the experiments upon the production of sugar and sirup from the beet-root and from sorghum, the annual inspection of all commercial fertilizers sold in the State, the introduction of special manures for special crops, and the scientific inquiries in regard to the circulation of sap, the phenomena of plant-growth, the temperature of the soil, and the relations of the moisture in the air and the earth to fertilization, have been of more direct pecuniary value to the citizens of the Commonwealth than the entire cost of the College up to this time. And yet these admirable results are but indications of the far grander and more useful possibilities which might be achieved with suitable appliances and encouragement.

Professor Levi Stockbridge, in January of last year, generously offered the sum of one thousand dollars to defray the necessary expenses, for one season, of an experimental station at the College, provided the Trustees would authorize its establishment. Accordingly, President Clark, Professor Stockbridge, Professor Goessmann, Secretary Flint, and Honorable Richard Goodman were appointed a committee, with full power to act as the managers of the station. They soon after held a meeting, and, after discussion, assigned subjects for investigation to different members, and appropriated the money to defray the cost of apparatus and necessary assistance. The results of the year's labors, so far as prepared for publication, are appended to this report, and are both interesting and instructive.

Professor Stockbridge has constructed a lysimeter and much other ingenious apparatus, and made an immense number of observations upon a variety of subjects connected with the fall of rain and dew, the temperature of different soils at all hours of the day and night, and the effects of various fertilizers upon the soil and upon each other. His report will be found to contain many new facts of vast importance both to the science and the art of agriculture.

Dr. Goessmann's report on the Early Amber cane, a variety of sorghum produced in Minnesota, seems to show conclusively that it cannot be profitably cultivated in Massachusetts for the production of dry sugar, though the yield and quality of the sirup are quite satisfactory. The experiment was carried out upon an extensive scale, at an expense of more than five hundred dollars. About twenty different fields were planted in Amherst and neighboring towns, and more than two thousand gallons of sirup were made at the mill on the College farm. After four years of laborious and intelligent trial, it is clearly demonstrated that the sugar-beet is the most desirable crop which can now be introduced into Massachusetts, whether for the economical production of sugar, or for the improvement of agriculture. Perhaps the experiments which are in progress in Maine under the patronage of the State may show the possibility of developing this industry without the investment of large sums of money in building sugar-factories, which is the only hinderance to its immediate introduction into the Connecticut Valley. The sugar-beet now furnishes more than thirty per cent of the sugar of the world, and is the most profitable crop of France and Germany, which raise, not only the sugar they consume, but also a large quantity for exportation.

It is certainly to be hoped, in the interests of scientific agriculture, that the liberality and enterprise of Professor Stockbridge in thus starting the Massachusetts Experimental Station will be followed up by the appropriation or gift of means for its continuance.

THE FARM.

Superintendent Southwick has attended faithfully to his duties in the care of the live-stock and the general management of the farm. He has done some important work in draining wet places, and in breaking up several acres of new land west of the Colleges. His crops have, in the main, been good. Besides the usual large yield of hay, he has harvested twenty-six hundred bushels of ears of excellent corn, three hundred and fifty-six bushels of mixed wheat and oats, and two hundred and seventy-five bushels of rye.

The neat-stock consists of twenty-three thorough-bred Short-horns, twenty-one Ayrshires, six Jerseys, and two Brittanies. Besides these, there are also on the farm five horses and twenty-five very fine Berkshire swine. Notwithstanding the extremely low price of pork and live pigs, the receipts from sales during the year amounted to five hundred and twenty-eight dollars. The swine have been kept in fine condition at a mere nominal cost in pasture. During the winter the neat-cattle, which are in excellent condition and of superior quality, are fed once a day on cooked fodder, at a cost of three cents for each animal. Corn-stover and poor hay are cut and steamed in a covered box with a mixture of ground rye, oats, and corn on the cob; and this feed has proved to be both palatable and nutritious, as well as economical.

THE HORTICULTURAL DEPARTMENT.

Professor Maynard and Superintendent Clark have successfully managed the plant-houses, the nurseries, the orchards, the vineyard, and the plantations of small-fruits. The strawberry-crop amounted to twenty-five hundred baskets, and a larger number of vegetable and bedding plants were sold than ever before; the total receipts of the department amounting to a little over sixteen hundred dollars. The peach-orchard is in good condition; but the crop of fruit was destroyed by the warm weather of December, 1877. The fruit-buds at present are sound and promising. The vineyard produced but few grapes, and those mostly of poor quality, in consequence, largely, of mildew. The apple and pear trees are healthy, but not old enough to yield much fruit. Three thousand European larch and five thousand white-ash seedlings have been cultivated in the nursery, and are to be set next spring upon two acres of land which has been prepared for them. The following list shows the number of certain valuable fruit and ornamental trees and shrubs added to the stock during the year 1878: —

Apple-seedlings root grafted	9,150
Pear-seedlings budded	1,200
Plum-seedlings budded	500
Peach-seedlings budded	300
Quince-stocks budded with pear	800
Orange-quince grafted on apple-roots	600
Grape-vines from cuttings	4,200
Evergreens, mostly Japanese, from cuttings	10,000
Umbrella pine (*Sciadopitys verticillata*)	3,000
Katsura (*Cercidiphyllum Japonicum*)	200
Japanese maple in twenty-three varieties.	

In addition to these, a large number of all the more desirable species of ornamental shrubs, and many herbaceous perennials, have been propagated; and two thousand hills of the best varieties of blackberries and raspberries will come into bearing next summer.

A very interesting collection of fifty species of grass and forage plants has been raised from seeds presented by J. M. Thorburn & Co. of New-York City.

Col. Eliphalet Stone of Dedham kindly sent to the College scions of four very promising seedling pears originated by him.

Valuable collections of the woods of the United States and of Brazil have been received for the botanic museum from the Department of Agriculture at Washington, and numerous species of seeds, woods, and other specimens from Japan, through the favor of Professor D. P. Penhallow of the Sapporo Agricultural College.

ANNIVERSARY EXERCISES.

The Farnsworth Prize Declamations occurred as usual in Amherst-College Hall, on Monday evening, June 17. The gold medals were awarded to William Gilbert Lee of the sophomore class, and Charles Rudolph of the freshman class; and the silver medals, to Alvan Luther Fowler, sophomore, and Charles Louis Flint, jun., freshman.

The Totten Military Prize was awarded to Charles Francis Coburn, who read his essay on "The American Military Problem" to a large and interested audience in the College Chapel, on Wednesday, June 19, after the usual drill and review on the parade. Mr. Coburn also had the honor of being selected as the orator to represent the College at the commencement exercises of Boston University on the 9th of June.

The Hills Botanical Prizes were awarded to Willie Levi Boutwell, who had the best general herbarium and the best collection of woods, and received twenty dollars; and to Horace Edward Stockbridge, who received ten dollars for the second best herbarium.

The competition for the Grinnell Agricultural Prizes was unusually sharp, and showed that the honor and the money were highly appreciated by the contestants. The following account of the examination is taken from "The Journal of Chemistry," and was written by Dr. James R. Nichols, chairman of the examining committee appointed by the board of overseers, and an acknowledged authority in scientific agriculture: —

"It became our duty as well as our pleasure to be present at the examinations of some of the classes at our State Agricultural College, at the annual commencement in June. The senior class, in the examination for the Grinnell Prizes, fell under our special supervision, and a very thorough examination resulted. Messrs. O. B. Hadwen of Worcester and W. L. Warner of Sunderland were associated with us on the committee, both gentlemen of culture, and practical men on the farm. The first prize, of fifty dollars, was awarded to C. F. Coburn of Lowell; and the second, of thirty dollars, to H. E. Stockbridge of Amherst, son of Professor Stockbridge of the College. These young men, together with the class of about twenty, sustained an examination, continued through three hours, on a wide variety of topics. We were desirous, independent of the matter of the prizes, of ascertaining what the young men had actually acquired at the College which fitted them for the practical duties of the farm. Here were twenty students before us who had completed the course of study as set down in the college curriculum; and an opportunity was afforded for obtaining some knowledge of the extent and value of their acquisition as students of agriculture. The practical nature of the examination is shown by a glance at the topics considered, — 'Origin and Composition of Soils;' 'Implements of Tillage;' 'Plants, their Composition, and Sources from which the Material is obtained;' 'The Susceptibility of the Plant to Modification and Improvement by Cultivation;' 'Changes produced in Soil by the Growth of Plants;' 'Methods by which the Fertility of the Soil may be retained, or Exhausted Soils restored;' 'Grain-Growing, its Influence on the Fertility of the Farm, and how retaining in its Culture;' 'Root-Crops;' 'Hay and Grass Crops;' 'Fruit-Culture on the Farm;' 'Stock-Husbandry, and the Adaptations of the United States to this Industry;' and, 'Breeds of Cattle.'

"It is true, a class examination, however fair and above-board it may be, is not an infallible test of the positive attainments of students in any branch of education: still, any one with a clear comprehension of the nature of the topics introduced, and possessing ordinary sagacity, can judge quite satisfactorily and justly of the value of the instruction imparted.

"We say unhesitatingly that the young men acquitted themselves exceedingly well, and no one of them appeared incompetent for taking charge of a farm, and conducting its affairs in accordance with good sense and advanced knowledge of husbandry. They had evidently been well drilled in the 'science of agriculture,' and the drill embraced the various departments which closely and remotely relate to the interests of the farm. Each of the young men was required to write upon a practical topic, without text-books, or any aid except what his own knowledge supplied; and thus above twenty essays were placed in the hands of the committee for examination. This was an important test of scholarship, and supplied a clew to the general training or culture of the students at the College. Some of their papers were brief and unimportant; but others were quite extended and able essays, worthy even of publication. We are pleased to be able to bear testimony to the good appearance of the graduating class at Amherst. How much influence the graduates will exert in the direction of improving our farms and our stock it is impossible to decide, as it is not known how many will put in practice the facts and principles in agriculture acquired at the College. It is certainly of some importance to turn out upon the world twenty young men apparently so well qualified for the successful prosecution of the arts of husbandry."

The anniversary exercises of the eighth graduation day were held in Amherst-College Hall on Wednesday afternoon. The theses were of superior quality, and well delivered, the valedictory addresses being spoken by Arthur Amber Brigham. The diplomas of the university were presented by President Clark; while the college diplomas, with the signature of the Governor of the Commonwealth, were bestowed upon the members of the graduating class by the Hon. Marshall P. Wilder, who spoke as follows: —

"Friends and Fellow-Citizens, — Called on, as I am, unexpectedly, to perform the duties of his Excellency the Governor, whose absence we so much regret, my words will be brief. I desire, however, to offer you my hearty congratulations on the prosperity of our College, and especially on the noble representation of young gentlemen who appear before you to receive the degrees to which they are so justly entitled.

"Nothing has given me more pleasure than the very creditable manner in which they have acquitted themselves to-day; and I am quite sure, whether they are to become farmers, professional men, or tradesmen, they will ever be grateful for the education which they have here received, and of which they have given such substantial evidences to-day.

"Few things have given me more pleasure than the fact that this College has sent forth so many young men who have been ornaments to society, and blessings to our land. Especially have I been gratified that the Government of Japan, after surveying the continent of Europe, should have selected our beloved president to build and put in operation the first agricultural college in those far-off isles, and to have installed in office as its president and faculty young gentlemen who were graduates of the Massachusetts Agricultural College.

"Gentlemen of the Graduating Class, — By virtue of authority committed to me, I hereby admit you to the degree of Bachelor of Science, to all the honors, rights, and privileges of graduates of the Massachusetts Agricultural College.

"In testimony whereof I now deliver to each of your number a diploma, duly signed by the president of the faculty, and by his Excellency the Governor of the Commonwealth.

"And now may you go forth, animated and inspired by a spirit of noble manhood and Christian principle, to share in the responsibilities and rewards of well-spent lives, — go forth valiant and stout-hearted, as messengers of peace and plenty, not to enrich the earth by human blood, but to make it yield more and more abundantly, ever remembering that the highest triumph of civilization is the conquest of mind over matter, the dominion of man over Nature, improving, adorning, and elevating her to the noblest purposes of creation. Thus will you honor our College, shine as stars in the crown of our good old Commonwealth, and become benefactors in our land.

"God bless you in your going out! God bless us all in our endeavors to promote the welfare of our race! God bless this institution in the future as in the past, and make it an honor to the State and country, a power in our land, and a blessing to the millions that are to follow us!"

Respectfully submitted,

By order of the Trustees,

W. S. CLARK,

President.

AMHERST, Jan. 30, 1879.

AN ACT

DONATING PUBLIC LANDS TO THE SEVERAL STATES AND TERRITORIES WHICH MAY PROVIDE COLLEGES FOR THE BENEFIT OF AGRICULTURE AND THE MECHANIC ARTS.

Be it enacted by the Senate and House of Representatives of the United States of America, in Congress assembled, —

That there be granted to the several States, for the purposes hereinafter mentioned, an amount of public land, to be apportioned to each State, a quantity equal to thirty thousand acres for each senator and representative in Congress, to which the States are respectively entitled by the apportionment under the census of eighteen hundred and sixty, *provided* that no mineral lands shall be selected or rchased under the provisions of this act.

SECT. 2. *And be it further enacted*, That the land aforesaid, after being surveyed, shall be apportioned to the several States in sections, or subdivisions of sections not less than one-quarter of a section ; and, whenever there are public lands in a State subject to sale at private entry at one dollar and twenty-five cents per acre, the quantity to which said State shall be entitled shall be selected from such lands within the limits of such State. And the Secretary of the Interior is hereby directed to issue to each of the States in which there is not the quantity of public lands subject to sale at private entry at one dollar and twenty-five cents per acre, to which said State may be entitled under the provisions of this act, land-scrip to the amount in acres for the deficiency of its distributive share ; said scrip to be sold by said States, and the proceeds thereof applied to the uses and purposes prescribed in this act, and for no other use or purpose whatsoever : *provided*, that in no case shall any State to which land-scrip may thus be issued be allowed to locate the same within the limits of any other State, or of any Territory of the United States ; but their assignees may thus locate said land-scrip upon any of the unappropriated lands of the United States, subject to sale at private entry at one dollar and twenty-five cents or less per acre : *and provided further*, that not more than one million acres shall be located by such assignees in any one of the States : *and provided further*, that no such location shall be made before one year from the passage of this act.

SECT. 3. *And be it further enacted*, That all the expenses of management, superintendence, and taxes, from date of selection of such lands, previous to their sales, and all expenses incurred in the management and disbursements of the moneys which may be received therefrom, shall be paid by the States to which they may belong out of the treasury of said States, so that the entire proceeds of the sale of said lands shall be applied, without any diminution whatever, to the purposes hereinafter mentioned.

SECT. 4. *And be it further enacted*, That all moneys derived from the sale of the lands aforesaid by the States to which the lands are apportioned, and from the sales of land-scrip hereinbefore provided for, shall be invested in stocks of the United States, or of the States, or some other safe stocks yielding not less than five per centum upon the par value of said stocks ; and that the moneys so invested shall constitute a perpetual fund, the capital of which shall remain forever undiminished (except so far as may be provided in section fifth of this act), and the interest of which shall be inviolably appropriated by each State which may take and claim the benefit of this act, to the endowment, support, and maintenance of at least one college, where the leading object shall be — without excluding other scientific and classical studies, and including military tactics — to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the Legislatures of the States may respectively prescribe in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life.

SECT. 5. *And be it further enacted*, That the grant of land, and land-scrip hereby authorized, shall be made on the following conditions, to which, as well as to the provisions hereinbefore contained, the previous assent of the several States shall be signified by legislative acts.

First, If any portion of the fund invested, as provided by the foregoing section, or any portion of the interest thereon, shall by any action or contingency be diminished or lost, it shall be replaced by the State to which it belongs, so that the capital of the fund shall remain forever undiminished; and the annual interest shall be regularly applied without diminution to the purposes mentioned in the fourth section of this act, except that a sum not exceeding ten per centum upon the amount received by any State under the provisions of this act may be expended for the purchase of lands for sites or experimental farms, whenever authorized by the respective Legislatures of said States.

Second, No portion of said fund, nor the interest thereon, shall be applied directly or indirectly, under any pretence whatever, to the purchase, erection, preservation, or repair of any building or buildings.

Third, Any State which may take and claim the benefit of the provisions of this act shall provide, within five years, at least not less than one college, as described in the fourth section of this act, or the grant to such State shall cease : and said State shall be bound to pay the United States the amount received of any lands previously sold, and that the title to purchasers under the State shall be valid.

Fourth, An annual report shall be made regarding the progress of each college, recording any improvements and experiments made, with their cost and results, and such other matters, including State industrial and economical statistics, as may be supposed useful; one copy of which shall be transmitted by mail free, by each, to all other colleges which may be endowed under the provisions of this act, and also one copy to the Secretary of the Interior.

Fifth, When lands shall be selected from those which have been raised to double the minimum price, in consequence of railroad grants, they shall be computed to the States at the maximum price, and the number of acres proportionally diminished.

Sixth, No State, while in a condition of rebellion or insurrection against the Government of the United States, shall be entitled to the benefit of this act.

Seventh, No State shall be entitled to the benefits of this act unless it shall express its acceptance thereof by its Legislature within two years from the date of its approval by the President.

Sect. 6. *And be it further enacted*, That land-scrip issued under the provisions of this act shall not be subject to location until after the first day of January, one thousand eight hundred and sixty-three.

Sect. 7. *And be it further enacted*, That the land officers shall receive the same fees for locating land-scrip issued under the provisions of this act as is now allowed for the location of military bounty land warrants under existing laws, *provided* their maximum compensation shall not be thereby increased.

Sect. 8. *And be it further enacted*, That the governors of the several States to which scrip shall be issued under this act shall be required to report annually to Congress all sales made of such scrip until the whole shall be disposed of, the amount received for the same, and what appropriation has been made of the proceeds.

Approved July 2, 1862.

An Act to incorporate the Trustees of the Massachusetts Agricultural College.

Be it enacted by the Senate and House of Representatives in General Court Assembled, and by the authority of the same, as follows: —

Section 1. Marshall P. Wilder of Dorchester, Charles G. Davis of Plymouth, Nathan Durfee of Fall River, John Brooks of Princeton, Henry Colt of Pittsfield, William S. Southworth of Lowell, Charles C. Sewall of Medfield, Paoli Lathrop of South Hadley, Phinehas Stedman of Chicopee, Allen W. Dodge of Hamilton, George Marston of Barnstable, William B. Washburn of Greenfield, Henry L. Whiting of Tisbury, John B. King of Nantucket, their associates and successors, are hereby constituted a body corporate, by the name of the Trustees of the Massachusetts Agricultural College, the leading object of which shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life, to be located as hereinafter provided; and they and their successors, and such as shall be duly elected members of said corporation, shall be and remain a body corporate by that name forever. And, for the orderly conducting of the business of said corporation, the said trustees shall have power and authority from time to time, as occasion may require, to elect a president, vice-president, secretary, and treasurer, and such other officers of said corporation as may be found necessary, and to declare the duties and tenures of their respective offices; and also to remove any trustee from the same corporation, when, in their judgment, he shall be rendered incapable, by age or otherwise, of discharging the duties of his office, or shall neglect or refuse to perform the same; and, whenever vacancies shall occur in the Board of Trustees, the Legislature shall fill the same: *provided, nevertheless*, that the number of members shall never be greater than fourteen, exclusive of the Governor of the Commonwealth, the Secretary of the Board of Education, the Secretary of the Board of Agriculture, and the President of the Faculty, each of whom shall be, *ex officio*, a member of said corporation.

SECT. 2. The said corporation shall have full power and authority to determine at what times and places their meetings shall be holden, and the manner of notifying the trustees to convene at such meetings; and also, from time to time, to elect a president of said college, and such professors, tutors, instructors, and other officers of said college, as they shall judge most for the interest thereof, and to determine the duties, salaries, emoluments, responsiblities, and tenures of their several offices. And the said corporation are further empowered to purchase or erect, and keep in repair, such houses and other buildings as they shall judge necessary for the said college; and also to make and ordain, as occasion may require, reasonable rules, orders, and by-laws not repugnant to the Constitution and laws of this Commonwealth, with reasonable penalties, for the good government of the said college and for the regulation of their own body, and also to determine and regulate the course of instruction in said college, and to confer such appropriate degrees as they may determine and prescribe; *provided, nevertheless*, that no corporate business shall be transacted at any meeting unless one-half at least of the trustees are present.

SECT 3. The said corporation may have a common seal, which they may alter or renew at their pleasure; and all deeds sealed with the seal of said corporation, and signed by their order, shall, when made in their corporate name, be considered in law as the deeds of said corporation; and said corporation may sue and be sued in all actions, real, personal, or mixed, and may prosecute the same to final judgment and execution, by the name of the Trustees of the Massachusetts Agricultural College; and said corporation shall be capable of taking and holding in fee simple, or any less estate, by gift, grant, bequest, devise, or otherwise, any lands, tenements, or other estate, real or personal: *provided* that the clear annual income of the same shall not exceed thirty thousand dollars.

SECT. 4. The clear rents and profits of all the estate, real and personal, of which the said corporation shall be seized and possessed, shall be appropriated to the uses of said college in such manner as shall most effectually promote the objects declared in the first section of this act, and as may be recommended from time to time by the said corporation, they conforming to the will of any donor or donors in the application of any estate which may be given, devised, or bequeathed, for any particular object connected with the college.

SECT. 5. The Legislature of this Commonwealth may grant any further powers to, or alter, limit, annul, or restrain, any of the powers vested by this act in, the said corporation, as shall be found necessary to promote the best interests of the said college; and more especially may appoint and establish overseers or visitors of the said college, with all necessary powers for the better aid, preservation, and government thereof. The said corporation shall make an annual report of its condition, financial and otherwise, to the Legislature at the commencement of its session.

Sect. 6. The Board of Trustees shall determine the location of said college in some suitable place within the limits of this Commonwealth, and shall purchase, or obtain by gift, grant, or otherwise, in connection therewith, a tract of land containing at least one hundred acres, to be used as an experimental farm, or otherwise, so as best to promote the objects of the institution; and, in establishing the by-laws and regulations of said college, they shall make such provision for the manual labor of the students on said farm as they may deem just and reasonable. The location, plan of organization, government, and course of study, prescribed for the college, shall be subject to the approval of the Legislature.

Sect. 7. One-tenth part of all the moneys which may be received by the State treasurer from the sale of land-scrip, by virtue of the provisions of the one hundred and thirtieth chapter of the acts of the thirty-seventh Congress, at the second session thereof, approved July second, eighteen hundred and sixty-two, and of the laws of this Commonwealth, shall be paid to said college, and appropriated towards the purchase of said site or farm, *provided*, *nevertheless*, that the said college shall first secure, by valid subscriptions or otherwise, the further sum of seventy-five thousand dollars, for the purpose of erecting suitable buildings thereon; and, upon satisfactory evidence that this proviso has been complied with, the governor is authorized from time to time to draw his warrants therefor.

Sect. 8. When the said college shall have been duly organized, located, and established, as and for the purposes specified in this act, there shall be appropriated and paid to its treasurer each year, on the warrant of the governor, two-thirds of the annual interest or income which may be received from the fund created under and by virtue of the act of Congress named in the seventh section of this act and the laws of this Commonwealth, accepting the provisions thereof, and relating to the same.

Sect. 9. In the event of a dissolution of said corporation by its voluntary act at any time, the real and personal property belonging to the corporation shall revert and belong to the Commonwealth, to be held by the same, and be disposed of as it may see fit, in the advancement of education in agriculture and the mechanic arts. The Legislature shall have authority at any time to withhold the portion of the interest or income from said fund provided in this act, whenever the corporation shall cease or fail to maintain a college within the provisions and spirit of this act and the before-mentioned act of Congress, or for any cause which they deem sufficient.

Approved April 29, 1863.

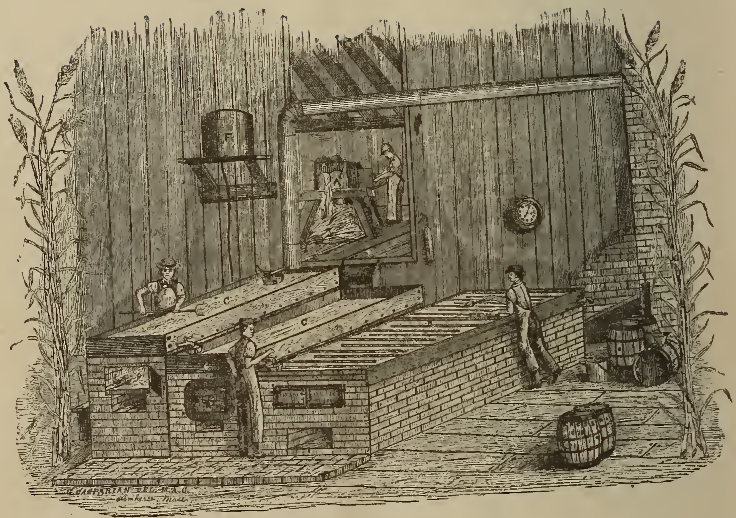
REPORT TO THE DIRECTORS

OF THE

MASSACHUSETTS EXPERIMENTAL STATION.

BY

PROFESSOR C. A. GOESSMANN.



SORGHUM-MILL, M. A. C., 1878.

A, Victor Crushing-Mill. B, Cook's Evaporator. C, C, Sheet-iron Pans. D, D, D, Strainers. E, Metallic Pipe conducting Juice from Mill to Pan. F, Water-Tank.

REPORT ON EARLY AMBER CANE.

The unusual interest which of late the Minnesota Early Amber Cane has awakened in some of the Western States, as a plant qualified for the production of sirup and sugar for the general market, induced President Clark to make arrangements for the purpose of ascertaining the value of this particular kind of sorghum upon the soil of Massachusetts. The seeds which served for the trial were secured through the department of agriculture at Washington, D.C., to obtain the genuine article. Somewhat more than twenty acres were planted in our vicinity during the past season, from one-fourth of an acre to one acre of cane being raised by each party. The experimental field upon the College-grounds contained just one acre. The apparatus used for crushing and pressing the cane, and the pan for evaporating the juice, were the same as those extensively used in Minnesota, — a Victor Mill and a Cook's Evaporator, both of the size recommended by the patentees for the working of the produce from twenty acres of cane. The entire management of the practical part of the experiment was, for obvious reasons, confined to the selection of such modes of operation as could be carried on by any intelligent farmer with a moderate outlay of money. The kind information received from Mr. S. H. Kinney of Morristown, Rice County, Minn., one of the foremost successful experimenters with the Early Amber Cane, regarding the current practice among his acquaintances, served as a guide in the cultivation of the cane and the working of its juice. To the writer was assigned the task of studying the changes which the cane undergoes during the later period of its growth, in order to learn the time when the sugar becomes more prominent in its juice, to ascertain the rate at which its percentage increases, and to determine the particular point in the ripening process of the plant when the largest amount of sugar is present, and to notice, finally, the changes which the cane subsequently suffers in regard to the quantity and quality of its saccharine matter. Having studied in previous years, soon after its first introduction into the agricultural interests of the country, the Chinese sugar-cane for a similar purpose,[1] I propose to introduce into the following discussion such facts established on that occcasion as may aid in a due understanding of the questions involved.

The origin of the Early Amber Cane on trial is described by the commissioner of statistics of Minnesota, in his report for 1877, p. 38, in the following words: "After the close of the war two men, strangers to each other, whose homes were twenty miles apart (Messrs. Seth H. Kinney of Morristown, and Charles F. Miller of Dundas, Rice County), in the heart of that immense forest known as the 'Big Woods' of Minnesota, struggled, with a tenacity and persistence that excited the mournful pity of their neighbors, to successfully manufacture molasses from the sorghum, or Chinese sugar-cane. One of these men (Miller) chanced upon the seed of a hybrid, an acclimated species of the cane, known as the 'Minnesota Early Amber,' which, by some inspiration, he was induced to send to a friend in Missouri, with directions to plant it there, and return to him the ripened seed. From the first crop produced by that seed he was able to manufacture a sirup that was so immeasurably superior to his former productions, that he was assured of complete success. After that, the difficulties were of detail, some of them almost insurmountable from lack of means, and others were equally so from the very simplicity of them, and their remedies. Either of these men might have succeeded alone; but when they came together, as they did at last, and combined their experience, and their resources of skill and invention, a new industry was born, and a new factor in the wealth and the commerce of this State will very soon command public attention." In connection with these introductory remarks are also published letters of Messrs. Miller and Kinney to the

[1] See Transactions of the New-York State Agricultural Society of 1861, vol. xxi. pp. 787–811: Contribution to the Knowledge of the Nature of the Chinese Sugar-cane, *Sorghum saccharatum* (W.), by C. A. Goessmann.

commissioner, containing an interesting and somewhat detailed account of their mode of cultivating and harvesting the cane, and of securing and working its juice into sirup and sugar, besides a description of the actual results obtained, as well as the prospects held out for future enterprise by the introduction of improved systems of trèatment, based on a better knowledge of the subject in its scientific and industrial relations.

As the Early Amber Cane raised upon the College-grounds has furnished almost exclusively the material for my investigation, previous to the harvesting of the cane from the experimental fields on other farms in the Connecticut Valley, I begin my report with a short statement from Professor Stockbridge, concerning the course pursued in the cultivation of the field under his immediate charge. The land engaged in the experiment was one acre in extent, and consisted of a heavy sandy loam. Part of it had been used previously for the raising of garden-vegetables. It was fertilized at an early date in the spring with chemicals at a cost of fifteen dollars. The fertilizer contained potash, phosphoric acid, and nitrogen, in proportions favorable for the formation of sugar in the crop. The seed was planted on the 18th of May, in drills three feet and a half apart, with the plants about five inches distant from each other in the drill. The field was four times cultivated, and the harvesting began on the 14th of September, and closed on the 22d. The crop when fully grown was from eleven to twelve feet high, with canes unusually vigorous and handsome, resembling in general appearance rather those of the broom-corn than those of the sorghum of an earlier day.

The examination of the cane was carried out in the following manner. On the dates specified the stalks were cut off six inches above the ground; and two feet in length of the tops, and all the leaves, were removed. The remaining part of the cane was subsequently crushed and pressed to secure its juice. The latter — after being tested for its specific gravity by Brix's saccharometer, and for its relative amount of free acid at boiling heat by means of a solution of carbonate of soda, containing one gramme of sodium carbonate anhydride in a hundred cc. of distilled water — was treated without delay with a solution of basic acetate of lead to secure a good defecation, in the same manner as is usual in the case of the juice of the sugar-beet root. The filtered juice was subsequently divided, in every instance, into two portions, one of which was tested directly in the usual manner, with Fehling's solution, for grape-sugar; and the other, after being treated in the customary way with hydrochloric acid at a moderate heat, to convert the cane-sugar present into glucose, was treated like the former portion for the total amount of sugar. The difference noticed between the two tests was calculated, according to well-known rules, as cane-sugar.

It has been the aim during the entire investigation to secure in all cases, not otherwise specified, a comparative value to the various analytical statements.

I. — Examination of the Early Amber Cane raised upon the College Farm.

1.

1878.
Aug. 15. — Juice obtained from plants *five* feet high; no flower-stalks in sight. Specific gravity, 4.2° Brix, at 27° C. temperature. Grape-sugar present, 2.48 per cent. Cane-sugar present, none. Standard soda solution required, 6.8 cc. The microscope revealed the presence of many granules of starch. Cane lost at 100° to 110° C., 92.07 per cent moisture. Cane left at 100° to 110° C., 7.93 per cent solid matter.

2.

Aug. 16. — Juice obtained from plants *ten* feet high; no flower-stalks in sight. Specific gravity, 5.8° Brix, at 24° C. temperature. Grape-sugar present, 4.06 per cent. Cane-sugar present, none. Soda solution required, 9 cc. Cane lost at 100° to 110° C., 88.90 per cent moisture. Cane left at 100° to 110° C., 11.10 per cent solid matter.

3.

Aug. 20. — Juice obtained from plants with the lower leaves of the canes turned reddish; flower-stalks well developed; flowers, however, not yet open. Specific gravity, 7.9° Brix, at 24° C. temperature. Grape-sugar present, 3.47 per cent. Cane-sugar present, 2.15 per cent. Soda solution required, 7 cc. Cane lost at 100° to 110° C., 87 per cent moisture. Cane left at 100° to 110° C., 13 per cent solid matter.

4.

Aug. 24. — Juice from plants bearing flower-stalks with fully developed open flowers. Specific gravity, 8.7° Brix, at 23° C. temperature. Grape-sugar present, 3.7 per cent. Cane-sugar present, 3 per cent. Soda solution required, 4 cc. Cane lost at 100° to 110° C., 85.93 per cent moisture. Cane left at 100° to 110° C., 14.07 per cent solid matter.

5.

Aug. 27. — Juice from canes of plants in full blossom. Specific gravity, 10.0° Brix, at 25° C. temperature. Grape-sugar present, 3.65 per cent. Cane-sugar present, 4.13 per cent. Soda solution required, 10 cc. Cane lost at 100° to 110° C., 84.52 per cent moisture. Cane left at 100° to 110° C., 15.48 per cent solid matter.

6.

Aug. 30. — Juice from canes of plants with the formation of the seed fairly begun. Specific gravity, 9.50° Brix, at 30° C. temperature. Grape-sugar present, 4 per cent. Cane-sugar present, 3.81 per cent. Soda solution required, 9.5 cc. Cane lost at 100° to 110° C., 83.86 per cent moisture. Cane left at 100° to 110° C., 16.14 per cent solid matter.

7.

Sept. 2. — Juice from canes of plants with seeds in the milk, i.e., seeds of full size, yet still soft. Specific gravity, 10.70° Brix, at 27° C. temperature. Grape-sugar present, 3.85 per cent. Cane-sugar present, 4.41 per cent. Soda solution required, 9.5 cc. Cane lost at 100° to 110° C., 84.15 per cent moisture. Cane left at 100° to 110° C., 15.85 per cent solid matter.

8.

Sept 9. — Juice from canes of plants with seeds still soft. Specific gravity, 12.10° Brix, at 22° C. temperature. Grape-sugar present, 3.21 per cent. Cane-sugar present, 6.86 per cent. Soda solution required, 9.5 cc. Cane lost at 100° to 110° C., 73.87 per cent moisture. Cane left at 100° to 110° C., 26.13 per cent solid matter.

9.

Sept. 9. — Juice from canes of plants from which, on the 2d of September, the leaves and the tops had been removed, without disturbing them otherwise. Specific gravity, 12.8° Brix, at 22° C. temperature. Grape-sugar present, 3.77 per cent. Cane-sugar present, 6.81 per cent. Soda solution required, 9.5 cc. Cane lost at 100° to 110° C., 73.25 per cent moisture. Cane left at 100° to 110° C., 26.75 per cent solid matter.

10.

Sept. 18. — Juice from canes of plants left upon the field without any alteration regarding leaves or tops. Specific gravity, 13.2° Brix, at 22° C. temperature. Grape-sugar present, 3.57 per cent. Cane-sugar present, 7.65 per cent.

11.

Sept. 18. — Juice from canes of plants from which only the tops had been removed, leaving the remaining portion undisturbed in the soil. Specific gravity, 13.8° Brix, at 22° C. temperature. Grape-sugar present, 3.16 per cent. Cane-sugar present, 8.49 per cent.

12.

Sept. 18. — Juice from canes of plants from which the tops and all the leaves had been removed on the 9th of September, whilst the remaining portion was not disturbed in the soil until cut on the 18th of September. Specific gravity, 11.5° Brix, at 22° C. temperature. Grape-sugar present, 3.16 per cent. Cane-sugar present, 5.85 per cent.

13.

Sept. 18. — Juice from canes of plants which were cut off on the 9th of September, had their tops removed as usual, yet their leaves left on, and subsequently left upon the field for *nine* days, before the sample tested was secured by pressing. Specific gravity, 12.8° Brix, at 22 C. temperature. Grape-sugar present, 10 per cent. Cane-sugar present, .60 per cent.

14.

Sept. 21. — The juice secured from the cane of No. 13 on the 21st of September showed specific gravity, 13° Brix, at 21° C. temperature, and, when taken still two days later, its specific gravity was equal to 15° Brix, at 18° C. temperature.

From the previously-stated observations we may safely deduce the following conclusions regarding the questions above specified, at least, as far as the conditions of our soil and climate bear on the growth and development of the Minnesota Early Amber Cane as a sugar-producing plant: —

1. The grape-sugar appears in the cane at an early stage of its growth (Nos. 1 and 2), and increases slowly to from three to four per cent before cane-sugar is formed.

2. The cane-sugar is first noticeable at the time when the flower-stalks become visible above the leaves; and its amount

increases steadily until the seeds are of full size, yet still soft (Nos. 3–8).

3. The relative proportion of grape-sugar to cane-sugar did not exceed, at any time before the hardening of the seeds, 3.16 per cent of the former to 8.49 per cent of the latter: in the majority of cases it was about three to seven.

4. The cane loses a considerable amount of its moisture during the period of the development of the seeds, from ten to twelve per cent (see Nos. 7 and 8), aiding thereby in increasing the density of the juice: the better quality of the latter during later periods in the life of the plant has, for this reason, to be ascribed largely to that cause, and not to the continued formation of sugar. The quality of the juice is improved at that stage, largely, therefore, if not entirely, at the expense of its quantity.

5. The increase in the density of the juice of the cane after the seeds are full grown may be somewhat retarded by taking off the leaves, without disturbing the remaining plant in the soil (No. 12).

6. The cane-sugar of the plants changes gradually yet steadily into grape-sugar, after they are once cut off. The degree of that change varies widely, and depends largely on their exposure, being more serious during moist and warm than in dry and cold weather.

7. The safest way to secure the full benefit of the Early Amber Cane crop for sirup and sugar manufacture is to begin cutting the canes when the seed is full grown, yet still soft (in our case between the 10th and 15th of September), and to grind them without delay.

The grinding of the cane raised upon the College farm began on the 15th of September. As quite a difference of opinion prevailed among the cultivators of the Early Amber Cane, according to advice received from well-informed parties in Minnesota, regarding the most appropriate time for cutting the cane, — some maintaining that it should not be cut until the mill was ready to grind it without delay; while others claimed to have obtained the best results after keeping the cut cane for a week or more spread upon the ground, before carrying it to the mill for grinding, — a part of our cane, after being cut, was left upon the field for about ten days (see experiments Nos. 10–13) before being ground and pressed:

the remainder was cut, and without delay sent to the mill. The examination of the juice obtained from both of these lots of cane gave the results which are stated above in experiments Nos. 10–13. They admit of no other explanation, but that the best course to pursue consists in grinding the matured cane as soon as it is cut.

The juice coming from the mill was carried through an iron pipe to a metal sieve to remove the suspended particles of cane, and thence into a sheet-iron pan of seventy to eighty gallons' capacity, for defecation. Following the practice of Messrs. Kinney and Miller, for some time nothing was added to the juice to assist in the defecation. Towards the close of the season, when the coagulation of the albuminoids was less thorough, a small amount of slaked lime was added, avoiding, however, an excess of lime; for the re-action of the latter on the grape-sugar present would tend to increase the color, and to affect at the same time the taste unpleasantly. The efficient use of boneblack filters for the removal of both objectionable results was, for economical reasons, out of the question. The copious scum produced by the heating of the fresh juice to from 85° to 95° C. in the defecating pan was removed as much as possible by skimming, and subsequent filtering through a woollen cloth filter on its passage into a second iron pan, where the heating was continued. From this second pan the hot, defecated juice was drawn, as required, into a Cook's evaporator, constructed of copper, where the skimming process was continued until the sirup had reached the desired density, which, as a general rule, was equal to 75° of Brix's saccharometer when hot. The color of the sirup thus produced from recently-cut cane was yellowish; its taste, as might be expected without the use of boneblack, was somewhat peculiar, yet pleasant, and quite generally liked. The average yield amounted to from a hundred and sixty to a hundred and seventy gallons per acre. To study the effect of the mode of manufacture pursued, on the composition of the sirup, the following experiment was instituted. The juice of a healthy, fresh-cut cane was tested before it passed into the defecator, and also, subsequently, the sirup obtained from it.

Sept. 29. — Juice, 14.7° Brix, at 15° C. temperature. Grape-sugar present, 3.61 per cent. Cane-sugar present, 8.16 per cent.

The sirup obtained from the previously-stated juice contained

Grape-sugar, 37.87 per cent; cane-sugar, 37.48 per cent.

A glance at these results shows that the relative proportion of the cane-sugar and the grape-sugar, as found in the juice, is seriously altered in the course adopted for its manufacture into sirup. In sight of these facts, it will be quite generally conceded that the sugar-production from sirup like the above must remain a mere incidental feature in the Amber Cane industry in our section of the country, as long as the cost of separating the sugar does not offer more substantial advantages.

II.—Examination of the Early Amber Cane raised by Farmers in the Vicinity of the College.

As soon as the crop of the College had been disposed of, the canes from outside experimental fields were treated in a like manner. The interest in our experiments taken by farmers generally began soon to make itself felt at the mill by the arrivals of lots of cane from all sides, rendering it necessary to increase the working force. The mill, being worked by three horses, was run day and night, and the evaporators were thus supplied with juice without any serious interruption, except the short time required for cleaning. The management of the mill, and the manufacture of the sirup during the entire season (from the 15th of September to the 25th of October), were very efficiently superintended by Messrs. Atherton Clark and H. E. Stockbridge, both graduates of the College, and special students of chemistry in the post-graduate course. Mr. E. B. Bragg of the class of 1875 also rendered valuable assistance in the chemical examination of the juices.

Some of the cane sent on was ground soon after it had been cut: other lots had been cut weeks before their turn in the mill came round. In some instances the yield of sirup per acre exceeded two hundred gallons, — one instance being reported where it amounted to two hundred and fifty-four gallons per acre, — in others, it fell behind the average, on account of the exposure the canes had suffered before being ground. No systematic examination of the juice of the cane coming from outside fields was attempted, partly on account of the absence of such facts as impart special value to the tests caried out, partly on account of want of time to follow up each case in a satisfactory manner. A general examination of the juice worked on each day was, however, continued; and, as the results obtained in this connection are not entirely without interest regarding some points involved in our inquiry, I enter them on record.

Sept. 25. — The cane, after being cut, left for three weeks upon the field, during dry warm weather. Juice, 19.8° Brix, at 21 C. temperature. Grape-sugar present, 11.91 per cent. Cane-sugar present, 6.27 per cent.

Sept. 26. — Juice, 14.7° Brix, at 15° C. temperature.

Sept. 28. — Juice, 17.8° Brix, at 12° C. temperature. Grape-sugar present, 16.6 per cent. Cane-sugar, not determined.

Oct. 1. — Juice, 17.5° Brix, at 19° C. temperature.

Oct. 3. — Juice, 15° Brix, at 22° C. temperature.

Oct. 4. — Juice, 16.1° Brix, at 17° C. temperature. Grape-sugar present, 8.62 per cent. Cane-sugar present, 6.16 per cent. Soda solution required, 12 cc.

Oct. 7. — Cane cut just before grinding, and sent with its leaves through the mill. Juice, 16.7° Brix, at 20° C. temperature. Grape-sugar present, 4.16 per cent. Cane-sugar present, 9.94 per cent. Soda solution required, 6.8 cc.

Oct. 8. — Cane cut fresh the day before grinding; the leaves had, however, been taken off the canes two weeks before cutting them. Juice, 12.8° Brix, at 17° C. temperature. Grape-sugar present, 5.16 per cent. Cane-sugar, present, 5.27 per cent. Soda solution required, 7 cc.

Oct. 9. — Juice, 18.4° Brix, at 17° C. temperature. Grape-sugar present, 7.57 per cent. Cane-sugar, not determined. Soda solution required, 10.6 cc.

Oct. 10. — Cane cut five days before grinding. Juice, 15.2° Brix, at 15° C. temperature.

Oct. 11. — Cane having been kept two weeks at the mill. Juice, 17.1° Brix, at 16° C. temperature.

Oct. 14. — Cane several weeks old when ground. Juice, 18.2° Brix, at 15° C. temperature. Grape-sugar present, 10.42 per cent. Cane-sugar, not determined. Soda solution required, 10.4 cc.

Oct. 15. — Juice, 15.2° Brix, at 18° C. temperature.

Oct. 16. — Juice, 17.3° Brix, at 22° C. temperature.

Oct. 17. — Juice, 18° Brix, at 20° C. temperature.

Oct. 18. — Juice, 15.1° Brix, at 23° C. temperature. Grape-sugar present, 7.57 per cent. Cane-sugar, not determined.

Oct. 19. — Juice, 15.5° Brix, at 15° C. temperature. Grape-sugar present, 9.22 per cent. Cane-sugar, not determined. Soda solution required, 13.6 cc.

Oct. 20. — Juice, 17.3° Brix, at 15° C. temperature.
Oct. 22. — Juice, 16.2° Brix, at 16° C. temperature. Grape-sugar present, 8.3 per cent. Cane-sugar, not determined.
Oct. 23. — Juice, 18.3° Brix, at 17° C. temperature. Grape-sugar present, 11.3 per cent. Cane-sugar present, 5.5 per cent. Soda solution required, 14 cc.
Oct. 24. — Juice, 16.6° Brix, at 15° C. temperature. Grape-sugar present, 8.63 per cent. Cane-sugar, not determined. Soda solution required, 9 cc.

The above-stated observations lead, on the whole, to the same conclusions as those arrived at in connection with the examination of the cane from the College-field. The relative proportion between grape-sugar and cane-sugar noticed in the cane from the College-grounds has in no instance been changed for the better. The injurious changes which the cane undergoes after being once cut off are rendered quite conspicuous. A trial to decide whether it would be better economy to grind the cane after its leaves have been removed, as has been the rule, or to send it with its leaves through the mill, demonstrated the fact that the saving of labor in the field by omitting the stripping does not compensate for the loss suffered in the clogging of the mill, and the waste of juice, which occurs when the leaves are left on.

III. — Valuation of the Crop raised on the College-Grounds.

The expenses incurred in the cultivation and harvesting of one acre of the Early Amber Cane upon the College-grounds have been as follows: —

Cost of chemicals used as fertilizers	$15 00
tillage	19 00
cutting cane, stripping leaves, cutting tops, and carting to mill	16 00
	$50 00

The crop produced has yielded one hundred and sixty-four gallons of a good sirup, about forty bushels of seed of a middling quality, besides from four to five tons of moist *bagasse*, and from one ton to one ton and a half of semi-dry leaves. The sirup has been partly sold in retail, at fifty cents per gallon, to visitors at the sugar-mill. The seed has been estimated by Professor Stockbridge to be equal to about forty bushels, and is considered worth, for feeding purposes, thirty-five cents per bushel, or fourteen dollars for the entire yield. The *bagasse* is known to be suitable for paper manufacture, and is supposed to bring about five dollars; whilst the leaves, even for fertilizing purposes, cannot be considered worth less than from three to four dollars.

The manufacturing expenses of the sirup have been higher than they would have been in case of a more permanent arrangement for manufacturing purposes, where steam or water power would be used as motive power instead of horses. Judging from the results obtained under similar conditions elsewhere, it seems quite safe to assume that the cost would not exceed from twelve to thirteen cents per gallon, or about one-half of what it actually amounted to in our experiments. Comparing, on the basis of the previously-adopted values, the expenses and the returns per acre of our trial with the Early Amber Cane, we find, —

Expenses equal to	$70 00
Returns equal to	105 00
Leaving thus a surplus of	$35 00

I need not, however, to add that these results may be materially improved by a larger yield of sirup, which is fully within reach; for in two instances it rose up to two hundred and forty gallons per acre. Every additional fifty gallons of sirup would be equal to from six to seven dollars increased cash return.

The Western cultivators of the Early Amber Cane claim for it in two important points a superiority over the Chinese sorghum of twenty years ago: —

1. It ripens earlier, and offers thereby a better chance to raise it on an extensive scale, with less risk of having the crop partly destroyed by frost.

2. Its juice furnishes a better sirup, which proves its better fitness for that purpose.

It remains a matter of regret that no systematic chemical examination into the changes which this variety of cane undergoes during its growth and its period of ripening in Minnesota has been made; since the exact period of the maturity of a plant, as well as the particular amount of its constituents, as sugar, starch, &c., are known to be not unfrequently greatly affected by climate, and by the condition and peculiar adaptation of the soil turned to account for its cultivation.

It remains for me merely to state that our results are not as satisfactory as we hoped for when entering on the experiment. By pursuing a course of treatment based on strictly scientific principles, without reference to cost, I succeeded many years ago in securing between eight and nine per cent of cane-sugar from the juice of the Chinese sorghum: others have since obtained similar results.

The presence of a large amount of grape-sugar in all the later stages of the Early Amber, as well as of all other varieties of this species, is a serious feature in the composition of the juice, impairing greatly the chances for a copious separation of the cane-sugar by simple modes of treatment. The necessity of applying more costly apparatus, and engaging skilled labor to secure the larger portion of the cane-sugar, if once conceded, places the production of dry sugar from sorghum beyond the scope of general farm enterprise.

REPORT TO THE DIRECTORS

OF THE

MASSACHUSETTS EXPERIMENTAL STATION.

BY

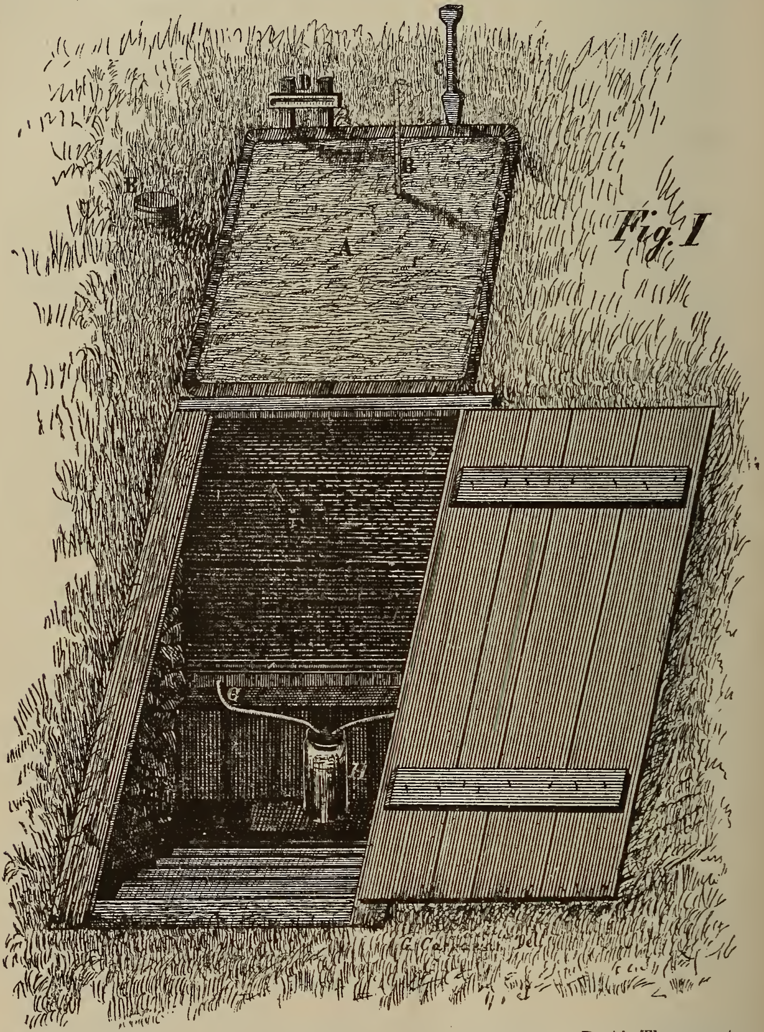
PROFESSOR LEVI STOCKBRIDGE.

REPORT.

The undersigned, upon whom, by your vote, was devolved the duty of conducting experiments on the deportment of soils towards water and various manures by the use of the lysimeter, has performed that duty with as much care and accuracy as the time and means at his disposal would allow, and is able to submit the following results: —

Method of constructing the Lysimeter.

Though not found in dictionaries or encyclopædias, the word "lysimeter" means simply an instrument for measuring the natural percolation of rain falling upon the soil. At the time the experiment was instituted, it was quite difficult to obtain definite information as to its proper mode of construction and use. There was but one such instrument in America, and that not thoroughly constructed nor fully equipped. The instrument, such as it was, was on the farm of the Sturtevant Brothers of South Framingham, Mass., who had kept a record of its operations for two years. A visit was made those gentlemen, who kindly showed me the instrument, and its method of operation ; and from one of them, Dr. E. Lewis Sturtevant, a paper was received making invaluable suggestions in relation to the details of construction and equipment, and the direction of investigations considered of the greatest importance. From the information here obtained, and in view of the small appropriation for the purpose, it was deemed advisable to confine the experiments to one variety of soil, and to a medium depth ; and the lysimeter was accordingly constructed as follows: A box was made of two-inch chestnut plank, three feet deep, 45.726 inches square on the inside, and which would enclose $\frac{1}{3000}$ of an acre of land to the depth of the box. The planks on the sides were grooved and tongued, dovetailed at the corners, and firmly spiked together. The box was painted inside and out with coal-tar, and lined on the inside with sheet-copper, which was doubled over the upper and lower edges of the box, and securely tacked on the outside. The bottom was made of the same material, put together in the same manner, painted and lined with the same, but was made six inches larger than the square of the box. One end of the bottom was scarfed to an edge to facilitate its passage through the soil when driven under the box, and in the other two one-inch holes were bored in the centre of the end of the plank diagonally upward to and through the copper lining of the box. Into these holes, copper tubes were inserted, which on the inside were soldered water-tight to the lining of the bottom, and which protruded one inch and a half from the end of the plank to carry off the percolating water. The soil selected to experiment upon was a *drift* which had been in grass nine years without manure. The first ten inches on the surface was a chocolate-colored sandy loam, in which were many pebbles and small round stones; the next fourteen inches consisted of a light yellow gravelly loam, and the fourteen inches at the bottom was made up of smooth round stones from pebble-size to six inches in diameter, the interspaces being filled with sand and gravel. The whole depth was thirty-eight inches, and it would be called a very "leachy" soil. The box was filled with this earth, without materially disturbing it, by placing it, without the bottom, on the turf, and digging a wide space on the outside, to the depth of a few inches below the edge, and then driving it down with a heavy timber. Care was taken not to dig under its edge, but to make it cut its way as it was driven, and thus to fill perfectly. In this manner it was settled to the required depth, or until its upper edge was even with the surrounding turf. Owing to the nature of the subsoil, the putting under of the bottom was attended with the greatest difficulty, but was accomplished by making a strong timber frame, square, but two inches larger on the inside than the box. This was dropped down over it to the gravel, into which it was sunk until its upper surface was two inches below the lower edge of the box. The scarfed end of the bottom was then placed on this frame under the box, and then, with two jack-screws on the back side to hold the box and its contained earth in place, and two in front operating against the end of the bottom, it was forced into its proper position. The copper lining of the bottom, and that of the box which turned under the lower edge, was then soldered together, so that there could be no escape of water. The whole apparatus was set with an incline of one inch to the front to carry the water to the percolating tubes, and to hold which a glass jar was procured containing one gallon, but scaled on its side in ounces and pints. To prevent evaporation from this jar, it was fitted with a large stopper, through which were two orifices, into which were inserted rubber pipes connected with the copper tubes as conductors of the percolating water. It was finished by throwing back and tamping in the earth which had been excavated on three sides, and building walls on the fourth, from the bottom to the surface of the ground, and enclosing sufficient space for the collecting jar and a flight of stairs for the accommodation of the attendant, which was covered with a frame and door for the protection of the jar and tubes, but with an incline to carry rain from the space. A rain-gauge of the same dimensions and scale as that used at the Smithsonian Institution was placed by the side of the lysimeter, the size of the latter being such that one inch of rainfall deposited in it 9.05 gallons of water, which would be equivalent to 27,150 gallons or 848.43 barrels per acre. For recording the temperature two Fahrenheit thermometers were used having corresponding scales. The one for recording the air temperature was hung on a scalloped board, with the bulb two inches above the soil, its stem, but not its bulb, receiving the direct rays of the sun. The one in the soil had a bulb one inch in length, which through the season was kept buried one-half an inch below the surface, and its lower end was generally or always in moist soil; and in the following records this depth is the point indicated in temperature of surface soil. After all the appliances were completed, the soil within the box was turned over to the depth of seven inches, and it has been hoed and kept clear of vegetation through the season, which fact should be borne in mind, as affecting its temperature by day and night as well as the percolation. The record of the rainfall and percolation was commenced May 1, and will be continued through the year, but, for the purposes of this report, is brought only to Nov. 30. Owing to delay caused by difficulty in obtaining correct and agreeing thermometers, the record of temperature



A, Soil in Lysimeter. B, Soil Thermometer. C, Air Thermometer. D, Air Thermometer. E, Rain Gauge. F, Front of Lysimeter Box. G. Rubber Pipes to conduct Water from Tubes to Jar. H, Water Jar.

could not be commenced until May 23, and was closed for the year Nov. 30.

Plate No. 1 represents the lysimeter with the door of the jar-room open, and with its different appliances and instruments.

RAINFALL. — *The number of days on which rain fell between May 1 and Dec. 1 was sixty-two. The daily fall, the total for each month, and for the entire period, were as follows:* —

Month and Day.	Rainfall in Inches.	Month and Day.	Rainfall in Inches.	Month and Day.	Rainfall in Inches.	Month and Day.	Rainfall in Inches.	Month and Day.	Rainfall in Inches.	Month and Day.	Rainfall in Inches.	Month and Day.	Rainfall in Inches.	RÉSUMÉ. Month.	RÉSUMÉ. Rainfall.
May 4	.14 inch.	June 4	.02 inch.	July 4	.06 inch.	Aug. 1	.17 inch.	Sept. 1	.29 inch.	Oct. 7	.06 inch.	Nov. 12	.13 inch.	May	2.14 inch.
" 5	.72 "	" 8	1.95 "	" 8	.02 "	" 6	.38 "	" 2	.33 "	" 9	.51 "	" 18	2.47 "	June	5.88 "
" 10	.35 "	" 10	.09 "	" 9	.22 "	" 7	1.36 "	" 3	.12 "	" 19	.25 "	" 20	.18 "	July	3.52 "
" 11	.11 "	" 11	.17 "	" 10	.47 "	" 9	.45 "	" 5	.44 "	" 23	.52 "	" 22	.84 "	Aug.	4.45 "
" 21	.26 "	" 12	.26 "	" 12	.10 "	" 11	.56 "	" 6	.14 "	" 28	.30 "	" 23	.25 "	Sept.	2.09 "
" 26	.11 "	" 17	.10 "	" 18	.09 "	" 13	.15 "	" 12	.15 "	" 30	.31 "	" 25	.11 "	Oct.	2.38 "
" 30	.29 "	" 22	1.47 "	" 21	1.05 "	" 16	.26 "	" 13	.13 "	" 31	.03 "	" 27	1.43 "	Nov.	5.24 "
" 31	.16 "	" 23	.88 "	" 27	.32 "	" 17	.32 "	" 21	.10 "	-	-	" 28	2.03 "	-	-
-	-	" 24	.05 "	" 30	1.19 "	" 21	.19 "	" 26	.39 "	-	-	-	-	-	-
-	-	" 25	.11 "	-	-	" 25	.61 "	-	-	-	-	-	-	-	-
-	-	" 27	.78 "	-	-	-	-	-	-	-	-	-	-	-	-
Total	2.14 inches	Total	5.88 inches	Total	3.52 inches	Total	4.45 inches	Total	2.09 inches	Total	2.38 inches	Total	5.24 inches	Total	25.70 inch.

Each inch of rainfall deposited 9.05 gallons of water in the lysimeter. Total water received in the seven months was 222.585 gallons, which was equal to 697,755 gallons, or 22,150.95 barrels, per acre.

PERCOLATION. — *The number of days in which the percolation was sufficient to require the emptying of the jar was thirty-seven. The days of the month, the total for each month, and for the entire period, were as follows:* —

Month and Day.	Percolation. Pints.	Percolation. Ounces.	Month and Day.	Percolation. Pints.	Percolation. Ounces.	Month and Day.	Percolation. Pints.	Percolation. Ounces.	Month and Day.	Percolation. Pints.	Percolation. Ounces.	Month and Day.	Percolation. Pints.	Percolation. Ounces.	Month and Day.	Percolation. Pints.	Percolation. Ounces.	Month and Day.	Percolation. Pints.	Percolation. Ounces.	Recapitulation. Month.	Recapitulation. Percolation. Pints.	Recapitulation. Percolation. Ounces.
May 5	4	0	June 9	5	0	July	0	0	Aug. 7	16	0	Sept. 6	5	0	October	0	0	Nov. 18	8	0	May	21	12
" 6	14	0	" 10	9	13	–	–	–	" 8	8	0	" 7	5	0	–	–	–	" 19	15	4	June	106	3
" 9	2	2	" 11	6	0	–	–	–	" 9	8	0	" 10	1	6	–	–	–	" 20	7	8	July	0	0
" 14	1	10	" 12	6	14	–	–	–	" 10	8	0	–	–	–	–	–	–	" 21	7	0	August	61	12
–	–	–	" 13	6	8	–	–	–	" 11	5	8	–	–	–	–	–	–	" 22	16	0	September	11	6
–	–	–	" 18	5	4	–	–	–	" 12	8	0	–	–	–	–	–	–	" 23	24	0	October	0	0
–	–	–	" 22	8	0	–	–	–	" 19	8	0	–	–	–	–	–	–	" 24	14	0	November	171	4
–	–	–	" 23	42	14	–	–	–	" 28	0	4	–	–	–	–	–	–	" 25	6	2	–	–	–
–	–	–	" 24	8	0	–	–	–	–	–	–	–	–	–	–	–	–	" 27	32	0	–	–	–
–	–	–	" 26	1	4	–	–	–	–	–	–	–	–	–	–	–	–	" 28	33	4	–	–	–
–	–	–	" 28	6	10	–	–	–	–	–	–	–	–	–	–	–	–	" 29	8	2	–	–	–
Total	21	12	Total	106	3	Total	0	0	Total	61	12	Total	11	6	Total	0	0	Total	171	4	Total for 7 months	372	5

The percolation for the entire period, reduced to gallons, was 46,543, or 4,432.38 barrels per acre; the rainfall for the same time, as previously given, amounted to 22,150.95 barrels. The average daily evaporation from this soil for seven days, from June 27 to July 4, was 164 barrels per acre. This must be considerable more than the daily average for the season; but it may be safe to say, that, deducting the sixty-two days on which rain fell, the evaporation was a hundred barrels daily, or 15,100 barrels for the season. The percolation and evaporation, then, amounted to 19,532.38 barrels, showing that on Dec. 1 this surface-soil, to the depth of three feet, was holding 2,618.57 barrels of water per acre.

REPORT ON THE PERCOLATED WATERS OF THE LYSIMETER.

BY PROFESSOR C. A. GOESSMANN.

The samples of water received from the lysimeter at different times amounted, in most instances, to from twelve to fourteen pounds of the liquid. An equal volume of the percolated water was used in the various tests, to impart to them an approximate comparative value. The examination was of a qualitative character, as directed, and, as a general rule, only with reference to the presence or absence of the chemicals previously applied to the soil. In no case was a new application of chemicals made until the percolation of the water of the previous rainfall had ceased. The sample of water which passed through the lysimeter (May 12, 1878) soon after its construction, and before any chemicals were applied, contained the usual constituents of drainage-waters coming from an unfertilized drift-soil characteristic of our section of the State; viz., a considerable amount of carbonate of lime, smaller portions of the carbonates of iron and magnesia, besides not unfrequently traces of potassium oxide and nitric acid. The entire amount of the mineral constituents, and of the carbonate of lime in particular, was somewhat larger than may be noticed in ordinary cases. The exceptional condition of the first sample of drainage is most likely due to an unavoidable partial disturbance of the soil in the lysimeter, incidental to its construction, which, in turn, must have favored the disintegrating atmospheric agencies.

I. — The soil of the lysimeter was dressed in the customary way with muriate of potash, containing eighty per cent of chloride of potassium, at the rate of two hundred and fifty pounds per acre. This operation was carried out on the 17th of May: the percolation of rain-water began on the 9th of June. The percolated water contained .0076 per cent of chlorine, and but .00017 per cent of potassium oxide. Allowing .000128 of the chlorine for the formation of potassium chloride, there remains .00747 per cent of the chlorine in excess, which proved to be present in combination with lime as chloride of calcium. Taking into calculation that the first sample of water which passed through the original soil contained a noticeable amount of potassium oxide, it is quite safe to assume that the soil retained practically the entire amount of potassium which had been added to it in the form of muriate of potash, whilst the chlorine thereby liberated, after entering into combination with an equivalent amount of lime in the soil, appears in the percolated water as chloride of calcium. The results obtained in this experiment correspond well with those of earlier investigations regarding the action of the chloride of potassium on soils containing lime and magnesia; they furnish also a good illustration of the fact that both the removal of crops and the peculiar forms of the fertilizing materials used for their growth may modify, independent of each other, more or less seriously, the composition of the soil left behind.

II. — The soil was dressed on the 20th of June with six hundred pounds of sulphate of ammonia per acre, the salt containing twenty-four per cent ammonia. The water began to flow on the 23d of June. One part of it was acidulated with sulphuric acid before being carefully evaporated to dryness, to retain the ammonia, if present. A careful test established the absence of ammonia in the residue. The second half of the water was rendered alkaline by means of carbonate of soda, previous to its evaporation, to prevent the loss of nitric acid in particular. The saline matter thus secured contained a trace of nitric acid. Whether the presence of this acid under existing circumstances can be ascribed to an oxidation of some of the ammonia applied is somewhat doubtful, considering the short time of exposure; yet it is by no means impossible, judging from the observations of Tuttle and others.

III. — Superphosphate of lime, at the rate of two hundred and fifty pounds per acre, and containing fifteen per cent of soluble phosphoric acid, was incorporated into the soil of the lysimeter on the 6th of July. The percolation of the rain-water began Aug. 7. From thirteen to fourteen pounds of that liquid were evaporated to dryness. The saline matter left behind was dissolved in some diluted nitric acid, and subsequently tested for phosphoric acid, by means of molybdate of ammonia: no trace of that acid could be discovered. The soil had retained the entire amount of phosphoric acid used in the experiment.

IV. — Nitrate of soda, containing sixteen per cent of nitrogen, was applied as a final dressing of the lysimeter soil on the 24th of August, at the rate of six hundred pounds per acre. The percolated water was secured the first week of September. The residue left after its careful evaporation contained a considerable quantity, comparatively speaking, of nitric acid as nitrate of lime, and also gave a decided re-action of phosphoric acid. These results coincide with previous observations under similar circumstances. The nitric acid, in its well-known downward course, had exchanged its soda for the lime of the soil, and at the same time carried some of the phosphoric acid of the previous dressing into the subsoil, and ultimately into the drainage-water.

The facts disclosed by Professor Goessmann's analysis of the water which percolated from the lysimeter after its soil had been dressed with chemicals, though perhaps previously known to chemical experts, are worthy the careful attention and study of practical men. It should be remembered that twenty-eight of the thirty-eight inches in soil depth was little better than open gravel, that it was hoed and kept clear of vegetation during the season, and that the chemicals applied were largely in excess of ordinary manuring. Yet in no case did the drainage-water contain more than the slightest traces of any thing which had been applied. It is also apparent that the power of soils to take and hold salines is not merely a physical one, but may be most essentially modified and increased by chemical action, and in this case caused the retention of the potassium oxide, the soda, and the ammonia. At the same time, the application of such large quantities of nitric acid and chlorine as were contained in the nitrate of soda and the chloride of potassium, caused the filtration of lime and phosphoric acid.

Temperature.

The following tables show the monthly averages of the temperature of the soil in the lysimeter, and of the air, day and night; it being taken daily at the warmest time of the day and the coldest time at night, but the time by clock varying as the length of the days increased and decreased.

MONTH.	Temperature of Air.		Temperature of Soil.	
	Day.	Night.	Day.	Night.
Average for May . .	71.10°	53.10°	62.10°	54.55°
for June . .	79.63°	58.66°	82.63°	64.43°
for July . .	88.32°	62.68°	90.68°	67.39°
for August .	80.48°	56.90°	82.10°	62.52°
for September .	80.60°	49 40°	79.20°	58.80°
for October .	63.61°	40.48°	65.19°	49.62°
for November .	46.83°	26.43°	42.53°	37.29°

The table shows that the average temperature of the air by day, for the season, was 72.940°, and that of the soil, 72.061°. The average temperature of the air at night was 49.664°, and that of the soil, 56.370°. As the night temperature was taken at its supposed lowest point, it was possible that it did not give what might be called the average difference for the entire night between the soil and the air, and that if, instead of taking it just before daylight in the morning, it should be taken the previous evening, a very different result might be obtained. Observations were therefore made every night in the month of June, at ten P.M. The average temperature as found at that time was, for the air, 58.300°, and the soil, 64.430°. It will be noticed that the average difference is almost identical; that of the former showing the soil to be 6.706° warmer than the air, and the latter 6.130°.

Temperature of the General Soil.

As the recorded temperature of the air and soil at night, from the 22d of May, showed the soil in the lysimeter to be warmer than the air, a series of somewhat random investigations was made over the surrounding country, within two miles of the College, to ascertain whether this comparative temperature was in accord with the general fact; and the following are the recorded results. June 11, four A.M. — Garden-soil, 50°; air, 49°. Grassland recently mown, soil 54; air, 49°. Grassland covered with heavy crop, soil 54°; air, 49°. June 12, four A.M. — Garden-soil, 48°; air, 44°. Grassland recently mown, soil, 54°; air, 44°. Grassland covered with heavy crop, soil, 54°; air, 44°. Peat-swamp, wet, but covered with grass, soil, 53°; air, 43°. Peat-swamp, wet, but without grass, soil, 51°; air, 42°. June 16, four A.M. — Garden-soil, 60°; air, 58°. Grassland recently mown, soil, 62°; air, 58°. Grassland covered with heavy crop, soil, 62°; air, 58°. Gravelly knoll tilled, soil, 60°; air, 58°. Gravelly knoll in grass, soil, 64°; air, 58°. June 19, four A.M. — Garden-soil, 57°; air, 50°. Sandy loam soil, ploughed and harrowed the previous day, soil, 52°; air, 50°. Cornfield, light sandy loam, soil 54°; air, 50°. Field covered with heavy clover, land very moist, soil, 59°; air, 50°. Under trees in grassland orchard, soil wet, soil, 59°; air, 50°. Same soil, but not under trees, soil, 58°; air, 50°. Same, but soil dry, soil, 60°; air, 50°. Gravelly knoll in grass, soil, 60°; air, 51°. June 28, four A.M. — Garden-soil, 62°; air, 60°. Grassland north of building where sun's rays do not strike between nine A.M. and five P.M., soil, 64°; air, 60°. Clay-plot, very wet, soil, 63°; air, 60°. At brookside, mud, 62°; air, 59°. July 1, at half-past two A.M. — Wet grassland near Mill River, soil, 71°; air, 66°. Sandy knoll covered with growing grain, soil, 70°; air, 66°. Sandy loam grain-field, soil, 68°; air, 66°. Sandy knoll without grass, soil, 69°; air, 66°. Tobacco-field near Connecticut River, soil, 68°; air, 66°. Grassland on river-bank, soil, 70°; air, 65°. Centre of large forest, soil, 66°; air, 67°. Turf-land outside of woods, soil, 70°; air, 66°

Woodland on hill, soil, 66°; air, 66°. The average night temperature of the soil as found by these investigations was 66.13°, and of the air 60.75°, showing that the general soil of the vicinity had a higher average temperature than that contained in the lysimeter. Of the whole series, but one record was made of air temperature higher than the soil, and that was in the centre of a dense forest, and on a night succeeding a day when the thermometer indicated 102° at half-past two P.M., and the air of the night was remarkably still. These investigations were made at odd times snatched from other duties or from sleep, and were thought not to be so methodical in relation to dates and varieties of soils as the importance of the subject demanded. Another series was therefore instituted, the investigations to be made the 5th, 16th, and 26th of every month, in forest-land, cultivated land dry and wet, grassland dry and wet, and at the surface of the soil, and at a depth of five inches. By dry land, land which had moisture on the surface of its particles is meant, and by wet land, that which had water standing between its particles, and, in most cases, that in which the impression left when the thermometer was withdrawn would fill with the liquid. The following is the record of the monthly averages: —

MONTH.	Dry Cultivated Soil.			Wet Cultivated Soil.			Dry Grassland.			Wet Grassland.			Forest Soil.		
Average for	4 A.M. Air.	Surface Soil.	Soil 5 inches deep.	4 A.M. Air.	Surface Soil.	Soil 5 inches deep.	4 A.M. Air.	Surface Soil.	Soil 5 inches deep.	4 A.M. Air.	Surface Soil.	Soil 5 inches deep.	4 A.M. Air.	Surface Soil.	Soil 5 inches deep.
August	57.33°	61.67°	66.22°	55.80°	62.00°	66.00°	52.12°	63.18°	66.36°	54.29°	64.00°	66.71°	57.50°	62.25°	63.25°
September . . .	46.63°	55.00°	58.13°	35.50°	46.50°	56.50°	44.30°	58.30°	62.21°	42.50°	57.67°	60.67°	50.43°	59.38°	60.50°
October	46.00°	52.60°	54.60°	42.75°	51.75°	54.25°	43.05°	54.74°	55.95°	42.20°	53.20°	55.00°	45.86°	54.57°	55.86°
November . . .	21.43°	33.86°	35.71°	20.00°	35.33°	39.00°	19.94°	36.38°	38.50°	20.50°	37.50°	40.67°	22.89°	40.00°	41.33°

The stations of the foregoing observations were long distances apart, on different kinds of soils, and in different exposure; and it is believed they show with accuracy the night temperature of the soil of the country, for the period they cover, in this latitude. The average night temperature of the air for the entire period was 41.036°; the surface of dry, cultivated soil, 50.282°, and, at five inches deep, 53.665°. Wet cultivated soil averaged at the surface 48.895°, and, at a depth of five inches, 53.937°. Dry land in grass averaged 53.150° at the surface, and 55.755° at a depth of five inches. Wet land in grass averaged 53.092° at the surface, and 55.762° at a depth of five inches. Forest-land averaged 54.050° at the surface, and 55.235° at a depth of five inches. The average temperature of the soil to the depth of five inches, as found by the whole investigation from Aug. 1 to Dec. 1, was 53.381°, or 12.345° warmer than the air at night for the same period. It has ever been taught that wet soils, as compared with dry, are cold, from which assumed fact many important conclusions have been drawn; but, if no mistake in observation has been made, this is an error. The average temperature of all the dry soils examined, and to the depth of five inches, was 53.381°; that of the wet soils to the same depth was 52.921°, or 460° colder. Practically the temperature is the same. The temperature of dry soils by day is higher than that of wet, and the diurnal variation greater; but the equality of temperature at night indicates pretty clearly that temperature is by no means the only factor to be considered in discussing the condition and improvement of wet lands.

The result of the investigations to ascertain the comparative temperature of the soil and air during the night, and in natural conditions, made it more than doubtful if the general belief respecting the comportment of soils to the vapor of water in the air is in agreement with the fact. If I am not mistaken, it is believed and taught, that at night the soil obtains water from the air, and in such considerable quantities as to be of the "utmost agricultural value," and, that in time of scarcity of rain, it invigorates and sustains plants, which, but for this supply, would wither and die. This, we are taught, is the result of the operation of three causes, each of which is worthy of examination and careful analysis. The first cause is the "hygroscopic property of soils." Water, in both the liquid and vapor forms, seeks an equilibrium. When the substances containing unequal quantities of water are brought in contact, the element passes from the wet to the dry, or from the moist to the less moist substance. It is assumed that the soil is the dry, and the air the moist object, and during the night there is a movement of water from the latter to the former. This is accepted as a proved fact by the experiments of Schubler, Davy, and others. But all those experiments were tried under such perfectly unnatural and distorted conditions, that it is more than doubtful if they illustrate the natural fact in the case. In those investigations the soils experimented with were first carefully and thoroughly dried by heating to 212° F., and were then confined over water in saturated air. They absorbed the vapor of the water, and increased their weight. But that is not singular. A plate of burnished steel or flint-glass would have done the same thing, — would have absorbed moisture after heating to 212°, even in the atmosphere of a warm room; and the experiments do not show any peculiar property of soils in this respect, nor prove, that, in natural position in the field and in free air, they would absorb vapor. That soils are hygroscopic there is no doubt; but such investigations do not reach the case. By an examination of the soil of a cultivated field in time of drought, or in average summer condition, the following facts will be found: first, a thin layer of soil on the surface fully exposed to the air, and which, if not in absolute hygroscopic equilibrium with it, is simply air-dry: it must contain more rather than less water than the air in contact with it, and it lies on, and is intimately connected with, a lower layer of soil, which contains not only hygroscopic water, but moving capillary water, which is constantly passing upward to it, and through it into the air; and both the lower and upper layers have a higher temperature at night than the air. These being the facts respecting the condition of the soil and air, it is hardly possible that the film of water found on the surface of the upper layer of soil on a summer morning could have been received from the air; but it would be very natural and reasonable that it should be moisture which arose from the lower layer, and was condensed on the surface by the colder air of the night.

The second influence which causes absorption of water by the soil from the vapor of the air is stated as follows: During the day the soil absorbs the heat created by the sun's rays, and becomes very warm. At night this heat is radiated, and the soil cools rapidly, becoming colder than the air at or near its surface. It thus cools and condenses the vapor it contains, which is deposited upon and absorbed by the soil. To this theory there are some objections, and many natural facts it is difficult to explain by it. For example: a cock of hay standing on a dry gravel-knoll during the night will always be found in the morning quite moist entirely through at the bottom. The mower drops his scythe-stone on the ground just at nightfall: in the morning he finds it dry on the top, and covered with water below. A board is thrown upon the ground at night: in the morning it is dry on the top; but the bottom is wet. Now, it is a fact, that all soils are warmed, and evaporate watery vapor, during the day; and it may be said that in these and similar cases, as the soil is covered at night, its heat is not radiated, and evaporation continues, which would be checked but for the covering, and this causes the local moisture beneath. This is undoubtedly true to a certain extent. But allow the hay, the board, or the stone, to lie on the ground during the following day, or many days, so that the soil cannot be warmed by the heat of the day, and it will become comparatively cold; yet every night moisture will accumulate beneath. But, if no mistake has been made in relation to the comparative temperature of the soil and air at night, this theory cannot be true. If the average night temperature of our general soils is 12.345° warmer than that of the air, there can be no condensation of watery vapor caused by the soil, there is no absorption by it of water from the air; but the natural phenomenon of evaporation from the soil is continued through the night, though less rapidly than in the daytime.

The last natural influence given as conveying water from vapor to the soil is called "dew-fall," and is almost identical in principle and result with that just considered as condensation and absorption. The principle is fully and clearly illustrated by the phenomenon of the "ice-pitcher." The vessel filled with iced water during a warm day, when the air has a high per cent of humidity, soon has its outside covered with a perceptible film of moisture, which rapidly increases; and soon liquid water is trickling down its side. This is water condensed, and taken from the air; and the belief is, that at night the soil is in the same relation to the air as the pitcher during the day, and in like manner receives water. This whole matter is one vastly too important to be left undetermined except by speculation; and an extensive series of investigations was instituted to ascertain the precise facts. And, first, does the soil stand in the same relation to the air as the "ice-pitcher" in the illustration given? If so, then the pitcher filled with soil directly from the field would be soon covered with moisture.

Fig. 2.

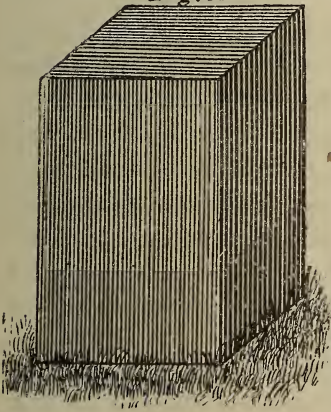


Fig. 3

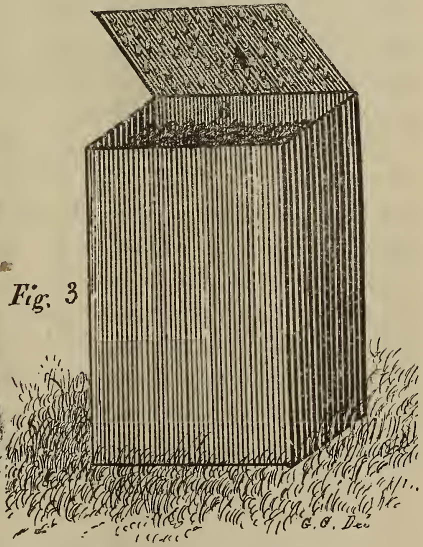


Fig. 2. The box containing soil, with the lid on, but no dew on the outside.
Fig. 3, A. The box with the lid raised, showing the water on the under side.
Fig. 3, B. Soil in the box.

Experiment 1. — A can of thin tin was prepared, which was three inches square, five inches deep, and without top or bottom. At eight o'clock of the evening of July 20, it was filled with soil from a cultivated field, in the same manner as the soil is taken into a lysimeter. It was placed on a grass-plot, and there remained until the morning of the 21st, and, though the surrounding grass was loaded with dew, there was not the slightest trace of it on the box. At four A.M. of the 21st the temperature of the soil in the box was 66°; that of the air was 60°. The experiment was repeated many times, with identical results. The soil does not bear the same relation to the air as the "ice-pitcher." On the night of July 25 a loose cover was placed on the top of the box: on the succeeding morning the top of this cover was dry; but the under side, next to the soil, was thickly studded with drops of water. Plate II., Figs. 2 and 3, represent this device.

The principle illustrated by the "ice-pitcher" is a natural one; but it does not apply to the soil: in this case the soil becomes the warm, moist substance, performing the office of the air, and the air the cold substance, condensing its evaporating water. If the soil of the field gathers water from the air at night, then a given portion of it in natural position will be heavier in the morning than at night; if it evaporates water, it will be lighter.

Experiment 2. — Two boxes were prepared with capacity of a cubic foot. They were filled with soil in the same manner that soil is taken into a lysimeter, and without disturbing its particles, or disarranging its strata. One was filled with absorbent, retentive loam, the other with peat; and these soils were taken, because it was supposed that evaporation from them would be less rapid than from gravel or sand. Tight bottoms were nailed upon them, and they were placed in a trench in the open field, level with the surrounding ground, and exposed to all the vicissitudes of the weather. The experiment commenced the 1st of June, and was continued through the month, except when interrupted by rain or fog, the boxes being weighed night and morning. It will be noticed that the increase and decrease of the weight was not uniform, which was due to varying amounts of rainfall; but the results were as follows: —

DATE.	LOAM.						PEAT.					
June.	EVENING WEIGHT.		MORNING WEIGHT.		GAIN.	LOSS.	EVENING WEIGHT.		MORNING WEIGHT.		GAIN.	LOSS.
	lbs.	oz.	lbs.	oz.	oz.	oz.	lbs.	oz.	lbs.	oz.	oz.	oz.
1 .	110	4	110	1	0	3	112	0	111	8	0	4
2 .	109	2	109	2	0	0	110	2	110	0	0	2
3 .	108	9	108	8	0	1	108	12	108	12	0	0
4 .	108	0	108	0	0	0	107	6	107	7	1	0
5 .	107	1	106	15	0	2	105	1	105	2	1	0
6 .	106	6	106	5	0	1	103	13	103	10	0	3
7 .	105	14	105	11	0	3	102	5	102	1	0	4
9 .	115	8	115	5	0	3	109	0	108	13	0	3
14 .	115	12	115	9	0	3	109	4	109	0	0	4
15 .	114	9	114	8	0	1	107	9	107	8	0	1
17 .	113	13	113	13	0	0	106	9	106	7	0	2
19 .	112	4	112	2	0	2	104	4	104	2	0	2
20 .	109	4	109	3	0	1	103	14	103	12	0	2
21 .	110	6	110	6	0	0	101	13	101	12	0	1
23 .	116	12	116	12	0	0	107	7	107	6	0	1
28 .	115	15	115	13	0	2	106	14	106	14	0	0
29 .	114	6	114	4	0	2	105	2	105	1	0	1

This experiment, though not conclusive, indicates that the soil at night evaporates water, and that it is possible that the little moisture we find on the surface of a field in the morning may have been received from deeper soil rather than from the air. But the experiment was crude, the weights taken large, and the danger of mistake in exact fine weighing imminent: therefore the fact was sought by a different method.

EXPERIMENT 3. — A tin cup or can was prepared, seven inches in diameter and eight inches high, and holding 308.67 cubic inches of air. The sides were made double, but with the tin plates an inch and a half apart to contain water to reduce the temperature within the can to the same degree as the air outside: it was without bottom, but had a top through which was an orifice made tight by a cork, but in which was an aperture to insert a thermometer. It was well soldered; so that when it was put down upon, and its lower edge cut into, the soil, it was practically air-tight. For the purpose of absorbing moisture a piece of fine sponge was taken of twenty grams' weight. The sponge was placed under the can on a pine pin two inches above the ground or board, on which the cup was alternately placed, and was weighed night and morning. It was assumed, that, if the water absorbed by the sponge came from the air, there would be a marked uniformity in the weight of the sponge, whether the can stood on the board or the ground; but, if it came

Fig. 4.

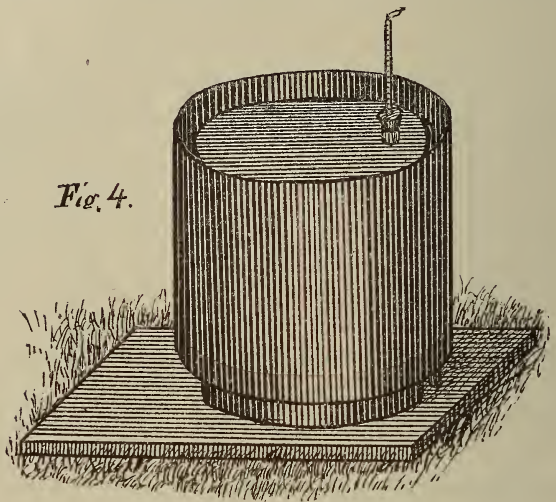


Fig. 4. The can as used on a board.

from the soil, its weight would be greatest when the board was removed. When the can stood on the board, the outside

Fig. 5

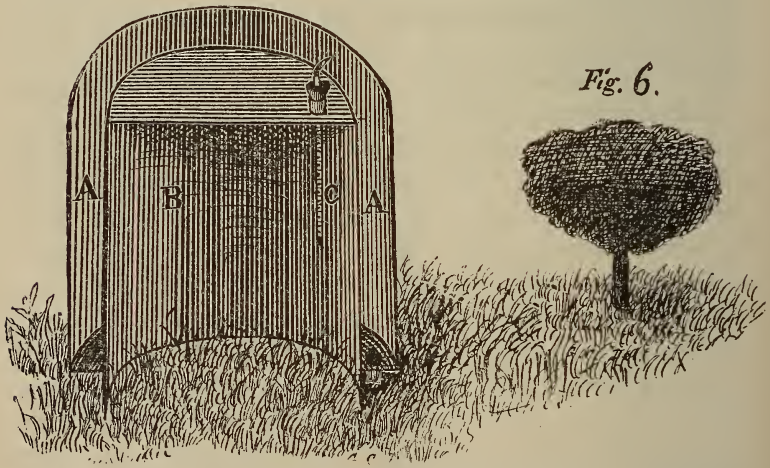


Fig. 5. A vertical section of the cup. A, space for water; B, inner space; C, thermometer.
Fig. 6. The sponge on the pin as covered by the can.

air was excluded by banking around the bottom with dry soil. Plate III., Figs. 4, 5, and 6, represent this device.

The following table exhibits the result of the trial: —

Date.	Per cent of Humidity in Air.	Inside Temperature.	Outside Temperature.	Cup on Board. Moisture on Sponge.	Cup on Ground. Moisture on Sponge.	Temperature of Soil.	Remarks.
June 7	67	54°	52°	–	3.00 grams	68°	
" 9	86	51°	49°	–	2.35 "	56°	
" 10	92	51°	49°	–	3.10 "	52°	Rain previous day, and soil wet.
" 12	88	50°	48°	.030 grams,	–	53°	
" 13	88	58°	53°	.431 "	–	60°	
" 14	72	52°	50°	.620 "	–	68°	
" 15	88	58°	58°	.550 "	–	65°	
" 16	62	58°	59°	–	1.76 "	65°	
" 17	74	60°	58°	–	1.43 "	64°	
" 19	70	52°	50°	.245 "	–	64°	
" 20	88	59°	58°	–	2.76 "	70°	
" 21	70	55°	54°	.250 "	–	67°	
" 23	83	58°	56°	–	1.94 "	66°	
" 24	87	59°	59°	–	4.50 "	66°	
" 25	87	54°	57°	.740 "	–	62°	
" 28	95	62°	60°	–	2.88 "	69°	Ground not hoed after rain.
" 29	96	65°	64°	–	4.16 "	77°	Ground just hoed, and very moist.

Rapidity of evaporation from any object is supposed to be according to its temperature and the amount of water it contains, modified by the motion of the air, its temperature, and its per cent of humidity. But the table does not show by the amount of water collected over the ground or board, any special uniformity in this respect. It is noticeable that when the air under the can was comparatively dry, as on the nights of the 16th, 17th, 19th, and 21st, the least water was collected; but no attempt was made to ascertain, if, during that time, its humidity was increased by the soil evaporation, or decreased by sponge absorption on the nights of the 10th, 20th, 28th, and 29th, when it had a high per cent of moisture, and sponge contained the most water. It is quite possible, however, that, when the humidity of the air was near the point of saturation, the sponge received all the water evaporated by the soil, making its quantity large, and, on the other hand, when the air was dry, that received and held a portion of the evaporation, making the sponge collection small. As a rule, the amount of moisture taken by the sponge was largest immediately after rain, when the soil was wet, and at a high temperature. The result, as a whole, corroborates the conclusions drawn from the second experiment. The amount of water collected, though small, must have been received principally from soil evaporation; but it does not determine what the maximum evaporation would be if the soil had not been covered by the can; for, as the contained air approached saturation, the sponge would not fully relieve it, and there must be a diminution in the soil evaporation. Therefore the more completely to eliminate the whole truth, the investigations were continued in the following manner.

Experiment 4. — A double vessel of thin tin was prepared, which within would cover one square foot of soil, and contain half a cubic foot of air, and of the same holding-capacity in the outside receptacle. On the inside, one inch above the bottom edge, a gutter was soldered on the four sides, slightly inclining to one point, and connected with a tube which passed through the side of the vessel; a tight-fitting rubber-hose was drawn over this, and its outer end inserted in a phial. When in use, the lower edge of the vessel was cut into the soil to the depth of one inch, or as deep as the gutter would allow, to exclude the external air, and the outside receptacle was filled with ice and water to act as a condenser of the water-vapor within. The can is represented by Plate IV.

Fig. 7

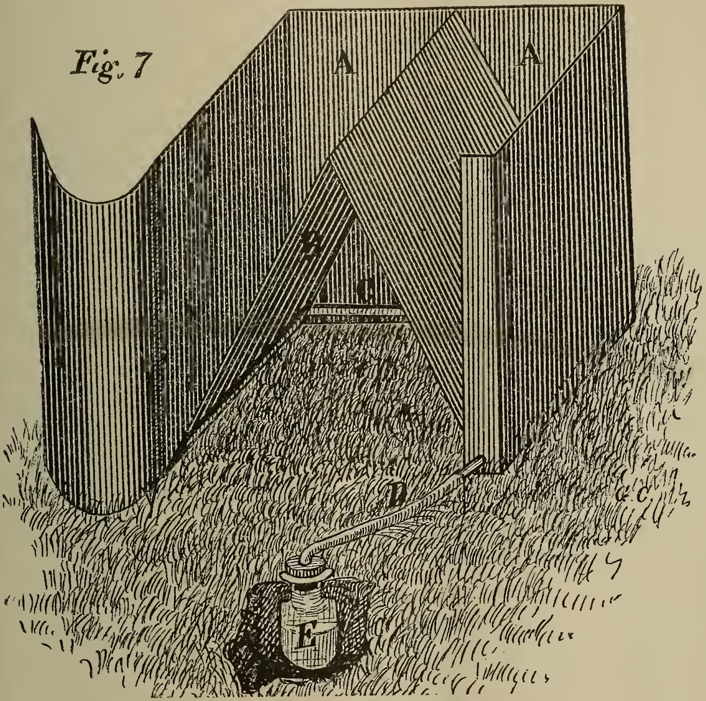


Fig 8

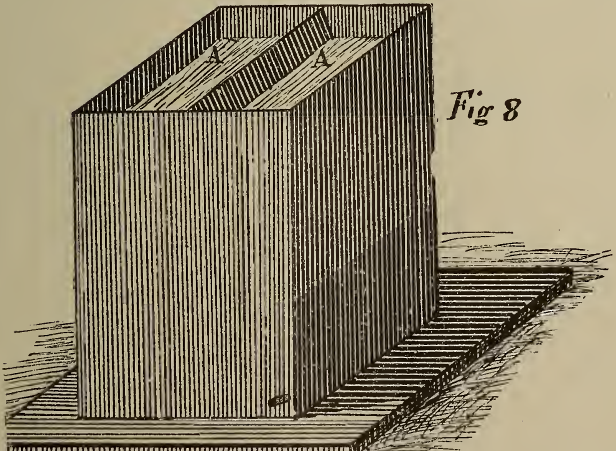


Fig. 7. A vertical section of the can, with side turned away to show the internal arrangement. A, A, water-space; B, air-space; C, gutter to catch water; D, rubber tube to conduct water from gutter to jar; E, water-jar. Fig. 8. Can as used on a board. A, A, ice-cold water.

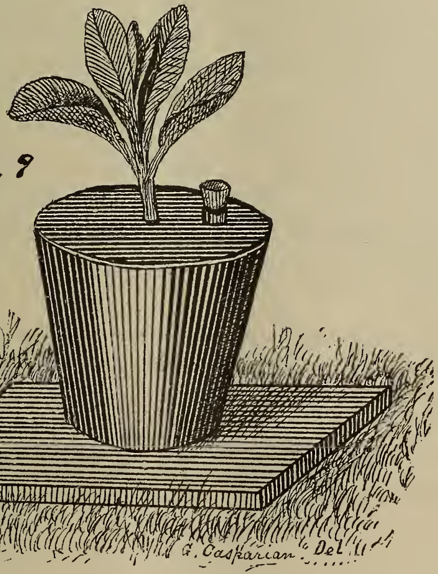
The results of its use on cultivated and sod-land, and on a board, were as follows: —

Date.	Per cent of Humidity of Air enclosed.	Actual Water in Air enclosed.	Actual Water obtained.	Gain over that contained in the Air enclosed.	Amount of Water obtained per Acre.	Temperature of the Outside Air.	Temperature of the Soil.	Remarks.
Night of		grams.	grams.	grams.	barrels.			
July 8 . .	82	0.1555	2.550	2.3945	8.950	70°	75°	A leak at the tube.
" 9 . .	96	0.3045	19.220	18.9155	70.941	76°	79°	Vessel on garden soil recently hoed.
" 10 . .	95	0.2786	33.060	32.7814	122.216	76°	79°	Soil wet by heavy rain previous day.
" 13 . .	92	0.2267	.445	0.2183	0.818	70°	74°	Vessel on a board.
" 15 . .	82	0.1555	13.050	12.8945	48.364	68°	74°	Vessel on dry sandy land.
" 16 . .	86	0.1684	17.430	17.2616	64.745	65°	72°	Vessel on grassland, and grass under it, loaded with dew, but little on grass outside.

The water collected in this experiment was the evaporation from a square foot of surface, and, though so small as to be hardly appreciable for that area, yet in nature it is a vast movement, as can be seen by noticing the collection of the night of July 10, when it was at the rate of more than a hundred and twenty-two barrels per acre. This may or may not be the maximum of soil evaporation at night; but it conclusively proves that the law of evaporation is not suspended or contravened, but is in active operation, at night, modified, of course, in degree by those influences which affect it during the day. The drift of the four separate investigations is clearly in one direction, and teaches, that in the open field, with soil and air in natural condition, — the general soil, the upper stratum or film of air-dry soil, — lifeless substances lying on the ground or near it do not absorb water from the comparatively cold, dry air, but obtain it directly from the water which is being evaporated by the warmer and more moist soil. On this principle, and this alone, can the phenomena to which allusion has been made be understood or explained, or that more striking natural appearance commonly known as "ground fog." This is seen during the night, when there is no perceptible motion to the air, as a compact sheet of mist of one or two feet in thickness, and resembling a covering of snow, and always over water or very wet land. The surface-soil beneath the fog is many degrees warmer than the air, and contains hundreds of times more water in an equal space. Its abundance and warmth cause rapid evaporation, which is immediately condensed and made visible by the colder air. The principle which these observations appear to establish as governing the natural relations which exist between the soil and water in both the liquid and vapor forms, and its movement thence to the air, may have a more extended influence and application than has now been given it, and exhibit the cause and process of "dew-fall" in the case of the living plant; which phase of the subject should here receive our careful examination.

Allusion has already been made to the principle of "dew-fall" as illustrated by the "ice-pitcher;" and dew is described as "moisture from the atmosphere condensed by cool bodies on their surfaces at night. With the principle and the fact as stated, the belief appears to be and is in harmony, if no mistake is made in the application. It is, however, pertinent to inquire if this universally-accepted and time-honored theory of "*dew-fall*" is consistent with many well-established laws of plant-life and many well-known natural phenomena. And, first, the plant is endowed with a most wonderful and elaborate system of roots, extending deep, far, and wide in the soil, which has a temperature at night many degrees warmer than the air, and saturated with water of its own temperature. The most important function of this root-system is to gather soil-water, and force it upward, through every part of the structure of the plant, to the leaves. Their power is so great, that when the plant is in rapid growth, and there is a full water-supply in the soil, it is subjected to great pressure. The root-force of plants has been frequently investigated, but never more completely, or with a clearer or more decided record, than by the experiments at the Agricultural College, under the direction of President Clark, in the years 1874 and 1875. It is recorded in those experiments that the pressure exerted by a birch-root severed from its connection with the tree was equal to a column of water 85 feet in height; and that of a squash-plant eight weeks old, soft, open in its texture, and very tender, exerted a force equal to a column of water 45.5 feet high. Such plants as corn, tobacco, and the dahlia, exhibited a similar power. The leaves, acting in conjunction with the roots, pass nearly all the water thus forced into their tissues, through their stomata, into the air. A rapidly-growing calla in the College conservatory has been noticed to exude water from its leaf-pores in such quantity as to stand upon the surface or fall to the ground in large drops. An Indian-corn plant, during its season of growth, has been found to evaporate thirty-six times its own weight of water. It has been stated, after careful investigation, that the leaves on an average acre of forest exhale many thousand tons of water during their summer growth, and a sunflower-plant has evaporated three pounds in twenty-four hours. There is no natural reason why this evaporation should not be constant during growth, modified only in quantity by the supply of water in the soil, its temperature as affecting the activity of the roots, the rapidity of the motion of the air, and its content of water. Second, young, succulent, rapidly-growing plants standing in the field by the side of those nearly ripe and comparatively dry always exhibit much the most dew. Third, other things being equal, those leaves and plants nearest to the ground "collect" the most dew. Fourth, other things being equal, plants growing on soils fully supplied with water show more dew than those on dry land. The Colorado wheat-grower, producing his crop by irrigation, determines when his lands are dry, and need watering, not by examining the *soil*, but by viewing the growing *crop* early in the morning. If this is well covered with water, he knows the soil is moist; if it has little or none upon it, it is the reverse, and the irrigating-sluices are at once opened. Fifth, some plants, at certain stages of their existence, have

Fig. 9



dew upon them, if the direct rays of the sun do not strike them, although it is several hours above the horizon, and the temperature several degrees above the "dew-point." These phenomena may not prove that plants do not receive their dew from the air; but they give occasion for serious doubts, and indicate the possibility that it may come from the plant itself, or be a deposit of moisture rising from the soil as in the case of the "ground fog." A consideration of the mutual relations of root-action and leaf-evaporation leads to the conviction that it is hardly possible that the force or the result is one of diurnal periods, as in the case of the opening and closing of certain flowers, but rather that the cause is active day and night, unintermitted during the period of growth. But the positive fact could be proved only by investigation, and was, therefore, attempted in the following manner: Do plants evaporate water at night? Two petunias and a cabbage-plant were selected, of convenient size for the experiment, and in thrifty, growing condition. A tin pot was prepared for each, in which they were potted and soldered in. Tubes were inserted in the top and bottom to admit water, and for drainage. The orifice around the stems was closed perfectly with grafting-wax, and, when on trial, the apertures for water and drainage were plugged with rubber-lined corks, so that it was impossible for any thing to escape from the pots but through the stems and leaves of the plants. In this condition the plants, with their pots, were weighed night and morning. The corks were removed during the day, and the plants watered as their health required. Fig. 9 represents one of these plants as potted for use. Plants show no dew when kept at night in a sitting-room, a conservatory, or under a roof; and to know if, during that time, evaporation was taking place, one of the petunia-plants was kept under cover, and weighed evening and morning, with the following result: —

Date.	Evening Weight.	Morning Weight.	Loss.	Gain.	Remarks.
	grams.	grams.	grams.	grams.	
June 10 . .	240.040	238.260	1.78	0	Temp. of room, 53°. Humidity of air, 88.
" 11 . .	231.050	229.850	1.20	0	Temp. of room, 55°. Humidity of air, 70.
" 20 . .	224.130	222.910	1.22	0	
" 21 . .	233.065	231.855	1.21	0	
" 23 . .	229.595	228.335	1.26	0	
" 24 . .	233.635	232.445	1.19	0	
" 25 . .	230.575	229.145	1.43	0	
" 26 . .	220.605	219.395	1.21	0	
" 28 . .	228.355	226.975	1.38	0	
" 29 . .	214.785	213.325	1.46	0	
" 30 . .	233.825	232.295	1.53	0	

Though the result shows no regularity of loss in proportion to the whole weight, yet the unvarying decrease proves conclusively that one plant evaporated water at night, and indicates clearly that that may be the law of all, whether situated in the open air or in a room. But, to prove or disprove this supposition, one of the potted petunias and the cabbage-plant were nightly placed in the open air in the garden, with the pots thoroughly wrapped in cloth to prevent their collecting water from the soil, and with results as follows: —

Petunia-Plant.

Date.		Evening Weight.	Morning Weight.	Loss.	Gain.	Temperature of the Air.	Per cent of Humidity.	Water on the Plant.
		grams.	grams.	grams.	grams.			grams.
June	13	221.700	218.370	3.33	0 00	52°	88	–
"	14	246.800	246.550	0.25	0.00	60°	72	–
"	15	252.900	251.460	0.44	0.00	61°	88	–
"	17	242.880	242.160	0.76	0.00	62°	74	–
"	20	148.060	148.240	0.00	0.14	64°	88	–
"	21	169.125	169.165	0.00	0.35	61°	70	–
"	25	167.905	167.605	0.30	0.00	56°	66	0.52
"	26	165.305	165.105	0.20	0.00	57°	87	0.93
"	29	158.955	158.925	0.43	0.00	72°	96	0.38
July	6	158.395	158.155	0.24	0.00	83°	65	0.46

Cabbage-Plant.

Date.		Evening Weight.	Morning Weight.	Loss.	Gain.	Temperature of the Air.	Per cent of Humidity.	Water on the Plant.
		grams.	grams.	grams.	grams.			grams.
June	26	234.685	232.725	1.96	0.00	57°	87	1.80
"	27	259.005	254.775	4.23	0.00	63°	91	2.77
"	28	250.720	250.805	0.00	0.85	64°	93	4.87
"	29	238.255	237.705	0.55	0.00	72°	96	4.15

Cabbage-plant placed under tin can on a board, and the temperature reduced.

Date.	Evening Weight.	Morning Weight.	Loss.	Gain.	Temperature of the Air.	Per cent of Humidity.	Water on the Plant.
	grams.	grams.	grams.	grams.			grams.
June 30	253.145	248.925	4.22	0.00	73°	–	1.32
July 5	203.745	198 955	4.79	0.00	66°	–	0.90
" 6	173.875	173.405	0.47	0.00	51°	–	0.47

No attempt was made to determine the amount of water on the plants as dew until the 25th, when, after the morning weighing, the leaves were wiped with a soft sponge as dry as possible, and the plant re-weighed. It will be noticed, that, on nights when the plants lost weight materially, they at the same time had dew upon them. This is explained by the fact that frequently the plants stood in the garden several hours before they gathered moisture: at other times it commenced gathering very soon after they were carried out. It may be, that, in the former case, the loss was occasioned by evaporation which was not condensed. It was assumed that if the plants in the morning, with the dew upon them, weighed more than at night, it would be proof that the dew came from the general air, or moisture arising immediately from the ground; if they weighed the same, or less, it must have exhaled from and accumulated on the leaves. The result is not an absolute demonstration; but it furnishes the missing link in the chain of evidence which will enable us to deduce conclusions having all the force of principle; and, that the evidence may be distinctly seen in its proper relations, we recapitulate. The declaration is made, "that dew on plants is water of vapor of the air, which is deposited on cold objects at night, it being condensed thereby." Proof: The exhibit of the "ice-pitcher." Answer, 1st: The pitcher is at least twelve degrees colder than the surrounding air, and on the outside hygroscopically much dryer; and plants at night are, on the average, at least as warm as the air, and could not condense it. Answer, 2d: The natural office of the leaves under force and pressure of the roots is to exhale water into the air, and they do it at night, nearly regardless of temperature. Answer, 3d: Some plants exhibit dew in the daytime, if removed from the evaporating influence of the direct rays of the sun, and when the temperature of the air which surrounds them is many degrees warmer than what is technically termed the "dew-point." Answer, 4th: Plants abundantly supplied with, and containing, the largest per cent of water, and whose roots and leaves are the most active, exhibit the most dew. Answer, 5th: In time of severe drought, plants have little dew, though there is a high per cent of moisture in the air, and the nights are cold. Is it probable, then, that living, growing plants are under the control of the law exhibited by the "ice-pitcher," or has a mistake been made in the application of the principle?

But, again: the declaration is made, that dew on plants is caused by condensation, by the air, of warm vapor as it rises from the soil, and which therefore collects on plant-leaves. Proofs. 1st: The vapor of the soil is much warmer at night than the air, and would be condensed by it. 2d: Vapor from the soil is soon diffused and equalized in the whole atmosphere, but is in largest proportion when evaporation is taking place near the surface of the soil; and, other things being equal, leaves and plants near the earth have the most dew. 3d: Dew under boards, hay-cocks, and like objects on the ground, could receive it from no other source. Answers. 1st: Admitting the facts, can they annul or make inoperative the law of evaporation from the surface of leaves at night, and its condensation there? 2d: Living organisms in the action of their functions are superior to, supersede, and in a measure control, the laws of dead substance; and the subject-matter of dew relates more specifically to the living herbage of the fields. 3d: Water on the leaves of a plant on a board under a can could not have been received from the ground. The declaration is here made, that dew is the condensed exhalation of the plant. Proofs. 1st: Plants evaporate water at night. 2d: The air is colder than the plant and its exhaled vapor, and would condense it at the surface. 3d: The great preponderance of testimony is, that, other things being equal, plants with the dew on them weigh less in the morning than on the previous evening, which could not be possible if it was received from any foreign source. 4th: A plant confined at night or during the day from the general air and the ground will, if the temperature is reduced, have more dew upon it after eight hours' seclusion than all the water in the air with which it is confined. Though of the greatest importance to the cultivator of the soil, the natural phenomena we have thus investigated are so extremely subtle and delicate in their nature as to make absolute demonstration a matter of the greatest difficulty. But the facts obtained harmonize quite perfectly with the known natural laws of the absorption, retention, and radiation of heat by different kinds of matter, and the movement and changes of form of liquid water in the soil and plant. They give a rational and consistent explanation of many facts and phenomena which have been enveloped in more or less of mystery, and may direct to better or more intelligent methods in the treatment of soils and crops.

If the facts are as they appear, the soil receives no water from the air in the form of vapor, but liquid water, as rain or fine falling mist. Its evaporation is rapid; and proper means should be employed, when the supply is deficient, to conserve it for the time of sorest need. Our climate is one of extremes, and is not so favorable for the development of plant-food out of crude material as that of many countries. The mean of meteorological influences during the season gives us abundant crops; but, if the season is characterized by extremes, the crops are materially diminished, if not destroyed. Extremes of water-supply and temperature, as "cold and wet," "hot and dry," are the farmer's most formidable difficulties, and how the soil should be treated in such emergencies to avoid or mitigate their blighting effects, is a matter of much moment. In time of drought, with the soil at a high temperature, and the little water it contains rapidly moving to the surface and passing away, with crops withering and dying, can the farmer do any thing to save it for the benefit of his plants? Will tillage save it, or hasten its dissipation? Should the farmer cultivate and hoe in such emergency, or allow the soil to remain untouched? Being aware that in this matter opinions and practices differ widely, and that both extremes could not be correct, the subject has been investigated by the following method.

Six boxes were prepared of a cubic foot capacity, and were filled with soil, immediately after a rainfall of .78 of an inch, without disturbing the position of its particles or strata. The soils were taken from fields in cultivation with corn, and manured on the surface with yard-manure. Two were filled with light, sandy loam ; two with heavy, retentive loam ; and two with heavy, clayey loam or clay. After the soils had been taken into the boxes, the latter were fitted with tight bottoms, weighed, and placed in a trench, with their surfaces level with the surface of the ground. The soil in one box of each variety was well hoed every morning, and turned over to the depth of four inches, pulverizing and bringing up the moist soil to the surface. The experiment extended through seven days, — from June 26 to July 4, — and was closed in consequence of approaching rain. During the time the weather was very warm, and the sky clear of clouds both day and night, the average day temperature of the soil was 98.14°, and of the night, 70.85°. The average day temperature of the soil was 95°, its night temperature 67°, and the average humidity of the air 70. The afternoon of July 4, the boxes were all re-weighed, and the shrinkage of each variety of soil, and of that tilled and untilled, recorded. The results were as follows: The box of clay soil which was tilled lost 5 pounds, 5 ounces, or at the rate of 904 barrels per acre; the untilled clay lost 6 pounds, 14 ounces, or at the rate of 1,170 barrels per acre. The untilled clay lost 256 barrels the most per acre. The box of light sand which was tilled lost 3 pounds, 3 ounces, or 542 barrels, 12 gallons, per acre; the untilled lost 7 pounds, 8 ounces, or at the rate of 1,276 barrels per acre. The untilled lost 734 barrels the most per acre. The box of heavy loam which was tilled lost 6 pounds, 13 ounces, or at the rate of 1,106 barrels per acre; the untilled lost 7 pounds, 13 ounces, or at the rate of 1,329 barrels per acre. The untilled lost 223 barrels more than that tilled. The average diurnal loss of water by evaporation per acre was, from the tilled clay, 129 barrels, from the untilled, 167 barrels; from the tilled sand, 77 barrels, from the untilled, 182 barrels; from the tilled heavy loam, 158 barrels, and from the untilled, 189 barrels. In other words, a farmer who should as thoroughly cultivate an acre of land in similar weather, and during the same time, would if it was heavy loam save 223 barrels, if it was clay 256 barrels, and if it was sand 734 barrels of water, which would be lost if it remained uncultivated. The lesson is, cultivate the land to save crops from the dire effects of drought. The quantity of water evaporated is surprising; but it does not tell the quantity which would have been carried off if the soil had been in perfectly natural position. The bottom of the box prevented the ascension of water from the deep subsoil to take the place of that evaporated, which decreased the evaporation, and made the soil dryer than that which surrounded it.

At first thought the result of this experiment is a perfect enigma. We turn over and shake up our hay and other objects that they may dry the faster, and produce that result. But in this case the disturbance of the soil — the turning of it over, and bringing the moist soil to the surface, and exposure to the sun's rays and a temperature of nearly one hundred degrees — has retarded drying; yet it is what might have been anticipated, and in accordance with physical laws. The place of the water carried from the surface by evaporation is continually supplied from the deeper soil by capillary attraction. The water moves upward in fine tubes formed by the particles of soil: if the soil is compact, as when beaten down by rain, the tubes are perfect, and the water moves upward to the surface rapidly; but if the tubes are broken up, the soil particles being separated by cultivation, the subsoil water must rise slowly, although the immediate surface is very dry. Heat also has its influence. Solid bodies transmit it more rapidly, and hold it longer, than those which are light and porous. In this case, the boxes with perfect capillary tubes and the most heat (the untilled) must evaporate the fastest. The average temperature of the untilled soil at a depth of six inches was three degrees warmer than that of the tilled. This investigation was repeated three times between recurring rains, a change being made in each case of the soil tilled, and with identical results in the proportion evaporated by the tilled and untilled; but the total quantity lost varied with the change of temperature.

But drought is not the only water difficulty with which the farmer has to contend. Superabundance of the liquid is as injurious as its scarcity, and one of these extremes is liable to succeed the other. Retentive soils, drained or undrained, may by great and constant rains become so completely waterclogged as to retard the growth of crops by suffocating or drowning the roots. In such an emergency can any thing be done to give immediate relief? Will tillage do it? We have just seen that this preserves the water; but then we were at the other extreme, or far removed from the point of saturation; and it may be possible that a saturated soil could be greatly relieved, to a certain point, by breaking its rain-formed crust, and roughening or increasing its surface space for the action of the sun's rays. An investigation was therefore made in this direction. The boxes which have been described were taken from the trench, and drenched with water beyond the point of saturation, and allowed to stand in the air until percolation ceased: they were then weighed, the soil in one of each variety turned over, and loosened to the depth of four inches, and the boxes replaced. The trial continued six days, during which time they were weighed each morning, but not tilled. The result was, that the first day the sand tilled lost 1 pound, 3 ounces; the untilled, 10 ounces. The heavy loam tilled lost 1 pound, 14 ounces; the untilled lost nothing. The tilled clay lost 1 pound, 3 ounces; the untilled, 4 ounces. From the first day there was a proportional increase of the loss from the untilled, which, before the close of the trial by rain, materially exceeded that of the tilled in the clay. The entire loss in each was: Tilled sand, 5 pounds, 13 ounces; untilled sand, 4 pounds. Heavy loam, tilled, 6 pounds, 15 ounces; untilled, 4 pounds, 11 ounces. Clay, tilled, 4 pounds, 4 ounces; untilled, 5 pounds, 15 ounces. It is clear, then, that, in open field-culture, such cultivation gives relief from both these extremes; but it is obvious, that, in the latter case, tillage should not commence until the soil so relieved of its surplus water, that it will not be solidified is by the incident pressure.

For the purposes of this report these investigations were assumed to be completed on the 30th of November; but they will be continued regularly to the end of the year, so far as waterfall and percolation are concerned; and at intervals the temperature of the soil will be examined, in forest and field, beneath the frost-crust if any exists. Their peculiar nature has demanded uninterrupted care, attention, and labor, not only by day, but by night, not only near the homestead, but abroad in the open field and forest, which could not be delegated to assistants. They have consumed a great amount of time difficult to spare from other duties; but if any facts have been found which are new to science, or any method discovered to make old facts more practically useful in the treatment of soils and plants, the compensation will be ample. With this series, these and kindred investigations should be considered not as completed, but only commenced, and should be persistently continued year after year; and it is earnestly to be hoped, that, in the interest of an improved and advanced agriculture, the means may be provided to carry forward and make the work of the station permanent.

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OF

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1878.

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WILLIAM S. CLARK, Ph.D., LL.D.,
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HENRY H. GOODELL, M.A.,
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HENRY W. PARKER, M.A.,
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Lecturer on Veterinary Science and Practice.

GEORGE MONTAGUE,
Instructor in Book-keeping.

SAMUEL T. MAYNARD, B.S.,
Gardener, and Assistant Professor of Horticulture.

ANDRE A. SOUTHWICK, B.S., Farm Superintendent.

Graduates of 1878.[1]

Baker, David Erastus	Franklin.
Boutwell, Willie Levi (Boston Univ.) .	Leverett.
Brigham, Arthur Amber . . .	Marlborough.
Choate, Edward Carlisle (Boston Univ.)	Cambridge.
Clark, Xenos Young (Boston Univ.) .	San Francisco, Cal.
Coburn, Charles Francis (Boston Univ.)	Lowell.
Foote, Sandford Dwight (Boston Univ.).	Springfield.
Hall, Josiah Newhall (Boston Univ.) .	Revere.
Howe, Charles Sumner (Boston Univ.) .	Boston.
Hubbard, Henry Francis (Boston Univ.)	New Rochelle, N.Y.
Hunt, John Franklin	Amherst.
Koch, Henry Gustave Heath (Boston University)	New-York City.
Lovell, Charles Otto (Boston Univ.) .	Amherst.
Lyman, Charles Elihu (Boston Univ.) .	Middlefield, Conn.
Myrick, Lockwood	Concord.
Osgood, Frederick Huntington (Boston University)	Cambridge.
Spofford, Amos Little (Boston Univ.) .	Georgetown.
Stockbridge, Horace Edward (Boston University)	Amherst.
Tuckerman, Frederick (Boston Univ.) .	Boston.
Washburn, John Hosea (Boston Univ.) .	Bridgewater.
Woodbury, Rufus Putnam (Boston Univ.)	Norwalk, Conn.
Total	21

Senior Class.

Dickinson, Richard Storrs (Boston Univ.)	Amherst.
Green, Samuel Bowdlear (Boston Univ.)	Chelsea.
Howard, Joseph Clark	West Bridgewater.
Knox, Reuben	New-York City.
Sherman, Walter Alden (Boston Univ.) .	Lowell.
Smith, George Parmenter (Boston Univ.)	Sunderland.
Swan, Roscoe Willard (Boston Univ.) .	Framingham.
Vaill, William Henry	Enfield.
Waldron, Hiram Edmund Baylies . .	Rochester.
Total	9

[1] The Annual Report, being made in January, necessarily includes parts of two academic years; and the catalogue gives the names of such students as have been connected with the College during any portion of the year 1878.

Junior Class.

Endicott, George	New-York City.
Fowler, Alvan Luther	Westfield.
Gladwin, Frederick Eugene	Westfield.
Hall, Alfred Sigourney	Revere.
Lee, William Gilbert	Amherst.
McQueen, Charles Manjie	Longmeadow.
Parker, William Colverd (Boston University)	Wakefield.
Ripley, George Arms	Worcester.
Rudolph, Charles (Boston University)	New Haven, Conn.
Stone, Almon Humphrey	Phillipston.
Wood, Lewis	West Upton.
Total	11

Sophomore Class.

Brooks, William Cummings	Boston.
Clark, Wallace Valentin	Amherst.
Fairfield, Frank Hamilton	Waltham.
Flint, Charles Louis, jun.	Boston.
Hall, Albert Oliver	Chelsea.
Hills, Joseph Lawrence	Boston.
Hobbs, John Folsom	North Hampton, N.H.
Howe, Elmer Dwight	Marlborough.
Howe, Winslow Brigham	Marlborough.
Perry, Alfred Dwight	Worcester.
Peters, Austin	Boston.
Sattler, Hermann Charles	Baltimore, Md.
Whitaker, Arthur	Needham.
Wilcox, Henry Harrison	Nawiliwili, S.I.
Wolfe, Walter Madson	Montclair, N.J.
Wood, Wilbur	West Upton.
Total	16

Freshman Class.

Abercrombie, Fred Norman	Boston.
Allen, Francis Sherwin	Medfield.
Allen, George Dickinson	Amherst.
Aplin, George Thomas	East Putney, Vt.
Beach, Charles Edward	Hartford, Conn.
Bingham, Eugene Percyval	Fitchburg.

Bishop, William Herbert	Diamond Hill, R.I.
Bowman, Charles Abel	Billerica.
Boynton, Charles Enoch	Groveland.
Brodt, Harry Snowden	Dansville, N.Y.
Brown, Charles Henry	Taunton.
Carr, Walter Frank	Clinton.
Casparian, Gregory	Nicomedia, Turkey.
Chandler, Everett Sawyer	Coldwater, Mich.
Chandler, Willard Mayne	South Natick.
Chapin, Henry Edgerton	Springfield.
Chase, Harry Kirk	Boston.
Chipman, Frank Ellsworth	Beverly.
Clarke, Henry Little	New Bedford.
Clay, Cassius Morey	Westminster, Vt.
Cochran, Robert Armstrong	Maysville, Ky.
Comins, William Henry	North Hadley.
Crafts, George Eben	North Hadley.
Currier, George Francis	Amherst.
Cutter, John Ashburton	Cambridge.
Damon, Samuel Chester	Lancaster.
Delano, Julio Joaquin	Valparaiso, Chili.
Deuel, Frank Dennis	Amherst.
Doyle, John Joseph	Sunderland.
Dutton, Charles Kitteridge	Hatfield.
Fish, Charles Sumner	South Boston.
Floyd, Charles Walter (Boston Univ.)	Boston.
Goodale, David	Marlborough.
Gowdy, Harry Morgan	Westfield.
Harris, Louis Lincoln	Westfield.
Harris, Richard Brown	Boston.
Hashiguchi, Boonzo	Tokio, Japan.
Hillman, Charles Dexter	Hardwick.
Hill, Charles Henry	North Amherst.
Holmes, Samuel Judd	Montclair, N.J.
Howard, Joseph Henry	Hyannis.
Howe, George Dickinson	North Hadley.
Jackson, Andrew	San Francisco, Cal.
Johnson, Frank Prescott	Waltham.
Jones, Edward Spaulding	Worcester.
Jones, Frank Waldo	South Scituate.
Jones, Nathaniel Nelson	Georgetown.
Joyner, Frank Hall	North Egremont.
Kenfield, Charles Robert	Amherst.
Kingman, Morris Bird	Amherst.

Kinney, Burton Arial . . . . Lowell.
Knowles, William Fletcher, jun. . . North Cambridge.
Krauss, Alonzo Augustus . . . Boston.
Leonard, Arthur (Boston University) . Rock.
Livermore, Nathaniel Lyon . . . Clinton City, Io.
Lindsey, Frank B. . . . . Clayton.
Luques, Edward Childs . . . . Biddeford, Me.
Manton, William James . . . Line Rock, R.I.
May, Frederick Goddard . . . Boston.
Meade, William George . . . Springfield.
Miller, Willie Smith . . . . South Hadley.
Morse, William Austin . . . . Boston.
Myrick, Herbert . . . . . Concord.
Paige, James Breckenridge . . . Prescott.
Parsons, Howard Albert . . . Enfield, Conn.
Perkins, Charles Brookhouse . . . Salem.
Perkins, Dana Edson . . . . Lynn.
Plumb, Charles Sumner . . . . Westfield.
Putnam, Henry Anderson . . . Worcester.
Rawson, Edward Briggs . . . Brooklyn, L.I.
Rhodes, William Herbert . . . Boston.
Shiverick, Asa Frank . . . . Wood's Holl.
Smith, Hermann Kellogg . . . Hadley.
Smith, Hiram Fred Markley . . . Cleveland, O.
Spalding, Abel Walter . . . . Billerica.
Stone, Winthrop Ellsworth . . . Amherst.
Taft, Levi Rawson (Boston University) . Mendon.
Taylor, Alfred Howland . . . Yarmouth.
Taylor, Frederick Patterson . . . Boston.
Thurston, Wilbur Herbert . . . Upton.
Warner, Clarence Duane (Boston Univ.) Granby.
Wheeler, Henry Lewis . . . . Great Barrington.
Wheelock, Victor Lamont . . . North Amherst.
Wilder, John Emery . . . . Lancaster.
Willard, Daniel . . . . . North Hartland, Vt.
Williams, James Stoddard . . . Glastonbury, Conn.
Wilmarth, Frederick Augustus (Boston University) . . . . . Upton.
Windsor, Joseph Libbey . . . Grafton.
Total 88

Select Class.

Bristol, Frank Edwin . . . . Harwinton, Conn.
Chittenden, Edgar Davis . . . Sunderland.

Codman, Francis	Brookline.
Courtney, Matthew	Amherst.
Hawley, Amasa Stetson	Hadley.
McKenna, James Peter	Amherst.
Porter, Royal Luther	Brooklyn, L.I.
Smith, Benjamin Salter	New-York City.
Smith, John Leland	Barre.
Warner, William Edward	Newton.
Wing, Edgar Russell	Needham.
Young, Charles Elisha	Amherst.
Zabriskie, Frank Hunter	New-York City.
Total	13

Post-Graduates.

Benson, B. S., David Henry (Boston University)	Bridgewater.
Bragg, B. S., Everett Burt	Amherst.
Clark, B. S., Atherton (Boston Univ.)	Amherst.
Howe, B. S., Charles Sumner (Boston University)	Boston.
Hunt, B. S., John Franklin	Amherst.
Lovell, M. A., Henry Lyman (Amherst College)	Amherst.
Stockbridge, B. S., Horace Edward (Boston University)	Amherst.
Total	7

Summary.

Post-Graduates	7
Graduates of 1878	21
Senior Class	9
Junior Class	11
Sophomore Class	16
Freshman Class	88
Select Class	13
Total	165
Deduct for names inserted twice	3
Total	162

GRADUATES.

Allen, Gideon H., '71, Humboldt, Allen County, Kan., Agent Adams Express Company.

Bagley, David A., '76, Franklin, Brakeman, N. Y. & N. E. R.R.

Baker, David E., '78, Franklin, Travelling Agent.

Barrett, Joseph F., '75, 3 Park Place, New-York City, Travelling Salesman, W. H. Bowker & Co.

Barri, John A., '75, 13 Norfolk Street, Cambridgeport, Clerk, Metropolitan National Bank, Boston.

Bassett, Andrew L., '71, New-York City, Clerk, Vermont C. R.R. & Steamship Co.

Bell, Burleigh C., '72, Arcata, Humboldt County, Cal., Druggist.

Bellamy, John, '76, Brookline, Clerk.

Benedict, John M., '74, Bethel, Conn., Student of Medicine.

Benson, David H., '77, Boston, Superintendent, Fertilizer-Works of W. Bradley & Co.

Birnie, William P., '71, Springfield, Conductor, Conn. Central Railroad.

Blanchard, William H., '74, Westminster, Vt., Farmer.

Boutwell, Willie Levi, '78, Leverett, Farmer.

Bowker, William H., '71, 43 Chatham Street, Boston, Manufacturer and Importer of Fertilizers.

Bragg, Everett B., '75, 43 Chatham Street, Boston, Consulting Chemist, W. H. Bowker & Co.

Brett, William F., '72, Fall River, Merchant.

Brewer, Charles, '77, North Wilbraham, Teacher.

Brigham, Arthur A., '78, Marlborough, Farmer.

Brooks, William P., '75, Sapporo, Japan, Professor of Agriculture, and Farm Superintendent, Agricultural College.

Bunker, Madison, '75, 3 Park Place, New-York City, Dealer in Fertilizers, W. H. Bowker & Co.

Callender, Thomas R., '75, Grantville, Florist.

Campbell, Frederick G., '75, West Westminster, Vt., Farmer.

Caswell, Lilley B., '71, Athol, Civil Engineer and Farmer.

Chandler, Edward P., '74, Abilene, Kan., Farmer.

Chickering, Darius O., '76, Enfield, Farmer.

Choate, Edward C., '78, Cambridge, no business.

Clark, Atherton, '77, Amherst, Post-Graduate, Agric. College.
Clark, John W., '72, Amherst, Nurseryman, Agricultural College.
Clark, Xenos Y., '78, San Francisco, Cal., Teacher.
Clay, Jabez W., '75, 43 Chatham Street, Boston, Dealer in Fertilizers, W. H. Bowker & Co.
Coburn, Charles F., '78, Lowell, Assistant Editor, "Lowell Daily Citizen."
Cowles, Frank C., '72, Amherst, Farmer.
Cowles, Homer L., '71, Hadley, Farmer.
Curtis,[1] Wolfred F., '74.
Cutter, John C., Sapporo, Japan, Professor of Anatomy, Physiology, and Hygiene, Sapporo Agricultural College.
Deuel, Charles F., '76, Amherst, Druggist.
Dodge, George R., '75, 43 Chatham Street, Boston, Superintendent Fertilizer Factory, Brighton, W. H. Bowker & Co.
Dyer, Edward N., '72, Kohala, S.I., Teacher.
Easterbrook, Isaac H., '72, Diamond Hill, R.I., Farmer.
Eldred, Frederick C., '73, New-York City, Insurance Agent.
Ellsworth, Emory A., '71, Ashfield, Farmer.
Fisher, Jabez F., '71, Fitchburg, Local Freight Cashier, Fitchburg Railroad.
Fiske, Edward R., '72, Philadelphia, Penn., Merchant, Folwell & Brothers.
Flagg, Charles O., '72, Diamond Hill, R.I., Farmer.
Foote, Sandford D., '78, Springfield, no business.
Fuller, George E., '71, Greenfield, Civil Engineer.
Grover, Richard B., '72, Andover, Student of Theology.
Guild, George W. M., '76, Boston, no business.
Hague, Henry, '75, Manville, R.I., Clergyman.
Hall, Josiah N., '78, Revere, Medical Student, Harvard University.
Harwood, Peter M., '75, Barre, Farmer.
Hawley, Frank W., '71, Trucking business, F. Hamlin.
Hawley, Joseph M., '76, Berlin, Wis., Banker's Clerk.
Herrick, Frederick St. C., '71, Methuen, Farmer.
Hibbard, Joseph R., '77 Stoughton, Wis., Farmer.
Hitchcock, Daniel G., '74, Warren, Merchant.
Hobbs, John A., '74, Bloomington, Neb., Farmer.
Holmes, Lemuel LeB., '72, Mattapoisett, Lawyer.
Howe, Charles S., '78, Amherst, Post-Graduate, Agric. College.
Howe, Waldo V., '77, Framingham, Clerk, Framingham Brick Co.
Hubbard, Henry F., '78, 93 Duane Street, New-York City, Office, James E. Halsey.

[1] Died Nov. 8, 1878, of inflammation of the brain.

Hunt, John F., '78, Amherst, Post-Graduate, Agricultural College.
Kendall, Hiram, '76, Providence, R.I., Chemist and Superintendent, Kendall Manufacturing Company.
Kimball, Francis E., '72, Worcester, Clerk, B. B. & G. R.R.
Knapp, Walter H., '75, Grantville, Florist.
Koch, Henry G. H., '78, Wurmdorf, Hanover, Germany, Farmer.
Ladd, Thomas H., '76, Boston, Student.
Lee, Lauren K., '75, Grinnell, Io., Hotel Clerk.
Leland, Walter S., '73, Sherborn, Farmer.
Leonard, George, '71, Springfield, Lawyer.
Libby, Edgar H., '74, New-York City, Editor, "American Agriculturist."
Livermore, Russell W., '72, Toledo, O., Lawyer, firm of Bissell & Gorrill.
Lovell, Charles O., '78, Amherst, Photographer.
Lyman, Asahel H., '73, Manistee, Mich., Druggist.
Lyman, Charles E., '78, Middlefield, Conn., Farmer.
Lyman,[1] Henry, '74.
Lyman, Robert W., '71, Boston, Law Student, Boston University.
Mackie, George, '72, Attleborough, Physician.
Macleod, William A., '76, Boston, Student of Law, Boston University, Office of Dana & Harding.
Mann, George H., '76, Sharon, Manufacturer.
Martin, William E., '76, Clerk, Excelsior, Minn.
Maynard, Samuel T., '72, Amherst, Assistant Professor Horticulture, Agricultural College.
McConnel, Charles W., '76, Woonsocket, R.I., Student of Dentistry.
Miles, George M., '75, Miles City, Montana, Judge U. S. Comm. and Raiser of Sheep.
Mills, George W., '73, Medford, Physician.
Minor, John B., 73, New Britain, Conn., Clerk, Union Mfg. Co.
Montague, Arthur H., '74, South Hadley, Farmer.
Morey, Herbert E., '72, 49 Haverhill Street, Boston, Clerk, Morey & Smith.
Morse, James H., '71, Salem, Civil Engineer.
Myrick, Lockwood, '78, Concord, Law Student, Office, Hon. E. R. Hoar, Boston.
Nichols, Lewis A., '71, Chelsea, Civil Engineer.
Norcross, Arthur D., '71, Monson, Farmer.
Nye, George E., 77, Sandwich, Farmer.
Osgood, Frederick H., '78, Edinburgh, Scotland, Student of Veterinary.

[1] Died Jan. 8, 1879, of pneumonia, at Middlefield, Conn.

Otis, Harry P., '75, Leeds, Supt., Northampton Emery Wheel Co.
Page, Joel B., '71, Conway, Farmer.
Parker, George A., '76, Poughkeepsie, N.Y., Gardener, Vassar Coll.
Parker, George L., '76, Dorchester, Florist.
Parker, Henry F., '77, Bristol, R.I., Draughtsman.
Peabody, William R., '72, Atchison, Kan., General Agent, A. T. & S. F. R.R.
Penhallow, David P., '73, Sapporo, Japan, Professor of Chemistry and Botany, Agricultural College.
Phelps, Charles H., '76, South Framingham, Florist.
Phelps, Henry L., '74, Northampton, Dealer in Fertilizers.
Porter, William H., '76, Hatfield, Farmer.
Porto, Raymundo M. da S., '77, Para, Brazil, Planter.
Potter, William S., '76, LaFayette, Ind., law firm of W. D. Wallace.
Renshaw, James B., '73, Oberlin, O., Student of Theology.
Richmond, Samuel H., '71, Boston, Professor of Penmanship, French's Business College.
Rice, Frank H., '75, Aurora, Nev., Clerk.
Root, Joseph E., '76, Hartford, Conn., Assistant Superintendent, Walnut Hill Asylum.
Russell, William D., '71, Turner's Falls, Chemist.
Salisbury, Frank B., '72, Diamond Fields, South Africa, Clerk.
Sears, John M., '76, Ashfield, Farmer.
Shaw, Elliot D., '72, Holyoke, Florist.
Simpson, Henry B., '73, Centreville, Md., Farmer.
Smead, Edwin, '71, 83 Edmonson Avenue, Baltimore, Md., Dealer in Coal.
Smith, Frank S., '74, Hampden, Woollen Manufacturer.
Smith, Thomas E., '76, West Chesterfield, Manufacturer.
Snow, George H., '72, Leominster, Farmer.
Somers, Frederick M., '72, San Francisco, Cal., Editor "Argonaut."
Southmayd,[1] John E., '77.
Southwick, Andre A., '75, Amherst, Farm Supt., Agric. College.
Sparrow, Lewis A., '71, 43 Chatham Street, Boston, Chemist, W. H. Bowker & Co.
Spofford, Amos L., '78, Georgetown, Student of Medicine, Harvard University.
Stockbridge, Horace E., '78, Amherst, Post-Graduate, Agric. Coll.
Strickland, George P., '71, Stillwater, Mich., Machinist, Seymour, Sabin, & Company.
Taft, Cyrus A., '76, Whitinsville, Machinist.

[1] Died Dec. 11, 1878, of consumption, at Minneapolis, Minn.

Thompson, Edgar E., '71, Brockton, Druggist.
Thompson, Samuel C., '72, Natick, Civil Engineer.
Tucker, George H., '71, Dakota, Farmer and Sheep-Raiser.
Tuckerman, Frederick, '78, Tunbridge Wells, Eng., travelling in Europe.
Urner, George P., '76, 54 Leonard Street, New-York City, Superintendent, American Ruffle-Works.
Wakefield, Albert T., '73, Peoria, Ill., Physician.
Ware, Willard C., '71, 32 North Street, Boston, Salesman, Oak Hall.
Warner, Seth S., '73, San Francisco, Cal., Clerk.
Washburn, John H., '78, North Raynham, Teacher.
Webb, James H., '73, New Haven, Conn., Attorney-at-Law.
Wellington, Charles, '73, Washington, D.C., Chemist, U. S. Agricultural Department.
Wells, Henry, '72, Rochester, N.Y., Clerk.
Wetmore, Howard G., '76, New-York City, Student of Medicine.
Wheeler, William, '71, Sapporo, Japan, Pres. Agric. College.
Whitney, Frank LeP., '71.
Whitney, William C., '72, Boston, Architect.
Williams, John E., '76, Amherst, Editor, "Record."
Winchester, John F., '75, Lawrence, Veterinary Surgeon.
Wood, Frank W., '73, Providence, R.I., Civil Engineer.
Woodbury, Rufus P., '78.
Woodman, Edward E., '74, Jersey City, N.J., Florist, Peter Henderson.
Wyman, Joseph, '77, Arlington, Farmer.
Zeller, Harrie McK., '74, Hagerstown, Md., Farmer.

COURSE OF STUDY AND TRAINING.

FRESHMAN YEAR.

First Term. — Chemistry, 5 hours each week; Human Anatomy, Physiology, and Hygiene, 3 hours; Algebra, 5 hours; English, 2 hours; Agriculture, 2 hours; Declamation, 1 hour; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term. — Inorganic Chemistry, 2 hours; Botany, 3 hours; Geometry, 5 hours; Agriculture, 3 hours; English, 2 hours; Elocution, 1 hour; Freehand Drawing, 3 hours; Military Drill, 3 hours.

Third Term. — Systematic Botany, 4 hours; Geometry, 4 hours; French, 5 hours; Elocution, 2 hours; Agriculture, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

SOPHOMORE YEAR.

First Term. — Systematic Botany, 3 hours each week; Geometry, 4 hours; French, 5 hours; English, 1 hour; Agriculture, 2 hours; Declamation, 1 hour; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term. — Geology, 3 hours; Trigonometry, 5 hours; French, 4 hours; English, 1 hour; Agriculture, 3 hours; Declamation, 1 hour; Drawing, 3 hours; Military Drill, 3 hours;

Third Term. — Zoölogy, 5 hours; Surveying, 5 hours; Agriculture, 2 hours; English, 3 hours; Declamation, 1 hour; Levelling, 3 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

JUNIOR YEAR.

First Term. — German, 5 hours each week; Mechanics, 5 hours; Entomology, 2 hours; Market-Gardening, 2 hours; Horticulture, 2 hours; Military Drill, 3 hours; Manual Labor, 6 hours.

Second Term. — German, 4 hours; Physics, 5 hours; Practical Chemistry, 9 hours; Drawing, 3 hours; Agricultural Debate, 1 hour; Declamation, 1 hour; Military Drill, 3 hours.

Third Term. — German, 4 hours; Astronomy, 4 hours; Practical Chemistry, 9 hours; Declamation, 1 hour; Stock and Dairy Farming, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

SENIOR YEAR.

First Term. — English Literature, 4 hours each week; Practical Chemistry, 7 hours; Book-keeping, 2 hours; Roads and Railroads, 3 hours; Military Science, 2 hours; Original Declamation, 1 hour; Military Drill, 3 hours.

Second Term. — English Literature, 4 hours; Theses, 1 hour; Mental Science, 4 hours; Agriculture, 2 hours; Veterinary Science, 3 hours; Military Science, 2 hours; Microscopy, 4 hours; Military Drill, 3 hours.

Third Term. — Veterinary Science, 2 hours; Military Science, 2 hours; Botany, 3 hours; Landscape-Gardening, 3 hours; Rural Law, 1 hour; Lectures on English Language, 2 hours; Theses, 1 hour; Agricultural Review, 4 hours; Military Drill, 4 hours.

LIST OF BOOKS.

BOTANY AND HORTICULTURE.

Gray's Lessons, Manual and Botanical Text-Book.
Sachs' Text-Book of Botany, Morphological and Physiological.
Masters' Henfrey's Elementary Course of Botany.
Berkeley's Introduction to Cryptogamic Botany.
Cooke's Microscopic Fungi.
Carpenter's The Microscope and its Revelations.
Flint's Grasses and Forage-Plants.
Downing's Fruits and Fruit-Trees of America.
Thomas's American Fruit-Culturist.
Hoope's Book of Evergreens.
Strong's Grape-Culture.
Henderson's Practical Floriculture.
Fuller's Forest-Tree Culturist.
Williams's Choice Stove and Greenhouse Plants.
Helmsley's Hand-Book of Hardy Trees, Shrubs, and Herbaceous Plants.
Loudon's Cyclopædia of Plants.
Loudon's Cyclopædia of Gardening.
Lindley and Moore's Treasury of Botany.
Kemp's Landscape-Gardening.
Downing's Landscape-Gardening.

AGRICULTURE.

Johnson's How Crops Grow.
Johnson's How Crops Feed.
Pendleton's Scientific Agriculture.

Hyde's Lowell Lectures on Agriculture.
Liebig's Natural Laws of Husbandry.
French's Farm Drainage.
Flint's Milch Cows and Dairy Farming.
Sturtevant's, The Dairy Cow, — Ayrshire.
Waring's Handy-Book of Husbandry.
Henderson's Gardening for Profit.
Donaldson's British Agriculture.
Morton's Cyclopædia of Agriculture.
Low's Domesticated Animals.
Flint's Reports on the Agriculture of Massachusetts.
Agricultural Gazette and Gardener's Chronicle, London, Eng.

CHEMISTRY AND GEOLOGY.

Bolton's Hooker's Chemistry.
Watt's Fownes's Manual of Elementary Chemistry.
Sibson's Agricultural Chemistry.
Caldwell's Agricultural Chemical Analysis.
Smith's Classen's Quantitative Analysis.
Nason's Woehler's Chemical Analysis.
Will's Analytical Chemistry.
Johnson's Fresenius' Qualitative and Quantitative Analysis.
Liebig's Ernährung der Pflanzen.
Wolff's Landwirthschaftliche Analyse.
Hoffman's Ackerbau Chemie.
Watt's Chemical Dictionary.
Dana's Mineralogy.
Hitchcock's Geology.
Dana's Text-Book and Manual of Geology.

VETERINARY SCIENCE AND ZOÖLOGY.

Fleming's Chauveau's Comparative Anatomy of Domesticated Animals.
Dalton's Human Physiology.
Cleland's Animal Physiology.
Williams's Principles of Veterinary Surgery.
Williams's Principles of Veterinary Medicine.
Gamgee's On Horse-shoeing and Lameness.
Gamgee's On Domestic Animals in Health and Disease.
Armitage's Clater's Cattle Doctor.
Youatt's Treatises on the Domestic Animals.
Blaine's Veterinary Art.
Morton's Manual of Pharmacy.
Wood and Bache's United-States Dispensatory.

Harbison's Elementary Zoölogy.
Lankester's Advanced Zoölogy.
Packard's Guide to the Study of Insects.
Harris's Insects Injurious to Vegetation.
Westwood's Principles of Classification of Insects.
Baird's Mammals of North America.
Murray's Geographical Distribution of Mammals.
Samuels's Birds of New England.
Cobbold's Entozoa.
Denney's Parasitic Insects.
Moquin-Tandon's Manual of Medical Zoölogy.

MATHEMATICS, PHYSICS, AND CIVIL ENGINEERING.

Wells's Algebra.
Loomis's Geometry and Conic Sections.
Murray's Land-Surveying.
Greenleaf's Trigonometry.
Gilmore's Roads and Railroads.
Hill's Stewart's Natural Philosophy.
Everett's Deschanel's Natural Philosophy.
Atkinson's Ganot's Physics.
Peabody's Astronomy.
Loomis's Meteorology.

ENGLISH, FRENCH, AND GERMAN.

Hart's Composition.
Fowler's English Grammar.
Shaw's Complete Manual of English Literature.
Chambers's Cyclopædia of English Literature.
Morley's English Writers.
Taine's History of English Literature.
Languillier and Monsanto's French Grammar.
Spiers and Surenne's French Dictionary.
Glaubensklee's German Grammar.
Adler's German Dictionary.

The French and German books for translation are changed every year, selections being made from recent literary and scientific publications.

MENTAL, MORAL, AND SOCIAL SCIENCE.

Haven's Mental Science.
Hickok's Empirical Psychology.
Porter's Elements of Intellectual Science.
Seelye's Schwegler's History of Philosophy.

Hickok's Moral Science.
Haven's Moral Philosophy.
Hopkins's Law of Love, and Love as Law.
Chadbourne's Natural Theology.
Walker's Science of Wealth.
Perry's Political Economy.
Carey's Principles of Social Science.
Stirling's Bastiat's Harmonies of Political Economy.

MILITARY SCIENCE.

Lippitt's Tactical Use of the Three Arms.
Lippitt's Treatise on Intrenchments.
Lippitt's Field Service in Time of War.
Lippitt's Special Operations of War.
Welcker's Military Lessons.
Upton's Infantry Tactics.
United-States Artillery Tactics.
Kent's Commentaries.
Benet's Courts-Martial.
Holt's Digest of Opinions.
Halleck's International Law.
Regulations of United-States Army.
United-States Ordnance Manual.
General and State Militia and Volunteer Laws.
Scott's Military History.
Histories of Revolution, War of 1812, Mexican War, and Rebellion.
Public Documents, and Reports of Naval and Military Departments.

CALENDAR FOR 1879.

The third term of the collegiate year begins March 27, and continues till June 25.

The first term begins Aug. 28, and continues till Nov. 27.

The second term begins Dec. 11, and continues till March 11, 1880.

There will be an examination of candidates for admission to the College, at the Botanic Museum, at nine A.M., Tuesday, June 24, and also on Thursday, Aug. 28.

The Farnsworth Prize Declamations take place Monday evening, June 23.

The public examination of the graduating class for the Grinnell Prize for excellence in agriculture, and the examination of the other classes in the studies of the term, will take place on Tuesday forenoon, June 24.

The exercises of Graduation Day occur June 25.

ADMISSION.

Candidates for admission to the Freshman Class are examined, orally and in writing, upon the following subjects: English Grammar, Geography, Arithmetic, Algebra through simple equations, and the History of the United States.

Candidates for higher standing are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the College until he is fifteen years of age; and every student is required to furnish a certificate of good character from his late pastor or teacher, and to give security for the prompt payment of term-bills. Tuition and room-rent must be paid in advance, at the beginning of each term; and bills for board, fuel, &c., at the end of every term.

The regular examinations for admission are held at the Botanic Museum, at nine o'clock A.M., Tuesday, June 24, and on Thursday, Aug. 28; but candidates may be examined and admitted at any other time in the year.

EXPENSES.

Tuition	$25 00 per term.
Room-rent	5 00 to 10 00 "
Board	2 50 to 3 50 per week.
Expenses of chemical laboratory to students of practical chemistry	10 00 per term.
Public and private damages, including value of chemical apparatus destroyed or injured,	at cost.
Annual expenses, including books	250 00 to 350 00.

REMARKS.

The regular course of study occupies four years; and those who complete it receive the degree of Bachelor of Science, the diploma being signed by the Governor of Massachusetts, who is president of the corporation.

Regular students of the College may also, on application, become members of Boston University, and upon graduation receive its diploma in addition to that of the College, thereby becoming entitled to all the privileges of its alumni.

The instruction in the languages is intended to qualify the graduates to write and speak English with correctness and effect, and to translate German and French with facility. The scientific course is as thorough and practical as possible, and every science is taught with constant reference to its application to agriculture and the wants of the farmer.

The instruction in agriculture and horticulture includes every branch of farming and gardening which is practised in Massachusetts, and is both theoretical and practical. Each topic is discussed thoroughly in the lecture-room, and again in the plant-house or field, where every student is obliged to labor. The amount of required work, however, is limited to six hours per week, in order that it may not interfere with study. Students are allowed to do additional work for wages, provided they maintain the necessary rank as scholars.

Indigent students are allowed to do such work as may offer about the College or farm buildings, or in the field; but it is hardly possible for one to earn more than from fifty to one hundred dollars per annum besides performing other duties. So far as is consistent with circumstances, students will be permitted to select such varieties of labor as they may for special reasons desire to engage in.

Those who pursue a select course attend recitations and lectures with the regular classes; but those properly qualified, who desire special instruction in botany, chemistry, civil engineering, veterinary science, agriculture or horticulture, may make private arrangements with the officers having charge of these departments.

An expenditure of from ten to fifty dollars is necessary to provide furniture, which may be purchased at reasonable rates, either new or second-hand. At the beginning of the second term of attendance each student is required to provide himself with the full uniform prescribed for the battalion of Agricultural Cadets, the cost of which is about thirty dollars.

On Sundays students are required to attend church in the forenoon, and invited to join a class for the study of the Bible in the afternoon. They will be permitted to select their place of attendance from among the churches in the town, of the following denominations; viz., Baptist, Congregational, Episcopalian, Methodist, and Roman-Catholic.

POST-GRADUATE COURSE.

Graduates of colleges and scientific schools may become candidates for the degree of Doctor of Science, or Doctor of Philosophy, from the College or from the University, and pursue their studies under the direction of Professor Goessmann in chemistry, or other members of the faculty in their respective departments.

BOOKS, APPARATUS, AND SPECIMENS IN NATURAL HISTORY.

The Library of the College contains about fifteen hundred volumes. Among them are several valuable sets of cyclopædias, magazines, and newspapers, reports of agricultural societies and state boards of agriculture, and many standard works on agriculture and horticulture. There are also many useful works of reference in chemistry, botany, surveying, and drawing.

The faculty and students also have the privilege of drawing books from the excellent library of Amherst College, which contains over thirty thousand volumes.

The State Cabinet of specimens, illustrating the geology and natural history of Massachusetts, has been removed from Boston to the College, and is of much value for purposes of instruction.

The Knowlton Herbarium contains more than ten thousand species of named botanical specimens, besides a large number of duplicates. The Botanic Museum is supplied with many interesting and useful specimens of seeds, woods, and fruit-models. There is also a set of diagrams illustrating structural and systematic botany, including about three thousand figures.

About fifteen hundred species and varieties of plants are cultivated in the Durfee Plant-House, affording much pleasure and information to students and visitors.

The very extensive, and in some respects unsurpassed, collections in geology, mineralogy and natural history, ethnology and art, belonging to Amherst College, are accessible to members of the Agricultural College.

The chemical, engineering, and military departments of the Agricultural College are well furnished.

The class in microscopy has the use of seven of Tolles's best compound microscopes, with objectives from four inches to one-eighth of an inch in focal distance, and a variety of eye-pieces.

PRIZES.

FARNSWORTH RHETORICAL MEDALS.

Isaac D. Farnsworth, Esq., of Boston, has generously provided a fund of fifteen hundred dollars, which is to be used for the purchase of gold and silver medals, to be annually awarded, under the direction of the College Faculty, for excellence in Declamation.

GRINNELL AGRICULTURAL PRIZES.

Hon. William Claflin of Boston has given the sum of one thousand dollars for the endowment of a first prize of fifty dollars, and a second prize of thirty dollars, to be called the Grinnell Agricultural Prizes, in honor of George B. Grinnell, Esq., of New York. These prizes are to be paid in cash to those two members of the graduating class who may pass the best oral and written examination in Theoretical and Practical Agriculture.

HILLS BOTANICAL PRIZES.

For the best Herbarium collected by a member of the class of 1879, a prize of fifteen dollars is offered, and, for the second best, a prize of ten dollars; also a prize of five dollars for the best collection of woods, and a prize of five dollars for the best collection of specimens of dried plants, from the College Farm.

TOTTEN MILITARY PRIZE.

For the best Essay by a member of the Senior class on such topic as may be assigned, a prize of twenty-five dollars is offered.

Subject for 1879, "The Sword and the Plough."

REGULATIONS.

I. — Students are forbidden to combine together for the purpose of absenting themselves from any required exercise, or violating any known regulation of the College.

II. — The roll shall be called five minutes after the ringing of the bell for each exercise of the College, by the officer in charge, unless a monitor be employed; and students who do not answer to their names shall be marked absent, provided that any student coming in after his name has been called shall be marked tardy. Two tardinesses shall be reckoned as one absence.

III. — Absence from a single exercise may be alloweed or excused by the officer in charge of the same, if requested beforehand; but permission to be absent from several exercises must be obtained in advance from the general excusing officer, or from the president. In such cases the officer excusing will furnish a certificate of excuse, which shall state the precise time for which absence is permitted, and which shall be a satisfactory reason for absence from all exercises occurring within the time specified.

IV. — Excuses for all absences, whether with permission obtained beforehand or not, must be submitted to the excusing committee. They must be rendered promptly within one week from the date of absence; and those deemed unsatisfactory will be returned to the student with the indorsement of the committee.

V. — Whenever the aggregate number of unexcused absences in all departments reaches five, the student so delinquent shall be informed of the fact. When the number of such absences reaches eight, the parent or guardian of the student shall be informed of his delinquency; and, when ten such delinquencies are justly recorded against any student, his connection with the College may be terminated.

VI. — Students are forbidden to absent themselves without excuse from the regular examinations, to give up any study without permission from the president, or to remove from one room to another without authority from the officer in charge of the dormitory buildings; and no student shall be permitted to make such change until he has procured from the inspecting officer a written statement that the room about to be vacated is in perfect order.

VII. — Students shall be required to attend the church of their selection regularly on Sunday morning, and report in writing to the excusing officer, during the ensuing week, whether they attended or not.

VIII. — The record of deportment, scholarship, and attendance, will be carefully kept; and, whenever the average rank of a student falls below fifty, he will not be allowed to remain a member of the College except by a special vote of the faculty. Admission to the College, and promotion from class to class, as well as to graduation, are granted only by vote of the faculty.

IX. — Students are required to abstain from any thing injurious to the buildings and other property of the College, and in all respects to conduct themselves with propriety.

X. — Parents and guardians are specially urged to co-operate with the faculty in securing the faithful attendance of students upon every appointed exercise of the College.

SIZE OF ROOMS.

For the information of those desiring to carpet their rooms, the following measurements are given. In the south dormitory the main corner-rooms are fifteen by eighteen feet, and the adjoining bedrooms eight by twelve feet. The inside rooms are fourteen by fifteen feet, and the bedrooms eight by eight feet. In the north dormitory the corner-rooms are fourteen by fifteen feet, and the annexed bedrooms eight by ten feet; while the inside rooms are thirteen feet and a half by fourteen feet and a half, and the bedrooms eight by eight feet.

SCHOLARSHIPS.

The Massachusetts Society for Promoting Agriculture pays annually into the treasury of the College the sum of three hundred dollars, which is assigned by the faculty to the payment of the tuition of four worthy indigent students who intend to engage in agricultural pursuits after graduation.

The income of the Robinson Fund of one thousand dollars, the bequest of Miss Mary Robinson of Medfield, is assigned by the faculty to such indigent student as they may deem most worthy.

The Trustees voted in January, 1878, to establish one free scholarship for each of the eleven congressional districts of the State. Applications for such scholarships should be made to the representative from the district to which the applicant belongs. The selection for these scholarships will be determined as each member of Congress may prefer; but, where several applications are sent in from the same district, a competitive examination would seem to be desirable. Applicants should be good scholars, of vigorous constitution; and should enter College with the intention of remaining through the course, and then engaging in some pursuit connected with agriculture. To every such student the cash value of a scholarship is three hundred dollars.

FINANCIAL STATEMENT, Jan. 1, 1879.

REAL ESTATE.

College Farm and Quarry	$37,500 00
North College	36,000 00
South College	36,000 00
College Hall	30,000 00
South Boarding-House	8,000 00
North Boarding-House	8,000 00
Durfee Plant-House	12,000 00
Botanic Museum	5,000 00
South Barn	14,500 00
Farm-House	4,000 00
Four Dwellings and Barns purchased with the Estate,	9,000 00
Total Real Estate, Cost	$200,000 00

FARM STATEMENT.

Value of Live-Stock	$4,470 00
Vehicles and Implements	1,246 00
Produce on Hand	1,617 50

FUND FOR MAINTENANCE OF COLLEGE, IN CHARGE OF THE STATE TREASURER.

Agricultural College Fund.

Cash Balance on hand Jan. 1, 1879		$71,000 00
Present investments, —		
City of Lynn Bonds	$25,000 00	
Chelsea Note	25,000 00	
Town of Milford Bonds	14,200 00	
Hudson Note	35,000 00	
Brighton Note	10,000 00	

Town of Milton Note . . .	$10,000 00	
Plymouth Note . . .	6,724 65	
West-Roxbury Note . .	30,000 00	
Westborough Note . .	12,000 00	
Lee Note	4,142 75	
Somerset Note . . .	10,000 00	
County of Hampden Notes . .	75,000 00	
		$257,067 40
Massachusetts, Troy, and Greenfield Railroad Bonds	$8,000 00	
Massachusetts Bonds . . .	20,000 00	
		28,000 00
Maine Bonds		4,000 00
Total Fund		$360,067 40

Two-thirds of the income of this fund is by law paid to the Treasurer of the College, and one-third to the Treasurer of the Institute of Technology.

The Hills Fund of ten thousand dollars, for the maintenance of the Botanic Garden, is in charge of the College Treasurer.

To this sum should be added the receipts for tuition and room-rent, and the receipts from the sale of the products of the farm and garden.

Summary Statement of all Income and Receipts on Account of the Massachusetts Agricultural College, from its Incorporation in 1863, to Jan. 1, 1879.

	1864-66.	1867.	1868.	1869.	1870.	1871.
Balance	–	–	$4,485 83	–	–	–
Income from Agricultural College Fund	–	$10,930 00	8,908 10	$9,035 52	$4,839 82	$12,364 22
State Appropriations	$20,000 00	–	50,000 00	50,000 00	25,000 00	50,000 00
Received for $\frac{1}{10}$ Land Scrip	29,778 40	–	–	–	–	–
Dr. N. Durfee for Plant-House	–	10,000 00	–	–	–	–
Town of Amherst and Friends	–	60,156 67	–	–	–	–
Farm Account	–	2,030 22	2,204 16	1,840 06	3,004 78	633 01
Amherst College and Friends	–	–	12,343 33	–	2,500 00	–
Income of Hills Fund	–	–	500 00	500 00	500 00	500 00
Bills Payable	–	–	11,000 00	–	–	–
Term Bills	–	–	7,620 87	11,554 38	13,204 56	12,932 65
Botanical Department	–	–	107 28	–	–	106 69
Contingent Fund	–	–	–	119 10	281 78	153 88
Interest on Deposits	–	–	–	–	–	–
Insurance	–	–	–	–	–	–
Mary Robinson Fund	–	–	–	–	–	–
Farnsworth Prize Fund	–	–	–	–	–	–
Grinnell Prize Fund	–	–	–	–	–	–
Income Grinnell Fund	–	–	–	–	–	–
Totten Military Prize Fund	–	–	–	–	–	–
Total	$49,778 40	$83,116 89	$97,169 57	$73,049 06	$49,330 94	$76,690 45

Summary Statement of all Income and Receipts on Account of the Massachusetts Agricultural College, from its Incorporation in 1863, to Jan. 1, 1879. — Concluded.

	1872.	1873.	1874.	1875.	1876.	1877.	1878.
Balance	–	–	–	–	–	–	–
Income from Agricultural College Fund	$15,083 07	$14,982 91	$15,701 75	$15,459 00	$15,178 66	$14,985 47	$13,064 28
State Appropriations	–	–	18,000 00	–	5,000 00	3,665 90	1,334 10
Received for $\frac{1}{10}$ Land Scrip	–	–	–	–	–	–	–
Dr. N. Durfee for Plant-House	–	–	–	–	–	–	–
Town of Amherst and Friends	–	–	–	–	–	–	–
Farm Account	873 50	2,107 69	1,487 54	1,637 12	1,722 64	2,073 76	1,506 78
Amherst College and Friends	–	–	–	–	–	–	–
Income of Hills Fund	500 00	500 00	500 00	500 00	500 00	500 00	500 00
Bills Payable	–	10,460 00	3,500 00	4,000 00	20,690 42	24,500 00	6,000 00
Term Bills	10,386 02	9,395 51	9,892 92	13,107 28	11,090 06	7,865 88	8,140 25
Botanical Department	724 95	580 59	549 20	955 80	1,089 41	2,066 02	1,644 59
Contingent Fund	–	90 59	190 60	9 84	37 82	661 74	409 33
Interest on Deposits	390 00	–	140 00	–	–	–	–
Insurance	1,501 63	–	–	–	–	–	–
Mary Robinson Fund	–	–	1,000 00	–	–	–	35 00
Farnsworth Prize Fund	–	–	90 00	100 00	100 00	100 00	100 00
Grinnell Prize Fund	–	–	1,000 00	–	–	–	–
Income Grinnell Fund	–	–	100 00	80 00	80 00	80 00	80 00
Totten Military Prize Fund	–	–	–	–	–	–	3 00
Total	$29,459 17	$38,117 29	$52,152 01	$35,849 04	$55,489 01	$57,044 60	$32,640 08

Summary Statement of all Payments and Expenditures on Account of the Massachusetts Agricultural College, from its Incorporation in 1863, to Jan. 1, 1879.

	1864-66.	1867.	1868.	1869.	1870.	1871.
Salaries	–	$9,250 00	$5,250 00	$12,459 72	$16,389 92	$15,016 67
Land and Buildings	$32,499 50	–	6,000 00	7,000 00	–	–
Building Fund	–	53,290 94	51,352 15	31,419 71	11,006 29	3,711 45
Current Expenses	8,955 26	17,824 93	9,686 23	13,640 96	6,102 51	13,184 02
Farm Expenses	–	11,074 66	3,467 71	6,253 18	6,116 77	6,337 83
Bills Payable	–	–	–	–	–	11,000 00
Interest	–	–	365 67	1,379 20	1,138 31	385 00
Income of Hills Fund paid out	–	–	450 92	281 44	30 00	269 97
Term Bill Expenses, and Laboratory Account .	–	–	1,394 83	4,644 62	4,519 61	3,155 59
Board of Students	–	–	4,447 36	5,672 27	4,746 61	6,833 55
Botanical Department	–	–	–	65 86	121 66	607 90
Extra Instruction	–	–	–	–	1,893 25	1,445 00
Investment of Grinnell Prize Fund	–	–	–	–	–	–
Grinnell Agricultural Prizes	–	–	–	–	–	–
Farnsworth Rhetorical Prizes	–	–	–	–	–	–
Indebtedness paid	–	–	–	–	–	–
	$41,454 76	$91,440 53	$82,414 77	$82,816 96	$52,064 93	$61,946 98

Summary Statement of all Payments and Expenditures on Account of the Massachusetts Agricultural College, from its Incorporation in 1863, to Jan. 1, 1879. — Concluded.

	1872.	1873.	1874.	1875.	1876.	1877.	1878.
Salaries	$17,705 00	$19,540 89	$19,995 83	$18,272 50	$19,032 50	$16,350 00	$13,693 20
Land and Buildings	–	–	–	–	–	–	–
Building Fund	–	–	–	–	–	–	–
Current Expenses	9,656 29	6,556 49	12,755 16	6,866 96	5,084 35	4,581 35	3,117 15
Farm Expenses	7,313 54	4,548 55	4,222 24	3,495 00	5,180 02	3,669 80	2,574 64
Bills Payable	–	–	3,960 00	–	14,690 42	23,500 00	3,000 00
Interest	–	371 16	684 02	1,079 92	822 80	1,636 24	1,381 66
Income of Hills Fund paid out	916 42	725 73	509 04	252 04	416 43	240 97	1,010 24
Term Bill Expenses, and Laboratory Account	2,031 13	2,315 12	1,263 99	3,142 83	2,174 14	2,561 86	3,053 34
Board of Students	4,249 51	4,281 82	3,851 97	4,773 27	3,790 37	1,795 19	3,368 56
Botanical Department	364 38	274 75	473 96	1,117 35	915 39	2,103 75	1,628 65
Extra Instruction	846 00	–	400 00	664 38	–	–	–
Investment of Grinnell Prize Fund	–	–	1,000 00	–	–	–	–
Grinnell Agricultural Prizes	–	–	117 00	70 00	70 00	70 00	70 00
Farnsworth Rhetorical Prizes	–	–	70 00	117 00	100 00	100 00	100 00
Indebtedness paid	–	–	–	–	3,232 12	–	–
	$43,082 27	$38,614 51	$49,303 21	$39,851 25	$55,508 54	$56,609 16	$33,017 34

Summary Statement of all Income and Receipts and all Payments and Expenditures on Account of the Massachusetts Agricultural College, from its Incorporation in 1863, to Jan. 1, 1879.

Income and Receipts.		Payments and Expenditures.	
Balance, Jan. 1, 1868	$4,485 83	Salaries	$182,956 23
From Income from Agricultural College Fund	150,532 80	Land and Buildings	45,499 50
State Appropriations	223,000 00	Building Fund Account	150,780 54
One-tenth Land Scrip for Purchase of Farm	29,778 40	Current Expense Account	118,011 66
Dr. Nathan Durfee for Plant-House	10,000 00	Farm Account[1]	64,253 94
Town of Amherst and Friends	75,000 00	Bills Payable	56,150 42
Farm Account	21,121 26	Interest Account	9,243 88
Income of Hills Fund	5,868 58	Income of Hills Fund, expended	5,103 20
Bills Payable	80,150 42	Term Bill Account	30,257 06
Term Bill Account	115,189 38	Board of Students	47,810 48
Botanical Department	7,824 53	Botanical Department	7,673 65
Contingent Fund	1,954 68	Extra Instruction and Lectures	5,248 63
Interest on Deposits	530 00	Grinnell Prize Fund Investment	1,000 00
Insurance	1,501 63	Income Grinnell Prize Fund, expended	417 00
Bequest of Miss Mary Robinson	1,000 00	Income Farnsworth Prize Fund, expended	487 00
Income of Miss Mary Robinson Fund, unexpended	35 00	Mary Robinson Fund Investment	1,000 00
Farnsworth Prize Fund	490 00	Indebtedness, paid 1876	3,232 12
Grinnell Prize Fund	1,000 00		$729,125 31
Income of Grinnell Prize Fund	420 00	Balance Jan 1, 1879	760 20
Totten Military Prize Fund	3 00		
	$729,885 51		$729,885 51

[1] A considerable part of the sum here charged as farm expenses includes also the labor of men and teams in building and repairing roads, grading and preparing the foundation of buildings, hauling gravel and stone, — work distinct from the cultivation of the farm.

Dr. George Montague, *Treasurer, in Account with* Massachusetts Agricultural College. Cr.

1878.			1878.		
Jan. 1.	To Balance	$1,137 56		By Salaries for three quarters	$13,693 20
	Income of Hills Fund	322 75		Expenses Hills Fund Account	1,010 24
	State Endowment Fund	13,064 28		Contingent Account	2,707 82
	State Appropriation for Students' Labor	1,334 10		Botanical Account	1,628 65
	Mary Robinson Fund	35 00		Farm Account	2,574 64
	Prize Funds	180 00		Interest Account	1,381 66
	Totten Prize Fund	3 00		Prize Account	190 00
	Receipts from Students	3,052 45		Bills payable, Notes paid and renewed	3,000 00
	Farm Superintendent	1,506 78		Students' Bills, paid from Labor Fund	1,334 10
	Botanical Account	1,644 59	Dec. 31.	Balance	760 20
	Bills payable, Notes for loans and renewal,	6,000 00			
		$28,280 51			$28,280 51

Respectfully submitted,

GEO. MONTAGUE, *Treasurer.*

I have examined the Treasurer's accounts, and find them correctly stated, and accompanied by the proper vouchers.

HENRY COLT, *Auditor.*

SUMMARY

OF

METEOROLOGICAL OBSERVATIONS FOR THE YEAR

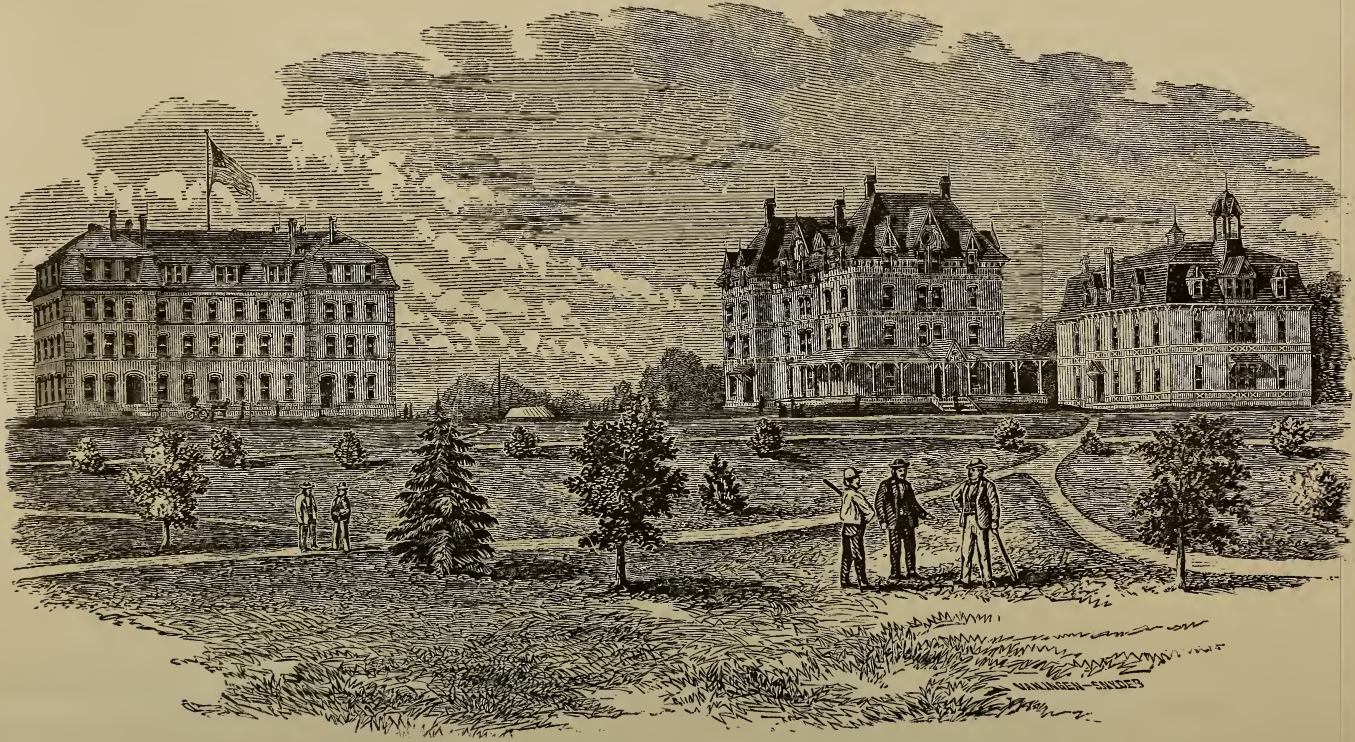
1878.

TAKEN AT AMHERST, MASS., BY MISS SABRA C. SNELL.

LATITUDE, 42° 22′ 17″. LONGITUDE, 72° 34′ 30″. ELEVATION ABOVE THE SEA LEVEL, 267 FEET.

Summary of Meteorological Observations for 1878.

MONTH.	THERMOMETER IN OPEN AIR.			Amount of Rain or Melted Snow in gauge, in inches.	Depth of Snow, in inches.	Mean per cent of Sky.	WINDS PER CENT OF TIME AND FORCE.				BAROMETER HEIGHT REDUCED TO FREEZING POINT.			FORCE OR PRESSURE OF VAPOR, in inches.			RELATIVE HUMIDITY OR FRACTION OF SATURATION.		
	Max.	Min.	Mean.				N.W.	S.W.	S.E.	N.E.	Max.	Min.	Mean.	Max.	Min.	Mean.	Max.	Min.	Mean.
January .	44.4	-12.5	25.29	3.575	6 0	5.1	63	12	12	13	30.374	28.831	29.742	.252	.012	.126	100	36	71
February .	50.3	-3.2	27.14	3 665	13.5	4.6	57	16	9	18	29.968	29.199	29.666	.216	.025	.114	100	22	71
March .	65.1	13.2	39.24	2.565	–	5.4	61	20	9	10	30.203	28.764	29.654	.335	.050	.166	98	24	68
April .	73.1	37.0	52.17	5 853	–	7.4	35	23	36	6	30 006	28.927	29.569	.522	.149	.282	100	26	71
May . .	83.2	40.5	57.38	2.360	–	5.4	58	37	30	6	30.001	29.237	29.633	.613	.135	.318	94	25	69
June . .	90.2	46.4	64.73	6 003	–	4.5	41	30	25	4	29 980	29 250	29.661	.774	.168	.448	99	29	75
July . .	92.2	55.2	73.33	2 163	–	4.2	32	38	27	3	29.944	29.241	29.674	.900	.174	.599	99	35	83
August .	82.2	49.9	68.63	6.974	–	5.3	35	29	36	0	29.925	29.286	29.625	.914	.325	.577	100	41	83
September	84.5	38.0	63 20	2.821	–	5 0	31	24	37	8	30.220	29.465	29.871	.863	.136	.491	100	39	84
October .	77.3	27.0	54.43	2 054	–	5.2	47	22	27	4	30.067	29.194	29.737	.555	.091	.308	100	11	70
November .	57.2	19 8	39.11	5.339	–	7.3	59	15	16	10	30.219	28.732	29.653	.325	.047	.166	100	13	67
December .	53.7	11.7	28.95	6.020	9.0	5.6	59	27	12	2	30.176	28.641	29.657	.423	.006	.120	97	3	69
Year . .	92.2	-12.5	49.47	49.392	28.5	5.4	48	23	22	7	30.374	28.641	29.678	.914	.006	.309	100	3	72



MASSACHUSETTS AGRICULTURAL COLLEGE, AMHERST, MASS.

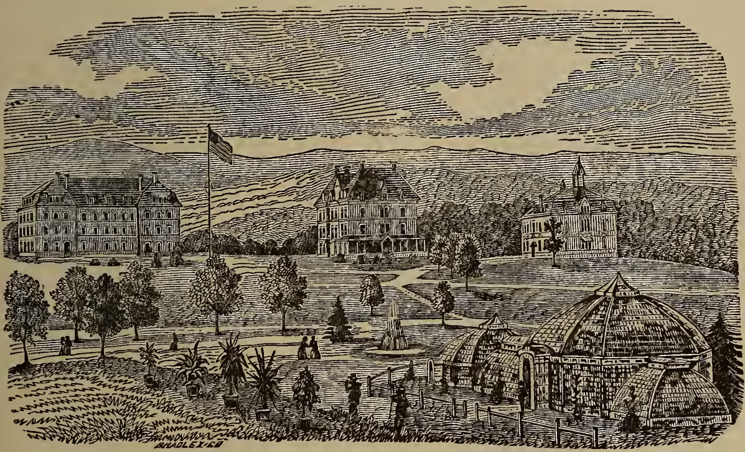
SENATE. No. 125.

SEVENTEENTH ANNUAL REPORT

OF THE

Massachusetts Agricultural College.

JANUARY, 1880.



BOSTON:
Rand, Avery, & Co., Printers to the Commonwealth,
117 Franklin Street.
1880.

Commonwealth of Massachusetts.

STATE HOUSE, BOSTON,
Feb. 12, 1880.

To his Excellency, JOHN D. LONG:—

Sir, —I have the honor herewith to present to your Excellency and the Honorable Council the Seventeenth Annual Report of the Massachusetts Agricultural College.

Very respectfully your obedient servant,

CHARLES L. FLINT,
President.

Commonwealth of Massachusetts.

Executive Department, Boston,
Feb. 12, 1880.

To the Honorable the Senate: —

I have the honor herewith to transmit for the consideration of the General Court the Seventeenth Annual Report of the Massachusetts Agricultural College

JOHN D. LONG.

INDEX.

ANNUAL REPORT.

To his Excellency the Governor and the Honorable Council: —

THE Trustees of the Massachusetts Agricultural College respectfully submit their Seventeenth Annual Report.

The College is now, for the first time in several years, practically free from debt. Since the adjournment of the last Legislature, it has been thoroughly re-organized, so as to place it, if possible, upon a sound and strong financial or business basis. The current expenses have been reduced by more than ten thousand dollars a year, — sufficient to bring them within the income of the institution, and to leave a small margin.

To effect this reduction, it has been necessary to abolish one professorship and to withhold the president's salary. The salaries of one or two professors, and that of the treasurer, though small already, were somewhat cut down; while a saving of about four hundred dollars has been made in the janitor's work, and a little more than that in the office of farm superintendent. It is impossible to see how the expenses can be reduced to a much lower figure, without seriously crippling the usefulness of the College, and curtailing its efficiency.

The origin of the fund received under the Act of Congress of July 2, 1862, and the Act establishing the College by the Legislature of 1863, were stated in detail in the last Annual Report of the Trustees. As but few copies of that report were printed, and it is not readily accessible, the Acts of Congress and of the Legislature accepting the grant, and establishing the College, are presented on a subsequent page, where they will be found convenient for reference.

The real estate of the College, or what, to use a business phrase, may be called "the plant," — including the land of the farm, the dormitories, halls, boarding-houses, and other college and farm buildings,—have cost two hundred thousand dollars. The college fund now in the hands of the State treasurer, and to be kept there in accordance with the provisions of the Act of Congress accepted and agreed to by the formal action of the Legislature, amounts to $360,067.40. Two-thirds of the income of this fund is by law paid over to the treasurer of the College, and one-third to the treasurer of the Massachusetts Institute of Technology. When it is reported, therefore, that the State has at different times appropriated $255,000 for the establishment and maintenance of the College, it ought, in justice, to be borne in mind that the greater part of this large aggregate (nearly three-fifths) was given in the form of an addition to the fund arising from the sale of national land scrip, not a dollar of which has been expended, and that the College receives but two-thirds of the income of this fund; so that the advantage of these generous gifts does not wholly accrue to the Agricultural College, and its income is, in consequence, very much less than it otherwise would be.

The financial embarrassments of the College have arisen, in part, from the reduction of the income of the fund in the hands of the State treasurer, consequent upon the general depression of business so universally prevalent during the last few years, and in part, it must be admitted, from want of attention to business details in the expenditures of the farm and other departments of the institution. The re-organization was designed to remedy these defects, and it is believed that it has accomplished the object. The financial status of the College may be presented substantially as follows:—

Real estate	$200,000 00
Farm stock appraised at	2,747 00
Implements, vehicles, &c.	1,005 50
Farm produce on hand	2,019 25
	$205,771 75

RESOURCES.

Income of fund in State treasury . . .	$12,000 00
Income from other funds	700 00
Income from tuition, room-rent, &c. . .	3,500 00
Total income	$16,200 00

EXPENDITURES.

Salary account	$10,100 00
Current expense account	4,000 00
Extra instruction	800 00
Cost	$14,900 00

The ledger balance and treasurer's report will be found on a subsequent page.

In the above estimate of expenditures no allowance is made for a president's salary. It is impracticable to reduce the teaching force of the College below its present limits. One professorship, as already stated, has been vacated by the action of the trustees during the past year, for the express purpose of keeping the expenses within the income; but it must be evident that this reduction cannot be carried further without great injury to the reputation of the institution. The studies to be pursued must be such in variety, in extent, and in value, as shall meet in good faith the requirements of the Act of Congress to which we are indebted for the original endowment. It must be presumed that in accepting the grant, and obligating itself to fulfil its conditions, the State meant to do it honorably, and to comply with the spirit as well as with the letter of the Act.

No one can fail to see, in reading the conditions of the grant, that it implies something more than the maintenance of a mere manual labor school. The very name of "College" implies a broader and more generous culture: it implies a place of education for the young. Whatever the institution may do in the way of affording models of farming for the public, or in searching for new facts, or the investigation of scientific principles applied to agriculture, must be secondary, and subordinate to the main objects, which the very name given in the Act of Congress implies. The leading and prominent idea conveyed is that learning and labor, science and practice, are to meet in a more profitable life upon the farm; that the chief aim shall be to develop the man in the farmer, and to develop farming through the man engaged in it. This means discipline, which lies at the foundation of all genuine education: it means that we are to do something to educate the mind as well as the hand, to make intelligent men and good citizens, and this object has been kept constantly in view.

It is to be borne in mind, that, at the time the College was founded, there were no models in this country by which our early steps could be guided. Many institutions of the kind had been established and maintained by most of the governments of Europe, and some of them were broader in scope than our own; but they could hardly furnish any complete guide for us in circumstances so widely different. Mistakes might, therefore, have reasonably been expected. But whatever mistakes may have been made by the trustees, acting as the agents of the Commonwealth, the history and the record of the College have, on the whole, been honorable, and highly creditable to the State. It was opened for the admission of students in 1867; and since that time more than six hundred and fifty have been admitted on examination or diploma. The yearly average number of students has exceeded a hundred. Its first class graduated in 1871, and it has graduated a hundred and fifty-seven in all, more than a third of whom are devoting themselves exclusively to agriculture, and pursuits intimately connected with it. In addition, it has given instruction to four hundred others who have taken partial courses in agriculture, and returned to the farms from which they came.

The facilities gathered there for illustration, and for imparting a sound and substantial education, in which the natural sciences constitute the basis, are much greater than has been commonly supposed. The College library consists of over two thousand volumes, mostly on technical subjects, embracing every department of agriculture and the natural sciences. The Knowlton Herbarium contains more than ten thousand species of catalogued plants and botanical specimens. The State cabinet of geology, ornithology, and entomology, is complete in its illustration of the natural history of Massachusetts. The chemical laboratory has accommodations for seventy students. This department is in a high state of efficiency. Practical laboratory work is required of each student daily for an entire year.

The department of physics and civil engineering, under the charge of Professor Graves, is well equipped with apparatus; and practical field-work in surveying, laying out roads, &c., is required of every student, sufficient to give him a knowledge of the most approved instruments, and methods to be pursued under a great variety of circumstances. The military department, required, officered, and equipped by the General Government, and under the charge of an accomplished army officer, a graduate of West Point, affords unsurpassed facilities for valuable discipline, and is educating far more thoroughly and completely than any militia system can be expected to do, a large number of young men, who go out capable of serving as officers or soldiers in case of emergency. This feature of the course of study and training, as was said in the last Report, is far more important than is generally supposed, and has from the first received the most careful attention, and been eminently successful. The horticultural department, under the charge of Professor Maynard, contains extensive plant and propagating houses, peach, pear, and apple orchards, vineyards and nurseries, affording ample facilities for instruction and for the labor of students, who are paid by the hour for all work beyond the limits of what is called "class-work," which is required of all students six hours a week as a part of the educational course.

The farm, of nearly four hundred acres, must be regarded as an important adjunct of the College, as it affords facilities for observation and labor which could not be had without it. It has been somewhat cramped for means, and has been required to do a vast amount of work — in the way of grading grounds, building roads and walks, and teaming of various kinds — for the College, so that its accounts have not shown its actual working; but its capacities for usefulness in connection with other departments of the College are too obvious to need comment.

Though the education and training of young men must be regarded as the primary object, the contributions of the College to the science and practice of agriculture have been extensive and valuable; and they are universally recognized throughout the country as in the highest degree creditable to the institution and to the State: they have, indeed, in repeated instances, been taken as the basis of important legislative action in other States. The following may be stated as a few of the subjects that have been investigated, most of them exhaustively, and with valuable practical results: —

1. The growing of sugar-beets, the manufacture of sugar

from them, and trials of their value for cattle foods. This industry is soon to grow up in our midst, and to absorb large amounts of capital.

2. The sources of supply and the quantity and quality of our manurial agents. These careful scientific investigations have been the prime means of revolutionizing the manufacture and trade in fertilizers, not only in this State, but throughout the country.

3. Laboratory and physical examinations of the South-Carolina phosphates, and trials of their agricultural value in the raw state, and after treatment with acids.

4. On the use and effect of common salt on the grain and root crops.

5. The chemical and physical condition of the salt-marshes of the State, and the devising of methods by which they can be made available for agricultural purposes.

6. Experiments with compound commercial fertilizers to test their comparative agricultural value, and their value as compared with single elements.

7. To determine what elements will make practically a complete manure on our average soils.

8. Investigations of the quality and composition of commercial fertilizers offered for sale, and the protection of the community, by legal control and inspection, from frauds in them.

9. Observations and study of the phenomena of plant-life.

10. The circulation of sap in plants, and their expansive power during growth.

11. To determine the proportions of different elements of nutrition in feeding substances to be used, to save needless expense, and to produce the most certain results.

12. Experiments on the continuous growth of crops on the same soil, with chemical fertilizers alone.

13. The influence of different kinds of fodder-plants fed to milch cows on the quantity and quality of their milk and butter.

14. Examinations and trials to test the comparative value of different methods of setting and treating milk in the butter-dairy.

15. Practical trials of new implements and a great variety of farm machinery.

16. Investigations as to the effect of girdling fruit-trees and plants to hasten the time of ripening, and to improve the quality of the fruit.

17. The effect of chemical salts on the carbo-hydrate contents of plants and the quality of fruits.

18. The construction and repair of common roads.

19. The growing of early-amber cane, and the manufacture of sugar from its juice.

20. The influence of temperature, and the vital functions of plants, and temperature of soils and air, on the changes in form of water in soils, and plants and vapor in air.

21. Investigations in relation to the evaporation and percolation of water from the soil.

22. The tilling of soils of different characteristics as affecting the loss of water by evaporation.

23. The determination of the elements of plant-nutrition lost from the soil by leaching and of those it retains.

24. Investigations in relation to the comparative temperature of the soil and air by day and by night.

25. The establishment of true meridian lines to regulate the practice of surveying.

26. The comparative study of the milk of different breeds of cows.

27. Accurate investigations of the comparative nutritive and feeding value of Northern, Southern, and Western varieties of Indian-corn.

This list, which might be greatly extended, will serve to show the wide range of scientific study and investigation to which the attention of the College has been devoted. "From this day forward," said Professor Agassiz, when a single one of the above papers was presented to the State Board of Agriculture in 1873, — "from this day forward, the Agricultural College at Amherst has its place among scientific institutions, if it had not before; for only those institutions have a place in the scientific world which do something, and this is something extraordinary: it is a revelation to physiologists. Let me say to those who have not thought that the Agricultural College was doing any thing worth its expense, that the production of this one paper has amply paid for every dollar which the State has thus far bestowed upon the institution."

Equally unqualified testimony might be presented with reference to the high character and value of nearly every one of the investigations named in the above list. Every land-surveyor, for instance, knows that previous to the establishment of permanent monuments in every county of the State, giving the accurate meridian lines, the means of correcting his instruments were comparatively difficult of access; and when it is considered that very many of our farms are bounded and described by the points of the compass, often for long distances, it is easy to see that the College has had its influence upon nearly every farm in the State, and that, too, in more ways than one. It can justly challenge comparison with the work of any other similar institution in the country, both in its contributions to science and to the methods and results of intelligent practice.

But these investigations, as already intimated, are secondary, and subordinate to the chief object of the institution,—the education of young men for the practical pursuits of life. That the College has fulfilled its mission in this direction is sufficiently evident from the reports of the Examining Committee of the State Board of Agriculture. In its capacity as a Board of Overseers of the College, it has, for several years, appointed a committee to examine into the condition and working of the institution, and especially to examine the graduating classes from year to year, and to report upon their proficiency. These reports have appeared in the reports of the Secretary of the State Board of Agriculture, where they are accessible to the public.

It will not be out of place, for obvious reasons, to present, as briefly as possible, the opinions of experts who not only had abundant opportunity, but whose special duty it was, to investigate all departments of the College, and pass judgment upon them. The Examining Committee of the past year, Dr. James R. Nichols of Haverhill, editor of "The Journal of Chemistry," chairman, submitted a report, from which the following is an extract: "The duty assigned to me the present year, of visiting the Agricultural College at Amherst, and conducting the examination of the senior class, was pleasant, and also encouraging as regards the usefulness of the institution. The College has labored under some peculiar difficulties and discouragements in the present and past years, owing to the want of means to carry forward the work of the institution as planned by its officers. The graduating class was found to be small, numbering only seven; but their appearance and acquirements were certainly very creditable.

"The examination was conducted with the view of obtaining as clear an insight into the results of the practical workings of the College as possible; and every facility was afforded by Professor Stockbridge and others that could be desired. For a period of nearly or quite three hours the young men of the class were under examination; and the questions put to them were such as must of necessity call out answers to be made promptly, without the aid of books or instructors; and the results were highly gratifying. A prominent aim was to ascertain if the young men were really qualified to go upon a farm, and conduct its operations in an intelligent and practical manner. It was deemed desirable to learn if they had been instructed in a way to enable them to carry forward the principles of advanced husbandry so as to promote its best interests wherever they might be located. This requires a knowledge of the principles and practice of chemistry, also an acquaintance with the physical character of soils, their origin, and methods of reclamation and fertilization; the nature and nutritive value of the cereal grains, roots, and grasses; the value of the different breeds of animals, and the best methods of feeding and utilizing their products; the care of seeds; and all the implements of husbandry. Upon these points and many others the young men were examined sufficiently in detail to bring out what they really knew; and it is gratifying to report that the answers showed marked proficiency in these departments of study. They were such as to increase our confidence in the usefulness of the College in its direct bearings upon the agriculture of our state and country."

An equally authoritative indorsement might be presented from every committee whose duty it has been to examine into and report upon the details of the working and efficiency of the College. The Committee of 1870, for instance, Professor Louis Agassiz, chairman, say, "The examinations of the students in classes have been upon agriculture, horticulture, botany, physiology, chemistry, geology, mental and kindred sciences; and we have witnessed the military drills, and observed with gratification the topographical drawings by the students. We are convinced that the system of instruction is well calculated for the ends in view, that the students are making commendable progress in their studies, and that the several professors are not only accomplished in their respective departments, but earnest and thorough in the prosecution of their duties.

"The leading object in this institution, in compliance with the Act of Congress to which it owes its endowment, is to teach such branches of learning as are related to agriculture, and to include military tactics; and it seems to us that the course of instruction laid down is eminently in consonance with that object, and that the sciences taught are with pointed reference to the uses of the farm. The theory of scientific agriculture is thoroughly taught, and the application of such knowledge is made on the farm, under the direction of the professor of agriculture, who is a practical farmer; and all students are compelled to work at the details of husbandry; so that manual labor becomes a valuable adjunct to mental application. Chemistry, botany, physiology, and zoölogy, are, of course, invaluable to the farmer in regard to the analysis of soils, the use of manures, the food of animals, the growth of grains and fruits, the anatomy and physiology of animals, and the conditions and habits of destructive insects; and mathematics and civil engineering, in the case of the chain, compass, and level, are almost equally necessary.

"Your Committee cannot refrain from alluding to the interest which all the young men take in the drills, and the evident beneficial effect upon their bearing and health, and the value of the accomplished soldiers and officers thus made for the future service of the Commonwealth in the event of another call to send forth her sons for herself or the nation. Were no other result accomplished by this institution, the money of the Commonwealth could be no more judiciously expended; and yet this instruction is but an incident to the regular course."

The Examining Committee of 1871, of which Professor Agassiz was still the chairman, after visiting the College several times, and a careful inspection of all its details, state in their report that "the graduating class, consisting of twenty-seven members, acquitted themselves with great credit in their several examinations and graduating exercises. Their uniformly gentlemanly bearing and manly appearance were noticeable in a marked degree. No one could look upon that company of young men without realizing the wisdom and foresight of those minds that originated the idea of requiring 'military tactics' to be taught in agricultural colleges. The influence of their military training was so manifest, not only upon their general physical health and development, but also in those indispensable attributes which help to make a true gentlemen, that we do not believe too much importance can be laid upon this branch of their education, both as exerting a healthful influence upon the students themselves and as a safeguard for the protection of our country in the future."

The Examining Committee of 1872, Hon. Leverett Saltonstall, chairman, having attended the quarterly examinations, and the annual graduation exercises in the month of June, say in their report, "It is truly wonderful, that, in so short a time, this admirable institution should have assumed such proportions. Only incorporated in 1863, receiving its first class late in 1867, it now stands in the front rank of agricultural colleges in this country, — an object of reasonable pride to the Commonwealth.

"The classes in April were examined in botany, moral philosophy, agricultural chemistry, mathematics, English literature, and practical farming; at Commencement (*inter alia*), in the relation of science to practice in agriculture, renovation of exhausted soils, rotation of crops, manures, stock-husbandry, and in agriculture as a business-pursuit; in November, in road and railroad construction, zoölogy, use of manures, chemistry, and military drill; all of which were creditable alike to professors and students, the relations between whom seem to be of the most agreeable nature."

The Committee of 1873, Dr. Horace P. Wakefield, chairman, enter into the condition of the institution at considerable length, both as to the details of the farm and the educational departments, and say, "In November, at the close of the term, the freshmen were examined in physiology, the sophomores in agriculture, the juniors in physics, and the seniors in botany. The classes acquitted themselves creditably, and, when compared with similar performances a little to the south forty years ago, they were of a high order. But facilities, advantages, and times change, and boys must change with them. Not that every student was a perfect master of the subject he had studied, an adept in science, — the teachers themselves would not claim that, — but these young men were familiar with the principles laid down in text-books, and inculcated by their teachers, and showed that they had them fixed in their minds, and could use them in stating a proposition, and defending the same, even when questioned by the professors. Having gathered a few facts, they had made them their own, and had the manliness to stand by their theories, and defend their positions. Evidently they had been taught to think, and that is education in its essence.

"The conservatory is an honor to the institution and the State. From the laboratory, with its appliances for teaching agricultural chemistry, and its liberal, learned, and live professor, so competent to fill such a position anywhere in the world, results may be looked for of the highest order, and expectation without limit must be realized.

"The College affords young men an opportunity to obtain a good, substantial knowledge of the science of farming, and also a fair knowledge of the practical part thereof; and every farmer's son in the Commonwealth stands a better chance to obtain an education, and prepare himself to meet and grapple successfully with opposing forces, and with honor compete with other young men struggling for honorable distinction in the various pursuits of business, — especially every farmer's son who belongs to the poorer class, or the class of moderate means, — from the fact that this institution has been established."

The Committee of 1874, Joseph N. Sturtevant, Esq., chairman, visited the College several times, carefully examined into the workings of all its departments, and say in their report that "the occasion of the examination of the graduating class, to mark who should be the recipients of the Grinnell Agricultural Prizes, was of much interest. The young men, as they replied to the questions addressed to them, in language lucid, unconventional, and thoughtful, showed that they carried with them from the College something of real value. We think of no occasion when the College appeared to so good advantage.

"The presence at the College of a United-States army officer as professor of military science and tactics secures able instruction in this essential part of the education of the complete citizen. If we pass by the chance of war, and the value of possessing among the people individuals fitted by previous training to become militia officers upon sudden call, the value of a military training as promotive of a manly bearing, orderliness, promptness of action, and fitness of speech, &c., is obvious, and recurs with greater force to such as witness the several classes in their military manœuvres. We trust there will be no diminution of interest in the military features of the College."

The Committee of 1875, Hon. Edmund H. Bennett, chairman, made two official visits to the College. Judge Bennett says in his report, that the committee "were deeply impressed with the value and importance of a scientific agricultural school and an experimental farm such as we there possess, and of the general success with which the same has been managed. They desire also to express their high appreciation of the scientific experiments made there, and its importance as a permanent scientific station.

"The 'leading object' of the College is, as its charter declares 'to teach such branches of learning as are related to agriculture and the mechanic arts, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life.' From this it seems that the primary purpose was to give to farmers' sons and others of the industrial class such useful and practical training as would best fit them for their contemplated pursuits in life. Other branches of scientific and even classical study might also be pursued; but apparently they were, in the mind of the Legislature, but auxiliary to the main purpose of this particular school. Without saying whether one course of study is more or less important as a general rule in society, this institution was not founded as a classical, a medical, or a theological school, but simply as an agricultural college. With its splendid endowment, its large and noble farm, its healthful and admirable situation, its convenient and ample buildings, its admirable and salutary military discipline, its corps of accomplished, scientific, and enthusiastic instructors, it ought to occupy a high position in the agricultural world; it ought to be 'a burning and a shining light,' attracting the attention, and becoming the pride and admiration, of every son of Massachusetts throughout the land."

The Committee of 1877, O. B. Hadwen, Esq., chairman, reported at considerable length upon the management of the farm, and say, "The productive capacity of the farm is rapidly increasing, the acres yielding larger annual returns. Unproductive lands are being renovated, and brought into profit; rough places being made smooth; the preliminary labors with view of improvement are nearly completed; and the whole outlook of the lands is more pleasing to the eye in all respects. As far as we are able to form an opinion from observation, we are satisfied that the Agricultural College will instruct and turn out men who can use both head and hands, — men pre-eminently fitted for the business relations of life; and that agriculture will be exalted and stimulated by men trained to close and exact observation in the varied departments of rural and farming pursuits."

The Examining Committee of 1878, Dr. James R. Nichols editor of "The Journal of Chemistry," chairman, say, —

"The senior class, in the examination for the Grinnell Prizes, fell under our special supervision, and a very thorough examination resulted. Here were twenty students before us who had completed the course of study as set down in the College curriculum; and an opportunity was afforded for obtaining some knowledge of the extent and value of their acquisition as students of agriculture. The practical nature of the examination is shown by a glance at the topics considered, — 'Origin and Composition of Soils;' 'Implements of Tillage;' 'Plants, their Composition, and Sources from which the Material is obtained;' 'The Susceptibility of the Plant to Modification and Improvement by Cultivation;' 'Changes produced in Soil by the Growth of Plants;' 'Methods by which the Fertility of the Soil may be retained, or Exhausted Soils restored;' 'Grain-Growing, its Influence on the Fertility of the Farm, and how retaining in its Culture;' 'Root-Crops;' 'Hay and Grass Crops;' 'Fruit-Culture on the Farm;' 'Stock-Husbandry, and the Adaptation of the United States to this Industry;' and, 'Breeds of Cattle.'

"It is true, a class-examination, however fair and above-board it may be, is not an infallible test of the positive attainments of students in any branch of education: still any one with a clear comprehension of the nature of the topics introduced, and possessing ordinary sagacity, can judge quite satisfactorily and justly of the value of the instruction imparted.

"We say unhesitatingly that the young men acquitted themselves exceedingly well; and no one of them appeared incompetent for taking charge of a farm, and conducting its affairs in accordance with good sense, and advanced knowledge of husbandry. They had evidently been well drilled in the 'science of agriculture;' and the drill embraced the various departments which closely and remotely relate to the interests of the farm. Each of the young men was required to write upon a practical topic, without text-books, or any aid except what his own knowledge supplied; and thus above twenty essays were placed in the hands of the Committee for examination. This was an important test of scholarship, and supplied a clew to the general training or culture of the students at the College. Some of their papers were quite extended and able essays, worthy even of publication. We are pleased to be able to bear testimony to the good appearance of the graduating class at Amherst."

THE FARM.

The stock on the farm now consists of twenty-five head, old and young, all but two of which are pure Ayrshires. The Trustees felt obliged, by the advice of the Governor and Council, and the existence of a very considerable debt, which the appropriation of the last Legislature did not cover, to dispose of the Shorthorn, Jersey, and Brittany cattle belonging to the farm; and it was accordingly sold at auction on the 12th of June, and realized about twelve hundred dollars, — a sum which was found to be quite insufficient to extinguish the debt.

The crops of the season were satisfactory, the first crop of grass yielding nearly a hundred and fifty tons of hay; while the second crop, or rowen, together with the corn fodder and roots, was nearly sufficient to carry the present stock of cattle through the winter. The farm will have from seventy-five to a hundred tons of hay for sale.

The horticultural department has been nearly or quite self-sustaining, and has been kept in as satisfactory a condition as could be expected, with the large amount of work which has been undertaken. The crops, with one or two exceptions, were good. The vineyard produced a large crop; but owing to a heavy hail-storm, and perhaps, also, to the want of some additional fertilization, the bunches were small, and required more labor than would otherwise have been the case to prepare them for market. The crop yielded about a hundred and fifty dollars. The nursery is in good condition, and contains a very large stock of peach and other fruit and ornamental trees, consisting of apple, pear, plum, and peach seedlings (root grafted or budded), quince stocks budded with pear, grape-vines from cuttings, evergreens (mostly Japanese) from cuttings, a large stock of the umbrella pine, Japanese maple, &c. Many of these trees and shrubs will be in a condition for sale the coming year. The severe wind and hail storm which occurred in August, and did extensive damage in most parts of the State, destroyed about five hundred lights in the plant houses. The lights have been reset, and the sash bars painted on the outside. Various other repairs and improvements have been made, entirely by the help of students, who are paid by the hour for their labor.

ANNIVERSARY EXERCISES.

The ninth anniversary exercises, or graduation of the senior class, began with the Farnsworth Prize declamations, in Amherst College Hall, on Monday, June 23. The prizes consist of two gold medals of fifty dollars each, and two silver medals of twenty-five dollars each, to be competed for by members of the sophomore and freshman classes. The judges selected were Professor E. P. Crowell of Amherst College, Dr. James R. Nichols of Haverhill, Benjamin P. Ware, Esq., of Marblehead, W. H. Bowker, Esq., of Boston, and Dr. George Mackie of Attleborough. The prizes in the sophomore class were awarded, to Charles L. Flint, jun., the gold medal, and to Joseph S. Hills the silver medal; in the freshman class, to George D. Allen the gold medal, and to John E. Wilder the silver medal.

The examination of the graduating class for the Grinnell Prizes took place in the chapel on Tuesday; the committee consisting of Dr. James R. Nichols of Haverhill, O. B. Hadwen, Esq., of Worcester, J. F. Brown, Esq., of Lunenburg, and Benjamin P. Ware, Esq., of Marblehead. The examination embraced the following topics: —

Soils. — Composition and origin of soils; practical varieties of soils, their characteristics and adaptations; soil tillage; the methods and effect of the same.

Plants. — The structure of plants; the organs of plants and their offices; composition of plants, and the sources from which the materials of their structure are obtained.

Soils and Plants. — The effect on the soil of *natural* plant-growth; effect of artificial production; the condition of an exhausted soil; fertilization, what agents or substances may be employed for the purpose; sources from which they may be obtained, and their influence on soils and plants.

Farm Management. — Farm economy; farm accounts; selection, division, fencing, and cropping of a general farm; the influence of agriculture on national character, wealth, and prosperity; growing grain as a market-product, and its effect on the farm; the fruits of the farm; the demand for cattle and their products, and the source and extent of the supply; improved breeds of cattle, their characteristics.

The Grinnell Prizes were awarded, to Samuel B. Greene of Chelsea a first prize of fifty dollars, to George P. Smith of Sunderland a second prize of thirty dollars. The Hills Botanical Prizes were awarded, first to Walter A. Sherman of Chelsea, fifteen dollars; the second to Richard S. Dickinson of Amherst, ten dollars.

The diplomas were distributed, after the graduation exercises on Wednesday, by his Honor Lieut.-Gov. Long, with an eloquent and appropriate address.

Respectfully submitted by order of the Trustees.

Charles L. Flint, *President.*

Boston, Feb. 6, 1880.

AN ACT

DONATING PUBLIC LANDS TO THE SEVERAL STATES AND TERRITORIES WHICH MAY PROVIDE COLLEGES FOR THE BENEFIT OF AGRICULTURE AND THE MECHANIC ARTS.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, —

That there be granted to the several States, for the purposes hereinafter mentioned, an amount of public land, to be apportioned to each State, a quantity equal to thirty thousand acres for each senator and representative in Congress, to which the States are respectively entitled by the apportionment under the census of eighteen hundred and sixty, *provided* that no mineral lands shall be selected or purchased under the provisions of this act

SECT. 2. *And be it further enacted*, That the land aforesaid, after being surveyed, shall be apportioned to the several States in sections, or subdivisions of sections not less than one-quarter of a section ; and, whenever there are public lands in a State subject to sale at private entry at one dollar and twenty-five cents per acre, the quantity to which said State shall be entitled shall be selected from such lands within the limits of such State. And the Secretary of the Interior is hereby directed to issue to each of the States in which there is not the quantity of public lands subject to sale at private entry at one dollar and twenty-five cents per acre, to which said State may be entitled under the provisions of this act, land-scrip to the amount in acres for the deficiency of its distributive share ; said scrip to be sold by said States, and the proceeds thereof applied to the uses and purposes prescribed in this act, and for no other use or purpose whatsoever : *provided*, that in no case shall any State to which land-scrip may thus be issued be allowed to locate the same within the limits of any other State, or of any Territory of the United States ; but their assignees may thus locate said land-scrip upon any of the unappropriated lands of the United States, subject to sale at private entry at one dollar and twenty-five cents or less per acre : *and provided further*, that not more than one million acres shall be located by such assignees in any one of the States : *and provided further*, that no such location shall be made before one year from the passage of this act.

SECT. 3. *And be it further enacted*, That all the expenses of management, superintendence, and taxes, from date of selection of such lands, previous to their sales, and all expenses incurred in the management and disbursements of the moneys which may be received therefrom, shall be paid by the States to which they may belong out of the treasury of said States, so that the entire proceeds of the sale of said lands shall be applied, without any diminution whatever, to the purposes hereinafter mentioned.

SECT. 4. *And be it further enacted,* That all moneys derived from the sale of the lands aforesaid by the States to which the lands are apportioned, and from the sales of land-scrip hereinbefore provided for, shall be invested in stocks of the United States, or of the States, or some other safe stocks yielding not less than five per centum upon the par value of said stocks; and that the moneys so invested shall constitute a perpetual fund, the capital of which shall remain forever undiminished (except so far as may be provided in section fifth of this act), and the interest of which shall be inviolably appropriated by each State which may take and claim the benefit of this act, to the endowment, support, and maintenance of at least one college, where the leading object shall be — without excluding other scientific and classical studies, and including military tactics — to teach such branches of learning as are related to agriculture and the mechanic arts, in such manner as the Legislatures of the States may respectively prescribe in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life.

SECT. 5. *And be it further enacted,* That the grant of land, and land-scrip hereby authorized, shall be made on the following conditions, to which, as well as to the provisions hereinbefore contained, the previous assent of the several States shall be signified by legislative acts.

First, If any portion of the fund invested, as provided by the foregoing section, or any portion of the interest thereon, shall by any action or contingency be diminished or lost, it shall be replaced by the State to which it belongs, so that the capital of the fund shall remain forever undiminished; and the annual interest shall be regularly applied without diminution to the purposes mentioned in the fourth section of this act, except that a sum not exceeding ten per centum upon the amount received by any State under the provisions of this act may be expended for the purchase of lands for sites or experimental farms, whenever authorized by the respective Legislatures of said States.

Second, No portion of said fund, nor the interest thereon, shall be applied directly or indirectly, under any pretence whatever, to the purchase, erection, preservation, or repair of any building or buildings.

Third, Any State which may take and claim the benefit of the provisions of this act shall provide, within five years, at least not less than one college, as described in the fourth section of this act, or the grant to such State shall cease: and said State shall be bound to pay the United States the amount received of any lands previously sold, and that the title to purchasers under the State shall be valid.

Fourth, An annual report shall be made regarding the progress of each college, recording any improvements and experiments made, with their cost and results, and such other matters, including State industrial and economical statistics, as may be supposed useful; one copy of which shall be transmitted by mail free, by each, to all other colleges which may be endowed under the provisions of this act, and also one copy to the Secretary of the Interior.

Fifth, When lands shall be selected from those which have been raised to double the minimum price, in consequence of railroad grants, they shall be computed to the States at the maximum price, and the number of acres proportionally diminished.

Sixth, No State, while in a condition of rebellion or insurrection against the Government of the United States, shall be entitled to the benefit of this act.

Seventh, No State shall be entitled to the benefits of this act unless it shall express its acceptance thereof by its Legislature within two years from the date of its approval by the President.

SECT. 6. *And be it further enacted*, That land-scrip issued under the provisions of this act shall not be subject to location until after the first day of January, one thousand eight hundred and sixty-three.

SECT. 7. *And be it further enacted*, That the land officers shall receive the same fees for locating land-scrip issued under the provisions of this act as is now allowed for the location of military bounty land warrants under existing laws, *provided* their maximum compensation shall not be thereby increased.

SECT. 8. *And be it further enacted*, That the governors of the several States to which scrip shall be issued under this act shall be required to report annually to Congres all sales made of such scrip until the whole shall be disposed of, the amount received for the same, and what appropriation has been made of the proceeds.

Approved July 2, 1862.

AN ACT TO PROVIDE FOR THE RECEPTION OF A GRANT OF CONGRESS, AND TO CREATE A FUND FOR THE PROMOTION OF EDUCATION IN AGRICULTURE AND THE MECHANIC ARTS.

Be it enacted by the Senate and House of Representatives in General Court Assembled, and by the authority of the same, as follows: —

SECT. 1. The Commonwealth of Massachusetts hereby accepts the grant offered to it by the United States, as set forth and defined in the act of Congress entitled "An Act donating public lands to the several States and Territories which may provide colleges for the benefit of agriculture and the mechanic arts," said act being chapter one hundred and thirty of the statutes of the United States, passed at the second session of the thirty-seventh Congress, and approved by the President July second, eighteen hundred and sixty-two, upon the terms and conditions contained and set forth in said act of Congress; and the Governor of the Commonwealth is hereby authorized and instructed to give due notice thereof to the Government of the United States.

SECT. 2. The Governor is hereby authorized and instructed to receive by himself or his order, from the Secretary of the Interior, or any other person authorized to issue the same, all the land-scrip to which this Commonwealth may be entitled by the provisions of the before-mentioned act of Congress.

SECT. 3. The Governor, by and with the advice and consent of the Council, is hereby authorized and instructed to appoint a commissioner, whose duty it shall be to locate, without unnecessary delay, all the land-scrip which may come into the possession of the Commonwealth by virtue of this act, and to sell the same, from time to time, on such terms as the Governor and Council shall determine. Said commissioner shall give a bond, with sufficient sureties, in the penal sum of fifty thousand dollars, to be approved by the Governor and Council, that he will faithfully perform the duties of his office, and shall render full and accurate returns to them at the end of every six months, or oftener if required to do so by them, of his proceedings under this act. The compensation of said commissioner shall be fixed by Governor and Council, and shall be paid out of the treasury of the Commonwealth, and the Governor is hereby authorized to draw his warrant therefor.

SECT. 4. All moneys received by virtue of this act, for the sale of land-scrip, shall be immediately deposited with the Treasurer of the Commonwealth, who shall invest and hold the same in accordance with the fourth section of the before-mentioned act of Congress. The moneys so invested shall constitute a perpetual fund, to be entitled the Fund for the Promotion of Education in Agriculture and the Mechanic Arts, which shall be appropriated and used in such manner as the Legislature shall prescribe, and in accordance with the said act of Congress.

SECT. 5. This act shall take effect upon its passage. Approved March 18, 1863.

AN ACT TO INCORPORATE THE TRUSTEES OF THE MASSACHUSETTS AGRICULTURAL COLLEGE.

Be it enacted by the Senate and House of Representatives in General Court Assembled, and by the authority of the same, as follows: —

SECTION 1. Marshall P. Wilder of Dorchester, Charles G. Davis of Plymouth, Nathan Durfee of Fall River, John Brooks of Princeton, Henry Colt of Pittsfield, William S. Southworth of Lowell, Charles C. Sewall of Medfield, Paoli Lathrop of South Hadley, Phinehas Stedman of Chicopee, Allen W. Dodge of Hamilton, George Marston of Barnstable, William B. Washburn of Greenfield, Henry L. Whiting of Tisbury, John B. King of Nantucket, their associates and successors, are hereby constituted a body corporate, by the name of the Trustees of the Massachusetts Agricultural College, the leading object of which shall be, without excluding other scientific and classical studies, and including military tactics, to teach such branches of learning as are related to agriculture and the mechanic arts, in order to promote the liberal and practical education of the industrial classes in the several pursuits and professions of life, to be located as hereinafter provided; and they and their successors, and such as shall be duly elected members of said corporation, shall be and remain a body corporate by that name forever. And, for the orderly conducting of the business of said corporation, the said trustees shall have power and authority from time to time, as occasion may require, to elect a president, vice-president, secretary, and treasurer, and such other officers of said corporation as may be found necessary, and to declare the duties and tenures of their respective offices ; and also to remove any trustee from the same corporation, when, in their judgment, he shall be rendered incapable, by age or otherwise, of discharging the duties of his office, or shall neglect or refuse to perform the same ; and, whenever vacancies shall occur in the Board of Trustees, the Legislature shall fill the same : *provided, nevertheless*, that the number of members shall never be greater than fourteen, exclusive of the Governor of the Commonwealth, the Secretary of the Board of Education, the Secretary of the Board of Agriculturc, and the President of the Faculty, each of whom shall be, *ex officio*, a member of said corporation.

SECT. 2. The said corporation shall have full power and authority to determine at what times and places their meetings shall be holden, and the manner of notifying the trustees to convene at such meetings ; and also, from time to time, to elect a president of said college, and such professors, tutors, instructors, and other officers of said college, as they shall judge most for the interest thereof, and to determine the duties, salaries, emoluments, responsiblilities, and tenures of their several offices. And the said corporation are further empowered to purchase or erect, and keep in repair, such houses and other buildings as they shall judge necessary for the said college; and also to make and ordain, as occasion may require, reasonable rules, orders, and by-laws not repugnant to the Constitution and laws of this Commonwealth, with reasonable penalties, for the good government of the said college and for the regulation of their own body, and also to determine and regulate the course of instruction in said college, and to confer such appropriate degrees as they may determine and prescribe ; *provided, nevertheless*, that no corporate business shall be transacted at any meeting unless one-half at least of the trustees are present.

SECT. 3. The said corporation may have a common seal, which they may alter or renew at their pleasure; and all deeds sealed with the seal of said corporation, and signed by their order, shall, when made in their corporate name, be considered in law as the deeds of said corporation; and said corporation may sue and be sued in all actions, real, personal, or mixed, and may prosecute the same to final judgement and execution, by the name of the Trustees of the Massachusetts Agricultural College; and said corporatiohn shall be capable of taking and holding in fee simple, or any less estate, by gift, grant, bequest, devise, or otherwise, any lands, tenements, or other estate, real or personal : *provided* that the clear annual income of the same shall not exceed thirty thousand dollars.

SECT. 4. The clear rents and profits of all the estate, real and personal, of which the said corporation shall be seized and possessed, shall be appropriated to the uses of said college in such manner as shall most effectually promote the objects declared in the first section of this act, and as may be recommended from time to time by the said corporation, they conforming to the will of any donor or donors in the application of any estate which may be given, devised, or bequeathed, for any particular object connected with the college.

SECT. 5. The Legislature of this Commonwealth may grant any further powers to, or alter, limit, annul, or restrain, any of the powers vested by this act in, the said corporation, as shall be found necessary to promote the best interests of the said college; and more especially may appoint and establish overseers or visitors of the said college, with all necessary powers for the better aid, preservation, and government thereof. The said corporation shall make an annual report of its condition, financial and otherwise, to the Legislature at the commencement of its session.

SECT. 6. The Board of Trustees shall determine the location of said college in some suitable place within the limits of this Commonwealth, and shall purchase, or obtain by gift, grant, or otherwise, in connection therewith, a tract of land containing at least one hundred acres, to be used as an experimental farm, or otherwise, so as best to promote the objects of the institution; and, in establishing the by-laws and regulations of said college, they shall make such provision for the manual labor of the students on said farm as they may deem just and reasonable. The location, plan of organization, government, and course of study, prescribed for the college, shall be subject to the approval of the Legislature.

SECT. 7. One-tenth part of all the moneys which may be received by the State treasurer from the sale of land-scrip, by virtue of the provisions of the one hundred and thirtieth chapter of the acts of the thirty-seventh Congress, at the second session thereof, approved July second, eighteen hundred and sixty-two, and of the laws of this Commonwealth, shall be paid to said college, and appropriated towards the purchase of said site or farm, *provided*, *nevertheless*, that the said college shall first secure, by valid subscriptions or otherwise, the further sum of seventy-five thousand dollars, for the purpose of erecting suitable buildings thereon; and, upon satisfactory evidence that this proviso has been complied with, the Governor is authorized from time to time to draw his warrants therefor.

SECT. 8. When the said college shall have been duly organized, located, and established, as and for the purposes specified in this act, there shall be appropriated and paid to its treasurer each year, on the warrant of the Governor, two-thirds of the annual interest or income which may be received from the fund created under and by virtue of the act of Congress named in the seventh section of this act and the laws of this Commonwealth, accepting the provisions thereof, and relating to the same.

SECT. 9. In the event of a dissolution of said corporation by its voluntary act at any time, the real and personal property belonging to the corporation shall revert and belong to the Commonwealth, to be held by the same, and be disposed of as it may see fit, in the advancement of education in agriculture and the mechanic arts. The Legislature shall have authority at any time to withhold the portion of the interest or income from said fund provided in this act, whenever the corporation shall cease or fail to maintain a college within the provisions and spirit of this act and the before-mentioned act of Congress, or for any cause which they deem sufficient.

Approved April 29, 1863.

CATALOGUE

OF

TRUSTEES, OVERSEERS, FACULTY, AND STUDENTS.

1879.

TRUSTEES, OVERSEERS, FACULTY, AND STUDENTS.

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CHARLES L. FLINT, *President of the College.*
JOHN W. DICKINSON, *Secretary of Board of Education.*
CHARLES L. FLINT, *Secretary of Board of Agriculture.*

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Secretary.

CHARLES L. FLINT OF BOSTON.

Auditor.

HENRY COLT OF PITTSFIELD.

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Board of Overseers.

THE STATE BOARD OF AGRICULTURE.

Examining Committee of Overseers.

JAMES R. NICHOLS . . . . of Haverhill.
JOHN F. BROWN . . . . of Lunenburg.
JOHN B. MOORE . . . . of Concord.
AVERY P. SLADE . . . . of Somerset.
E. F. BOWDITCH . . . . of Framingham.

Members of Faculty.

CHARLES L. FLINT, President.

LEVI STOCKBRIDGE,
Professor of Agriculture.

HENRY H. GOODELL, M.A.,
Professor of Modern Languages.

CHARLES A. GOESSMANN, Ph.D.,
Professor of Chemistry.

WILLIAM B. GRAVES, M A.,
Professor of Physics and Civil Engineering.

SAMUEL T. MAYNARD, B.S.,
Professor of Botany and Horticulture.

First Lieut. CHARLES MORRIS, Fifth Artillery, U.S.A.
Professor of Military Science and Tactics.

GEORGE MONTAGUE,
Instructor in Book-keeping.

JOHN W. CLARK, B.S.,
Superintendent of Nurseries.

Graduates of 1879.[1]

Dickinson, Richard Storrs	Amherst.	
Green, Samuel Bowdlear (Boston Univ.)	Chelsea.	
Rudolph, Charles (Boston Univ.)	New Haven, Conn.	
Sherman, Walter Alden (Boston Univ.)	Lowell.	
Smith, George Parmenter (Boston Univ.)	Sunderland.	
Swan, Roscoe Westley (Boston Univ.)	Framingham.	
Waldron. Hiram Edmund Baylies (Boston University)	Rochester.	
Total		7

Senior Class.

Endicott, George	New-York City.	
Fowler, Alvan Luther	Westfield.	
Gladwin, Frederic Eugene	Westfield.	
Lee, William Gilbert	Amherst.	
McQueen, Charles Manjie	Longmeadow.	
Parker, William Colvard (Boston Univ.)	Wakefield.	
Ripley, George Arms	Worcester.	
Stone, Almon Humphrey	Phillipston.	
Wood, Lewis	West Upton.	
Total		9

Junior Class.

Bowman, Charles Abel	Billerica.	
Clark, Wallace Valentin	Amherst.	
Fairfield, Frank Hamilton	Waltham.	
Flint, Charles Louis, jun.	Boston.	
Hall, Albert Oliver	Chelsea.	
Hills, Joseph Lawrence	Boston.	
Howe, Elmer Dwight	Marlborough.	
Howe, Winslow Brigham	Marlborough.	
Perry, Alfred Dwight	Worcester.	
Peters, Austin	Boston.	
Rawson, Edward Briggs	Brooklyn, L.I.	
Sattler, Hermann Charles	Baltimore, Md.	
Spalding, Abel Walter	Billerica.	
Whitaker, Arthur	Needham.	
Wilcox, Henry Harrison	Nawiliwili, S.I.	
Total		15

[1] The Annual Report, being made in January, necessarily includes parts of two academic years; and the catalogue gives the names of such students as have been connected with the College during any portion of the year 1879.

Sophomore Class.

Abercrombie, Fred Norman	Boston.
Allen, Francis Sherwin	Medfield.
Allen, George Dickinson	Amherst.
Aplin, George Thomas	Putney, Vt.
Beach, Charles Edward	Hartford, Conn.
Bingham, Eugene Percival	Fitchburg.
Bishop, William Herbert	Diamond Hill, R.I.
Boynton, Charles Enoch	Groveland.
Brodt, Harry Snowden	Dansville, N.Y.
Brown, Charles Henry	Taunton.
Carr, Walter Frank	Clinton.
Chandler, Everett Sawyer	Coldwater, Mich.
Chapin, Henry Edgerton	Springfield.
Chase, Harry Kirk	New-York City.
Chipman, Frank Ellsworth	Beverly.
Clay, Cassius Morey	Westminster, Vt.
Comins, William Henry	North Hadley.
Cooper, James Willard	East Bridgewater.
Currier, George Francis	Amherst.
Cutter, John Ashburton	Boston.
Damon, Samuel Chester	Lancaster.
Deuel, Frank Dennis	Amherst.
Dutton, Charles Kitteridge	Hatfield.
Fish, Charles Sumner	South Boston.
Floyd, Charles Walter (Boston Univ.)	Boston.
Goodale, David	Marlborough.
Gowdy, Harry Morgan	Westfield.
Harris, Louis Lincoln	Westfield.
Hillman, Charles Dexter	Hardwick.
Holmes, Samuel Judd	Montclair, N.J.
Howard, Joseph Henry	Hyannis.
Howe, George Dickinson	North Hadley.
Jones, Frank Waldo	South Scituate.
Jones, Nathaniel Nelson	Georgetown.
Joyner, Frank Hall	North Egremont.
Kingman, Morris Bird	Amherst.
Kinney, Burton Arial	Lowell.
Krauss, Alonzo Augustus	Boston.
Livermore, Nathaniel Lyon	Alexandria, Minn.
Lindsey, Frank B.	Clayton.
May, Frederick Goddard	Boston.
Meade, William George	Springfield.

Miller, Willie Smith	South Hadley.
Morse, William Austin	Boston.
Myrick, Herbert	Concord.
Paige, James Breckenridge	Prescott.
Perkins, Charles Brookhouse	Salem.
Perkins, Dana Edson	Lynn.
Platt, John Cheney	New-York City.
Plumb, Charles Sumner	Westfield.
Putnam, Henry Anderson	Worcester.
Shiverick, Asa Frank	Wood's Holl.
Stone, Winthrop Ellsworth	Amherst.
Taft, Levi Rawson (Boston Univ.)	Mendon.
Taylor, Alfred Howland	Yarmouth.
Taylor, Frederic Patterson	Boston.
Thurston, Wilbur Herbert (Boston Univ.)	Upton.
Warner, Clarence Duane (Boston Univ.)	Granby.
Wheeler, Henry Lewis	Great Barrington.
Wheelock, Victor Lamont	North Amherst.
Wilder, John Emery	Lancaster.
Willard, Daniel	North Hartland, Vt.
Williams, James Stoddard	Glastonbury, Conn.
Wilmarth, Frederick Augustus (Boston University)	Upton.
Windsor, Joseph Libbey	Grafton.
Total	65

Freshman Class.

Bagley, Sydney Currier	Boston.
Bishop, Edgar Allen	Diamond Hill, R.I.
Chaplin, John Dorr Hayward	East Bridgewater.
Fletcher, Frank Howard	Townsend.
Hevia, Alfred Armand	Havana, Cuba.
Holman, Samuel Morey	Attleborough.
Manton, William James	Lime Rock, R.I.
Minott, Charles Walter	Westminster.
Nourse, David Oliver	Bolton.
Owen, Henry Willard	Amherst.
Preston, Charles Henry	Danvers.
Seldon, John Lincoln	Ashfield.
Smith, William Edward	Sheffield.
Tryon, Charles Osmer	So. Glastonbury, Conn.
Wheeler, Homer Jay	Bolton.
Total	15

Select Class.

Brooks, William Cummings	Boston.
Casparian, Gregory	Nicomedia, Turkey.
Chandler, Willard Mayne	South Natick.
Chittenden, Edgar Davis	Sunderland.
Clarke, Henry Little	New Bedford.
Cochran, Robert Armstrong, jun.	Maysville, Ky.
Delano, Julio Joaquin	Valparaiso, Chili.
Hashiguchi, Boonzo	Tokio, Japan.
Hill, Charles Henry	North Amherst.
Jackson, Andrew	San Francisco, Cal.
Johnson, Frank Prescott	Waltham.
Jones, Edward Spaulding	Worcester.
Knowles, William Fletcher, jun.	North Cambridge.
Leonard, Arthur	Rock.
McKenna, James Peter	Amherst.
Parsons, Howard Albert	Enfield, Conn.
Porter, Royal Luther	Brooklyn, L.I.
Smith, Benjamin Salter	New-York City.
Smith, Hiram Fred Markley	Cleveland, O.
Smith, John Leland	Barre.
Wolfe, Walter Madson	Montclair, N.J.
Wood, Wilbur	West Upton.
Young, Charles Elisha	Amherst.
Total	23

Post-Graduates.

Clark, B.S., Atherton (Boston Univ.)	Amherst.
Hunt, B.S., John Franklin	Amherst.
Lovell, M.A., Henry Lyman (Amherst College)	Amherst.
Stockbridge, B.S., Horace Edward (Boston University)	Amherst.
Total	4

Summary.

Post-Graduates	4
Graduates of 1879	7
Senior Class	9
Junior Class	15
Sophomore Class	65
Freshman Class	15
Select Class	23
Total	138

COURSE OF STUDY AND TRAINING.

FRESHMAN YEAR.

First Term. — Chemistry, 3 hours each week; Human Anatomy, Physiology, and Hygiene, 3 hours; Algebra, 5 hours; English, 2 hours; Agriculture, 2 hours; Declamation, 1 hour; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term. — Inorganic Chemistry, 3 hours; Botany, 3 hours; Geometry, 5 hours; Agriculture, 3 hours; English, 2 hours; Elocution, 1 hour; Freehand Drawing, 3 hours; Military Drill, 3 hours.

Third Term. — Systematic Botany, 4 hours; Geometry, 4 hours; French, 5 hours; Elocution, 2 hours; Agriculture, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

SOPHOMORE YEAR.

First Term. — Systematic Botany, 3 hours each week; Geometry, 4 hours; French, 5 hours; English, 1 hour; Agriculture, 2 hours; Declamation, 1 hour; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term. — Geology, 3 hours; Trigonometry, 5 hours; French, 4 hours; English, 1 hour; Agriculture, 3 hours; Declamation, 1 hour; Drawing, 3 hours; Military Drill, 3 hours.

Third Term. — Zoölogy, 5 hours; Surveying, 5 hours; Agriculture, 2 hours; English, 3 hours; Declamation, 1 hour; Levelling, 3 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

JUNIOR YEAR.

First Term. — Mechanics, 5 hours each week; Entomology, 2 hours; Market-Gardening, 2 hours; Horticulture, 2 hours; Military Drill, 3 hours; Manual Labor, 6 hours.

Second Term. — Physics, 5 hours; Practical Chemistry, 9 hours; Drawing, 3 hours; Agricultural Debate, 1 hour; Declamation, 1 hour; Military Drill, 3 hours.

Third Term. — Astronomy, 4 hours; Practical Chemistry, 9 hours; Declamation, 1 hour; Stock and Dairy Farming, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

SENIOR YEAR.

First Term. — English Literature, 4 hours each week; Practical Chemistry, 7 hours; Book-keeping, 2 hours; Roads and Railroads, 3 hours; Military Science, 2 hours; Original Declamation, 1 hour; Military Drill, 3 hours.

Second Term. — English Literature, 4 hours; Theses, 1 hour; Mental Science, 4 hours; Agriculture, 2 hours; Veterinary Science, 3 hours; Military Science, 2 hours; Microscopy, 4 hours; Military Drill, 3 hours.

Third Term. — Veterinary Science, 2 hours; Military Science, 2 hours; Botany, 3 hours; Landscape-Gardening, 3 hours; Rural Law, 1 hour; Lectures on English Language, 2 hours; Theses, 1 hour; Agricultural Review, 4 hours; Military Drill, 4 hours.

CALENDAR FOR 1880.

The third term of the collegiate year begins March 25, and continues till June 23.

The first term begins Aug. 26, and continues till Nov. 24.

The second term begins Dec. 9, and continues till March 9, 1881.

There will be an examination of candidates for admission to the College, at the Botanic Museum, at nine A.M., Tuesday, June 22, and also on Thursday, Aug. 26.

The Farnsworth Prize Declamations take place Monday evening, June 21.

The public examination of the graduating class for the Grinnell Prize for excellence in agriculture, and the examination of the other classes in the studies of the term, will take place on Tuesday forenoon, June 22.

The exercises of Graduation Day occur June 23.

ADMISSION.

Candidates for admission to the Freshman Class are examined, orally and in writing, upon the following subjects: English Grammar, Geography, Arithmetic, Algebra through simple equations, and the History of the United States.

Candidates for higher standing are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the College until he is fifteen years of age; and every student is required to furnish a certificate of good character from his late pastor or teacher, and to give security for the prompt payment of term-bills. Tuition and room-rent must be paid in advance at the beginning of each term; and bills for board, fuel, &c., at the end of every term.

The regular examinations for admission are held at the Botanic Museum, at nine o'clock A.M., Tuesday, June 22, and on Thursday, Aug. 26; but candidates may be examined and admitted at any other time in the year.

EXPENSES.

Tuition	$12 00 per term.
Room-rent	5 00 to 10 00 "
Board	2 50 to 3 50 per week.
Expenses of chemical laboratory to students of practical chemistry	10 00 per term.
Public and private damages, including value of chemical apparatus destroyed or injured .	At cost.
Annual expenses, including books . .	$250 00 to 350 00

REMARKS.

The regular course of study occupies four years; and those who complete it receive the degree of Bachelor of Science, the diploma being signed by the Governor of Massachusetts, who is president of the corporation.

Regular students of the College may also, on application, become members of Boston University, and, upon graduation, receive its diplomas in addition to that of the College, thereby becoming entitled to all the privileges of its alumni.

The instruction in the languages is intended to qualify the graduates to write and speak English with correctness and effect, and to translate French with facility. The scientific course is as thorough and practical as possible; and every science is taught with constant reference to its application to agriculture and the wants of the farmer.

The instruction in agriculture and horticulture includes every branch of farming and gardening which is practised in Massachusetts, and is both theoretical and practical. Each topic is discussed thoroughly in the lecture-room, and again in the plant-house or field, where every student is obliged to labor. The amount of required work, however, is limited to six hours per week in order that it may not interfere with study. Students are allowed to do additional work for wages, provided they maintain the necessary rank as scholars.

Indigent students are allowed to do such work as may offer about the College or farm buildings, or in the field; but it is hardly possible for one to earn more than from fifty to one hundred dollars per annum, besides performing other duties. So far as is consistent with circumstances, students will be permitted to select such varieties of labor as they may, for special reasons, desire to engage in.

Those who pursue a select course attend recitations and lectures with the regular classes; but those properly qualified, who desire special instruction in botany, chemistry, civil engineering, veterinary science, agriculture, or horticulture, may make private arrangements with the officers having charge of these departments.

An expenditure of from ten to fifty dollars is necessary to provide furniture, which may be purchased at reasonable rates, either new or second-hand. At the beginning of the second term of attendance each student is required to provide himself with the full uniform prescribed for the battalion of Agricultural Cadets, the cost of which is about thirty dollars.

On Sundays students are required to attend church in the forenoon, and invited to join a class for the study of the Bible in the afternoon. They will be permitted to select their place of attendance from among the churches in the town, of the following denominations; viz., Baptist, Congregational, Episcopalian, Methodist, and Roman Catholic.

POST-GRADUATE COURSE.

Graduates of colleges and scientific schools may become candidates for the degree of Doctor of Science, or Doctor of Philosophy, from the College or from the University, and pursue their studies under the direction of Professor Goessmann in chemistry, or other members of the faculty in their respective departments.

BOOKS, APPARATUS, AND SPECIMENS IN NATURAL HISTORY.

The library of the College contains about two thousand volumes. Among them are several sets of cyclopædias, magazines, and newspapers, reports of agricultural societies and state boards of agriculture, and many standard works on agriculture and horticulture. There are also many useful works of reference in chemistry, botany, surveying, and drawing.

The faculty and students also have the privilege of drawing books from the excellent library of Amherst College, which contains over thirty thousand volumes.

The State Cabinet of specimens, illustrating the geology and natural history of Massachusetts, has been removed from Boston to the College, and is of much value for purposes of instruction.

The Knowlton Herbarium contains more than ten thousand species of named botanical specimens, besides a large number of duplicates. The Botanic Museum is supplied with many interesting and useful specimens of seeds, woods, and fruit-models. There is also a set of diagrams illustrating structural and systematic botany, including about three thousand figures.

About fifteen hundred species and varieties of plants are cultivated in the Durfee Plant-House, affording much pleasure and information to students and visitors.

The class in microscopy has the use of seven of Tolles' best compound microscopes, with objectives from four inches to one-eighth of an inch in focal distance, and a variety of eye-pieces.

PRIZES.

FARNSWORTH RHETORICAL MEDALS.

Isaac D. Farnsworth, Esq., of Boston, has generously provided a fund of fifteen hundred dollars, which is to be used for the purchase of gold and silver medals, to be annually awarded, under the direction of the College Faculty, for excellence in declamation.

GRINNELL AGRICULTURAL PRIZES.

Hon. William Claflin of Boston has given the sum of one thousand dollars for the endowment of a first prize of fifty dollars, and a second prize of thirty dollars, to be called the Grinnell Agricultural Prizes, in honor of George B. Grinnell, Esq., of New York. These prizes are to be paid in cash to those two members of the graduating class who may pass the best oral and written examination in theoretical and practical agriculture.

HILLS BOTANICAL PRIZES.

For the best herbarium collected by a member of the class of 1880, a prize of fifteen dollars is offered, and, for the second best, a prize of ten dollars; also a prize of five dollars for the best collection of woods, and a prize of five dollars for the best collection of dried plants from the College Farm.

REGULATIONS.

I. — Students are forbidden to combine for the purpose of absenting themselves from any required exercise, or violating any known regulation of the College.

II. — The roll shall be called five minutes after the ringing of the bell for each exercise of the College, by the officer in charge, unless a monitor be employed; and students who do not answer to their names will be marked absent, provided that any student coming in after his name has been called shall be marked tardy. Two tardinesses shall be reckoned as one absence.

III. — Absence from a single exercise may be allowed or excused by the officer in charge of the same, if requested beforehand; but permission to be absent from several exercises must be obtained in advance from the general excusing officer, or from the president. In such cases the officer excusing will furnish a certificate of excuse, which shall state the precise time for which absence is permitted, and which shall be a satisfactory reason for absence from all exercises occurring within the time specified.

IV. — Excuses for all absences, whether with permission obtained beforehand or not, must be submitted to the excusing committee. They must be rendered promptly within one week from the date of absence; and those deemed unsatisfactory will be returned to the student with the indorsement of the committee.

V. — Whenever the aggregate number of unexcused absences in all departments reaches five, the student so delinquent shall be informed of the fact. When the number of such absences reaches eight, the parent or guardian of the student shall be informed of his delinquency; and, when ten such delinquencies are justly recorded against any student, his connection with the College may be terminated.

VI. — Students are forbidden to absent themselves without excuse from the regular examinations, to give up any study without permission from the president, or to remove from one room to another without authority from the officer in charge of the dormitory buildings; and no student shall be permitted to make such change until he has procured from the inspecting officer a written statement that the room about to be vacated is in perfect order.

VII. — Students shall be required to attend the church of their selection regularly on Sunday morning, and report in writing to the excusing officer, during the ensuing week, whether they attended or not.

VIII. — The record of deportment, scholarship, and attendance, will be carefully kept; and, whenever the average rank of a student falls below fifty, he will not be allowed to remain a member of the College, except by a special vote of the faculty. Admission to the College, and promotion from class to class, as well as to graduation, are granted only by vote of the faculty.

IX. — Students are required to abstain from any thing injurious to the buildings and other property of the College, and in all respects to conduct themselves with propriety.

X. — Parents and guardians are specially urged to co-operate with the faculty in securing the faithful attendance of students upon every appointed exercise of the College.

SIZE OF ROOMS.

For the information of those desiring to carpet their rooms, the following measurements are given. In the south dormitory the main corner-rooms are fifteen by eighteen feet, and the adjoining bedrooms eight by twelve feet. The inside rooms are fourteen by fifteen feet, and the bedrooms eight by eight feet. In the north dormitory the corner-rooms are fourteen by fifteen feet, and the annexed bedrooms eight by ten feet; while the inside rooms are thirteen feet and a half by fourteen feet and a half, and the bedrooms eight by eight feet.

SCHOLARSHIPS.

The income of the Robinson Fund of one thousand dollars, the bequest of Miss Mary Robinson of Medfield, is assigned by the faculty to such indigent student as they may deem most worthy.

The Trustees voted in January, 1878, to establish one free scholarship for each of the eleven congressional districts of the State. Applications for such scholarships should be made to the representative from the district to which the applicant belongs. The selection for these scholarships will be determined as each member of Congress may prefer; but, where several applications are sent in from the same district, a competitive examination would seem to be desirable. Applicants should be good scholars, of vigorous constitution; and should enter College with the intention of remaining through the course, and then engaging in some pursuit connected with agriculture. To every such student the cash value of a scholarship is one hundred and forty-four dollars.

DR. JOHN CUMMINGS, *Treasurer*, *in Account with* MASSACHUSETTS AGRICULTURAL COLLEGE. CR.

Date	Dr.	Amount	Date	Cr.	Amount
1879.			1879.		
Jan. 1.	To Balance, cash, in hands of George Montague,	$760 20		By Expenses, Farm account	$3,795 16
	Receipts, Farm account	2,938 05		Current expense account	4,940 93
	Term bill account	5,932 63		Term bill account	2,255 97
	Grinnell Prize Fund account	80 00		Interest account	713 42
	Totten Prize Fund account	5 00		Hills Fund account	1,148 26
	Interest account, rebate on notes	32 45		Mary Robinson Fund	70 00
	Hills Fund, income	640 50		Botanical account	1,811 94
	Mary Robinson Fund, income	70 00		Salary account	17,461 30
	Botanical account	1,602 19		Bills payable	33,350 00
	State Endowment Fund, income,	12,720 11		Laboratory account	385 96
	State appropriation	32,000 00		Farnsworth Prize Fund	60 73
	Bills payable	9,350 00		Grinnell Prize Fund	80 00
	Farnsworth Prize Fund, income	100 00		Whiting Street Fund, invested by vote of trustees,	1,000 00
	Salary account	300 00	1880.		
	Expense account	89 26			
	Laboratory account	28 77	Jan. 16.	By Balance, cash	575 49
	Whiting Street estate	1,000 00			
		$67,649 16			$67,649 16

JOHN CUMMINGS, *Treasurer*.

SENATE. No. 14.

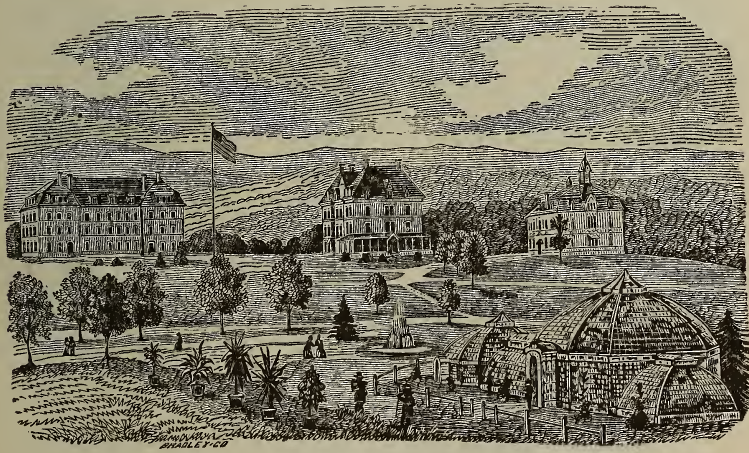
EIGHTEENTH ANNUAL REPORT

OF THE

MASSACHUSETTS

AGRICULTURAL COLLEGE.

JANUARY, 1881.



BOSTON:
Rand, Avery, & Co., Printers to the Commonwealth,
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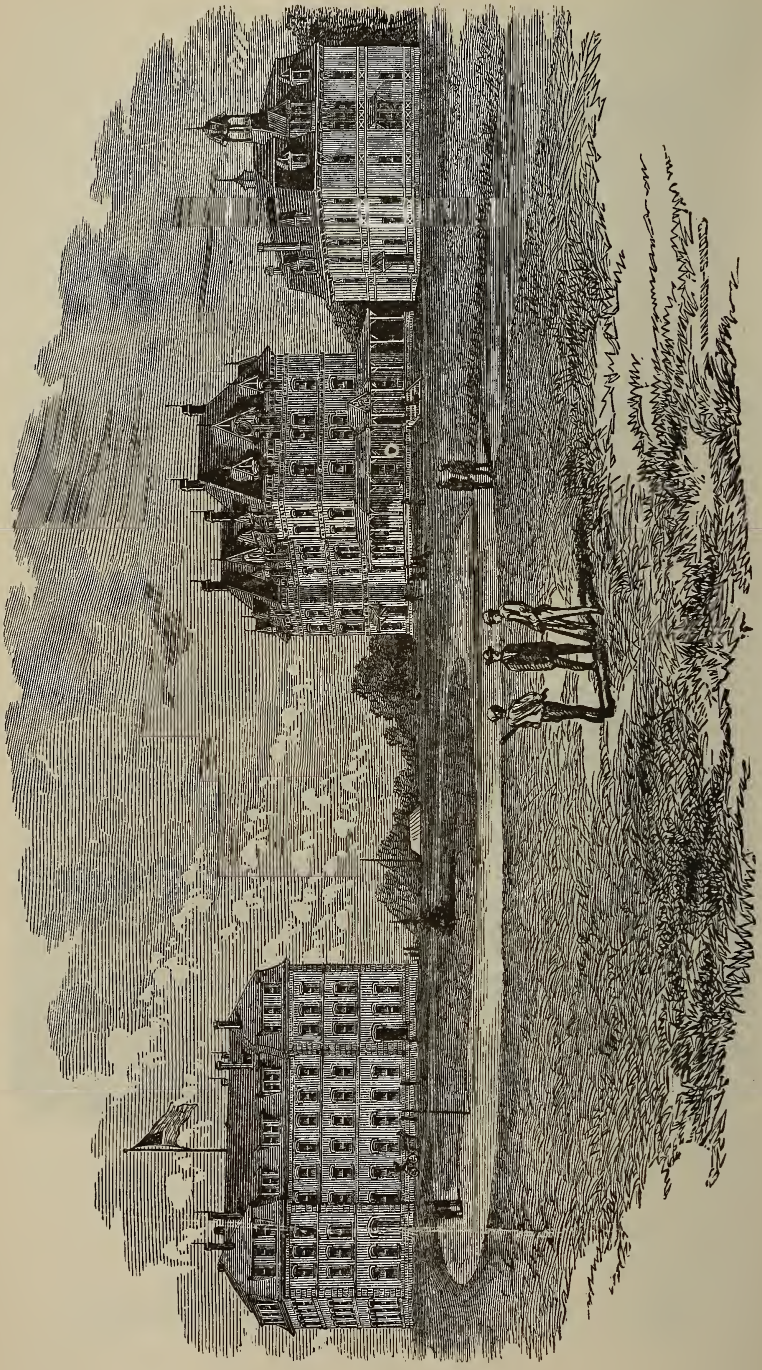
1881.



Commonwealth of Massachusetts.

EXECUTIVE DEPARTMENT, BOSTON, Jan. 14, 1881.

To the Honorable Senate.

I HAVE the honor herewith to transmit for the information and use of the General Court the Eighteenth Annual Report of the Trustees of the Massachusetts Agricultural College.

JOHN D LONG.

Commonwealth of Massachusetts.

MASSACHUSETTS AGRICULTURAL COLLEGE,
AMHERST, MASS., Jan. 13, 1881.

To His Excellency JOHN D. LONG.

DEAR SIR, — I have the honor herewith to present to your Excellency and the Honorable Council the Eighteenth Annual Report of the Trustees of the Massachusetts Agricultural College.

I am, sir, very respectfully,
Your obedient servant,

LEVI STOCKBRIDGE, *President.*

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ANNUAL REPORT.

To His Excellency the Governor and the Honorable Council.

The Trustees of the Massachusetts Agricultural College respectfully submit their Eighteenth Annual Report.

In the last Annual Report a detailed statement was made of the efforts of the Trustees of the College to contract the field of its activities to correspond with its diminished income and the mandate of the Legislature by reducing the wages for student labor, by discharging a portion of the Faculty, lessening the salaries, and increasing the duties of those retained, and by deferring the procurement of appliances to make the exercises of the recitation-room more efficient and instructive.

The resignation of President William S. Clark, whose popular talents and prestige as a successful educator contributed so largely to the success of the College during the first eleven years of its operations, and the two subsequent changes of its executive head, making three administrations in a period of ten months, were a very important part of these modifications, and were sufficiently radical and influential to derange or stagger an older and more thoroughly established institution. It is perhaps now too early to determine what is to be the ultimate result of these changes on the College as an educational institution, or on its position and influence in winning the community to such an accord with its plans and purposes, as to secure the desired accession of students, and the sympathetic aid of a liberal public. The enactment of the Legislature of 1879, growing in part undoubtedly out of the strife of parties to secure the commendation of the people as the special champions of retrenchment and financial reform, and which made the Governor and Council a commission to examine into the status of the institution with the intent of severing its connection with, and releasing the State from, its obligations and guaranties to the General Government respecting it, culminated in a report to the Legislature of 1880, practically recommending that the College with all its real and personal estate, with its trust funds received from the United States for its specific support, be given to Amherst College, and further effort to maintain it be abandoned. The phraseology of the resolve creating the commission, and defining its work, was so peculiar, that it had little or no discretionary power, and there was no other course for it to take. But it was a measure so radical and subversive of the integrity of the State, so forgetful of the intent and design for which Congress gave its endowment fund, that it not only met with no favorable public response, but with almost universal remonstrance, especially so by the agricultural portion of the community; and no effort was made by the Legislature to accept of the proposal, or to give it legal force. It is charitable to believe that the original authors of this measure had no intent to destroy or injure the institution for the benefit of another, but an honest purpose to relieve the tax burden of the Commonwealth. But the suspicion of such a purpose called out the latent friendship and sympathies of farmers and the friends of high education for agricultural pursuits, and aroused them to a consciousness of the fact, that, though the College was the ward of the State, its perpetuity, power, and influence could be enhanced by their active moral support. This effort to settle, or unsettle, the status of the College, resulted in giving it strength. And it may be reasonable to conclude that just this struggle was required to permanently establish its relations to the State, and to show that there must be a union of public and private duty and responsibility, if it would attain the highest prosperity and usefulness.

The operations of the past year have demonstrated the fact that the College can live, and secure, temporarily at least, a certain measure of success on its present basis. But we should remember that it was endowed by the Congress of the United States, with the approval of the nation, for the legally defined, but unique and noble purpose of giving advanced education to the producing classes, to secure their elevation, and increase their wealth-producing power; was adopted by Massachusetts, under bond to foster, maintain, and provide for it; and it cannot be seriously said that this basis is a credit to, or in keeping with, its high origin, or that it can be very efficient in accomplishing its originally designed work. The Trustees act as the agents of the State, and are ready at all times to obey its behests by employing the means placed at their disposal, be they large or small, in the best manner their judgment can direct to secure the greatest and best possible results. But they cannot believe that the very large expenditures made during the early years of its history were enhanced by either extravagance or folly. They accepted in good faith the clearly expressed ideas of the originators of the College grant; and, guided by the detailed plan of the institution adopted by the Governor and Council by the direction of the Legislature, they made an earnest endeavor to provide for it in farm lands and buildings, dormitories and boarding-houses for students, structures for recitation-rooms and other public purposes, physical, chemical, and mathemetical apparatus, and other appliances for the lecture-room, to elucidate the facts of science, and to convey knowledge, discipline, and culture to the pupil. All this in the direction of, but not above, or hardly equal to, the model of it, which was exhibited in the Statutes of the United States and Massachusetts. The total of the expenditures for all these purposes was a large sum, but no larger than should have been anticipated by the legislators, who thoroughly discussed the objects to be attained, and adopted the plan; but too large in the opinion of any one who considered the plan to be simply that of a manual-labor school, or one of an inferior grade.

In some respects, also, the period from 1867 to 1873, when the larger expenditures occurred, was very unfavorable. The sums appropriated were estimated and recorded as dollars; but to the Trustees they were not dollars of a value currency. Neither could they be exchanged for a dollar of real value in any of the details of the expenditure. Without any choice on their part, they were obliged to expend the fixed sums at their disposal for the countless needs of their work, receiving small values at fictitious prices, and were perhaps somewhat influenced by the expanded views of all private business men and municipalities then in vogue. If, during the period named, and when these large outlays were principally made, they had not been obliged to pay common laborers from two to two and a half, and mechanics from three to four dollars per day, and for every form of material required in that proportion, instead of one and two dollars per day for different kinds of labor, and material on that basis, as now, the record would have shown an expenditure of a hundred thousand dollars less than it now does.

The personal farm equipment of stock, teams, tools, implements, vehicles, and machines, was unavoidably procured on the high-price basis; and if from year to year the inventory has shown a decreased money value, notwithstanding the increase of stock, the result can only be charged to that general depreciation of prices which has effected the entire property of the State, and plunged many careful, judicious men into ruin.

To reap the full advantage which the property acquired under these circumstances is capable of yielding, a larger annual income is required.

Though extremely desirous of securing, for the institution, every modern appliance of practical education and culture, and of enlarging the sphere of its influence in its special field, yet we are satisfied, that, by the practice of the most scrupulous economy in the management of its affairs, and some personal sacrifice on the part of its Faculty, its future will not be devoid of usefulness.

THE SCHOOL.

Considering all the circumstances of the case, the work of the year may be pronounced a success. There has been no serious diminution in the number of students. They have manifested their usual interest in their specific routine of study, work, and drill, and in the general welfare and progress of the College. They were never before so public-spirited, and eager to contribute their effort for its improvement, as is evinced by the erection by the class of '82 of an elegant fountain, at the cost of two hundred and fifty dollars, in the centre of the grass-plat in front of the buildings, which adds greatly to the beauty of the scene. It is worthy of note, that they have taken the most lively interest in the agricultural operations of the surrounding vicinity, attending and participating in the essays and discussion of the agricultural organizations, and serving as judges, and writing reports on different departments of their exhibitions. The good has been mutual. The farming community has taken much more interest in the young men as such, as students of agriculture, and in the College, its work, and progress.

An invitation having been extended to the College Battalion to attend and participate as a military organization in the ceremonies attendant on the celebration of the settlement of Boston on the 17th of September, and our late president, Charles L. Flint, and Isaac Farnsworth, Esq., having generously offered to defray the expense of transportation, the invitation was accepted. Under the command of its military instructor, Lieut. Charles Morris, it left Amherst on Thursday, Sept. 16, after College exercises, and returned and broke ranks for home duty on the 18th. There was a doubt in the minds of some of the College officers, of the propriety of the excursion, and fears of its influence on the students individually, and on the institution; but the result was altogether favorable. By the quiet and gentlemanly deportment of the young men when out of the ranks, and the soldierly appearance, the precision of movement, and admirable drill exhibited by the battalion in the procession and on the line of march, they won the highest praise of their commanding officer, and the warm encomiums of both friends and strangers. In the exhibition of all the qualities which combine to make an efficient military organization, it was, by the best judges, accredited as second to but one in the immense military array of the occasion.

The devotion of the officers of the different departments, and the alacrity and cheerfulness with which they discharge their increased and arduous duties, was never more marked than at present. In this connection it should be remembered, that, though the teaching force has been seriously decreased, the regular course of instruction according to the curriculum has been retained. The branches of study taught by the discharged professors, nearly all of which were of the highest importance, have in some cases been assigned to those who remain, and others have been continued by special instructors from abroad. In the latter cases the attempt has been successfully made to secure the services of proficient and experienced teachers in the departments to be taught. But, however advantageous this may be to the pupils, practically, it does not increase the Faculty, or divide with its members the care, labor, and responsibility of the general management of College affairs.

The anniversary exercises, instead of being held in the centre of the town, a mile from the College premises, as in most former years, were conducted in the College chapel, which, though of meager seating capacity, accommodated the different assemblies with little discomfort; this, with the fact that the musical associations of the students furnished all the music for the military parade and the in-door exercises, served to concentrate and unify the College sentiment, which apparently was shared alike by the College fraternity, friends, and visiting strangers. The exercises were attended by his Excellency the Governor, a large proportion of the Board of Trustees, the examining committee of the Board of Overseers, and a larger number than usual of citizen farmers from the surrounding community and different parts of the State; all of whom evinced great interest in the College and its work, and expressed satisfaction with the character of the exercises. After an address pregnant with good advice to the graduates, the Faculty, and Trustees, congratulations at the success of the institution, and pleasure at the spirit which appeared to pervade all, the Governor delivered the diplomas of the State to the members of the graduating class, conferring the degree of Bachelor of Science; and the diplomas of the Boston University were delivered by the College president.

The Grinnell prizes offered to the members of the graduating class for the two best written and oral examinations in agriculture, and the Farnsworth prizes to the sophomore and freshman classes for excellence in declamation, were sharply competed for, and great interest was manifested in each. But the importance of the former exercise is not fully appreciated, and does not attract the full attention of the public which its importance deserves. While the hope of winning the fifty or thirty dollar prize may stimulate the members of the class to excel, and temporarily constitute the absorbing feature of the exercise, to the friends of the College and of agriculture it has a vastly more important phase. The topics selected for the examination are intended, as far as possible, to embrace the whole field of scientific agriculture, and the best modes of farm-practice in all its details. And their discussion is not only an exhibit of the culture and proficiency of the members of the class, but also of the correctness, the thoroughness, and the practicability of the instruction in this most important field of the College work. There is no better method for fault-finders and friends, to determine whether the instruction is fulfilling its mission, than by attending and participating in these annual examinations as examiners, as are all earnestly urged to do. In this examination the first prize was awarded to Almon H. Stone of Phillipston, and the second to William G. Lee of Amherst. The gold medals of the Farnsworth prizes were awarded to Samuel C. Damon of Lancaster, and David O. Nourse of Bolton; and the silver medals to John E. Wilder of Lancaster, and Homer J. Wheeler of Bolton. The Hills botanical prizes for the best general herbarium, and the best collection of native woods, were awarded, the first to Almon H. Stone of Phillipston, and the second to William C. Parker of Wakefield.

Professors Goodell, Goessmann, Graves, Maynard, and Morris have each conducted their departments with ability and a good measure of success, though all, but especially the physical department under the care of Professor Graves, are crippled by a deficiency of apparatus to make the instruction more clear and complete. The wants of the agricultural department are radical, and its equipment radically defective, and must remain so, until, by the acquisition of large means, the way is opened for the erection of commodious buildings, and the collection of illustrative material.

IMPROVEMENTS OF THE YEAR.

Great as are all the school wants which have been last enumerated, they have not been considered so immediately and economically pressing as the need of repairs to many of the buildings; some of which by thirteen years' use and exposure had taken on a neglected appearance, and suffered a marked deterioration, and others were being injured by defects in the original structure: therefore, money saved from many sources hes been expended in this direction.

The North College dormitory, which had settled in the centre, by the decay and "brooming" up of the post-pillars in the basement, has been lifted to its original position, and supported on granite blocks bedded down to hardpan. All the wood-work on this and the other brick dormitory has been thoroughly painted and sanded. The large laboratory chapel and drill-hall building, the dwelling-house until recently occupied by Professor Graves, the boarding-house, the botanic museum building, the plant-house, the old farmhouse occupied by the president, and the dwelling occupied by Professor Maynard, have all been well painted; and the latter structure has been improved by erecting an addition, which makes it much more commodious and convenient, as well as increases its attractiveness. These special repairs were made at a cost of nine hundred and fifty dollars. The whole work has materially improved the appearance of the estate, and contributed to the preservation of the property. By natural wear, and perhaps somewhat by carelessness of employés, the furniture of the kitchen and dining-room of the boarding-house had become so broken and marred as to be hardly serviceable or suitable for use. This has been replaced by new, at considerable expense; the establishment placed under the care of a competent matron who has succeeded in managing its affairs so as to preserve the College property, and make the house homelike and pleasant for the students.

The water-supply of the estate has never been in sufficient quantity, or of sufficient force, to be of any practical utility in the emergency of a fire, and recently, owing to the gradual filling-up of the reservoir with wash, and the decay of its log dam, has afforded a scant supply for ordinary use some months of the year; and, the Amherst Water Company having brought it from Pelham to the vicinity, a contract was made, for taking any quantity of it which was desired, for one hundred and fifty dollars a year. An eight-inch pipe has therefore been connected with their main and the reservoir-pipe, which gives an unlimited quantity to every part of the estate, and with sufficient head to throw it over the highest building, which gives such security that it should lessen the cost of fire insurance.

The distance from building to building, which the students are obliged to walk to their various exercises and to their meals, has always made the matter of walks of great consequence, and much pains has been taken to construct and keep them in repair with gravel. But in wet weather, and in the spring and fall, the sinking of the gravel to the clay has made them any thing but desirable, and a source of great annoyance in consequence of the mud which was unavoidably carried to the halls and rooms. To obviate the difficulty, a contract was made to supply gravel from the knoll south of the president's house, to construct tarred walks in the village, compensation being made by laying such walks around the College buildings. The amount of gravel thus taken has been sufficient to construct this year an eight-foot walk from South to North College and the laboratory, and from the main entrances of the buildings to the travelled road, thence over the worst ground to the boarding-house. They are found to be a source of great convenience, of cleanliness, and a marked improvement to the general appearance of the grounds.

COLLEGE FARM.

On the abolition of the office of farm superintendent, in consequence of straitened financial circumstances, its duties practically devolved upon the professor of agriculture. But the subsequent election of that officer to the presidency has made it utterly impossible for him to give a personal supervision to the details of farm work, or to have more than a general care of its business affairs. All details and much specific business has been committed to Mr. Henry Tillson as farm foreman, who with his family has occupied the farm-house, and boarded the persons employed as teamsters. Mr. Tillson has taken great interest in his work, and discharged his delicate and arduous duties in the care of the farm, its labor, stock, crops, and general property, with gratifying success.

For the reasons above stated, Mr. John W. Clark, a graduate of the College, who for two or three years has been superintendent of the nurseries, has kindly assumed the care and management of the required farm work of students. Mr. Clark, who as a student had become familiar with this exercise, has experienced no difficulty in the task, and has succeeded in maintaining the system in its usual efficiency.

Though the farm crops in certain cases have suffered somewhat for want of rain, they have been generally good, and of good quality. The following is the acreage and the crop yield of the past year, some of it given by estimation, but more by actual weight and measure: Corn, ten acres on the stump pasture, yield five hundred bushels shelled corn and twenty tons fodder; sugar-beets, three acres grown for the Franklin factory, yield thirty-six tons; potatoes, four acres on the light sandy loam west of the College buildings, yield five hundred bushels; oats, on land adjoining the pasture, twenty acres, yield one thousand bushels; rye, twelve acres on the light land north of the ravine, yield two hundred and fifty bushels; oat and rye straw, thirty-five tons; mowing land, seventy-five acres, yield of hay one hundred and fifty tons. The apple-crop of the farm was abundant, but of small market value, and was largely fed to cattle and swine, in both the raw and cooked state, and with marked beneficial results in both cases. The live stock has increased in number and value, the details of which will be found in the inventory of farm property annexed.

As a purely money-making and business affair, the year's operations on the farm have not been a success, though an analysis af the treasurer's report will show a deficiency of but from five to six hundred dollars. The management of the farm for this purpose never has been, and it is more than doubtful, if all the lands in their present condition are to be used for that purpose, if it ever can be. It may be said with truth, perhaps, that what the farm loses the institution gains; but that gives no brighter view of the farm balance as such. Though farm lands, with all their attachments, are absolutely essential as an illustration for a college of agriculture, and make a valuable return as do other educational appliances, yet their complication with school wants and affairs makes it difficult, if not impossible, to manage them on those strict business principles which are indispensable for profit. If the prime objects of connecting farm lands with the College are to give practical illustration to school-room instruction, to give opportunity for experiments with soils, crops, and farm stock, to give students the privilege of learning something of farm labor, or to assist themselves to a limited extent by labor wages, it may be seriously considered whether they could not be as well or even better secured, with one hundred or one hundred and fifty acres of suitable variety and quality, as with four hundred in an unimproved condition, and whose improvement when attempted is practically a failure for want of sufficient means. If the income of the College, and the number of students, is permanently to remain as at present, it may be a matter worthy of thought, whether that portion of the large farm now held, which is not needed for school purposes and experiment, might not be sold at some opportune time, and the avails invested for the increase of the annual income.

HORTICULTURAL DEPARTMENT.

The horticultural and botanical department has been conducted by Professor Maynard with his usual skill and faithfulness. Its value for educational purposes, not only to the students of the College, but also to the general community, is every year becoming more apparent. While this is its chief value, the production and sale of choice varieties of plants, but especially of nursery stock, is highly appreciated, and the demand constantly increasing. The sales from this department during the year have amounted to the sum of $2,792.76. For details respecting it, reference is made to the report of Professor Maynard annexed.

EXPERIMENT STATION.

The experiment station organized and put in operation at the College in the spring of 1878, on the basis of a meager private donation, not having been supported by public or private aid, and the officers upon whom devolved the responsibility of conducting it having been crowded with increased duties in other directions incident to the changes of the following year, has been necessarily suspended, so far as any systematic assigned work is concerned. The Sixteenth Annual Report contains a detailed account of the finished work, and of the investigations then in progress.

The experiments with sorghum as a sugar-producing plant forever settled the fact, that no known variety of it can be profitably employed for that purpose, unless chemical science can discover a law by which glucose can be changed to cane sugar.

The experiments in feeding different kinds of fruit-bearing plants with special chemical elements, to improve the quantity and quality of their products, have been continued to date, and a synopsis of their progress may be found in the annexed report of Professor Goessmann on the condition of the chemical department. The investigations into the physical deportment of certain soils to temperature and water, and its influence on plant-growth, were continued in 1879, and to a limited extent in 1880. The rainfall in the former year, at the point where the lysimeter is located, during the months from April to November was 22.3 inches, which was equivalent to 608,430 gallons per acre. The percolation was 89.520 gallons per acre; or, of the rainfall, 14.71 per cent percolated, and 85.29 per cent evaporated. In the same months of 1880 the rainfall was 19.11 inches, equivalent to 543,620 gallons per acre. Of this, 4.75 per cent, or 25,800 gallons, percolated, and 95.25 per cent, or 517,820 gallons, evaporated. There was 64,810 gallons more water to the acre in 1879 than in 1880, but the percolation was more than three times as much in the former as in the latter year. The fall of rain in 1880 was generally small in each storm, evenly distributed, and with no percolation in four months of the six named. In 1879 the rainfall of single storms was very large, with more than a corresponding amount of percolation. In 1879 a record was kept of the temperature of dry gravel and wet peat soil in natural position, at the surface and five inches in depth, at 5 A.M. and 2.30 P.M., from April to October. The average temperature of the whole surface soil of five inches in depth, day and night for the whole time, was found to be, for gravel, 70.2°, and peat, 66.86°; a result that corroborates and sustains the conclusions of the much smaller number of observations made in 1878, to which reference is made.

Early in the year a vacancy occurred in the Board of Trustees by the resignation of Hon. Richard Goodman of Lenox. It was filled at a meeting in June by the election of William Wheeler, B.S., of Concord, a graduate of the

College in the class of 1871. This election is an epoch in the College history, indicating its advancement in age, and bringing the experience and sympathy of the Alumni into connection with its active management, which must be to them a cause of pleasure and pride.

In 1879 a bequest of a thousand dollars to the College was received from the executors of Whiting Street of Northampton. The bequest did not specify any special purpose for which it should be used, and it was temporarily employed for contingent wants. But it has now been invested, and is to be known as the Whiting Street Fund. An examination of the treasurer's report will show, that, notwithstanding the special expenditure of nearly a thousand dollars in repairs, which cannot soon occur again, there is in his hands a balance to the credit of the College of $1,238.01.

Respectfully submitted by order of the Trustees.

LEVI STOCKBRIDGE, *President.*

Agricultural College, Amherst,
Jan. 12, 1881.

THE CHEMICAL DEPARTMENT.

REPORT BY PROFESSOR CHARLES A. GOESSMANN.

THE entire course of instruction in theoretical and experimental chemistry during the past year has been given in accordance with the lately revised plan of studies. The change in transferring the branches of applied chemistry from the sophomore to the junior and senior year has proved very acceptable to both the students and the teacher. The attendance of all classes engaged in the various exercises of the department has been quite satisfactory, and their progress, on the whole, encouraging. The chemical laboratory is kept open five days during the week, four hours in the forenoon of each day, to accommodate all who wish to pursue a special course in practical chemistry. Several post-graduates have availed themselves of this opportunity during the past year; and quite a number of students of all classes have spent their spare hours in some practical laboratory work suited to their particular state of information, or related to their future special occupation. This course of action, judging from past experience, serves two purposes: it creates among the students a desirable interest in the study of chemistry, and aids essentially in procuring the pecuniary means to meet the unavoidable expenses of the department, as far as the regular instructions, specified in the College curriculum, necessitate. The expenses of the department have been kept, as in past years, within its income from the fees charged to those who take part in laboratory exercises.

Aside from the regular class duties, much time has been devoted to analytical chemical investigations in various directions. The examination of the commercial fertilizers offered for sale in our markets, as well as the composition of noted refuse materials recommended for fertilizing purposes, have received careful attention. The results of this work will be published, in conformity with our State laws for the regulation of the trade in "commercial fertilizers," through the coming report of the Secretary of the State Board of Agriculture. The inquiry into the action of special fertilizers upon the quantity and the quality of fruit, mentioned already in a previous annual report, has been continued. Although some interesting facts have been noticed, it seems advisable to defer their publication, in the interest of a more complete presentation, to a future suitable occasion. Some active part has also been taken in securing desirable material for the examination of the chemical composition, and the comparative agricultural value of reputed fodder crops of Europe, — new to our farm industry. Forty varieties of seeds of forage plants, secured from a reliable seed-dealer in Germany, have been handed over for cultivation to the botanical department, where they receive a careful attention. In this connection, it gives me particular pleasure to state that I have enjoyed, throughout the entire course of my experimental field work, the hearty co-operation of Professor Maynard, to whose report I leave the task of describing the details of the latter.

REPORT OF BOTANIC DEPARTMENT.

BY PROFESSOR SAMUEL T. MAYNARD.

INSTRUCTION.

THE freshman and sophomore classes have been instructed in botany and drawing; the junior class in theoretical and practical horticulture; and the senior class in botany, microscopy, and landscape-gardening.

BOTANY.

The method pursued in the study of botany has been, first, to give the student a thorough knowledge of the structure of plants and the function of each part, using the microscope to show the actual appearance.

This is followed by the study of systematic botany, devoting most of the time to the study of the more common plants, such as weeds, grasses; and other useful plants. The one term with the senior class was devoted to systematic botany, giving particular attention to the characteristics of the different divisions, classes, and families, especially the injurious fungi and other cryptogamic plants, with the aid of the microscope.

HORTICULTURE.

In horticulture the limited time assigned was devoted to the most practical points in the cultivation of fruits, trees, shrubs and flowers, and the construction and care of greenhouses, pits, hot-beds and cold-frames, &c. It has been my aim to give each student actual practice, in the field and greenhouse, in every branch of the subject taken up in the class-room. In order to make this branch of instruction as valuable as it ought to be, more time should be allowed, as it is impossible to do justice to the large range of subjects that ought to be taken up, in one term of two hours each week. I would suggest that but four hours each week for the summer and fall terms be devoted to class work, and that the two hours thus gained be employed in the instruction of horticulture.

MICROSCOPY.

The course of instruction consists in the study of the microscope itself, how to use it properly, and, at the same time, taking up a careful and systematic study of plant-tissue.

This enables the student to review the entire subject of the structure and uses of the various organs of plant-growth, while he is gaining knowledge of the manipulation and care of the microscope.

LANDSCAPE-GARDENING.

The time assigned to this subject was taken up in the study of the most important trees and shrubs used for ornamental purposes, together with the principles upon which are based the artistic arrangement of trees, shrubs, flowers, walks, lawns, buildings, &c.

DRAWING.

This work, although not directly in the line of botany or horticulture, was assigned to me, for want of better arrangements. The course with the freshman class has been, instruction in freehand drawing, giving most of the time, after the study of some of the elementary principles, to object-drawing. The sophomore class have received instruction in instrumental drawing, taking up such work as making plans of buildings from actual measurement, after the preliminary instruction in the care and use of the instruments. Both classes have made good progress, considering the limited time given to the elementary instruction.

GREENHOUSES AND FRAMES.

The Durfee Plant-House, while a very ornamental structure, and a good one in which to keep large specimens for instructional purposes, is not adapted to the use we are now obliged to make of it; i.e., the growing of plants for the trade.

The sash-bars and other parts of the structure are sadly in need of repairs and painting. Material has been cut for the renewal of the walks and benches, and drawn to the mill for sawing.

To put this house and the new one in thorough repair, will require the expenditure of from three to five hundred dollars.

The lower wood-work outside of the large house, the sash of the new one, and between sixty and seventy of the cold-frame sash have been painted the past season.

This work was done wholly by students, as are all the repairs of glass, and many other things, which, in other departments, are done by assistance from outside.

CROPS.

The farm crops grown have been: corn, two acres; oats, one and a half acres; potatoes, one acre; peas, an eighth of an acre; squashes, three-quarters of an acre; early cabbages, half an acre; late cabbages, a quarter of an acre. About two and a half tons of hay has been cut and put into the barn in good condition, and about the same amount sold standing.

The fruit-crop has been above the average: peaches and grapes being very good; raspberries and blackberries, fair; and strawberries, light.

The sales of plants have been: larger than in previous years. The total sales of trees, plants, fruit, and vegetables, amount to $2,796.72. Of this amount, $630.27 are the sales of the nursery.

About three and a half acres of land north-east from the pear-orchard has been seeded down the past season, and one and a half acres south of the plant-house was turned over and reseeded. Three-quarters of an acre was planted with strawberries last spring, and the old plantation ploughed under, after the crop had been gathered. The new plantation bids fair to be the best piece we have ever had.

NURSERY.

About five acres are devoted to the growth of trees, shrubs, vines, &c., which are in a very flourishing condition, the sales the past year amounting to a little over six hundred dollars, with orders for the spring trade for nearly three hundred dollars more.

The sales, up to the present time, have been largely of stock on hand at the time of starting the business, or which has been bought in to be resold.

After the present year, nearly every thing sold will be of our own growing.

Among the stock that is particularly fine, are about six thousand peach-trees one year from bud, several thousand apple-trees three years from root graft, with a good stock of vines, shrubs, small fruits, and a large and very complete stock of the various varieties of retinosporas and the more dwarf arbor-vitæs.

NEW PLANTS AND FRUITS.

Several of the new plants introduced by Col. Clark from Japan promise to be very valuable. Among them is the vigorous and hardy vine Actinidia polygama, and the beautiful deciduous tree Cercidophyllum. We are fortunate in having a good stock of the above, as well as of the noted umbrella-pine. The climbing hydrangea, which was introduced at the same time, is very slow in growth, and requires more time to prove whether it will be valuable or not. In the pear-orchard are several trees grafted with the promising new pears originated by Francis Dana, Esq., the stock of which was kindly sent us by Col. Stone of Dedham. The grafts have made a good growth, and will probably bear the coming season. The names of the varieties are President Clark, Francis Dana, Student, and Crumbs of Comfort.

As the first has been favorably mentioned by the committee of the Massachusetts Horticultural Society, I think it desirable to propagate a few of them for sale.

EXPERIMENTS.

In the pear-orchard, upon alternate rows, has been sown iron in two forms, to determine its effect upon the growth of the tree, and particularly upon the diseases to which they are liable. Upon the first row was sown Navassa phosphate, containing a large per cent of iron, about two pounds to each tree. Upon the second row was applied the same quantity of iron filings and sweepings from the blacksmith's shop. This course was continued through the orchard, and extended to the peach-trees and a few rows of vines in the vineyard.

In the peach-orchard experiments have been made for several years to determine the effect of severe pruning and an abundance of plant-food, particularly the chloride of potassa, upon the disease known as the "yellows." The results have been so marked, that we hope to be able to show that the disease is due to the exhausted condition of the soil and the injuries of the borer, and that a remedy is in the hands of every cultivator. In fact, every experiment we have made upon the various diseases attacking plant-life leads us to the conclusion that fungoid growths only attack living plants when they are in an unnatural or unhealthy condition.

A large collection of grasses and forage plants has been grown in plats twelve feet square, and each kind carefully labelled with both the Latin and common name, so that students and others can make a study of their characteristics.

It is proposed to make this collection as complete as possible by adding all the grasses and forage plants of any value that we can obtain.

A small plat of sugar-beets were grown from seed obtained by Dr. Goessmann from France and Germany.

Although the results were not as satisfactory as could be desired, it is hoped, by the application of special fertilizers, to produce a variety that will yield a larger per cent of sugar than any now grown in this country. A fine lot of seed was grown from a small lot of roots imported at the same time as the seed, which will serve as a basis for next year's experiment.

The experimental fruit-plats carried on for Dr. Goessmann are in a good growing condition.

From each of the five plats, strawberries of two varieties were gathered for analysis; and the coming season will yield raspberries, currants, gooseberries, and possibly grapes, from which something of the effects of the different fertilizers upon the character of the fruit may be determined.

Our knowledge of plant-life, and the effects of the different fertilizing elements upon their growth, must largely depend upon the work of the chemist; and no institution can boast of better facilities for original work than our own.

Upon the east side of the above plats, it is proposed to devote a narrow strip of land to the growth of the newer small fruits.

IMPROVEMENTS.

A border of trees and shrubs was planted last spring, beginning near the new propagating house, and extending south of the large houses and a short distance along the main road toward the village. These have made a good growth, and, in a year or two, will add much to the beauty of the place. The willow hedge above the large house having become a nuisance, as a harbor for insects and vermin, and by the exhaustion of the soil upon either side, has been pulled out by the roots, and burned, and the space devoted to the growth of pear-seedlings.

It is proposed to obtain the desired wind-break by planting a row of hemlocks and spruces along the north side of the road leading to Col. Clark's.

LABOR.

The labor of the department the past year has been nearly all done by students; and, while it may not be as profitable as if done by more regular help, yet there is great pleasure in having the work done by young men who desire to learn, and who are faithful and inteligent in the discharge of their duties.

The main difficulty in the way of the successful employment of students' labor is in our inability to arrange for their irregular work.

This requires a thorough equipment and some skilled labor to assist in the preparation.

CATALOGUE

OF

TRUSTEES, OVERSEERS, FACULTY, AND STUDENTS.

1880.

TRUSTEES, OVERSEERS, FACULTY, AND STUDENTS.

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JOHN F. BROWN . . . . . . of Lunenburg.
JOHN B. MOORE . . . . . . of Concord.
AVERY P. SLADE . . . . . . of Somerset.
E. F. BOWDITCH . . . . . . of Framingham.
JOHN P. LYNDE . . . . . . of Athol.

Members of Faculty.

LEVI STOCKBRIDGE,
President and Professor of Agriculture.

HENRY H. GOODELL, M.A.,
Professor of Modern Languages.

CHARLES A. GOESSMANN, Ph.D.,
Professor of Chemistry.

WILLIAM B. GRAVES, M.A.,
Professor of Physics and Civil Engineering.

SAMUEL T. MAYNARD, B.S.,
Professor of Botany and Horticulture.

FIRST LIEUT. CHARLES MORRIS, Fifth Artillery, U.S.A.,
Professor of Military Science and Tactics.

JOHN F. WINCHESTER, D.V.S.,
Lecturer on Veterinary Science and Practice.

BENJAMIN K. EMERSON, Ph.D.,
Lecturer on Geology.

JOHN M. TYLER, M.A.,
Lecturer on Zoölogy and Entomology.

JOHN W. CLARK, B.S.,
Superintendent of Nurseries.

Graduates of 1880.*

Fowler, Alvan Luther	Westfield.
Gladwin, Frederic Eugene . . .	Westfield.
Lee, William Gilbert	Amherst.
McQueen, Charles Manjie . . .	Longmeadow.
Parker, William Colvard (Boston Univ.),	Wakefield.
Ripley, George Arms	Worcester.
Stone, Almon Humphrey . . .	Phillipston.
Total	7

Senior Class.

Bowman, Charles Abel (Boston Univ.) .	Billerica.
Boynton, Charles Enoch . . .	Groveland.
Carr, Walter Frank	Clinton.
Chapin, Henry Edgerton . . .	Springfield.
Fairfield, Frank Hamilton (Boston Univ.),	Waltham.
Flint, Charles Louis, jun. (Boston Univ.),	Boston.
Hashiguchi, Boonzo (Boston Univ.) .	Tokio, Japan.
Hills, Joseph Lawrence (Boston Univ.),	Boston.
Howe, Elmer Dwight	Marlborough.
Perry, Alfred Dwight	Worcester.
Peters, Austin (Boston Univ.) . .	Boston.
Rawson, Edward Briggs . . .	Brooklyn, N.Y.
Sattler, Hermann Charles . . .	Baltimore, Md.
Smith, Hiram Fred Markley . . .	North Hadley.
Spalding, Abel Walter (Boston Univ.) .	Billerica.
Taylor, Frederic Patterson (Bost. Univ.),	Boston.
Warner, Clarence Duane (Boston Univ.),	Granby.
Whittaker, Arthur.	Needham.
Wilcox, Henry Harrison . . .	Nawiliwili, S.I.
Total	19

Junior Class.

Allen, Francis Sherwin	Medfield.
Allen, George Dickinson . . .	Amherst.
Aplin, George Thomas	East Putney, Vt.

* The Annual Report, being made in January, necessarily includes parts of two academic years; and the catalogue gives the names of such students as have been connected with the College during any portion of the year 1880.

Beach, Charles Edward	Hartford, Conn.
Bingham, Eugene Percival	Fitchburg.
Bishop, William Herbert	Diamond Hill, R.I.
Brodt, Harry Snowden	Dansville, N.Y.
Chandler, Everett Sawyer	Coldwater, Mich.
Chipman, Frank Ellsworth	Beverly.
Cooper, James Willard	East Bridgewater.
Cutter, John Ashburton	New-York City.
Damon, Samuel Chester	Lancaster.
Floyd, Charles Walter	Boston.
Goodale, David	Marlborough.
Hillman, Charles Dexter	Hardwick.
Holmes, Samuel Judd	Montclair, N.J.
Howard, Joseph Henry	Hyannis.
Howe, George Dickinson	North Hadley.
Jones, Frank Waldo	South Scituate.
Jones, Nathaniel Nelson	Georgetown.
Joyner, Frank Hall	North Egremont.
Kingman, Morris Bird	Amherst.
Kinney, Burton Arial	Lowell.
Knowles, William Fletcher, jun.	North Cambridge.
May, Frederick Goddard	Boston.
Morse, William Austin	Boston.
Myrick, Herbert	Concord.
Paige, James Breckenridge	Prescott.
Perkins, Charles Brookhouse	Salem.
Perkins, Dana Edson	Wakefield.
Platt, John Cheney	New-York City.
Plumb, Charles Sumner	Westfield.
Putnam, Henry Anderson	Worcester.
Shiverick, Asa Frank	Woods Holl.
Stone, Winthrop Ellsworth	Amherst.
Taft, Levi Rawson	Mendon.
Taylor, Alfred Howland	Yarmouthport.
Thurston, Wilbur Herbert	Upton.
Wheeler, Henry Lewis	Great Barrington.
Wheelock, Victor Lamont	North Amherst.
Wilder, John Emery	Lancaster.
Williams, James Stoddard	Glastonbury, Conn.
Wilmarth, Frederick Augustus	Upton.
Windsor, Joseph Libbey	Grafton.
Total	44

Sophomore Class.

Bagley, Sydney Currier	Boston.
Bishop, Edgar Allen	Diamond Hill, R.I.
Chaplin, John Dorr Hayward	East Bridgewater.
Conger, Charles Thompson	New-York City.
Fletcher, Frank Howard	Townsend.
Hevia, Alfred Armand	Havana, Cuba.
Lindsey, Joseph Bridgeo	Marblehead.
Manton, William James	Lime Rock, R.I.
Minott, Charles Walter	Westminster.
Nourse, David Oliver	Bolton.
Owen Henry Willard	Amherst.
Preston, Charles Henry	Danvers.
Selden, John Lincoln	Ashfield.
Smith, William Edward	Sheffield.
Tryon, Charles Osmer	S. Glastonbury, Conn.
Wheeler, Homer Jay	Bolton.
Total	16

Freshman Class.

Braune, Domingos Henrique	Nova Friburgo, Brazil.
Brown, Henry Clinton	Pittsfield.
Dickinson, Howard Wilmot	Amherst.
Dwight, Edwin Wells	Pittsfield.
Goessman, Henry Edward Victor	Amherst.
Herms, Charles	Louisville, Ky.
Holland, Harry Dickinson	Amherst.
Jones, Elisha Adams	Rockville.
Lublin, Alfred William	New-York City.
Mayo, Walter Parker	Wellesley.
Redding, Merton Jay	Amherst.
Smith, Llewellyn	Amherst.
Smith, William Henderson	Amherst.
Smith, William Ratliffe	Amherst.
Total	14

Select Class.

Casparian, Gregory	Nicomedia, Turkey.
Chandler, Willard Mayne	South Natick.

Clay, Cassius Morey	Westminster, Vt.
Cochran, Robert Armstrong, jun.	Maysville, Ky.
Cutler, George, jun.	Amherst.
Davis, Arthur Emmons	Amherst.
Fish, Charles Sumner	Boston.
Holman, Samuel Morey	Attleborough.
Jackson, Andrew	San Francisco, Cal.
Johnson, Frank Prescott	Waltham.
Jones, Edward Spaulding	Worcester.
Kenfield, Charles Robert	Amherst.
Smith, Benjamin Salter	New-York City.
Total	13

Post-Graduates.

Clark, B.S., Atherton (Boston Univ.)	Amherst.
Lovell, M.A., Henry Lyman (Amherst College)	Amherst.
Parker, B.S., William Colvard (Boston Univ.)	Wakefield.
Stockbridge, B.S., Horace Edward (Boston Univ.)	Amherst.
Stone, B.S., Almon Humphrey	Phillipston.
Total	5

Summary.

Post-Graduates	5
Graduates of 1880	7
Senior Class	19
Junior Class	44
Sophomore Class	16
Freshman Class	14
Select Class	13
Total	118

GRADUATES.

Allen, Gideon H., '71, Winfield, Cowley Co., Kan., Agent, Adams Express Co.
Bagley, David A., '76, Winchendon, Farmer.
Baker, David E., '78, Franklin, Student, Harvard Medical School.
Barrett, Joseph F., '75, 3 Park Place, New-York City, Salesman, Bowker Fertilizer Co.
Barri, John A., '75, 65 Austin St., Cambridgeport, Student.
Bassett, Andrew L. '71, New-York City, Clerk, Vermont C. R.R. & Steamship Co.
Bell, Burleigh C., '72, 113 Third St., San Francisco, Cal., Druggist.
Bellamy, John, '76, 659 Washington St., Boston, Nichols, Bellamy & Co.
Benedict, John M., '74, 3 Park Place, New-York City, Bowker Fertilizer Co.
Benson, David H., '77, 3 Park Place, New-York City, Chemist and Superintendent, Works, Bowker Fertilizer Co. at Elizabethport, N.J.
Birnie, William P., '71, Springfield, Conductor, Conn. Central R.R.
Blanchard, William H., '74, Westminster, Vt., Farmer.
Boutwell, Willie L., '78, Leverett, Farmer.
Bowker, William H., '71, 43 Chatham St., Boston, President, Bowker Fertilizer Co.
Bragg, Everett B., '75, 3 Park Place, New-York City, Manager New-York Office, Bowker Fertilizer Co.
Brett, William F., '72, Brockton, Clerk, B. H. White & Co., Boston.
Brewer, Charles, '77, Pelham, Farmer.
Brigham, Arthur A., '78, Marlborough, Farmer.
Brooks, William P., '75, Sapporo, Japan, Professor of Agricul ture and Farm Superintendent, Japan Agricultural College.
Bunker, Madison, '75, New-York City, Student, American Veterinary College.
Callender, Thomas R. '75, Grantville, Florist.

Campbell, Frederick G., '75, West Westminster, Vt., Farmer.
Caswell, Lilley B., '71, Athol, Civil Engineer and Farmer.
Chandler, Edward P., '74, Abilene, Kan., Farmer.
Chickering, Darius O., '76, Enfield, Farmer.
Choate, Edward C., '78, Southborough, Farmer.
Clark, Atherton, '77, Georgetown, El Dorado Co., Cal., Miner.
Clark, John W., '72, Amherst, Superintendent of Nurseries, Agricultural College.
Clark, Xenos Y., '78, Baltimore, Md., Fellow, John Hopkins University.
*Clay, Jabez W., '75.
Coburn, Charles F., '78, Lowell, Teller, Five Cents Savings Bank, and Paragrapher, "Daily Citizen."
Cowles, Frank C., '72, Amherst, Farmer.
Cowles, Homer L., '71, Hadley, Farmer.
†Curtis, Wolfred F., '74.
Cutter, John C., '72, Sapporo, Japan, Professor of Natural Science, Japan Agricultural College.
Deuel, Charles F., '76, Amherst, Druggist.
Dickinson, Richard S., '79, Odell, Livingston Co., Ill., Farmer.
Dodge, George R., '75, Brighton, Foreman, Works, Bowker Fertilizer Co.
Dyer, Edward N., '72, Kohala, S.I., Teacher.
Easterbrook, Isaac H., '72, Diamond Hill, R.I., Farmer.
Eldred, Frederick C., '73, 119 Chambers St., New-York City, Salesman, D. W. Wilson & Bro.
Ellsworth, Emory A., '71, Holyoke, Architect, Civil and Mechanical Engineer with D. H. & A. B. Tower.
Fisher, Jabez F., '71, Fitchburg, Local Freight Agent, Fitchburg Railroad.
Fiske, Edward R., '72, Philadelphia, Penn., Merchant, Folwell, Bro. & Co., 629 Chestnut St.
Flagg, Charles O., '72, Diamond Hill, R.I., Farmer.
Foote, Sanford D., '78, Springfield, Hampden Watch Co.
Fowler, Alvan L., '80, Westfield, Clerk and Paymaster, Smith & Ripley.
Fuller, George E., '71.
Gladwin, Frederic E., '80, Westfield, Surveyor.
Green, Samuel B., '79, Amherst, Post-Graduate, Agricultural College.
Grover, Richard B., '72, Andover, Student, Theological Seminary.

* Died Oct. 1, 1880, of pneumonia, at New-York City.
† Died Nov. 8, 1878, of inflammation of the brain, at Westminster.

Guild, George W. M., '76, New-York City, employ of Adams Express Company.
Hague, Henry, '75, Manville, R.I., Clergyman.
Hall, Josiah N., '78, Revere, Student, Harvard Medical School.
Harwood, Peter M., '75, Barre, Farmer.
Hawley, Frank W., '71, Hadley, Farmer.
Hawley, Joseph M., '76, Berlin, Wis., Banker, C. A. Mather & Co.
Herrick, Frederick St. C., '71, Methuen, Farmer.
Hibbard, Joseph R., '77, Stoughton, Wis., Farmer.
Hitchcock, Daniel G., '74, Warren, Merchant.
Hobbs, John A., '74, Bloomington, Neb., Farmer.
Holmes, Lemuel Le B., '72, Mattapoisett, Lawyer.
Howe, Charles S., '78, Albuquerque, N.M., Principal, Albuquerque Academy.
Howe, Waldo V., '77, Framingham, Superintendent, Framingham Brick Co.
Hubbard, Henry F., '78, New Rochelle, N.Y., Surveyor.
Hunt, John F., '78, Atascosa, Baxar Co., Texas, Surveyor.
Kendall, Hiram, '76, Providence, R.I., Chemist and Superintendent, Kendall Manufacturing Co.
Kimball, Francis E., '72, Worcester, Clerk, B. B. & G. R.R.
Knapp, Walter H., '75, Grantville, Florist.
Koch, Henry G. H., '78, Sixth Avenue and Twentieth St., New-York City, H. C. F. Koch & Son.
Ladd, Thomas H., '76, care Wm. Dadmun, Watertown, Student.
Lee, Lauren K., '75, Des Moines, Ia., Agent, Kellogg & McDougal, Buffalo Linseed Oil Works.
Lee, William G., '80, Georgetown, El Dorado Co., Cal., Miner.
Leland, Walter S., '73, Concord, Officer, State Prison.
Leonard, George, '71, Springfield, Lawyer.
Libby, Edgar H., '74, Agricultural Journalist.
Livermore, Russell W., '72, 9 and 11 Chamber of Commerce, Toledo, O., Attorney-at-Law.
Lovell, Charles O., '78, Rutland, Vt., with A. D. Perkins, Photographer.
Lyman, Ashael H., '73, Manistee, Mich., Druggist and Bookseller.
Lyman, Charles E., '78, Middlefield, Conn., Farmer.
*Lyman, Henry, '74.
Lyman, Robert W., '71, Belchertown, Lawyer.
Mackie, George, '72, Attleborough, Physician.
Macleod, William A., '76, 60 Devonshire St., Boston, Lawyer, with J. E. Maynadier.

* Died Jan. 8, 1879, of pneumonia, at Middlefield, Conn.

Mann, George H., '76, Sharon, Manufacturer.
Martin, William E., '76, Excelsior, Minn., Clerk.
Maynard, Samuel T., '72, Amherst, Professor of Botany and Horticulture, Massachusetts Agricultural College.
McConnel, Charles W., '76, Lonsdale, R.I., Dentist.
McQueen, Charles M., '80, Longmeadow, Nursery Agent.
Miles, George M., '75, Miles City, Montana, U. S. Commissioner of Courts, and engaged in sheep-raising.
Mills, George W., '73, Medford, Physician.
Minor, John B., '73, New Britain, Conn., Clerk, Russell & Erwin Manufacturing Co.
Montague, Arthur H., '74, South Hadley, Farmer.
Morey, Herbert E., '72, 49 Haverhill St., Boston, Merchant, Morey, Smith & Co.
Morse, James H., '71, 251 Essex St., Salem, Civil Engineer.
Myrick, Lockwood, '78, Tremont Bank Building, State St., Boston, Clerk, Soluble Pacific Guano Co.
Nichols, Lewis A., '71, Santa Fé, New Mexico, Civil Engineer.
Norcross, Arthur D., '71, Monson, Postmaster.
Nye, George E., '77, 70 Exchange Building, Union Stock Yards, Chicago, Ill., Bookkeeper, G. L. Swift.
Osgood, Frederick H., '78, 10 Albany St., Edinburgh, Scotland, Veterinary Student.
Otis, Harry P., '75, Leeds, Superintendent, Northampton Emery Wheel Co.
Page, Joel B., '71, Conway, Farmer.
Parker, George A., '76, Poughkeepsie, N.Y., Gardener, Vassar College.
Parker, George L., '76, Dorchester, Florist.
Parker, Henry F., '77, 229 Broadway, New-York City, Draughtsman, A. V. Briesen.
Parker, William C., '80, Wakefield, Farmer.
Peabody, William R., '72, Atchison, Kan., General Agent, Atchison, Topeka, & Santa Fé Railroad.
Penhallow, David P., '73, Europe, Student.
Phelps, Charles H., '76, South Framingham, Florist.
Phelps, Henry L., '74, Northampton, Dealer in Fertilizers.
Porter, William H , '76, Hatfield, Farmer.
Porto, Raymundo M. da S., '77, Para, Brazil, Planter.
Potter, William S., '76, Lafayette, Ind., Lawyer, firm of W. De Witt Wallace.
Renshaw, James B., '73, Hutchinson, Minn., Clergyman.
Rice, Frank H., '75, Aurora, Nev., Clerk.

Richmond, Samuel H., '71, 245 Broadway, New-York City, Correspondent Branch Office, Chicago Medical Record.

Ripley, George A., '80, Lincoln House, Worcester, no business.

Root, Joseph E., '76, Barre, Student of Medicine, New-York City.

Rudolph, Charles, '79.

Russell, William D., '71, Turner's Falls, Chemist, Montague Paper Company.

Salisbury, Frank B., '72, Kimberley Diamond Fields, South Africa, Clerk.

Sears, John M., '76, Ashfield, Farmer.

Shaw, Elliot D., '72, Holyoke, Florist.

Sherman, Walter A., '79, 141 West Fifty-fourth St., New-York City, Student, American Veterinary College.

Simpson, Henry B., '73, Centreville, Md., Farmer.

Smead, Edwin, '71, 129 Camden St., Baltimore, Md., Dealer in Scrap Iron.

Smith, Frank S., '74, Hampden, Woollen Manufacturer.

Smith, George P., '79, Sunderland, Farmer.

Smith, Thomas E., '76, West Chesterfield, Manufacturer.

Snow, George H., '72, Leominster, Farmer.

Somers, Frederick M., '72, San Francisco, Cal., Editor, "Argonaut."

*Southmayd, John E., '77.

Southwick, Andre A., '75, Talladega, Ala., Instructor in Agriculture, Talladega College.

Sparrow, Lewis A., '71, 43 Chatham St., Boston, Chemist, Bowker Fertilizer Co.

Spofford, Amos L., '78, Georgetown, Shoe-cutter.

Stockbridge, Horace E., '78, Amherst, Post-Graduate, Agricultural College.

Stone, Almon H., '80, Amherst, Post-Graduate, Agricultural College.

Strickland, George P., '71, Stillwater, Minn., Machinist, Seymour, Sabin & Co.

Swan, Roscoe W., '79, Framingham, Student, Harvard Medical School.

Taft, Cyrus A., '76, Whitinsville, Machinist.

Thompson, Edgar E., '71, East Weymouth, Teacher.

Thompson, Samuel C., '72, Natick, Civil Engineer.

Tucker, George H., '71, Grandin Farm, Dakota, Farmer.

Tuckerman, Frederick, '78, Dedham, Student, Harvard Medical School.

* Died Dec. 11, 1878, of consumption, at Minneapolis, Minn.

Urner, George P., '76, 116 Franklin St., New-York City, Superintendent Magic Ruffle Company.

Wakefield, Albert T., '73, Peoria, Ill., Physician.

Waldron, Hiram E. B., '79, North Rochester, Farmer.

Ware, Willard C., '71, 255 Middle St., Portland, Me., Manager, Boston & Portland Clothing Company.

Warner, Seth S., '73, Florence, Farmer.

Washburn, John H., '78, Providence, R.I., Teacher, State Reform School, and Student, Brown University.

Webb, James H., '73, New Haven, Conn., Attorney-at-Law.

Wellington, Charles, '73, Washington, D.C., Chemist, United States Agricultural Department.

Wells, Henry, '72, Rochester, N.Y., Clerk, "Blue Line," Fast-Freight Office.

Wetmore, Howard G., '76, 3 East Seventeenth St., New-York City, Physician.

Wheeler, William, '71, Concord, Civil Engineer and Inventor.

Whitney, Frank Le P., '71.

Whitney, William C., '72, Minneapolis, Minn., Architect.

Williams, John E., '76, Amherst, Editor, "Record."

Winchester, John F., '75, Lawrence, Veterinary Surgeon and Lecturer, Massachusetts Agricultural College.

Wood, Frank W., '73, Providence, R.I., Civil Engineer.

Woodbury, Rufus P., '78, Elk Falls, Howard Co., Kan., Druggist and News-dealer.

Woodman, Edward E., '74, Danvers, Florist, E. & C. Woodman.

Wyman, Joseph, '77, Arlington, Farmer.

Zeller, Harrie McK., '74, Hagerstown, Md., Agent, Singer Sewing Machine Company.

COURSE OF STUDY AND TRAINING.

FRESHMAN YEAR.

First Term. — Chemistry, 3 hours each week; Human Anatomy, Physiology, and Hygiene, 3 hours; Algebra, 5 hours; English, 2 hours; Agriculture, 2 hours; Declamation, 1 hour; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term. — Inorganic Chemistry, 3 hours; Botany, 3 hours; Geometry, 5 hours; Agriculture, 3 hours; English, 2 hours; Elocution, 1 hour; Freehand Drawing, 3 hours; Military Drill, 3 hours.

Third Term. — Systematic Botany, 4 hours; Geometry, 4 hours; French, 5 hours; Elocution, 2 hours; Agriculture, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

SOPHOMORE YEAR.

First Term. — Systematic Botany, 3 hours each week; Geometry, 4 hours; French, 5 hours; English, 1 hour; Agriculture, 2 hours; Declamation, 1 hour; Military Drill, 4 hours; Manual Labor, 6 hours.

Second Term. — Geology, 3 hours; Trigonometry, 5 hours; French, 4 hours; English, 1 hour; Agriculture, 3 hours; Declamation, 1 hour; Drawing, 3 hours; Military Drill, 3 hours.

Third Term. — Zoölogy, 5 hours; Surveying, 5 hours; Agriculture, 2 hours; English, 3 hours; Declamation, 1 hour; Levelling, 3 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

JUNIOR YEAR.

First Term. — German, 5 hours each week; Mechanics, 5 hours; Entomology, 2 hours; Market-Gardening, 2 hours; Horticulture, 2 hours; Military Drill, 3 hours; Manual Labor, 6 hours.

Second Term. — German, 4 hours; Physics, 5 hours; Practical Chemistry, 9 hours; Drawing, 3 hours; Agricultural Debate, 1 hour; Declamation, 1 hour; Military Drill, 3 hours.

Third Term. — German, 4 hours; Astronomy, 4 hours; Practical

Chemistry, 9 hours; Declamation, 1 hour; Stock and Dairy Farming, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

SENIOR YEAR.

First Term. — English Literature, 4 hours each week; Practical Chemistry, 7 hours; Book-keeping, 2 hours; Roads and Railroads, 3 hours; Military Science, 2 hours; Original Declamation, 1 hour; Military Drill, 3 hours.

Second Term. — English Literature, 4 hours; Theses, 1 hour; Mental Science, 4 hours; Agriculture, 2 hours; Veterinary Science, 3 hours; Military Science, 2 hours; Microscopy, 4 hours; Military Drill, 3 hours.

Third Term. — Veterinary Science, 2 hours; Military Science, 2 hours; Botany, 3 hours; Landscape-Gardening, 3 hours; Rural Law, 1 hour; Lectures on English Language, 2 hours; Theses, 1 hour; Agricultural Review, 4 hours; Military Drill, 4 hours.

CALENDAR FOR 1881.

The third term of the collegiate year begins March 24, and continues till June 22.

The first term begins Aug. 25, and continues till Nov. 23.

The second term begins Dec. 8, and continues till March 8, 1882.

There will be an examination of candidates for admission to the College, at the Botanic Museum, at 9 A.M., Tuesday, June 21, and also on Thursday, Aug. 25.

The Farnsworth Prize Declamations take place Monday evening, June 20.

The public examination of the graduating class for the Grinnell Prize for excellence in agriculture, and the examination of the other classes in the studies of the term, will take place on Tuesday forenoon, June 21.

The exercises of Graduation Day occur June 22.

ADMISSION.

Candidates for admission to the Freshman Class are examined, orally and in writing, upon the following subjects: English Grammar, Geography, Arithemetic, Algebra through simple equations, and the History of the United States.

Candidates for higher standing are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the College until he is fifteen years of age; and every student is required to furnish a certificate of good character from his late pastor or teacher, and to give security for the prompt payment of term-bills. Tuition and room-rent must be paid in advance at the beginning of each term; and bills for board, fuel, &c., at the end of every term.

The regular examinations for admission are held at the Botanic Museum, at nine o'clock A.M., Tuesday, June 21, and on Thursday, Aug. 25; but candidates may be examined and admitted at any other time in the year.

EXPENSES.

Tuition	$12 00 per term.
Room-rent	5 00 to 10 00 "
Board	2 50 to 3 50 per week.
Expenses of chemical laboratory to students of practical chemistry	10 00 per term.
Public and private damages, including value of chemical apparatus destroyed or injured .	At cost.
Annual expenses, including books . .	$250 00 to 350 00

REMARKS.

The regular course of study occupies four years; and those who complete it receive the degree of Bachelor of Science, the diploma being signed by the Governor of Massachusetts, who is president of the corporation.

Regular students of the College may also, on application, become members of Boston University, and, upon graduation, receive its diplomas in addition to that of the College, thereby becoming entitled to all the privileges of its alumni.

The instruction in the languages is intended to qualify the graduates to write and speak English with correctness and effect, and to translate French with facility. The scientific course is as thorough and practical as possible; and every science is taught with constant reference to its application to agriculture and the wants of the farmer.

The instruction in agriculture and horticulture includes every branch of farming and gardening which is practised in Massachusetts, and is both theoretical and practical. Each topic is discussed thoroughly in the lecture-room, and again in the plant-house or field, where every student is obliged to labor. The amount of required work, however, is limited to six hours per week in order that it may not interfere with study. Students are allowed to do additional work for wages, provided they maintain the necessary rank as scholars.

Indigent students are allowed to do such work as may offer about the College or farm buildings, or in the field ; but it is hardly possible for one to earn more than from fifty to one hundred dollars per annum, besides performing other duties. So far as is consistent with circumstances, students will be permitted to select such varieties of labor as they may, for special reasons, desire to engage in.

Those who pursue a select course attend recitations and lectures with the regular classes ; but those properly qualified, who desire special instruction in botany, chemistry, civil engineering, veterinary science, agriculture, or horticulture, may make private arrangements with the officers having charge of these departments.

An expenditure of from ten to fifty dollars is necessary to provide furniture, which may be purchased at reasonable rates, either new or second-hand. At the beginning of the second term of attendance each student is required to provide himself with the full uniform prescribed for the battalion of Agricultural Cadets, the cost of which is about thirty dollars.

On Sundays students are required to attend church in the forenoon, and invited to join a class for the study of the Bible in the afternoon. They will be permitted to select their place of attendance from among the churches in the town, of the following denominations: viz., Baptist, Congregational, Protestant Episcopal, Methodist Episcopal, and Roman Catholic.

POST-GRADUATE COURSE.

Graduates of colleges and scientific schools may become candidates for the degree of Doctor of Science, or Doctor of Philosophy, from the College or from the University, and pursue their studies under the direction of Professor Goessmann in chemistry, or other members of the faculty in their respective departments.

BOOKS, APPARATUS, AND SPECIMENS IN NATURAL HISTORY.

The library of the College contains about two thousand volumes. Among them are several sets of cyclopædias, magazines, and newspapers, reports of agricultural societies and State boards of agriculture, and many standard works on agriculture and horticulture. There are also many useful works of reference in chemistry, botany, surveying, and drawing.

The Faculty and students also have the privilege of drawing books from the excellent library of Amherst College, which contains over thirty thousand volumes.

The State cabinet of specimens, illustrating the geology and natural history of Massachusetts, has been removed from Boston to the College, and is of much value for purposes of instruction.

The Knowlton Herbarium contains more than ten thousand species of named botanical specimens, besides a large number of duplicates. The Botanic Museum is supplied with many interesting and useful specimens of seeds, woods, and fruit-models. There is also a set of diagrams illustrating structural and systematic botany, including about three thousand figures.

About fifteen hundred species and varieties of plants are cultivated in the Durfee Plant-House, affording much pleasure and information to students and visitors.

The class in microscopy has the use of seven of Tolles' best compound microscopes, with objectives from four inches to one-eighth of an inch in focal distance, and a variety of eye-pieces.

PRIZES.

FARNSWORTH RHETORICAL MEDALS.

Isaac D. Farnsworth, Esq., of Boston, has generously provided a fund of fifteen hundred dollars, which is to be used for the purchase of gold and silver medals, to be annually awarded, under the direction of the College Faculty, for excellence in declamation.

GRINNELL AGRICULTURAL PRIZES.

Hon. William Claflin of Boston has given the sum of one thousand dollars for the endowment of a first prize of fifty dollars, and a second prize of thirty dollars, to be called the Grinnell Agricultural Prizes, in honor of George B. Grinnell, Esq., of New York. These prizes are to be paid in cash to those two members of the graduating class who may pass the best oral and written examination in theoretical and practical agriculture.

HILLS BOTANICAL PRIZES.

For the best herbarium collected by a member of the class of 1880, a prize of fifteen dollars is offered, and, for the second best, a prize of ten dollars; also a prize of five dollars for the best collection of woods, and a prize of five dollars for the best collection of dried plants from the College Farm.

REGULATIONS.

I. — Students are forbidden to combine for the purpose of absenting themselves from any required exercise, or violating any known regulation of the College.

II. — The roll shall be called, five minutes after the ringing of the bell for each exercise of the College, by the officer in charge, unless a monitor be employed; and students who do not answer to their names will be marked absent, provided that any student coming in after his name has been called shall be marked tardy. Two tardinesses shall be reckoned as one absence.

III. — Absence from a single exercise may be allowed or excused by the officer in charge of the same, if requested beforehand; but permission to be absent from several exercises must be obtained in advance from the general excusing officer, or from the president. In such cases the officer excusing will furnish a certificate of excuse, which shall state the precise time for which absence is permitted, and which shall be a satisfactory reason for absence from all exercises occurring within the time specified.

IV. — Excuses for all absences, whether with permission obtained beforehand or not, must be submitted to the excusing committee. They must be rendered promptly within one week from the date of absence; and those deemed unsatisfactory will be returned to the student with the indorsement of the committee.

V. — Whenever the aggregate number of unexcused absences in all departments reaches five, the student so delinquent shall be informed of the fact. When the number of such absences reaches eight, the parent or guardian of the student shall be informed of his delinquency; and, when ten such delinquencies are justly recorded against any student, his connection with the College may be terminated.

VI. — Students are forbidden to absent themselves without excuse from the regular examinations, to give up any study without permission from the president, or to remove from one room to another without authority from the officer in charge of the dormitory buildings; and no student shall be permitted to make such change until he has procured from the inspecting officer a written statement that the room about to be vacated is in perfect order.

VII. — Students shall be required to attend the church of their selection regularly on Sunday morning, and report in writing to the excusing officer, during the ensuing week, whether they attended or not.

VIII. — The record of deportment, scholarship, and attendance, will be carefully kept; and, whenever the average rank of a student falls below fifty, he will not be allowed to remain a member of the College, except by a special vote of the Faculty. Admission to the College, and promotion from class to class, as well as to graduation, are granted only by vote of the Faculty.

IX. — Students are required to abstain from any thing injurious to the buildings and other property of the College, and in all respects to conduct themselves with propriety.

X. — Parents and guardians are specially urged to co-operate with the Faculty in securing the faithful attendance of students upon every appointed exercise of the College.

SIZE OF ROOMS.

For the information of those desiring to carpet their rooms, the following measurements are given: In the south dormitory the main corner-rooms are fifteen by eighteen feet, and the adjoining bedrooms eight by twelve feet. The inside rooms are fourteen by fifteen feet, and the bedrooms eight by eight feet. In the north dormitory the corner-rooms are fourteen by fifteen feet, and the annexed bedrooms eight by ten feet; while the inside rooms are thirteen feet and a half by fourteen feet and a half, and the bedrooms eight by eight feet.

SCHOLARSHIPS.

The income of the Robinson Fund of one thousand dollars, the bequest of Miss Mary Robinson of Medfield, is assigned by the Faculty to such indigent student as they may deem most worthy.

The Trustees voted in January, 1878, to establish one free scholarship for each of the eleven congressional districts of the State. Applications for such scholarships should be made to the representative from the district to which the applicant belongs. The selection for these scholarships will be determined as each member of Congress may prefer; but, where several applications are sent in from the same district, a competitive examination would seem to be desirable. Applicants should be good scholars, of vigorous constitution; and should enter College with the intention of remaining through the course, and then engaging in some pursuit connected with agriculture. To every such student the cash value of a scholarship is one hundred and forty-four dollars.

REPORT OF THE BOARD OF OVERSEERS.

The committee appointed by the State Board of Agriculture to examine the Agricultural College ask leave to submit the following report: —

We assume that the Board desires something more than a mere report of the graduating exercises of the students, and with that view we have carefully examined other departments and the working of the College.

The members of this committee have visited the institution at various times the last year; and some of us have watched its progress from the time it was founded, to the present time, with a great deal of interest.

The Act of Congress passed in the year 1862, donating public lands for the purpose of founding colleges to benefit agriculture and the mechanic arts, was a noble act; and it will live in history as a monument of the wisdom of our government, which, in the dark days of the war, had the foresight to encourage that great interest lying at the foundation of all national prosperity, and in comparison to which any other interest sinks into insignificance, and the product of which is to-day paying the national debt.

In 1863 the State of Massachusetts accepted the offer of the United States, and incorporated the Massachusetts Agricultural College, and, with its proverbial liberality, has given it, at different times, between two and three hundred thousand dollars.

All new enterprises cost more than well-settled projects: the Hoosac Tunnel cost the State some twenty millions of dollars, and, as an engineer has said, fifteen millions to find out how, and five millions to make it. Like all new enterprises, it costs more to find out how, than it does to do it: our College is not an exception to this rule.

The establishment of an institution for the purpose of teaching practical, and we may also say theoretical, agriculture, was an experiment in this country. There were no trained instructors who could teach the art of producing crops in the greatest perfection, nor the natural sciences relating to the animal or vegetable kingdom, the true knowledge of causes and effects, and the laws of nature, which, we may say, is science applied to agriculture.

All these difficulties we have had to contend with. Is it any wonder, then, that mistakes have been made? And these mistakes have not been in the College itself; but, like the tunnel, it has been in developing how the best work can be done.

FARM.

We found last June that the fields of grass were looking in a fair condition, and the corn about the same, and that there was about the usual amount of each harvested in their season. The means at the disposal of the Trustees of the College are so limited, that they are unable to make the improvements on the farm which would exhibit to the farmers of Massachusetts those evidences of improved and progressive agriculture which they would have a right to expect on a model farm of the State.

The policy adopted by the Trustees in the year 1880, in regard to the farm, was to sell the hay, and also a part of the stock. This course reduces the quantity of manure to be applied to the land, and therefore necessarily impairs its power of production of future crops, unless an equivalent be returned in some form to the soil, which, we are informed, has not been done. A long continuance of cropping without manure means sterility.

We do not mean to censure any one for this: the circumstances in which the finances of the College were unfortunately found may have rendered it necessary to pursue the course which was adopted; neither should we expect the farm to pay, as it is termed. A student in chemistry, to acquire even a small amount of knowledge, has to work out under his teacher his problems in the laboratory, which must be thoroughly equipped so as to give the best instruction. Why? Theoretical chemistry seldom makes a chemist; theoretical farming never makes a farmer. The student — after receiving the theoretical knowledge as to raising crops, and the management of every thing pertaining to the farm, which, we think, is well taught here — should be required, as a part of his course of studies, to do all the operations required on the farm, so that he may fully understand practically, as well as theoretically, what farming means, to the end that he may make a farmer that will be competent to instruct in that branch in any institution, or by his example on a farm to elevate and adorn the great business of farming. This requires a teacher on the farm itself, one who is competent to instruct any student how to plant and cultivate all kinds of crops, the management of stock, the use of tools, and to economically manage and improve a farm.

HORTICULTURAL.

We found the plants in the greenhouses in as good condition as we could expect. These houses, or rather the large house, is not so constructed as to be economical in its running expenses. In fact, a house costing one-half as much would accommodate as many plants, could be run at one-half the expense, would grow plants better, could be used to illustrate in the teaching just as well, and we only wonder that Professor Maynard has succeeded so well in growing plants under such difficulties.

In the gardens and pleasure-grounds we found every thing neat, orderly, and in good condition. The nurseries, seedling trees, &c., were promising, all looking well, and showing evidence of good cultivation.

The orchards of apples, pears, and peaches, were in an unsatisfactory condition, some of the trees growing well, while others were stunted and dying. There was only a very small crop of fruit in the vineyard. No method of pruning seems to have been adopted, and here was where we would like to have seen the various methods of pruning grapevines illustrated: it would involve no particular trouble or expense, and would be practical teaching to the students, and also to the public who visit the College.

CHEMICAL DEPARTMENT.

As usual, the laboratory and every thing connected with this department was in perfect order; the researches of the able gentleman at its head have been of great value to the farming interest of our State as well as to the College itself;

and his methods of imparting knowledge to his classes are said to be admirable.

In all of the recitation-rooms every thing appeared to be going along properly. In the examinations the students displayed a great interest, and appeared well.

The president is enthusiastic, and works hard to make all departments of the institution a success, and, as a teacher of theoretical agriculture, hardly has his equal.

FINANCIAL.

There has been an improvement in the financial exhibit of the College.

For the first time in its existence it has lived within its means, and has a balance in its treasury. The outlay needed for repairs, however, would probably absorb all of this balance.

It is economy for the State to keep the College buildings in good repair, and there is great need of it at the present time. One of the large buildings occupied by the students was apparently finished with unseasoned lumber, and, although nearly new, is almost unfit for use, and will require a large expenditure to put it in a proper condition for the suitable accommodation of the occupants.

We know that the College is in need of more money. One great mistake has been, that the management have endeavored to do more than their means would allow. And, as a rule, we should say, —

1st, That the College should not incur any debts.

2d, That the teaching should be directed to the exact purpose for which the College was founded; viz., to support one college where the leading object shall be to teach such branches of learning as are related to agriculture.

3d, The farm. No more acres should be cultivated than can be done in the very best manner, to the end that such cultivation may illustrate practically, to the students, advanced and progressive agriculture; and also compel the respect and admiration of visitors in the actual working of the farm.

All of which is respectfully submitted.

JOHN B. MOORE.
A. P. SLADE.
M. I. WHEELER.

REPORT OF COMMITTEE.

The committee appointed by the Board of Agriculture to visit the Agricultural College, and examine the senior class in agriculture, attended to that duty June 23, 1880.

Only one member of the committee reached the College in the morning in season to participate in the public exercises as advertised; and Mr. Benjamin P. Ware of Marblehead, a member of our Board, and W. L. Warner of Sunderland, President of the Hampshire Argicultural Society, very kindly assisted your committee in the examination.

The class was small in numbers; but we hope and trust that this deficiency was more than compensated for in the quality of brain, culture, and acquirements of the young men.

The public examination continued for two hours, embracing a variety of topics: such as soils, their composition, origin, varieties, characteristics, adaptations, the methods and effects of tillage.

Plants, their structure; organs of plants, and their offices; their composition, and the sources from which the materials of their structure are obtained.

Soils and plants, the effect on the soil of natural plant-growth, and the effect of artificial production.

The conditions of an exhausted soil, fertilization of the soil, agents and substances employed for this purpose, how obtained, and their influences on soils and plants.

Farm management, economy, and accounts; selection, division, and cropping of a farm.

Growing grain as a market-product, and its effect on the farm.

The influence of agriculture on national character, wealth, and prosperity; and several other topics.

The young men acquitted themselves very creditably, showing that they had been carefully and thoroughly instructed in general principles, answering questions readily and intelligently, expressing their thoughts in good English, clearly, properly, concisely.

Essays were submitted for our examination, written by the class in the presence of President Stockbridge, without the aid of books, upon topics given out by him at the time.

The merits of these papers, together with the oral examination in the morning, was to determine the award of the Grinnell prizes of fifty and thirty dollars.

That of fifty dollars was awarded to Almon H. Stone of Phillipston, and that of thirty dollars to William G. Lee of Amherst.

Your committee were present at the rhetorical exercises of the other classes, and the graduating exercises of the seniors in the presence of his Excellency Gov. Long, the Trustees and Faculty of the College, and the public. We also witnessed the military drills and observed the deportment of the young men in their intercourse with each other, the Faculty, and visitors; and it gives us much pleasure to express our appreciation of their gentlemanly bearing and refined manners, and the respect, good will, and esteem they manifested towards President Stockbridge and the Faculty of instructors.

We fully believe that the institution is doing good faithful work in the line of practical education for the duties of the field and laboratory, and also fitting its young men for military service and the varied duties of citizenship; and we trust the time is not far in the future when a larger share of that public confidence, which is the support and most powerful incentive to high attainment of all institutions of learning recognized and fostered by the parental care of the State, may be more generously extended to this young College; filling its halls with students; securing from its friends and from the State a more ample pecuniary endowment; enabling its board of management and Faculty to provide more perfect courses and appliances of instruction, enter new fields of investigation and experiment, enlarging the boundaries of human knowledge, and devising new and improved methods of employing the vast productive forces of Nature and civilization, and thus elevate the laborer by relieving him of drudgery, giving intelligent direction to his powerful energies, while securing to him those results and rewards that can only be achieved, in any department of human industry, by the exercise of skill, based on the possession of scientific knowledge.

JAMES P. LYNDE,
For the Committee.

JAN. 10, 1881.

Dr. JOHN CUMMINGS, *Treasurer, in Account with* MASSACHUSETTS AGRICULTURAL COLLEGE. Cr.

Date	Dr.	Amount
1880. Jan. 16,	To Balance, Cash on hand . . .	$575 49
	Receipts, Farm account . . .	2,395 73
	Term-bill account . .	4,253 53
	Grinnell Prize Fund account,	80 00
	Hills Fund account . .	600 00
	Massachusetts Society School Fund account . . .	288 00
	Mary Robinson School Fund account	70 00
	Botanical account . . .	2,094 68
	State Endowment Fund acc't,	13,080 21
	Farnsworth Prize Fund acc't,	100 00
	Current expense account .	118 04
	Laboratory account . .	678 09
		$24,333 77

Date	Cr.	Amount
1880.	By Expenses, Farm account . . .	$3,804 01
	Term-bill account . .	990 51
	Grinnell Prize Fund account,	80 00
	Hills Fund account . .	565 61
	Salary account . . .	10,101 00
	Farnsworth Prize Fund acc't,	65 00
	Current expense account .	2,953 92
	Laboratory account . .	712 16
	Botanical account . .	2,579 79
	Extra instruction account .	870 76
	Mass. Scholarship Fund acc't,	288 00
	Mary Robinson Fund acc't .	70 00
	Interest account . . .	15 00
1881. Jan. 10,	By Balance, Cash	1,238 01
		$24,333 77

JOHN CUMMINGS, *Treasurer.*

Sundries Dr. to Mass. Agricultural College, Jan. 1, 1881.

Real estate	$200,000 00	
Live stock, appraised	3,202 00	
Implements, vehicles, &c.	1,896 00	
Produce on hand	2,023 00	
Cash	1,238 01	
		$208,359 01

Mass. Agricultural College Dr. to Sundries.

Robinson Prize Fund account	$35 00	
Farnsworth Prize Fund account	74 27	
Grinnell Prize Fund account	50 00	
Toten Prize Fund account	8 00	
Hills Fund account	132 76	
Laboratory account	173 54	
		$473 57

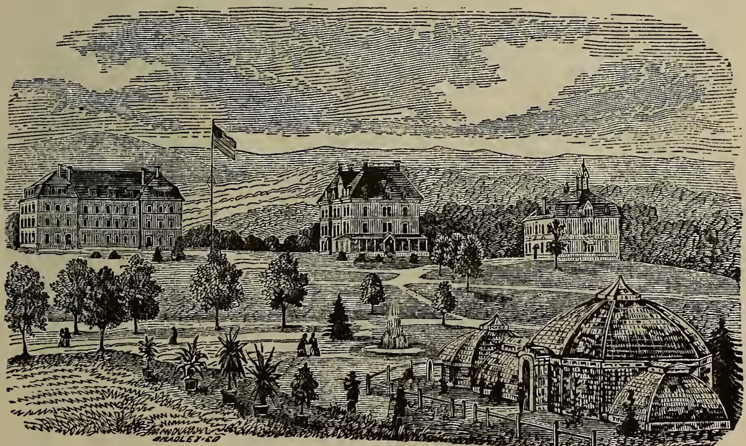
HOUSE DOCUMENT. No. 35.

NINETEENTH ANNUAL REPORT

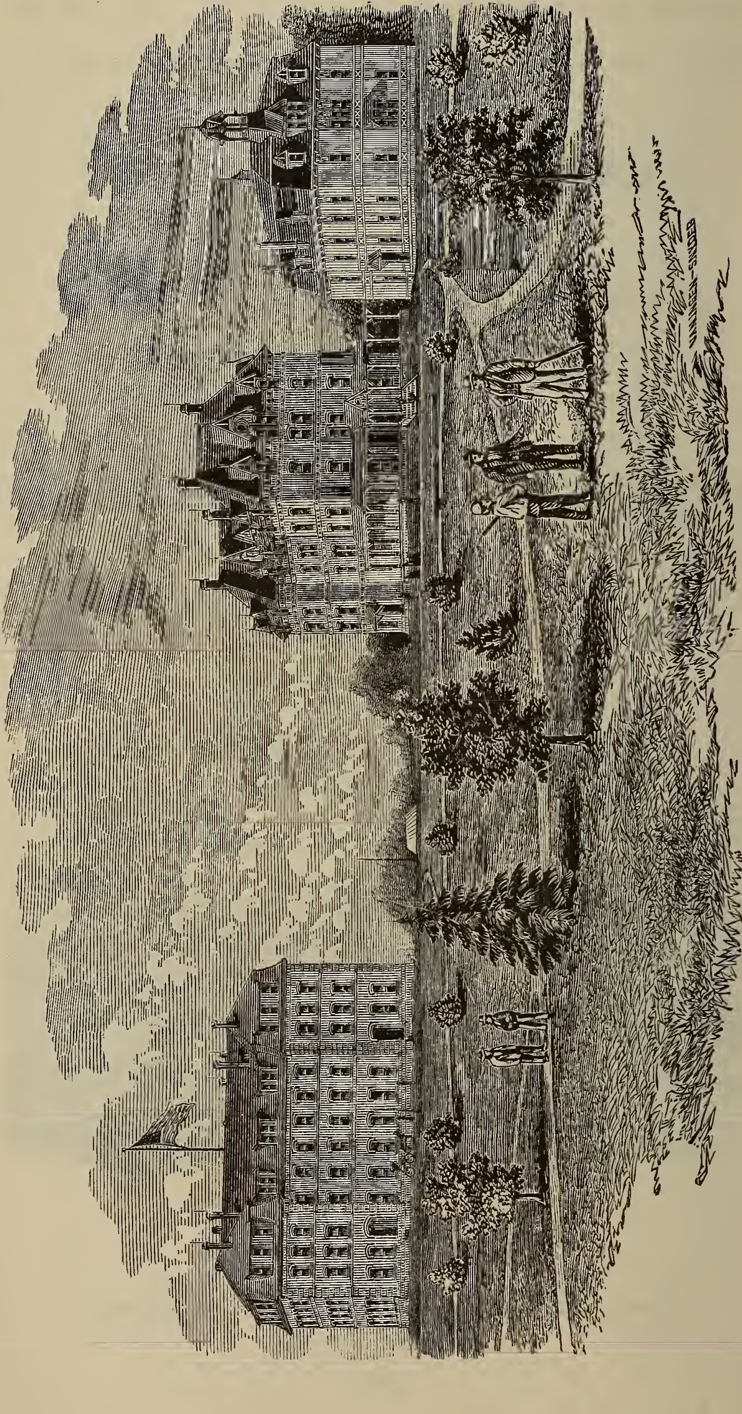
OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

JANUARY, 1882.



BOSTON:
Rand, Avery, & Co., Printers to the Commonwealth,
117 Franklin Street.
1882.



Commonwealth of Massachusetts.

Executive Department, Boston, Jan. 28, 1882.

To the Honorable the House of Representatives.

I have the honor herewith to transmit for the information and use of the General Court the Nineteenth Annual Report of the Trustees of the Massachusetts Agricultural College.

JOHN D. LONG.

Commonwealth of Massachusetts.

MASSACHUSETTS AGRICULTURAL COLLEGE,
AMHERST, MASS., Jan. 27, 1882.

To his Excellency JOHN D. LONG.

DEAR SIR, — I have the honor herewith to present to your Excellency and the Honorable Council the Nineteenth Annual Report of the Trustees of the Massachusetts Agricultural College.

I am, sir, very respectfully,

Your obedient servant,

LEVI STOCKBRIDGE, *President.*

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ANNUAL REPORT.

To his Excellency the Governor and the Honorable Council.

The Trustees of the Massachusetts Agricultural College, in compliance with the provisions of law, herewith present their annual report. During the year, they and their College officers have made the most strenuous efforts to continue and maintain the established system in all departments, and, considering the difficulties of the present situation, with a good degree of success. By assigning extra work to the professors, and keeping their salaries at the lowest point possible without losing their services, by refusing all appropriations for investigations and improvements on the estate, by confining all our operations to those of imperative necessity, and the practice of rigid economy in these, we have succeeded in keeping our expenses within our income, and making sundry needed repairs on the buildings. The work of the farm has been directed to ordinary crop operations, with the exception of ploughing and reseeding some portions of the pasture for the purpose of increasing the quantity and improving the quality of its grasses. The area in tillage was forty-seven acres; viz., Indian corn, twenty acres, yielding eighteen hundred bushels of ears and forty-five tons of fodder; rye, twelve acres, yielding a hundred and eighty bushels of grain and fifteen tons of straw; oats, eight acres, yielding four hundred bushels of grain and fourteen tons of straw; potatoes, four acres, yielding five hundred bushels; turnips, one acre, yielding four hundred bushels; and two acres in cabbage and other garden vegetables. Seventy-five acres were in grass, yielding a hundred and sixty tons of hay. Twelve acres have been ploughed and sown with winter rye for next year's crop, and forty acres were ploughed in the fall to be cropped next year. The neat stock at the present time is forty-three head, included in which are two pairs of large oxen, being stall fed, and nineteen cows. There are ninety swine of the Berkshire breed. The herd of cattle has nearly doubled since its reduction in 1879, and is in good condition, with many choice animals. It has not been sufficiently large, since the time named, to consume the hay and fodder product of the farm, quite a large part of which has been sold, and a portion of the proceeds expended in purchasing stable manure at the village, or commercial fertilizers. The receipts and expenditures for the farm, including the payment for student-labor, show a small balance in its favor.

Mr. D. H. Tillson as farm-foreman has discharged his difficult and responsible duties with great fidelity, and made unwearied efforts to command success. As usual, the horticultural department has been ably conducted by Professor Maynard. Its business is enlarging and becoming more important every year. The sale of flowers, bedding and potted plants, shrubs, ornamental trees, fruit-trees, and fruits, is quite large, aggregating during the last season about four thousand dollars. What may be called the business of this department is carried on at a profit, and would show a decided balance in its favor; but this balance is more than consumed in the support of the Durfee Plant-House, which is little but a show-house, returning small revenue, though of much interest to the public, and very valuable for study and instruction. For further information of this department, reference is made to the annexed report of Professor Maynard. During the past year there have been the following changes in our corps of instructors: Professor William B. Graves, who for six years occupied the chair of physics and mathematics, and discharged its duties with fidelity and success, resigned his position in August to take a situation at Phillips Academy in Andover; and the place has been temporarily filled by the employment of Professor Charles L. Harrington, whose course here has fully sustained his reputation as a successful and enthusiastic teacher. The detail period of three years of Lieut. Charles Morris, as instructor of military science and tactics, expired the 1st of September;

and he returned to his regiment. The United States Government detailed Lieut. Victor H. Bridgman to the place, and he has entered upon his duties in such a manner as to give bright promise of the greatest efficiency and success. These new men have apparently imbibed to the full of the Agricultural College enterprise, have harmonized perfectly with the previous members of the faculty, giving their sympathy and co-operation in all their trials and successes. Annexed is a report from each on the present condition and wants of their respective departments. The other members — Professors Goodell, Goessmann, and Maynard — have as usual put forth every effort to maintain the efficiency of their departments, the general *morale* of the College, and a high standard as an educational institution. Though the duties of the permanent members have been increased to a dangerous point since 1879, they have found it impossible to give instruction in all the branches required by the curriculum; and it has been necessary to employ specialists to take the courses in geology, zoölogy, and veterinary. There has been no material diminution in the number of students. At the opening of the college year nineteen were received to the freshman class in the regular course, one as a special, and five for the post-graduate course. The students as a whole have availed themselves of their privileges, and performed their required duties with cheerfulness and alacrity, have respected the regulations of the College, been earnest in contributing to maintain its high character, and enthusiastic in supporting its distinctive features. The present winter they have originated and carried into successful operation a course of weekly evening lectures from specialists in the science and practice of agriculture, which the public are invited to attend, and which cannot fail of being highly beneficial. The anniversary exercises were of a superior order. They were attended by his Excellency the Governor and staff, by the members of the Board of Agriculture, the friends of the College and graduates, many of the Alumni, and more generally than usual by the public. It is evident that these exercises are yearly attracting more and more attention, that the circle of their influence is enlarging, and that the agricultural portion of the community are coming to consider the commencement exercises of the College an occasion of great import. The Farnsworth prizes for excellence in declamation were awarded, — the gold medals to Charles T. Conger of New York, of the sophomore class, and George Cutler, jun., of Amherst, of the freshman class; the silver medals to Homer J. Wheeler of Boston, of the sophomore class, and Elisha A. Jones of Rockville, Mass., of the freshman class. The Grinnell prizes to the graduating class for the best written and oral examinations in agriculture were awarded, the first, of fifty dollars, to Henry W. Wilcox of Nawiliwili, S.I., and the second, of thirty dollars, to Austin Peters of Boston. The graduating class numbered nineteen, who, having completed the required course of study and examinations, received the degree of Bachelor of Science; and seven of the number who were matriculants of the Boston University received the diplomas of that institution. A valuable addition has been recently made to the natural-history cabinet of the College, by a donation from Winfred A. Stearns, a young naturalist of Amherst. It consists of many thousand specimens in the departments of mineralogy, entomology, and conchology, and a large collection of the nests and eggs of the birds of New England. Want of room and cases have seriously interfered with its arrangement in suitable order for exhibition and study, but yet it is a great acquisition to this department. For want of means the improvements of the year on the land or buildings have been few, and those more in the direction of preserving what we have from unavoidable decay and deterioration rather than of changes for permanent improvement. On the farm, work, in gradually developing the arranged system of drainage, and breaking up and subduing the uncultivated land near the western boundary, was discontinued in the fall of 1879, and has not been renewed; but, as already stated, fourteen acres of the pasture, which was becoming infested with small shrubs and coarse grasses, have been ploughed and reseeded; and there has been much grading and reseeding done near the L. D. Cowles homestead. The Durfee Plant-House, which was getting seriously out of repair by the settling of the arches of the roof, and the decay of the sills, the floors, and benches, has been repaired by lifting the arches, and supporting them with iron standards, putting down new floors, benches, and shelves, and painting the entire structure inside and out, the whole cost of which has been more than six hundred dollars. At an early day it will require further repairs on the foundations, sills, and walls of the propagating pits. By act of the last Legislature, the Massachusetts Central Railroad was granted the right of way to cross the College farm; and the surveys have been made, and the permanent line definitely located. The line runs from the south farm-bound in a north-west direction on a long curve, through the full width of the estate, about thirty rods west of the College buildings and farm-barn, and between the latter and the pastures. The road does not come at grade with the surface to any extent, but consists of cuts and fills, and will be a serious disarrangement of our system of field-plotting, will cause no little inconvenience in the management and care of the farm-stock, and the general operations of carrying on the west half of the farm. The land-damages have not been adjusted, though propositions have been made by both parties. It is believed that a settlement will soon be made, reasonable compensation given, direct and indirect, in money and privileges; but it must result in a lasting injury to the estate.

When the Commonwealth received the endowment-fund of the College from the United States, it was stipulated in the compact that the State should provide all the buildings needed by the institution, and keep them in repair, without using any of the fund, or the income thereof, for that purpose. In 1867 and 1868 funds were provided by the State and the town of Amherst for the erection of such structures as were deemed necessary. Some of them were built rapidly, to meet existing emergencies; and thirteen years' use, and perhaps, in some cases, the original employment of improper material and poor workmanship, has caused much deterioration and need of repair. The State having made no provision for such necessities, the Trustees, to prevent serious losses, have deemed it their duty, during the last two years, to expend sixteen hundred dollars for this purpose from their general income. The money thus expended was greatly needed by the different educational departments, and nothing but the imperative necessities of the case could justify its employment in this manner. Similar work is still needed; and we respectfully suggest to the consideration of the Legislature whether the spirit or letter of the compact with the General Government can be complied with, only by the State assuming this obligation, and employing the income exclusively for educational purposes.

WANTS OF THE INSTITUTION.

As the law required military tactics and drill to be taught in the College, it was deemed best, that, so far as possible, this instruction should be given in the winter months, when the students could not have full employment on the farm; and, as winter drill in the field was impracticable, a drill-hall was provided in the third or attic story of the laboratory building. But the marching and evolutions of the battalion, continued for ten years, have so strained and weakened the structure, as to create serious apprehension of its complete ruin: therefore, for three years, its use for this purpose has been discontinued; and the winter drill, so important in the general system, has been practically abandoned. Estimates were made by a practical builder of the cost of such repairs and supports as were considered necessary to make the structure secure and safe to the battalion; but it has been beyond our power to make the necessary repairs and improvements. The agricultural department has always suffered for want of proper accommodations and appliances, and for apparatus and objects for lecture instruction. To make it thoroughly effective and useful, the professor should have an ample lecture-room, with cabinet-rooms adjoining, where specimen crops, tools, implements, and farm machines and appliances in all its departments could be collected and arranged for use before his classes, and for private study. Such a cabinet would cost no money, but would be of incalculable advantage to the students, and a place of resort and instruction to the farmers of the State. A suitable building could be erected for fifteen thousand dollars; and on the earth in its basement a military drill-room could be provided, for winter and stormy weather, which would be convenient, and beyond the possibility of injury by the marching and evolutions of the cadets. By this method the expense of repairs on the present hall would be avoided; and it could be used for other college purposes, and the suffering want of the agricultural department supplied. Repairs and refitting are needed at the boarding-house; and the kitchen and dining-room furniture, which has been in constant use fourteen years, should be replaced by new. The library is far from being what is needed, either in the number of its volumes or its departments; and it is thus, not because the Trustees do not appreciate the great value of books to both instructors and students, but because of their inability to replenish it from year to year with new and standard works for culture, reference, and instruction. When the College was opened, the trustees of Amherst College kindly offered the use of their extensive and valuable library to our students and Faculty on the same conditions as to their own. This generous offer has been availed of quite freely, and its advantages highly prized; but there is an extensive line of works specially needed, and adapted to the wants of the students of the Agricultural College, which are not found there: and its distance is such as to make its use a great inconvenience. Some means should be provided for making regular additions to the College library, and a suitable room for its keeping; and the College will be far from having its necessary equipment until this is done. We thus express our views of the wants of the institution committed to our care, with the feeling that it is doubtful if the general public, or even the Legislature, fully appreciate the magnitude of the enterprise, or the skill, intelligence, and means necessary to carry it forward successfully, or in a manner creditable to the State. As was intended by its founders, the College is an educational institution, with its distinct departments, apparatus, cabinets, and instructors like other New England colleges, but with the addition of technical courses relating to the theory and practice of agriculture, and other industrial arts, to make which efficient and useful, requires of its Trustees the same executive care and oversight in all details, the same financial provisions, and the same responsibilities in kind and extent as are required of the trustees of other colleges. The farm is a very large one, with its buildings, stock, tools, teams, crops, and business operations of all kinds, like other large farms, and, owing to the peculiar circumstances of its connections and objects, requires more than ordinary care, foresight, and responsibility. The horticultural department, with its conservatories, nurseries, fruiteries, and landscape gardening areas, is a business operation of no small magnitude. Each of these divisions of the enterprise is indispensable as a part of the general system of the institution;

and each, from a business stand-point, is of sufficient size and importance to monopolize the time and thought of an able board of direction, the skill and energy of the best executive talent; and the whole and each is enlarged and complicated by the necessity of making each contribute to the technical education of the students. In addition to this, there is a somewhat pronounced public opinion that constant effort should be made, and expenses incurred, for the benefit of the general agriculture of the State, by carrying forward investigations to demonstrate and establish principles of practical importance. If the entire institution consisted of the College proper, with the indispensable professorships supplied with the necessary appliances and apparatus to make the instruction what it should be, the present income of the College would be inadequate to its proper support; and, as the farm and horticultural departments must be used to a greater or less extent to give technical education to students, they cannot be relied upon to contribute to this purpose. Our efforts the last two years to bring the College to the highest efficiency having convinced us of its impossibility with only its present income, it was thought desirable to institute measures to increase the endowment-fund to such an amount as is required to yield an ample and reliable revenue. Therefore a joint convention to consider the subject, consisting of his Excellency the Governor and Executive Council, the Board of Trustees, and the Board of Agriculture, was held at the College on the 22d of last June.

Gov. Long acted as president of the convention, and called upon Hon. Daniel Needham of the Board of Trustees to make statements showing the condition and wants of the College, and the reasons for calling the convention. In response Col. Needham passed in rapid review the history of the agricultural colleges of Europe, and the great benefit resulting therefrom; the early efforts to establish them in this country, alluding in particular to the commission given by the State of Massachusetts in 1851 to Dr. Hitchcock, to examine the agricultural schools of England, France, and Germany, and his report thereon to the Legislature. He traced, with some detail, the subsequent efforts to establish agricultural schools in several of the States, and the gradual and decided change in public opinion in their favor until about 1860, when the —

"Hon. Justin S. Morrill of Vermont, then a member of the House of Representatives, brought the matter again before Congress. It was discussed from time to time, — now prostrated by defeat, and again bidding fair promise of success, until 1862, when the Act upon which the present Agricultural College is based was passed by both Houses of Congress, received the signature of the President, and became a law.

"As is well known, the law provided grants of lands proportioned to the population in the several States, as a fund for the support of agricultural colleges. Among the provisions of the Act, was one that military tactics should be taught in the College. I think this has been one of the most difficult obstacles we have had to overcome. The people have found it difficult to see the connection between agriculture and military tactics. Many a severe jest has been made, based upon the provisions of this requirement. But the provision is in the law, and we cannot go back of it. It is no fault of the State that it is there; it is no fault of the trustees that it is there: and perhaps, as we are a nation of citizen soldiers, keeping no standing army, and forever dependent upon the citizens, in case of rebellion or invasion from a foreign foe, it is well that the requirement is made; for, without a soldier's education, the American citizen cannot perform the full duties of citizenship.

"In 1863 the Massachusetts Legislature considered the Act providing for the establishmert of colleges in the several States. It was discussed in committee, and reported favorably; it was discussed in the House and Senate, — discussed carefully in detail; every objection was considered and weighed and overcome; and the bill making provision for the Massachusetts Agricultural College was passed by both Houses of the Legislature, received the signature of the Governor, and became the law of the State. The bill fully, unequivocally, and unreservedly accepted the national bounty and the terms of the congressional Act. The State accepted the contract. If it was a mistake, it is now too late to rectify it. The Legislature and the executive head of the State entered into a solemn and deliberate contract with the nation. That responsibility once accepted was accepted for all time. Massachusetts will not go back of her contracts, — she is no repudiator. She cannot shift this College off to other shoulders. She cannot make it a part of another institution. It is an independent organization, — chartered and created for independent work; and the time to regret it has long since passed.

"In the bill accepting the grant, a Board of Trustees was elected by both branches of the Legislature. The gentlemen elected were carefully selected, and were elected without their request or solicitation. They accepted the responsibility, — it was a great one, for an Agricultural College was a new thing, an experiment in Massachusetts: it had older and richer institutions to compete with, it had prejudice from the people to combat, it had a plan to make and shape for which it had no precedent. The agricultural colleges established by despotic governments were no model for the College in the republic of America. So they felt their way — slowly — little by little — in great doubt, uncertainty, and darkness — seldom with great confidence except in the fact that the principle was sound, the object good, and that in the end the College would justify the act of its founders.

"The town of Amherst, in its recognition of the value of the institution, invited the Trustees to locate it within its borders, and, as an inducement, offered seventy-five thousand dollars. After great deliberation the offer was accepted. In this liberal offer the people of Amherst had the right to expect that the College would be well maintained, and that both State and Trustees would see that no stone would be left unturned to secure success.

"The College was not richly endowed, and the number of students was not large. For this reason poverty met the Trustees at every turn, — in the compensation of professors, in the management of the farm, in the erection of houses for the Faculty; but this poverty was no fault of the Trustees, — they had not agreed, neither could it be expected, that they would furnish money from their own pockets to make good deficits that might occur. So from time to time appeals were made to the Legislature to which every year a full report of the management and condition was made by the Trustees.

"By and by legislators grew weary of these annual or bi-annnal calls. The press took up the complaint. Denunciations of the College were in every-day editorials, and at times the public press seemed to be striving to see which could get the lead in its abusive attempts to set forth the uselessness of the State Agricultural College.

"In 1870 or thereabout, the Legislature made a change in the election of the members of the Board of Trustees. Theretofore elected by the Legislature, it was now provided that the Board should be self-perpetuating, and in this way brought into harmony with all educational boards that had been chartered by the State. It was thought, too, that this change would relieve the State of the burden of the College, and that the new Act would shift responsibility.

"The Trustees made no interference with the new action of the Legislature. They had not asked it; they did not oppose it: but, knowing the history of the College, they knew that State responsibility could not be thrown off. Acts might be passed, the statute-book might be covered with resolutions, but this great fact would remain the same. It was too late — too late. By solemn obligation and deliberation the responsibility had been assumed, the lands granted by the government had been sold, the gift of the town of Amherst had been accepted, and there was nothing to be done except for the State to fulfil its part of the contract.

"The Trustees under the new Act of legislation continued to struggle on. The press was against them, and many of the leading farmers of the State preferred to make them and the College the basis of a joke rather than give a word of encouragement.

"At last, determining to test the popular will, free scholarships were offered. That was three years since, and to their delight the College for the first time was filled. Then it was discovered that the people were beginning to appreciate the College, and that prejudice was giving way. But in another year it was found that the finances of the College would not justify free scholarships, and with deep regret the Trustees were obliged to renew the former policy. The College classes relapsed into their former small numbers, and the taunt of a want of appreciation or absolute uselessness was revived by the press.

"But was it the fault of the Trustees that the College was poor? Had it been for once only that they would be called upon to bridge over a deficit, or even twice, and then they could have assurance that the College would move on with ease and certainty, they would have gladly put their hands in their pockets, and made good the needed funds. But if free scholarships were to be given the public, there would be no end to this demand; and therefore necessity compelled the change which was most reluctantly made.

"But one thing is now established, and established beyond questions. The farming public have yielded their prejudices, and the Agricultural College is recognized as one of the great means demanded by our advancing civilization. The only impediment now is our poverty. With means we can again offer free scholarships, and with free scholarships our College will be filled.

"As a means, then, for meeting our great want, and removing the only remaining obstacle in the pathway of the State Agricultural College, I present the following resolution: —

"*Whereas*, The opportunity afforded for free tuition three years since fully demonstrated that the Agricultural College was appreciated by a large proportion of our farming population, by the increased numbers who sought and secured membership; and

"*Whereas*, The increasing necessities of our civilization demand free scholarships of all our young men who are ambitious to secure practical education, and whose circumstances do not favor the expenses of tuition; and

"*Whereas*, The only remaining obstacle in the development and prosperity of the Agricultural College is found in the small means at its disposal, thereby preventing the Trustees from continuing the liberal policy of free scholarships so successfully inaugurated three years since; therefore,

"*Resolved*, That a committee be appointed to consider the perfect means for the establishment of a large permanent fund for the College, in addition to its present endowment, that its usefulness shall be made commensurate with the designs of its originators, and its scholarships brought within the reach of all the youth of the Commonwealth."

The resolutions were unanimously adopted after full and free discussion. The following gentlemen were appointed as a committee to consider the entire subject, and to submit a plan at a subsequent meeting of the College Trustees: Hon. Daniel Needham of Groton, Hon. William Knowlton of Upton, Hon. George Taylor of Chicopee, Lieut.-Gov. Weston of Dalton, and Hon. C. L. Flint of Boston. By the suggestion of Gov. Long, the following resolution was passed, and the convention adjourned: —

Resolved, "That the State Board of Agriculture be requested to require all agricultural societies in this State receiving bounties to support at an expense not less than $75 one student residing within its limits at the Massachusetts Agricultural College, and that, in case no student is so supported, such amount shall be withheld in the payment of the agricultural bounty to said society, and applied to the general uses of the College."

The committee attended to their assigned duties; and at the annual meeting, by their chairman, Hon. Daniel Needham, reported the following plan: —

"That a fund of one hundred thousand dollars be raised by subscriptions of one thousand dollars each, payable in ten instalments of one hundred dollars a year, with interest at four per centum on all unpaid balances, until the entire sum is paid; and that, whenever said one hundred thousand dollars shall be paid, it shall be handed over by the committee to the treasurer of the College as a permanent fund, the income of which shall be used under the direction of the Board of Trustees.

"That the conditions upon which this fund shall be bound, shall be as follows: 1st, The present system of electing trustees for filling vacancies shall not be changed. 2d, That the committee shall be perpetuated by the filling of vacancies by the Board of Trustees during the period of ten years during the time which the subscription shall be open."

The report was accepted, and laid on the table; and it was voted that the plan should be considered in detail, and measures perfected at an adjourned meeting for its execution.

The Trustees of the College, though a legal "body corporate," are simply the agents of the State, with duties and powers clearly defined by law. In the statute of Congress the great aims and purposes for which the College endowment was provided, and the obligations assumed by the State in accepting it, are fully set forth; and in the statute of the State the details of administration by which it is proposed to realize those aims are defined, even to the course of study to be pursued, and the proportion of time to be given to each. The responsibility of the Trustees is confined to an economical expenditure of the funds committed to them for purposes expressly defined, and a faithful adherence to the established system. If this is incapable of producing the designed result, or if the income from funds is inadequate to sustain and develop the system, the responsibility must belong to the State. The experience of fourteen years has demonstrated that the plan of organization is no more extensive, its grade is no higher, than was contemplated by the donors of the endowment, or than is essential to the attainment of the ends sought. Therefore as it exists, in all these respects, it should be supported and maintained.

Respectfully submitted by order of the Trustees.

LEVI STOCKBRIDGE, *President.*

Agricultural College, Amherst,
Jan. 27, 1882.

CHEMICAL DEPARTMENT.

REPORT BY PROFESSOR CHARLES A. GOESSMANN.

THE instructions in theoretical and practical chemistry have been given during the past year in conformity with the prescribed general course of studies. The freshman class has attended lectures with recitations on elementary chemistry, the junior class on analytical and organic chemistry, and the senior class on industrial and agricultural chemistry. The senior and the junior classes have also devoted the usual time assigned for practical chemical analysis. The substances tested by the students in the laboratory were selected with reference to their interest in every-day life as well as to their special relation to various branches of chemical agricultural industry, and to practical agriculture in particular. Both classes have manifested during the entire year a gratifying interest in these exercises. Five graduates have returned to continue their studies in practical chemistry for a more or less extended period. The number of students attending the exercises in the laboratory during the main part of the year amounted to from forty to forty-five. Aside from the regular class instruction, the usual amount of analytical work has been carried out in the interest of the farming community, which will be reported in the official report of the inspector of commercial fertilizers to the State Board of Agriculture. The investigations regarding the special action of particular articles of plant-food on the character of the plant and on the composition of the fruits has been continued, and some of the results will soon be ready for publication.

The finances of the chemical department are, in consequence of a rigid economy and a large attendance of the practical exercises in the laboratory, in a very satisfactory condition, as may be noticed from the detailed statement of the financial agent of the College, which accompanies this report. The sum credited to the department on the 1st of January, 1882, after deducting all expenses previously incurred, amounts to eight hundred and twelve dollars. The interest of the College, as well as of the chemical department, render it desirable that permission should be granted to devote at least two-thirds of the above-stated surplus, as soon as convenient, to the increase of collections, and of apparatus for the illustration of lectures in chemistry, and of the practical instruction in the chemical laboratory.

REPORT OF THE BOTANIC DEPARTMENT.

BY PROFESSOR SAMUEL T. MAYNARD.

During the past season the "Durfee Plant-House" has been thoroughly repaired and painted. This work required the expenditure of the entire appropriation; besides, a large amount of work has been done by students, and others in our regular employ.

The plants in these houses, although somewhat injured in the process of repairs, are again presenting a fair condition.

The orchards are in better condition than ever before, having received better cultivation than in any previous year. The peach-trees have again yielded a moderate crop of fruit, which, owing to the cool summer, was of rather poor quality. Some of these trees, from ten to fourteen years old, and which have, apparently, passed through all the stages of the disease known as the "yellows," are now in perfect health, and bore some fine fruit the past season.

The vineyard has done remarkably well the past season, considering the care it has received. The income from the sales of fruit amounted to $259.69, although nearly one ton of unripe fruit was destroyed by the frosts. The vines are all trained in a natural fan system, as requiring the least care. The vines planted in the experimental plots, it is designed to train according to four or five of the leading systems, for illustration.

The small fruits, aside from the grapes, consist of about two acres of strawberries, which are in fine condition; the raspberries and blackberries planted in and around the orchards, and one and one-half acres of the same planted this fall, with the more lately introduced and promising varieties. The varieties of strawberries grown are, for the main crop, Charles Downing, Crescent Seedling, Wilson's Albany, Sharpless, Glendale, Forest Rose, with smaller lots of these new and promising kinds; viz., Bidwell, Crystal City, Triple Crown, Oliver Goldsmith, Duchesse, Miner's Prolific, Hervey

Davis, Pioneer, Champion, Golden Defiance, and Manchester. The latter varieties have been planted in widely varying soil and with several kinds of fertilizers, to enable us to test their real merits for general cultivation.

The varieties of raspberries grown are the Turner, Cuthbert, Caroline, Henrietta, Herstine, and Highland Hardy; with the two most common black-caps, Doolittle and Mammoth Cluster. Of the blackberries we have the Kittatinny, Wilson's Early, Dorchester, Wachusett, Snyder, Taylor's Prolific, and Sable Queen.

IMPROVEMENTS.

The two unsightly gravel-pits on the land, under the direction of this department, have been graded off, compost carted on, and seeded to grass.

Upon the hillside, near the reservoir, about six hundred feet of tile have been laid, to take away the water from several surface springs, the underbrush and a few of the useless trees removed, and the whole thoroughly ploughed.

A walk has been constructed from the plant-house door to the south boundary of the farm along the side of the road. In its construction about seventy-five loads of stone, taken from the land in the orchard, were used to fill in along the roadside opposite the house occupied by President Stockbridge.

The land to be planted next spring has all been ploughed, and much done to help along the work in the spring. Manure has been carted around the fruit-trees, grape-vines, raspberries, blackberries, and the ornamental trees and shrubs, more liberally than ever before.

EXPERIMENTS.

Besides the experimental plots of fruit under the direction of Dr. Goessmann, which have been cared for, several experiments have been carried on; but limited space will permit of the mention of only one. In July twelve rows of grape-vines were selected; and all surplus canes, i.e., those not needed for the formation of the next season's fruit-spurs, having good bunches of fruit upon them, were girdled by taking out a ring of bark one-fourth of an inch wide just below the fruit. Account of the cost of this labor, which extended from July 10 to Aug. 1, was kept, and the sales of fruit from the girdled branches, before the main crop ripened. The cost of labor was $18.75 (about one-half more than it ought to have been), and the fruit sold for $36.18 above the price for the same amount of fruit from the main crop. No injury to the vine has ever been noticed from this practice.

INSTRUCTION.

Aside from the duties directly connected with the Botanic Department, — i.e., the teaching of Botany and Horticulture, the direction of the business and care of the grounds, — extra work has been done in teaching Microscopy, Freehand Drawing, and Landscape Gardening.

SUGGESTIONS.

I would again urge that the course of study be so changed that botany be taught during the summer and fall terms, and not, as is now done, during the winter term, when very few illustrations can be had. I would also ask that more time be allowed me for the instruction of botany and horticulture, and that it be more evenly distributed through the four years' course of study.

To this I have appended a detailed statement of the accounts of the department, as far as my books can show, together with a statement of the amounts received from the sale of each crop.

To this might be added the crop of hay, oats, and corn, which is sufficient for the keeping of two horses, besides exchanging several tons of hay for stable manure.

STATEMENT OF HORTICULTURAL DEPARTMENT.

Cash on hand Jan. 1, 1881	$2 59
Total cash paid Treasurer from —	
sales of plants, fruits, etc.	1,566 26
from sales of nursery	875 82
paid for labor, materials, and sundries	792 56
on hand Jan. 1, 1882	100 56
Total Cash sales of the Botanic Department	$3,337 79
Plants turned to balance bills —	
for labor, materials, etc.	$125 25
trees, etc., for College grounds and farm	103 45
Outstanding bills due	209 84
Trees exchanged for nursery stock	47 60
Bills of College paid by fruit	21 71
Total sales of Botanic Department	$3,845 64

Sales in Detail.

Plants	$825 46
Flowers	421 10
Apples	16 61
Pears	41 40
Peaches	117 42
Grapes	259 69
Strawberries	265 53
Blackberries	13 75
Raspberries	25 54
Cabbages	100 91
Cabbage-plants	210 40
Strawberry-plants	28 10
Pease	55 09
Squashes	45 00
Beans (green),	20 34
Sweet corn	31 21
Potatoes	30 72
Celery	15 00
Beets	16 05
Turnips	5 95
Cucumbers	5 42
Tomatoes	6 09
Sundries	37 64
Total sales of nursery	1,251 22
Total sales of Botanic Department	$3,845 64

DEPARTMENT OF PHYSICS AND CIVIL ENGINEERING.

REPORT BY PROFESSOR CHARLES L. HARRINGTON.

THE work in this department is progressing favorably. The science of physics is growing of more importance, as new discoveries are made in electricity and chemistry; and, while it is not advisable to make this branch of study as prominent as some others, it is advisable to make it correspond to the needs of the College. To this end I have, so far as practicable, introduced the lecture method of giving instruction; and I find that the students have a better understanding of the matter under discussion, take more interest in their work, and accomplish double the work in the same time as under the method formerly in vogue. To fully carry out my plan, the apparatus should be repaired and increased. Mechanics and electricity are well provided for; but sound, heat, and light are wholly deficient. Four thousand dollars is the amount required to place the physical cabinet in even respectable condition for a college in the position of our Agricultural College. As soon as your Board are in a condition to make the additions and changes you so much desire, this matter should be thoroughly examined and acted upon. The cabinet in its present position is unsafe; and, whenever a new building is erected, I would recommend that a change be made to a more safe position. If these suggestions result according to my desire, I cannot but believe that you will be fully repaid by the increased interest of the students in their study.

The time allotted for mathematics is used to the best advantage. I would like your Board to consider whether it would not be advisable to raise the standard of admission so as to include one or perhaps two books of geometry. The change would enable us to accomplish that for which now we have no time, and which is necessary to a full understanding of some other branches of study.

Your Board have reason to be congratulated on the present condition of the department, and any change for the better will be heartily welcomed by those most interested in the success of the College.

REPORT ON THE MILITARY DEPARTMENT.

BY PROFESSOR VICTOR H. BRIDGMAN, LIEUTENANT SECOND UNITED STATES ARTILLERY.

I HAVE the honor to submit the following as a brief report of the military department, and my observations and suggestions concerning same. It has been under my charge during the past four months.

On Aug. 27, 1881, I received orders from the War Department, Washington, to report to you, relieving Lieut. Charles Morris, Fifth Artillery, as professor of military science and tactics at this institution. Before my arrival he had been necessarily called away; so that, unacquainted with the requirements of the position, and with no defined order of instruction to be followed, I found some temporary embarrassment in the satisfactory execution of my office. This was greatly diminished by the kindness of Lieut. Morris, who had left some general instructions for my guidance. The necessity of a carefully defined course of instruction being thus presented, it has met my early attention; and the request that each class, commencing as freshmen, should be called to the section-room, has resulted therefrom.

Previously seniors alone have had theoretical instruction, and with these results: The studies which naturally first engage their attention are tactical. Satisfactorily pursued with the time allotted, — two hours each week, — they must engage their attention one-half of their senior year, leaving too little time for military science. Upon entering their final year, it has become the recognized plan of the department to place all seniors by detail in active charge of practical work on the drill-ground, both to familiarize them in the actual requirements of such duties, teaching them to command, and as a necessary aid to the military professor, who can only take a supervisory charge when, as is ordinarily the case, two or three distinct drills are being carried on at the same time in different parts of the drill-ground by different classes. It is obvious that a system which perfected instructors only after half of the time in which they were to instruct had elapsed is faulty. Tactical accuracy is especially necessary, and *any* imperfect instruction creates faults hard to eradicate. Again, junior classes, as they advance in successive years, will take a more decided interest in drills while acquiring them for the first time than months after, when exercised therein more to keep them up to a proper standard than to acquire what, at least, is generally known. Each class in the section-room for from six to eight weeks, two hours each week, the latter half of their first term of successive school years, called upon to explain theoretically what they are there learning practically for the first time, will be *accurately* taught; and, the time being brief, the lessons do not become a burden. In this way seniors will take their places well prepared to perform such duties as devolve upon them, and their entire year can be devoted to scientific and other profitable study. Hereto appended is the modified course of theoretical and practical instruction of this department; and I earnestly recommend that it may be incorporated into the curriculum of the institution entire, thereby introducing the desired changes. The time asked for each junior class does not exceed sixteen hours in the section-room for an entire year; and, from the experience I am now having, the advantage of this course will be invaluable. Much detriment to the proper continuance of practical instruction during the winter months and in inclement weather is caused by the insecurity of the drill-hall. Its location in the upper story of a not over-strong building is unfortunate. At present the hall can with safety be used but little for the purposes designed. The winter months are particularly useful for such preliminary drills as lay the basis to extended exercises; and, as these are thus greatly restricted, the effect is to partially defeat the purposes of this instruction. I recommend that immediate steps be taken to repair this hall, and would suggest that the most expedient method would be the erection of a new building, the lower story to be used for military purposes. The present uniform, while neat and military in appearance, does not fulfil the requirements of all the drills. A jacket allowing more freedom for the upper portion of the body at mortar and artillery drills is desirable. This can be introduced, still keeping within the prescribed cost of the military outfit; and it would be generally worn at all times. A suitable military cabinet would be of material aid in the section-room, and could be obtained from the State without much expense. The department is in serious need of a small permanent fund to be used for the gradual formation of a military library. The necessity for this is self-evident, and its lack is especially felt in the more advanced studies.

It seems proper to call the attention of the honorable Board of Trustees to the excellent military condition of the school. The time devoted to all drills does not exceed four hours per week, scarcely more than students at other colleges, for healthful purposes, devote to prescribed physical exercises. To-day it may safely be asserted, that, on short notice, the corps could creditably appear on company, skirmish, battalion, mortar, and artillery drills; and that the majority of the present senior class will graduate, prepared, if an emergency should require it, to immediately perform efficient service, at least, as company officers. The purposes of the endowment of 1862 on the part of the General Government — the quasi-military education of the students, that they shall be enabled to impart that instruction, and, when needed, be capable of exercising subordinate military offices — seems to be successfully carried out at this institution. This is largely due to the interest manifested by the students, who, as a class, respond cheerfully to the performance of all duties. Additional means should be taken to encourage them to more zealous efforts. The inducement held out by the State or General Government to some official position for excellence seems the most natural means of effecting this. This department is at all times prepared to practically explain its utility to visitors; and more frequent visits from the honorable Board of Trustees, collectively or individually, as well as from others, would induce additional exertion. I am convinced that a more general knowledge of the interior workings of the department would result markedly to its advantage.

Promptness of conception and execution must follow the proper execution of the drills. Self-command and self-discipline must obtain to the individual who efficiently commands the same; all of which, in their natural order, falls to the lot of the student at this College. While the avowed purpose of the United States, in endowing this and similar institutions, was to diffuse a limited military instruction, the result is directly beneficial to the individual student in any life-avocation he may select. To this may be added the advanced course which is given to seniors, embracing, as it always will, a variety of useful and interesting subjects.

THEORETICAL AND PRACTICAL COURSE OF INSTRUCTION.

All students, unless disqualified physically, are required to attend prescribed military exercises, those who pursue special or partial courses at the College not being exempt so long as they remain at the institution. By the commencement of their second term, students are required to provide themselves with a full uniform, the cost of which is less than thirty dollars.

Correctness of deportment and discipline is required of all, the routine of the West Point Academy being followed as closely as circumstances will permit. To insure a proper sanitary condition of the College, the commandant makes careful inspections of all rooms and College buildings each Saturday morning, during which all students in uniform are required to be in their rooms, for the proper police of which they are held to a strict accountability.

At the beginning of each term, issues of such equipments as they will require are made to all students. They will be charged for all injury, loss, and for any neglect in the care of the same.

For practical instruction the following public property is in the hands of the College authorities: —

One platoon of light Napoleons (dismounted).

One six-pounder with limber and equipments.

Seventy-five sabres and belts.

One hundred and fifty breech-loading rifles (Cadet model).

Several accurate target rifles.

Two 8-inch siege mortars with complete equipments.

For practice firing, the United States furnishes blank cartridges for all guns, and ball cartridges for rifle target practice, which is encouraged by the department.

Fall term, freshman year.

Recitations in infantry tactics (Upton's). School of the soldier. School of the company. Skirmish drill. Two hours per week for eight weeks.

Fall term, sophomore year.

Recitations in United States artillery tactics.

School of the soldier (dismounted), sabre exercise, manual of the piece and mechanical manœuvres, bayonet exercise (infantry tactics). Ammunition, equipment of carriages. Modified service of 8-inch mortars. Two hours per week for six weeks.

Fall term, junior year.

Recitations in infantry tactics (Upton's).

School of the battalion. Ceremonies. Camping and field service. Two hours per week for eight weeks.

Spring term, junior year.

A general review of all tactical studies two hours per week for six weeks.

Drills amounting to about four hours per week as follows: —

Infantry tactics; the schools of the soldier, company, and battalion; manual of arms and sword; bayonet exercise, skirmish drill, target practice; ceremonies, marches, and field service.

Artillery tactics: the schools of the soldier, detachment, and battery (dismounted). Mortar drill, sabre exercise, pointing, and field service.

MILITARY SCIENCE.

This instruction is given to seniors, extending through the entire college year, two hours per week.

It will include, in the form of lectures and recitations from selected text-books, the following subjects: —

Ordnance and gunnery; constitutional and military law and history; campaigns and battles; systems of warfare, present and past; an elementary course in strategy and engineering. It will be modified by such additions and changes as shall seem desirable.

Two essays are required from each senior on military subjects during the course. Those of the first set are read before the entire college during the winter term. The second set, all upon the same subject, are written for prizes. The award of same is left to a board of army officers, and the successful competitors read their productions at the graduating exercises.

Subject for class of 1882, "The Military Problem of the United States."

BATTALION ORGANIZATION.

For instruction in infantry tactics and discipline, the cadets are organized into a battalion of two or more companies under the commandant. The officers, commissioned and non-commissioned, are selected from those cadets who are best instructed and most soldier-like in the discharge of their duties. As a rule, the commissioned officers are taken from the seniors, the sergeants from the juniors, and the corporals from the sophomores. All seniors are detailed to act as commissioned officers.

Commissioned Staff.

J. E. Wilder, *Capt. and Adjutant.* S. C. Damon, *Lieut. and Quartermaster.*

Captains.

B. A. Kinney. A. H. Taylor.

Lieutenants.

F. S. May. W. H. Bishop. D. Goodale.
A. F. Shiverick. C. D. Hillman. J. S. Williams.
W. H. Thurston.

Non-commissioned Staff.

A. A. Hevia, *Sergeant-Major.* D. O. Nourse, *Q. M. Sergeant.*

Sergeants.

H. J. Wheeler. C. W. Minott.
F. H. Fletcher. S. C. Bagley.

Corporals.

G. Cutler. H. E. V. Goessmann. C. Hermes.
E. A. Jones. W. A. Mayo.

CATALOGUE

OF

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1881.

TRUSTEES, OVERSEERS, FACULTY, AND STUDENTS.

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Members of Faculty.

LEVI STOCKBRIDGE,
President and Professor of Agriculture.

HENRY H. GOODELL, M.A.,
Professor of Modern Languages.

CHARLES A. GOESSMANN, Ph.D.,
Professor of Chemistry.

SAMUEL T. MAYNARD, B.S.,
Professor of Botany and Horticulture.

CHARLES L. HARRINGTON, M.A.,
Professor of Physics and Civil Engineering.

SECOND LIEUT. VICTOR H. BRIDGMAN, Second Artillery, U.S.A.,
Professor of Military Science and Tactics.

JOHN F. WINCHESTER, D.V.S.,
Lecturer on Veterinary Science and Practice.

BENJAMIN K. EMERSON, Ph.D.,
Lecturer on Geology.

JOHN M. TYLER, M.A.,
Lecturer on Zoölogy and Entomology.

JOHN W. CLARK, B.S.,
Superintendent of Nurseries.

Graduates of 1881.*

Bowman, Charles Abel (Boston Univ.) .	Billerica.
Boynton, Charles Enoch . . .	Groveland.
Carr, Walter Frank	Clinton.
Chapin, Henry Edgerton . . .	Springfield.
Fairfield, Frank Hamilton (Boston Univ.),	Waltham.
Flint, Charles Louis, jun. (Boston Univ.),	Boston.
Hashiguchi, Boonzo (Boston Univ.) .	Tokio, Japan.
Hills, Joseph Lawrence (Boston Univ.) .	Boston.
Howe, Elmer Dwight	Marlborough.
Peters, Austin (Boston Univ.) . .	Boston.
Rawson, Edward Briggs . . .	Brooklyn, N.Y.
Smith, Hiram Fred Markley . . .	North Hadley.
Spalding, Abel Walter (Boston Univ.) .	Billerica.
Taylor, Frederic Patterson (Bost. Univ.),	Boston.
Warner, Clarence Duane . . .	Granby.
Whittaker, Arthur	Needham.
Wilcox, Henry Harrison . . .	Nawiliwili, S.I.
Total	17

Senior Class.

Allen, Francis Sherwin	Medfield.
Aplin, George Thomas	East Putney, Vt.
Beach, Charles Edward	Hartford, Conn.
Bingham, Eugene Percival . . .	Fitchburg.
Bishop, William Herbert . . .	Diamond Hill, R.I.
Brodt, Harry Snowden	Dansville, N.Y.
Chandler, Everett Sawyer . . .	Coldwater, Mich.
Cooper, James Willard	East Bridgewater.
Cutter, John Ashburton . . .	New York City.
Damon, Samuel Chester . . .	Lancaster.
Floyd, Charles Walter	Boston.
Goodale, David	Marlborough.
Hillman, Charles Dexter . . .	Hardwick.
Howard, Joseph Henry	Hyannis.
Howe, George Dickinson . . .	North Hadley.
Jones, Frank Waldo	South Scituate.
Joyner, Frank Hall	North Egremont.
Kingman, Morris Bird	Amherst.

* The Annual Report, being made in January, necessarily includes parts of two academic years; and the catalogue gives the names of such students as have been connected with the College during any portion of the year 1881.

Kinney, Burton Arial	Lowell.
May, Frederick Goddard	Boston.
Morse, William Austin	Boston.
Myrick, Herbert	Concord.
Paige, James Breckenridge	Prescott.
Perkins, Dana Edson	Wakefield.
Plumb, Charles Sumner	Westfield.
Shiverick, Asa Frank	Woods Holl.
Stone, Winthrop Ellsworth	Amherst.
Taft, Levi Rawson	Mendon.
Taylor, Alfred Howland	Yarmouthport.
Thurston, Wilbur Herbert	Upton.
Wheeler, Henry Lewis	Great Barrington.
Wilder, John Emery	Lancaster.
Williams, James Stoddard	Glastonbury, Conn.
Wilmarth, Frederick Augustus	Upton.
Windsor, Joseph Libbey	Grafton.
Total	35

Junior Class.

Bagley, Sydney Currier	Boston.
Bishop, Edgar Allen	Diamond Hill, R.I.
Braune, Domingos Henrique	Nova Friburgo, Brazil.
Conger, Charles Thompson	New York City.
Fletcher, Frank Howard	Townsend.
Hevia, Alfred Armand	Havana, Cuba.
Holman, Samuel Morey	Attleborough.
Lindsey, Joseph Bridgeo	Marblehead.
Minott, Charles Walter	Westminster.
Nourse, David Oliver	Bolton.
Preston, Charles Henry	Danvers.
Selden, John Lincoln	Ashfield.
Wheeler, Homer Jay	Bolton.
Total	13

Sophomore Class.

Brown, Henry Clinton	Pittsfield.
Dickinson, Howard Wilmot	Amherst.
Dwight, Edwin Wells	Pittsfield.
Goessmann, Henry Edward Victor	Amherst.
Herms, Charles	Louisville, Ky.

Holland, Harry Dickinson . . .	Amherst.
Jones, Elisha Adams	Rockville.
Lublin, Alfred William	New York City.
Mayo, Walter Parker	Wellesley.
Redding, Merton Jay	Amherst.
Smith, Llewellyn	Amherst.
Smith, William Henderson . . .	Amherst.
Smith, William Ratliffe	Amherst.
Total	13

Freshman Class.

Allen, Edwin West	Amherst.
Almeida, Luciano José de . . .	São Paulo, Brazil.
Barber, George Holcomb . . .	Glastonbury, Conn.
Brooks, Paul Cuff Phelps . . .	Boston.
Browne, Charles William . . .	Salem.
Buffington, Charles Owen . . .	Ware.
Cutter, Charles Sumner	Arlington.
Day, William Lyman	Warren.
Dickinson, John Francis . . .	Amherst.
Howell, Hezekiah	Blooming Grove, N.Y.
March, Wilbur Marriam . . .	Millbury.
Nichols, Andrew, jun.	Danvers.
Phelps, Charles Shepard . . .	Florence.
Putnam, George Herbert . . .	Millbury.
Spaulding, Charles Plumb . . .	Amherst.
Spaulding, George Edwin . . .	Billerica.
Tekirian, Benon Onnig	Yozgad, Turkey.
Whittemore, Joseph Sidney . . .	Leicester.
Woodhull, George Gouge . . .	Blooming Grove, N.Y.
Total	19

Select Class.

Cutler, George, jun.	Amherst.
Davis, Arthur Emmons	Amherst.
Fish, Charles Sumner	Boston.
Kendall, Charles Irving . . .	Amherst.
Kenfield, Charles Robert . . .	Amherst.
Owen, Henry Willard	Amherst.
Total	6

Post-Graduates.

Fairfield, B.S., Frank Hamilton (Boston Univ.)	Waltham.
Green, B.S., Samuel Bowdlear (Boston Univ.)	Chelsea.
Hills, B.S., Joseph Lawrence (Boston Univ.)	Boston.
Lovell, M.A., Henry Lyman (Amherst College)	Amherst.
Smith, B.S., Hiram Fred Markley	North Hadley.
Stockbridge, B.S., Horace Edward (Boston Univ.)	Amherst.
Stone, B.S., Almon Humphrey	Phillipston.
Washburn, B.S., John Hosea (Boston Univ.)	Bridgewater.
Total	8

Specials in Chemistry.

Cardoso, Peleusia	Rio Janeiro, Brazil.
Jaqueth, Isaac Samuel	Liverpool, N.Y.
Total	2

Summary.

Specials in Chemistry	2
Post-Graduates	8
Graduates of 1881	17
Senior Class	35
Junior Class	13
Sophomore Class	13
Freshman Class	19
Select Class	6
Total	113

GRADUATES.

Allen, Gideon H., '71, Winfield, Cowley Co., Kan., Agent, Wells, Fargo, & Co.'s Express.

Bagley, David A., '76, Winchendon, Farmer.

Baker, David E., '78, Franklin, Student, Harvard Medical School.

Barrett, Joseph F., '75, 84 Broad St., New York City, Travelling Salesman, Bowker Fertilizer Co.

Barri, John A., '75, 84 Broad St., New York City, Office Clerk, Bowker Fertilizer Co.

Bassett, Andrew L., '71, New York City, Clerk, Vermont C. R.R. & Steamship Co.

Bell, Burleigh C., '72, corner 16th and Howard Streets, San Francisco, Cal., Druggist and Chemist.

Bellamy, John, '76, 659 Washington St., Boston, Nichols, Bellamy, & Co., Hardware and Cutlery.

Benedict, John M., '74, 138 Second Avenue, New York City, Student of Medicine.

Benson, David H., '77, South Weymouth, Superintendent of Acid Works, Bradley Fertilizer Co.

Birnie, William P., '71, Springfield, Salesman, Birnie Paper Co.

Blanchard, William H., '74, Westminster, Vt., Farm Laborer.

Boutwell, Willie L., '78, Leverett, Farmer.

Bowker, William H., '71, 43 Chatham St., Boston, President, Bowker Fertilizer Co.

Bowman, Charles A., '81, Billerica, Farmer.

Boynton, Charles E., '81, Great Falls, N.H., Student, law-office of Copeland & Edgley.

Bragg, Everett B., '75, 84 Broad St., New York City, Buying Agent, Bowker Fertilizer Co.

Brett, William F., '72, Brockton, Clerk, B. H. White & Co., Boston.

Brewer, Charles, '77, 88 Worthington St., Springfield, Assistant Book-keeper, Troy Laundry.

Brigham, Arthur A., '78, Marlborough, Farmer.

Brooks, William P., '75, Sapporo, Japan, Professor of Agriculture and Farm Superintendent, Japan Agricultural College.

Bunker, Madison, '75, 141 West 54th St., New York City, House Surgeon, American Veterinary College.

Callender, Thomas R., '75, Grantville, Florist.

Campbell, Frederick G., '75, West Westminster, Vt., Farmer.

Carr, Walter F., '81, Boston, Student, Massachusetts Institute Technology.

Caswell, Lilley B., '71, Athol, Civil Engineer and Farmer.

Chandler, Edward P., '74, Abilene, Kan., Farmer.

Chapin, Henry E., '81, Boylston, Teacher.

Chickering, Darius O., '76, Enfield, Farmer.

Choate, Edward C., '78, Southborough, Farmer.

Clark, Atherton, '77, Grass Valley, Nevada Co., Cal., Assistant Manager, Menlo Gold Quartz Co.

Clark, John W., '72, Amherst, Superintendent of Nurseries, Agricultural College.

Clark, Xenos Y., '78, Oakland, Cal., Scientist.

*Clay, Jabez W., '75.

Coburn, Charles F., '78, Lowell, Teller, Five Cents Saving Bank, and Paragrapher, "Daily Citizen."

Cowles, Frank C., '72, Amherst, Farmer.

Cowles, Homer L., '71, Hadley, Farmer.

† Curtis, Wolfred F., '74.

Cutter, John C., '72, Sapporo, Japan, Professor of Natural Science, Japan Agricultural College.

Deuel, Charles F., '76, Amherst, Druggist.

Dickinson, Richard S., '79, Kankakee, Ill., Contractor, grading of railroads.

Dodge, George R., '75, Brighton, Shipping Clerk, Bowker Fertilizer Co.

Dyer, Edward N., '72, Kohala, S.I., Teacher.

Easterbrook, Isaac H., '72, Diamond Hill, R.I., Farmer.

Eldred, Frederick C., '73, 119 Chambers St., New York City, Salesman, Wilson Bros. Toy Co.

Ellsworth, Emory A., '71, Holyoke, Architect, Civil and Mechanical Engineer with D. H. & A. B. Tower.

Fairfield, Frank H., '81, Amherst, Post-Graduate, Agricultural College.

Fisher, Jabez F., '71, Fitchburg, Local Freight Agent, Fitchburg Railroad.

Fiske, Edward R., '72, 625 Chestnut St., Philadelphia, Penn., Merchant, Folwell, Bro., & Co.

Flagg, Charles O., '72, Diamond Hill, R.I., Farmer.

* Died Oct. 1, 1880, of pneumonia, at New York City.

† Died Nov. 8, 1878, of inflammation of the brain, at Westminster.

Flint, Charles L., jun., '81, 29 Newbury St., Boston, no business.
Foote, Sanford D., '78, Springfield, Hampden Watch Co.
Fowler, Alvan L., '80, Tombstone, Arizona, Superintendent, Woronoco Mining Co.
Fuller, George E., '71.
Gladwin, Frederic E., '80, Tombstone, Arizona, Superintendent.
Green, Samuel B., '79, Chelsea, no business.
Grover, Richard B., '72, Ludlow, Vt., Clergyman.
Guild, George W. M., '76.
Hague, Henry, '75, Manville, R.I., Clergyman.
Hall, Josiah N., '78, City Hospital, Boston, House Physician.
Harwood, Peter M., '75, Barre, Farmer.
Hashiguchi, Boonzo, '81, Tokio, Japan, Department of Agriculture.
Hawley, Frank W., '71, Fayetteville, Ark., with S. A. Brown & Co., Lumber Dealers.
Hawley, Joseph M., '76, Berlin, Wis., Banker, C. A. Mather & Co.
Herrick, Frederick St. C., '71, Methuen, Farmer.
Hibbard, Joseph R., '77, Stoughton, Wis., Farmer.
Hills, Joseph L., '81, Amherst, Post-Graduate, Agricultural College.
Hitchcock, Daniel G., '74, Warren, Agent American Express Co.
Hobbs, John A., '74, Bloomington, Neb., Farmer.
Holmes, Lemuel Le B., '72, Mattapoisett, Lawyer.
Howe, Charles S., '78, Prescott, Arizona, Mining Expert.
Howe, Elmer D., '81, Marlborough, Farmer.
Howe, Waldo V., '77, Framingham, Agent, Framingham Brick Co.
Hubbard, Henry F., '78, 94 Front St., New York City, with Jno. H. Catherwood & Co.
Hunt, John F., '78, Guerrero, Mexico, Care E. R. Larroche, Surveyor.
Kendall, Hiram, '76, Providence, R.I., Chemist and Superintendent, Kendall Manufacturing Co.
Kimball, Francis E., '72, 15 Union St., Worcester, Book-keeper, E. W. Vaill.
Knapp, Walter H., '75, Grantville, Florist.
Koch, Henry G. H., '78, Sixth Avenue and Twentieth Street, New York City, H. C. F. Koch & Son.
Ladd, Thomas H., '76, care Wm. Dadmun, Watertown, no business.
Lee, Lauren K., '75, Des Moines, Ia., Manager, Buffalo Linseed Oil Works.

Lee, William G., '80, Grass Valley, Nev. Co., Cal., Miner.
Leland, Walter S., '73, Concord, Officer, State Prison.
Leonard, George, '71, Springfield, Lawyer.
Libby, Edgar H., '74, Chicago, Ill., Editor, "Farmer's Review."
Livermore, Russell W., '72, 9 and 11 Chamber of Commerce, Toledo, O., Attorney-at-Law.
Lovell, Charles O., '78, 178 Washington St., Boston, General Agent for James H. Earle, Publisher.
Lyman, Asahel H., '73, Manistee, Mich., Druggist and Bookseller.
Lyman, Charles E., '78, Middlefield, Conn., Farmer.
* Lyman, Henry, '74.
Lyman, Robert W., '71, Belchertown, Lawyer.
Mackie, George, '72, Attleborough, Physician.
Macleod, William A., '76, 60 Devonshire St., Boston, Patent Lawyer.
Mann, George H., '76, Sharon, Manufacturer.
Martin, William E., '76, Excelsior, Minn., Clerk in Post-Office.
Maynard, Samuel T., '72, Amherst, Professor of Botany and Horticulture, Massachusetts Agricultural College.
McConnel, Charles W., '76, 14 North Pearl St., Albany, N.Y., Dentist.
McQueen, Charles M., '80, Springfield, W. G. Medlicott & Co.
Miles, George M., '75, Miles City, Montana, Hardware Merchant and Real-Estate Dealer.
Mills, George W., '73, Medford, Physician.
Minor, John B., '73, New Britain, Conn., Clerk, Russell & Erwin Manufacturing Co.
Montague, Arthur H., '74, South Hadley, Farmer.
Morey, Herbert E., '72, 49 Haverhill St., Boston, Merchant, Morey, Smith, & Co.
Morse, James H., '71, 251 Essex St., Salem, Civil Engineer.
Myrick, Lockwood, '78, Tremont Bank Building, State St., Boston, Chemical Clerk, Pacific Guano Co.
Nichols, Lewis A., '71, San Diego, Cal., Civil Engineer.
Norcross, Arthur D., '71, Monson, Postmaster.
Nye, George E., '77, 70 Exchange Building, Union Stock Yards, Chicago, Ill., Book-keeper, G. F. Swift & Co.
Osgood, Frederick H., '78, Springfield, Veterinary Surgeon.
Otis, Harry P., '75, Leeds, Superintendent, Northampton Emery Wheel Co.
Page, Joel B., '71, Conway, Farmer.

* Died Jan. 8, 1879, of pneumonia, at Middlefield, Conn.

Parker, George A., '76, Poughkeepsie, N.Y., Bailiff of "Cliffdale."
Parker, George L., '76, Dorchester, Florist.
Parker, Henry F., '77, 229 Broadway, New York City, Briesen & Betts. Student of Law at University of City of New York.
Parker, William C., '80, Wakefield, Farmer.
Peabody, William R., '72, Atchison, Kan., General Agent, Atchison, Topeka, & Santa Fé Railroad.
Penhallow, David P., '73, 85 Brattle St., Cambridge, Lecturer on Botany.
Peters, Austin, '81, 141 West 54th St., New York City, Student, American Veterinary College.
Phelps, Charles H., '76, South Framingham, Florist.
Phelps, Henry L., '74, Northampton, Dealer in Fertilizers.
Porter, William H., '76, Hatfield, Farmer.
Porto, Raymundo M. da S., '77, Para, Brazil, Planter.
Potter, William S., '76, Lafayette, Ind., Lawyer.
Rawson, Edward B., '81, Wilcox, Elk Co., Penn., Civil Engineer.
Renshaw, James B., '73, Hutchinson, Minn., Clergyman.
Rice, Frank H., '75, Aurora, Nev., Trader in Cattle.
Richmond, Samuel H., '71, Altoona, Orange Co., Fla., Planter.
Ripley, George A., '80, 5 Franklin St., Worcester, Dealer in Grain.
Root, Joseph E., '76, Barre, Student of Medicine, New York City.
Rudolph, Charles, '79, New York City, Student, Columbia Law School.
Russell, William D., '71, Turner's Falls, Montague Paper Company.
Salisbury, Frank B., '72, Kimberley Diamond Fields, South Africa, Trader.
Sears, John M., '76, Ashfield, Farmer.
Shaw, Elliot D., '72, Holyoke, Florist.
Sherman, Walter A., '79, Long Island College, Brooklyn, N.Y., Student of Medicine.
Simpson, Henry B., '73, Centreville, Md., Farmer.
Smead, Edwin, '71, 223 North Cary St., Baltimore, Md., Dealer in Scrap Iron.
Smith, Frank S., '74, Hampden, Woollen Manufacturer.
Smith, George P., '79, Sunderland, Farmer.
Smith, Hiram F. M., '81, Amherst, Post-Graduate, Agricultural College.
Smith, Thomas E., '76, West Chesterfield, Manufacturer.
Snow, George H., '72, Leominster, Farmer.

Somers, Frederick M., '72, San Francisco, Cal., Newspaper Correspondent.

* Southmayd, John E., '77.

Southwick, Andre A., '75, Talladega, Ala., Instructor in Agriculture, Talladega College.

Spalding, Abel W., '81, 907 North Main St., St. Louis, Mo., with Ripley & Kimball.

Sparrow, Lewis A., '71, 43 Chatham St., Boston, Chemist, Bowker Fertilizer Co.

Spofford, Amos L., '78, Georgetown, Shoe-cutter.

Stockbridge, Horace E., '78, Germany, Student.

Stone, Almon H., '80, Phillipston, Farmer.

Strickland, George P., '71, Stillwater, Minn., Machinist, Seymour, Sabin, & Co.

Swan, Roscoe W., '79, Framingham, Student, Harvard Medical School.

Taft, Cyrus A., '76, Whitinsville, Machinist.

Taylor, Frederick P., '81, Hartford, Conn., Foreman, Vine Hill Farm.

Thompson, Edgar E., '71, East Weymouth, Teacher.

Thompson, Samuel C., '72, Natick, Civil Engineer.

Tucker, George H., '71, Fargo, Dakota, Civil Engineer.

Tuckerman, Frederick, '78, Hotel Brunswick, Boston, Student, Harvard Medical School.

Urner, George P., '76, 116 Franklin Street, New York City, Superintendent, Magic Ruffle Co.

Wakefield, Albert T., '73, Peoria, Ill., Physician.

Waldron, Hiram E. B., '79, North Rochester, Farmer.

Ware, Willard C., '71, 255 Middle Street, Portland, Me., Manager, Boston & Portland Clothing Co.

Warner, Clarence D., '81, Providence, R.I., Teacher, Rhode Island State Reform School.

Warner, Seth S., '73, 43 Chatham Street, Boston, Travelling Salesman, Bowker Fertilizer Co.

Washburn, John H., '78, Amherst, Post-Graduate, Agricultural College.

Webb, James H., '73, 20 Exchange Building, New Haven, Conn., Attorney-at-Law.

Wellington, Charles, '73, Germany, Student.

Wells, Henry, '72, Rochester, N.Y., Clerk, "Blue Line," Fast-Freight Office.

Wetmore, Howard G., '76, 3 East 17th Street, New York City, Physician.

* Died Dec. 11, 1878, of consumption, at Minneapolis, Minn.

Wheeler, William, '71, 70 Kilby Street, Boston, President, Wheeler Reflector Co.

Whitney, Frank Le P., '71.

Whitney, William C., '72, Minneapolis, Minn., Architect.

Whittaker, Arthur, '81, Needham, Farmer.

Wilcox, Henry H., '81, Nawiliwili, S.I., Sugar industry.

Williams, John E., '76, Amherst, Editor, "Record."

Winchester, John F., '75, Lawrence, Veterinary Surgeon and Lecturer, Massachusetts Agricultural College.

Wood, Frank W., '73, Providence, R.I., Civil Engineer.

Woodbury, Rufus P., '78, Kansas City, Mo., News and Telegraph Editor of "Kansas City Daily Times."

Woodman, Edward E., '74, Danvers, Florist, E. & C. Woodman.

Wyman, Joseph, '77, 68 Belmont Ave., Boston, Produce Dealer.

Zeller, Harrie McK., '74, Hagerstown, Md., Student of Telegraphy.

COURSE OF STUDY AND TRAINING.

FRESHMAN YEAR.

First Term. — Chemistry, 3 hours each week; Human Anatomy, Physiology, and Hygiene, 3 hours; Algebra, 5 hours; English, 2 hours; Agriculture, 2 hours; Declamation, 1 hour; Military Drill, 4 hours; Recitation in Tactics, 1 hour; Manual Labor, 6 hours.

Second Term. — Inorganic Chemistry, 3 hours; Botany, 3 hours; Geometry, 5 hours; Agriculture, 3 hours; English, 2 hours; Elocution, 1 hour; Freehand Drawing, 3 hours; Military Drill, 3 hours.

Third Term. — Systematic Botany, 4 hours; Geometry, 4 hours; French, 5 hours; Elocution, 2 hours; Agriculture, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

SOPHOMORE YEAR.

First Term. — Systematic Botany, 3 hours each week; Geometry, 4 hours; French, 5 hours; English, 1 hour; Agriculture, 2 hours; Declamation, 1 hour; Military Drill, 4 hours; Recitation in Tactics, 1 hour; Manual Labor, 6 hours.

Second Term. — Geology, 3 hours; Trigonometry, 5 hours; French, 4 hours; English, 1 hour; Agriculture, 3 hours; Declamation, 1 hour; Drawing, 3 hours; Military Drill, 3 hours.

Third Term. — Zoölogy, 5 hours; Surveying, 5 hours; Agriculture, 2 hours; Lectures in History, 3 hours; Declamation, 1 hour; Levelling, 3 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

JUNIOR YEAR.

First Term. — German, 5 hours each week; Mechanics, 5 hours; Entomology, 2 hours; Market-Gardening, 2 hours; Horticulture, 2 hours; Military Drill, 3 hours; Recitation in Tactics, 1 hour; Manual Labor, 6 hours.

Second Term. — German, 4 hours; Physics, 5 hours; Practical Chemistry, 9 hours; Drawing, 3 hours; Agricultural Debate, 1 hour; Declamation, 1 hour; Military Drill, 3 hours.

Third Term. — German, 4 hours; Roads and Railroads, 4 hours;

Practical Chemistry, 9 hours; Declamation, 1 hour; Stock and Dairy Farming, 2 hours; Military Drill, 4 hours; Manual Labor, 6 hours.

SENIOR YEAR.

First Term. — Lectures in History, 4 hours each week; Practical Chemistry, 7 hours; Book-keeping, 2 hours; Astronomy, 3 hours; Military Science, 2 hours; Original Declamation, 1 hour; Military Drill, 3 hours.

Second Term. — English Literature, 4 hours; Theses, 1 hour; Mental Science, 4 hours; Agriculture, 2 hours; Veterinary Science, 3 hours; Military Science, 2 hours; Microscopy, 4 hours; Military Drill, 3 hours.

Third Term. — Veterinary Science, 2 hours; Military Science, 2 hours; Botany, 3 hours; Landscape-Gardening, 3 hours; Rural Law, 1 hour; English Literature, 3 hours; Agricultural Review, 4 hours; Military Drill, 4 hours.

CALENDAR FOR 1882.

The third term of the collegiate year begins March 23, and continues till June 21.

The first term begins Aug. 24, and continues till Nov. 22.

The second term begins Dec. 7, and continues till March 7, 1883.

There will be an examination of candidates for admission to the College, at the Botanic Museum, at 9 A.M., Tuesday, June 20, and also on Thursday, Aug. 24.

The Farnsworth Prize Declamations take place Monday evening, June 19.

The public examination of the graduating class for the Grinnell Prize for excellence in agriculture, and the examination of the other classes in the studies of the term, will take place on Tuesday forenoon, June 20.

The exercises of Graduation Day occur June 21.

ADMISSION.

Candidates for admission to the Freshman Class are examined, orally and in writing, upon the following subjects: English Grammar, Geography, Arithmetic, Algebra through simple equations, and the History of the United States.

Candidates for higher standing are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the College until he is fifteen years of age; and every student is required to furnish a certificate of good character from his late pastor or teacher, and to give security for the prompt payment of term-bills. Tuition and room-rent must be paid in advance at the beginning of each term, and bills for board, fuel, etc., at the end of every term.

The regular examinations for admission are held at the Botanic Museum, at nine o'clock A.M., Tuesday, June 21, and on Thursday, Aug. 25; but candidates may be examined and admitted at any other time in the year.

EXPENSES.

Tuition	$12 00 per term.
Room-rent	$5 00 to 10 00 "
Board	2 50 to 3 50 per week.
Expenses of chemical laboratory to students of practical chemistry	10 00 per term.
Public and private damages, including value of chemical apparatus destroyed or injured .	At cost.
Annual expenses, including books . .	$250 00 to $350 00

REMARKS.

The regular course of study occupies four years; and those who complete it receive the degree of Bachelor of Science, the diploma being signed by the Governor of Massachusetts, who is president of the corporation.

Regular students of the College may also, on application, become members of Boston University, and, upon graduation, receive its diplomas in addition to that of the College, thereby becoming entitled to all the privileges of its alumni.

The instruction in the languages is intended to qualify the graduates to write and speak English with correctness and effect, and to translate French with facility. The scientific course is as thorough and practical as possible, and every science is taught with constant reference to its application to agriculture and the wants of the farmer.

The instruction in agriculture and horticulture includes every branch of farming and gardening which is practised in Massachusetts, and is both theoretical and practical. Each topic is discussed thoroughly in the lecture-room, and again in the plant-house or field, where every student is obliged to labor. The amount of required work, however, is limited to six hours per week, in order that it may not interfere with study. Students are allowed to do additional work for wages, provided they maintain the necessary rank as scholars.

Indigent students are allowed to do such work as may offer about the College or farm buildings, or in the field; but it is hardly possible for one to earn more than from fifty to one hundred dollars per annum, besides performing other duties. So far as is consistent with circumstances, students will be permitted to select such varieties of labor as they may, for special reasons, desire to engage in.

Those who pursue a select course attend recitations and lectures with the regular classes; but those properly qualified, who desire special instruction in botany, chemistry, civil engineering, veterinary science, agriculture, or horticulture, may make private arrangements with the officers having charge of these departments.

An expenditure of from ten to fifty dollars is necessary to provide furniture, which may be purchased at reasonable rates, either new or second-hand. At the beginning of the second term of attendance each student is required to provide himself with the full uniform prescribed for the battalion of Agricultural Cadets, the cost of which is about thirty dollars.

On Sundays students are required to attend church in the fore-noon, and invited to join a class for the study of the Bible in the afternoon. They will be permitted to select their place of attendance from among the churches in the town, of the following denominations: viz., Baptist, Congregational, Protestant Episcopal, Methodist Episcopal, and Roman Catholic.

POST-GRADUATE COURSE.

Graduates of colleges and scientific schools may become candidates for the degree of Doctor of Science, or Doctor of Philosophy, from the College or from the University, and pursue their studies under the direction of Professor Goessmann in chemistry, or other members of the Faculty in their respective departments.

BOOKS, APPARATUS, AND SPECIMENS IN NATURAL HISTORY.

The library of the College contains about two thousand volumes. Among them are several sets of cyclopædias, magazines, and newspapers, reports of agricultural societies, and State boards of agriculture, and many standard works on agriculture and horticulture. There are also many useful works of reference in chemistry, botany, surveying, and drawing.

The Faculty and students also have the privilege of drawing books from the excellent library of Amherst College, which contains over thirty thousand volumes.

The State cabinet of specimens, illustrating the geology and natural history of Massachusetts, has been removed from Boston to the College, and is of much value for purposes of instruction.

The Knowlton Herbarium contains more than ten thousand species of named botanical specimens, besides a large number of duplicates. The Botanic Museum is supplied with many interesting and useful specimens of seeds, woods, and fruit-models. There is also a set of diagrams illustrating structural and systematic botany, including about three thousand figures.

About fifteen hundred species and varieties of plants are cultivated in the Durfee Plant-House, affording much pleasure and information to students and visitors.

The class in microscopy has the use of seven of Tolles's best compound microscopes, with objectives from four inches to one-eighth of an inch in focal distance, and a variety of eye-pieces.

PRIZES.

FARNSWORTH RHETORICAL MEDALS.

Isaac D. Farnsworth, Esq., of Boston, has generously provided a fund of fifteen hundred dollars, which is to be used for the purchase of gold and silver medals, to be annually awarded, under the direction of the College Faculty, for excellence in declamation.

GRINNELL AGRICULTURAL PRIZES.

Hon. William Claflin of Boston has given the sum of one thousand dollars for the endowment of a first prize of fifty dollars, and a second prize of thirty dollars, to be called the Grinnell Agricultural Prizes, in honor of George B. Grinnell, Esq., of New York. These prizes are to be paid in cash to those two members of the graduating class who may pass the best oral and written examination in theoretical and practical agriculture.

HILLS BOTANICAL PRIZES.

For the best herbarium collected by a member of the class of 1880, a prize of fifteen dollars is offered, and, for the second best, a prize of ten dollars; also a prize of five dollars for the best collection of woods, and a prize of five dollars for the best collection of dried plants from the College Farm.

REGULATIONS.

I. — Students are forbidden to combine for the purpose of absenting themselves from any required exercise, or violating any known regulation of the College.

II. — The roll shall be called five minutes after the ringing of the bell for each exercise of the College, by the officer in charge, unless a monitor be employed; and students who do not answer to their names will be marked absent, provided that any student coming in after his name has been called shall be marked tardy. Two tardinesses shall be reckoned as one absence.

III. — Absence from a single exercise may be allowed or excused by the officer in charge of the same, if requested beforehand; but permission to be absent from several exercises must be obtained in advance from the general excusing officer, or from the president. In such cases the officer excusing will furnish a certificate of excuse, which shall state the precise time for which absence is permitted, and which shall be a satisfactory reason for absence from all exercises occurring within the time specified.

IV. — Excuse for absence from a College exercise must be obtained before the same occurs; and no excuse will be granted afterwards, unless the student shows the cause of the absence to be one of imperative necessity, and which could not be foreseen or prevented.

Permission to be absent from several consecutive exercises must be obtained from the excusing officer or the president; but excuse for absence from a single exercise *must* be obtained of the officer in charge of the same.

Permission for absence by the excusing officer or president will be given in the form of a certificate, the recipient of which must exhibit the same to each officer from whose exercise it gives leave of absence, as soon as the first exercise of the officer at which he is thereafter present; and his failure to do so will annul his right to excuse from the exercise of such officer.

A record of all tardinesses will be rigidly kept; and, unless excused by the officer with whom they occur, two such will be entered on the record as an unexcused absence.

Each unexcused absence will be considered disobedience to College rule; and, if the aggregate number of such absences in all departments reaches *two*, the student so delinquent shall be informed of the fact. If the number of such absences reaches *four*, the parent or guardian of the student shall be informed of his delinquencies; and, if *five* such delinquencies are justly recorded against any student, his connection with the College may be terminated.

V. — Students are forbidden to absent themselves without excuse from the regular examinations, to give up any study without permission from the president, or to remove from one room to another without authority from the officer in charge of the dormitory buildings; and no student shall be permitted to make such change until he has procured from the inspecting officer a written statement that the room about to be vacated is in perfect order.

VI. — Students shall be required to attend the church of their selection regularly on Sunday morning, and report in writing to the excusing officer, during the ensuing week, whether they attended or not.

VII. — The record of deportment, scholarship, and attendance will be carefully kept; and, whenever the average rank of a student falls below fifty, he will not be allowed to remain a member of the College, except by a special vote of the Faculty. Admission to the College, and promotion from class to class, as well as to graduation, are granted only by vote of the Faculty.

VIII. — Students are required to abstain from any thing injurious to the buildings and other property of the College, and in all respects to conduct themselves with propriety.

IX. — Parents and guardians are specially urged to co-operate with the Faculty in securing the faithful attendance of students upon every appointed exercise of the College.

X. — Military drill must be continued to graduation; and any student who neglects this exercise any part of graduation week, will not be entitled to a recommendation for a College diploma.

SIZE OF ROOMS.

For the information of those desiring to carpet their rooms, the following measurements are given: In the south dormitory the main corner-rooms are fifteen by eighteen feet, and the adjoining bedrooms eight by twelve feet. The inside rooms are fourteen by fifteen feet, and the bedrooms eight by eight feet. In the north dormitory the corner-rooms are fourteen by fifteen feet, and the annexed bedrooms eight by ten feet; while the inside rooms are thirteen feet and a half by fourteen feet and a half, and the bedrooms eight by eight feet.

SCHOLARSHIPS.

The income of the Robinson Fund of one thousand dollars, the bequest of Miss Mary Robinson of Medfield, is assigned by the Faculty to such indigent student as they may deem most worthy.

The Trustees voted in January, 1878, to establish one free scholarship for each of the eleven congressional districts of the State. Applications for such scholarships should be made to the representative from the district to which the applicant belongs. The selection for these scholarships will be determined as each member of Congress may prefer; but, where several applications are sent in from the same district, a competitive examination would seem to be desirable. Applicants should be good scholars, of vigorous constitution, and should enter College with the intention of remaining through the course, and then engaging in some pursuit connected with agriculture. To every such student the cash value of a scholarship is one hundred and forty-four dollars.

Statement of Cash Receipts and Payments for the Year 1881.

1881.	*Receipts.*		*Payments.*	
Jan. 1,	Balance on hand	$1,238 01	Expenses, —	
	Income from endowment-fund	12,958 18	Farm account	$3,052 63
	from term-bills	4,601 31	Botanical account	2,325 59
	from farm-produce	1,614 15	Term-bill account	1,203 19
	from plant-house and nursery	2,480 69	Expense account	3,342 39
	from Mary Robinson Fund	70 00	Hills Fund	466 66
	Farnsworth Prize Fund	100 00	Laboratory account	908 73
	Grinnell Prize Fund	60 00	Salaries	11,137 00
	Whiting Street Fund	80 00	Farnsworth Prize Fund	65 00
	from Hills Fund	597 38	Grinnell Prize Fund	80 00
	from laboratory account	1,045 79		
				$22,581 19
			Balance	2,264 32
		$24,845 51		$24,845 51

Sundries Dr. to Massachusetts Agricultural College, Jan. 1, 1882.

Real estate	$200,000 00	
Live-stock account	5,182 00	
Implements and vehicles account . . .	1,842 00	
Farm account for produce on hand . . .	3,240 00	
		$210,264 00

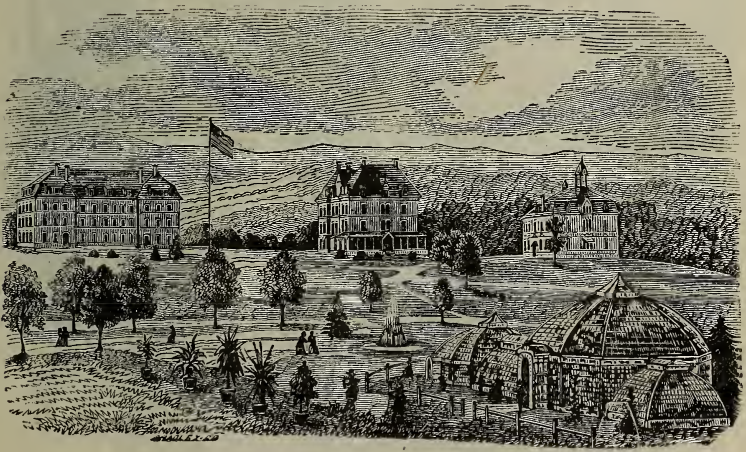
HOUSE...... ......No. 325.

TWENTIETH ANNUAL REPORT

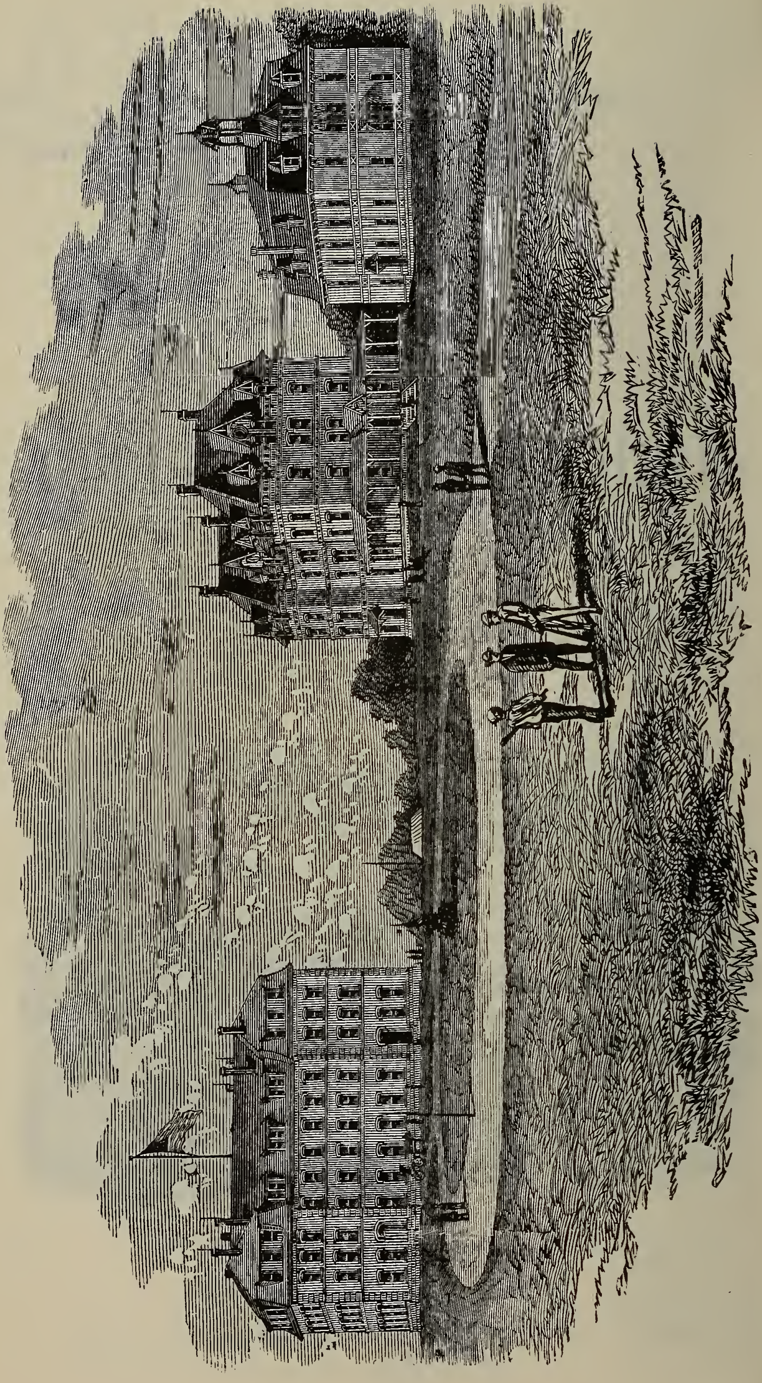
OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

JANUARY, 1883.



BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE,
1883.



Commonwealth of Massachusetts.

EXECUTIVE DEPARTMENT,
BOSTON, February 23, 1883.

To the Honorable the House of Representatives :

I have the honor to transmit herewith the twentieth annual report of the trustees of the Massachusetts Agricultural College, and in so doing I take leave to more than make a formal transmission of that document to the House. I especially call attention to its contents, and submit that in the opinion of the Executive it would be for the benefit of the people of the Commonwealth, that a very considerable number of copies of it should be printed and widely distributed.

I am convinced, both from the state of my own knowledge heretofore, of the Agricultural College, and from conversation with several gentlemen of intelligence, that that institution is entirely misunderstood as to its purposes, its methods of instruction and the scope of its educational power. A too commonly received opinion seems to be that at that college only some information is imparted to the pupil concerning soils, the methods of treating them, and the practical work of the farm, and therefore that only sons of farmers, or those who are intending to devote their lives to farming, should seek to obtain an education therein. While it is true that these things are taught and well taught therein, they are by no means the limit of the educational course.

For practical instruction, to every branch of professional life except perhaps theology, the *curriculum*, and the methods of imparting knowledge to the pupil, are as beneficial as those of any other institution of learning. In addition, the elements of military science, so far as the "school of the soldier," and the officer of the battalion are concerned, are imparted to the pupil, and he is fitted, if attentive and apt, to take a commission in any regiment, practically quite as well in so far as if from West Point.

The instruction in the order of business, in neatness and care of the person, in habits of cleanliness in the care of apartments wherein men live, which are the embodied results of the experience of all armies, are as useful to the civilian who shall have the care of others, especially if dependents, as they are to the officer in the care of his men. From experimental knowledge I testify to the value of this branch of instruction.

From the economy which can well be practised by the student at the Agricultural College, because of the cheapness of living, the absence of those inducements to extraordinary expenses by the pupil which render a college course so burdensome to men of moderate means, the sons of such men will be enabled either by their own exertions, or the support of their parents, to obtain at a cost within their reach a good practical education, as good in my judgment as anywhere else to fit them for the business of life.

I commend, therefore, this institution, founded both by endowment by the United States and the State, to the attention of the legislature, and ask for it such appropriations as may meet its very economical needs.

BENJ. F. BUTLER.

Commonwealth of Massachusetts.

MASSACHUSETTS AGRICULTURAL COLLEGE,
AMHERST, Jan. 30, 1883.

To His Excellency BENJAMIN F. BUTLER:

SIR, — I have the honor herewith to present to your Excellency and the Honorable Council the Twentieth Annual Report of the Trustees of the Massachusetts Agricultural College.

I am, sir, very respectfully,
Your obedient servant,

P. A. CHADBOURNE,
President.

INDEX.

ANNUAL REPORT

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

To His Excellency the Governor and the Honorable Council:

Since the last report was made, important changes have occurred among the officers of government and instruction in the college. Edward C. Choate of Southborough has been elected trustee in place of William Wheeler, resigned. Both of these gentlemen are graduates of the college. The resignation of the Hon. Levi Stockbridge, as president, has removed from the college one who has been identified with it from the beginning, and who, by his long and successful labors here, has won for himself a high position among the agriculturists and educators of the country. His place was filled by the election of P. A. Chadbourne, late president of Williams College and formerly president of this institution. Mr. A. B. Bassett has been elected to the chair of mathematics and physics, and is performing his work with marked skill and success. The chair of agriculture, left vacant by the resignation of President Stockbridge, has been temporarily filled in a very acceptable manner by Mr. John W. Clark. Dr. Manly Miles, formerly of the Michigan Agricultural College, has been elected to this chair and commences his instruction the present term. Mr. Clark will continue as associate instructor in agriculture, having care of the class work in the field. Robert W. Lyman, Esq., of Belchertown, a graduate of the college, has given instruction in rural law, and Dr. Edward Hitchcock, Jr., in elocution. The president has given instruction in general zoölogy, entomology, and mental philosophy. In the present year he is also to give instruction in geology. He also conducts religious worship on the Sabbath in the college chapel. The other departments of instruction remain as they were at the time of the last report.

The course of study has been so far modified as to introduce more instruction in the structure of the English language, rhetoric and history. The study of French and German heretofore required has been made optional, and the time of recitations so arranged that each student can study both languages if he so elects.

The work of the college has been most efficiently done. The improvement of the students in their studies and in that good order and gentlemanly deportment so desirable in college, has been highly satisfactory.

While we could use to great advantage much larger means than we have, and should have the assistance of specialists in different departments of science, which our limited means do not warrant us now in securing, we should be false to the best interests of the college, as well as ungrateful towards the nation and Commonwealth, if we did not fairly recognize what they have already done in making this college an efficient agency in the work of practical, liberal education. In seeking for more which is needful, we have perhaps too much lost sight of, or kept from the public view, what we now have.

It is plainly evident that the people of the State, as a whole, have not understood the provisions here made for the education of the young men of Massachusetts. When committees from the legislature and others have visited the institution and become acquainted with its organization, its means of instruction, and its actual work, the college has proved its own best advocate. To make the college and its work better known to all the people of the State, we ask a careful consideration of the course of study and of the reports of various departments. We also feel justified in once more calling the attention of the legislature and the people of the State to the founding and organization of this institution as well as to its present condition.

The grant of land and land-scrip for founding agricultural colleges was made by the general government in 1862. The civil war had brought out with great clearness the elements of national strength, — varied production in agriculture and the mechanic arts, and a citizen soldiery well trained in the art of war. To secure all these in their greatest perfection, was the aim of the bill for establishing "Industrial Colleges" in the various loyal States. Whatever mistakes may have been made in the organization and management of these institutions, no fault can be charged home to the original bill. It was eminently a wise measure, and suggested an outline of organization and management that has not as yet been improved upon. Its significant words are as follows: "The endowment, support and maintenance of at least one college where the *leading object* shall be, without excluding scientific and classical studies, and including military tactics, to teach such branches of learning as are *related* to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the *liberal* and *practical* education of the industrial classes in the several pursuits and professions of life." No branch of learning peculiar to the old colleges was to be necessarily excluded; but the new colleges were to push on to the practical application of the sciences they taught, and they were to train all their students as defenders of their country against domestic rebellion or foreign invasion. In a word, they were to educate their students as *men* and as *American citizens*. The rank of the education given is "*liberal*," the term applied to the education given by the highest institutions then known. It was to be so broad as to fit men for the "several pursuits and professions of life." The object of these colleges was to obliterate the supposed superiority of the so-called "learned professions," by securing a "liberal," that is, the highest education, for those who chose industrial pursuits, thus lifting agriculture and the mechanic arts from the plane of mere routine labor to the dignity of learned professions, founded upon scientific knowledge and allied to, or connected with, those branches of learning essential for a broad and generous culture of the whole man. Many who have attempted the management of these colleges, as well as many who have criticised them, have apparently overlooked the broad and generous plan upon which they were founded. It is doubtful if they will ever accomplish the great work for which they were intended, until their original purpose is so fully and constantly recognized and carried out by judicious, painstaking work, that the currents of education shall be once fairly turned toward these new channels. When once fairly turned, that they will continue to flow can no more be doubted than we can doubt the success of any natural process when not artificially obstructed. An education that "gives boys what they need to daily use when they become men," commends itself as rational and practical. All true education should aim at this. And this certainly is the idea that is embodied in the bill founding the industrial colleges of the several States. The provisions of this bill were accepted by Massachusetts. One-third of the funds received from the United States was given to the Institute of Technology in Boston for the promotion of the mechanic arts, and two-thirds were devoted to founding a college at Amherst for the special work of agriculture. By the gift to the Institute of Technology, the Agricultural College has been freed from much labor in building up a mechanical department, — a fact that has been lost sight of by some, — and is left free to carry out the idea of a college making agriculture the leading idea, while it secures rigid training in military tactics and provides such a range of studies in science, literature and philosophy, as shall, in the words of the bill, promote "*liberal education.*"

The college now has 383½ acres of land for farm, gardens, nurseries, etc. It has college buildings, laboratory, botanic museum, plant-houses, gardens and nurseries, so that provision is made for teaching all the sciences that relate to the cultivation of the soil, and these sciences are practically applied to all the work of the farm, garden, vineyard and orchard. The Durfee plant-house and propagating houses afford practical instruction the year round.

The course of study aims to do what the original bill declared should be done,—give a practical knowledge of agriculture and horticulture, and at the same time so educate the *man*, that the students from the Agricultural College shall not be mere artisans, having learned a trade or business and nothing more, but be liberally educated, so that, as farmers, they shall rank in intellectual training with those who chose what have heretofore been called the "learned professions." It is plain that farming will never take its true place, nor farmers have that influence in the government of our land which they ought to have, until they take their place with those in other professions, not only as men of power and practical ability, but as men of learning and culture. Those who claim that the farmer's life forbids this result, have never yet fully appreciated the farm as a place for study and thought, as well as a place for labor.

The course of study in the Massachusetts Agricultural College, at the present time, embraces the following topics:—

1. *Lectures on Health and Habits of study*, and general plan of the college work. These lectures are now given by the president. The student, as he begins his college work, is instructed as to the best means of preserving health, the best methods of study and of recitation to secure knowledge, and the best mental training at the same time. He has laid before him the studies of the whole course, so far as he then is able to understand them, that he may in the beginning have some just idea of the value of the different studies, may understand why they come in the order they do, and how they make a complete educational whole to secure the purpose for which the college exists.

2. *Botany* — structural and systematic — special application to cultivated plants — *Microscopy*.

3. *Zoölogy* — systematic, with special studies in *Entomology*.

4. *Agriculture* — extending through the entire course of four years — study of soils — methods of working — fertilizers — draining — farm implements — special crops, etc. *Stock* and *Dairy Farming*, with lectures on *Veterinary Science*. *Work on the Farm* under direction of the Professor of Agriculture, six hours a week, when such work can be supplied.

5. *Horticulture*. Market Gardening—Arboriculture, Care of Nurseries—Landscape Gardening. Work in nurseries,

propagating houses and vineyard done under direction of Professor of Horticulture.

6. *Chemistry.* Theoretical and practical. Work in Laboratory, Junior and Senior years, under direction of the Professor of Chemistry.

7. *Geology and Mineralogy*, with special reference to Agriculture. The origin of soils, location of Artesian wells, etc.

8. *Military Science* and *Military Drill* continued through the whole course under direction of officers of the Regular Army, detailed by the United States Government for this special service. This includes weekly inspection of all halls and rooms in college buildings, thus securing neatness and proper sanitary conditions. The students of the college when graduated are competent, in their military knowledge, to receive commissions in the Regular Army.

9. *Mathematics* — Algebra, Geometry, Trigonometry and its application, Mechanics, Physics and Astronomy.

10. *English Literature, History, Constitution of the United States, Elocution, Essay Writing and Debates, Book-Keeping, Drawing.*

11. *Rural Law, Outlines of Mental and Moral Science.*

12. *French and German Languages.*

This is a brief outline of studies, without any attempt at systematic arrangement, as they are given in the curriculum of terms. Other subjects are introduced as circumstances favor. To some of the subjects here named, but little time can be given, and this varies with different classes; but to those studies, like Botany, Chemistry, Agriculture and Horticulture, which are the practical studies of the course, the time and strength of the student are specially given.

The course of study is so arranged that students may be absent from the college during the spring and summer, and yet go on with their classes. The studies of the first and second terms of each year make a connected course, or one which the student can complete by a moderate amount of study while absent in the summer. Students who complete this partial course receive certificates, but not the regular degree of Bachelor of Science.

In addition to the college proper, the work of which henceforth will be mainly that of instruction, the State has now established an experiment station which will give to the student a constant acquaintance with the methods and results of agricultural experimenting under the direction of the most competent men the board of control can employ. The college can use to advantage larger funds than it has. In many directions, increased funds are absolutely essential for carrying out the true idea of the college.

The apparent income, as shown by the treasurer's report, is quite delusive. Several of the items generally given there represent the amount of business done by the farm and department of horticulture, rather than income for support of the institution. The net income is very small, while the work of instruction in practical science is very great, much greater than in an ordinary classical college that has no special scientific department. Small classes require the same amount of instruction as large ones.

The farm and department of horticulture are both subjected to large expense in the care of roads, grounds, plant-houses, etc., all of which must be kept in order for the credit of the institution, and as a means of instruction in practical work. This special care and ornamentative of grounds is provided for in most institutions by special funds. Here this expense, which is very large, is charged to the departments. They are thus made accountable for expense that does not properly belong to them. This gives their products an apparent cost which misrepresents the real state of the case. An attempt will be made to separate these items of expense, so that the real working of the farm and horticultural department shall be more clearly seen.

We feel the need of larger funds for every department of college work. We must look to private individuals as well as to the State for the aid the college must have to sustain and increase its efficiency, and make it second to none in the facilities it offers. While money is given so freely to educate men away from productive pursuits, it is certainly strange that in Massachusetts not a dollar has yet been given by private benevolence for the endowment of a chair of instruction in the Massachusetts Agricultural College, — an institution founded to fit men to become intelligent producers in time of peace, and efficient defenders of the State and Union in time of war. When all the legislators and citizens understand the true state of the case, we believe that the Massachusetts Agricultural College will never lack for students or the funds needful for carrying on this institution founded by the joint action of the United States and the Commonwealth of Massachusetts.

EDUCATIONAL PLAN OF THE COLLEGE.

For the outline of studies and the special work in each department, we refer to the course of study, and the tabulated report of work in each department in the second part of this report.

It is the aim of the trustees to keep the requirements for entrance such that every boy in the State can find facilities for fitting himself for the college, without leaving his home, or incurring any expense for schooling which the well-ordered schools of the various towns cannot afford. If boys from fifteen to twenty years of age come with a good common-school education and give themselves heartily to the work here presented for them, they will, in four years' time, be well educated to begin any practical business of life.

The expense of education for four years is a serious matter for most farmers' sons. The other colleges have large funds for aiding indigent students, and a large proportion of those thus aided are as well able to pay their bills as the average farmer's son. It should be the aim of this college, then, to reduce as much as possible the college expenses, and to foster habits of economy among the students themselves. It now furnishes free scholarships, but it has no funds except a single scholarship to make good the loss of tuition. So that while the college diminishes the expense of the student, it diminishes its own power to do for him what ought to be done. Professors can do double work for a time, but there is a limit to their time and strength, and to their ability to properly teach so many subjects as are now required of them.

From necessity the college makes provision for the board of students, and it secures this at reduced cost by giving rent free the boarding-house and its furniture. The necessity for this provision arises from the fact that the college is so far removed from the thickly settled portion of the town that boarding places are difficult to be obtained within reasonable distance from the college grounds.

REPAIRS.

The legislature of 1882 granted to the college $4,000 for repairs. This money has been expended and the bills deposited with the treasurer of the State. The farm buildings have been repaired and painted; the laboratory repaired and painted, and provided with cases for proper protection of apparatus and specimens. The botanic museum has been painted outside and in. The lecture-room repaired and provided with cases for protection of specimens and instruments. The Durfee plant-house and propagating houses have been thoroughly repaired and painted. The heat and moisture in those houses had caused more serious damage than at first appeared. The farm-house now occupied by the market gardener has been shingled and otherwise repaired. The barns connected with this house have been remodelled and repaired for the use of the horticultural department, and the professor's house, to be occupied by Prof. Miles, has been repaired, painted and papered. All of these buildings from long neglect of repairs from want of means had become in many places unsightly and hardly fit for occupation. They are now essentially in good order, though much more might have been done to most of them with great profit, had the appropriation allowed. As is generally the case, the work proved more formidable than it appeared before it was begun. The carpenter in charge gave entire satisfaction, and we believe every dollar of the money has been judiciously expended. It would require at least $1,000 to complete the repairs upon the buildings, including the painting of the roofs which would be economy in the end.

It was supposed by the trustees that the Cowles buildings would be taken and repaired by the board of control of the experiment station. No estimate was therefore made for their repairs. If these buildings are not taken by the experiment station, they can be made of great service to the college for the assistant professor of agriculture. It will require $2,000 to put them in proper order for college use.

IMPROVEMENTS.

The unsightly gravel-pit near the road has been filled at large expense, and other important improvements have been made as indicated in the farm and horticultural reports.

Mr. Danforth K. Bangs has given to the college three-fourths of an acre of land at the intersection of the two roads that cross the college grounds from the south. This piece of land, rough, neglected and unsightly, was a great injury to the appearance of the college property. By this generous gift of Mr. Bangs, we have been able to transform this piece of land to a small ornamental park, so that the entrance to our grounds is now marked by the appearance of ornamentation and culture, instead of roughness and neglect.

The plan henceforth will be to concentrate the farm-work near the roads and farm buildings, and spend less money upon the pastures and swamps, till we have more to expend. Much of such labor gives very slow returns, and much of this kind of labor is still to be done on this farm. With so much land to be cared for by the work of students and by hired help, it is a very difficult problem to gain profit while trying to use the farm as a means of education. Much labor upon it has thus far been like labor in the laboratory, without any direct pecuniary profit. Now that the experiment station is to take the burden of experimenting, the farm-work should be narrowed to that limit that it can be done with profit. The position of the college, away from markets, renders the work more difficult for both the farm and garden than it would be were the institution near some large city affording a ready market for the most profitable crops.

Notwithstanding the improvements made, involving large expense, and the loss on nearly all crops in consequence of the unprecedented drought, the expenses of the college as a whole have been kept within its income. If we add to the reported balance $1,309,12, paid on debts of 1881, and $2,045.19, income delayed on account of change in securities, we should show a balance of $4,098.07, as the real condition of the college, January, 1883, as compared with January, 1882. It is estimated that the bills due the college will pay its present outstanding debts.

WANTS OF THE COLLEGE.

While we have set forth the capabilities of the college, we have not lost sight of what it urgently needs to increase its efficiency. Its library is not adequate for our purpose, — for the wants of the students. We have no proper library-room. There is no proper place for the cabinet, which is a valuable one for the purposes of instruction. It is the "State Collection," enlarged and enriched by private donations. During the past year it has received valuable additions of several thousand specimens of minerals, fossils, shells, insects and bird's eggs and nests, the entire private collection of Mr. Winfred A. Stearns, who presented it to the college, and personally superintended its classification and arrangement. Both this and the library are in dormitory buildings, with all their inconvenience for such purposes, and exposure to fire. We have no room suitable for public college exercises. The hall we now use for chapel is too small for any commencement exercise, and this room is needed to enlarge the chemical department.

One of our pressing needs, therefore, is a public building containing hall for public exercises, for the library and cabinet. We trust some public-spirited man will soon give funds for such a building. The names of the Hills, of Knowlton, and Durfee remind us of what has already been generously given to the college for specific purposes, and we feel that when the work and needs of the college are known, other names will be added to the list of our benefactors.

Our second need, perhaps first in importance, is a fund for payment of instructors. We should have more men, and they should be better paid. We must have men, the equals at least of those in other colleges, and they have more work to do than is ordinarily required of professors in classical colleges.

It was found to be impracticable to erect such a building as the college should have for the military department, for $5,000. The plans were cut down, but still no bid warranted the trustees in making a contract. They concluded to build by the day. The work has progressed far enough to show that a large saving has been made over the lowest contract price. Still, the grant will not complete the building. It will be covered so that it can be used for drilling, but it will require from $1,000 to $1,500, to complete it for its whole work as drill-hall, armory, gymnasium and lecture room combined. The grant for repairs has been exhausted, and $1,500 is needed to complete those repairs, and put the old drill-hall in proper condition for a museum of agriculture.

It is hoped that the Cowles buildings may be found adapted to the wants of the experiment station, in which case those buildings will be repaired from the experiment station fund.

NOTE. — The present condition of the several departments is set forth in the special reports hereto annexed, and the plan and work of the college, as an educational institution, are given in the second part of this report, in the curriculum of studies and the schedules of work in the several full departments of instruction.

REPORT OF D. H. TILLSON,

Farm Superintendent.

The farm has suffered by the very severe and long-continued drouth, which made crops lighter than they would have been, and almost entirely destroyed the second crop of grass.

The whole area in tillage was 63 acres. Seventeen acres planted to corn yielded 1,500 bushels of ears, and 30 tons of fodder. A part of this corn was the Longfellow variety, raised for seed corn, and was planted in such position on the farm as to keep it free from mixture with the Sturtevant variety, which constituted the bulk of the crop. Both of these varieties give good satisfaction. Four acres to potatoes gave 500 bushels; $1\frac{7}{8}$ acres fodder-corn, 6 tons; 1 acre turnips, 400 bushels; $1\frac{1}{8}$ acres wheat, 41 bushels; 8 acres oats, 350 bushels; 12 acres rye, 180 bushels; wheat and rye straw, 16 tons; 1 acre in garden; 60 acres in grass yielded 90 tons.

The diminished amount of hay cut the present year is accounted for by the loss of the second crop through drouth, by the setting off from the farm of 12 acres highly manured land to the horticultural department, and by keeping as pasture 12 acres more, that, for two years, had been highly manured for grass. Seventeen acres were seeded to rye for feed, and to rye and grass.

Fall seeding. Fourteen acres to rye and grass for feed in pasture; 20 acres to rye; 5 acres to winter wheat; 25 acres to grass; 30 acres were ploughed in the fall, to be cropped next year. The swamp in front of the Cowles house has been drained; loam in brook has been carted on to the clayey knolls in front of the laboratory; 100 loads of loam have been carted into the barn cellar, bushes cut on 4 acres of pasture, and roads on college farm and grounds kept in good repair. This, from the extent of the grounds and the nature of the roads, is an important item in our labor account.

The teams have done extra work in grading drill-hall, drawing lumber, stone, coal, etc., to an amount of $411.34.

The neat stock consists of 42 head: 16 cows, 3 oxen, 6 three-year-old steers, 18 head of young cattle, and 1 bull,— all Ayrshire stock.

There are 25 pure blood Berkshire swine, and two small Yorkshires, the latter the gift to the college from Samuel Goodwin of Miller's Falls.

A portion of the college farm is to be set off for the use of the experiment station. This will, for the coming year, further diminish the grass land belonging to the college farm proper. But the remote parts of the farm can be cultivated only at large expense, and the directions for the coming year are to cultivate less ground, and that near the farm buildings. It is difficult to secure help that will be profitable except under immediate supervision of the superintendent, and the labor from students is more for instruction and practice than for profit as labor on the farm. But the experiment station will relieve the farm from all special expense in experimenting, and leave it to do simple farm-work, as a means of giving the students an opportunity to have practical experience in raising crops and managing stock.

NOTE. — As Dr. Miles entered upon his duties January 1, 1883, no report from his department is included in the present trustees' report. For an outline of the course of instruction, proposed by Dr. Miles, reference is made to the schedules of work in the various departments of the college, as given in the second part of this report.

BOTANIC DEPARTMENT.

I have the honor to report the following upon the condition of the botanic department.

The year past has been, as a whole, a prosperous one, although nearly all of the field crops have been injured more or less by drouth. The crops, although not large, have been sold at good prices, which, in a measure, will compensate for the falling off in quantity.

The expenses of the department, as will be seen by the treasurer's report, have exceeded our income; but if the cost of improvements made, and the increased value of the stock and tools be added to the income, the balance will be found on the other side.

The nursery stock in general has been kept fully up to that of 1881, with an increase of 25,000 peach trees budded last fall, and 3,000 budded in 1881, the value of which will exceed $650, and an increase in the value of teams and tools of more than $150.

The Durfee plant-house and the propagating house have been put in thorough repair, but an annual expenditure of from $100 to $200 must be made to keep them in their present condition. The stock of plants has been very much improved, but if it is desirable to keep them in a "show" condition, much more help must be employed in taking care of them. It is hoped that we shall soon be able to have all the plants in the houses, and the trees and shrubs on the grounds, neatly labelled for the instruction of students and visitors.

The undertaking of new work, and the employment of a man to take charge of the details of the market gardening and seed-growing business, has necessitated the expenditure of quite a large sum for fertilizers, teams and implements, and fitting the land for future work. Owing to the drouth, the income from this work has been very small compared with the expenses.

We labor under a great disadvantage in carrying on business of any kind here, that our time is often taken up by other matters than of a purely business nature. The longer I am engaged in this work the more fully I am convinced that those departments devoted to business should be given up largely to the superintendence of persons who can devote their entire attention to the work; general superintendence only being needed to keep the work in harmony with the theory of instruction in each department. The special branches of business engaged in, as seed-growing, nursery, plant and fruit-growing, require an unusual amount of intelligence and skill to compete successfully with those already in the field.

Much of the land of the botanic department is unsuited, from its location, for profitable cultivation, and I would again offer the suggestion made in my last report that such land, when properly fitted, be planted with fruit-trees, which in a few years will give more income than could be obtained from it in any other way. The cost of planting would be but trifling, and the trees are already grown in the nurseries on the grounds.

It is difficult to determine how much effort should be directed to the purely ornamental in the care of the green-houses and grounds; and in passing judgment upon their condition, it must be remembered that the extent of land laid out in walks and roads, and occupied by buildings, the surroundings of which must be more or less ornamented, is exceeded by the public parks of few of the cities of this Commonwealth, and that to keep them in a thoroughly neat and pleasing condition, would require the expenditure of several thousands of dollars.

There are within the limits of the college grounds not far from two and one-half miles of regularly laid out and gravelled roads, the surface of which must be kept in good condition for a large amount of travel, and their borders so as to present a neat appearance at all times during the year.

There are also not far from one and one-half miles of walks, which must be kept in passable condition during the winter, the borders kept trimmed, and the surface smooth and free from weeds during the summer.

More than one thousand ornamental trees and shrubs have been planted on the grounds, requiring a great amount of care to keep them in a good growing condition. In addition to the above, all employees are liable to be interrupted at any time by visitors to whom some courtesy must be shown.

It is hoped that some of the work of this department, which in years past has been experimental, will be assumed by the experiment station, thus relieving us of some expense and enabling us to do better the work we undertake.

The following is a statement of the income of the botanic department for 1882 :—

Total cash received from sales of plants, vegetables, fruits, flowers, etc.,		$2,830 28
Total cash received from sales of trees, shrubs, vines, etc.,		1,419 78
Total cash income,		$4,250 06
Outstanding bills of nursery,	$52 09	
Outstanding bills of plant-house,	308 21	
		360 30
Produce on hand to sell: —		
Cabbages,	$75 00	
Carrots,	20 00	
Seed, carrots and cabbages,	25 00	
		120 00
Increase in nursery stock: —		
25,000 budded peach-trees,	$500 00	
3,000 budded peach-trees,	150 00	
Increase in value of teams, tools, etc.	150 00	
		800 00
Total income,		$5,530 36

From the expenses of the department, as shown by the treasurer's report, should be deducted the following items: —

Expense of grading, filling, seeding and planting the gravel-pit lot,	$325 00
Same on Bangs lot,	75 00
Care of walks and roads,	50 00
Plants for decorating grounds of farm-house, dormitories, boarding-house, etc.,	22 00

Trees and shrubs for grounds, ...	$35 00
Keeping horse and carriage used in part by president, carrying college mail, and care of botanic museum,. . .	50 00
	$557 00

The details of the work of the department have been carried out by Mr. L. R. Taft, in the care of the plant-houses, grounds, and sales of produce, etc.; and by Mr. David Wentzell, in the growth and care of the vegetables and other out-door crops. Both have been very faithful in the discharge of their various duties.

The students employed have generally been faithful in doing the work given them, and many of them have shown special skill in various branches of the work.

The changes in the course of study made during the past year are such as to make the instruction in botany and horticulture much more satisfactory than ever before.

In every particular I am glad to report that this department was never in better condition for future work than at present.

Very respectfully submitted,

S. T. MAYNARD.

MATHEMATICS AND PHYSICS.

The present report embodies no novel features of work in the mathematical department. Its scheme of studies is affected but slightly by the modifications of the curriculum. The allowance of time for mechanics, physics, levelling, and roads and railroads has been diminished, but the work of this department still bears much the same relation to the entire course of study as in previous years.

The mathematics comprise the chief disciplinary studies of the course; therefore my first aim is to develop in the students the mental habit of exactness, not only indispensable for mastery of the pure mathematics, but the first requisite for successful pursuit of all branches of natural science. My second aim is to introduce such exercises as will stimulate ingenuity and originality. My third aim is to give a practical bearing to all studies, by means of experiment and illustration drawn from familiar fields of observation.

During the past term, instruction has been given in algebra, geometry, mechanics and astronomy. The freshmen have made five recitations weekly in algebra. The time allotted would be sufficient for proper treatment of this subject, if the students were at the outset well grounded upon the rudiments of the science. In the present instance the subject will be continued for one month. The sophomores have devoted four hours weekly to the geometry of planes and solids, and the parabola. It is desirable that in future the entire geometry of conic sections be included in the course. Wentworth's Geometry has been introduced for the use of the freshmen who begin this study in the second term. I agree with my predecessor upon the desirability of requiring of candidates for admission some preparatory work in geometry. A newly revised edition of Peck's Ganot's Popular Physics, is used as text-book of mechanics and physics. Recitations upon the text are supplemented with frequent use of illustrative apparatus, informal lectures, and citation of illustrations. The students have opportunity to become personally familiar with the use of such apparatus as the college possesses, but the incomplete equipment of the department, lack of time, and the policy of the institution, do not favor extensive individual work in the physical laboratory. Special effort will be made to present clearly the subject of sound, heat and light, in which our apparatus is entirely deficient. The college is without facilities for giving instruction in astronomy; and our course of mathematics does not adequately prepare the average student to pursue a demonstrative treatment of the subject. I am therefore convinced that the attention of the class should be chiefly directed to a descriptive view of the science. Particular emphasis seems due to the apparent and actual planetary movements, and their important practical effects, the measurement of time, and familiarity with prominent constellations and first magnitude stars. To this study are allotted three hours weekly during the first term of senior year. Five hours of recitation weekly are assigned to the sophomores in trigonometry, and its application to surveying, navigation and celestial measurements. In this connection, particular attention will be given to mensuration, with reference to measurement of lumber, masonry and excavations. The work in surveying and levelling occupies five hours weekly in the third term, divided between class-room exercises and actual field practice. It is probable that additional time for field work may be secured. It is hoped that every student will become proficient in the use of the instruments commonly employed in engineering work, and will acquire practical familiarity with various methods of land measurement and division. The work in levelling anticipates the study of roads and railroads, to which is assigned three hours weekly in the third term of junior year. The policy of the college prescribes that special attention be given to the discussion of approved and economical methods of making highways. To such extent as time will allow, field work will be provided in the experimental location of roads, side ditches, culverts and curves, and in the calculation of earthwork from notes of actual railroad surveys.

I infer from recent observation that the applicants for admission to the college have for the most part no systematic preparatory training. As a consequence they differ widely in attainments, and in capacity for steady application. Some weeks must therefore be spent in bringing the less advanced students into line with their classmates, and in awakening a resolute scholarly spirit among them. Such time is well-nigh lost so far as the curriculum work is concerned. This difficulty may be partially obviated, and better preparation secured, by increasing the requirements for admission, or by setting more rigid entrance examinations than heretofore. In my opinion such an elevation of its scholarship would promote the interests of the college.

The trustees and other friends of the institution will be very welcome at the class exercises of the mathematical department. Such manifestation of interest would gratify and stimulate both students and instructor.

AUSTIN B. BASSETT.

REPORT ON THE MILITARY DEPARTMENT.

HON. PAUL A. CHADBOURNE,

President of the Massachusetts Agricultural College.

SIR: — I have the honor to make the following report of the military department, and to append its theoretical and practical course of instruction.

The fall drills, where seniors for the first time act as instructors, have been more than usually successful. Promptness in efficiently performing their duties has been the rule. This, in a large degree, must be attributed to the few hours that they were assigned to the tactical section room, while juniors. From this, and from the general progress to be seen in the entire corps, which may be reasonably traced to their tactical recitations, and to the added zeal always arising from more complete success, — I am encouraged to urge that juniors be assigned to the tactical section room for one hour per week, in fall terms of succeeding years. Sixteen hours recitation for an *entire year*, cannot be of injury to them in other departments, and in this will produce the most satisfactory results. It is worthy of note that all the various artillery and infantry drills of the course occupy little more than three hours per week, not varying essentially in time from the calisthenics of the average college. They are of a character to give the most general exercise to the entire body, — are in the main, out of doors, and necessitate the united action of the mind and body. Upon graduation, the average student has received such instruction, that under equal circumstances, he would immediately occupy a responsible position alike beneficial to himself and the general government, should circumstances make his services necessary.

While thus obtaining needed physical exercise, *all* must secure lasting benefit, from the discipline and self-command acquired, the military etiquette, personal neatness enforced by careful inspections at all exercises and the weekly inspection of dormitories, — which will follow them into *any* future position. The immediate advantages resulting from the establishment of a military library, to all seeking the information therein contained, are fully realized. A small permanent fund for its gradual increase is needed. At the least, it is hoped that an increased appropriation may be made this year for this purpose. Powder in its various forms, projectiles, fuzes, etc., with little expense could be obtained from this State, or from the United States. This would serve as the nucleus of a military cabinet, of general interest, and whose lack makes much needed instruction difficult. Some changes will be considered the coming year, looking to a rigid accountability from cadet officers, who may be assigned to the charge of sub-divisions in the college dormitories. Some modified form of the system in vogue at West Point may be successfully introduced. The rifle association has been creditably conducted this year. It is entirely optional, and yet fully one-half the students have taken active part. Such rules have been adopted as make the practice as free from danger as possible. A building, now in an advanced stage of construction, which will add much to the general beauty of the college grounds, replaces the inconvenient and unsafe rooms formerly used for drills in the winter. It contains suitable recitation and gun rooms, and no obstruction to regular exercises will be experienced in the future from inclement weather. The State has been generous in its appropriation, and can expect a fitting return from the students. It is especially gratifying to me to note the general excellence of the prize theses of last year's graduates. The commendation extended to them as a class by the board of award through its president, Major John H. Calef, U. S. A., was flattering in the extreme. I may be permitted to urge that the benefits derivable from such stimulants should not escape the attention of the honorable board of trustees.

Theoretical and Practical Course of Instruction.

THEORY.

Fall term, Freshman year. One hour per week for the term. Recitations in infantry tactics (Upton's). School of the Soldier. School of the Company. Skirmish drill.

Fall term, Sophomore year. One hour per week for the term. Recitations in U. S. Artillery tactics. School of the Soldier (dismounted), sabre exercise, manual of the piece and mechanical manœuvres, bayonet exercise (infantry tactics). Ammunition, equipment of carriages. Modified service of 8-inch mortars.

Fall term, Junior year. Recitations in infantry tactics (Upton's). One hour per week for the term. School of the battalion. Ceremonies. Company and field service.

Military Science.

This instruction is given to seniors, extending through the entire college year, two hours per week.

It will include in the form of lectures and recitations from selected text-books, the following subjects: — Ordnance and Gunnery; constitutional and military law and history; campaigns and battles; systems of warfare, present and past; an elementary course in strategy and engineering. It will be modified by such additions and changes as shall seem desirable. Essays are required from each senior on military subjects, when they have become sufficiently instructed to prepare them advantageously. These papers will be read in the recitation room for general note and criticism, or before the entire college. One set, all upon the same subject, are written for prizes, — the award being made by a board of army officers. The successful competitors read their productions at the graduating exercises. Subject for the class of 1883, Military education as a factor of American government.

The competition of the class of 1882 resulted as follows :—

Board of Award.

Major John H. Calef, Second U. S. Artillery.
Captain James Chester, Third U. S. Artillery.
Lieutenant Constantine Chase, Third U. S. Artillery.

Subject.

The Military Problem of the United States.

Award.

First prize, $25. W. E. Stone, Amherst, Mass.
Second prize, $15. W. A. Morse, Boston, Mass.

Especial Mention.

J. B. Paige, Prescott, Mass. J. D. Howe, North Hadley. J. E. Wilder, Lancaster. A. F. Shiverick, Woods Holl, Mass. D. Goodale, Marlborough, Mass. W. H. Thurston, Upton, Mass.

Practice.

All students unless disqualified physically, are required to attend prescribed military exercises, those who pursue special or partial courses at the college not being exempt so long as they remain at the institution. By the commencement of their second term, students are required to provide themselves with a full uniform, comprising coat, blouse, trowsers, cap, white gloves, etc., all of which costs about $30. Correctness of deportment and discipline are required of all, the routine of the West Point Academy being followed as closely as circumstances will permit. To insure a proper sanitary condition of the college, the commandant makes careful inspections of all rooms and college buildings each Saturday morning, during which all students in full uniform are required to be in their rooms, for the proper police of which they are held to a strict accountability.

At the beginning of each term, issues of such equipments as they will require are made to all students. They will be charged for all injury, loss, and for any neglect in the care of the same.

For practical instruction, the following public property is in the hands of the college authorities: —

One platoon of light Napoleons (dismounted).
One six-pounder with limber and equipments.
Seventy-five sabres and belts.
One hundred and fifty breech loading rifles (cadet model).

Several accurate target rifles.

Two 8-inch siege mortars with complete equipments.

For practice firing, the United States furnishes blank-cartridges for all guns, and ball-cartridges for rifle practice, which is encouraged by the department.

Drills, amounting to rather less than four hours per week, are as follows :—

Infantry : schools of the soldier, company, and battalion ; manual of arms, and sword ; bayonet exercise, skirmish drill, target practice ; ceremonies, marches, field service.

Artillery : schools of the soldier, detachment, and battery (dismounted). Mortar drill, sabre exercise, pointing, and field service.

Battalion Organization.

For instruction in infantry tactics and discipline, the cadets are organized into a battalion of two or more companies under the commandant. The officers, commissioned and non-commissioned, are selected from those cadets who are best instructed and most soldier-like in the discharge of their duties. As a rule, the commissioned officers are taken from the seniors, the sergeants from the juniors, and the corporals from the sophomores. All seniors are detailed to act as commissioned officers.

Commissioned Staff.

A. A. Hevia, *Lieut. and Adjutant.* D. O. Nourse, *Lieut. and Quartermaster.*

Captains.

1. C. H. Preston. 2. E. A. Bishop. 3. H. J. Wheeler.

Lieutenants.

1. J. B. Lindsey. 2. S. C. Bagley.

Non-commissioned Staff.

C. Herms, *Sergeant-Major.*

Sergeants.

1. C. W. Minott. 2. S. M. Holman. 3. E. A. Jones.

Corporals.

1. E. W. Allen. 2. P. C. P. Brooks. 3. G. H. Putnam.
4. G. H. Barber. 5. C. P. Spaulding. 6. C. W. Browne.

CATALOGUE

OF

TRUSTEES, OVERSEERS, FACULTY AND STUDENTS.

1882.

TRUSTEES, OVERSEERS, FACULTY, AND STUDENTS.

Board of Trustees.

MEMBERS EX OFFICIIS.

His Excellency BENJ. F. BUTLER, *Governor of the Commonwealth.*
PAUL A. CHADBOURNE, *President of the College.*
JOHN W. DICKINSON, *Secretary of Board of Education.*
JOHN E. RUSSELL, *Secretary of Board of Agriculture.*

MEMBERS BY ELECTION.

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CHARLES G. DAVIS, ...	Plymouth.
HENRY COLT, ...	Pittsfield.
PHINEAS STEDMAN, ...	Chicopee.
HENRY L. WHITING, ...	Cambridge.
DANIEL NEEDHAM, ...	Groton.
WILLIAM KNOWLTON, ...	Upton
JOHN CUMMINGS, ...	Woburn.
JAMES S. GRINNELL, ...	Greenfield.
BENJAMIN P. WARE, ...	Marblehead.
O. B. HADWEN, ...	Worcester.
GEORGE NOYES, ...	Boston.
J. H. DEMOND, ...	Northampton.
EDWARD C. CHOATE, ...	Southborough.

Executive Committee.

PAUL A. CHADBOURNE.
O. B. HADWEN.
BENJAMIN P. WARE.
JOHN E. RUSSELL.
J. H. DEMOND.
GEORGE NOYES.

Secretary.

CHARLES L. FLINT of Boston.

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THE STATE BOARD OF AGRICULTURE.

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WILLIAM R. SESSIONS, ...	of Hampden.
DANIEL E. DAMON, ...	of Plymouth.

Members of Faculty.

PAUL A. CHADBOURNE, D. D., LL D.,
*President.**

HENRY H. GOODELL, M. A.,
Professor of Modern Languages.

CHARLES A. GOESSMANN, Ph. D,
Professor of Chemistry.

SAMUEL T. MAYNARD, B. S.,
Professor of Botany and Agriculture.

AUSTIN B. BASSETT, A. B.,
Professor of Physics and Civil Engineering.

MANLY MILES, M. D.,
Professor of Agriculture.

SECOND LIEUT. VICTOR H. BRIDGMAN, Second Artillery, U.S.A.,
Professor of Military Science and Tactics.

JOHN F. WINCHESTER, D. V. S.,
Lecturer on Veterinary Science and Practice.

ROBERT W. LYMAN, Esq,
Lecturer on Rural Law.

JOHN W. CLARK, B. S.,
Superintendent of Nurseries and Instructor in Agriculture.

EDWARD HITCHCOCK, Jr., M. D.,
Special Instructor in Elocution.

D. H. TILLSON,
Farm Superintendent.

* Gives instruction in Mental and Moral Philosophy and Natural History.

Graduates of 1882.*

Allen, Francis Sherwin, ...	Medfield.
Aplin, George Thomas, ...	East Putney, Vt.
Beach, Charles Edward (Boston Univ.), .	Hartford, Conn.
Bingham, Eugene Percival (Bost. Univ.),	Fitchburg.
Bishop, William Herbert, . . .	Diamond Hill, R. I.
Brodt, Harry Snowden, ...	Dansville, N. Y.
Chandler, Everett Sawyer, . . .	Coldwater, Mich.
Cooper, James Willard, ...	East Bridgewater.
Cutter, John Ashburton (Boston Univ.), .	New York City.
Damon, Samuel Chester (Boston Univ.), .	Lancaster.
Floyd, Charles Walter (Boston Univ.), .	Boston.
Goodale, David (Boston Univ.), . .	Marlborough.
Hillman, Charles Dexter, ...	Hardwick.
Howard, Joseph Henry, ...	Hyannis.
Howe, George Dickinson (Boston Univ.),	North Hadley.
Kingman, Morris Bird, ...	Amherst.
Kinney, Burton Arial, ...	Lowell.
May, Frederick Goddard (Boston Univ.),	Boston.
Morse, William Austin (Boston Univ.), .	Boston.
Myrick, Herbert (Boston Univ.), . .	Concord.
Paige, James Breckenridge, . . .	Prescott.
Perkins, Dana Edson, ...	Wakefield.
Plumb, Charles Sumner, ...	Westfield.
Shiverick, Asa Frank (Boston Univ.), .	Woods Holl.
Stone, Winthrop Ellsworth, . . .	Amherst.
Taft, Levi Rawson (Boston Univ.), .	Mendon.
Taylor, Alfred Howland (Boston Univ.), .	Yarmouth Port.
Thurston, Wilbur Herbert (Boston Univ.),	Upton.
Wilder, John Emery (Boston Univ.), .	Lancaster.
Williams, James Stoddard (Bost. Univ.),	Glastonbury, Conn.
Windsor, Joseph Libbey, ...	Grafton.
Total, ...	31

Senior Class.

Bagley, Sydney Currier, ...	Boston.
Bishop, Edgar Allen, ...	Diamond Hill, R. I.
Braune, Domingos Henrique, . . .	Nova Friburgo, Brazil.
Fletcher, Frank Howard, . . .	Townsend.
Hevia, Alfred Armand, ...	Havana, Cuba.

* The Annual Report, being made in January, necessarily includes parts of two academic years; and the catalogue gives the names of such students as have been connected with the college during any portion of the year 1882.

Holman, Samuel Morey, ... Attleborough.
Lindsey, Joseph Bridgeo, . . . Marblehead.
Minott, Charles Walter, ... Westminster.
Nourse, David Oliver, ... Bolton.
Preston, Charles Henry, ... Danvers.
Wheeler, Homer Jay, ... Bolton.
Total, ... 11

Junior Class.

* Goessmann, Henry Edward Victor, . Amherst.
Herms, Charles, ... Louisville, Ky.
Holland, Harry Dickinson, . . . Amherst.
Jones, Elisha Adams, ... Rockville.
Mayo, Walter Parker, ... Wellesley.
Redding, Merton Jay, ... Amherst.
Smith, Llewellyn, ... Amherst.
Total, ... 7

Sophomore Class.

Allen, Edwin West, ... Amherst.
Almeida, Luciano José de, . . . São Paulo, Brazil.
Barber, George Holcomb, . . . Glastonbury, Conn.
Brooks, Paul Cuff Phelps, . . . Boston.
Browne, Charles William, . . . Salem.
Buffington, Charles Owen, . . . Ware.
Chadbourne, Albert Hopkins, . . . Amherst.
Cutter, Charles Sumner, ... Arlington.
Day, William Lyman, ... Warren.
Dickinson, John Francis, ... Amherst.
Flint, Edward Rawson, ... Boston.
Goldthwait, Joel Ernest, ... Marblehead.
Howell, Hezekiah, ... Blooming Grove, N. Y.
Leary, Lewis Calvert, ... Brooklyn, N. Y.
March, Wilbur Marriam, ... Millbury.
Nash, John Adams, ... Amherst.
Nichols, Andrew, Jr., ... Danvers.
Phelps, Charles Shepard, . . . West Springfield.
Putnam, George Herbert, . . . Millbury.
Spalding, George Edwin, . . . Billerica.
Spaulding, Charles Plumb, . . . Amherst.
Taylor, Isaac Newton, Jr., . . . Northampton.

* Died April 27, 1882, of inflammation of brain.

Tekirian Benoni, ... Yozgad, Turkey.
Whittemore, Joseph Sidney, . . . Leicester.
Woodhull, George Gouge, . . . Monroe, N. Y.
Total, ... 25

Freshman Class.

Barker, John King, ... Three Rivers.
Bement, John Emery, ... North Amherst.
Clapp, Charles Wellington, . . . Montague.
Copeland, Alfred Bigelo, . . . Springfield.
Doucet, Walter Hobart, ... Philadelphia, Penn.
Eaton, William Alfred, ... Piermont-on-Hudson, N. Y.
Felt, Charles Frederick Wilson, . . Northborough.
Gaskill, Milo Audubon, ... Mendon.
Kinney, Arno Lewis, ... Lowell.
Leland, William Edwin, ... Grafton.
Palmer, Robert Manning, . . . Brookline.
Stone, George Edward, ... Spencer.
Winslow, Edgar Daniel, ... Ware.
Total, ... 13

Select Class.

Almeida, Luis Augusto de, . . . São Paulo, Brazil.
Cutler, George, Jr., ... Amherst.
Danks, Edward Field, ... Chicopee.
Davis, Arthur Emmons, ... Amherst.
Day, Robert Cutler, ... South Framingham.
Kendall, Charles Irving, ... Amherst.
Kenfield, Charles Robert, . . . Amherst.
Lang, Charles Joseph, ... Washington, D. C.
Owen, Henry Willard, ... Amherst.
Smith, Walter Storm, ... Syracuse, N. Y.
Total, ... 10

Post-Graduates.

Allen, B.S., Francis Sherwin, . . . Medfield.
Brewer, B.S., Charles, ... Amherst.
Fairfield, B S., Frank Hamilton (Boston Univ.), ... Waltham.

Floyd, B.S., Chas. Walter (Boston Univ.),	Boston.
Hills, B.S., Joseph Lawrence (Boston Univ.),	Boston.
Kinney, B.S., Burton Arial,	Lowell.
Plumb, B S., Charles Sumner,	Westfield.
Smith, B.S., Hiram Fred Markley,	North Hadley.
Stockbridge, B.S., Horace Edward (Boston Univ.),	Amherst.
Taft, B.S., Levi Rawson (Boston Univ.),	Mendon.
Washburn, B.S., John Hosea (Boston Univ.),	Bridgewater.
Total,	11

Specials in Chemistry.

Cardoso, Peleusia,	Rio Janeiro, Brazil.
Jaqueth, Isaac Samuel,	Liverpool, N. Y.
Total,	2

Summary.

Specials in Chemistry,	2
Post-Graduates,	11
Graduates of 1882,	31
Senior Class,	11
Junior Class,	7
Sophomore Class,	25
Freshman Class,	13
Select Class,	10
Total,	110

COURSE OF STUDY AND TRAINING.

FRESHMAN YEAR.

First Term. — Structural Botany; Lectures on Agriculture; Algebra; Declamations; Military Tactics; Lectures on health and habits of study, and general plan of college work; Military Drill; Practical work in Agriculture under direction of Professor; French (optional).

Second Term. — Agriculture; Systematic Botany; Freehand Drawing; Declamations; Geometry; Rhetoric and Elements of Composition; Military Drill; French (optional).

Third Term. — Agriculture; Geometry; Systematic Botany; History; Declamations; Compositions; Military Drill; Labor, under direction of Professors of Agriculture and Horticulture; French (optional).

SOPHOMORE YEAR.

First Term. — Botany, with special reference to forage, field and garden crops; Chemistry; Agriculture; History; Compositions; Declamations; Military Tactics; Geometry and Trigonometry; Military Drill; Labor; German (optional).

Second Term. — Agriculture; Practical Study in Plant-house; Chemistry; Zoölogy; Declamations; Trigonometry and its applications; Military Drill; German (optional).

Third Term. — Human Anatomy and special subjects in Zoölogy; Practical Surveying, with use of instruments in the field; History; Compositions; Declamations; Military Drill; Labor; German (optional).

JUNIOR CLASS.

First Term. — Agriculture; Horticulture and Market Gardening; Entomology, — useful and injurious insects, — care of bees, etc.; Mechanics; English Literature; Military Tactics; Compositions; Declamations; Military Drill; Labor.

Second Term. — Practical Chemistry; Arboriculture and care of Nurseries; Physics; Mechanical Drawing; Original Declamations; Agricultural Debate; Military Drill.

Third Term. — Practical Chemistry; English Literature; Modern History and Constitution of the United States; Original Declamations; Road-making and Railroads; Military Drill; Labor.

SENIOR YEAR.

First Term. Stock and Dairy Farming; Practical Chemistry; Original Declamations; Book-keeping and business forms; Astronomy; Military Science; Mental Science; Military Drill.

Second Term. — Agriculture; Geology and Mineralogy, with special reference to Agriculture; Original Declamations; Formation of English Language, its history and elements; Lectures on Veterinary; Organic Chemistry; Microscopy; Military Science; Military Drill.

Third Term. — Forestry and Landscape Gardening; Agricultural Reviews; Military Science; Moral Science; Formation of English Language, its history and elements; Elocution; Military Drill.

NOTE. — For a fuller account of the work done, reference is made to the following outlines and explanations of the work in each of the leading departments of the college.

INSTRUCTION NOW GIVEN BY THE PRESIDENT.*

FRESHMAN CLASS.

Lectures on health and habits of study; the best use of time in college; explanation of the plan and work of the college; outline of the work in each department.

SOPHOMORE CLASS.

General Zoölogy, with text-book and lectures:

Special studies in Zoölogy: Domestic animals; Insects injurious and beneficial; care of bees, etc.

SENIOR CLASS.

Geology, with text-book and lectures: Structure of the earth's crust; Geological agencies now in operation; formation of soils, marsh-beds, peat-beds, etc.

Outline Study of Man: His physical organization; outlines of mental and moral philosophy; principles of logic.

For the study of all these subjects needing illustration, the college furnishes ample facilities in its cabinets, collection of plates, manikins, skeletons.

* The subjects taught by special instructors and lecturers are not given in the following list of departments.

REPORT OF THE DEPARTMENT

OF

ENGLISH AND THE MODERN LANGUAGES.

By Prof. H. H. Goodell.

REPORT.

President Paul A. Chadbourne:

Sir, — I have the honor to submit the following tabularized statement of the department of which I have charge: —

English Studies.

Rhetoric. History. English Literature.

Freshman	2d Term — 4 hours.	Rhetoric and Elements of Composition.
	3d Term — 4 hours.	History, European.
Sophomore	1st Term — 1 hour.	History, English.
	3d Term — 4 hours.	History, American.
Junior	1st Term — 4 hours.	English Literature.
	3d Term — 4 hours.	
Senior	2d Term — 1 hour.	Formation of the English Language, treated historically.
	3d Term — 1 hour.	

Composition.

Freshman	2d Term — 1 hour.	Descriptive.
	3d Term — 1 hour.	
Sophomore	1st Term — 1 hour.	Biographical.
	3d Term — 1 hour.	Historical.
Junior	1st Term — 1 hour.	Imaginative & Argumentative.
	2d Term — 1 hour.	Original Declamations.
	3d Term — 1 hour.	
Senior	1st Term — 1 hour.	Original Declamations.
	2d Term — 1 hour.	
	3d Term — 1 hour.	

Drill in Elocution.

One hour per week for each class.

Modern Languages. (Optional.)

French.

Freshman	1st Term — 4 hours.	Grammar and Reader.
	2d Term — 4 hours.	Translation Fiction or History.
	3d Term — 4 hours.	Translation Scientific Works.

GERMAN.

Sophomore	1st Term — 4 hours.	Grammar and Reader.
	2d Term — 4 hours.	Fiction or History.
	3d Term — 4 hours.	Scientific Works.

The aim has been to make the course progressive and thoroughly practical. Commencing in freshman year with the study of rhetoric and the principles of composition, the student is led by easy and successive steps, from exercises in simple, descriptive narration, up to the higher forms of essay and original declamation. The instruction in history during freshman and sophomore years is given partly by text-book and partly by lecture. Of the three terms set apart for this work, the first is devoted to a discussion of the prominent points of European history; the second to English history, with special reference to its bearing upon that of our own country; and the third to American history, — the whole being introductory to a study of the Constitution of the United States as provided for in the third term of junior year.

The course in modern languages has, during the past year, been made optional. The method of instruction pursued has been the same in both languages, the object being to secure fluency and ease in translation, rather than to make finished scholars. To this end, the first term has been devoted to mastering the general principles of grammar, the rules for pronunciation, and to the reading of some light, easy work. In the second term, more advanced translation has been attempted, usually from some standard author in fiction or history; while in the third, the selection has been made of a scientific work, which should not only afford practice in translation, but furnish information in some one of the various departments of agriculture. In this way have been read Puys — Plants under Glass; Vaulx — What Constitutes a Dairy; Schleiden — Plant-Life; Prosch — Breeding and Care of Cattle.

DAILY ROUTINE, FIRST TERM, 1882-83.

GENERAL EXERCISES.

At 7.15 A. M.,	Breakfast.
8.15 "	Chapel.
8.30 "	Inspection rooms, Saturdays.
10.30 "	Church, Sundays.
12.30 P. M.,	Dinner.
2.00 "	Declamation, Wednesdays.
6.00 "	Supper.

Exercises of Senior Class.

At	8.30 A. M.,	Chemistry, Mondays, Tuesdays, Wednesdays.
	8.30 "	Stock and Dairy Farming, Thurs., Fridays.
	9.30 "	Chemistry, Mondays, Tuesdays, Wednesdays.
	9.30 "	Mental Science, Thursdays, Fridays.
	10.30 "	Stock and Dairy Farming, Mondays.
	10.30 "	Bookkeeping, Tuesdays.
	10.30 "	Military Science, Wednesdays, Thursdays.
	10.30 "	Chemistry, Fridays.
	11.30 "	Astronomy, Mon., Tues., Wed., Thurs.
	11.30 "	Bookkeeping, Fridays.

Rehearsals as directed. Military drill as ordered.

Exercises of Junior Class.

At	8.30 A. M.,	Agriculture, Mondays, Tuesdays.
	9.30 "	English.
	10.30 "	Mechanics, Mon., Tues., Wed., Thurs.
	10.30 "	Rehearsals, Fridays.
	11.30 "	Horticulture, Mondays, Tuesdays.
	11.30 "	Entomology, Wed., Thursdays, Fridays.
	1.30 P. M.,	Class Work as directed.

Military Drill as ordered.

Exercises of Sophomore Class.

At	8.30 A. M.,	English, Mondays.
	8.30 "	French, Tues., Wed., Thurs., Fri.
	9.30 "	Geometry, Mon., Tues., Wed., Fri.
	9.30 "	Military Tactics, Thursdays.
	10.30 "	Botany, Mondays, Tuesdays, Wednesdays.
	10.30 "	Agriculture, Thursdays, Fridays.
	11.30 "	Chemistry, Mon., Tues., Wed., Thurs.
	11.30 "	English, Fridays.

Rehearsals as directed.

	1.30 P. M.,	Class Work as directed.

Military Drill as ordered.

Exercises of Freshman Class.

At	8.30 A. M.,	Algebra.
	9.30 "	Botany.
	10.30 "	Lectures on Health, Mondays.
	10.30 "	Agriculture, Tuesdays, Wednesdays.
	10.30 "	Rehearsals, Fridays.
	11.30 "	Military Tactics, Thursdays.
	1.30 P. M.,	Class Work as directed.

Military Drill as ordered.

CALENDAR FOR 1883.

The third term of the collegiate year begins April 5, and continues till June 20.

The first term begins Sept. 13, and continues till Dec. 18.

The second term begins Jan. 10, and continues till April 4, 1884.

There will be an examination of candidates for admission to the college, at the Botanic Museum, at 9 A. M., Tuesday, June 19, and also on Thursday, Sept. 13.

The Farnsworth Prize Declamations take place Monday evening, June 18.

The public examination of the graduating class for the Grinnell Prize for excellence in Agriculture, will take place on Tuesday forenoon, June 19.

The exercises of Graduation Day occur June 20.

ADMISSION.

Candidates for admission to the Freshman Class are examined, orally and in writing, upon the following subjects: English Grammar, Geography, Arithmetic, Algebra through simple equations, and the History of the United States.

Candidates for higher standing are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the college until he is fifteen years of age; and every student is required to furnish a certificate of good character from his late pastor or teacher. Tuition and room-rent must be paid in advance at the beginning of each term, and bills for board, fuel, etc., at the end of every term.

The regular examinations for admission are held at the Botanic Museum, at 9 o'clock, A.M., Tuesday, June 19, and on Thursday Sept. 13; but candidates may be examined and admitted at any other time in the year.

Certificates. — Students who have completed the whole work of preparation may be admitted on diplomas of high schools. All students are admitted on probation only, and if not able to go on with their classes in a satisfactory manner, they will be notified to leave.

EXPENSES.

Tuition,	$12 00	per term.
Room-rent,	$5 00 to 10 00	per term.
Board,	2 50 to 3 50	per week.
Expenses of chemical laboratory to students of practical chemistry,	10 00	per term.
Public and private damages, including value of chemical apparatus destroyed or injured,	At cost.	
Annual expenses, including books,	$250 00 to $350 00	

REMARKS.

The regular course of study occupies four years; and those who complete it receive the degree of Bachelor of Science, the diploma being signed by the Governor of Massachusetts, who is president of the corporation.

Regular students of the college may also, on application, become members of Boston University, and, upon graduation, receive its diplomas in addition to that of the college, thereby becoming entitled to all the privileges of its alumni.

The instruction in the languages is intended to qualify the graduates to write and speak English with correctness and effect, and to translate French with facility. The scientific course is as thorough and practical as possible, and every science is taught with constant reference to its application to agriculture and the wants of the farmer.

The instruction in agriculture and horticulture includes every branch of farming and gardening which is practised in Massachusetts, and is both theoretical and practical. Each topic is discussed thoroughly in the lecture-room, and again in the plant-house or field, where every student is obliged to labor under the direction of the professor when suitable work can be done on the farm, gardens or nurseries. The amount of required work, however, is limited to six hours per week, in order that it may not interfere with study. Students are allowed to do additional work for wages, provided they maintain the necessary rank as scholars.

Indigent students are allowed to do such work as may offer about the college or farm buildings, or in the field; but it is hardly possible for one to earn more than from fifty to one hundred dollars per annum, besides performing other duties. So far as it consistent with circumstances, students will be permitted to select such varieties of labor as they may, for special reasons, desire to engage in.

Those who pursue a select course attend recitations and lectures with the regular classes; but those properly qualified, who desire special instruction in botany, chemistry, civil engineering, veterinary science, agriculture, or horticulture, may make private arrangements with the officers having charge of these departments.

EXTRA EXPENSES.

An expenditure of from ten to fifty dollars is necessary to provide furniture, which may be purchased at reasonable rates, either new or second hand. At the beginning of the second term of attendance each student is required to provide himself with the full uniform prescribed for the battalion of Agricultural Cadets, the cost of which is about thirty dollars. Students tax themselves for the support of a reading-room and literary societies.

SIZE OF ROOMS.

For the information of those desiring to carpet their rooms, the following measurements are given: In the south dormitory the main corner-rooms are fifteen by eighteen feet, and the adjoining bedrooms eight by twelve feet. The inside rooms are fourteen by fifteen feet, and the bedrooms eight by eight feet. In the north dormitory the corner-rooms are fourteen by fifteen feet, and the annexed bedrooms eight by ten feet; while the inside rooms are thirteen feet and a half by fourteen feet and a half, and the bedrooms eight by eight feet.

SCHOLARSHIPS.

The income of the Robinson Fund of one thousand dollars, the bequest of Miss Mary Robinson of Medfield, is assigned by the Faculty to such indigent student as they may deem most worthy.

The trustees voted in January, 1878, to establish one free scholarship for each of the eleven congressional districts of the State. Applications for such scholarships should be made to the representative from the district to which the applicant belongs.

The selection for these scholarships will be determined as each member of Congress may prefer; but, where several applications are sent in from the same district, a competitive examination would seem to be desirable. Applicants should be good scholars, of vigorous constitution, and should enter college with the intention of remaining through the course, and then engaging in some pursuit connected with agriculture. To every such student the cash value of a scholarship is one hundred and forty-four dollars.

RELIGIOUS SERVICES.

Prayers in chapel every morning at a quarter before eight o'clock. On Sundays the students, unless excused by request of their parents to attend church elsewhere, attend service in the chapel. This service is conducted by the president or such clergyman as he invites. The students are also invited to join a class for the study of the Bible.

The Young Men's Christian Association holds weekly meetings.

POST-GRADUATE COURSE.

Graduates of colleges and scientific schools may become candidates for the degree of Doctor of Science, or Doctor of Philosophy, from the College or from the University, and pursue their studies under the direction of Professor Goessmann in chemistry, or other members of the Faculty in their respective departments.

BOOKS, APPARATUS, AND SPECIMENS IN NATURAL HISTORY.

The library of the college contains about two thousand volumes. Among them are several sets of cyclopædias, magazines, and newspapers, reports of agricultural societies, and State boards of agriculture, and many standard works on agriculture and horticulture. There are also many useful works of reference in chemistry, botany, surveying, and drawing.

The Faculty and students also have the privilege of drawing books from the excellent library of Amherst College, which contains over thirty thousand volumes.

The State cabinet of specimens, illustrating the geology and natural history of Massachusetts, has been removed from Boston to the college, and is of much value for purposes of instruction.

The Knowlton Herbarium contains more than ten thousand species of named botanical specimens, besides a large number of duplicates. The Botanic Museum is supplied with many interesting and useful specimens of seeds, woods, and fruit-models. There is also a set of diagrams illustrating structural and systematic botany, including about three thousand figures.

About fifteen hundred species and varieties of plants are cultivated in the Durfee Plant-House, affording much pleasure and information to students and visitors.

The class in microscopy has the use of seven of Tolles's best compound microscopes, with objectives from four inches to one-eighth of an inch in focal distance, and a variety of eye-pieces.

PRIZES.

FARNSWORTH RHETORICAL MEDALS.

Isaac D. Farnsworth, Esq., of Boston, has generously provided a fund of fifteen hundred dollars, which is to be used for the purchase of gold and silver medals, to be annually awarded, under the direction of the College Faculty, for excellence in declamation.

GRINNELL AGRICULTURAL PRIZES.

Hon. William Claflin of Boston has given the sum of one thousand dollars for the endowment of a first prize of fifty dollars, and a second prize of thirty dollars, to be called the Grinnell Agricultural Prizes, in honor of George B. Grinnell, Esq., of New York. These prizes are to be paid in cash to those two members of the graduating class who may pass the best oral and written examination in theoretical and practical agriculture.

HILL'S BOTANICAL PRIZES.

For the best herbarium collected by a member of the class of 1883, a prize of fifteen dollars is offered, and, for the second best, a prize of ten dollars; also a prize of five dollars for the best collection of woods, and a prize of five dollars for the best collection of dried plants from the College Farm.

REGULATIONS.

I. — Students are forbidden to combine for the purpose of absenting themselves from any required exercise, or violating any known regulation of the college.

II. — The roll shall be called five minutes after the ringing of the bell for each exercise of the college, by the officer in charge, unless a monitor be employed; and students who do not answer to their names will be marked absent, provided that any student coming in after his name has been called shall be marked tardy. Two tardinesses shall be reckoned as one absence.

III. — Absence from a single exercise may be allowed or excused by the officer in charge of the same, if requested beforehand; but permission to be absent from several exercises must be obtained in advance from the general excusing officer, or from the president. In such cases the officer excusing will furnish a certificate of excuse, which shall state the precise time for which absence is permitted, and which shall be a satisfactory reason for absence from all exercises occurring within the time specified.

IV. — Excuse for absence from a college exercise must be obtained before the same occurs; and no excuse will be granted afterwards, unless the student shows the cause of the absence to be one of imperative necessity, and which could not be foreseen or prevented.

Permission to be absent from several consecutive exercises must be obtained from the excusing officer or the president; but excuse for absence from a single exercise *must* be obtained of the officer in charge of the same.

Permission for absence by the excusing officer or president will be given in the form of a certificate, the recipient of which must exhibit the same to each officer from whose exercise it gives leave of absence, as soon as the first exercise of the officer at which he is thereafter present; and his failure to do so will annul his right to excuse from the exercise of such officer.

A record of all tardiness will be rigidly kept; and, unless excused by the officer with whom they occur, two such will be entered on the record as an unexcused absence.

Each unexcused absence will be considered disobedience to college rule; and, if the aggregate number of such absences in all departments reaches *two*, the student so delinquent shall be informed of the fact. If the number of such absences reaches *four*, the parent or guardian of the student shall be informed of his delinquencies; and, if *five* such delinquencies are justly recorded against any student, his connection with the college may be terminated.

V. — Students are forbidden to absent themselves without excuse from the regular examinations, to give up any study without permission from the president, or to remove from one room to another without authority from the officer in charge of the dormitory buildings; and no student shall be permitted to make such change until he has procured from the inspecting officer a written statement that the room about to be vacated is in perfect order.

VI. — Students shall be required to attend the church of their selection regularly on Sunday morning, and report in writing to the excusing officer, during the ensuing week, whether they attended or not.

VII. — The record of deportment, scholarship and attendance will be carefully kept; and, whenever the average rank of a student falls below fifty, he will not be allowed to remain a member of the college, except by a special vote of the Faculty. Admission to the college, and promotion from class to class, as well as to graduation, are granted only by vote of the Faculty.

VIII. — Students are required to abstain from any thing injurious to the buildings and other property of the college, and in all respects to conduct themselves with propriety.

IX. — Parents and guardians are specially urged to co-operate with the Faculty in securing the faithful attendance of students upon every appointed exercise of the college.

X. — Military drill must be continued to graduation; and any student who neglects this exercise any part of graduation week, will not be entitled to a recommendation for a college diploma.

Statement of Cash Receipts and Payments for the Year 1882.

1882.	*Receipts.*		*Payments.*	
Jan.	Balance on hand,	$2,264 32	Expenses,—	
	Income from endowment fund,*	11,428 97	Farm account,	$4,674 78
	" " term-bills,	3,849 24	Botanical account,	5,295 55
	" " farm produce,	2,786 07	Term-bill account,	1,001 67
	" " plant-house and nursery,	3,865 99	Expense account,	2,240 44
	" " Mary Robinson Fund,	70 00	Hills Fund,	449 81
	" " Farnsworth Prize Fund,	75 00	Laboratory account,	756 75
	" " Grinnell Prize Fund,	80 00	Salaries,	9,742 48
	" " Whiting Street Fund,	40 00	Farnsworth Prize Fund,	65 35
	" " Hills Fund,	592 00	Grinnell Prize Fund,	80 00
				$24,306 83
			Balance,	744 76
		$25,051 59		$25,051 59

* By change in securities the income received from this fund Jan., 1883, was only $2,669.50, as against $4,714.69 in 1882. The large receipts from the State fund are now in April and October.

JOHN CUMMINGS, *Treasurer.*

SENATE. No. 5.

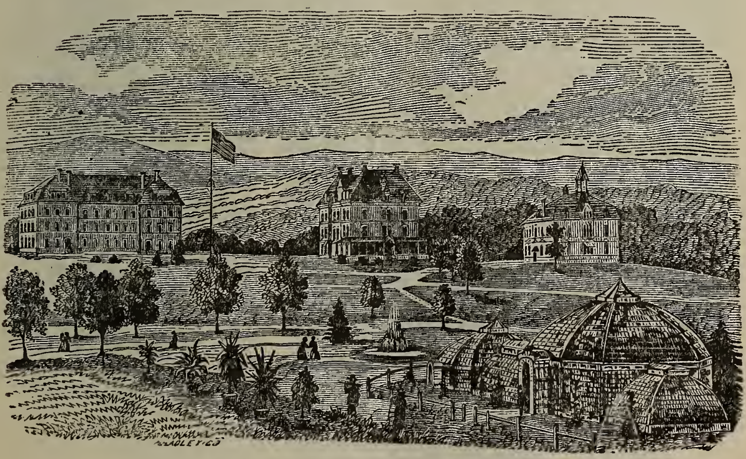
TWENTY-FIRST ANNUAL REPORT

OF THE

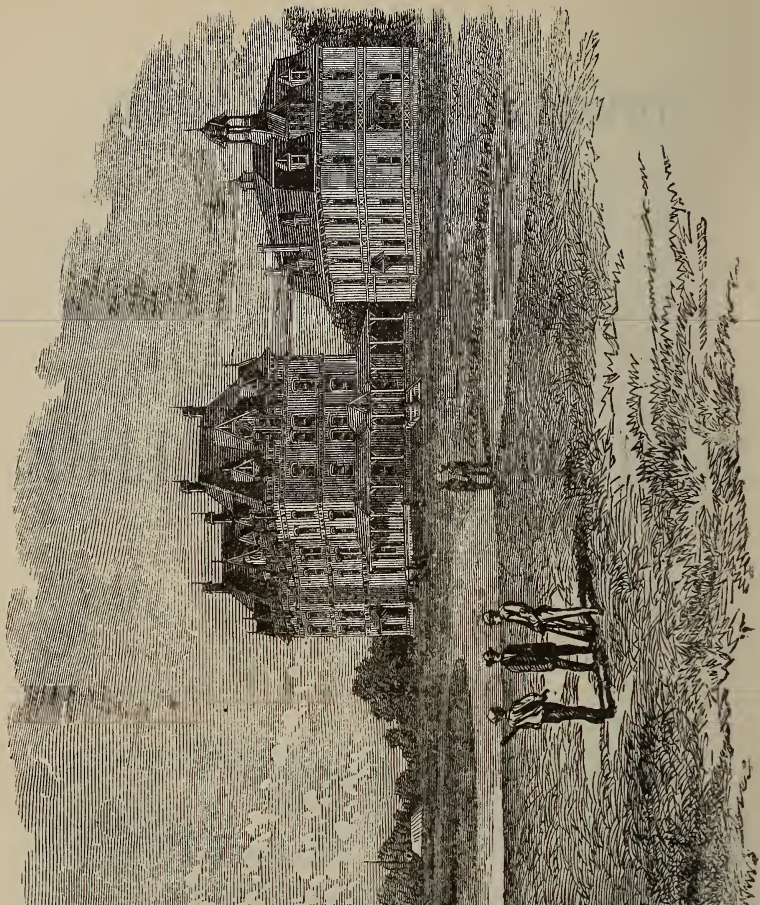
MASSACHUSETTS

AGRICULTURAL COLLEGE.

JANUARY, 1884.



BOSTON:
WRIGHT & POTTER PRINTING CO., STATE PRINTERS,
18 POST OFFICE SQUARE.
1884.



Commonwealth of Massachusetts.

EXECUTIVE DEPARTMENT,
BOSTON, January 11, 1884.

To the Honorable Senate and House of Representatives:

I have the honor herewith to transmit, for the information and use of the General Court, the Twenty-first Annual Report of the Trustees of the Massachusetts Agricultural College.

GEO. D. ROBINSON,
Governor.

Commonwealth of Massachusetts.

MASSACHUSETTS AGRICULTURAL COLLEGE,
AMHERST, Jan. 10, 1884.

To His Excellency GEO. D. ROBINSON:

SIR, — I have the honor herewith to present to your Excellency and the Honorable Council the Twenty-first Annual Report of the Trustees of the Massachusetts Agricultural College.

I am, sir, very respectfully,

Your obedient servant,

JAMES C. GREENOUGH,
President.

ANNUAL REPORT

OF THE

MASSACHUSETTS AGRICULTURAL COLLEGE.

To His Excellency the Governor and the Honorable Council:

The year that has passed will doubtless prove one of the most important in the history of the college. The energy, the wisdom and the devotion of Dr. Chadbourne, aided by many friends of the college, have begun to yield fruit promising lasting benefit to every section of the State. It is seldom that an institution is subjected to so severe a loss as the college sustained in the death of its president, Paul A. Chadbourne, LL.D., Feb. 23, 1883. Speaking of his acceptance of the office early in 1882, a member of the Board of Trustees says: —

"After due consideration, he consented to accept the proffered position, and lost no time in entering upon the duties it involved. The State College at that time needed all the energy, oversight, executive ability, ripe experience, innate enthusiasm and educational resources which such a man only could supply. Rarely have a man and his work so happily met. He seemed to comprehend the extent and peculiarity of the field on which he had entered, as it were with a single steady glance; and it at once became obvious that the college was to have the benefit of a masterly mind and character."

In the obituary sketch which is found in the Alumni Record of 1883 Prof. Bassett thus speaks of him:

"During the period of his service here, President Chadbourne impressed himself upon faculty and students as a man of power and sincere purpose. All have caught in some measure his earnest, resolute spirit. He imparted an impetus to the college which has become a vigorous internal life. His plans were large, his execution prompt and effectual. The erection of a commodious drill hall, the improvement of other buildings and their surroundings, and the revision of the curriculum, are evident features of his work. More valuable, even, were his services in securing to the college the interest and confidence of the people. . . . He is mourned by associates in business interests, who found him enterprising and sagacious; by the champions of pure legislation and civil-service reform, who will miss from their councils one whom they knew to be fair-minded in his opinions, unflinching in his convictions, and fearless in assault upon false systems and corrupt institutions; by the people of Massachusetts, who esteemed him a trustworthy citizen, actuated by pure motives for the public weal; by fellow-members of scientific and literary associations, who valued his scholarly labors and respected his high attainments; by the friends of truth and righteousness, nation-wide, who honor him as the foe of evil and the advocate of true religion; by hundreds of men who have caught inspiration from his teachings and wisdom from his counsels; by the trustees, faculty and students of the college to which his last strength was given. Few men have touched human life at so many points or with so firm a hand. Few have exerted influence so permanent; written records so fair; bequeathed memories more fragrant. None have been more loyal to high purposes; none more true to convictions of duty."

We cannot specifically state the good work for the college attempted by Dr. Chadbourne, but we are able to give the general outline of what he proposed, in his own words. Speaking of the act of Congress, in accordance with which our own college and those in other States were founded, he says: —

"Whatever mistakes may have been made in the organization and management of these institutions, no fault can be charged home to the original bill. It was eminently a wise measure, and suggested an outline of organization and management that has not as yet been improved upon. Its significant words are as follows: 'The endowment, support and maintenance of at least one college where the *leading object* shall be, without excluding scientific and classical studies, and including military tactics, to teach such branches of learning as are *related* to agriculture and the mechanic arts, in such manner as the legislatures of the States may respectively prescribe, in order to promote the *liberal* and *practical* education of the industrial classes in the several pursuits and professions of life.' No branch of learning peculiar to the old colleges was to be necessarily excluded; but the new colleges were to push on to the practical application of the sciences they taught, and they were to train all their students as defenders of their country against domestic rebellion or foreign invasion. In a word, they were to educate their students as *men* and as *American citizens*. The rank of the education given is '*liberal*,' the term applied to the education given by the highest institutions then known. It was to be so broad as to fit men for the 'several pursuits and professions of life.' . . . Many who have attempted the management of these colleges, as well as many who have criticised them, have apparently overlooked the broad and generous plan upon which they were founded. It is doubtful if they will ever accomplish the great work for which they were intended, until their original purpose is so fully and constantly recognized and carried out by judicious, painstaking work, that the currents of education shall be once fairly turned toward these new channels. When once fairly turned, that they will continue to flow can no more be doubted than we can doubt the success of any natural process when not artificially obstructed. An education that 'gives boys what they need to daily use when they become men,' commends itself as rational and practical."

The plan as thus in general outlined secured the hearty approval of the trustees, and its execution was well begun when Dr. Chadbourne was suddenly removed by death.

From the time of his death until the beginning of the present college year, the affairs of the college were wisely administered by Prof. H. H. Goodell, as acting president. As he was unwilling to assume the duties of the presidency permanently, the trustees, by a special committee, sought a successor to Dr. Chadbourne. After much inquiry and careful deliberation, it was determined to secure the services of James C. Greenough, a graduate of Williams College, who, by his early training, was skilled in agriculture, and who, owing to his administrative ability, his acquirements, and his success in teaching, had already been urged to accept the presidency of a classical college in another State. Mr. Greenough refused to allow his name to be used as a candidate, but as the trustees, through their committee, persistently urged the need of his services at the college, and the wide field for usefulness which it presented, he at length severed his connection with the State Normal School in Rhode Island, and entered upon his duties as president in September, 1883.

Course of Study.

After a careful study of the condition and prospects of the college, President Greenough determined to specifically work out the plan proposed by Dr. Chadbourne. The studies of the college course are now so arranged as to form two general courses of study. One is termed the Scientific and Agricultural Course, the other is termed the Scientific and Literary Course. The first provides for all the agricultural study which our facilities allow. We are increasing the opportunities for special instruction in agriculture as fast as we can. We believe it will be for the advantage of the State to invest more in the farm as a means of agricultural training. To make the farm the effective basis of a training school, considerable expenditures must be made. To secure desirable practical results, a variety of crops should be cultivated under different conditions, as a means of instruction rather than of profit. In training to any employment so varied and complex as agriculture in its several departments, there must be loss of material.

The Scientific and Literary course of study is adapted to those whose previous practical knowledge of agriculture, or whose choice of other employments than that of tilling the soil, requires that less time shall be spent in field work. The college, as now organized, offers its course of instruction to any young man who is qualified to pursue it. The question may here be asked, "Do not other colleges in the State provide for the instruction of those who are not to be farmers?" The other colleges in the State require for admission to their regular course from two to four years' preparatory study of Latin and Greek. Many students cannot afford to give so much time to the study of these languages before entering college, and wish to pursue other branches during their college course. These students need the culture that comes by the study of language and literature, and this they must secure by the critical study of the English language and by the study of the modern languages. Some of those who were graduated at our older colleges, and who appreciate the culture there gained, prefer for their sons the more practical course at the State College. This college, as now organized, fills a place in our general system of education that no other of our colleges can fill. It meets the wants of those who have been trained in our common schools, our high schools and our academies; but who have not pursued a course of preparatory study in Latin and Greek. It supplements the work in the English department of our high schools, as the older colleges supplement the work of the classic department.

It is evident that the State College must lack that organized support which the older colleges are able to secure through their graduates. Owing to the brief period during which the college has been established, its graduates are yet young men and comparatively few in number. They have not acquired that wealth and influence which will be theirs at the close of another decade, yet they have evinced a deep interest in the welfare of the college. They have begun to contribute liberally toward the establishment of a library fund for the college. The success of the graduates in their several fields of labor, and their zeal for the welfare of the college, augur well for its future.

But the college is not a private institution, and neither the alumni nor the trustees can so regard it. Its appeal must be to the people of the State, and this is just, for it is organized to meet their wants. It is not organized upon the basis of any mediæval models. It is a State college, organized to serve the present interests of the people, by providing practical instruction for a large and increasing number of young men. It should be so liberally sustained, and the expense of attendance should be so reduced, that every boy in the State will consider it possible for him, by industry, frugality and faithful study, to find a path through it to competence and usefulness. It must be steadily adapted to meet the wants of our young men, especially of those who are to engage in the productive industries.

The question may here be put, "By thus broadening the field and the work of the college, will it not lose its value as an ‘agricultural’ college?” In answer to this we may say, that if the institution is narrowed to the special needs of those who are to till the soil, it becomes a mere technical school, and loses the distinctive characteristics of a college. Every college must do something more than teach the technics of any employment, or it is no longer a college. The objects of study and training are two, — to form the man and to form the workman. The work of a college is, mainly, to develop manhood. The object of an agricultural college is to form men, and also to furnish special training for those who are to till the soil, or are to direct others in tilling the soil. No narrow structure was contemplated in the broad foundation proposed by the act of Congress, under which the Massachusetts Agricultural College was established. It has ever striven to make men, though it has often suffered the misfortune of being considered a mere training school for farmers. This view is degrading to the farmers and to their employment. Technical training without liberal culture subordinates the man to his employment, and tends to make him something less than a man. The full course of study, as now arranged, is needed by every young man who attends the college, whatever may be his future employment.

But the question may still be urged: “How is this college to aid the agricultural interests of the State?” In reply to this question, we would say that the college enables a large class of young men to prepare for wide usefulness who cannot pursue, or who do not wish to pursue, the courses of study in the older colleges. Through the intelligent labor of these graduates, agriculture and other productive industries of the State will receive fresh impulse, and will be more wisely developed.

The question may be asked: “How does this college promote the agricultural interests of the State as other institutions of the State do not?” We answer: —

1. By providing special opportunities for the culture and training of those engaged in agricultural pursuits, thus emphasizing the importance of such pursuits.

2. By recognizing the value of a thorough education for those engaged in agricultural pursuits. The day is past

when it can be said that a farmer needs little or no education beyond the ability to read, to write and to cipher. His success to-day depends upon his ability to understand the principles of physics involved in the machinery he uses. By means of the mechanical contrivances of our time, the farmer is now able to accomplish quickly with his horses what was once slowly accomplished by hand. The great advance in agricultural chemistry renders a knowledge of the principles of this science necessary to the farmer who would correctly note the changes in the laboratory of nature, and read the books and papers published to aid him in his work. The progress in the cultivation of fruits and vegetables renders it needful that he understand the laws of plant life. The study of botany is becoming more and more a necessity. The laws of animal life are also indispensable to him who would intelligently care for the animals in his charge.

But the college recognizes the fact that the farmer needs more than scientific and technical knowledge. He needs to know himself and his relations to his fellow-men. He needs to be able to wisely discharge the duties of citizenship. He needs to be a man qualified for that leadership in public affairs which in the past has secured to our land the wise counsel of her yeomanry.

3. By providing for that instruction and training in the field which is requisite to success in every department of agriculture. Agriculture is an art as well as a science, and hence it demands manual training.

4. By giving those engaged in agricultural pursuits an opportunity to gain a scientific education adapted to their needs. All the sciences taught in the college are taught in their relations to agriculture.

Every scientific principle taught in a college course must be presented in some of its applications in order to be understood. In the State College the applications are made in the several departments of agriculture and in kindred employments. We here touch one important difference between the proper work of the State College and the work of other institutions. For instance, the principles of chemistry are the same whether taught in one place or in another. The illustrations and the applications by which the principles are taught and understood are not the same in every institution. In the State College the illustrations and applications relate to agriculture. The same is true of botany, and should be true of every department of science.

This is the only justifiable mode of teaching sciences in an agricultural college. This mode is none the less serviceable to those who are not to be farmers. There is no better way of understanding the sciences than by the illustrations and applications taken from the field. Those who are thus taught, whether their future employment is in the field, or shop, or office, cannot fail to be interested in agriculture, and may be expected to co-operate with farmers in devising better methods of developing the productive industries of the field.

But scientific training is not sufficient to form the true man, nor the wise leader of others. That one may wisely forecast the future, he must study the past. History properly finds its place in our curriculum. Every young man entering upon active life should know the social forces acting about him. Civil polity, political economy and kindred studies should not be disregarded in any college course. Every graduate should have knowledge of his own mental and moral powers, and the laws of their proper exercise. Hence studies that lead to this knowledge are wisely incorporated into the course of the college.

In the modern discussions respecting the value of scientific studies, the necessity of literary culture is too often overlooked or denied. No course of study is liberal from which is excluded that culture which is the result of the patient study of language and literature. This college excludes an extended course in the study of the ancient classics, hence the greater the necessity of providing other means of literary culture. Here, if nowhere else, the English language, both in its spoken and written forms, should be thoroughly studied. Because of their aid in a knowledge of the English language, and their help in its use, Latin, to some extent, French and German, should be patiently studied. There are many other evident reasons for the study of these languages at this college which it is unnecessary to mention. The thorough work which has been done in the department of literature and language should be increased. Every student should be trained to accurate, effective and graceful expression, both oral and written. No one is prepared for the battle of life until he is ready to find solace, inspiration and guidance by converse, through our literature, with the great masters that have preceded us.

Nor is the course, as thus partially outlined, sufficient. Man is a religious being. The college should provide means of religious culture. The brief chapel exercise of each morning, and the Sabbath services now regularly held, together with such other means of religious culture as are now provided, we believe are essential to the highest welfare of every student.

Gifts to the College.

Gifts to Library.

From Leander Wetherell, of Boston, 1,410 bound volumes, including complete sets of Agricultural Reports of Ohio, New York, Vermont, and several hundred pamphlets.

From Herbert S. Carruth, of Boston, seventy volumes of latest publications in history, science and literature.

Gifts to Museum.

From the United States Fish Commission, a representative collection, numbering some two hundred species of the invertebrates of the coast.

From W. E. Rutherford, of Westhampton, a collection of one hundred and fifty specimens of birds' eggs, containing some quite rare species.

Gift to Botanical Museum.

From William S. Lyon, of Los Angeles, Cal., over two hundred specimens of the flora of California, to the herbarium of the college.

Gift to the College.

From the United States Government, a set of weights and measures, to be kept as a standard of authority. (Joint Resolution of Congress, March 3, 1881.)

Immediate Needs of the College.

1. The North College is well-nigh unfit for occupancy. Repairs have been made from time to time, but, owing to the fact that the building was hastily and cheaply built, and has been subjected to constant wear for some fifteen years, it needs a thorough renovation. The estimated cost of the repairs and necessary improvements is $5,000. Unless this building is put in good condition, it will be impossible to accommodate the next class that enters.

2. A house on the grounds, to be occupied by the president and his family, is an admitted necessity. President Chadbourne selected a site, and the trustees were planning to build, at the time of his death. At the time of the appointment of President Greenough, it was agreed to provide a house upon the grounds. A balance in the treasury of the college justified the trustees in beginning the house in August. As the funds of the college did not allow us to finish the building, nothing has been done upon it since the early days of November, when the first coat of plastering was put on. It did not seem wise to stop the work at an earlier stage. The amount expended upon the house is about $2,000. The amount needed to pay outstanding bills, and to complete the house and the grading, will be $6,000. It will be more economical for the State to complete this house than to continue the allowance for house-rent agreed to be paid to the president until it is finished. The main reason, however, for completing the house, is that the services of the president, when living on the grounds, will be of far more value to the college than they can be while he is obliged to live at a distance of a mile from the college.

3. The room now used as a chapel for morning and Sabbath services is part of the chemical building. The increased work in the chemical department of the college demands that the whole building shall at once be occupied by that department. In fact, much of the work incident to the Experiment Station is now accomplished with difficulty, because of the lack of room in the chemical building. Our present chapel room must be given up to the chemical department. Where, then, shall the students assemble for

morning service, for lectures and for Sabbath services? The only way of meeting this question is by the erection of a chapel. When this building is erected, provision should be made for a library. We have noticed elsewhere the gifts of Leander Wetherell, Esq., and others to the library. We have no suitable room in which to put these books. Hon. Marshall P. Wilder has agreed to place a set of books, which cost him upwards of $500, in the library, as his gift. These books would be of great practical value to the college; but we cannot transfer them to Amherst until the State shall provide a suitable place.

During the month of December, in response to the solicitations of the President, several thousands of dollars were pledged, as a permanent fund for a library. Most of this was pledged by certain gentlemen now on the board of trustees of the college. If allowed, we would gladly give the names of those who have thus provided a permanent library fund. Three thousand dollars have been collected, but all of the remainder cannot be collected, nor the income used, unless a suitable place is provided for keeping the books. The alumni of the college are also moving to secure an alumni fund for the library. It is seldom that one of our State institutions has received such gifts as are now proffered. Whether these gifts shall be available depends upon the action of the present legislature.

In the accompanying reports some of the needed appliances by which the work of the several departments of the college can be made more effective, are specifically noted.

Scholarships.

The class that entered last September was, for the most part, made up of those admitted by competitive examination, in the several senatorial districts, under the direction of State senators.

The faithfulness of the senators in giving notice in their several districts, and in arranging for examinations, indicated an earnest purpose on their part to extend the usefulness of the college. Though the measure was new, and but partially understood in many sections of the State, sixty-six of those examined reached the required rank and were admitted to the college. The lack of means and other circumstances have prevented some of these from attending. Upwards of fifty have been in attendance, constituting one of the best classes that was ever admitted to the college. This class will be increased by others who are soon to be admitted. The number admitted from Franklin County is larger than from any other county in the State.

Concluding Remarks.

Those who enter this college are, with few exceptions, young men who have learned by their own labor the value of money, and are disposed to make the most of their opportunities for study and personal improvement. They are worthy of more liberal provisions for their wants at the college than the State has yet made.

The members of the Faculty are something more than excellent instructors of classes; they care for the students individually, and the students, in turn, cordially co-operate with their instructors.

As the experiment station is now separate from the college, we present, in connection with the reports of the several departments of the college, a list prepared by Dr. Goessmann of the more important experiments carried on at the Massachusetts Agricultural College since 1870.

DEPARTMENT OF PRACTICAL AGRICULTURE.

President James C. Greenough.

Sir: — The following report on the course of instruction in this department, for the year 1883, is respectfully presented: —

In accordance with arrangements which assigned a part of my time to work in connection with the experiment station, my duties at the college have been strictly confined to instruction in the class room.

Owing to a revision of the courses of study, at the beginning of the year, it has been necessary to give instruction in special topics in a different order than that laid down in the regular course, to bring the standing of the several classes in agriculture in harmony with the curriculum published in the catalogue.

From the want of suitable text-books, instruction in agriculture must be given almost entirely by lectures, and a certain amount of mental discipline, particularly in the habit of concentrated systematic attention, is required on the part of the student to enable him to derive the greatest profit from them. For this reason, it seems desirable that the course in agriculture should not begin until the last term of the freshman year.

My aim has been, in all parts of the course, to give prominence to the practical principles of the art, which represent the accumulated experience of the best farmers.

The mission of science, in its relations to agriculture, in its several departments of physics, — chemistry, biology (including animal and vegetable physiology), and political and social economy, — is to explain the established methods of practice, interpret the more exact results obtained in experiments, and to suggest new lines of experimental inquiry in regard to improved methods of practice.

The applications of science to agriculture have, therefore, been discussed with reference to their bearing upon questions of practical importance, and particular attention has been given to the results of experiments which have been made for the improvement of the art.

One of the leading objects, in the course of instruction in agriculture, is to develop in the student correct habits of observation, and give him a knowledge of the exact methods of experimentation which are required for the solution of the many problems that may present themselves in his practice. Empirical knowledge is thus brought in contact with a consistent interpretation of natural laws, and practice and science are thus made to go hand in hand in the class-room, as they must in the work of the farm, if the student is to receive the full benefits of an agricultural education. Theories are discussed with reference to their legitimate use as a means of investigation, and they are not presented as representing the aggregate of established truths.

In the second term of the year, lectures were given to the sophomore class (two hours a week, or nineteen exercises) on the history of agriculture, tracing the development of rules of practice, — pioneer farming and mixed husbandry, — and the properties and management of different soils.

The junior class had a course of lectures on animal husbandry (one hour each week).

The course of the senior class (two hours per week, or nineteen exercises) embraced methods of agricultural improvement, including experiments and how to conduct them, the methods and results of high farming, and the nitrification of soils, with the practical applications indicated in the results of experiments.

In the third term, lectures were given to the senior class (five hours per week, or forty-five exercises) on stock-breeding, mixed husbandry, drainage, and a general review of the course.

In the first term, the sophomore class had twenty-six exercises in stock-breeding and animal motors, partly by lectures and partly with text-book.

The junior course consisted of twenty lectures on manures and crop rotations, and a course of lectures (twenty-six exercises) was also given to the senior class on stock breeding.

In addition to the regular class work, a number of illustrated lectures have been given to the students generally, and to the members of the Natural History Society, on topics relating to agriculture not embraced in the regular course.

Lectures to farmers' clubs have likewise been given in different parts of the State.

A class-room is very much needed for the use of this department, and it should have connected with it a room for apparatus and for preparing experiments to illustrate the course, and an agricultural museum.

The advantages of object teaching in the course of instruction in agriculture are largely lost from want of a class-room, where charts, models and selected specimens can be displayed to illustrate the subjects under discussion.

My large collection of stereopticon views of animal portraits and other objects, with a lantern for their exhibition, are of but little use in teaching, from the want of a suitable room in which they can be exhibited.

It is impossible to present to the student the detailed applications of the wide range of sciences relating to agriculture, in a form that will enable him to fully appreciate them, without the best possible facilities for illustrating the facts presented from so many sources.

MANLY MILES,

Professor of Agriculture.

REPORT OF J. W. CLARK,

Farm Superintendent.

President James C. Greenough.

Sir:—I have the honor to submit my report of farm operations since April 1st, 1883. During the past year the farm was under the control of Mr. D. H. Tillson until April 1st, when it came under its present management. The plans for the season had been formed in part, so that little change was made in the general work of the farm; but from the first the aim has been to systematize the work so that it might be done with the least possible expense. In caring for the stock it has been insisted on that it should be done with regularity and by competent men, which shows a marked improvement in both the yield of milk and the condition of stock. A careful record of the number of pounds of milk given by each cow has been kept, and such as do not prove themselves profitable have been or will be disposed of just as soon as they do not pay for the food consumed; this being the only way that stock can be kept with profit. The boarding-house has been supplied with milk, and some sold to families living near the farm; the remainder has been set and the cream sent to the Amherst Creamery, which is found more profitable than making butter on the farm.

The crops grown the past season have been: corn, twelve acres; potatoes, four acres; fodder corn, one acre; carrots, one and one-half acres; mangels, one acre; Swedish turnips, one-half acre; buckwheat, six acres; wheat, two and one-half acres; rye, ten acres. The corn was so injured by the frost that not more than half a crop of sound corn was harvested. The buckwheat also gave promise of a large yield, but was injured by the frost. The root crops were all good. The greater portion of the land on which the rye was sown was low and wet, causing much of it to be thrown out and killed by the frost, in consequence of which the crop was light. The hay crop was below that of previous years, owing to the dry weather preventing the second crop, and the practice of selling hay and grain when it should have been fed upon the farm and the number of the stock increased. The crops of the farm should be fully double what they are at present. The soil of the farm is particularly adapted to grass, and the farm might be made one of the best dairy farms in the State, if the right course was taken to reclaim the wastes of the pasture and break up and re-seed some of the worn-out pieces of mowing, giving them a liberal dressing of manure and draining where it is needed. This will of necessity require considerable outlay, but it will be money well invested. A private individual could not afford to let his land remain in the condition of many acres on this farm, neither can the State afford it, and the sooner every available acre is made to produce a full crop, the sooner will the farm become a credit to the State and a paying investment. A beginning has been made the past season. About fourteen acres of land in the pasture that was ploughed the year before, and left without anything being sown upon it, has been re-ploughed and sown to rye and grass-seed, to furnish pasturing where the past year was nothing but smartweed, positively worthless for feed. Besides this, some sixteen acres of the pasture grown up to alders, briers, etc., have been grubbed out and ploughed, a part of it for the first time. This, well fitted, and sown to oats and grass-seed in the spring, will add fully thirty acres of feed to the pasture.

The stock of the farm consists of 27 head of Ayrshires, 3 grade cows, 2 yoke of steers, 1 yoke of cattle, 1 fine Guernsey bull, — a gift of Mr. W. A. Reed, of Hadley, Mass., — and 1 Ayrshire bull presented by Ben. P. Ware, of Marblehead, Mass.; 3 horses, 20 Berkshire swine, 3 medium Yorkshires and 1 grade hog, — all of which, with the exception of the last mentioned, are pedigree animals,—and 75 fowls.

In taking the inventory of stock, I have put the value according to the worth of the animal, and what it would sell for if placed on the market. In this way the value of the stock can be compared from year to year, without the uncertainty of fancy prices, for these vary greatly different seasons, and also with different breeders, one selling an animal for $500 which another could not for $100. I include in this report the inventory of stock, hay, grain, etc., as I found it April 1st, giving credit for all stock since sold and the price received. To the value of the young stock I have added from $5 to $15 each, according to the growth and condition of the several animals. The increased value of the steers is the increase in weight, reckoned at five cents per pound. Comparing the value of live stock of April 1st, 1883, with that of Jan. 1st, 1884, a balance is found in favor of Jan. 1st, 1884. The value of the hay, grain, roots, etc., will vary little from what it was Jan. 1st, 1883. The tools and vehicles have been taken at the value given last year, they being fully as valuable as then. Besides doing the regular farm work, the roads have been kept in order, grading has been done about the Drill Hall and other college buildings, the grounds have been kept in order, the cellar dug for the president's house and the grounds about it graded. The team-work of the experiment station has been done, the crops harvested, grading about its buildings and construction of the road upon its grounds. Besides having charge of the farm, I have given instruction in agriculture to the freshman class throughout the year, and also taken charge of class work.

The first great need of the farm is to settle upon some fixed plan for the future, to decide what branch of farming shall be carried on, and then to work for that, and not be shifting from one thing to another. The buildings and soil of the farm are adapted to stock farming, and money should be furnished with which to purchase fertilizers the coming spring, that more hay, grain and roots may be grown, that more stock may be kept, and in this way to improve the farm by the increased amount of manure made: for the more stock kept, the more manure, and the more manure the greater will be the crops, and the larger the crops the more stock can be kept. The milk can be set and the cream taken every day by the Creamery Association, netting about $2\frac{1}{2}$ cents per quart for the milk set, and the skim-milk can be fed to swine and young stock; in this way returning nearly all of the valuable constituents of the food back to the farm, making it better and more productive each year.

Another need of the farm is suitable shed-room for the wagons and carts where it will be convenient, that all such property may be housed when not in actual use, and not be exposed to the weather as was the case the past summer. If the shed which now extends across the south side of the barn-yard were moved so as to form a continuation of the shed on the west side of the yard, a portion of it converted into a place for storing wagons, carts, etc., much space which is now of little use could be made valuable, and the barn-yard which is now nearly ruined by this shed, shutting out the sunshine, would be made comfortable during the winter months. One end of the shed should be made into a tenement for the help, and the farm be saved the expense of hiring a tenement for the men, off the farm. The Agricultural Department of the college needs more money than any other branch of the institution to place it on a level with the other departments. It has always been compelled to take a secondary place in importance, but the time has come when it should rank second to none, and money should be given for a building to be known as the Agricultural Hall, where different kinds of farm produce and implements can be brought together to be used for illustrations. The other departments of the institution have their collections to aid them in explaining or applying the subjects taught, and why not the agricultural? for a more useful and interesting collection could not be brought together than one composed of agricultural products and implements.

The farm account from April 1st, 1883, to Jan. 1st, 1884, without giving the farm credit for the improvement made in the pasture, which cost at the lowest estimate $175, or credit for other improvements, stands as follows : —

Expenses from April 1st, 1883, to Jan. 1st, 1884,		$2,872 05
Cash received since April 1st, ...	$1,333 17	
Bills handed in " " "	1,067 96	
Bills due, ...	290 16	
Increased value of stock since April 1st, . .	177 25	
		2,868 54
		$3 51

Respectfully submitted,

J. W. CLARK.

REPORT OF THE BOTANIC DEPARTMENT.

J. C. Greenough, *President*.

I have the honor to report the following upon the condition of the department under my charge.

Early in the year this department met with a great loss in the burning of the "Durfee Plant House" and the destruction of a large and very valuable collection of plants, including most of the stock for the propagation of bedding plants for the spring sales and for planting.

About 8 o'clock in the evening of January 23d, fire was discovered in the work-room, but it had gained such headway that nothing could save the main building. The students were soon on the grounds, and by the use of light snow, which was abundant, the two wings — the lily and stove rooms, and the propagating pits were saved, although the plants within them were very much injured. At this time the thermometer indicated 8° below 0°, and as soon as the flames were under control, stoves were procured, by which means, and covering the sides of the houses with mats the temperature within was kept above freezing until the boiler and pipes could be repaired, which was not until the afternoon of the 25th. The origin of the fire cannot be satisfactorily accounted for, but it undoubtedly started in a pile of wood not far from the large boiler.

The wings and the pits were at once temporarily repaired, and stock plants purchased for propagation for spring sales. The two most valuable plants in the collection, the sago and fan palms, were taken up as soon as possible the next morning, and although their tops were burned completely off, and they were exposed to extreme cold for more than twelve hours they are now growing vigorously and in a few years will reach their original proportions.

During the summer and fall the parts of the building destroyed have been replaced by structures which are thought to be much more ornamental and are certainly more convenient and better adapted to the work of the department. The work-room which covers the furnace cellar is two stories high, the lower one being divided into two rooms, one for a reception or waiting and sales-room, and the other the work-room proper. In the second story two rooms have been fitted up for a study and sleeping room, while the north half is devoted to the purposes of a tool and work room. The foundation of this building was raised one foot higher than that of the one destroyed, and by removing two or three large piers and rearranging the heating pipes, more space has been obtained, and the risk from fire very greatly reduced.

The sales of flowers and plants for the remainder of the winter and spring was much less than it would have been but for this accident.

Crops.

The crops, notwithstanding the drought, have been much better than last season. A detailed statement of the income is appended to this report.

Improvements.

Among the improvements made upon the grounds of the department are the draining of the land between the county road and the one leading by the Botanic Museum, and the springy side hill south-east from the plant houses. Nearly 2,000 feet of tile was laid in the most thorough manner in the former, and the land, which, before scarcely produced hay enough to pay for cutting, planted with corn, cabbages, squashes and turnips. The crops upon this land were very satisfactory, and it is now in the best possible condition for almost any farm crop. The side-hill lot was underdrained with stone-drains, — the stones being gathered from the orchard and other land on the hill east from the plant house. The drains are working perfectly and the land produced a fine crop of squashes.

The hot-beds, which were located west of the propagating house, have been removed to a more sheltered location south of the same, and the land graded and seeded and the collection of some twenty-five varieties of Japanese maples planted in groups or singly. More than the usual amount of work has been done the past season in keeping the roads and walks in good condition and in the decoration of the grounds.

Wants.

One of the urgent needs of this department is a barn for keeping two horses, carriages, tools, etc., and for packing trees and shrubs during wet weather. A cellar is also needed for storing vegetables and fruit, and a portion of it for storing half-hardy trees and shrubs. The barn where the work horses and the heavy wagons and tools are now kept is fully occupied by them; the stable in the rear of the Botanic Museum will only accommodate one horse and hay enough to keep it for only three or four weeks, while the room is much needed for small tools of the department and for a work-room.

When the president of the college becomes located in his new house on the grounds, a stable will be needed to accommodate his horse and carriages also. These needs will require a building 40 by 60 feet, with 14 or 16 feet posts and a frost-proof cellar. For the construction of such a building timber for the frame can be easily and cheaply obtained from the chestnut grove near by, without injury to it, and pine lumber in large quantities is already on hand at the farm buildings.

Another urgent need is a complete set of gardening tools, independent of those used for the ordinary business of the department, which may always be on hand for illustration or educational purposes.

Sources of Income for 1884.

In addition to the same sources of income as the past season, we have about one acre of asparagus, one and one-half acres of raspberries and blackberries, and about three-fourths of an acre of currants, all two years from planting. Besides the above, we have about 25,000 more peach trees for sale than last year, and a much larger general nursery stock, and the orders now in indicate a very much larger sale than ever before. The land under cultivation is in a much improved condition, and having been kept quite clear from weeds for the past three years, can be cultivated at less expense. Nearly all the land to be planted next spring has been ploughed, which will greatly assist in the work of the spring.

Financial Statement.

Cash Dr.

Cash on hand Jan. 1st, 1883,	$18 06
received for plants,	1,096 48
flowers,	338 74
vegetables,	1,001 14
trees and shrubs,	1,718 07
fruit,	573 98
sundries,	89 95
collected by Bursar,	450 29
income of Hills fund,	675 92
on hand Dec. 31st,	7 58
Total cash income,	$5,970 21

To the above should be added credits as follows: —

Outstanding bills,	350 65
Expense of draining side-hill lot,	145 00
Expense of draining north lot,	215 00
Work upon roads, walks, etc.,	102 50
Planting trees along roadway,	20 00
Plants for decorating grounds of farm-house, etc.,	25 00
Increased value of produce on hand,	25 00
Increased value of grain,	35 00
Increased value of nursery stock,	1,000 00
Value of seeds on hand,	55 00
Total income,	$7,943 36

Cash Cr.

Total cash paid out,	6,822 39
Balance,	$1,120 97

S. T. MAYNARD.

APPENDIX.

List of Plants desired for Educational Purposes, to replace those Destroyed by Fire.

Illicium religiosum,	
Bixa orellana, ...	*Arnotta.*
Polygala Dalmaisiana,	
Camellia Japonica, ...	*Double and single.*
" sasanqua, ...	*Varieties.*
Thea Bohea, ...	*Black Tea.*
" veridis, ...	*Green Tea*
Hiptage mandablota,	
Swietenia mahagoni, ...	*Mahogany.*
Hibiscus splendens,	
" sinensis,	
Pistachia lentiscus, ...	*Mastic tree.*
Acacia melanoxylon,	
Indigo-fera tinctoria, ...	*Indigo.*
" anil,	
Tamarindus Indicus, ...	*Tamarind.*
Myrtus communis, ...	*Myrtle.*
Lagerstroemia Indica, ...	*Crape Myrtle.*
Eryngium eburnum,	
Aralia papyrifera, ...	*Paper aralia.*
Coffea Arabica, ...	*Coffee.*
Posiqueria longiflora,	
Montanoa hieracleifolia, ...	*Tree Astor.*
Stylidium,	
Azalea Indica, ...	*Single and double var.*
" Pontica,	
Volckameria acauleata,	
Cobea scandens variegata,	
Stephanotus floribundus,	
Olea sativa, ...	*Olive.*
Mackaya bella,	
Laurus camphora, ...	*Camphor tree.*
" cinnamomum, ...	*Cinnamon* "
Grevillea asplenifolia,	
Piper nigra, ...	*Black pepper.*
" betel, ...	*Betel* "
" cubeba, ...	*Cubeb* "
Stenocarpus Cunninghamii,	

Manihot utilissima, ...	*Tapioca.*
Croton pictum,	
Artrocarpus Indicus, ...	*Bread-fruit.*
Ficus elasticus, ...	*India rubber.*
Siphonia elastica, ...	*Caoutchouc.*
Damara australis, ...	*Broad leaved pine.*
Cycas cercinalis, ...	*Sago cycad.*
Zamia tennifolia,	
Phœnix dactylifera, ...	*Date palm.*
Cocos nucifera, ...	*Cocoa-nut palm.*
Elaeis guineensis, ...	*Oil* "
Areca catechu, ...	*Betel* "
Sagus laevis, ...	*Sago* "
Caryota urens, ...	*Sugar* "
Ceroxylon audicolor, ...	*Wax* "
Phytelphus macrocarpa, ...	*Ivory* "
Calamus Rotang, ...	*Rattan* "
Zinziber officinalis, ...	*Ginger.*
Maranta arundinacea, ...	*Arrow-root.*
Testudinaria elephantipes,	
Diosperus ebenum, ...	*Ebony tree.*
Victoria regia, ...	*Amazon lily.*
Papyrus antiquorum, ...	*Paper papyrus.*
Nymphea cœrulea, ...	*Blue lily.*
Ouverandria fenestralis, ...	*Lace leaf.*
Dicksonia antartica, ...	*Tree fern.*
Alsophylla Australis, ...	*Tree fern, 6 ft. high.*
Platycerium grande, . . .	*Stag-horn Fern.*
Dendrobium nobile.	

CHEMICAL DEPARTMENT.

J. C. Greenough, *President.*

The instructions in theoretical and practical chemistry during the past year have been given in conformity to the curriculum of the college. It has been the aim of the instructor to make the instructions as practical as time and circumstances admitted. The elements were treated with reference to their importance in science and art; and the illustrations were chosen with a design to promote the special object of the institution, — to prepare the student for the various branches of industry, and of agriculture in particular. The instructions in the lecture-room are followed by practical observations in the laboratory. The characteristics of the various elements, and their most important compounds are studied by chemical analysis. Mineral substances prominent in the sciences and arts, as well as in agriculture are carefully tested, and their constituents ascertained. As soon as the student has become familiar by personal observation with the general qualities of many of these compounds, is competent to recognize the more common elements in their various combinations, and comprehends the working of the chemical laws in mineral matter, he receives a course of instruction in organic chemistry. Lectures in chemistry, applied in the sciences and arts, and especially in agriculture, finish the course of instruction.

The following regular class instructions have been given during the past year: The Sophomore class has attended one term of lectures and recitations in elementary chemistry on metallic elements. The Junior class has received for two terms, instructions in analytical chemistry, on the modes of ascertaining the constituents of industrial products. The

Senior class has studied for one term the composition of ores, ashes, fertilizers, and soils.

Besides this regular class exercise, a considerable amount of work has been carried on by special students in chemistry, and by post-graduates of the college.

The rooms of the chemical department of the college which have been spacious enough during past years, will be insufficient to meet the demands of incoming larger classes, and of the experiment station.

As it will be impossible to accommodate satisfactorily both institutions a year hence, it seems most desirable that action should be taken soon, to meet the growing wants of the chemical department of the college in regard to additional rooms and permanent assistance.

C. A. GOESSMANN.

EXPERIMENTS

Carried on at the Massachusetts Agricultural College since 1870.

The growing of sugar-beets, the manufacture of sugar from them, and trials of their value for cattle foods. This industry is soon to grow up in our midst, and to absorb large amounts of capital.

The sources of supply, and the quantity and quality of our manurial agents. These careful scientific investigations have been the prime means of revolutionizing the manufacture and trade in fertilizers, not only in this State, but throughout the country.

Laboratory and physical examinations of the South Carolina phosphates, and trials of their agricultural value in the raw state, and after treatment with acids.

On the use and effect of common salt, on grain and root crops.

The chemical and physical condition of the salt marshes of the State, and the devising of methods by which they can be made available for agricultural purposes.

Experiments with compound commercial fertilizers, to test their comparative agricultural value, and their value as compared with single elements.

To determine what elements will make practically a complete manure, on our average soils.

Investigations of the quality and composition of commercial fertilizers offered for sale, and the protection of the community by legal control and inspection from frauds in them.

Observations and study of the phenomena of plant-life.

The circulation of sap in plants, and their expansive power during growth.

To determine the proportions of different elements of nutrition in feeding substances to be used to save needless expense, and to produce the most certain results.

Experiments on the continuous growth of crops, on the same soil, with chemical fertilizers alone.

The influence of different kinds of fodder-plants fed to milch cows on the quality and quantity of their milk and butter.

Contribution to the chemistry of American wild and cultivated varieties of grape-vines.

Investigations of dairy products, — oleo-margarine, Jersey, and skim-milk cheese.

Examinations of animal secretions; variety of urinary calculi, etc.

Examinations of various vegetables and fruits.

Examinations of varieties of sugar-beets raised throughout the State of New York, Lower Canada, and the Connecticut River Valley.

Investigations concerning the saccharine qualities of several varieties of corn and melons.

Examinations and trials to test the comparative value of different methods of setting and treating milk in the butter-dairy.

Practical trials of new implements, and a great variety of farm machinery.

Investigations as to the effect of girdling fruit-trees and plants to hasten the time of ripening, and to improve the quality of the fruits.

The effect of chemical salts on the carbo-hydrate contents of plants, and the quality of the fruits.

The construction and repair of common roads.

The growing of early-amber cane, and the manufacture of sugar from its juice.

The influence of temperature, and the vital functions of plants, and temperature of soils and air, on the changes in form of water in soils, and plants and vapor in air.

Investigations in relation to the evaporation and percolation of water from the soil.

The tilling of soils of different characteristics, as affecting the loss of water by evaporation.

The determination of the elements of plant nutrition lost from the soil by leaching, and of those it retains.

Investigations in relation to the comparative temperature of the soil and air by day and by night.

The establishment of true meridian lines, to regulate the practice of surveying.

The comparative study of milk of different breeds of cows.

Accurate investigations of the comparative nutritive and feeding value of Northern, Southern and Western varieties of Indian corn.

Experiments regarding diseased peach trees, yellows, etc.

Experiments regarding the influence of special manures on fruits, etc.

MATHEMATICS AND PHYSICS.

The work of the mathematical department during the past year has been conducted upon the plan indicated in the last annual report. The only variation in the amount or order of work indicated in that schedule was the substitution of nine hours instead of five hours for instruction in surveying during the third term. Much of this time was occupied in actual field practice, making surveys by various methods, and plotting and calculating areas from the notes. The revised course increases slightly the time devoted to mathematical studies, but the changes are so immaterial that the schedule presented in the present report may be referred to for an outline of the work of this department during the past as well as the present year.

Some obstacles to satisfactory work in this department still present themselves. Although the average scholarship of the present freshman class is creditable, and in the case of a few individuals very gratifying, there is a greater diversity of ability and attainment than is noticeable in institutions whose students have all been subjected to a somewhat uniform course of preparatory training. As a result, there is difficulty in allotting work sufficiently rigid to properly occupy the better trained members of the class, which shall not overburden and discourage the less forward ones. This evil manifests itself especially in the study of algebra. The progress of the class during the past term has therefore been retarded by the necessity of an effort to bring the poorly trained students into line. It is impossible to entirely obviate this difficulty by increasing the requirements for admission. The remedy lies in the hands of the teachers of high schools throughout the State, upon whom rests the responsibility of giving a thorough drill in the principles and operations of elementary algebra to all young men anticipating membership in this college.

Another obstacle is the deficiency in the apparatus for illustrating sound, heat and light, branches of science which especially require demonstration to the senses. An adequate enlargement of the physical cabinet is certainly one of the most stringent needs of the institution.

The mathematics comprise the chief disciplinary studies of the course; therefore my first aim is to develop in the students the mental habit of exactness, not only indispensable for mastery of the pure mathematics, but the first requisite for successful pursuit of all branches of science. My second aim is to introduce such exercises as will stimulate ingenuity and originality. My third aim is to give a practical bearing to all studies, by means of experiment and illustration drawn from familiar fields of observation.

The trustees and other friends of the institution will be very welcome at the class exercises of the mathematical department. Such manifestation of interest would gratify and stimulate both students and instructor.

AUSTIN B. BASSETT.

DEPARTMENT OF ENGLISH AND THE MODERN LANGUAGES.

President James C. Greenough.

Sir: — I have the honor to submit the following report of the department of modern languages and English literature.

The course as now established does not differ materially from that of preceding years. Its most essential feature is the making optional the study of French and German. The change in the time of commencing these studies, making them coincide with the opening of the college year, cannot fail to be of practical advantage to the student, allowing him three consecutive terms of work without the intervening of the long summer vacation. The method of instruction pursued has been the same in both languages, the object being to secure fluency and ease in translation rather than to make finished scholars. To this end the first term has been devoted to mastering the general principles of grammar, the rules for pronunciation, and the reading of some light, easy work. In the second term, more advanced translation has been attempted, usually from some standard author in fiction or history; while in the third, the selection has been made of a scientific work, which should combine practice in translation with information in some one of the various departments of agriculture. In this way have been read, among other books, Puys — Plants under Glass; Marion — Wonders of Vegetation; Vaulx — What Constitutes a Dairy; Schleiden — Plant-Life; Prosch — Breeding and Care of Cattle; Peschel — Physical Geography.

The instruction in English literature has been partly oral and partly by the study of a text-book. A series of lectures on the great race epochs of English history opened the course, and the text-book has been supplemented by lectures at the close of each literary period. English history and English literature have been, as far as practicable, taught together, and it has been the constant aim to make the one the complement of the other.

MILITARY DEPARTMENT.

James C. Greenough,

President of the Massachusetts Agricultural College.

Sir: — I have the honor to submit the following brief report, and to append the theoretical and practical course of the military department, with the names and grades of those holding official places in the present battalion organization.

It is a pleasure to note a general improvement in all which pertains to this department. A building enclosing recitation-room, office, armory and an ample drill-hall has finally been completed. Its tasteful design adds much to the appearance of the grounds, and it at once embodies and supplies the needs which have been particularly apparent in winter, a season which inclines the student to the least exercise. Much of the old regalia, as hats, plumes, sashes, has been replaced by new. A small but growing military library, thoroughly interesting to all, has been established. A few samples of powder, shells, fuzes, etc., form the basis of a museum which, improved, will materially aid in giving the student proper ideas of Ordnance. The interest, discipline and information of the students are constantly improving, and the present assurance of larger classes is the sure precursor of still greater advancement. In considering the scope of this department, the plan thus far followed has been to take a middle course in discipline and instruction between a distinctly military institution like our National Academy, and the ordinary literary college. Due recognition is given to the claims of the United States, its purpose in founding this and similar colleges, — and to the fact that the student after graduation is not identified with, dependent upon or especially aided by the government. The tactical instruction has therefore been confined to the time devoted by the best colleges to calisthenics. The student acquires with his physical exercise what will be of mutual profit to his country and himself in case of need. Should our volunteer soldiery be called into active service, the average graduate of this college could not fail to secure an honorable position at once. The varied drills, mainly in the open air, besides exercising every part of the body, and under the most favorable circumstances, for health, — have a purpose beyond the development of the mere physical man. The student must use his reason, his voice, his body. He must control himself as well as others. The artillery, mortar, company, skirmish and battalion drills have each their different commands, different formations and distinctive objects. They are alike only in requiring exact discipline, quick and implicit obedience from the instructed; from the instructors, — usually seniors, — a comprehension of their purposes and a capacity to control and command obedience from others. To be straightened into "the position of the soldier," *once*, is to be benefited; and no estimate can be made of the good derived by those who even reluctantly are brought to a regular methodical course of drills for four years. These matters are not sufficiently considered when boys are sent away from their homes for an advanced education. The weekly inspection of the dormitories, and the daily inspection at all drills, are calculated to remedy the careless tendencies of students by the enforcement of personal neatness, which is the basis of a proper, healthful and instructed life. Tactical studies are taken in regular course, but not to exceed one hour per week during the first term of each school year for each of the junior classes. The time thus employed, as it is distributed is scarcely missed, and more perfected practical instruction is thus permitted. The studies pursued by the seniors, amounting to two hours each week through the year, alone take appreciable time from the students. They are arranged to include the elements of fortifications and ordnance, especially useful in war, — a brief survey of Constitutional and military law, and much important history, by the review of prominent campaigns of ancient and modern times. It is not desired to give exact information concerning marches, camping, field fortifications, and such other matters as would be of especial importance to field and company officers in the service; but rather to excite some taste for the future reading of military works, than to go into the reasons for intricate strategic movements. It is hoped that the State or general government will respond to a demand for a second platoon of field pieces, which the increasing numbers in the lower classes will soon require. It is proposed, commencing with the next school year, for obtaining more perfect quiet in the dormitories during study hours, to place cadet officers, under proper regulations, in control of the different entries. The best results are anticipated where interest and the confidence reposed, combine to urge a strict compliance with the requirements. I take this opportunity of urging that a more intimate connection be recommended to His Excellency the Governor, between this corps as an organization and the State militia. Massachusetts takes much merited pride in her present organization, and a wisdom among legislators and officials which recognizes the necessity of having an experienced body of State troops ever ready, — must see the desirability of giving the students of the *State College*, where military duties are an essential feature, an opportunity for a few weeks camp life, yearly. It seems practical that this corps should be placed on the same footing with regimental organizations of the State, transported to Framingham, and paid at the same rates as the same grades in the militia. Two weeks yearly in camp, at a convenient time in the summer, would be of the greatest advantage. The few hundreds thus expended would be an economical outlay, and some additional interest might be excited in the State college, and in the students who seek an education there which prepares them at once to be intelligent men in peace and valuable soldiers in war.

Very respectfully,

Your obedient servant,

VICTOR A. BRIDGMAN,

1st Lieut. 2d U. S Artillery,

Prof. of Military Science and Tactics

Theoretical and Practical Course of Instruction.

THEORY.

Fall term, Freshman year. One hour per week for the term. Recitations in infantry tactics (Upton's). School of the Soldier. School of the Company. Skirmish drill.

Fall term, Sophomore year. One hour per week for the term. Recitations in U. S. Artillery tactics. School of the Soldier (dismounted), sabre exercise, manual of the piece and mechanical manœuvres, bayonet exercise (infantry tactics). Ammunition, equipment of carriages. Modified service of 8-inch mortars.

Fall term, Junior year. Recitations in infantry tactics (Upton's). One hour per week for the term. School of the battalion. Ceremonies. Company and field service.

Military Science.

This instruction is given to seniors, extending through the entire college year, two hours per week.

It will include, in the form of lectures and recitations from selected text-books, the following subjects : — Ordnance and Gunnery ; constitutional and military law and history ; campaigns and battles ; systems of warfare, present and past ; an elementary course in strategy and engineering. It will be modified by such additions and changes as shall seem desirable. Essays are required from each senior on military subjects, when they have become sufficiently instructed to prepare them advantageously. These papers will be read in the recitation room for general note and criticism, or before the entire college. One set, all upon the same subject, are written for prizes, — the award being made by a board of army officers. The successful competitors read their productions at the graduating exercises. Subject for the class of 1883, Military education as a factor of American government.

The competition of the class of 1883 resulted as follows : —

Board of Award.

First Lieutenant C. A. L. Totten, Fourth Artillery.
First Lieutenant A. B. Dyer, Fourth Artillery.
Lieutenant H. A. Springett, Fourth Artillery.

Subject.

Military Education as a Factor of American Government.

Award.

First prize, $25. J. B. Lindsey, Marblehead.
Second prize, $15. S. M. Holman, Jr., Attleborough.

Especial Mention.

S. C. Bagley, Boston, and E. A. Bishop, Diamond Hill, R. I.

Practice.

All students, unless disqualified physically, are required to attend prescribed military exercises, those who pursue special or partial courses at the college not being exempt so long as they remain at the institution. By the commencement of their second term, students are required to provide themselves with a full uniform, comprising coat, blouse, trowsers, cap, white gloves, etc., all of which costs about $30. Correctness of deportment and discipline are required of all, the routine of the West Point Academy being followed as closely as circumstances will permit. To insure a proper sanitary condition of the college, the commandant makes careful inspections of all rooms and college buildings each Saturday morning, during which all students in full uniform are required to be in their rooms, for the proper police of which they are held to a strict accountability.

At the beginning of each term, issues of such equipments as they will require are made to all students. They will be charged for all injury, loss, and for any neglect in the care of the same.

For practical instruction, the following public property is in the hands of the college authorities: —

One platoon of light Napoleons (dismounted).
One six-pounder with limber and equipments.
Seventy-five sabres and belts.
One hundred and fifty breech loading rifles (cadet model).

Several accurate target rifles.

Two 8-inch siege mortars, with complete equipments.

For practice firing, the United States furnishes blank-cartridges for all guns, and ball-cartridges for rifle practice, which is encouraged by the department.

Drills, amounting to rather less than four hours per week, are as follows: —

Infantry: schools of the soldier, company, and battalion; manual of arms, and sword; bayonet exercise, skirmish drill, target practice; ceremonies, marches, field service.

Artillery: schools of the soldier, detatchment, and battery (dismounted). Mortar drill, sabre exercise, pointing, and field service.

Battalion Organization.

For instruction in infantry tactics and discipline, the cadets are organized into a battalion of two or more companies under the commandant. The officers, commissioned and non-commissioned, are selected from those cadets who are best instructed and most soldier-like in the discharge of their duties. As a rule, the commissioned officers are taken from the seniors, the sergeants from the juniors, and the corporals from the sophomores. All seniors are detailed to act as commissioned officers.

Commissioned Staff.

J. E. Goldthwait, *First Lieut and Adjutant.*
H. D. Holland, *First Lieut and Quartermaster*

Non-commissioned Staff.

G H. Barber, *Sergeant-Major.*
C. W. Browne, *Quartermaster Sergeant.*

Color Guard.

Sergeants — E. R. Flint, *National Colors;* H. Howell, *State Colors.*
Corporals — G. W. Wheeler; C. W. Clapp; K. Sanborn
Privates — L. J. de Almeida; J. A. Nash; E. D. Winslow.

Captains.

C. Herms, Co. A. E. A. Jones, Co. B.

Lieutenants.

L. Smith, Co. A. G. H. Putnam, Co. A. E. W. Allen, Co. B.

First Sergeants.

P. C. P. Brooks, Co. A. C. S. Phelps, Co. B.

Sergeants.

E. R. Flint, Co. A. H. Howell, Co. B.
C. S. Cutter, Co. A. B. Tekirian, Co. B.

Corporals.

A. L Kinney, Co. A. C. W. Clapp, Co. A. K. Sanborn, Co. A.
G. W. Wheeler, Co. B. C. F. W. Felt, Co. B. W. Ayres, Co. B

CATALOGUE

OF

TRUSTEES, OVERSEERS, FACULTY AND STUDENTS,

1883.

CALENDAR FOR 1884.

The third term of the collegiate year begins April 9th and continues till June 25th.

The first term begins Wednesday, Sept. 10th, and continues till Dec. 18th.

The second term begins Jan. 7th and continues till March 31st, 1885.

There will be an examination of candidates for admission to the college, at the Botanic Museum, at 9 A.M., Tuesday, June 24th, and also on Tuesday, Sept. 9th.

The Farnsworth Prize Declamations take place Monday evening, June 23d.

The public examination of the graduating class for the Grinnell Prize for excellence in Agriculture, will take place on Tuesday forenoon, June 24th.

The exercises of Graduation Day occur June 25th.

TRUSTEES, OVERSEERS, FACULTY AND STUDENTS.

Board of Trustees.

Members Ex-Officiis.

His Excellency GEO. D. ROBINSON, *Governor of the Commonwealth.*
JAMES C. GREENOUGH, *President of the College.*
JOHN W. DICKINSON, *Secretary of Board of Education.*
JOHN E. RUSSELL, *Secretary of Board of Agriculture.*

Members by Election.

MARSHALL P. WILDER,	Boston.
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HENRY COLT,	Pittsfield.
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HENRY L. WHITING,	Cambridge.
DANIEL NEEDHAM,	Groton.
WILLIAM KNOWLTON,	Upton.
JOHN CUMMINGS,	Woburn.
JAMES S. GRINNELL,	Greenfield.
BENJAMIN P. WARE,	Marblehead.
O. B. HADWEN,	Worcester.
GEORGE NOYES,	Boston.
J. H. DEMOND,	Northampton.
EDWARD C. CHOATE,	Southborough.

Executive Committee.

JAMES C. GREENOUGH,
O. B. HADWEN,
BENJAMIN P. WARE,
JOHN E. RUSSELL,
J. H. DEMOND,
GEORGE NOYES.

Secretary.

CHARLES L. FLINT of Boston.

Auditor.

HENRY COLT of Pittsfield.

TREASURER.

DANIEL NEEDHAM OF GROTON.

BOARD OF OVERSEERS.

THE STATE BOARD OF AGRICULTURE.

EXAMINING COMMITTEE OF OVERSEERS.

GEORGE JEWETT,	of Fitchburg.
AVERY P. SLADE,	of Somerset.
WILLIAM R. SESSIONS,	of Hampden.
DANIEL E. DAMON,	of Plymouth.
ATKINSON C. VARNUM,	of Lowell.
JONATHAN BUDDINGTON,	of Leyden.

MEMBERS OF FACULTY.

PAUL A. CHADBOURNE, D. D., LL. D.,
*President.**

JAMES C. GREENOUGH, M. A.,
President.
College Pastor and Professor of Mental and Moral Science.
Provisional Instructor of Political Economy and History.

LEVI STOCKBRIDGE,
Honorary Professor of Agriculture.

HENRY H. GOODELL, M. A.,
Professor of Modern Languages and English Literature.
Provisional Instructor of Rhetoric and English Composition.

CHARLES A. GOESSMANN, PH. D.,
Professor of Chemistry.

SAMUEL T. MAYNARD, B. S.,
Professor of Botany and Horticulture.

AUSTIN B. BASSETT, A. B.,
Professor of Mathematics and Physics.
Provisional Instructor in Elocution.

MANLY MILES, M. D.,
Professor of Agriculture.

——— ———
Professor of Comparative Anatomy and Veterinary Science.

* Died February 23, 1883.

FIRST LIEUT. VICTOR H. BRIDGMAN, Second Artillery, U. S. A.,
Professor of Military Science and Tactics.

HORACE E. STOCKBRIDGE, Ph. D.,
Assistant Professor of Chemistry.

JOHN F. WINCHESTER, D. V. S.,
Lecturer on Veterinary Science and Practice.

ROBERT W. LYMAN, Esq.,
Lecturer on Rural Law.

EDWARD HITCHCOCK, Jr., M. D.,
Special Instructor in Elocution.

WINFRED A. STEARNS, A. B.,
Instructor in Entomology.

FREDERICK TUCKERMAN, M. D.,
Instructor in Physiology.

JOHN W. CLARK, B. S.,
Farm Superintendent and Instructor in Agriculture.

LEVI R. TAFT, B. S.,
Bursar and Assistant Professor in Horticulture.

Graduates of 1883.*

Bagley, Sydney Currier, ...	Boston.
Bishop, Edgar Allen (Boston Univ.), .	Diamond Hill, R. I.
Braune, Domingos Henrique, . .	Nova Friburgo, Brazil.
Hevia, Alfred Armand (Boston Univ.), .	Havana, Cuba.
Holman, Samuel Morey, Jr. (Boston Univ.), ...	Attleborough.
Lindsey, Joseph Bridgeo (Boston Univ.),	Marblehead.
Minott, Charles Walter (Boston Univ.), .	Westminster.
Nourse, David Oliver (Boston Univ.), .	Bolton.
Preston, Charles Henry (Boston Univ.), .	Danvers.
Wheeler, Homer Jay (Boston Univ.), .	Bolton.
Total, ...	10

* The Annual Report, being made in January, necessarily includes parts of two academic years; and the catalogue gives the names of such students as have been connected with the college during any portion of the year 1883.

Senior Class.

Herms, Charles,	Louisville, Ky.
Holland, Harry Dickinson,	Amherst.
Jones, Elisha Adams,	Rockville.
Owen, Henry Willard,	Amherst.
Smith, Llewellyn,	Amherst.
Total,	5

Junior Class.

Allen, Edwin West,	Amherst.
Almeida, Luciano José de,	Bananal, São Paulo, Brazil.
Barber, George Holcomb,	Glastonbury, Ct.
Brooks, Paul Cuff Phelps,	Boston.
Browne, Charles William,	Salem.
Buffington, Charles Owen,	Ware.
Chadbourne, Albert Hopkins,	Amherst.
Cutter, Charles Sumner,	Arlington.
Flint, Edward Rawson,	Boston.
Goldthwait, Joel Ernest,	Marblehead.
Howell, Hezekiah,	Blooming Grove, N. Y.
Leary, Lewis Calvert,	Amherst.
Nash, John Adams,	Amherst.
Phelps, Charles Shepard,	West Springfield.
Putnam, George Herbert,	Millbury.
Spaulding, Charles Plumb,	Amherst.
Taylor, Isaac Newton, Jr.,	Northampton.
Tekirian, Benoni,	Yozgad, Turkey.
Whittemore, Joseph Sidney,	Leicester.
Total,	19

Sophomore Class.

Atkins, William Holland,	Westfield.
Ayres, Winfield,	Oakham.
Barker, John King,	Three Rivers.
Bement, John Emery,	North Amherst.
Carpenter, David Frederic,	Millington.
Clapp, Charles Wellington,	Montague.
Copeland, Alfred Bigelo,	Springfield.
Doucet, Walter Hobart,	Philadelphia, Penn.
Eaton, William Alfred,	Piermont-on-Hudson, N. Y.
Felt, Charles Frederic Wilson,	Northborough.
Fowler, John Henry,	Westfield.
Kinney, Arno Lewis,	Lowell.
Lang, Charles Joseph,	Washington, D. C.
Leland, William Edwin,	Grafton.
Mackintosh, Richards Bryant,	Dedham.
Palmer, Robert Manning,	Brookline.

Sanborn, Kingsbury,	Lawrence.
Smith, Walter Storm,	Syracuse, N. Y.
Stone, George Edward,	Spencer.
Stone, George Sawyer,	Otter River.
Wheeler, George Waterbury,	Deposit, N. Y.
Winslow, Edgar Daniel,	Ware.
Total,	22

Freshman Class.

Allen, Frederick Cunningham,	West Newton.
Almeida, Augusto Luis de,	Bananal, São Paulo, Brazil.
Ateshian, Osgan Hagope,	Sivas, Turkey.
Avery, David Ebenezer,	Plymouth.
Ball, William Monroe,	Amherst.
Barrett, Edward William,	Milford.
Bond, Richard Henry,	Brookline.
Breen, Timothy Richard,	Ware.
Brown, Herbert Lewis,	Peabody.
Caldwell, William Hudson,	Peterborough, N. H.
Carpenter, Frank Berton,	Leyden.
Chapin, Clinton Gerdine,	Chicopee.
Chase, William Edward,	Warwick.
Clarke, Frank Scripture,	Lowell.
Cushman, Ralph Henry,	Bernardston.
Daniels, Joseph Frank,	Somerville.
Davis, Fred Augustus,	Lynn.
Duncan, Richard Francis,	Williamstown.
Felton, Truman Page,	Berlin.
Fisherdick, Cyrus Webster,	Palmer.
Fowler, Fred Homer,	North Hadley.
Hathaway, Bradford Oakman,	New Bedford.
Howe, Clinton Samuel,	Marlborough.
Kasmire, George Frank,	New Bedford.
Long, Stephen Henry,	East Shelbourne.
Marsh, James Morrill,	Lynn.
Marshall, Charles Leander,	Lowell.
Martin, Joseph, second,	Marblehead.
Meehan, Thomas Francis Benedict,	Boston.
Merchant, Charles Eddy,	East Weymouth.
Merritt, Walter Heston,	Amherst.
Nourse, Silas Johnson,	Bolton.
Osterhout, Jeremiah Clark,	Lowell.
Paine, Ansel Wass,	Boston.
Rice, Thomas, second,	Shrewsbury.
Rideout, Henry Norman Waymouth,	Quincy.
Robinson, George Prescott,	Northampton.
Rose, Newton Augustus,	Fitchburg.
Shaughnessy, John Joseph,	Stowe.

Stone, Fremont Ernest,	Heath.
Tolman, William Nichols,	Concord
Torelly, Firmino da Silva,	Rio Grande do Sul, Brazil.
Tucker, Frederick Deming,	Monson.
White, Herbert Judson,	Wakefield.
Total,	44

Post-Graduates.

Brewer, B.S., Charles,	Amherst.
* Floyd, B.S., Charles Walter (Boston Univ.),	Boston.
Groeger, Gustavus (Univ. of Vienna),	Amherst.
Hills, B.S., Joseph Lawrence (Boston Univ.),	Boston.
Jaqueth, Isaac Samuel,	Liverpool, N. Y.
Kingman, B.S., Morris Bird,	Amherst.
Lindsey, B.S., Joseph Bridgeo (Boston Univ.),	Marblehead.
Myrick, B.S., Lockwood,	Concord.
Nourse, B.S., David Oliver (Boston Univ.),	Bolton.
Preston, B.S., Charles Henry (Boston Univ.),	Danvers.
Taft, B.S., Levi Rawson (Boston Univ.),	Amherst.
Washburn, B.S., John Hosea (Boston Univ.),	Mansfield, Ct.
Wheeler, B S., Homer Jay (Boston Univ.),	Bolton.
Total,	13

Summary.

Post-Graduates,	13
Graduates of 1883,	10
Senior Class,	5
Junior Class,	19
Sophomore Class,	22
Freshman Class,	44
Total,	113

Graduates.

Allen, Francis S., '82, 141 West Fifty-fourth St., New York City, Student, American Veterinary College.

* Died October 10, 1883, of consumption.

Any information respecting the Alumni
will be gladly received by
H. H. Goodell. Am[illegible]

[illegible]gent, Wells, Fargo

[illegible]lerk and Assistant

and Surgeon.

[illegible]Salesman, Bowker Fertilizer Co.

Barri, John A., '75, Water St. and Fairfield Ave., Bridgeport, Conn., Chittenden, Barri & Sanderson, National Fertilizer Co.

Bassett, Andrew L., '71, New York City, Clerk, Vermont C. R. R. & Steamship Co.

Beach, Charles E., '82, care Beach & Co., Hartford, Conn., Farmer.

Bell, Burleigh C., '72, 16th and Howard Sts., San Francisco, Cal., Druggist and Chemist.

Bellamy, John, '76, 659 Washington St., Boston, Nichols, Bellamy & Co., Hardware and Cutlery.

Benedict, John M., '74, Commercial Block, Bank St., Waterbury, Conn., Physician.

Benson, David H., '77, North Weymouth, Analytical and Consulting Chemist and Superintendent of Chemical Works, Bradley Fertilizer Co.

Bingham, Eugene P., '82, 13 Foster Wharf, Boston, Bingham & Bennison, Makers of Embalming and Disinfecting Fluids.

Birnie, William P., '71, Springfield, Salesman, Birnie Paper Co.

Bishop, Edgar A., '83, Diamond Hill, R. I., Farmer.

Bishop, William H., '82, Tongaloo, Miss., Superintendent of Industrial Department, Tongaloo University.

Blanchard, William H., '74, Westminster, Vt., Farm Laborer.

Boutwell, Willie L., '78, Leverett, Farmer.

Bowker, William H., '71, 43 Chatham St., Boston, President Bowker Fertilizer Co.

Bowman, Charles A., '81, Brookline, Civil Engineer.

Boynton, Charles E., '81, Groveland, Lecturer.

Bragg, Everett B., '75, Glidden & Curtis, Tremont Bank Building, Boston, Chemist.

Braune, Domingos H., '83, Nova Friburgo, Province of Rio de Janeiro Brazil, Planter.

Brett, William F., '72, Brockton, Clerk, R. H. White & Co., 518 Washington St., Boston.

Brewer, Charles, '77, Orange, Florist.

Brigham, Arthur A., '78, Marlborough, Farmer.

Brodt, Harry S., '82, Frankfort, N. Y., Surveying, North River Construction Co., N. Y. West Shore & Buffalo R. R.

Brooks, William P., '75, Sapporo, Japan, Professor of Agriculture, Japan Agricultural College.

Bunker, Madison, '75, Newton, Veterinary Surgeon.

Callender, Thomas R., '75, Everett, Florist.

Stone, Fremont Ern
Tolman, William N
Torelly, Firmino da
Tucker, Frederick I
White, Herbert Jud
Total, . .

POST-GRADUATES.

Brewer, B.S., Charles, ...	Amherst.	
* Floyd, B.S., Charles Walter (Boston Univ.), ...	Boston.	
Groeger, Gustavus (Univ. of Vienna), .	Amherst.	
Hills, B.S., Joseph Lawrence (Boston Univ.), ...	Boston.	
Jaqueth, Isaac Samuel, ...	Liverpool, N. Y.	
Kingman, B.S., Morris Bird, . . .	Amherst.	
Lindsey, B.S., Joseph Bridgeo (Boston Univ.), ...	Marblehead.	
Myrick, B.S., Lockwood, ...	Concord.	
Nourse, B.S., David Oliver (Boston Univ.), ...	Bolton.	
Preston, B.S., Charles Henry (Boston Univ.), ...	Danvers.	
Taft, B.S., Levi Rawson (Boston Univ.),	Amherst.	
Washburn, B.S., John Hosea (Boston Univ.), ...	Mansfield, Ct.	
Wheeler, B S., Homer Jay (Boston Univ.), ...	Bolton.	
Total, ...		13

SUMMARY.

Post-Graduates, ...	13
Graduates of 1883, ...	10
Senior Class, ...	5
Junior Class, ...	19
Sophomore Class, ...	22
Freshman Class, ...	44
Total, ...	113

GRADUATES.

Allen, Francis S., '82, 141 West Fifty-fourth St., New York City, Student, American Veterinary College.

* Died October 10, 1883, of consumption.

Allen, Gideon H., '71, Winfield, Cowley Co., Kans., Agent, Wells, Fargo & Co.'s Express.

Aplin, George T., '82, East Putney, Vt., Farmer.

Bagley, David A., '76.

Bagley, Sydney Currier, '83, 62 Sudbury St., Boston, Clerk and Assistant Gary Magneto-Signal Co.

Baker, David E., '78, Newton Lower Falls, Physician and Surgeon.

Barrett, Joseph F., '75, 84 Broad St., New York City, Salesman, Bowker Fertilizer Co.

Barri, John A., '75, Water St. and Fairfield Ave., Bridgeport, Conn., Chittenden, Barri & Sanderson, National Fertilizer Co.

Bassett, Andrew L., '71, New York City, Clerk, Vermont C. R. R. & Steamship Co.

Beach, Charles E., '82, care Beach & Co., Hartford, Conn., Farmer.

Bell, Burleigh C., '72, 16th and Howard Sts., San Francisco, Cal., Druggist and Chemist.

Bellamy, John, '76, 659 Washington St., Boston, Nichols, Bellamy & Co., Hardware and Cutlery.

Benedict, John M., '74, Commercial Block, Bank St., Waterbury, Conn., Physician.

Benson, David H., '77, North Weymouth, Analytical and Consulting Chemist and Superintendent of Chemical Works, Bradley Fertilizer Co.

Bingham, Eugene P., '82, 13 Foster Wharf, Boston, Bingham & Bennison, Makers of Embalming and Disinfecting Fluids.

Birnie, William P., '71, Springfield, Salesman, Birnie Paper Co.

Bishop, Edgar A., '83, Diamond Hill, R. I., Farmer.

Bishop, William H., '82, Tongaloo, Miss., Superintendent of Industrial Department, Tongaloo University.

Blanchard, William H., '74, Westminster, Vt., Farm Laborer.

Boutwell, Willie L., '78, Leverett, Farmer.

Bowker, William H., '71, 43 Chatham St., Boston, President Bowker Fertilizer Co.

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Boynton, Charles E., '81, Groveland, Lecturer.

Bragg, Everett B., '75, Glidden & Curtis, Tremont Bank Building, Boston, Chemist.

Braune, Domingos H., '83, Nova Fribu rgo, Province of Rio de Janeiro Brazil, Planter.

Brett, William F., '72, Brockton, Clerk, R. H. White & Co., 518 Washington St., Boston.

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Brodt, Harry S., '82, Frankfort, N. Y., Surveying, North River Construction Co., N. Y. West Shore & Buffalo R. R.

Brooks, William P., '75, Sapporo, Japan, Professor of Agriculture, Japan Agricultural College.

Bunker, Madison, '75, Newton, Veterinary Surgeon.

Callender, Thomas R., '75, Everett, Florist.

Campbell, Frederick G., '75, West Westminster, Vt., Farmer.
Carr, Walter F., '81, Boston, Student, Massachusetts Institute of Technology.
Caswell, Lilley B., '71, Athol, Civil Engineer and Farmer.
Chandler, Edward P., '74, Andersonville, Montana, Cattle Raiser.
Chandler, Everett S., '82, 20 Orchard St., North Cambridge, Student, Harvard Law School.
Chapin, Henry E , '81, Chicago, Ills., "Farmers' Review," Journalist.
Chickering, Darius O , '76, Enfield, Farmer.
Choate, Edward C., '78, Southborough, Farmer.
Clark, Atherton, '77, 131 Tremont St., Boston, Clerk.
Clark, John W., '72, Amherst, Farm Superintendent, Agricultural College, and Assistant Professor of Agriculture.
Clark, Xenos, Y., '78, P. O. Box, 1151, Boston, Scientist.
*Clay, Jabez W., '75.
Coburn, Charles F., '78, Lowell, Teller, Five Cents Savings Bank, and Editor "Daily Citizen."
Cooper, James W., jr., '82, East Bridgewater, Drug Clerk.
Cowles, Frank C., '72, City Engineer's Office, Worcester, Civil Engineer.
Cowles, Homer L., '71, Amherst, Farmer.
†Curtis, Wolfred F., '74.
Cutter, John A , '82, 213 West Thirty-fourth St., New York City, Student at Albany Medical College.
Cutter, John C., '72, Sapporo, Japan, Consulting Physician Sapporo Ken Hospital and Professor of Physical and Comparative Anatomy, Imperial College of Agriculture.
Damon, Samuel C., '82, Lancaster, Farmer.
Deuel, Charles F., '76, Amherst, Druggist.
Dickinson, Richard S , '79, Columbus, Neb., Farmer.
Dodge, George R., '75, Brighton, Superintendent of Factory, Bowker Fertilizer Co.
Dyer, Edward N., '72, Kohala, S. I., Pastor Native Church.
Easterbrook, Isaac H., '72, Diamond Hill, R. I., Farmer.
Eldred, Frederick C , '73, 128 Chambers St., New York City, New York Manager of Montpelier Carriage Co.
Ellsworth, Emory A., '71, 164 High St., Holyoke, Architect and Mechanical and Civil Engineer.
Fairfield, Frank H., '81, 30 Kilby St., Boston, Standard Fertilizer Co., Chemist.
Fisher, Jabez F., '71, Fitchburg, Freight Cashier, Fitchburg R. R. Co.
Fiske, Edward R., '72, 625 Chestnut St., Philadelphia, Pa., Folwell Bro. & Co., Merchant.
Flagg, Charles O., '72, Diamond Hill, R. I., Farmer.
Flint, Charles L., jun., '81, 29 Newbury St., Boston, no business.
‡Floyd, Charles W., '82.
Foot, Sanford D., '78, Paterson, N. J., Kearney & Foot, File Manufacturers.

* Died Oct. 1, 1880, of pneumonia, at New York City.
† Died Nov. 8, 1878, of inflammation of the brain, at Westminster.
‡ Died Oct. 10, 1883, of consumption, at Boston.

Fowler, Alvan L., '80, Tombstone, Arizona, Superintendent Woronoco Mining Co.
Fuller, George E., '71.
Gladwin, Frederic E., '80, Tombstone, Arizona, Assayer Woronoco Mining Co.
Goodale, David, '82, Marlborough, Farmer.
Green, Samuel B., '79, Mountainville, Orange Co., N. Y., Superintendent Horticultural Department, Houghton Farm.
Grover, Richard B., '72, Ludlow, Vt., Clergyman.
Guild, George W. M., '76, 17 & 19 Cornhill, Boston, Wire business.
Hague, Henry, '75, South Worcester, Rector St. Mathews.
Hall, Josiah N, '78, Sterling, Weld Co., Col., Physician.
Harwood, Peter M., '75, Barre, Farmer.
Hashiguchi, Boonzo, '81, Department of Commerce and Agriculture, Tokio, Japan, President Government Sugar Beet Co.
*Hawley, Frank W., '71.
Hawley, Joseph M., '76, Berlin, Wis., C. A. Mather & Co., Banker.
†Herrick, Frederick St. C., '71.
Hevia, Alfred A., '83, 13 Fifth St., Brooklyn E. D., N. Y., with "Universe Subscription Agency," 150 Nassau St., New York City.
Hibbard, Joseph R., '77, Stoughton, Wis., Farmer.
Hillman, Charles D., '82, Fresno City, Cal., Nurseryman.
Hills, Joseph L., '81, Amherst, Post-Graduate, Agricultural College.
Hitchcock, Daniel G., '74, Warren, Agent, American Express Co.
Hobbs, John A., '74, Bloomington, Neb., Farmer.
Holman, Samuel M., jun., '83, Attleborough, Student, Harvard Medical School.
Holmes, Lemuel Le B., '72, Mattapoisett, Lawyer.
Howard, Joseph H., '82, Springfield, Meter Inspector, Springfield Gas-Light Co.
Howe, Charles S., '78, Akron, Ohio, Buchtel College, Adjunct Professor of Mathematics.
Howe, Elmer D., '81, Marlborough, Farmer.
Howe, George D., '82, North Hadley, C. D. Dickinson & Son, Clerk.
Howe, Waldo V., '77, Framingham, Agent, Framingham Brick Co.
Hubbard, Henry F., '78, 94 Front Street, New York City, with John H. Catherwood & Co.
Hunt, John F., '78, Belmont, Civil Engineer.
Kendall, Hiram, '76, Providence, R. I., Superintendent and Chemist, Kendall Manufacturing Co.
Kimball, Francis E., '72, 15 Union Street, Worcester, Book-keeper, E. W. Vaill.
Kingman, Morris B., '82, Amherst, Post-Graduate, Agricultural College.
Kinney, Burton A., '82, United States Signal Service, Fort Myer, Va.
Knapp, Walter H., '75, Wellesley Hills, Florist.
Koch, Henry G. H., '78, Sixth Avenue and Twentieth Street, New York City, H. C. F. Koch & Son.

* Died Oct, 28, 1883, of congestive apoplexy, at Belchertown.
† Died Jan. 19, 1884, at Methnne.

Ladd, Thomas H., '76, care Wm. Dadmun, Watertown, no business.

Lee, Lauren K., '75, Valley Springs, Dak., Superintendent of Seed Farm for Kellogg & McDougall, Buffalo Linseed Oil Works.

Lee, William G., '80, Rock Point, Jackson Co., Oregon, Surveyor for Railroad.

Leland, Walter S., '73, Concord, Officer State Prison.

Leonard, George, '71, Springfield, Lawyer.

Libby, Edgar H., '74, Rochester, N. Y., Journalist and Agricultural Specialist, Farm and Garden Department of Hiram Sibley & Co., Seedsmen.

Lindsey, Joseph B., '83, Amherst, Assistant Chemist, Experiment Station.

Livermore, Russell W., '72. Pates Robeson Co., North Carolina, Lawyer.

Lovell, Charles O., '78, Amherst, Photographer.

Lyman, Asahel H., '73, Manistee, Mich., Druggist and Bookseller.

Lyman, Charles E., '78, Middlefield, Conn., Farmer.

*Lyman, Henry, '74.

Lyman, Robert W., '71, Belchertown, Lawyer and Lecturer Mass. Agricultural College.

Mackie, George, '72, Attleborough, Physician.

Macleod, William A., '76, 60 Devonshire Street, Boston, Patent Lawyer.

Mann, George H., '76, Sharon, Superintendent of Cotton Duck Mills.

Martin, William E., '76, Excelsior, Minn., Postmaster.

May, Frederick G., '82, Orlando (P. O. Box 192), Orange Co., Fla., Farmer.

Maynard, Samuel T., '72, Amherst, Massachusetts Agricultural College, Professor of Botany and Horticulture.

McConnel, Charles W., '76, 100 State Street, Albany, Dentist.

McQueen, Charles M., '80, First National Bank Building, Dearborn and Monroe Streets, Chicago, Ill., Standard Book Co., Treasurer.

Miles, George M., '75, Miles City, Montana, Miles & Strevell, Jobbers of Hardware.

Mills, George W., '73, Medford, Physician.

Minor, John B., '73, New Britain, Conn., Russell & Erwin Manufacturing Co., Clerk.

Minott, Charles W., '83, 2 Washington Square, Worcester, with W. H. Earle, Agricultural Warehouse and Seed Store.

Montague, Arthur H., '74, South Hadley, Farmer.

Morey, Herbert E., '72, 49 Haverhill Street, Boston, Morey, Smith & Co., Merchant.

†Morse, James H., '71.

Morse, William A., '82, 19 Milk Street, Boston, with Denison Manufacturing Co.

Myrick, Herbert, '82, Springfield, Assistant Editor "New England Homestead."

Myrick, Lockwood, '78, Boston, Pacific Guano Co., Chemist.

* Died Jan. 8, 1879, of pneumonia, at Middlefield, Conn.

† Died June 21, 1883, of Bright's disease, at Salem.

Nichols, Lewis A., '71, San Diequito, Mexico, via Laredo & Monteray, care Sr. Don Pedro del Hoyo, San Luis Potosi, Mexico, Civil Engineer.

Norcross, Arthur D., '71, Monson, Postmaster.

Nourse, David O., '83, Amherst, employed in Feeding Department, Experiment Station.

Nye, George E., '77, 70 Exchange Building, Union Stock Yards, Chicago, Ill., G. F. Swift & Co., Book-keeper.

Osgood, Frederick H., '78, Springfield, Veterinary Surgeon.

Otis, Harry P., '75, Leeds, Superintendent, Northampton Emery Wheel Company.

Page, Joel B., '71, Conway, Farmer.

Paige, James B., '82, Prescott, F. B. Paige & Son, Mellen Valley Fruit Farm.

Parker, George A., '76, Tunis Mills, Talbot Co., Md., Superintendent, "Fairview Farm."

Parker, George L., '76, Dorchester, Florist.

Parker, Henry F., '77, 5 Beekman Street and 182 Centre Street, New York City, Mechanical Engineer.

Parker, William C., '80, Wakefield, Farmer.

Peabody, William R., '72, Atchison, Kans., General Agent, Atchison, Topeka & Santa Fé Railroad.

Penhallow, David P., '73, Montreal, Canada, McGill University, Professor of Botany.

Perkins, Dana E., '82, care C. M. Winchell, U. S. Survey Boat Tennessee, Mississippi River Commission.

Peters, Austin, '81, care Peters & Parkinson, Boston, Student, Harvard Medical School.

Phelps, Charles H., '76, South Framingham, Florist.

Phelps, Henry L., '74, Northampton, Dealer in Fertilizers.

Plumb, Charles S., '82, 34 Park Row, New York City, Associate Editor "Rural New Yorker."

Porter, William H., '76, Watertown, Foreman S. R. Payson's farm.

Porto, Raymundo M. da S., '77, Para, Brazil, Planter.

Potter, William S., '76, Lafayette, Ind., Rice & Potter, Lawyer.

Preston, Charles H., '83, Amherst, Assistant Chemist, Experiment Station.

Rawson, Edward B., '81, Brockport, Elk Co., Penn., N. Y. L E. & W. R. R. Co., Civil Engineer.

Renshaw, James B., '73, Spokane Falls, Washington Territory, Clergyman.

Rice, Frank H., '75, Hawthorne, Nev., County Recorder and *ex officio* Auditor of Esmeralda Co.

Richmond, Samuel H., '71, Ocala, Marion Co., Fla., Magistrate and Deputy Clerk of Circuit Court.

Ripley, George A., '80, 5 Franklin St., Worcester.

Root, Joseph E., '76, Hartford, Conn., Retreat for Insane, Assistant Physician.

Rudolph, Charles, '79, Mitchell, Dak., Lawyer.

Russell, William D., '71, Turner's Falls, Montague Paper Co.

Salisbury, Frank B., '72, Kimberley Diamond Fields, South Africa, Trader.
Sears, John M., '76, Ashfield, Farmer.
Shaw, Elliot D., '72, Holyoke, Florist.
Sherman, Walter A., '79, 182 Central Street, Lowell, Veterinary Surgeon.
Shiverick, Asa F., '82, Wood's Holl, Pacific Guano Co., Chemist.
Simpson, Henry B., '73, Centreville, Md., Farmer.
Smead, Edwin, '71, 3 Cable St., Baltimore, Md., Clerk, Bushey, Carr & Co., Flour and Grain Commission Merchants.
Smith, Frank S., '74, Hampden, Woolen Manufacturer.
Smith, George P., '79, Sunderland, Farmer.
Smith, Hiram F. M., '81, 42 Austin St., Cambridgeport, Student, Harvard Medical School.
Smith, Thomas E., '76, West Chesterfield, Manufacturer.
Snow, George H., '72, Leominster, Farmer.
Somers, Frederick M., '72, 49 Broadway, New York City, Watson & Gibson, Brokers.
* Southmayd, John E., '77.
Southwick, Andre A., '75, Care Beach & Co., Hartford, Conn., Superintendent "Vine Hill and Ridge Farms."
Spalding, Abel W., '81, 907 North Main St., St. Louis, Mo., Ripley & Kimball, Clerk.
Sparrow, Lewis A., '71, 19 South Market St., Boston, Judson & Sparrow, Dealers in Fertilizers.
Spofford, Amos L., '78, Georgetown, Shoe-cutter.
Stockbridge, Horace E., '78, Assistant Professor of Chemistry, elect, Massachusetts Agricultural College.
Stone, Almon H., '80, Phillipston, Farmer.
Stone, Winthrop E., '82, Mountainville, Orange Co., N Y., Experiment Department, Houghton Farm.
Strickland, George P., '71, Stillwater, Minn., Seymour, Sabin & Co., Machinist.
Swan, Roscoe W., '79, 32 Pleasant St., Worcester, Physician.
Taft, Cyrus A., '76, Whitinsville, Machinist.
Taft, Levi R., '82, Amherst, Bursar and Assistant Professor Horticulture, Agricultural College.
Taylor, Alfred H., '82, Red Oak, Ia., Stock-raiser.
Taylor, Frederick P., '81, Athens, East Tenn., Farmer.
Thompson, Edgar E., '71, East Weymouth, Teacher.
Thompson, Samuel C., '72, New York City, Department Public Works, Annexed District, Assistant Engineer.
Thurston, Wilbur H., '82, Upton, Farmer.
Tucker, George H., '71, Fargo, Dak., Civil Engineer,
Tuckerman, Frederick, '78, Amherst, Physician and Lecturer, Agricultural College.
Urner, George P., '76, Sweet Grass, Montana, Sheep-raiser.
Wakefield, Albert T., '73, Peoria, Ill., Physician.
Waldron, Hiram E. B., '79, North Rochester, Farmer.

* Died December 11, 1878, of consumption, at Minneapolis, Minn.

Ware, Willard C., '71, 255 Middle St., Portland, Me., Manager Boston & Portland Clothing Co.

Warner, Clarence D., '81, Baltimore, Md., Student, Johns Hopkins University.

Warner, Seth S., '73, 43 Chatham St., Boston, Travelling Salesman, Bowker Fertilizer Co.

Washburn, John H., '78, Mansfield, Conn., Professor of General and Agricultural Chemistry, Storrs Agricultural School.

Webb, James H., '73, 81 Church St., New Haven, Conn., Clark, Swan & Webb, Attorneys and Counsellors at Law.

Wellington, Charles, '73, Germany, Student.

Wells, Henry, '72, 105 North 3d St., St. Louis, Mo., Contracting Agent West-bound Freight, "Blue Line," Fast Freight Office.

Wetmore, Howard G., '76, 41 West 9th St., New York City, Physician.

Wheeler, Homer J., '83, Amherst, Assistant Chemist, Experiment Station.

Wheeler, William, '71, 70 Kilby St., Boston, President, Wheeler Reflector Co.

Whitney, Frank Le P., '71, 280 Westminster St., Providence, R. I., F. L Whitney & C. H. Kimball, Dealers in Oil Stoves and Kerosene Fixtures.

Whitney, William C., '72, Minneapolis, Minn., Architect.

Whittaker, Arthur, '81, Needham, Farmer.

Wilcox, Henry H., '81, Nawiliwili, S. I., Sugar Industry.

Wilder, John E., '82, 179 Lake St., Chicago, Ill., Wilder & Hale, Dealers in Leather.

Williams, James S., '82, North Glastonbury, Conn., Farmer.

Williams, John E., '76, Amherst, Editor "Record."

Winchester, John F., '75, Lawrence, Veterinary Surgeon and Lecturer, Massachusetts Agricultural College.

Windsor, Joseph L., '82, St. Paul, Minn., Office North Pacific R. R. Co., Stenographer.

Wood, Frank W., '73.

Woodbury, Rufus P., '78, Kansas City, Mo., News and Telegraph Editor of "Kansas City Daily Times."

Woodman, Edward E., '74, Danvers, E. & C. Woodman, Florists.

Wyman, Joseph, '77, Cambridgeport, Book-keeper at 52 to 60 Blackstone St., Boston.

Zeller, Harrie McK., '74, Hagerstown, Md., Baltimore & Ohio Telegraph Co., Manager of Commercial Office.

COURSE OF STUDY AND TRAINING.

Freshman Year.

Scientific and Literary.

1st Term.—Algebra.
Botany.
French.

2d Term.—Geometry.
History.
Botany.
Lessons in Language.
Free-Hand Drawing.
French.

3d Term.—Geometry.
Botany.
French.

Scientific and Agricultural.

1st Term.—Algebra.
Botany.
Agriculture.

2d Term.—Geometry.
History.
Botany.
Lessons in Language.
Free-Hand Drawing.
Agriculture.

3d Term.—Geometry.
Botany.
Agriculture.

Sophomore Year.

1st Term.—Geometry and Trigonometry.
Botany.
Chemistry.
German.

2d Term.—Trigonometry.
Chemistry.
Physiology.
Mechanical Drawing.
German.

3d Term.—Surveying.
Botany.
Zoology.
German.

1st Term.—Geometry and Trigonometry.
Botany.
Chemistry.
Agriculture.

2d Term.—Trigonometry.
Chemistry.
Physiology.
Mechanical Drawing.
Agriculture.

3d Term.—Surveying.
Botany.
Zoology.
Agriculture.
Horticulture and Market Gardening.

Junior Year.

1st Term.— Mechanics.	*1st Term.*— Mechanics.
English Literature.	English Literature.
Constitutional History.	Agriculture. Entomology.
2d Term.— Physics.	*2d Term.*— Physics.
English Literature.	English Literature.
Chemistry.	Chemistry.
Latin	Agricultural Debate. Arboriculture and Care of Nurseries.
3d Term.— Physics.	*3d Term.*— Physics.
Chemistry.	Chemistry.
Latin.	Roads and Railroads.

Senior Year.

1st Term.— Book-keeping.	*1st Term* — Book-keeping.
Chemistry.	Chemistry.
Mental Science.	Mental Science.
Mineralogy.	Agriculture.
2d Term.— Organic Chemistry.	*2d Term.*— Organic Chemistry.
Political Economy.	Political Economy.
Microscopy.	Agriculture.
3d Term.— Moral Science.	*3d Term.*— Moral Science.
Geology.	Geology.
History of Philosophy.	Agriculture.

In all studies, students are to be trained to accurate and ready oral and written expression, and to use drawing as language. Military tactics and military drill, as ordered throughout the course. Weekly exercises in compositions and declamations throughout the course. The instruction in agriculture and horticulture is both theoretical and practical. Instruction in the field and manual training is given whenever such instruction and training will conduce to the progress of the student. Students are allowed to work for wages during such leisure hours as are at their command. A limited amount of work has been found to be beneficial, but work that withdraws the energy of the student from his studies is unprofitable to him. Students sometimes earn from fifty to one hundred dollars per annum. Those who complete the course receive the degree of Bachelor of Science, the diploma being signed by the Governor of Massachusetts, who is president of the corporation.

Regular students of the college may also, on application, become members of Boston University, and, upon graduation, receive its diplomas in addition to that of the college, thereby becoming entitled to all the privileges of its alumni.

LECTURES.

In addition to the instruction given by the resident instructors, gentlemen eminent in their several vocations give lectures on subjects of practical value to the students. Among those who have favored us or are to favor us with lectures during the present college year are: Hon. Levi Stockbridge, Amherst; Col. J. E. Russell, Secretary of Board of Agriculture; Hon. J. S. Grinnell, Greenfield; Major H. E. Alvord, Houghton Farm, Orange Co., N.Y.; B. P. Ware, Esq., Marblehead; Dr. J. R. Nichols, Haverhill; Rev. G. S. Dickerman, Amherst. All interested in the lectures given at the college, or in any other general exercises, are cordially invited to be present.

ADMISSION.

Candidates for admission to the Freshman Class are examined orally and in writing, upon the following subjects: English Grammar, Geography, Arithmetic, Algebra through simple equations, and the History of the United States.

Candidates for higher standing are examined as above, and also in the studies gone over by the class to which they may desire admission.

No one can be admitted to the college until he is fifteen years of age. Every applicant is required to furnish a certificate of good character from his late pastor or teacher. Candidates are requested to furnish the Examining Committee with their standing in the schools they have last attended. The previous rank of the candidate will be considered in admitting him. Tuition and room-rent must be paid in advance at the beginning of each term.

EXPENSES.

Tuition, ...	$12 00 per term.
Room-rent, ...	$5 00 to 10 00 per term.
*Board, ...	3 00 to 5 00 per week.

* At the time of issuing this report, board was furnished at the State boarding house at $3.25 per week, payable in advance, at the beginning of each term.

Expenses of chemical laboratory to students of practical chemistry,	$10 00 per term.
Furniture,	15 00 to 50 00
Uniform for the four years course,	30 00
Public and private damages, including value of chemical apparatus destroyed or injured,	At cost.
Annual expenses, including books,	$250 00 to 350 00

SIZE OF ROOMS.

For the information of those desiring to carpet their rooms, the following measurements are given: In the south dormitory the main corner rooms are fifteen by eighteen feet, and the adjoining bedrooms eight by twelve feet. The inside rooms are fourteen by fifteen feet, and the bedrooms eight by eight feet. In the north dormitory the corner rooms are fourteen by fifteen feet, and the annexed bedrooms eight by ten feet; while the inside rooms are thirteen feet and a half by fourteen feet and a half, and the bedrooms eight by eight feet.

SCHOLARSHIPS.

The income of the Robinson Fund of one thousand dollars, the bequest of Miss Mary Robinson of Medfield, is assigned by the Faculty to such indigent student as they may deem most worthy.

The trustees voted in January, 1878, to establish one free scholarship for each of the eleven congressional districts of the State. Applications for such scholarships should be made to the representative from the district to which the applicant belongs. The selection for these scholarships will be determined as each member of Congress may prefer; but, where several applications are sent in from the same district, a competitive examination would seem to be desirable. Applicants should be good scholars, of vigorous constitution, and should enter college with the intention of remaining through the course, and then engaging in some pursuit connected with agriculture. To every such student the cash value of a scholarship is one hundred and forty-four dollars.

The legislature of 1883 passed the following Resolve in favor of the Massachusetts Agricultural College: —

Resolved, That there shall be paid annually, for the term of four years, from the treasury of the Commonwealth to the treasurer of the Massachusetts Agricultural College, the sum of ten thousand dollars, to enable the trustees of said college to provide for the students of said institution, the theoretical and practical education required by its charter and the law of the United States relating thereto.

Resolved, That annually for the term of four years, eighty free scholarships be and hereby are established at the Massachusetts Agricultural College, the same to be given by appointment to persons in this Commonwealth, after a competitive examination, under rules prescribed by the president of the college, at such time and place, as the senator then in office from each district shall designate; and the said scholarships shall be assigned equally to each senatorial district; but if there shall be less than two successful applicants for scholarships from any senatorial district, such scholarships may be distributed by the president of the college equally among the other districts, as nearly as possible, but no applicant shall be entitled to a scholarship unless he shall pass an examination in accordance with the rules to be established as herein before provided.

In accordance with these resolves, any one desiring admission to the college can apply to the senator of his district for a scholarship.

RELIGIOUS SERVICES.

Prayers in chapel every morning at a quarter after eight o'clock. On Sundays the students, unless excused by request of their parents to attend church elsewhere, attend service in the chapel. This service is conducted by the president or such clergyman as he invites. The students are also invited to join a class for the study of the Bible.

The Young Men's Christian Association holds weekly meetings.

POST-GRADUATE COURSE.

Graduates of colleges and scientific schools may become candidates for the degree of Doctor of Science, or Doctor of Philosophy, from the college or from the University, and pursue their studies under the direction of Professor Goessmann in chemistry, or other members of the Faculty in their respective departments.

BOOKS, APPARATUS, AND SPECIMENS IN NATURAL HISTORY.

The library of the college contains at present about three thousand volumes. The income of the fund raised by the alumni and others is devoted to its increase, and additions are made from time to time, as the needs of the several departments require.

The State cabinet of specimens, illustrating the geology and natural history of Massachusetts, has been removed from Boston to the college, and is of much value for purposes of instruction. It has recently received valuable additions of several thousand specimens of minerals, fossils, shells, insects and birds' eggs and nests.

The Knowlton Herbarium contains more than ten thousand species of named botanical specimens, besides a large number of duplicates. The Botanic Museum is supplied with many interesting and useful specimens of seeds, woods and fruit-models. There is also a set of diagrams illustrating structural and systematic botany, including about three thousand figures.

About fifteen hundred species and varieties of plants are cultivated in the Durfee Plant House, affording the student an invaluable opportunity of studying the most important types of the vegetable kingdom in their scientific and economic relations.

The class in microscopy has the use of Tolles's best compound microscopes, with objectives from four inches to one-eighth of an inch in focal distance, and a variety of eye-pieces.

PRIZES.

Farnsworth Rhetorical Medals.

Isaac D. Farnsworth, Esq., of Boston, has generously provided a fund of fifteen hundred dollars, the income of which is to be used as prizes, to be annually awarded, under the direction of the College Faculty, for excellence in declamation.

Grinnell Agricultural Prizes.

Hon. William Claflin of Boston has given the sum of one thousand dollars for the endowment of a first prize of fifty dollars, and a second prize of thirty dollars, to be called the Grinnell Agricultural Prizes, in honor of George B. Grinnell, Esq., of New York. These prizes are to be paid in cash to those two members of the graduating class who may pass the best oral and written examination in theoretical and practical agriculture.

Hill's Botanical Prizes.

For the best herbarium collected by a member of the class of 1884, a prize of fifteen dollars is offered, and, for the second best, a prize of ten dollars; also a prize of five dollars for the best collection of woods, and a prize of five dollars for the best collection of dried plants from the College Farm.

CONDUCT.

Students are expected to co-operate with their instructors and with each other in promoting the welfare of the college, in order that every student may receive the best possible results of the course of study and training. Whenever it is evident that it is not for the good of a student to remain in the college, or that the welfare of the college requires that he should not remain, he will be dismissed.

LOCATION.

Amherst is on the New London & Northern R.R., connecting at Palmer with the Boston & Albany R.R., and at Miller's Falls with the Fitchburg R.R. A stage route of seven miles connects Amherst at Northampton with the Connecticut River R.R., and with the New Haven & Northampton R.R. The college buildings are on a healthful site commanding one of the finest views in New England. The large farm of three hundred and eighty-three acres with its varied surface and native forests gives the student the freedom and the quiet of a country home. The surrounding country is very helpful to the student of natural science. The location of the buildings prevents the student from the interruptions to study, incident on residence in a town or city, and helps to secure all the moral as well as the intellectual advantages of a college in the country.

STATEMENT

Of Cash Receipts and Expenses of Massachusetts Agricultural College for Year Ending Jan. 1st, 1884.

	Receipts.	Payments.
Cash on hand Jan. 1st, 1883,	$738 59	–
Term Bill Account,	4,361 53	$1,339 19
Botanic Account,	5,104 44	6,637 77
Farm Account,	2,711 40	3,829 89
Boarding House Account,	1,938 07	1,917 43
President's House,	–	2,082 85
Laboratory Account,	54 82	673 92
Hills Fund,	–	89 18
Expense Account,	305 87	4,939 87
John Cummings, *Treasurer*,	19,974 36	–
Plant House Cons. Account,	–	2,634 52
Drill Hall Cons. Account,	–	1,877 76
Grinnell Fund,	–	80 00
Farnsworth Fund,	–	65 30
Salary Account,	–	8,502 92
Cash on hand Jan. 1st, 1884,	–	318 48
	$34,989 08	$34,989 08

LEVI R. TAFT,

Bursar.

Amherst, Mass., Jan. 1, 1884.