Public Documents of Maine:

BEING THE

ANNUAL REPORTS

OF THE VARIOUS

PUBLIC OFFICERS AND INSTITUTIONS

FOR THE YEAR

1881.

VOLUME II.

AUGUSTA:
SPRAGUE & SON, PRINTERS TO THE STATE.
1881.

ANNUAL REPORTS

OF THE

TRUSTEES, PRESIDENT,

Farm Superintendent and Treasurer,

OF THE

STATE COLLEGE OF AGRICULTURE

AND THE

MECHANIC ARTS,

ORONO, MAINE, 1880.

Published agreeably to a Resolve approved February 25, 1871.

AUGUSTA:
SPRAGUE & SON, PRINTERS TO THE STATE.
1880.

TRUSTEES' REPORT.

To the Honorable Senate and House of Representatives, in Legislature assembled:

The Trustees of the State College respectfully submit, herewith, their annual report, together with the reports of the President of the College and the instructors of the several departments.

Another year in the history of the college has closed, and its record must be added to that of the years that have preceded.

It becomes the duty of its officers to submit, for your consideration, its present condition and prospects, its aims and methods, its wants and hindrances, and to invoke at your hands such assistance as an intelligent comprehension of its importance to the cause of industrial education demands. And, in making the estimate, it must be borne in mind that it is doing a work that no other institution in the State is attempting to do, or *can* do.

It is with a high degree of satisfaction to the Trustees, that they are able to bear to you the assurance that the year has been characterized by earnest and well directed effort, both on the part of instructors and students, followed by the measure of success that usually attends such effort.

Changes.

Some changes are to be noted as having occurred during the year. Hon. A. M. Robinson of Dover, has been appointed trustee to fill the vacancy occasioned by the death of Hon. James C. Madigan.

Prof. W. A. Pike, the able and highly esteemed Professor of Engineering, resigned his position, last summer, to enter upon service for the Minnesota University. During his nine years' of service for the State College, he has rendered much assistance in maturing and executing plans for promoting its usefulness. To him is due the credit of directing the attention of the trustees to the system of shop instruction, known as the Russian System, and of showing, by actual trial, its entire feasibility and great value. This single feature of the institution, when the State shall furnish the small amount of money neeessary for its development, will be worth more to the cause of industrial education than the whole cost of the college from the date of its inception to the present time. In his letter of resignation, Prof. Pike expressed much regret that he could not have seen the system well established before leaving the college.

Mr. W. H. Jordan, instructor in agriculture, resigned his position in August last, to occupy a similar position in the Pennsylvania State College. Mr. Jordan was graduated from the State College in the class of 1875, having been a promising student of the agricultural course. For most of the time since, he has been pursuing the same line of study. He has been in the service of the State College since the summer of 1879. He has, also, been employed by the Secretary of the Board of Agriculture to give addresses at Farmers' Institutes held at various points in the State, upon subjects connected with agricultural science and practice. These addresses have been received with favor. But, as in the case of Prof. Pike, the wealthier institution of another State could offer him greater inducements to *go*, than the Maine State College could offer him to *stay*.

Upon the retirement of Prof. Pike from the college, it was decided to separate the departments of Civil and Mechanical Engineering, both of which had been under his supervision. The former was assigned to Prof. G. H. Hamlin, and the latter to Mr. Charles H. Benjamin. Mr. Benjamin has been

connected with the college as a student. He is a practical machinist, a qualification that cannot fail to largely enhance his usefulness in this department.

Mr. W. F. Decker, a graduate of the college, will continue to give instruction in shop-work. He has already proved his ability to do valuable work in this department.

Mr. Walter Balentine, also a graduate of the college, has been employed to give instruction in the department of Agriculture in place of Mr. Jordan. He was graduated in 1874, from the class in agriculture, and has since pursued his studies in this country and Germany. Of the seven instructors now employed by the college, three are its own graduates and a fourth has been a student in one of the special courses.

It is creditable to the institution that it can supply a majority of its instructors from its own graduates, and furnish instructors to similar institutions in other States.

The accessions to the college at the opening of the present year number thirty-one—twenty-six to the Freshman class—three to advanced classes and two to special classes. This number will be increased at the beginning of the next term.

Occupations of Graduates.

The college opened its doors to its first class of students twelve years ago—in 1868. It graduated its first class eight years ago—in 1872.

By reference to the report of the President of the college, page 10, it will be seen that the whole number of graduates is one hundred and thirty-four. The number of students who have not completed a full course, but who have enjoyed its advantages for periods of time, ranging from a single term to three and one-half years, is one hundred and eighty-six, making a total of three hundred and twenty who have been connected with the institution.

Let it be noted that a large proportion of these students are from families in moderate circumstances. Some of them, depending entirely upon their own exertions for the means to

pay the expenses of their course, find themselves in debt at the end. More of them are destitute of means necessary to establish themselves in business immediately. With these hinderances in the way, it is highly creditable to the institution, and encouraging to the friends of industrial education, that within twelve years from the time when the first student passed the threshhold of its class-rooms, and within eight years after the adieus of its first class of graduates to the labors, companionships and associations of college life, more than one-half of the whole number have settled down to industrial occupations, while indications favor the assumption that three-fourths of the remaining half will ultimately be found engaged in similar occupations.

The State College, recognizing the fact that a large majority of the people in this country must work for a living, is endeavoring to educate its students with reference to this necessity.

Shop Instruction.

There need not be any apology made for again calling the special attention of the Legislature to the great importance of making adequate provision for practical instruction in the several processes necessary to the construction of machinery. Hitherto, only two of the five or six courses in shop instruction have been provided for, viz.: the courses in vice-work and forge-work. These courses have been divested of much of their usefulness by want of suitable shops.

The next step decided on, is the course in wood-work, and it ought to be taken without further delay. The courses in vice-work and forge-work have been conducted in detached and unsuitable rooms. The immediate and urgent need is a building large enough to accommodate all the courses, supplied with the necessary equipments. The small engine owned by the college could then supply all the power needed. With building and equipments provided at the onset, a moderate expenditure for equipments from time to time, as the subsequent courses come along in their natural order, is all the

case would require. The estimated cost of the building is $1,800, and of the equipments needed for immediate use, $500. Expenditures to considerable amount have already been made to provide for instruction in the *principles* of machinery. Apparatus has been supplied, salaries are annually paid to teachers in this department, students are spending their time in study and their money for expenses. Only a single step is now required to greatly increase the usefulness of the department of Mechanical Engineering, and that is to provide for its students the instruction that will enable them to *execute with their own hands all the processes that are required in the construction of machinery.* To withhold the necessary means under these circumstances, would be like the farmer who should prepare his ground with great care and expense, and should then forego the benefit of crop to save the cost of seed.

The trustees respectfully and earnestly urge an appropriation of $1,800 for the construction of a building and $500 for its equipment.

Financial Condition of the College.

The Treasurer's report discloses the encouraging fact, that the College is out of debt. This result has been reached by the practice of the most careful economy, and at the expense of abridging the usefulness of some of the departments. There is in the treasury, on temporary deposit, the sum of $10,000, which will be reinvested at the earliest favorable opportunity. This sum represents the proceeds of the surrender of stock, held by the college, in the St. Paul & Sioux City Railroad; said road having passed into the hands of another company, which desired to return the funds, and obtain possession of the stock. The Trustees, after advising with parties who had held much larger amounts of the same kind of stock, believed it best to accede to the request of the new company, and make the surrender. The difference between the $12,309.60 credited in the Treasurer's account as

the proceeds of said stock, and the amount indicated as on deposit, viz: $10,000, represents the interest and premium on the stock. Regarding this sum of $10,000 as a part of the permanent fund of the college, this fund now amounts to $131,300.68.

Estimate of Wants for 1881.

As there will be no session of the Legislature in 1882, it is necessary that the wants of the college for the years 1881 and 1882 should be presented in this report.

For the year 1881 the following sums will be needed:

To pay for instruction, in addition to the revenue of the Endowment Fund	$3,000
For farm experiments	200
apparatus	550
library	200
repairs of buildings	300
travelling expenses of trustees	250
construction of building for classes in shop work.	1,800
equipments for the same	500
Total	$6,800

Estimate of Wants for 1882.

The ordinary wants of the college for any given year are, in the main, a repetition of the wants of the preceding year. A larger sum, however, will be needed to pay for instruction in 1882 than in 1881. The reason for this is, that several of the younger members of the Board of Instruction have been employed at very moderate salaries, and their increased efficiency, following from enlarged experience, will entitle them to an increase of salary for the year 1882.

There will be needed to pay instruction for the year 1882, the sum of	$4,000
For ordinary current expenses, as indicated in the enumeration for 1881	1,500
Total for 1882	$5,500

The sums asked for to meet wants for the years 1881 and 1882 are imperatively required to maintain the usefulness of the institution. The trustees most earnestly appeal to your honorable body for appropriations for those years, that shall cover the amount of the sums named. They also beg to call your attention to the importance of the recommendation in the report of President Fernald, for the construction of a building, with rooms for the deposit, convenient arrangement and safe keeping of collections for the various departments. Many valuable collections for the Department of Natural History have already been made, that are practically useless for the want of rooms and cases for convenient arrangement and preservation, and these collections could be greatly enlarged without expense to the college.

Prof. C. H. Fernald, of the Department of Natural History, has collections of his own, of great value, the use of which he has kindly offered the college upon the condition that they shall be carefully preserved, and this is impossible without suitable apartments and cases.

The members of the Board of Instruction are working with great fidelity to promote the interests of the college. The experience of each year has strengthened them in the conviction that they are working in the right direction. They are spending the best years of their lives in earnest effort to establish the cause of industrial education in this State upon a firm basis. They are, therefore, anxious that the facilities necessary to make their work effective and enduring, should be provided. If faithful effort in a most useful educational enterprise is entitled to reasonable recognition and encouragement, it is not too much for them to ask to be supplied with such reasonable facilities as will make such effort the most effective.

Respectfully submitted.

WM. P. WINGATE, *President.*

PRESIDENT'S REPORT.

To the Trustees of the Maine State College of Agriculture and the Mechanic Arts:

GENTLEMEN: Simple justice requires the statement that, like the years that have preceded in the history of the College, the year now closing has been one of earnest endeavor on the part of the Faculty, and of substantial progress on the part of the students.

It has been a year which has brought from various sources, gratifying evidence of a more definite and wider appreciation of the important work which this institution is set to accomplish.

So marked have been these favorable indications, they compel the belief that with the aid which individuals may be expected to render, and with the fostering care of the State, a few years may suffice to establish the College on a foundation so secure that its proper maintenance shall be essentially assured, and its perpetuity beyond question.

ADOPTION OF MODIFIED SCHEME OF STUDIES.

It will be remembered that one year ago, the curriculum of studies was revised with a view of developing more fully the department of agriculture. The revised scheme met your approval, and went into effect at the beginning of the spring term, with results entirely favorable. Perhaps it was well that the subject of courses of study for the Maine State College of Agriculture and the Mechanic Arts, should have come before the Legislature for consideration at its session last winter. The very decided and emphatic vote by both branches of this body, to leave the arrangement of studies

with the Trustees and Faculty, where it properly belongs, must be regarded as a happy solution of this question, not only for the present, but relying on the wisdom of future legislators, it may confidently be believed for all time to come. It is an omen of good, that not only on this question, but also on the resolve whereby an appropriation was made to the College, the vote was without distinction of political parties, but in recognition of the principle that a State educational institution for the teaching of practical industries, is entitled to support by all the people of the State.

Commencement.

Immediately following the examinations at the last of the spring term come the exercises of Commencement week, beginning with the Sophomore Exhibition, on Saturday evening, June 26th. The Coburn prize for excellence in declamation, was awarded to Charles Swan Bickford, of Belfast, with honorable mention by the Committee of the name of Alonzo Hurd, of Brownfield.

On Sunday evening, June 27th, the baccalaureate address was given by the President of the College.

On Monday evening occurred the Junior Exhibition, at which were presented original themes. The Coburn prize for excellence in composition was awarded to Frank Swan Wade, of Athens, the writer of a paper entitled "Catholicism in America," the Committee of Award making honorable mention of the theme on "Oratory," written by Harold Mason Plaisted, of Bangor, and of that on "The Chinese Question," by Lorin Thompson Boynton, of Ashland.

On the afternoon of Tuesday, the Coburn Cadets gave an exhibition drill, which was followed by an exhibition of the work of students in the forge shop. A large number of interested visitors were present at each of these exercises.

The President's reception the same evening was a pleasant occasion, attended by the members of the graduating class, representatives from the Trustees, many of the Alumni, and other friends of the institution.

The exercises of the graduating class on Wednesday, June 30th, were of an impressive character, highly creditable to those who took part in them, and were listened to by a large and appreciative audience. His Excellency, Governor Davis, was present, and in behalf of the State presented the diplomas, prefacing this ceremony by an address to the class.

The degree of Bachelor of Science was conferred on Horace Ward Atwood, James Monroe Bartlett, Albert Hinckley Brown, Marcia Davis, Fred Burton Elliott, Sarah Perkins Farrington, Charles Wilbur Fernald, Fred Wilden Fickett, Frank Albert Mansfield, Annie Amelia Mathews, Charles Truman Pease, and James Frank Purington; and the degree of Bachelor of Civil Engineering on George William Lufkin and Franklin Robert Patten, and subsequently the same degree on Henry Wilson Murray.

Division of the Former Department of Civil and Mechanical Engineering.

From 1871, the department of engineering, both civil and mechanical, was under the very efficient direction of Professor W. A. Pike, until last August, when his resignation, to accept a more remunerative position in the West, rendered necessary the selection of a new instructor. It was deemed wise to separate the two departments of engineering, nominally and actually, and, accordingly, to Professor Hamlin, who had served the institution faithfully for several years as Professor of Drawing, and subsequently of Mathematics, was assigned the department of Civil Engineering; and to Mr. Charles H. Benjamin, a former student of the College in the course in Mechanical Engineering, and a practical machinist, was assigned the chair of Mechanical Engineering.

The new arrangement is a satisfactory one, and places a competent man at the head of each department.

Acknowledgements and other Topics.

The college is indebted within the year to Hon. Abner Coburn for a gift of two hundred and fifty dollars for the

library, and to others for various gifts acknowledged in the reports of the several departments. For all these tokens of remembrance and favor it gives me pleasure, in behalf of the institution and in behalf of the young men and young women who will be benefitted by them, to make grateful acknowledgement.

The accessions to the college at the commencement of the autumn term were thirty-one; one graduate returning for further study; one student joining the Junior class; one the Sophomore class, two entering for a special course and twenty-six entering the Freshman class.

In the spring, above two hundred shrubs and trees were transplanted under the direction of Prof. Hamlin, from the nursery to the grounds in front of and surrounding the colledge buildings, with marked improvement of the landscape. Although the season has been a trying one for trees and shrubs newly set, nearly all have survived and are apparently in thrifty condition.

The visit to Lewiston of the Coburn Cadets during the State Fair, was to them an occasion of much interest. It is gratifying to record that their deportment was such as to win for them high commendation. Fuller reference is made to this visit in the report of their Military Instructor.

Death of one of the Students.

At the beginning of the fall term, Lorin Thompson Boynton, of Ashland, a member of the Senior class, returned to the college, but was immediately stricken down by typhoid fever, which in a short time proved fatal. Mr. Boynton was a young man beloved for the kindness of his nature, and honored for his scholarly attainments and the sterling qualities of his character. His death has been a source of much sadness to all connected with the college.

Vocations of Graduates and of Former Students in the College.

The number of graduates is one hundred and thirty-four. The number of former students who were connected with the

college for periods ranging from one term to three and a half years, is one hundred and eighty-six.

Many of these, of both classes, are still engaged in temporary employments.

Of the three hundred and twenty who have been students in the college, forty-two per cent. of whom have pursued full courses of study and been graduated, the vocations of two hundred and thirty who may be regarded as established in the real work of life are known. Of these, twenty-seven per cent. are engaged in agricultural pursuits, and twenty-seven per cent. in the mechanic arts.

Of those whose vocations are regarded as settled, only eleven per cent. are in the so-called professions, while eighty-nine per cent. are engaged in callings of non-professional character.

Plans and Estimates in view of Biennial Sessions.

With the year 1881 the Legislature of the State commences to hold its sessions biennially. Appropriations will hereafter be made to cover a period of two years. It seems to be an opportune time for adopting a plan by which the aid rendered by the State to the institution shall be assured and uniform from year to year. The value to the college of such a plan adopted and faithfully carried out, cannot be over-estimated. Upon this subject of reliable provision for its needs, and at the same time a provision of a permanent nature, I again invite your attention to certain considerations furnished in my report of last year.

"It can hardly be necessary to indicate in detail, the specific needs of the college for the coming year, since it cannot have escaped your notice that, buildings and certain limited equipments excepted, the wants of one year are essentially the wants of another year. It would seem to be in the interests of a wise economy for the Legislature to provide for an annual appropriation which, with the interest on the national endowment, should be adequate to maintain the college in efficiency

in all its departments. The institution could thus render to the State much more valuable service than is possible with any uncertainty attending its financial condition. In the way of indicating some of the elements which enter into a determination of the amount that would be annually needed, the following considerations are presented:

It cannot be a mistake to assume that the intelligent citizens of Maine will demand of the State College of Agriculture and the Mechanic Arts, that its several courses of study be maintained in efficiency, that needful additions be made from time to time to the apparatus and the library, that the buildings, roads and walks be kept in good repair, and that experiments and investigations in the interests of agriculture be regularly and systematically carried on.

The inadequacy of the endowment resulting from the sale of the government land scrip (a sale authorized by the Legislature and made by the Governor and Council) is well known. With the buildings and equipments which have been already provided, an annual appropriation of a few thousand dollars would suffice for the purposes indicated. At the earliest moment deemed practicable, I beg to suggest that the attention of the Legislature be called to such a proposition to the end that the crippling effects attending the uncertainty of proper maintenance may be removed, and a higher degree of usefulness for the institution be secured, through its ability to make plans of a permanent character. The policy of temporary expedients is recognized as an expensive policy for the individual; it cannot be less costly for the State.

The principal items for which annual provision should be made, are:—supplementing interest of government endowment for instruction, (including instruction in the work shops,) farm experiments, improvement of grounds, walks, &c., travelling expenses of Trustees, insurance of buildings, repairs, and moderate addition to library, apparatus and cabinet."

For the first of these items about three thousand dollars

will be required for the year 1881; and for the remaining items about fifteen hundred dollars, making a total for that year of four thousand five hundred dollars. In 1882, for the first item will be required four thousand dollars; the increase arising from the fact that the younger members of the Faculty, having entered upon duty on very moderate salaries, will justly be entitled, from greater efficiency in their service, to larger remuneration. For the other items in that year, the amount required will be as in 1881, fifteen hundred dollars, making the total for 1882, five thousand five hundred dollars. It will thus be perceived that for the two years, there will be needed for the items named, the sum of ten thousand dollars, or an average of five thousand a year. With this amount, omitting buildings and special equipments from consideration, the institution can be maintained on its present basis, and do work of respectable quality. For a series of years the estimates for the items mentioned would probably vary not very materially from those which have now been submitted.

Buildings Needed.

It should not, however, be assumed that with its inadequate outfit of buildings and equipments for instructional purposes, the College is to be limited to precisely its present basis. A moderate advance in facilities for instruction should be made from year to year.

The system of shop-instruction cannot be carried further, without a building such as that for which plans have been submitted and accepted. This building, with Mansard roof, furnishing space for drawing rooms, will cost eighteen hundred dollars, and the fitting it with equipments for working in wood will cost five hundred dollars more, making a total of twenty-three hundred dollars. This amount of advance in developing the system of shop-instruction should be made the coming season. The building proposed would include filing-shop, forge-shop and wood-working shop, and ultimately, lathe-shop and foundry. The fitting up of the two

rooms last named could be deferred a few years, while more pressing wants in other departments of the institution are being met.

Several years ago the attention of the Trustees was called to the need of a building which should contain an agricultural museum, natural history museum, chapel, library, physical laboratory and working rooms for other purposes. During the period of recent financial depression, for obvious reasons, this matter has been allowed to rest. The necessity for such a building, however, has been constantly increasing. It is simply absurd to assume that an institution of agriculture and the mechanic arts can come into condition of the highest usefulness to the State, without the necessary buildings wherein the several departments can find space adapted to their purposes, space in which they can regularly and symmetrically grow. The departments here are cramped for room. The necessity of making ample provision for them is a *real* necessity.

It is possible that some person may be found willing to give his name to such a building as is needed, and to assume the expense of its construction. Such a person would be a public benefactor. Should it be deemed needful, on the other hand, to look to the State for the building, the requisite amount of money must evidently be obtained by instalments. In case the other requests which you will be obliged to make for State aid, do not render it impracticable, I beg you to ask of the Legislature for two thousand five hundred dollars, to be expended in 1882 in the manufacture of brick for the contemplated structure.

It should be stated in this connection, that with the buildings proposed, the wants of the institution in this regard, so far as can now be perceived, would be essentially met for the next twenty years. Moreover, the expense of equipping rooms properly arranged would be only moderate, inasmuch as the collections for the museums would come in the way of

gifts, or could be largely made by those connected with the institution, either as pupils or instructors.

Endowment.

In my report of last year, mention was made of the fact that Hon. Lewis Barker, of Bangor, had generously indicated his readiness to give five thousand dollars toward a citizens' endowment of one hundred thousand dollars. The encouragement since received is fully as great as the effort made to secure it would justify. Ex-Governor Coburn, with characteristic liberality, expresses readiness to join with other citizens of the State in this movement.

The Alumni of the College assume five thousand dollars of the subscription, and propose to furnish the interest annually at six per cent. upon this sum, until they shall have paid the principal to the College treasurer. This will give the College the benefit of three hundred dollars before next Commencement. Possessed as they are of limited means, the decisive and liberal action of the Alumni should constitute a strong appeal to the generous and able in our State to furnish also substantial aid.

Others whose names cannot yet be made public, have given reason for the belief that they will contribute to this fund.

I submit that the encouragement so kindly given on a very limited preliminary canvass, demands that a more active effort for securing the one hundred thousand dollars proposed, be immediately made, either by a committee of your Board, or such competent financial agent as you may be pleased to appoint. The value of an adequate endowment for the College is above estimate.

Conclusion.

For further information relating to the operations of the farm, to experiments, to the work accomplished by the several departments and their specific needs, reference is made to the accompanying reports.

It is proper for me to add, that during the year, the course of the students has, in the main, been characterized by the same earnestness, and upright and manly conduct which it was my privilege to commend in the report of last year. It is a pleasure, also, to again express my high appreciation of the fidelity and thoughtfulness which have constantly characterized my associates in the Faculty, in the discharge of their responsible duties. They, equally with myself, look to the Legislature of this great and thriving commonwealth for that generous recognition of services they have striven faithfully to render, which shall manifest itself in granting the aid you are compelled to seek, to the end that the Maine State College of Agriculture and the Mechanic Arts may more perfectly meet definite educational wants of the industrial classes, in whose interests it was established and for whose benefit it is to be maintained.

DEPARTMENT OF PHYSICS AND MENTAL AND MORAL SCIENCE.

In consequence of the comparatively small teaching force, considering the large number of class exercises, it has been found necessary that several of the instructors attend to recitations not connected with their own departments. To this law of necessity my own work has furnished no exception.

In the spring term, my class-room exercises were in English Literature, Descriptive Astronomy, Physics and Mental and Moral Philosophy; and in the fall term in Trigonometry, Practical Astronomy and History of Civilization, together with a course of illustrated lectures on Electricity, before the class in Physics. Throughout the year I have attended to the literary exercises of the Junior and Senior classes, including preparation for the Commencement exercises. With reference to class-room work, I desire to bear testimony to the faithfulness and efficiency of the several classes that have been under my charge.

Respectfully submitted.

M. C. FERNALD.

DEPARTMENT OF ENGINEERING.

President Fernald:

Since my last report, and during my connection with the College, no changes were made in methods, and no additions made to apparatus or facilities for instruction. The failure of the Legislature to make any appropriation for the work-shops, prevented any advance being made in this direction, but during the spring term the course in forge-work was carried out under the charge of Mr. Decker, and as good work was done as last year. Some slight modifications were made in the lessons given, adapting the work more closely to the needs of our students.

Graduates.

There were but two graduates in this department at the last Commencement, Mr. G. W. Lufkin and Mr. F. R. Patten, both of whom received the degree of Bachelor of Civil Engineering.

Mr. Lufkin's thesis was upon "The Trestles on the Portland and Ogdensburg Railroad in the White Mountains;" he made a thorough examination of the strength of the different pieces of these structures, taking into account their weight, the weight of heavily loaded trains, wind pressure and centrifugal force from a train at high speed.

Mr. Patten took for his subject, "Retaining Walls," in which he reviewed the various theories of such walls, and described the various methods of construction in common use.

As my connection with the College closed at the beginning of the fall term, the work of the remainder of the year will be presented by my successors.

In closing this, my last report, allow me to express my deep interest in the Maine State College with which I was so

long connected, and to express my regret that my personal interests seemed to demand my making the change I have.

Very respectfully,

W. A. PIKE.

DEPARTMENT OF CIVIL ENGINEERING.

President M. C. Fernald:

During the summer term I attended to the following recitations: algebra, geometry, analytical geometry, calculus, and descriptive geometry. I also attended to all of the work in the drawing room, and with the aid of two members of the Senior class, Messrs. Patten and Luf kin, to the field work.

At the commencement of the fall term, on account of the retirement of Professor Pike from the Faculty, it was found necessary, in order to carry the full amount of work demanded by the two courses in engineering, and not increase the number of instructors, to divide the department of engineering into the two departments of civil and mechanical engineering. It was believed that this was the division of studies which would render it possible for the greatest amount of work to be done in the most efficient manner; and so far as the department of civil engineering is concerned, this division has proven very satisfactory, rendering it possible for me to do an amount of work which otherwise would have been impossible; and I trust you will be pleased to recommend to the Trustees the continuance of this division of the department. According to this arrangement, all of the studies in the course in civil engineering, heretofore taught by Prof. Pike, together with the field work and drawing heretofore taught by me, come into the department of civil engineering.

It will be my endeavor to continue those methods of instruction which have heretofore been so successful in bring-

ing the department to its present state of efficiency, making such changes only as the advance of engineering science and practice shall from time to time demand. It has always been a ruling principle in this department, to teach students to do work in the most thorough and practical manner, and the success of our graduates has fully proven this to be a correct principle of instruction.

The department is well equipped with the instruments of ordinary engineering practice, but the drawing room is not at all suitable for the work of the department. It could be very much improved by supplying it with new tables, which could be done at a small expense.

In accordance with directions from the Trustees, the greater part of the ornamental trees in the nursery were transplanted to the college grounds this spring. The sum of $40.00 was appropriated for this purpose, and with the very generous aid of the students and Mr. Lander, 225 trees and shrubs were planted, and although the season has been exceptionally severe for such work, but few have died. I would respectfully call your attention to the necessity for a small appropriation for the prosecution of this work next spring, as the trees in the nursery are choice and will soon be too large for transplanting successfully.

Respectfully submitted.

G. H. Hamlin.

Condition of the Library.

During the past year 131 volumes of books and 41 pamphlets have been added to the library, making the whole number of books in the library at the present time 4105, and 750 pamphlets; 11 volumes have been re-bound. The donations to the library have been from:

Ex-Governor Coburn, 58 volumes.

Senator Hamlin, 22 volumes.

Smithsonian Institution, 15 volumes.

Superintendent of Coast Survey, 1 volume.

Pennsylvania Board of Agriculture, 1 volume.
Province of Quebec, 4 volumes.
Mr. L. P. Lernay, 1 volume, 1 pamphlet.
Department of Agriculture, 3 volumes, 5 pamphlets.
Department of Interior, 5 pamphlets.
Georgia State Agricultural Society, 3 pamphlets.
Massachusetts Horticultural Society, 1 volume.
Montreal Horticultural Society, 1 volume.
New Brunswick Agricultural Report, from Julius L. Inches, 8 volumes of bound magazines.
State Librarian, 2 volumes.
Hon. S. L. Goodale, 13 volumes.
Superintendent of American Ephemeris, 2 pamphlets.
New York Plow Company, 1 pamphlet.

Catalogues have been received from the following Institutions:

University of California; University of Minnesota; Wesleyan University; Ohio State University; Rutger's Scientific School; Kansas State Agricultural College; Missouri University; Pennsylvania State College; Ontario Agricultural School; Massachusetts Agricultural College; Cornell University; Arkansas Industrial University; University of Georgia; University of Wisconsin; University of Mississippi; Iowa Agricultural College; Illinois Industrial University; Catalogue and Report on experimental work, University Tennessee; Texas Agricultural College; Michigan Agricultural College; Maryland Institute of Mechanic Arts; Dartmouth College; Brown University; Massachusetts Institute of Technology.

G. H. HAMLIN, *Librarian.*

DEPARTMENT OF MECHANICAL ENGINEERING.

President Fernald:

I entered upon duty, as instructor in this department, August 16th of the present year.

During the fall term, I have had under my instruction the Senior and Junior classes in Mechanical Engineering, and the Junior class in Calculus.

The class in Calculus has done the usual work in that branch of study, taking up Differential and Integral Calculus as thoroughly as was possible in the brief time allotted them. I would suggest that, in the future, more of the spring term of the Sophomore year be devoted to this study, thus more nearly equalizing the amount of work in the two terms.

During the first six weeks of the term, the Senior class finished the work begun under Professor Pike; the rest of the time has been devoted to examination of the theoretical and practical efficiency of different forms of water-wheels, and the details of their construction. Their afternoon work has included the application of Descriptive Geometry in the development of boiler plates and pipe joints, and the construction of finished drawings of machinery, from actual measurements.

The Junior class have made good progress in the text-book work, besides completing a number of practical problems. Special attention has been given to the subject of gearing and the construction of cams. The need of drawings and models from modern practice, is much felt in connection with this class. The construction of machinery is a progressive science, and cannot be taught properly from a text-book alone; yet lectures without objective illustration are dry and profitless. If a small sum can be set aside for such a purpose, I can give the assurance that it will be profitably invested.

I need but mention the imperative need of an immediate appropriation, to cover the expense of a building for the accommodation of the practical work in this department. Unless this be granted, the ground now gained in the matter of practical shop instruction will be lost, for the want of suitable work-rooms.

Hoping that the system of industrial education may be succesfully carried out in this institution,

I am, very respectfully,

CHARLES H. BENJAMIN.

DEPARTMENT OF FREE-HAND DRAWING AND SHOP WORK.

President Fernald:

During the past year, my work of instruction has been as follows: during the spring term, forge work, and during the fall term, vise work, free-hand drawing, machine drawing, and algebra.

Work was commenced in the forge shop April 8th, this being the earliest possible date on account of the water freezing in the iron pipe through which it is brought from the laboratory building. Considerable difficulty was experienced at first, from the pipe bursting during the coldest nights; and I think that hereafter we cannot commence work before the 15th of April, with the means we now have of obtaining water for the boiler.

The class in forge work numbered thirteen, several of whom were intending to take the course in agriculture, though it is required only of the students in mechanical engineering. As there are but eight forges, it was necessary to work in two divisions, each division working every other day. The engine was run by the students in the Junior class, in

mechanical engineering, and a practical knowledge was thus gained of the proper care of engines and boilers.

The work done by the class in forge work was very satisfactory, and was essentially the same as that done by the class in the year before. Some of the lessons were transposed in order to make the work more progressive, and the points for marking, and a list of the tools to be used, were put on the paper with the working drawings supplied to each student.

At the beginning of the fall term, I commenced giving instruction in free-hand drawing, machine drawing and algebra, in connection with my duties as instructor in vise work. The class in vise work was small, on account of so many having taken the work while it was optional. The work done, however, has been very satisfactory. The work done by the classes in forge work and in vise work was on exhibition at the State Fair, in Lewiston, where it was examined by many mechanics, and others, who spoke in very high terms of the system of instruction.

The work in free hand drawing has been very nearly the same as that done by previous classes. About half of the term has been used in copying figures, to acquire facility in the use of the hand and eye, before attempting to represent objects by lines. The remaining part of the term was used in drawing from objects and finished drawings. I have endeavored to give the students an idea of some of the principles of perspective, and of light and shade, which I required them to employ in drawing objects before them.

I accompanied the Junior class in machine drawing to the Bangor water-works, where they took measurements, under my directions, of the pumping engine, and of the steam engine there; and they have made drawings in detail and elevation of those machines, from the measurements taken.

The class in algebra has done the usual amount of work required in the first term of that study. The wants of the department are quite urgent in the line of shop-work. There is immediate need of a set of tools,—hammer, square and

calipers,—for each of the eight forges. The tools used by the class last spring, were borrowed from students who purchased their own tools for the work, when the course was started two years ago. The cost of such a set need not exceed fifty dollars; and it is hoped that the Trustees will make the small appropriation needed for this purpose, so that we may have the tools to use next term.

The building used for a forge shop, as well as the forges which it contains, is of a temporary character. This building was erected by the students, two years ago, from such materials, and with such rude tools, as were at hand. The time was taken from the study hours of the term, and was therefore precious. The result was a temporary building, supplied with rude boxes, filled with earth and a few bricks, for forges. The engine and boiler were set up without a foundation below the frost, and are therefore liable to be injured from the heaving of the temporary foundation during cold weather. This building has served us, thus far, for our work in forging; but it is not at all suitable for a permanent forge shop, nor is it a suitable place for the engine and boiler, which are adequate to supply power for the whole system of shop work that has been proposed, and which could be well accommodated under one roof. The room now used for a vise shop is poorly adapted for a large class, as all the light it receives comes from a single skylight. I believe that when the system is fully developed, it will be of incalculable benefit to the State. The instructions are of such a character that the operations taught apply to a great number of mechanical trades. The operations taught by this system may well be compared to the principles and operations of arithmetic, which a scholar learns at school, and afterward applies to problems in every day life. I also believe that in the course of the progress which is so rapidly being made in Mechanic Arts, a system of this character will supersede the apprentice system, and that mechanical operations, which are now taught in no regular order, will soon be taught as they should be, in a systematic manner.

Although the work now done in our shops may not be precisely the foundation of such a broad system, it is believed that it is a step in that direction, and that some slight changes in the order of the operations taught, or the addition of new ones, as may be found necessary from time to time, will make this system the one demanded by the times.

Plans and estimates have been carefully made of a building 57½ by 41½, two stories high, with a Mansard roof, which will cost $1,800; and which will afford, besides the forge shop and vise shop, rooms for wood working, casting and machine finishing, as well as a large drawing room. The equipment of a shop for wood working, in the proposed building, will cost $500. The plan of this building has been accepted by the Trustees; and it is to be hoped that the work may be pushed forward as soon as possible, to the end that the building be erected, and the shops now running be put on a permanent basis, and that the course in wood work be soon established.

Respectfully submitted.

W. F. DECKER.

DEPARTMENT OF NATURAL HISTORY.

President M. C. Fernald:

No important changes have been made in the work of this department during the past year. Instruction has been given to the Freshmen, in physical geography, and also in human anatomy, physiology and hygiene. These studies, aside from their intrinsic value to the student, are introductory to others which follow later in the course. The Juniors, in agriculture, chemistry, and science and literature, received instruction in zoology and entomology, during the spring term, and the Seniors in the same courses, in comparative anatomy during the fall term; the Seniors, in agriculture, and science

and literature, also received lectures in stock breeding and veterinary science, and all the Seniors took mineralogy and geology during the spring term. The methods and facilities for instruction are indicated in the explanatory statements following the courses of study.

There is in this department a great and pressing need of rooms. Properly arranged laboratories for work on animals and plants are as much a necessity to the college as a chemical laboratory.

Agassiz has said that the science of agriculture is simply natural history applied. This statement is undoubtedly true, for the prime work of the farmer is to raise plants and animals of the best quality, with the least possible expenditure; but to accomplish this with the greatest success, it will be admitted, at once, that he should be thoroughly conversant with them in every detail. To gain this knowledge, it is necessary for the student to become perfectly familiar with the anatomy and physiology of those plants and animals which he desires to raise, and, as far as possible, with the various diseases common to them, and the best known remedies.

To acquire any good degree of proficiency in the above, in the short time allotted to it here, the student should have greatly improved facilities. The great need of the college in this as well as in the department of agriculture, is a building in which cabinets and laboratories shall be provided and equipped.

In regard to development of the cabinets, I would respectfully call your attention to my report of last year. For a working laboratory in zoology, perhaps that in the South Kensington museum, London, under the charge of Prof. Huxley, may offer a very good model. This consists of a long and well lighted room, supplied with a table for each student, where he makes his dissections, and executes his drawings of the same, studying not only the gross anatomy, but the histology as well. Opening out from this laboratory on one side, is the Professor's private room, where the objects are prepared for the student to work upon. On the other side of the lab-

oratory is a large and convenient lecture room, provided with an abundance of charts, a solar microscope ready for use at any moment, and a bountiful supply of microscopical preparations of plant and animal tissues, which may be placed in the microscope, and the image thrown, greatly enlarged, upon a screen before the class.

On the other side of the lecture room is a cabinet containing typical forms of each of the organic groups, and every preparation which can in any way aid in illustrating the lectures. At the close of the lecture the students pass to the laboratory and work upon the objects themselves, while the teacher passes from one to another giving such individual instruction as seems necessary. It is believed that the student, in this way, gains a knowledge of the subject he is studying, of far greater value than can possibly be obtained by any other plan.

In no way can one get a clearer idea of many of the principles of stock breeding than by studying practically the embryology of a few of our lower animals, and surely to understand the principles of veterinary science, the comparative anatomy and physiology of our domestic animals should be practically studied.

It is quite probable that time enough is spent here both by the teacher and the student to reach a fair degree of proficiency, if the facilities indicated were at hand. As it is, we can do little more than study one or two skeletons, together with a few lower animals, and rely upon lectures illustrated by a scanty supply of diagrams, supplemented with such figures as can be sketched upon the blackboard during the lecture.

There is, therefore, a pressing demand for a building with rooms equipped somewhat as indicated above, by means of which efficiency may be given to the instruction in this department, and also that a suitable cabinet may be furnished for collections which are constantly accumulating.

Respectfully submitted.

C. H. FERNALD.

DEPARTMENT OF CHEMISTRY.

President M. C. Fernald:

Some changes in my department have been made during the past year, owing to the remodeling of the course in agriculture, by which students in agriculture, chemistry and science and literature, take a twelve weeks' course in organic and biological chemistry.

The forenoons of the spring term were devoted to the Sophomore class in qualitative analysis; during which they became familiar with the tests for bases and acids, and were enabled to analyze simple compounds and complex mixtures. The Senior students of the chemical course worked at the same time in quantitative processes. The remainder of the morning was devoted to a series of lectures and recitations in organic and biological chemistry, which were taken by the Juniors in the courses of agriculture, chemistry and science and literature.

As this feature is new, it may be well to give an idea of the subjects studied. They are the following: Carbon—its immense number of compounds; Series of Hydro-carbons, Alcohols, Phenals, Aldehydes, Acetones, Acids, Amines, Amides, etc. Under biological chemistry were taken up: Fermentations, Substances found in the living organism, Chemistry of digestion, Gastric juice, The liver—its functions chemically considered, The pancreas and its functions, Blood, Chyle and Lymph, Bone, Adipose tissue, Nerves and nerve tissue, Muscular tissue, Urine, Milk, etc. The text-book used in the recitations was Watts' Organic Chemistry.

In the afternoon I attended to the Senior and Junior chemical students, and the Junior students in agriculture, who all worked in quantitative analysis. I also held recitations twice a week in advanced inorganic and organic chemistry for the

Senior students of the course in chemistry. During this term I had under my charge two post-graduate students who worked the whole day in the laboratory and assay room.

Three students in chemistry graduated at the commencement in June, 1880; their names and the titles of their theses are given below:

J. M. Bartlett—Butter, its analysis, etc.

A. H. Brown—Milk, its analysis, etc.

C. W. Fernald—Superphosphates and reverted phosphates.

I append to this, a report of the work they did in connection with their theses on the subjects above stated.

The Juniors of the courses in agriculture, chemistry, and science and literature, recited in agricultural chemistry during the fall term of this year. The whole Sophomore class studied general chemistry, and the Seniors of the course in chemistry devoted one hour every morning to advanced inorganic and organic chemistry.

The Juniors of the courses of agriculture and chemistry, and the Seniors of the course in chemistry worked in quantitative analysis under my direction every afternoon in the general labratory. Several special students also took up analytical chemistry. Naquet's Principes de Chimie, which has heretofore been used as a text book for the students in the chemical course was replaced by Wurtz's Chimie Moderne, which is somewhat shorter and more concise. On account of lack of accommodations for recitations, the general laboratory as well as my private room were used for the purpose; it is to be hoped that something may be done to relieve the laboratory building from some of the classes that now recite there. The wants of the department are numerous; we are often obliged to omit certain analyses, which should be performed, owing to a lack of proper apparatus. Some of the most necessary pieces are: a mill for grinding fodder stuffs, etc., in preparing them for analysis, stationary steam water baths, simple apparatus for gas analysis, another analytical balance, some platinum ware, a laboratory microscope, a

laboratory spectroscope, vapor density apparatus, a greater assortment of glassware and chemicals.

I can only repeat what I said in my last year's report in regard to our gas-making apparatus. It is inefficient, liable to get out of order, and dirty.

Respectfully submitted.

A. B. AUBERT.

Examination of some of the methods for the detection of adulteration in butter, by J. M. BARTLETT.

The butter fats used for the following experiments were obtained by melting some country-made butter and separating the fat carefully from the water, salt and curd.

The butter was analyzed and found to contain:

	Analysis No. 1.	Analysis No. 2.
Water	11.70 per cent.	12.06 per cent.
Casein	1.40 "	1.34 "
Fat	73.23 "	73.73 "
Salt	12.56 "	11.93 "
Total	98.89	99.06

A slight loss occurred probably in the determination of the fat.

The butter fat was analyzed by Hehner's method somewhat modified.

The butter was saponified with caustic potash solution, when a clear soap was obtained it was decomposed by the addition of sulphuric acid. This was done in a flask. The mixture was allowed to stand until the cake of non-volatile acids had solidified, when the liquid underneath was decanted through a filter, the acids were now washed five times with hot water, being each time thoroughly shaken up with the water and then allowed to harden into a cake which was pierced in order to admit of decanting the water through a filter. After the last washing the cake of non-volatile acids was broken up and transferred to the filter where it was washed with cold water. The fatty acids were transferred to weighed beakers, and the filter and funnel carefully washed with ether—(the filter and funnel being perfectly dry.)

The beakers were heated on water bath until a constant weight was obtained.

Two analyses of the butter fat made by this method gave an average result of 86.43 per cent. of non-volatile fatty acids.

W. G. Cook's new method of distinguishing butter from other fats, as given in "The Analyst," Vol. IV, page 111, was tested. This method distinctly showed the presence of a foreign fat when one-eighth lard or tallow had been added to seven-eighths of pure butter fats.

The test with sulphuric acid, as given in "Lexikon der Verfälschungen, von H. Klenke," page 86, was tried, but the results obtained were not at all satisfactory. The method described by Husson, on page 198, etc., of "Le lait, la crème et le beurre," was tried, the results were quite satisfactory, but as only a few experiments were made it is difficult to tell how the method will work when only very small quantities of foreign fats are added to butter. The mixtures used to test the method, contained as much as fifty per cent. of foreign fats.

An examination of Husson's method for estimating the amount of casein in milk, by A. H. Brown.

The method was slightly altered from that given by Husson in "Le lait, la crème et le beurre," page 152. The necessary solutions are:

1. A solution of bromine in water—one cubic centimeter of bromine being dissolved in one liter of cold water.

2. An iodine-starch solution made by adding one gramme of powdered starch to a solution of 4 grammes of potassium iodide in 50 cubic centimeters of water.

The method of proceeding is as follows:

Take 10 cubic centimeters of cow's milk, add to it 30 cubic centimeters of water, then add from a burette divided in $\frac{1}{2}$ c. c. enough of the bromine solution to entirely precipitate the casein. This is determined by allowing the milk and bromine water to stand about 20 minutes, then transferring a little of the supernatant liquid on a beaker cover, add to it a few drops of the starch-iodine solution; the casein is entirely precipitated when the starch-iodine solution becomes colored bluish purple.

By acting upon a normal specimen of cow's milk with the bromine solution it was found that one cubic centimeter of it precipitated .0136 grammes of casein.

With these data on hand, some determinations were made in order to compare the results of Husson's with Wanklyn's method, as given in his book on Milk Analysis.

DETERMINATION OF CASEIN IN MILK.

Analysis.	Per cent. Casein—	Wanklyn's method.	Husson's method.
No. 1,	casein,	5.07 per cent.	5.01 per cent.
No. 2,	casein,	4.87 per cent.	5.00 per cent.
No. 3,	casein,	4.59 per cent.	4.92 per cent.
No. 4,	casein,	3.92 per cent.	5.00 per cent.

The last analysis by Husson's method gives rather high results, probably because the solution, though kept cool and from the light, had lost some bromine, a larger quantity being therefore necessary to precipitate the casein than when first prepared.

The method does not seem to be very generally applicable, nor can one expect very exact results therefrom, the bromine solution changing rather too rapidly in strength.

The presence of some salts, such as sodic carbonate and borax, vitiate the results given by the above method. Albumen, as well as casein, is precipitated by the bromine solution.

It takes about 38 c. c. of the bromine to precipitate the casein in 10 c. c. of pure cow's milk.

Experiments on the reversion of superphosphate of lime, by C. W. FERNALD.

The superphosphate used was made from nearly pure tricalcic phosphate by the addition of the proper quantity of sulphuric acid. This gave a mixture of superphosphate and sulphate of calcium, containing 27.8 per cent. soluble phosphoric anhydride.

Experiment No. 1.

Some of the above superphosphate (25 grammes) was mixed with 15 grammes of calcic sulphate, the mixture was thoroughly moistened with water and allowed to stand till dry.

The total amount of phosphoric acid was	17.8 per cent.
Phosphoric acid, soluble in water,	16.2 per cent.
Reverted to phosphate, soluble in citrate of ammonia,	0.6 per cent.
Reverted to insoluble phosphate,	1.0 per cent.

Experiment No. 2.

Twenty-five grammes of tricalcic phosphate were mixed with 15 grammes of alumina, and treated with enough sulphuric acid to

convert the 25 grammes of tricalcic phosphate into acid phosphate (superphosphate). What influence did the presence of the alumina have on the reaction?

Phosphoric acid, soluble in water,	5.8 per cent.	
Reverted to phosphate, soluble in citrate of ammonia,	0.2 per cent.	
Reverted to insoluble phosphate,	0.9 per cent.	
Total phosphoric acid,		6.9 per cent.

Experiment No. 3.

Mixed 25 grammes of superphosphate with 10 grammes of alumina, moistened the mass carefully and dried.

Phosphoric acid, soluble in water,	6.4 per cent.	
Phosphoric acid, soluble in citrate of ammonia,	0.4 per cent.	
Insoluble phosphoric acid,	1.0 per cent.	
Total phosphoric acid,		7.8 per cent.

Experiment No. 4.

Mixed 25 grammes of superphosphate with 15 grammes of oxide of iron, moistened thoroughly, let stand until dry.

Phosphoric acid, soluble in water,	5.3 per cent.	
Reverted to phosphate, soluble in citrate of ammonia,	0.5 per cent.	
Reverted to insoluble phosphate,	2.4 per cent.	
Total phosphoric acid,		8.2 per cent.

The above experiments were made hurriedly, and in a short time, so that the quantity of soluble acid reverted was in no case very great. The mixture in experiment No. 3, after standing about five months, and without being moistened, only gave 4.8 per cent. of phosphoric acid, soluble in water.

The mixtures used in the above experiments nearly all contained a small percentage of water.

DEPARTMENT OF MODERN LANGUAGES AND MILITARY INSTRUCTION.

President Fernald:

During the past year, I have given instruction in French, German, Civil Government, Political Economy, Logic, American Literature and Book-keeping; I have also attended to the Sophomore declamations.

In these branches, the progress made by the different classes has been very satisfactory.

The plan proposed last year, of devoting a part of the time allotted to French and German, to the translation of elementary scientific works in those languages, has been tried and, I think, proved a success. The class in German, after reading about eighty pages in a novel, translated forty pages in "Hodge's Scientific German." The class in French did similar work in that language.

Military Department.

The arrangements for military exercises are essentially the same as given in my report last year; while the season is suitable, drill occurs twice a week; in the winter months I have an exercise in Tactics with the Juniors each Tuesday, and give lectures on International Law to the Seniors each Thursday; at the same hour that I am occupied with the Seniors, the Juniors drill the two lower classes in the halls of the dormitory.

The battalion visited Lewiston during the State Fair, and remained there in camp four days. The trip was one of great enjoyment and profit to the students, who received many compliments for their deportment. The following remarks were made to them by Hon. Rufus Prince, President of the Society, as they were about leaving the grounds:

"Young men: I take great pleasure in saying, in behalf of the Society, that your gentlemanly and soldierly bearing during your encampment on these grounds, have won for you much praise, and done more to break down the prejudice against the Agricultural College, than was ever done before in the same time; and in behalf of the Society I feel to most sincerely thank you for your presence, and for what you have done to add to the pleasure of our annual festival."

Here, I wish to acknowledge our obligations to the officers of the Society, who extended every courtesy to us; and also to the Superintendents of the Maine Central and European Railroads, who with great liberality furnished us with free transportation to and from Lewiston.

Respectfully submitted.

A. E. ROGERS.

DEPARTMENT OF AGRICULTURE.

President Fernald:

My instruction during the past year has been in accordance with the changes in the course in Agriculture, adopted by the Trustees one year ago. These changes involved bringing forward the agricultural branches previously taught during the Freshman and Sophomore years, so as to form a part of the technical instruction of the agricultural course, and also the addition to that course of the subjects of Cattle Feeding, Principles of Plant Feeding, Agricultural Engineering, Horticulture and Arboriculture.

During the spring term, lectures were given to the Seniors in Agriculture and in Science and Literature, on the Cultivation of Cereals, Care and Feeding of Animals, and Sheep Husbandry; and to the Juniors in the same courses, on the Principles of Plant Feeding. While these lectures, prepared for the first time, and drawn from so many sources, were not

so complete as I desired, yet I can speak with satisfaction of the acquaintance that the students made with the subjects thus presented. An attempt was made to apply scientific principles, so far as they have been established both in theory and practice, to the operations of the farm, and not to deal with mere speculations. I note with pleasure the appearance of a book on the subject of Cattle Feeding, written by Dr. Armsby of the Connecticut Experiment Station, which deals with the subject in a very exhaustive manner, and which will serve admirably the purposes of a text-book in agricultural schools. A similar text-book on "Plant Feeding," is needed.

Peck's Mechanics was used as a text-book by the Juniors in Agriculture. I wish to suggest that this book is not very well designed to serve as a basis for a study of the mechanics of the farm, and that a change for the better should be made as soon as it can be effected.

Agricultural Engineering was taught by lectures, which included the calculation of the safe stress for beams loaded in various ways, methods of preserving timber, and the main principles involved in building country roads.

The study of Botany began in the early part of the spring term, and continued during the greater part of the fall term, followed until the end of the term by lectures on Horticulture and Arboriculture. The work in Botany included as much of practical analysis and study of plants as was possible, when no room could be provided for the students to sit at tables, or have proper light. Successful, practical work on plants imperatively demands a laboratory furnished with tables, microscopes and good light, where the students can study under the direction of the instructor.

Besides the studies above enumerated, weekly exercises have been held for Analysis of English Authors during the spring, and Analysis of History during the fall term.

Graduates in the Course in Agriculture.

Of the last graduating class three had pursued the agricultural course, two of whom before leaving the college signified their intention of adopting agriculture as a profession, and the other of becoming a veterinary surgeon. In case their anticipations are being realized, as I believe they are, they can all be considered as at work in the calling for which they were educated. Below are given their names, together with the subjects of the theses which they presented upon agricultural topics.

Horace Ward Atwood, Albuminoids and Amides.

Fred Burton Elliot, Agriculture the Basis of Prosperity.

James Frank Purington, Agricultural Experiment Stations.

As bearing upon the statement so often made that the State College educates its students *away* from agriculture, perhaps I may be allowed to refer to remarks made to me by two of these graduates. One said, "I should not have been a farmer had I not come to this college. I have been educated *toward* the calling." In speaking of his course of study the other remarked, "I have learned much that will be of value to me in my future work." Coming from farmers' sons who were well acquainted with farm life and duties, thus being better able to measure the real value of the knowledge they had gained, these remarks should give assurance to the farmers of Maine that this college is an institution where education in the profession of agriculture can be obtained.

At the end of the last college year three of the present Senior class were pursuing the course in agriculture, and seven of the present Junior class signified their intention of so doing. The death of one of the Seniors, Mr. Boynton, a student whose abilities and worth gave promise of a successful future, leaves but two of that class in the agricultural course, and but five of the seven Juniors above mentioned returned to the college at the beginning of the year. It can thus be seen, that of the two upper classes now here, a fair

proportion are students of agriculture, and there are good reasons for believing that a similar condition of things will be maintained with the present Sophomore and Freshman classes.

Besides my work at the college, I have, at the request of the Secretary of the Maine Board of Agriculture, attended several of the Farmer's Institutes in various counties of the State, and there endeavored to discuss some of the more important questions bearing upon farm practice. Such labor has to me been pleasant and instructive, and judging from the reception which the efforts of myself and others with whom I co-operated, have met, I am led to believe that it has been far from profitless. It certainly behooves the college and the farmers of Maine to heartily co-operate in the work in which Secretary Gilbert is engaged. Intelligent farmers never fail to give close and inquiring attention to the discussion of subjects that to them are of practical importance. This is so because they recognize the value of correct knowledge. Let all such who are in Maine remember that the class rooms of the State College offer opportunities for their sons to acquire a familiarity with the correct principles of agricultural science, and to listen to a much more extended discussion of the difficult problems of agriculture than is possible at public gatherings.

Report of Experiments.

The failure of the Trustees to obtain from the State the funds asked for to defray the expenses of experimental work, rendered it necessary that only a limited number of experiments be conducted on the College farm during the past season. Those decided upon by a committee appointed by the Trustees were as follows:

1. An experiment on the effect of different fertilizers in growing corn.

2. An experiment on manuring corn with different forms of phosphoric acid.

3. An experiment on the best time for cutting grass.
4. Experiment in planting potatoes.

These experiments have been performed as faithfully as the time and means at my disposal would permit, and I submit the following report of the results.

Experiment on the effect of different fertilizers in growing corn.

This experiment is but a continuation of similar ones performed in 1878 and 1879, not only here, but in various other localities in New England. The considerations that have led to such experimenting I can best give, perhaps, by making use of a portion of my last year's report:

"The value of the fertilizers offered for sale in our markets depends almost entirely upon the amounts they contain of one, two or all three of the ingredients, *nitrogen*, *phosphoric acid* and *potash*. These ingredients have a commercial value because there is a demand for them to apply to the soil, and this demand exists because they are the elements of plant food, the supply of which in an available form is not only likely to get exhausted, but actually has been exhausted in many of our fields. When a farmer cannot grow fair crops on his soil, an application of one, two or all three of these manurial substances will, in a majority of cases, remedy the trouble.

Several hundred thousand dollars were probably expended in Maine last year for commercial fertilizers, and no one can doubt the importance of having this amount of capital judiciously applied. But to secure such a result is no easy matter. There is a variety of fertilizers for sale in our markets, some mostly nitrogenous, some largely phosphates, and some that furnish potash chiefly; and the claims of each as an efficient manure are boldly asserted by the respective parties interested in their sale, and none of them are unable to present testimonials as to the peculiar efficacy of their special fertilizers.

On the strength of these assertions farmers buy these manures, and many are disappointed because they do not receive satisfactory returns from their investment. Others are more than satisfied, and ready to purchase again. It is not to be doubted that one farmer may find one kind of manure efficient, when with another farmer it

proves itself of little value. It is not safe for any one to invest largely in any special fertilizer on the strength of what it has done in some locality of different conditions from his own. Every farmer should know from actual observation on his own soil whether this or that will be profitable. This is difficult, is it? The best achievements are always so.

But to avoid these difficulties some have attempted to put forth universal recipes that shall always prove profitable. So far these recipes are failures from an economic point of view. The time has not come when a universal rule can be formulated that shall at the same time meet the needs of a farmer's soil and his pocket.

And now the question comes, how shall farmers individually and generally gain a more definite knowledge of the science of manuring? Theoretical considerations alone are not safe to follow. A certain amount of practical experimental work must be done somewhere. A gentleman,* who was for a long time the distinguished Secretary of the Maine Board of Agriculture, said not long since in reply to a question as to the advisability of field trials of fertilizers, 'It is the only way to get the information we desire.'

The field experiments† made on the college farm have been with the view of gaining more definite knowledge as to the economical use of fertilizers, and while they are to a certain extent of most value as an indication of the true practice to be followed on the college farm, certain conclusions can be drawn from the results that may be of general application. The plan of the experiment is such that the valuable elements of plant food are applied to the soil singly, two by two, and a mixture of all three. In this way we learn what ingredient is most influential in producing an increased crop, and also what mixture of the ingredients is best. But in the following experiment more than this is done. An attempt is made to study the capacity of the corn to gather its nitrogen for itself from other sources than the manure supplied.

Nitrogen is an element of plant food that costs twenty-five cents a pound when bought in commercial fertilizers, being the most costly ingredient of manures. It is evidently not wise to purchase any more of it to apply to the soil than is necessary to furnish what the plant cannot get from other sources.

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* Hon. S. L. Goodale.

† Proposed by Professor W. O. Atwater of Wesleyan University, Middletown, Conn.

The investigations of Lawes and Gilbert have shown that wheat and other grains require nitrogenous manures in considerable quantities. Is this the case with corn, or can it gather nitrogen for itself?

In order to obtain an answer to this question of the nitrogen supply, a set of plots was manured so that the first received 24 pounds of nitrogen, the second 48, and the third 72. The full amount of mineral ingredients was added to each plot. This set of plots was duplicated."

The land upon which the experiment was performed, was originally old pasture land. It is a medium clayey loam with a strip running across the piece somewhat lighter in texture, and containing some small stones. Previous to last season three hoed crops had been removed from the land, each year a small quantity of stable manure being supplied. In 1879 the land was planted to corn, and after the removal of the crop in the fall it was ploughed, and again in the spring of the present season.

The field was divided into plots 335 feet long and $6\frac{1}{4}$ feet wide, each containing one-twentieth of an acre. The rows were $3\frac{1}{4}$ feet apart, with the same distance between the hills. The fertilizers were applied by strewing them in the rows at the points where the seed was to be dropped, and then thoroughly mixing them with the soil. The seed was planted May 27th and 28th, and the crop was well cultivated during the summer, but owing to the severe drought it was late in maturing, and much decreased in quantity. In the following table are given the order of the plots, quantities of fertilizers and valuable ingredients per acre, yield per plot and per acre.

No. of Plot.	Fertilizers* Per Acre.	Valuable ingredients per acre.			Yield per plot.				Yield per acre.			
		Nitrogen, lbs.	Phosphoric acid, lbs.	Potash, lbs.	Good corn, lbs.	Poor corn, lbs.	Total corn, lbs.	Stover, lbs.	Good corn, bush.	Poor corn, bush.	Total corn, bush.	Stover, lbs.
1	Nitrogen mixture, 150 lbs ..	24	–	–	27	26	53	116	7.2	5.0	12.4	2320
2	Superphosphate, 300 lbs	–	48	–	67	32	99	68	17.9	6.4	24.3	1360
3	Muriate of potash, 150 lbs..	–	–	75	39.5	35.5	75	50	10.5	7.1	17.6	1000
4	Nitrogen mixture, 150 lbs. Superphosphate, 300 lbs .	24	48	–	96	44	140	202	25.6	8.8	34.4	4040
5	Nitrogen mixture, 150 lbs. Muriate of potash, 150 lbs.	24	–	75	39	26	65	55	10.4	5.2	15.6	1100
6	Superphosphate, 300 lbs. Muriate of potash, 150 lbs., mixed minerals	–	48	75	69.5	39	99.5	135	16.1	7.8	23.9	3220
0	No manure.....	–	–	–	34.5	22	56.5	61	9.2	4.4	13.6	1210
7	Mixed minerals as No. 6. Nitrate of soda, 300 lbs.	24	48	75								
8	Mixed minerals as No. 6. Nitrate of soda, 300 lbs...	48	48	75								
9	Mixed minerals as No. 6. Nitrate of soda, 450 lbs...	72	48	75								
10	Mixed minerals as No. 6. Nitrogen mixture, 150 lbs.	24	48	75	45.5	43	88.5	158	12.2	8.6	20.8	3160
11	Mixed minerals as No. 6. Nitrogen mixture, 300 lbs.	48	48	75	57.0	40.5	97.5	171	15.2	8.1	23.3	3420
12	Mixed minerals as No. 6. Nitrogen mixture, 450 lbs.	72	48	75	45.5	40.5	85.5	158	12.2	8.1	20.3	316
13	Mixed minerals as No. 6. Sulph. of ammonia, 225 lbs.	48	48	75	63	26	89	146	16.8	5.2	24.0	2920
14	Mixed minerals as No. 6. Dried blood, 450 lbs.....	48	48	75	77	27	104	148	20.5	5.4	25.9	2960
15	Peruvian guano, "standard," 450 lbs. Muriate of potash, 150 lbs.....	48	?	75	36	35	71	118	9.6	7.0	16.6	2360
16	Superphosphate, 300 lbs. Muriate of potash, 150 lbs., mixed minerals	–	48	75	37	46	83	88	9.8	9.2	19.0	1760
00	No manure.....	–	–	–	18	31	49	65	4.8	6.2	11.0	1300

* These fertilizers were put up by the Mapes Formula and Peruvian Guano Co., New York city.

A study of the table reveals several facts worthy of notice.

1. The absence of phosphoric acid from the fertilizers is fatal to their otherwise good effect. This fact was very noticeable when the corn was growing. Those plots to which the superphosphate was applied showed an earlier growth and maturity, the corn being of much better quality.

2. The application of large quantities of nitrogenous fertilizers was useless, so far as the corn crop was concerned. This seems to be an almost universal result, not only on this farm, but wherever the test has been made experimentally in other States.

Amount of nitrogen used with uniform quantity of mineral fertilizers.	Average results from the duplicate sets of plots for two years.			Results for one year.		Cost of the different quantities of nitrogen
	1879.	1878.		1880.		
	Green corn per acre.	Corn per acre.	Stover per acre.	Corn per acre.	Stover per acre.	
⅓ ration* 24 lbs...	2,606 lbs.	44.1 bush.	3,975 lbs.	20.8 bush.	3,160 lbs.	$5 62
⅔ ration 48 lbs....	2,668 "	44.7 "	3,650 "	23.3 "	3,420 "	11 25
Full ration 72 lbs.	2,592 "	46.8 "	4,280 "	20.3 "	3,160 "	16 87

* By "ration" is meant the quantity of nitrogen that a crop of 48–50 bushels of corn with its stover would contain.

The above table shows the results of the experiments performed upon the College farm for three years. It is plainly shown that an increase of nitrogen above 24 lbs. does not induce a corresponding increase of crop. This fact is seen to exist quite universally, judging from the figures of the next table, which is taken from Prof. W. O. Atwater's "Report on Farm Experiments with Fertilizers for 1879."

	In Trials. Total number.	With Nitrogen. Amounts.	Costing.	The Nitrogen paid for itself in trials.	The Nitrogen failed to pay for itself in trials.	The average loss in the several trials was
1878	29	24 lbs.	$5.62½	8	21	$0 90
	15	48 "	11.00	1	14	4.45
	6	72 "	16.50	none.	6	8.51
1879	26	24 lbs.	$5.62½	5	21	$0.90
	14	48 "	11.00	1	13	9.48
	6	72 "	16.50	none.	6	16.26
1878 and 1879	55	24 lbs.	$5 62½	13	42	$0.90
	29	48 "	11.00	2	27	7.47
	12	72 "	16.50	none.	12	12.39

"The nitrogen increased the crop enough to pay the cost in fifteen trials out of ninety-six. The pecuniary loss rose and fell with the amount of nitrogen used. With mineral fertilizers alone the crop gathered, by the above estimates, some 65 pounds of nitrogen per acre."

Mr. Lawes of England, gave it as his opinion that the farmers of the United States would need, in order to produce full crops of maize, "large quantities of nitrogen to be supplied as ammonia or nitric acid." Prof. Stockbridge offered to the public, fertilizers for corn that involved the application

of 72 lbs. of nitrogen per acre, an amount that in twenty-four trials has been used at a loss of from $8.50 to $16.00 per acre. In view of the above facts, it is worth while to know the truth. The truth seems to be, that the buying of large quantities of nitrate of soda, sulphate of ammonia, dried fish, dried blood, or nitrogenous fertilizer of any kind for the purpose of corn growing, is not wise, but that a manure compounded as first class superphosphates usually are, is the one that farmers can most safely purchase to supply the needs of the corn crop, especially if a certain amount of farm manure be used besides.

Experiment on manuring corn with different forms of phosphoric acid.

Phosphoric acid is the ingredient of commercial manures most largely sold in Maine. It is furnished to farmers in different substances, and in different chemical forms. The different substances most common in the markets are superphosphates, dissolved bone, bone meal, bone ash, ground phosphatic rock, &c. The different chemical forms found in these substances are commonly known as "soluble," * "reverted," † and "insoluble," ‡ which are held to have different values for crop growing. The soluble is generally regarded as having the highest value, because more readily available to plants, that is, producing quicker returns than the other forms. It is manufactured by treating bones or ground rock with sulphuric acid.

Reverted phosphoric acid is that which has once been rendered soluble, but by chemical change has become insoluble in water. It is considered to be more valuable than that which has never been soluble, taking an intermediate position between the other two forms. Thus when a chemist analyzes a fertilizer he determines its value by estimating the soluble acid to be worth 12½ cents per pound, the reverted 9 cents, and the insoluble 6 to 3½ cents, according to whether it be in

* In water. † Not soluble in water, but in citrate of ammonia. ‡ In water, soluble only in acids.

ground bone or ground rock. It should also be noted that a distinction is made in the value of insoluble acid in bone, depending upon the fineness to which the bone is ground.

Agricultural chemistry, at present, rates the agricultural values of these forms of phosphoric acid in the same order in which they are rated commercially, and it is hard to see why the relation of the trade values is not in a general way the result of the estimated differences in effectiveness when applied to the soil. But what determines the agricultural value of a phosphate?

Soluble phosphoric acid is not the most valuable form, because it can easily be dissolved by the soil water and remain there in solution, thus being ready for plant use, as many may suppose. The state of solubility in water is maintained but a short time probably after the fertilizer is thoroughly mixed with the soil. The lime, alumina and iron compounds, so largely present in almost all soils, must very quickly render it insoluble. What advantage is there then in making phosphoric acid soluble at all? The argument in favor of so doing is, that it gets a much better distribution in the soil than it otherwise could. The soluble phosphate is dissolved by the soil moisture or rain water, and as it is carried through a layer of earth unites with other compounds and is precipitated over the particles of earth in a very finely divided, insoluble condition. From the particles of the phosphate thus formed, so small and so generally and evenly distributed as they are, the roots of plants can much more easily obtain their solutions than they could from bone ground to the ordinary fineness and distributed as it usually is. The above is no doubt the true explanation of the vigorous action of superphosphates or dissolved bone, when applied to land in need of phosphatic manures. It would seem then that the rendering of a phosphate soluble is only a means for securing as an ultimate result the thorough mixing of the fertilizing ingredient with the soil, and in a finely divided condition. This being a fact, it would seem that the more finely ground are the materials containing insoluble phosphoric acid, and

the more completely and evenly they are distributed in the soil, the more profitable is their use likely to prove.

From the above considerations, and from the practical results which seem to have been achieved by the use of soluble phosphoric acid, we have come to consider that form as the most profitable for use, and to measure the probable effect from using a phosphatic fertilizer, for the first year at least, chiefly by the solubility of its valuable ingredient in water. A number of European experiments performed by Peterman and Grandean seems to indicate, however, that reverted phosphoric acid may, in many cases, cause as large and immediate an increase of production as the form soluble in water; while Thomas Jamiesen of Scotland made a large number of experiments with turnips in which soluble phosphoric acid caused only ten per cent. more of growth than phosphates that had never been treated with sulphuric acid.

So far as molecular condition is concerned it is not easy to understand how phosphoric acid is more available that becomes reverted after it enters the soil than when such a change takes place before, provided the same compounds cause the change. The only point gained by applying a soluble phosphate is that the distribution over the particles of earth would be better. But we must remember that roots will search out and seize upon material rich in plant food even if it be much less intimately mixed with the soil than is possible with finely pulverized fertilizers.

The experiment conducted on the College farm during the past season was made with the view of adding something to our knowledge of the relative value of phosphoric acid when applied in different forms and substances.

The materials used were as follows:*

1. Superphosphate containing ten per cent. of phosphoric acid, seventy per cent. of which was soluble.

2. The same superphosphate to which an excess of finely powdered chalk had been added, and the mixture after having

* Analyzed by the writer in the laboratory of the College.

been thoroughly wet and stirred several times, and lying in moist condition for three weeks, was then applied to the soil. It was found that the phosphoric acid previously soluble in water had by this treatment became practically all insoluble in that liquid.

3. Bone meal, containing 22 per cent. of phosphoric acid.*

4. Bone ash, containing 24.2 per cent. of phophoric acid.*

5. Navassa rock finely ground, containing 31.5 per cent. phosphoric acid. *

The superphosphate, bone ash and ground rock were very kindly sent to the college by Hon. S. L. Goodale, of the Cumberland Bone Company.

The bone meal, a very fine sample, was presented by C. W. Belknap & Son, Portland, Me., to whom many thanks are due.

The character, previous treatment and cultivation of the soil, dimensions of the plots and manner of applying the fertilizers, are given in the details of the previously described experiment. The effect of the drought was also similar.

The same amount of phosphoric acid was supplied to each plot in the different substances above enumerated, to which were added muriate of potash and sulphate of ammonia in sufficient quantities so that each plot should be furnished with the same amounts of nitrogen and potash.

It is obvious that under such conditions, whatever marked differences might occur in the yield of the various plots, would be due to the forms in which the phosphoric acid was applied.

Twelve plots were made use of in the experiment, which embraced duplicate sets.

The order of the plots, and the rate per acre at which the fertilizers and valuable ingredients were applied are shown in the following table:

---

* Insoluble.

No. of Plot.	Quanties of fertilizers per acre.*	Quantities of valuable ingredients per acre.				
		Phosphoric acid.			Potash.	Nitrogen
		Soluble.	Insoluble.	Total.		
	380 lbs. superphosphate, 90 " muriate of potash, 80 " sulphate of ammonia,	26.6 lbs.	11.4 lbs.	38 lbs.	50 lbs.	24 lbs.
2	510 " superphosphate & chalk, 90 " muriate of potash, 80 " sulphate of ammonia,	-	38 "	38 "	50 "	24 "
3	170 " raw ground bone, 100 " muriate of potash, 100 " sulphate of ammonia,	-	38 "	38 "	50 "	24 "
4	160 " bone ash, 100 " muriate of potash, 120 " sulphate of ammonia,	-	38 "	38 "	50 "	24 "
5	120 " ground navassa rock, 100 " muriate of potash, 120 " sulphate of ammonia,	-	38 "	38 "	50 "	24 "
6	No manure.....	-	-	-	-	-

* Plots 7-12 were simply duplicates of plots 1-6.

In the next table is shown the yield from the various plots manured as indicated above.

	Yield per Plot.				Yield per Acre.			
	Good. lbs.	Poor. lbs.	Total. lbs.	Stalks. lbs.	Good. bushels.	Poor. bushels.	Total. bushels.	Stalks. lbs.
1	52.5	39	91.5	173	14	7.8	21.8	3460
2	35.5	32.5	68	91	9.5	6.5	16	1820
3	29	37	66	80	7.7	7.4	15.1	1600
4	20	31	51	87	5.3	6.2	11.5	1740
5	26	30½	56½	74	7	6	13	1480
6	14	24	38	61	3.8	4.8	8.6	1220
7	49	32	81	155	13.1	6.4	19.5	3100
8	49	45	94	123	13.1	9	22.1	2460
9	22	38	60	122	6	7.6	13.6	2440
10	42	29	71	123	11.2	5.8	17	2460
11	23	21	44	105	6.1	4.2	10.3	2600
12	21.5	18	39½	38	5.7	3.6	9.3	760

The average yield for the two sets of plots would then be as follows for the different forms of phosphoric acid:

Form in which the phosphoric acid was applied.	Yield per Acre.			
	Good. bushels.	Poor. bushels.	Total. bushels.	Stover. lbs.
1. In superphosphate with 70 pr. ct. of the phos. acid soluble in water.....	13.6	7.1	20.7	3280
2. In same superphosphate with the soluble phos. acid all reverted. Insoluble in water.....	11.3	7.8	19.1	2140
3. In bone meal, insoluble in water.....	6.9	7.5	14.4	2020
4. In bone ash, insoluble in water.....	8.3	6	14.3	2100
5. In Navassa Rock, insoluble in water.....	6.6	5.1	11.7	1790
6. No manure.....	4.8	4.2	9	990

The effects of the different forms of phosphoric acid is only partially shown by the above table. The corn fertilized with Nos. 1 and 2 began to make vigorous growth at once, thus maturing earlier, and furnishing a product superior to that of the other plots, the kernels being plumper and more thorougly ripened. But little difference could be seen between Nos. 1 and 2.

The growth of stalks from Nos. 3, 4 and 5, was made later in the season than in case of Nos. 1 and 2, the ears were later in maturing, and when harvested a larger proportion of corn was unsound. It is seen that the action of the superphosphate in which the soluble phosphoric acid had all been rendered insoluble in water, compares quite favorably with that in which the reversion had not been effected previous to application.

A single experiment attended as this was by unfavorable conditions does not offer much from which to draw concluclusions, nevertheless, it may furnish additional reason for further investigation of the question as to whether the fertilizing activity of a superphosphate is to be entirely measured, even for the first year, by its phosphoric acid soluble in water.

Experiment on the best time for cutting grass.

This experiment was repeated the past season for the third time. It involves the cutting of grass at four periods of growth, the weights of green and cured grass being taken in each case. In 1879 analyses were made of the samples, and such was the intention this year, but owing to a failure to save a sample from the second plots cut, it was not deemed best. I am indebted to J. B. Wilson of the Senior class for the supervision and report of the larger part of the work.

The following results will be valuable for use in establishing results in connection with a more extended number of analyses. The experiment involved two series of plots, one plot being cut in each series at each date. Size of plots .80 x 27.2 feet = 1-20 of an acre.

Stage of Growth.		Both series.		Average.		Percentage of loss in curing.
		Green.	Cured.	Green.	Cured.	
Nearly headed out June 23d	A. 1	522	226.5	511	220	56.75
	B. 1	500	213.5			
In full blossom July 5th.	A. 2	378.5	221	382	219	42.67
	B. 2	384	217			
Out of blossom July 20th,	A. 3	272	193	272.5	201.5	26.05
	B. 3	273	210			
Ripe July 29th,.....	A. 4	274	237	252.5	220	12.87
	B. 4	231	203			

The experiment in planting potatoes was a failure, owing to the devastations of popato bugs during my summer vacation.

The above experiments may seem meagre in quantity and results. Let those disposed to criticise, remember that to carry on an experiment, time and money are demanded. Time is lacking for such investigations with teachers already overtaxed with other duties. But granting that by extra effort time could be found, the necessary money is not forthcoming. The small sum asked for by the trustees last winter to defray the expenses of experimental work was denied.

Farmers will get very enthusiastic over an experiment performed by a brother farmer, who happens to be enterprising, for such work is so valuable to them they say. But when the agriculturalists of Maine are asked to see to it that their college is given means to do just such work in a much more exact way than the ordinary farmer can do it, they exhibit a most surprising indifference. One who is interested in a progressive agriculture can hardly help desiring to aid the farmers of Maine in making their fields more fertile and their profession more lucrative. But when one who works in this direction fails to get material aid or even sympathy from a large majority of those for whom he is laboring, he does well not to lose enthusiasm and courage. The Farmers' Institutes now being held in Maine are full of benefit, but let it be remembered as a fact that mere talk will not settle the disputed questions of agriculture. Nothing will do that save laborious and often costly investigation.

Respectfully submitted.

W. H. JORDAN.

FARM SUPERINTENDENT'S REPORT.

PRINCIPAL FARM CROPS.

Hay,	90	acres,	120 tons.
Potatoes,	4	"	525 bushels.
Wheat,	$3\frac{1}{2}$	"	40 "
Barley,	5	"	83 "
Oats,	$1\frac{1}{2}$	"	56 "
Sugar beets (for Me. Beet Sugar Co.)	$1\frac{1}{2}$	"	$20\frac{1790}{2240}$ tons.
Beets for stock,	2	"	1030 bushels.
Turnips,	$1\frac{1}{4}$	"	670 "
Onions,	1	"	435 "
Corn,	$\frac{1}{2}$	"	20 "
Squash,	$\frac{1}{4}$	"	5000 lbs.
Beans,	$\frac{1}{2}$	"	9 bushels.

Owing to the drought, which was severe in this section, the crops were very light, the grain, especially, suffering from the lack of rain.

The Colorado beetles made their usual annual attack, but we were able, eventually, to subdue them by a liberal use of Paris green.

The sugar beet crop was very light, it being so dry that we were obliged to sow the seed a second time, thus making it quite late before the roots began to grow; this, together with the continued drought, made a light crop inevitable.

Our thanks are due to the Pennock Manufacturing Company, Kennett Square, Chester County, Pa., for one of their "Double Harpoon Horse Hayforks." We have used this fork during the past summer, and found it superior to the single harpoon fork, working equally well in long and short hay; and we would recommend it to farmers as the most easily managed and perfect instrument of its kind we have ever used.

Mr. Ira Winn, Cumberland Center, Maine, manufacturer of the "Shuffle Hoe or Weeder," has presented to the farm one of these useful and labor-saving implements. From our experience with it we can heartily endorse the claim of Mr. Winn, that it is "a very excellent tool for cleaning weeds from growing crops."

Receipts for the year ending November 30, 1880.

Cash on hand Dec. 1, 1879	$ 21 64
Order on Treasurer, Aug. 3, 1880	280 00
Note, Orono Bank, given April 14, 1880	105 00
Note, Orono Bank, given Aug. 17, 1880	98 20
Hired money April 12, 1880	100 00
Hired money July 18, 1880	100 00
Labor of teams in woods, hauling coal, &c.	353 47
Pair team horses	150 00
Driving horse	55 00
Hay	497 90
Cattle and calves	143 00
Sheep and lambs	115 00
Wool	125 22
Pigs and pork	82 52
Sugar beets	94 22
Onions	330 30
Potatoes	81 89
Milk and cream	386 97
Butter and eggs,	53 64
Grain	94 70
All other farm produce, board, &c.	339 01
	$3,607 68

Expenditures for the year ending November 30, 1880.

Labor of farm hands	$574 98
" all others on farm	286 13
" students	378 04
" hired help in house	166 75
Groceries and provisions for board of family and hired help,	189 98
Meats and fish for board of family and hired help	54 24

Meal, corn and fine feed for horses, stock and swine	$337 78
Blacksmith's and wheelwright's work	77 16
Farm machines, implements and hardware	68 23
Fertilizers and seeds	217 68
Team furnishings	37 88
House furnishing	37 48
Repairs on cellar drain	31 24
Repairs on buildings	14 40
Lumber for hay scales, &c	12 81
Notes	613 63
Interest on student orders and notes	21 57
Stock	10 50
Oxen	150 00
Expenses driving oxen and shoeing	7 60
Driving horse	175 00
Pung	60 00
Harness	30 00
Fruit trees and plants, grafting apple trees, &c	36 65
Sundries	40 44
	$3,630,17

Permanent Improvements, Fertilizers, &c.

Hauling and spreading gravel on farm road	$ 75 00
Hauling and clearing of rocks from pasture for ploughing,	50 00
Fertilizers	217 68
	$342 68

STOCK.

5 Shorthorn cows.
1 " bull, three years old.
2 " heifers, one year old.
2 " steers, one year old.
3 Hereford cows.
1 " bull, two years old.
1 " heifer calf.
2 " steer calves.
2 Jersey cows.
1 Ayrshire cow, three years old.

2 Grade Shorthorn cows.
1 " " steer, one year old.
1 " Hereford cow.
3 " " heifer calves.
6 " " steer calves.
1 " Jersey cow.
1 " Ayrshire cow.
1 Pair Oxen, five years old.

Horses.

2 Team Horses.
1 Driving horse.

Sheep.

1 Shropshiredown buck.
5 " ewes.
3 Cotswold ewes.
24 Grade Cotswold ewes.
5 Lambs.

Swine.

2 Grade Suffolk breeding sows.
3 Spring pigs.
2 Fall pigs.

TIMOTHY G. RICH, *Farm Superintendent.*

TREASURER'S REPORT.

To the Trustees of the State College of Agriculture and Mechanic Arts:

GENTLEMEN—Your Treasurer herewith submits his annual report of receipts and disbursements for the College the past year.

GENERAL ACCOUNT.

1880.	RECEIPTS.		
Feb. 27,	Loan on treasury note issued	$1,000	
	Discount	10 50	$989 50
	Loan on treasury note issued	1,500	
	Discount	15 75	1,484 25
April 28,	State of Maine appropriation	–	3,000 00
Aug. 20,	St. Paul & S. C. Railroad stock sold	11,200 00	
	Ten per cent. premium	1,120 00	
		12,320 00	
	Less express charge	10 40	
			12,309 60
Jan. 1,	Rent of Professor Fernald	–	100 00
			$17,883 35
1879.	EXPENDITURES.		
Dec.	Balance due Treasurer at close of last report	–	344 29
1880.			
Feb. 27,	Paid treasury note	–	1,000 00
April 12,	L. S. Moore, Trustee expenses	–	34 28
28,	Treasury note, due February 25	$1,000 00	
	Two months' interest	10 00	1,010 00
	Treasury note, due April 27	–	1,500 00
June 30,	Professor Hamlin, planting trees	–	40 00
	W. P. Wingate, Trustee expenses	–	77 90
	S. T. Hincks, " "	–	11 40
	L. Oak, " "	–	36 87
	Q. T. V. Society, rent	–	30 00
	Superintendent College Farm, graveling	–	65 75
Aug. 3,	Hubbard & Co., supplies	–	280 00
31,	Professor Aubert, apparatus for Chemistry Department	–	50 00
	Treasury note, due April 27	1,000 00	
	Interest	20 50	1,020 50
Oct. 1,	Insurance, Kimball & Son	–	40 00
8,	Fairbanks, for hay scales	–	100 00
11,	Hubbard & Co., for supplies	–	278 83
Nov. 26,	W. H. Jordan, Experimental Department	–	28 99
			$5,948 81

CONGRESSIONAL ENDOWMENT FUND.

1880.	RECEIPTS.		
Jan. 1,	Interest, Bangor city bonds	–	$60 00
9,	" St. Paul & S. C. R. R.	–	224 00
Feb. 16,	" State of Maine bonds	–	900 00
28,	" Bangor bonds	–	30 00
Mar. 3,	" State "	–	60 00
April 7,	" St. Paul & S. C. R. R.	–	224 00
10,	" State bonds	–	444 00
June 1,	" " "	–	2,145 00
July 1,	" Bangor bonds	–	90 00
Aug. 20,	" St. Paul & S. C. R. R.	–	224 00
28,	" State bonds	–	960 00
Oct. 13,	" " "	–	444 00
Dec. 2,	" " "	–	2,145 00
			$7,950 00
1880.	EXPENDITURES.		
Feb. 18,	Paid T. G. Rich, one quarter's salary	–	125 00
March 1,	C. H. Fernald, " "	–	375 00
	W. A. Pike, " "	–	400 00
	A. B. Aubert, " "	–	375 00
	G. H. Hamlin, " "	–	300 00
	M. C. Fernald, " "	–	425 00
	W. H. Jordan, salary	–	166 67
	A. E. Rogers, "	–	166 67
April 12,	T. G. Rich, one quarter's salary	–	125 00
June 1.	M. C. Fernald, " "	–	425 00
	W. A. Pike, " "	–	400 00
	C. H. Fernald, " "	–	375 00
	A. B. Aubert, " "	–	375 00
	G. H. Hamlin, " "	–	300 00
	W. H. Jordan, " "	–	225 00
	A. E. Rogers, " "	–	225 00
25,	W. F. Decker, instruction	–	100 00
30,	" "	–	100 00
July 1,	T. G. Rich, one quarter's salary	–	125 00
3,	W. H. Jordan, instruction	–	30 00
Aug. 21,	W. A. Pike, salary	–	400 00
Sept. 1,	M. C. Fernald, one quarter's salary	–	425 00
	A. B. Aubert, " "	–	375 00
	G. H. Hamlin, " "	–	300 00
	W. H. Jordan, " "	–	225 00
	C. H. Benjamin, salary	–	25 00
	W. F. Decker, "	–	27 78
	C. H. Fernald, one quarter's salary	–	375 00
	A. E. Rogers, " "	–	225 00
Oct. 1,	T. G. Rich, " "	–	125 00
Nov. 13,	A. B. Aubert, " "	–	375 00
22,	C. H. Benjamin, " "	–	150 00
23,	W. H. Jordan, " "	–	225 00
	A. E. Rogers, " "	–	225 00
26,	C. H. Fernald, " "	–	375 00
Dec. 1,	G. H. Hamlin, " "	–	375 00
	M. C. Fernald, " "	–	450 00
			$9,816 12

SUMMARY.

GENERAL RECEIPTS.		
Loans	$2,473 75	
State of Maine	3,000 00	
Rent	100 00	
St. Paul & S. C. R. R. stock	12,309 60	
		$17,883 35
ENDOWMENT RECEIPTS.		
Interest, State bonds	7,098 00	
" Bangor bonds	180 00	
" St. Paul & S. C. R. R.	672 00	
		7,950 00
Total receipts	-	$25,833 35
EXPENDITURES.		
GENERAL ACCOUNT.		
Balance due Treasurer	344 29	
Loans and interest	4,530 50	
Trustees' expenses	160 45	
Rent, insurance	70 00	
Graveling, and trees	105 75	
Hay scales	100 00	
Farm supplies	558 83	
Apparatus and farm experiments	78 99	
		5,948 81
ENDOWMENT ACCOUNT.		
Salaries and instruction	9,816 12	
Balance in Treasury	10,068 42	
		19,884 54
		$25,833 35
LIABILITIES.		
Due on salaries	-	$125 00
RESOURCES.		
Six per cent. State of Maine bonds	-	$118,300 00
Six per cent. City of Bangor bonds	-	3,000 00
Cash in the Treasury	-	10,068 42
		$131,368 42

EBEN WEBSTER, *Treasurer.*

ORONO, December 3, 1880.

Having been directed by the Trustees to audit the foregoing account of the Treasurer, I have attended to that duty, and report that I find the same properly vouched and correctly cast.

W. P. WINGATE.

CATALOGUE

OF THE

Maine State College of Agriculture and Mechanic Arts.

ORONO, MAINE, 1880–81.

TRUSTEES.

HON. WILLIAM P. WINGATE, BANGOR, *President.*
HON. LYNDON OAK, GARLAND, *Secretary.*
HON. SYLVANUS T. HINCKS, BUCKSPORT.
HON. A. M. ROBINSON, DOVER.
HON. CALEB A. CHAPLIN, HARRISON.
HON. LUTHER S. MOORE, LIMERICK.
HON. EMERY O. BEAN, READFIELD.
HON. Z. A. GILBERT, EAST TURNER.
Secretary Maine Board of Agriculture, *ex-officio.*

TREASURER.

COL. EBEN WEBSTER, ORONO.

EXECUTIVE COMMITTEE:

HON. WILLIAM P. WINGATE.
HON. SYLVANUS T. HINCKS.
HON. LYNDON OAK.

EXAMINING COMMITTEE:

HIS EXCELLENCY HARRIS M. PLAISTED.
REV. CHARLES F. ALLEN, D.D.
REV. SAMUEL F. DIKE, D.D.

FACULTY.

MERRITT C. FERNALD, A. M.,
President and Professor of Physics and Mental and Moral Science.

ALFRED B. AUBERT, B. S.,
Professor of Chemistry and Secretary of the Faculty.

CHARLES H. FERNALD, A. M.,
Professor of Natural History.

GEORGE H. HAMLIN, C. E.,
Professor of Civil Engineering, and Librarian.

ALLEN E. ROGERS, A. M.,
Professor of Modern Languages and Instructor in Military Science.

* WHITMAN H. JORDAN, B. S.,
Instructor in Agriculture.

CHARLES H. BENJAMIN,
Instructor in Mechanical Engineering.

WILBUR F. DECKER, B. M. E.,
Instructor in Vise-work and Forge-work.

TIMOTHY G. RICH,
Farm Superintendent.

HENRY M. LANDER,
Steward.

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* Walter Ballentine, B. S., is successor to Mr. Jordan, as Instructor in Agriculture.

STUDENTS.

POST GRADUATES.

Fergerson, Willis Edwin, B. S.,	Bangor.
Morse, Charles Adelbert, B. C. E.,	Bangor.
Pease, Charles Truman, B. S.,	Bridgton.

SENIOR CLASS.

Andrews, Henry Harris,	Norway.
* Boynton, Lorin Thompson,	Ashland.
Brown, Henry William,	Calais.
Buck, Clara Louise,	Stillwater.
Colburn, Fannie Eliza,	Orono.
Farrington Edward Holyoke,	Orono.
Farrington, Oliver Cummings,	Orono.
Fogg, Charles Henry,	Biddeford.
Ingalls, Aldana Theodore,	South Bridgton.
Johnson, Robert John,	Portland.
Libby, Clara Alice,	Orono.
McIntyer, Horace Flanders,	Waldoborough.
Moor, Charles Lincoln,	Hartland.
Murray, Benjamin Franklin,	Solon.
Osborn, Edwin Winthrop,	Pembroke.
Pease, Oscar Leroy,	Stillwater.
Plaisted, Harold Mason,	Bangor.
Ring, Alice Isabel,	Orono.
Ring, May Lilian,	Orono.
Smith, Roscoe Loring,	East Orrington.
Sturtevant, George Washington,	Bowdoinham.
Wade, Frank Swan,	Athens.
White, Walter Adelbert,	Greenfield.
Wilson, John Barrows,	Orono.
Wyman, Levi Augustus,	Ellsworth.

* Deceased.

JUNIOR CLASS.

Bickford, Charles Swan,	Belfast.
Boynton, Jacob Leighton,	Ashland.
Brown, Charles Weston,	Hampden.
Buzzell, Stephen Jennings,	Argyle.
Dunn, Charles Lincoln,	Ashland.
Dunton, Oscar Howard,	Hampden.
Flint, Walter,	West Baldwin.
Fuller, George Ripley,	Tremont.
Garland, Charles Clinton,	W. Great Works.
Gould, Joseph French,	Stillwater.
Hine, Thomas Walton,	Bowdoin.
Howard, Will Russell,	Belfast.
Hurd, Alonzo L.,	Brownfield.
Keith, Alfred Justin,	Oldtown.
Kelleher, Bartholomew Patrick,	Orono.
Keniston, Frederic Andrew,	Ellsworth.
Kimball, Frank Issacher,	Alfred.
Page, Parker James,	Orono.
Patten, James Herbert,	Orono.
Reed, Frederic Martin,	Bangor.
Snow, Gleason Cyprian,	North Orrington.
Starrett, Avery Palmer,	Warren.
Tilley, Lewis Kossuth,	Castle Hill.
Todd, Frank Herbert,	Georgetown.
Webster, Eben Crowell,	Orono.
Wight, Willard Alberto,	Windsor.
Woodward, Daniel Carr,	Winthrop.

SOPHOMORE CLASS.

Cain, James Henry,	Orono.
Cilley, Jonathan Vernet,	Rockland.
Currier, George Russell,	Wilton.
Emery, Frank Edwin,	Canaan.
Emery, William Edward,	Hampden.
Fernald, Arthur Liddell,	South Levant.
Kelsea, Norman Fay,	Belfast.
Longfellow Henry Whitney,	Machias.
Merrill, Lucius Herbert,	Auburn.
Michaels, Jennie Chase,	Stillwater.
Patten, Truman Miller,	Hermon.
Powers, Harry Wilson,	Orono.
Putnam, Charles Edgar,	Jackson.
Rich, George Avery,	Orono
Robinson, Lewis, Jr.,	Hampden.
Sutton, George Arthur,	Orono.
Starbird, Ralph,	Fairfield.
Taylor, Levi William,	Jay.
Webster, Frank Carr,	Bangor.
Webster, Frank Gilman,	Orono.

FRESHMAN CLASS.

Allen, George Herman,	Dennysville.
Bailey, Edward Mansfield,	Orono.
Bartlett, Joseph Bradbury,	Nottingham, N.H.
Berry, William Alanson,	Hampden.
Burleigh, Willie Hall,	Fairfield.
Conroy, Mary Frances,	Brewer.
Dunning, James Alexander,	Bangor.
Folsom, Eugene Leslie,	Stillwater.
Hamblen, Evie Maria,	Stillwater.
Hill, John Edward,	Bangor.
Kelley, Joseph Grant,	Orono.
Ladd, Edwin Fremont,	Starks.
Longfellow, Gilbert, Jr.,	Machias.
Lunt, Clarence Sumner,	Stillwater.
McAvery, William Benson,	Charleston.
Moore, Cephas Raymond,	Starks.
Morey, William, Jr.,	Hampden.
Pattangall, William Robinson,	Pembroke.
Pendleton, Charles Shepard,	Searsport.
Rich, Herbert Lowell,	Orono.
Ricker, Flora May,	Stillwater.
Savage, Elmer Americus,	Livermore Centre.
Sawyer, Mertie,	Stillwater.
Trueworthy, Horace Griffin,	Orono.
Webber, William,	Guilford.
Whipple, Jotham, Jr.,	Solon.

SPECIAL COURSE.

Kendall, Edwin Perdy,	Bowdoinham.
Rich, Everett Frost,	Orono.
White, Louis Henry,	Greenfield.

SUMMARY.

Post Graduates,	3	Freshmen,	26
Seniors,	25	Special,	3
Juniors,	27		
Sophomores,	20	Total,	104

OFFICERS OF THE COBURN CADETS.

MAJOR—A. E. Rogers.
ADJUTANT—W. R. Howard.

COMPANY A.	COMPANY B.
Captain, F. I. Kimball.	Captain, H. A. Keith.
Senior 1st Lieut., W. Flint.	Senior 1st Lieut., J. L. Boynton.
Junior 1st Lieut., D. C. Woodward.	Junior 1st Lieut., W. R. Howard.
2d Lieut., A. P. Starrett.	2d Lieut., F. M. Reed.
1st Sergeant, C. W. Brown.	1st Sergeant A. L. Hurd.
2d Sergeant, J. F. Gould.	2d Sergeant, L. C. Tilley.
3d Sergeant, L. W. Taylor.	3d Sergeant, R. Starbird.
4th Sergeant, G. R. Currier.	4th Sergeant, H. W. Longfellow.
1st Corporal, W. E. Emery.	1st Corporal, L. H. Merrill,
2d Corporal, L. Robinson, Jr.	2d Corporal, A. L. Fernald.
3d Corporal, G. A. Rich.	3d Corporal, G. A. Sutton.
4th Corporal, J. H. Cain.	4th Corporal, F. G. Webster.

ARTILLERY OFFICERS.

Captain, G. W. Sturdevant.	1st. Sergeant, C. H. Fogg.
1st Lieut., L. A. Wyman.	2d Sergeant A. T. Ingalls.
2d Lieut., O. L. Pease.	1st Corporal, H. M. Plaisted.
	2d Corporal, R. J. Johnson.

PRIZES FOR 1880.

Coburn Prize for best Sophomore Declamation, awarded to C. W. Bickford.

Coburn Prize for best Junior Essay, awarded to F. S. Wade.

DESIGN OF THE INSTITUTION.

It is the design of the Maine State College of Agriculture and the Mechanic Arts, to give the young men of the State who may desire it, at a moderate cost, the advantages of a thorough, liberal and practical education. It proposes to do this by means of the most approved methods of instruction, by giving to every young man who pursues the course of study an opportunity practically to apply the lessons he learns in the class-room, and by furnishing him facilities for defraying a part of his expenses by his own labor.

By the act of Congress granting public lands for the endowment and maintenance of such colleges, it is provided that the leading object of such an institution 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."

While the courses of study fully meet this requisition, and are especially adapted to prepare the student for agriculture and mechanical pursuits, it is designed that they shall be also sufficiently comprehensive, and of such a character, as to secure to the student the discipline of mind and practical experience necessary for entering upon other callings or professions.

CONDITIONS OF ADMISSION.

Candidates for admission to the Freshman class must be not less than fifteen years of age, and must pass a satisfactory examination in Arithmetic, Geography, English Grammar, (especial attention should be given to Orthography, Punctuation and Capitals), History of the United States, Algebra as far as Quadratic Equations, and five books in Geometry.

Although the knowledge of Latin is not required as a condition of admission, yet the study of that language is earnestly recommended to all who intend to enter this Institution.

Candidates for advanced standing must sustain a satisfactory examination in the preparatory branches, and in all the studies previously pursued by the class they propose to enter.

Satisfactory testimonials of good moral character and industrious habits will be rigidly exacted. They should be presented on the day of examination.

The day after Commencement, which is the last Wednesday of June, and the day of the beginning of the first term, are the appointed times for the examination of candidates.

COURSES OF INSTRUCTION.

Five full courses are provided, viz: A Course in Agriculture, in Civil Engineering, in Mechanical Engineering, in Chemistry, and in Science and Literature.

The studies of the several courses are essentially common for the first two years, and are valuable not only in themselves, but also as furnishing a necessary basis for the more technical studies and the practical instruction of the Junior and Senior years.

Physical Geography, taught in the first term of the Freshman year, serves as a suitable introduction to Geology which is taken up later in each of the courses. Physiology serves as an introduction to Comparative Anatomy, and Algebra, Geometry and Trigonometry are needful preliminaries to the higher mathematics and the practical applications required in Surveying, Engineering proper, and Astronomy. Botany, Chemistry and Physics are highly important branches, common to all the assigned courses, and hence taken by all the students who are candidates for degrees.

Rhetoric, French and English Literature form the early part of a line of studies which later includes German, Logic, History of Civilization, U. S. Constitution, Political Economy and Mental and Moral Science, branches, several of which relate not more to literary culture than to social and civil relations, and to the proper preparation for the rights and duties of citizenship.

Composition and Declamation are regular exercises in all the courses throughout the four years. For the characteristic features of each course reference is made to the explanatory statements following the several schemes of study.

SPECIAL COURSES.

Students may be received for less time than that required for a full course, and they may select from the studies of any class such branches as they are qualified to pursue sucessfully. Students in Special Courses are not entitled to degrees, but may receive certificates of proficiency.

DEGREES.

The full course in Civil Engineering entitles to the Degree of Bachelor of Civil Engineering; the full course in Mechanical Engineering, to the Degree of Bachelor of Mechanical Engineering; the full course in Agriculture, Chemistry, or Science and Literature, to the Degree of Bachelor of Science.

Three years after graduation, on presentation of a satisfactory thesis with the necessary drawings, and proof of professional work or study, the Bachelors of Civil Engineering may receive the Degree of Civil Engineer; the Bachelors of Mechanical Engineering, the Degree of Mechanical Engineer; the Bachelors of Science, the Degree of Master of Science.

COURSE IN AGRICULTURE.

FIRST YEAR.

First Term.	*Second Term.*
Physical Geography.	Rhetoric and Botany.
Physiology.	Algebra and Geometry.
Algebra,	French.
P. M. Labor on Farm.	P. M. Book-Keeping and Labor on Farm.

SECOND YEAR.

First Term.	*Second Term.*
Botany, Horticulture and Arboriculture.	English Literature and Surveying or (L) History of England.
General Chemistry.	Physics.
French.	Qualitative Chemistry.
Trigonometry.	P. M. Mechanical Drawing.
P. M. Free hand Drawing.	Field Work and Forge Work.*

THIRD YEAR.

First Term.	*Second Term.*
Farm Drainage, Mechanical Cultivation of the Soil and Physics.	Organic Chemistry and Principles of Plant Feeding.
Agricultural Chemistry.	Zoology and Entomology.
Mechanics, Agricultural Engineering and Farm Implements.	German.
†American Literature.	P. M. Laboratory Work and Experimental Farming or †Analysis of English Authors.
German.	
P. M. Laboratory Work or †Analysis of American Authors.	

* Elective with a part of the Mechanical Drawing.

† To be taken in Course in Science and Literature in place of study preceding.

FOURTH YEAR.

First Term.	*Second Term.*
Landscape Gardening, Stock Breeding and Veterinary Science.	Cultivation of Cereals, care and Feeding of Animals, Dairy Farming and Sheep Husbandry.
Comparative Anatomy.	Mineralogy and Geology.
History of Civilization.	U. S. Constitution and Political Economy.
Logic.	Mental and Moral Science.
P. M. Experimental Farming and Agricultural Botany or *Historical Readings and Analysis.	

* To be taken in Course in Science and Literature in place of study preceding.

EXPLANATORY STATEMENTS.

This course is designed to fit young men to follow agriculture, as a profession, with success, as well as to prepare them for the intelligent performance of the duties of citizenship.

To this end, the curriculum of studies is largely scientific and technical, not omitting, however, those branches that have been referred to as pertaining to social and civil relations.

The instruction in agriculture is given largely by lectures, and embraces subjects of great practical importance to the farmer, which are briefly explained under the following heads:

Mechanics and Farm Implements.—Combined with recitations in mechanics from a text-book, lectures are given on the principles of construction and use of farm implements, illustrated by charts to the extent possible.

Agricultural Engineering.—The construction of roads, culverts and masonry and the strength of materials, are the principal topics treated under this head.

Mechanical Cultivation of the Soil.—This includes soil physics, or the relations of the soil to heat and moisture, the mechanical conditions of the soil best adapted to plant growth, and the objects to be gained by cultivation.

Principles of Plant Feeding.—Under this head are considered the various methods of retaining and increasing the fertility of the soil, the sources, composition and methods of valuation of commercial and farm manures, together with the principles governing their treatment and application.

Landscape Gardening.—The object of this study is to furnish correct notions of the manner of laying out and beautifying grounds.

Cultivation of Cereals.—Lectures are given upon the best methods of cultivating the principal farm crops.

Care and Feeding of Animals.—This subject includes the composition of cattle foods, their changes and uses in the animal system, and the value and economic use of the various kinds.

Dairy Farming.—This embraces the chemical and physical properties of milk, and the principles and practical operations that underlie its production and manufacture into butter and cheese.

Sheep Husbandry.—The characteristics and comparative merits of our different breeds of sheep are discussed, also their adaptability to different conditions and uses.

Botany, Horticulture and Arboriculture.—Following recitations and practical work in Botany, lectures are given upon fungi injurious to the farmer, and upon the principles of fruit and forest culture.

Chemistry.—One term is devoted to General Chemistry, one term to Agricultural Chemistry, one-half term to Organic Chemistry, and the afternoons of several terms are devoted to laboratory practice, including analyses of farm products.

Zoölogy and Entomology.—In Zoölogy, the larger groups of the animal kingdom are taken up and described in lectures which are illustrated by means of diagrams, models, or the objects themselves, and the students are required to make critical studies of typical animals of each group. Such laboratory practice is regarded an indispensable training for the more advanced study of the higher animals, and also forms the basis of the study of Historical Geology.

The studies in Entomology are conducted in a similar manner. After a general review of the orders has been given, illustrated by such common insects as are familiar to all, the beneficial and injurious are taken up more in detail, their round of life described, together with the injuries they do to the products of the farmer, the gardener, and the fruit-raiser, as well as to our forests and building materials, and the best known means of keeping them in check. For the purpose of making the instruction as practical and impressive as may be, many of the injurious insects are carried through their transformations in the class-room, where each student can note the various changes from day to day, and learn to recognize these insect enemies in any stage of their existence; and each member of the class is required to devote some time in field-collecting, and in observing the habits and work of insects in nature.

The subject of Bee-Keeping is taken up quite at length; the different kind of bees in a swarm, their habits, anatomy, and the mode of collecting the different products, are all described and illustrated by means of elaborate models, while artificial swarming, the mode of hybridizing a swarm, and the advantages of the same, with the most approved methods now in use for the care and management of bees, are also fully described.

Comparative Anatomy.—Under Comparative Anatomy are taken up the anatomy and physiology of our domestic animals, together with a brief outline of our wild animals, so far as time permits. This is followed by a course of illustrated lectures on Stock Breeding and Veterinary Science.

Mineralogy and Geology.—A preliminary course of lectures is given on Mineralogy, followed by laboratory practice in the determination of minerals, and in lithology, special attention being called to gypsum, limestone, and such other minerals as are of direct importance to the students of agriculture.

The instruction in Geology is by means of illustrated lectures and excursions, critical attention being given to the origin and formation of soils.

Law.—A course of lectures is given to the Senior class on International and Rural Law.

Throughout the course, the endeavor is made to inculcate established principles in agricultural science, and to illustrate and enforce them to the full extent admitted by the appliances of the laboratory and the farm. So far as possible, students are associated with whatever experimental work is carried on, that they may be better fitted to continue such work in after life.

Those who complete this course receive instruction also in Mathematics, French, German, English Literature, Logic, United States Constitution, Political Economy, and Mental and Moral Philosophy, and on presenting satisfactory theses upon some agricultural topic, are entitled to the degree of Bachelor of Science.

The Course in Science and Literature includes French and German, the general, mathematical and most of the scientific studies of the agricultural course. Instead of certain branches quite purely technical in the latter course, History and English and American Literature are substituted.

In the special laws of the State, passed in 1872, it is provided that young ladies "who possess suitable qualifications for admission to the several classes, may be admitted as students in the college."

In arranging the course in Science and Literature reference has been had to this enactment. From this course, however, young men who desire it, are not excluded, as, on the other hand, young ladies are not excluded from any of the other courses.

COURSE IN CIVIL ENGINEERING.

FIRST YEAR.

First Term.	*Second Term.*
Algebra.	Algebra and Geometry.
Physical Geography.	Rhetoric and Botany.
Physiology.	French.
P. M. Labor on Farm.	P. M. Book-Keeping and Labor on Farm.

SECOND YEAR.

First Term.	*Second Term.*
Trigonometry.	Analytical Geometry and Calculus.
Botany, Horticulture and Arboriculture.	English Literature and Surveying.
General Chemistry.	Physics.
French.	P. M. Mechanical Drawing and Field Work.
P. M. Free-Hand Drawing.	

THIRD YEAR.

First Term.	*Second Term.*
Henck's Field Book.	Mechanics.
Calculus.	Descriptive Geometry.
Physics.	Descriptive Astronomy.
German.	German.
P. M. Field Work and Drawing.	P. M. Isometric and Cabinet Projection and Perspective.

FOURTH YEAR.

First Term.	*Second Term.*
Civil Engineering.	Civil Engineering, Designs and Specifications.
Stereotomy.	Mineralogy and Geology.
Practical Astronomy.	U. S. Constitution and Political Economy.
Logic.	P. M. Machine Drawing and Designing.
P. M. Topography and R. R. Work.	

EXPLANATORY STATEMENTS.

The object of this course is to give the student a thorough knowledge of Higher Mathematics, Mechanics, Astronomy and Drawing, and at the same time a thorough drill in the use of instruments and in the application of mathematical principles and rules, so that the graduates can, at once, be made useful in engineering work and be fitted after a limited amount of experience, in the field, to fill positions of importance and trust. The course is also arranged so as to afford the education required to prepare the graduate for a responsible position among *men*, as well as among engineers. In this course the work is the same as for other courses until the second term of the second year, when Analytical Geometry is substituted for Qualitative Chemical Analysis.

In the first term of the Junior year, Henck's Field Book is used as a text-book, from which the student obtains methods of running railroad curves, putting in switches and turnouts, setting slope-stakes, and the calculation of earthwork. This is supplemented with examples worked by the student, and lectures on preliminary and final surveys and on the resistance to trains offered by grades and curves. These methods of the text-book, so far as possible, are applied in the field and drawing room, each student in the course being required to work two and one-half hours, either in the field or drawing room, every day.

The subject of Applied Mechanics is taken up the last term of this year, in which the students receive a thorough training in the principles underlying construction, illustrated as far as possible by practical examples, in which these principles are applied. During this term, each student in the class works two and one-half hours each day in the drawing room, where isometric, cabinet and perspective projection are taught by means of lectures and problems drawn by the students.

During the Senior year, Rankine's Civil Engineering is the text-book employed, though other works are used for reference. Besides these, much material is given in the form of lectures and notes on the blackboard.

In the first term of this year the principles of the strength of materials are taken up, supplemented by information as to durability, preservation and fitness for special purposes. The principles of hydraulics, as applied in engineering, the theories of ties, struts, beams, foundations, retaining walls and arches, are fully treated.

Stone cutting is taken up this term, by lectures and practical problems, each student being required to make a complete set of working drawings of the most common forms of masonry arches.

Also the subjects of topographical and railroad surveying are taken up this term and illustrated by a topographical survey of a portion of the college farm, and by the preliminary and final surveys for a railroad extending from the college grounds to some point on the E. & N. A. Railroad, together with the drawings, calculations of earthwork and estimate of building and equipping.

The first part of the last term of this year is devoted to the theory of roof and bridge trusses, lectures on the locomotive engine and its application to various kinds of traffic, while the greater part is given to the application of the principles already learned to the designing and calculation of various kinds of engineering structures, and to making out estimates and specifications.

This, together with the preperation of a satisfactory thesis, completes the work in the course in Civil Engineering.

The subjects of land surveying and elementary mechanical drawing, which are common to all courses, are included in the work of the department, and are taught during the summer term. The first eight weeks being devoted to drawing, while the remaining twelve weeks are devoted to practical surveying; besides an hour's recitation each day, the class is engaged two and one-half hours, either in the field or drawing room, becoming familiar with the use and care of instruments, putting into practice the problems found in their text-book, and making actual surveys.

MINERALOGY AND GEOLOGY.

Mineralogy is taught by an introductory course of lectures, followed by laboratory practice in the determination of minerals and rocks, especial attention being given to their value for building purposes. This is immediately followed by a course of lectures in Geology, together with excursions for the purpose of studying the rocks *in situ*, and also superficial deposits. Critical examinations are made in various railroad cuts, of the hardness, slaty structure, jointed structure, etc., as bearing upon the cost of excavation.

ASTRONOMY.

In the first part of the spring term, Descriptive Astronomy is taken by the students in Civil and Mechanical Engineering, of the Junior class, and Practical Astronomy, during the larger part of the term following.

The course in Astronomy is designed to enable students to determine with accuracy, geographical positions. The principal instruments employed are chronometer, sextant, transit, and for work of precision, the Repsold vertical circle, an instrument made in Hamburg, Germany, in 1874, for this institution. Practical instruction is given in the use of these instruments, and in the most approved methods of reducing observations for the determination of latitude and longitude.

DEGREES.

Students in this department secure the degree of Bachelor of Civil Engineering on graduating, with the full degree of Civil Engineering three years after, on presentation of a satisfactory thesis with proof of professional work or study.

COURSE IN MECHANICAL ENGINEERING.

FIRST YEAR.

First Term.	*Second Term.*
Algebra.	Algebra and Geometry.
Physiology.	Rhetoric and Botany.
Physical Geography.	French.
P. M. Labor on Farm.	P. M. Book-Keeping and Labor on Farm.

SECOND YEAR.

First Term.	*Second Term.*
Trigonometry.	Analytical Geometry and Calculus.
French.	English Literature and Surveying.
General Chemistry.	Physics.
Botany, Horticulture and Arboriculture.	P. M. Mechanical Drawing.
P. M. Free Hand Drawing.	Field work and Forge Work.

THIRD YEAR.

First Term.	*Second Term.*
Machinery and Mill Work.	Machinery and Mill Work.
Calculus.	Descriptive Geometry.
Physics.	Descriptive Astronomy.
German.	German.
P. M. Shop Work and Machine Drawing.	P. M. Isometric and Cabinet Projection and Perspective.

FOURTH YEAR.

First Term.	*Second Term.*
Prime Movers.	Steam Engine, Designs and Specifications.
Practical Astronomy.	Mineralogy and Geology.
Logic.	U. S. Constitution and Political Economy.
P. M. Applied Descriptive Geometry and Machine Drawing.	P. M. Machine Drawing and Designing.

EXPLANATORY STATEMENTS.

It is the design of this course to give such a knowledge of Mathematics, Mechanics, Principles of Mechanism, Drawing and Manual Art as shall enable the student successfully to enter practical life as an engineer, with the same thorough education in subjects required to fit him for the general duties of life, as is afforded by the other courses.

The first two years' work is identical with that of the students in Civil Engineering, except that forge work is taken up the second term of the second year. In the Junior year, Rankine's Machinery and Mill Work is the text-book used. The first term is devoted to the geometry of machinery, showing the students how different motions may be obtained, independently of the power required. Special attention is here given to the subject of gearing, and a full set of problems worked out, illustrating cases commonly occurring in practice. In the second term of this year the time is given to dynamics and the laws of the strength of materials.

In the Senior year Rankine's Prime Movers, Goodeve's Steam Engine and Mark's Proportions of the Steam Engine are the text-books used. During the first term, with Rankine's work as a basis, instruction is given on the prime movers in common use, illustrated by numerous problems in which students are required to work out

the important dimensions of motors to suit certain specified conditions. The second term is devoted to the steam engine and the calculution and design of machines, engines, &c.

SHOP WORK.

There are now two shops equipped according to the Russian system, and work in these is required of all students in this course. In the second term of the Sophomore year a course in forge-work is given, in which the student becomes familiar with the methods in use in actual construction. A similar course in vise work is given during the first term of the Junior year, in which a corresponding knowledge is obtained. It is the intention to add more shops at the earliest possible moment. It should be understood that it is the object in these shops to teach operations in use in a number of trades rather than the details of any one trade.

DRAWING.

The work in drawing commences with a course in Free Hand and Elementary Mechanical Drawing, extending through the Sophomore year. The first term of the Junior year the student gives the time not required for shop-work to line shading and drawing from dimensions taken by him from actual machines.

The second term of this year is devoted to isometric and cabinet projection and perspective. The time for drawing in the Senior year is given to drawing from dimensions, from locomotive details, and to designs by students, of machines, engines, &c.

The remarks under course in Civil Engineering, with regard to Astronomy, Mineralogy and Geology, apply also to this course, and to them reference is made.

These are required of all students as a condition of graduation, and must be on some subject directly connected with Mechanical Engineering.

Students in this course receive the degree of Bachelor of Mechanical Engineering upon graduation, with the full degree of Mechanical Engineer three years afterwards, upon presentation of a satisfactory thesis and proof of professional work or study.

COURSE IN CHEMISTRY.

FIRST YEAR.

First Term.	*Second Term.*
Physical Geography,	Rhetoric and Botany.
Physiology.	Algebra and Geometry.
Algebra.	French.
P. M. Labor on Farm.	P. M. Book-keeping and Labor on Farm.

SECOND YEAR.

First Term.	*Second Term.*
General Chemistry.	Qualitative Chemistry.
Botany, Horticulture and Arboriculture.	Physics.
French.	English Literature and Surveying.
Trigonometry.	P. M. Mechanical Drawing and Field Work.
P. M. Free Hand Drawing.	

THIRD YEAR.

First Term.	*Second Term.*
Chemistry.	Chemistry.
Physics.	Zoology and Entomology.
German.	German.
American Literature.	P. M. Laboratory Work.
P. M. Laboratory Work.	

FOURTH YEAR.

First Term.	*Second Term.*
Chemistry.	Chemistry.
Comparative Anatomy.	Mineralogy and Geology.
History of Civilization.	U. S. Constitution and Political Economy.
Logic.	
P. M. Laboratory Work.	P. M. Laboratory Work.

EXPLANATORY STATEMENTS.

This course aims to supply a want felt by students who wish to enter certain industries in which a somewhat extensive knowledge of Chemistry is important. The first two years are mainly like those of the other courses; Qualitative Analysis being, however, obligatory for these students in the second term of the Sophomore year.

During the Junior year, daily recitations are held in Agricultural Chemistry and elementary Organic Chemistry, and the study of advanced Inorganic Chemistry is begun. In the Senior year advanced Inorganic Chemistry is concluded and advanced Organic Chemistry taken up.

The afternoons are devoted to Quantitative Chemical Analysis by the Junior and Senior students of the course. The work consists of the most useful gravimetric and volumetric methods, beginning with the simple estimations, which are followed by more complex analyses of alloys, minerals, fertilizers, farm products, &c. A short course in the assay of gold and silver is also given.

The class-room text-books used by this department are: Roscoe's Lessons in Elementary Chemistry, Johnson's How Crops Grow, How Crops Feed, Watts' Organic Chemistry, and Wurtz's Chimie Moderne. In the laboratory are used: Craft's Qualitative Chemical Analysis, Fresenius' Quantitative Chemical Analysis, Caldwell's Agricultural Chemical Analysis, Wöhler's Mineral Analysis, J. A. Wanklyn's Milk Analysis, Flint's Examination of Urine, and Rickett's Notes on Assaying.

Some valuable books of reference are found in the library.

Students taking qualitative analysis must furnish a deposit of at least five dollars when they begin; those taking quantitative analysis are required to deposit at least seven dollars. Students taking the course in chemistry or an extended course in quantitative analysis, are expected to provide themselves with a small platinum crucible.

The students after passing all the required examinations and presenting satisfactory theses upon some chemical subject, graduate with the degree of Blachelor of Science.

Post graduate and special students can make arrangements with the Professor of Chemistry for an advanced or special course of laboratory work and recitations.

TABLE OF HOURS—First Term.

Time.	Seniors.	Juniors.	Sophomores.	Freshmen.
8 A. M.	History of Civilization, I, IV, V. Civil Engineering, II.	Agricultural Engineering, &c., I. American Literature, IV, V. Calculus, II, III.	General Chemistry.	Physiology.
9 A. M.	Landscape Gardening, Stock Breeding and Veterinary Science, I, V. Prime Movers, III. Stereotomy, II. Chemistry, IV.	German, I, II, III, IV, V.	Trigonometry.	
10 A. M.	Logic, I, II, III, IV, V.	Agricultural Chemistry, I, IV, V. Machinery and Millwork, III.	Botany, Horticulture and Arboriculture.	Physical Geography.
11 A. M.	Comparative Anatomy, I, IV, V. Practical Astronomy, II, III. (F. of T.)	Mechanical Cultivation of Soil, and Farm Drainage, I, V. Physics, I, II, III, IV, V. (L. of T.) Field Book, II.	French.	Algebra.
P. M.	Experimental Farming and Agricultural Botany, I. Historical Readings and Analysis, V. Applied Desc. Geometry and Machine Drawing, III. Topography and R. R. work, II. Laboratory work, IV. Military Drill.	Laboratory work, I, IV. Analysis of American authors, V. Field-work and Drawing, II. Shop-work and Machine Drawing, III. Military Drill.	Free-hand Drawing. Military Drill.	Labor on Farm. Military Drill.

Note.—Roman numerals refer to courses as follows: I, Agriculture; II, Civil Eng.; III, Mech. Eng.; IV, Chemistry; V, Science and Lit.

TABLE OF HOURS—SECOND TERM.

TIME.	SENIORS.	JUNIORS.	SOPHOMORES.	FRESHMEN.
8 A. M.	Mineralogy and Geology, I, II, III, IV, V.	Descriptive Astronomy, II, III. (F. of T.) Machinery and Mill work, III. Organic Chemistry, I, IV, V. (F. of T.) Advanced Chemistry, IV. (L. of T.) Principles of Plant Feeding, I, V. (L. of T.)	English Literature and Surveying, History of England (L).	Rhetoric. (F. of T.)
9 A. M.	Mental and Moral Science, I, V. Civil Engineering, II Steam Engine, III.	German, I, II, III, IV, V.	Qualitative Analysis, I, IV, V.	Algebra and Geometry.
10 A. M.	Cultivation of Cereals, care and feeding of animals, etc., I, V.	Applied Mechanics, II. Zoology and Entomology, I, IV, V.	Qualitative Analysis, I, IV, V. Analytical Geometry and Calculus, II, III.	French.
11 A. M.	U. S. Constitution and Political Economy, I, II, III, IV, V.	Zoology and Entomology, I, IV, V. Descriptive Geometry, II, III.	Physics.	Botany. (L. of T.)
P. M.	Machine Drawing and Designing, II, III. Laboratory work, IV. Chemistry, IV. Military Drill.	Chemistry and Experimental Farming, I. Analysis of English Authors, V. Isometric and Cabinet Projection, and Perspective, II, III. Laboratory work, IV. Military Drill.	Mechanical Drawing and Field work. Forge work, III. Military Drill.	Book-keeping and Labor. Military Drill.

LABOR.

It is a peculiarity of the college, that it makes provision for labor, thus combining practice with theory, manual labor with scientific culture.

The maximum time of required labor is three hours a day for five days in the week.

In the lowest class the students are required to work on the farm, and they receive compensation for their labor according to their industry, faithfulness and efficiency, the educational character of the labor being also taken into account. The maximum price paid is ten cents an hour. The labor is designed to be as much as possible educational, so that every student may become familiar with all the forms of labor upon the farm and in the garden.

The students of the three upper classes carry on their principal labor in the laboratory, the drawing rooms, the work shops, or in the field, and for it, they receive no pecuniary consideration, since this labor is of a purely educational character.

MILITARY INSTRUCTION.

Thorough instruction is given in Military Science by a competent officer. It extends through the whole college course; the Freshman, Sophomore and Junior classes receiving instruction in infantry tactics, and the Senior class, in artillery drill.

Arms are furnished by the State. The uniform is navy-blue yacht cloth, sack coat and pants, without brass buttons or trimmings that attract attention, and is required to be worn during the military exercises.

LOCATION.

The college has a pleasant and healthful location, between the villages of Orono and Stillwater, about a mile from each. Stillwater river, a tributary of the Penobscot, flows in front of the buildings, forming the western boundary of the college farm, and adding much to the beauty of the surrounding scenery.

The European and North American Railway, over which trains pass several times each day, has a station at the village of Orono. The college is within nine miles of the city of Bangor, and is consequently easily accessible from all parts of the State.

FARM AND BUILDINGS.

The college farm contains three hundred and seventy acres of land of high natural productiveness, and of great diversity of soil, and is therefore well adapted to the experimental purposes of the institution.

White Hall, the building first erected, affords excellent accommodations for a limited number of students. The lower rooms of this building are appropriated to general and class purposes.

Brick Hall contains forty-eight rooms, and has connected with it a boarding house for students. With these buildings, the institution furnishes desirable accommodations for one hundred and twenty-five students.

The Laboratory contains two apparatus rooms, a lecture room, a cabinet, a library and weighing room, a recitation room, and rooms for analytical and other purposes, and is in all respect admirably adapted to the wants of the chemical and mineralogical departments.

APPARATUS.

The college is furnished with new and valuable apparatus for the departments of Physical Geography, Chemistry, Physics, Surveying, Civil Engineering and Mechanical Engineering, to which additions will be made as the exigences of the several departments require. Models have been obtained from the United States Patent Office, and others have been purchased, that serve for purposes of instruction.

LIBRARY.

The library contains 4,855 volumes, the larger proportion of which, have been obtained through the generosity of Ex-Governor Coburn. Valuable additions have also been made to it by other friends of the college, only a small number having been purchased with money, appropriated by the State. It is earnestly hoped, that so important an auxiliary, in the education of the student, will not be disregarded by the people of the State, and that liberal contributions will be made to the library, not only of agricultural and scientific works, but also of those profitable to the general reader.

READING ROOM.

The reading room is supplied with a number of vauable newspapers and periodicals. Grateful acknowledgement is herewith made for the following papers, generously sent by the proprietors to the college:

American Cultivator, American Sentinel, Bangor Weekly Courier, Dexter Gazette, Eastern Argus, Easport Sentinel, Gospel Banner, Kennebec Journal, Maine Farmer, Maine Standard, New England Farmer, North Star, Official Gazette, U. S. Patent Office, Oxford Democrat, Piscataquis Observer, Somerset Reporter, Zion's Herald, Bangor Daily Whig and Courier, The New Religion, Portland Transcript, Newport Times, Fairfield Journal, Maine Mining Journal, Machias Union, Farmers' Review, American Naturalist.

The following are furnished by subscription:

American Agriculturist, American Journal of Science and Art, American Architect and Builder, Appleton's Journal, Atlantic Monthly, Boston Journal of Chemistry, Engineering Magazine, Gardeners' Monthly, Harper's Monthly, Harper's Weekly, International Review, Journal Royal Agricultural Society, England, Journal Franklln Institute, Lippincott's Magazine, Leslie's Illustrated News, Popular Science Monthly, Live Stock Journal, Scribner's Monthly, Agricultural Gazette, Burlington Hawkeye, Railroad Gazette, New York Tribune, Scientific American, Boston Herald, Detroit Free Press, New York World, The Household, Lewiston Journal, American Machinist, North American Rewiew.

CABINET.

Rooms have been fitted up with cases of minerals, and specimens of natural history, and several hundred specimens have been presented to the college. The valuable private cabinets of Prof. C. H. Fernald and Ex-President C. F. Allen are placed in these rooms, and are accessible to the students. All specimens presented will be properly credited and placed on exhibition. Rocks illustrating the different geological formation, and minerals found within the State, are particularly solicited.

PUBLIC WORSHIP.

All students are required to attend daily prayers at the college, and public worship on the Sabbath at some one of the neighboring churches, unless excused by the President.

EXPENSES.

Tuition is free to students residing within the State. Those from other States are charged the nominal sum of twelve dollars per term. Rooms are free to students who board in the college dining hall.

Bedding and furniture must be supplied by the students, who also furnish their own lights. Tables, chairs, bedsteads, sinks and husk mattresses can be purchased at the college at moderate rates.

The price of board is two dollars and sixty cents per week; washing averages not more than sixty cents per dozen.

The warming by steam of single rooms, (each suitable for two occupants) has averaged for the past four years about ten dollars a room for each term. The expense of heating recitation rooms and rooms for general purposes has been about two dollars a term for each student, and the incidental expenses including pay for the services of janitor, pay for bringing mail, for cleaning and renovating rooms, for general repairs, &c., have been less than three dollars per term for each student.

From the items given, with an allowance of a few dollars a year for necessary text-books, quite an accurate estimate of needful expenses can be made.

The college term-bills are payable, one-half at the commencement and the remainder at or before the close of each term.

MEANS OF DEFRAYING EXPENSES.

The terms are so arranged that the long vacation occurs in the winter, that students may have an opportunity to teach during that time. The summer vacation is in the haying season, when farm labor is most profitable. By availing themselves of the opportunities thus afforded, together with the allowance for labor on the college farm, industrious and economical students can cancel the greater part of their college expenses.

GRADUATES.

CLASS OF 1872.

Name and Occupation. *Residence.*

Benjamin F. Gould, C. E., Farmer .....San Juan, California
George E. Hammond, C. E., Civil Engineer.....Elliot
Edwin J. Haskell, B. S., Silk Manufacturer.....Saccarappa
Heddle Hilliard, C. E., Civil Engineer,
Grand Southern R. R., N. B
Eber D. Thomas, B. S., Civil Engineer.....Grand Rapids, Mich
George O. Weston, B. S., Farmer.....Norridgewock

CLASS OF 1873.

Russell W. Eaton, C. E. Cotton Mill Engineer....Providence, R. I
George H. Hamlin, C. E., Professor..... State College, Orono
Fred W. Holt, C. E., Civil Engineer..G. S. R. R., St. George, N. B
John M. Oak, B. S., Merchant.....Garland.
Charles E. Reed, C. E., Assistant Editor Free Press,
Detroit, Mich
Frank Lampsom Scribner, B. S., Tutor,
Girard College, Philadelphia
Harvey B. Thayer, B. S., Druggist.....Monson

CLASS OF 1874.

William A. Allen, C. E., Civil Engineer, M. C. R. R.....Portland
Walter Balentine, B. S., Instructor in Agriculture,
State College, Orono
William H. Gerrish, B. S., M. D., Physician.....Merrimac, Mass
John I. Gurney, B. S., Farmer..... Dorchester, Mass
David R. Hunter, B. S., Police officer.....Oakland, Cal
Louise H. Ramsdell, B. S., (Mrs. Milton D. Noyes)....Atkinson

CLASS OF 1875.

Name and Occupation. *Residence.*

Solomon W. Bates, C. E., Civil Engineer.....Waterville
Wilbur A. Bumps, C. E., M. D., Physician.....Dexter
Samuel H. Clapp, C. E., Teacher .....Newton, Mass
Lewis F. Coburn, C. E., Teacher.....Crescent City, Cal
Charles W. Colesworthy, B. S .....California
Charles F. Durham, C. E., Teacher.....Crescent City, Cal
Alfred M. Goodale, B. S., Superintendent Newton Mills, Newton Upper Falls, Mass
Edson F. Hitchings, C. E., Draughtsman..... ....Waterville
Whitman H. Jordan, B. S., Professor Agricultural Chemistry, State College, Penn
Edward D. Mayo, M. E., Draughtsman and Instructor in Drawing, Minneapolis, Minn
Albert E. Mitchell, M. E., Mechanical Engineer....Altoona, Penn.
Allen G. Mitchell, C. E., Civil Engineer.....Madison
* Fred W. Moore, B. S., Teacher.....California
Luther W. Rogers, B. S., Merchant .....Waterville
Minott W. Sewall, M. E., Mechanical Engineer...Wilmington, Del
George M. Shaw, C. E., Principal of Schools .....Oraville, Cal
Wesley Webb, B. S., Farmer.....South Freeport
* Edgar A. Work, C. E.....U. S. Military Academy

CLASS OF 1876.

Edmund Abbott, B. S., M. D., Physician.....Winterport
Charles P. Allen, B. S., Lawyer.....Presque Isle
Eldridge H. Beckler, C. E., Civil Engineer N. P. R. R., St. Paul, Minn
Fred M. Bisbee, C. E., Civil Engineer.....Santa Fe, New Mexico
Edward M. Blanding, B. S., Editor Maine Mining Journal..Bangor
Charles M. Brainard, B. S., Lumberman .....Skowhegan
George H. Buker, B. S., Apothecary.....Presque Isle
Florence H. Cowan, B. S.....Orono
Oliver Crosby, M. E., Foreman of Machine Shop...St. Paul, Minn
Vetal Cyr, B. S., Principal of Madawaska Training School, Fort Kent
James E. Dike, C. E., Surveyor.....Fargo, Dakota Ter
* Willis O. Dyke, B. S.....Gorham

*Deceased.

Name and Occupation. *Residence.*

Horace M. Estabrooke, B. S., Teacher.....Pembroke
Arthur M. Farrington, B. S., Veterinary Surgeon,
33 West 27th St. N. Y
George O. Foss, C. E., U. S. Engineer.....St. Paul, Minn
William T. Haines, B. S., Lawyer.....Waterville
Henry F. Hamilton, B. S., D. D. S., Dentist,
124 Commonwealth Avenue, Boston
Newall P. Haskell, B. S.....New Gloucester
Edward S. How, M. E., Book-keeper.....Portland
Philip W. Hubbard, B. S., Apothecary.....Farmington
Samuel M. Jones, M. E., Engineer,
Corliss Engine Works, Providence, R. I
Albert M. Lewis, B. S., Clergyman.....Sebec
Herbert A. Long, M. E., Farmer.....Bluehill
Luther R. Lothrop, C. E., Civil Engineer N. P. R. R., St. Paul, Minn
Nelson H. Martin, B. S., Teacher.....Fort Fairfield
Charles E. Oak, M. E., Surveyor.....Caribou
George D. Parks, C. E., Lawyer.....Brunswick
Hayward Peirce, B. S.....West Waldo Granite Works, Frankfort
Frank R. Reed, C. E., Carpenter.....Roxbury
Henry J. Reynolds, B. S., Druggist.....Machias
Charles W. Rogers, M. E., Machinist.....Charlestown, Mass
William L. Stevens, M. E., Agent of Flouring Mills,
Minneapolis, Minn
John H. Williams, B. S., Teacher.....Milo

CLASS OF 1877.

Alvah D. Blackington, C. E., City Engineer.....Rockland
Robert B. Burns, B. C. E., Superintendent of Schools,
Fort Fairfield
Eugene H. Dakin, B. S., Apothecary.....Bangor
Edward F. Danforth, B. S., Lawyer.....Skowhegan
Augustus J. Elkins, B. M. E., Draughtsman and Scaler..Oldtown
Alica T. Emery, B. S., Teacher.....Orono
Samuel W. Gould, B. S., Lawyer.....Showhegan
Joseph C. Lunt, B. C. E., Merchant.....Fort Fairfield
Fred F. Phillips, B. S., Law Student.....Bangor
Samuel Shaw, B. M. E., Architectural Draughtsman..Boston, Mass

Name and Occupation. *Residence.*

Frank P. Stone, B. S., Farmer.....Livermore Falls
Thomas J. Stevens, B. M. E., Apothecary.....Auburn
George E. Sturgis, B. C. E., Apothecary.....Oregon
Charles E. Towne, B. C. E., Government Surveyor,
Helena, Montana
James W. Weeks, B. M. E., Draughtsman... Cedar Rapids, Iowa
Nellie E. Weeks, B. S., (Mrs. Llewellyn Spencer).....Orono
Ivan E. Webster, B. S., Lumberman.....Orono

CLASS OF 1878.

Emma Brown, B. S., Teacher .....Orono
Andrew J. Caldwell, B. M. E., Draughtsman ....Brooklyn, N. Y.
Cecil C. Chamberlain, B. S., Clerk in Lumber Business, Geneseo, Ill
George C. Fernald, B. C. E., Merchant.....Waterloo, Iowa
James Heald, B. S., M. & St. P. R. R .....Minneapolis, Minn
John Locke, B. S. .....Maine Central R. R., Portland
Frank J. Oakes, B. C. E., Assistant City Engineer.....Lowell, Mass
John C. Patterson, B. C. E., Civil Engineer, St. Paul & Manitoba
R. R., Norman, Dakota Territory
Winfield E. Tripp, B. C. E., Law Student.....Albany, New York
Edward C. Walker, B. S., Lawyer.....Lovel
Otis C. Webster, B. S., Druggist.....Augusta

CLASS OF 1879.

Harry P. Bean, B. C. E., Civil Engineer C. M. & St. Paul R. R.,
Parker, Dakota Territory
Edward J. Blake, B. C. E., Civil Engineer, B. & M. R. R. R.,
Burlington, Iowa
Simon P. Crosby, B. S., Law Student.....Dexter
John D. Cutter, B. S., Medical Student,
University of the City of New York.
Wilbur F. Decker, B. M. E., Inst'r in Vise Work and Forge Work,
State College, Orono
David A. Decrow, B. C. E., Draughtsman....Lockport, New York
Willis E. Ferguson, B. S., Farmer.....Bangor
Charles W. Gibbs, B. C. E., B. & M. R. R. R., Burlington, Iowa
Annie M. Gould, B. S., Teacher.....Stillwater
Nellie M. Holt, B. S., Teacher .....Orono
Frank E. Kidder, B. C. E., Student of Architecture,
Institute of Technology, Boston, Mass

Name and Occupation.	*Residence.*
Mark D. Libby, B. C. E., Stock Breeder	Belmont, Kansas
Charles S. Loring, B. M. E., Machinist	Winthrop
George P. Merrill, B. S., U. S. Fish Commission,	Washington, D.C
Arthur L. Moore, B. S., Farmer	Limerick
Charles A. Morse, B. C. E., Draughtsman, C. B. & Q. R. R.,	Burlington, Iowa
Fred D. Potter, B. M. E., Draughtsman	Providence, R. I.
Alton J. Shaw, B. M. E., Mechanical Engineer	Auburn
Percia A. Vinal, B. S., Teacher	Orono
George O. Warren, B. S., Farmer	Fryeburg
Herbert Webster, B. S., Lumberman	Orono

CLASS OF 1880.

Horace W. Atwood, B. S., Student in Veterinary Science,	New York City
James M. Bartlett, B. S., Assistant in Chemistry,	Wesleyan University, Middletown, Conn
Albert H. Brown, B. S	Oldtown
Marcia Davis, B. S., Teacher	Stillwater,
Fred B. Elliott, B. S., Farmer	Bowdoin
Sarah P. Farrington, B. S., Teacher, State Reform School,	Cape Elizabeth
Charles W. Fernald, B. S., Teacher	Cedar Rapids, Iowa
Fred W. Fickett, B. S., Teacher	Etna
George W. Lufkin, B. C. E., Teacher	North Yarmouth
Frank A. Mansfield, B. S., Teacher	Camden
Annie A. Mathews, B. S., Teacher	Stillwater
Henry W. Murray, B. C. E., Teacher	Farmington, California
Franklin R. Patten, B. C. E., Civil Engineer	Newport, R. I
Charles T. Pease, B. S., Civil Engineer, P. W. & B. R. R.,	Philadelpaia, Pa
James F. Purington, B. S., Farmer,	Bowdoin

OFFICERS OF THE ASSOCIATE ALUMNI.

PRESIDENT.

EDWARD M. BLANDING, Bangor.

SECRETARY.

PROF. W. H. JORDAN, State College, Penn.

TREASURER.

PHILIP W. HUBBARD, Farmington.

CLASS SECRETARIES.

1872. E. J. HASKELL, Saccarappa.
1873. J. M. OAK, Garland.
1874. W. A. ALLEN, Portland.
1875. W. H. JORDAN, State College, Penn.
1876. N. P. HASKELL, New Gloucester.
1877. S. W. GOULD, Skowhegan.
1878. C. E. WALKER, Lovell.
1879. F. E. KIDDER, Inst. Tech., Mass.

CALENDAR.

1881—Feb. 8. Tuesday, Second Term commences.

June 23, 24. Thursday and Friday, Examinations.

" 25. Saturday, Prize Declamation by Sophomores.

" 26. Sunday, Baccalaureate Address.

" 27. Monday, Prize Essays by Juniors.

" 29. Wednesday, Commencement.

" 30. Thursday, Examination of candidates for Admission.

Vacation of five weeks.

Aug. 9. Tuesday, Examination of Candidates for Admission.

First Term commences.

Nov. 21, 22. Monday and Tuesday, Examinations.

Vacation of eleven weeks.

1882—Feb. 7. Tuesday, Second Term commences.

SUMMARY OF

METEOROLOGICAL OBSERVATIONS,

TAKEN AT THE

Maine State College of Agriculture and Mechanic Arts,

Latitude 44° 54′ 2″ N. Longitude 68° 40′ 11″ W.,

From January, 1880, to January, 1881.

BY PRESIDENT FERNALD.

Height of instruments above the level of the sea, 134 feet, until June, 1879, and 129 feet since that date.

EXPLANATIONS, DEDUCTIONS AND REMARKS.

The hours of observation are the same as those formerly adopted by the Smithsonian Institution, viz: 7 A. M., and 2 P. M., and 9 P. M.

The figures in the columns headed "Force or pressure of vapor," show the height at which a column of mercury is maintained by the weight of the moisture of the air.

The warmest day of the year 1880 was July 10th, when the mean temperature was 82°.3, and the coldest day was February 2nd, when the mean temperature was 4°.4 below zero.

The highest temperature (94°.8) recorded during the year was on the 10th of July, and the lowest temperature (15°.4 below zero) on the 14th of January.

The range of temperature between the two extremes is 110°.2, or 4°.6 less than the average range between the extremes for the last twelve years.

The warmest day within the period covered by the tables was August 7th, 1876, when the mean temperature was 85°.3, and the coldest day January 8, 1878, when the mean temperature was 17°.2 below zero. The highest temperature (96°.7) occured on August 6th, 1876, and the lowest temperature (35°.6 below zero) on January 8th, 1878.

A comparison, as regards temperature, of the several months of 1880 with the mean temperature of corresponding months for twelve years, is given below:

Months.	Mean temperature from 1869 to 1880, inclusive.	Mean temperature for 1880.		
January	16°.07	22°.23	6°.16	warmer.
February	19°.04	22°.30	3°.26	"
March	27°.05	25°.55	1°.50	colder.
April	39°.91	40°.41	0°.50	warmer.
May	52°.66	56°.64	3°.98	"
June	62°.37	64°.28	1°.91	"
July	67°.89	69°.41	1°.52	"
August	65°.69	65°.53	0°.16	colder.
September	57°.47	60°.41	2°.94	warmer.
October	46°.46	47°.53	1°.07	"
November	32°.31	31°.02	1°.29	colder.
December	19°.71	20°.83	1°.12	warmer.

The year 1880 (mean temperature 43°·85) averaged 1°.63 warmer than the mean temperature of the twelve years above noticed.

The earliest autumnal frosts was on the morning of September 24th.

Thunder showers occured on April 13th, May 8th, 9th, 10th and 20th; July 3d, 9th and 16th; and on August 21st and September 21st.

The rain-fall of 1880 (33.34 inches) was less by 9.94 inches than the average annual rain-fall for twelve years; and the amount (69 inches) of snow less by 25.75 inches than the average annual snow-fall for the same period.

The number of days in 1880 on which the sky was, at least, eight-tenths covered with clouds, was 79, or 22 per cent. of the whole number. The number of days on which, at least, .01 of an inch of rain or snow fell, was 140, or 38 per cent. of the whole number; the number of days, therefore, without any considerable quantity of rain or snow, was 226, or 62 per cent. of the whole number.

The prevailing wind during the month of September was from the northeast and north; during February, April and June, from the southwest and south; and during the remaining months of the year, from the northwest and west. The wind rose to a strong gale on February 6th, on April 29th, and on the night of October 22d and the morning of October 23d.

The prevailing wind for the twelve years from 1869 to 1880, inclusive, was from the northwest and west, although during the warm months it was principally from the southwest and south. The relative direction and force of the wind for this period are indicated approximately by the following numbers: N. W. and W., 4; S. W. and S., 3; S. E. and E., 1; N. E. and N., 2.

The principal auroras of 1880 were on the evenings of February 6th, April 1st and 28th, May 1st, August 12th, 13th, 26th and 31st, October 1st, and November 2d, 3d and 30th.

The principal lunar halos were on April 20th and August 18th, and the principal solar halo, on the 8th of May.

The zodiacal light was most conspicuous on the evening of January 11th.

The barometer indicated the greatest atmospheric pressure in the month of January, and the least in the month of March. The range between the two extremes was 1.554 inches.

The least mean pressure was during April, and the greatest during November, when the average height of the mercury in the barometer, at an elevation of 129 feet above sea level, was 30.006 inches. The mean pressure of vapor in the atmosphere was sufficient to sustain a column of mercury .269 of an inch in height.

Summary by Years—From 1869 to 1880, Inclusive.

Year	Thermometer in the Open Air.											Rain and Snow.		Clouds.	Winds.				Barometer.											
	Mean of hottest day.		Mean of coldest day.		Highest temperature.		Lowest temperature.		Mean of maximum temperature.	Mean of minimum temperature.	Mean of three daily observations.	Amount of rain or melted snow in gauge—inches.	Depth of snow—inches.	Mean percentage of cloudiness.	Per cent. of direction.				Barometer height reduced to freezing point.			Force or pressure of vapor in inches.			Relative humidity or fraction of saturation.				
	Day.	Temperature.	Day.	Temperature.	Day.	Temperature.	Day.	Temperature.							N. W. and W.	S. W. and S.	S. E. and E.	N. E. and N.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.			
		°		°		°		°	°	°	°																		
1869,	July 11	74.2	Jan. 22	-3.8	July 11	87.2	Mar. 6	-22.0	50.01	33.37	41.77	44.72	84.92	.55	.41	.29	.14	.16	30.519	28.858	29.780	.826	.005	.250	100	25	76			
1870,	July 24	82.8	Jan. 14	-9.7	July 24	94.0	Feb. 4	-17.0	53.02	35 45	44.26	40.98	78.75	.50	.35	.33	.10	.22	30.578	28.902	29.791	.878	.016	.279	100	13	74			
1871,	May 30	76.0	Jan. 23	-14.9	May 30	88.6	Jan. 23	- 20 6	50.44	33.33	41.92	41 63	80.50	.50	.42	.33	.10	.15	30.585	29.000	29.795	.956	.006	.244	100	17	75			
1872,	July 16	79.5	Dec. 25	-11 8	June 30	90.6	Dec. 25	-23.0	50.02	33.22	41.60	48.58	113.00	.53	.37	.28	13	.22	30.446	28.712	29.766	.793	.011	.258	100	23	77			
1873,	July 30	75.5	Jan. 30	-4.9	July 26	92 0	Jan. 30	-26.5	49.93	31.28	40.93	40.78	124.00	.49	.38	.30	.10	.22	30 680	28.423	29.794	778	.009	.232	100	20	74			
1874,	July 15	76.3	Jan. 26	-15.5	July 15	86.3	Feb. 2	-26.0	50.18	32 21	41.35	44.94	132.00	.52	37	.36	08	.19	30.719	28.981	29.825	.794	.009	.246	100	19	76			
1875,	Aug. 29	74.8	Nov 30	-9.8	Aug. 29	87.8	Dec. 20	23.0	48.49	30.11	39.58	41.94	93.80	.50	.46	.30	.09	.15	30.550	28.939	29.814	.844	.014	.239	100	24	76			
1876,	Aug. 7	85.3	Feb. 24	-13.4	Aug. 6	96.7	Dec. 26	-21.5	50.74	32.32	42.03	52 37	123.00	.49	.43	.30	.08	.19	30,783	28.458	29.808	.935	.014	.256	100	21	76			
1877,	Aug. 24	75.1	Jan. 25	-11.3	June 1	89.0	Jan. 26	-32.5	52.45	33.63	43 39	40.17	66.50	.52	.34	.30	.12	.24	30.494	28.888	29.837	.762	.009	.269	100	19	76			
1878,	June 30	81.9	Jan. 8	-17.2	June 30	93.5	Jan. 8	-35.6	52.07	35 38	44.34	48.57	59.50	.56	.33	.33	.13	.21	30.554	28.794	29.796	.872	.009	.286	100	20	78			
1879,	July 16	77.8	Dec. 21	-11.7	Aug. 2	88.0	Dec. 27	-26.0	50.10	31.64	41.62	46.73	112.00	.51	.38	.37	.07	.18	30.638	28.537	29.851	843	.012	.258	100	15	75			
1880,	July 10	82.3	Feb. 2	-4.4	July 10	94.8	Jan. 14	-15.4	52.05	33.57	43.85	33.84	69.00	.50	.39	.23	.18	.20	30.644	29.090	29.874	.790	.015	.269	100	23	75			
	1876.		1878.		1876.		1878.					Mn.	Mean.																
12 yrs	Aug. 7	85.3	Jan. 8	-17.2	Aug. 6	96.7	Jan. 8	-35.6	50.80	32.96	42.22	43.87	94.75	.52	.39	.31	.11	.19	30.783	28.423	29.812	.956	.005	.257	100	13	76			

Summary by Months—1880.

Months.	Thermometer in the Open Air.										Rain and Snow.		Clouds.	Winds.				Barometer.			Force or pressure of vapor in inches.			Relative humidity or fraction of saturation.		
	Mean of hottest day.		Mean of coldest day.		Highest temperature.		Lowest temperature.		Mean of maximum temperatures.	Mean of minimum temperatures.	Mean of three daily observations.	Amount of rain or melted snow in gauge—inches.	Amount of snow—inches.	Mean percentage of cloudiness.	Per cent. of direction.				Barometer height reduced to freezing point.								
	Day.	Temperature.	Day.	Temperature.	Day.	Temperature.	Day.	Temperature.							N. W. and W.	S. W. and S.	S. E. and E.	N. E. and N.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
		°		°		°		°	°	°	°																
January..	28	39.6	14	0.5	28	46.8	14	-15.4	32.62	8.88	22.23	2.83	13.00	.50	.46	.22	.10	.22	30.644	29.293	29.968	.267	.021	.109	100	27	81
February..	29	43.0	2	-4.4	29	49 5	2	-15.2	30.74	11.02	22.30	2.83	16.50	.47	.36	.38	.08	.18	30.510	29.21	29.948	.307	.015	.113	100	34	80
March.....	4	41.5	9	9.1	4	47.7	9	-5.6	32.96	16.08	25.55	2.86	18.00	.52	.42	.11	.14	.33	30.482	29.090	29.875	.216	.019	099	100	33	68
April.....	30	49.9	12	21.4	21	61.7	12	14.1	48.81	31.12	40.41	4.15	2.00	.49	·35	·37	.15	.13	30.244	29.101	29.789	.397	.062	.182	100	33	70
May.....	27	77.3	1	34.8	27	90.0	1	29.4	66.73	45.82	56.64	2.17	–	.48	.33	.25	.22	.20	30.145	29.370	29.861	.664	.124	.346	100	23	72
June.....	28	73.8	8	55.1	29	88.2	5	41.4	74.14	53.10	64.28	0.73	–	.45	.24	.31	.27	.18	30.133	29.353	29.818	.790	.248	.439	93	32	72
July.....	10	82.3	29	60.7	10	94.8	29	48.2	78 60	58.65	69.41	3.32	–	.50	.38	.19	.27	.16	30.009	29.493	29.790	.721	.216	.516	99	27	73
August....	1	79.8	26	54.7	1	90.0	26	38.1	74.67	54.22	65.53	1.54	–	.40	.29	.28	.18	.25	30.208	29.512	29.890	.730	.196	.475	100	31	74
September.	5	75.7	23	47.8	5	88.8	24	31.3	69.39	50.56	60.41	3.84	–	.58	.24	.17	.27	.32	30.214	29.553	29.870	.749	.181	.429	100	39	80
October....	17	62.7	28	32.0	16	71.1	29	21.6	56.15	37.13	47.53	4.15	–	.54	.43	·27	.24	.06	30.294	29.116	29.878	.533	.114	.266	100	38	76
November.	6	56.8	27	7.6	7	63.5	27	-6.5	38.72	22.95	31.02	3.52	7.00	.44	.66	.16	.13	.05	30.412	29.267	30.006	.526	.033	.152	100	40	77
December..	14	37.1	31	-0.5	14	41.8	31	-6.7	27·12	13.28	20.83	1.90	12.50	.57	.55	.02	.06	.37	30.336	29.237	29.792	.251	.035	.103	100	51	83
Year	J'ly 10	82.3	Feb 2	-4.4	J'ly 10	94.8	Jan 14	-15.4	52.05	33.57	43.85	33.84	69.00	.50	.39	.23	.18	.20	30.644	29.090	29.874	.790	.015	.269	100	23	75