Public Documents of Maine:

BEING THE

ANNUAL REPORTS

OF THE VARIOUS

Public Officers and Institutions

FOR THE YEAR

1886

VOLUME II.

AUGUSTA:
SPRAGUE & SON, PRINTERS TO THE STATE.
1886.

Dormitory and Boarding House. White Hall. Laboratory.

Principal Buildings of the State College of Agriculture and the Mechanic Arts, Orono.

ANNUAL REPORTS

OF THE

Trustees, President, Farm Superintendent and Treasurer

OF THE

STATE COLLEGE OF AGRICULTURE

AND THE

MECHANIC ARTS,

Orono, Me., 1885.

Published agreeably to a Resolve approved February 25, 1871.

AUGUSTA:
SPRAGUE & SON, PRINTERS TO THE STATE.
1886.

TRUSTEES' REPORT.

To His Excellency, the Governor, and the Executive Council:

The Trustees of the State College respectfully submit, herewith, their eighteenth annual report, together with the reports of the President and Members of the Board of Instruction, and of the Treasurer of the College.

These reports will indicate the character and amount of work performed during the year and the present condition of the Institution.

CHANGES.

Gen. R. B. Shepherd, of Skowhegan, has been appointed Trustee to fill the vacancy made by the expiration of the term of Hon. Caleb A. Chaplin, of Harrison.

Lieut. Charles L. Phillips, of the 4th U. S. Artillery, has been assigned to the position of Military Instructor in place of Lieut. Edgar W. Howe, the term of whose service at the College expired in July last, by virtue of a regulation of the War Department. Lieut. Howe discharged his duties as Military Instructor to the satisfaction of the Trustees, and retires with their best wishes. This is the only change that has occurred in the Board of Instruction.

EXPENDITURES.

The Legislature of 1885 appropriated $1,650 to provide apparatus for the use of the College. Of this sum, $1,250 have been expended. The purchases were made with careful discrimination as to what was first needed and most needed, and distributed to the several departments as required by the

wants of each, and in harmony with the views of the several instructors. The value of this fresh instalment of apparatus to the departments has fully justified the expenditure.

There was also an appropriation of $1,000 for finishing, and furnishing with tools and other equipments, several of the workshops. This sum has been very advantageously expended for the purposes indicated. It will be encouraging to the friends of practical education to know the fact, that much of the work of fitting the shop for use, has been performed by students.

Under the supervision of Mr. Flint, instructor in shop work, they made the drawing tables, work benches, and cases for the safe keeping of tools. They also hung the shafting, and set up the machinery and put it in running order, thus securing to themselves, valuable drill in mill-work. Much of this work required skill in the performance, and is very creditable to both the instructor and students.

The Trustees were much gratified to find a most creditable degree of interest in shop practice, on the part of the students. They not only give to such practice the hours assigned, but, in the course of the term, many hours not required by College regulations. As shown by the report of Prof. Benjamin, the shops now furnish considerable work outside the regular course of instruction, for which the students receive reasonable compensation. By the aid of newly acquired tools, many repairs are made by them of a character that formerly required skilled workmen from the outside.

THE FARM.

The farm management discloses fresh improvements each year. The grounds immediately around the farm buildings have been much improved since our last report, and the buildings have been repaired and painted. Eighteen acres of land having been reclaimed from bushes and barrenness and relieved of much of its surplus moisture by drainage, will be added to the productive area of the farm next season. The

stock has been improved in quality and increased in numbers and value. Its present fine condition shows unmistakable evidence of skilful management.

Valuable experiments in the feeding of stock, in determining the relative value of seeds, and the relative manurial value of different fertilizers, have been continued from preceding years, and new experiments of an important character have been commenced.

The last Legislature appropriated $1,000 to remove a large barn, standing somewhat remote from the farm buildings, to a location in convenient proximity to the present stock barn, and to make the necessary repairs and remodel it for use as a stock barn. Having been filled with hay and grain last summer, the removal will not be made until next spring. A substantial foundation has, however, been constructed, and other preparations made for completing the work in the spring.

EXPERIMENT STATION.

Since our last report an experiment station has been established on the College farm, in conformity to an act of the Legislature. The Trustees of the College were glad to be able to give to its managers space in the Chemical Laboratory for analytical purposes, and a room in another building for an office. Although the station has been located on the College farm, its management is as independent of that of the College as if its location were in another part of the State.

It cannot, however, fail of being of great, direct advantage to students in the Agricultural Course, as well as of indirect advantage to other classes of students.

THE AGRICULTURAL COURSE.

There has been somewhat prevalent a belief that the College has not been doing all that might reasonably be expected in behalf of students in the Agricultural Course.

The branches of study in this course are taught by men of large experience and exceptional ability. The skilful man-

agement of the farm, in its various branches, affords valuable opportunities to become acquainted with the best methods of farm practice now employed.

In addition to the features mentioned, there is now the presence upon the College farm of the recently established Experiment Station, where, under the direction of an able Board of Managers, experimentation of great importance, bearing upon questions of immediate interest to the farmers of the State, will be carried on, affording opportunity to the student in the Agricultural Course to become familiar with the methods employed and the results obtained.

With a well-devised scheme of study pursued under the direction of competent instructors, and the advantages of surroundings of a most favorable character, the College now offers to the student in agriculture, opportunities of exceptional excellence.

NEED OF MORE ROOM.

The most serious hindrance to the growth of the College, at the present time, is the want of room in several of the departments. A protracted effort resulted, two years ago, in obtaining more space for the Department of Mechanical Engineering, in the form of rooms for several kinds of shop work, where the student, with the requisite tools, "could learn to do things," in the line of such work, "by doing them."

The usefulness of these well-equipped rooms, and their importance to the department of which they constitute a part, are so obvious, that no intelligent friend of practical education, familiar with the facts, would desire to eliminate them, even if by so doing he could return to the State Treasury five times their cost. Such an act would be analogous to severing a limb from the human body. If the Departments of Natural History and Agriculture could be supplied with the room they need, their power of usefulness would be increased in like, perhaps in much greater, ratio.

The Library, inadequate under the most favorable circumstances to meet the reasonable wants of the College, is di-

vested of half the usefulness of which it is capable by limitations that can be removed only by affording it more room. If the pent-up Departments of Natural History and Agriculture, and of the Library, could be supplied with necessary rooms and cases and cabinets for classification and arrangement, the books and specimens that have been accumulating ever since the College began to exist would be brought forth from the nooks and corners and boxes, where they have been concealed in dust and darkness, and made to impart knowledge to the present and future generations of students.

Moreover, new and much-needed contributions would flow into these departments spontaneously, and greatly increase the value of the instruction therein given.

THE CADET.

Under the above name the students of the College, with the approval of its officers, commenced the issue of a monthly publication in September last. The first number issued was creditable to its publishers. Each number since has been an improvement upon the preceding number. The Trustees are glad to commend its spirit and purposes.

The present *morale* of the College is, in a high degree, encouraging. Unabated zeal, riper experience, a disposition to make the best use of the means at command, the inspiration of past success and unwavering faith in the future, are the characteristics that give to the Institution each year increased power of usefulness and a stronger hold upon the confidence of the people.

Respectfully submitted.

LYNDON OAK,
President of the Board of Trustees.

PRESIDENT'S REPORT.

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

GENTLEMEN: Inasmuch as no session of the Legislature is expected to occur during the coming winter, this report will not include statistical data, but will be devoted, chiefly, to a simple statement of changes and progress in the affairs of the College for the year now closing.

DEATH OF EX-GOVERNOR COBURN.

The earnest and abiding interest manifested by Ex-Gov. Coburn in this Institution, renders his removal by death from further participation in its affairs, a loss seriously felt by all connected with the College, as the loss of a warm, personal friend. After serving twelve years as President of the Board of Trustees, it is true his official relations with the College were dissolved, but so active were his sympathies with it and for it, they did not cease to manifest themselves, even down to the closing hours of life.

The magnificent contribution which he made in his will to the further endowment of the College will stand as a lasting memorial to the generosity of his nature and to his sympathetic interest in the cause of industrial education. When his benefaction shall become available, it cannot fail to enhance the usefulness of the College, and in the permanent good it will accomplish, it cannot fail to prove an enduring monument to his memory.

APPARATUS FOR THE SEVERAL DEPARTMENTS.

The provision made by the recent Legislature for apparatus has enabled the professors in charge of the several departments to make desirable additions to their collections, by which the instruction they give is rendered more satisfactory to themselves, and more valuable to the students. In the Department of Chemistry, a balance microscope, chemical glassware, and other pieces have been added to the previous stock; in the Department of Agriculture, a microscope, books of reference, and other pieces; in the Department of Natural History, several microscopes, together with microscopic slides for botanical study; in the Department of Physics, a dynamo, resistance coils and other electrical pieces; in the Department of Civil Engineering, a plane table of the value of three hundred dollars, and other engineering pieces, and in the Department of Mechanical Engineering, equipments to the shop (which will be given in the report of that department), to the amount of one thousand dollars.

INSTRUCTION.

The work of instruction has been carried forward during the year with but slight modifications requiring mention.

Lieut. Edgar W. Howe, whose term of successful service as Military Instructor in this Institution expired on July 1, 1885, has been succeeded by Lieut. Charles L. Phillips, 4th United States Artillery, under whose direction the efficiency of the military system in the College has been fully maintained. The Coburn Cadets have been divided into two companies, and the principle of competition comes in to contribute to the interest in the military exercises and to the success of the instruction given.

With increased facilities for shop instruction, and the consequently larger demands upon the time of Mr. Flint, it has been found necessary to relieve him of one recitation to which he has hitherto attended. Accordingly, the class in free-hand drawing has been taught during the autumn by Mr. Arthur

D. Page of Orono, a member of the Senior Class. The success of Mr. Page has justified his selection for this service.

In all the departments, the effort has been constant to maintain a high standard of instruction and to render the courses of study of real value. In this instruction the practical element has been a marked feature. In the laboratory, in the shop, in the drawing-rooms, and in the field, the lessons of the class-room are practically applied. The utility to the student of such application can scarcely be over-estimated.

COMMENCEMENT AND DEGREES.

The exercises of the fourteenth Commencement, beginning June 20th and ending June 25th, were well attended and elicited the customary manifestations of interest.

The Sophomore prize declamations were given on Saturday evening, June 20th, and resulted in the assignment of two prizes by the Committee of Award; the first to Addison Roberts Saunders of Hanover, and the second to Henry Allen McNally of Fort Fairfield. The Committee also named as entitled to honorable mention, Howard Scott Webb of Skowhegan.

At the Baccalaureate services, Sunday evening, June 21st, an eloquent and impressive discourse was given by Rev. A. K. P. Small, D. D., of Portland, from the words: "Eye hath not seen nor ear heard, neither hath entered into the heart of man the things which God hath prepared for them that love him." 1st Cor. 2-9.

The Junior exhibition, Monday evening, June 22nd, resulted in the award of a single prize to James Frederic Lockwood of Brewer, writer of the essay entitled "A New Civilization," with honorable mention of Arthur Dean Page of Orono, writer of the essay upon "State Education."

Both the Sophomore and Junior prizes were given by Mrs. H. E. Prentiss of Bangor.

On Tuesday afternoon, June 23rd, military exercises occurred on the College grounds; and in the evening the President's reception.

The graduating exercises of the Senior Class were on Wednesday, June 24th. The names and titles of the several parts, and the names of candidates receiving degrees, are given below.

Bachelor's Degree in Course. Degree of Bachelor of Science—Course in Agriculture: George Walter Chamberlain, West Lebanon; Stock Feeding: Joseph Perkins Moulton, Sanford; Farm Machinery and its Care: Fremont Lincoln Russell, No. Fayette; Profits of Agriculture. Degree of Bachelor of Science—Course in Chemistry: Henry Torsey Fernald, Orono; "Dirigo:" George Loring Hanscom, Orono; In Memory of the Union Soldiers. Degree of Bachelor of Science—Course in Science and Literature: Frank Orion Dutton, Orono; Relation of Physiological Laws to Education. Degree of Bachelor of Civil Engineering: Asher Dole, Brewer; Science and Engineering: Frank Eugene Hull, Warren; The Jury System: Austin Herbert Keyes, Orland; Professional and Practical Training for Engineers: William Morey, Jr., Hampden; Progress. Degree of Bachelor of Mechanical Engineering: Elmer Orlando Goodridge, Milo; Boiler Explosions: Leonard Gregory Paine, Bangor; Effect upon Operatives of Improved Machinery: Elmer Ellsworth Pennell, Saccarappa; Banking: Louis Warner Riggs, North Georgetown; Longfellow and his Writings.

Master's Degree in Course. Civil Engineer—Frank Issacher Kimball, Greensburg, Pa.: Thesis, Preliminary Surveys. Mechanical Engineer—Walter Flint, Orono: Thesis, Blue Print Apparatus.

Master's Degree out of Course. Master of Science—Wesley Webb, Newark, Del., class of 1875: Thesis, Psychic Influences in Breeding. Henry William Brown, Newcastle, class 1881: Thesis, Expression in the Human Eye. Civil Engineer—Franklin Reed Patten, Hampden, class 1880: Thesis, Town and City Drainage. George William Lufkin, Biddeford, class 1880: Thesis, Bridge Roundings. Me-

chanical Engineer—Henry Harris Andrews, Hampstead, Va., class 1881: Thesis, Filing and Running Circular Saws.

CONVENTION IN WASHINGTON.

Agreeably to a call of the United States Commissioner of Agriculture, for a meeting of "representatives of different agricultural colleges and allied State institutions," I attended the convention of such officers in Washington, the second week in July. It has been my privilege to attend before, two similar conventions in Washington, one in 1872 and the other in 1882. Opportunity has thus been afforded to make intelligent comparison of the state of these institutions at the different dates, based upon the representations of their executive officers. It is pleasing to know that these institutions clearly hold, at the present time, a stronger and more assured position than at any previous period of their history, and that the work they are accomplishing is of more satisfactory character than at any previous date. In most of the States they are receiving more and more completely the endorsement and sympathetic co-operation of the industrial classes, in whose interests they were organized.

It is, I believe, moreover, true that those colleges which, in their organization, courses of study and industrial features, have adhered most closely to the letter and spirit of the endowment act of 1862, have met with the greatest favor and the largest success.

On the subject of labor as associated with study, of practice as associated with theory, the trend of thought, as shown by statements of methods in the different institutions, seems to be in favor of larger prominence of really educational labor, with, perhaps, less prominence of labor which is not strictly educational, and which is, hence, performed simply for pay. It is a noticeable fact, that from the interchange of views secured by such conventions as that recently held in Washington, each college is profiting by the experience of others and also that in the methods which have proved most useful and satisfactory, they are approaching one another.

As one of the means of enlarging the field of usefulness of the land-grant colleges, the experiment station is coming to hold a conspicuous place; and very properly at the recent convention this subject received a generous share of attention. Hearty endorsement was given to the so-called Cullen bill (which was reported favorably by the Congressional Committee on Agriculture), for the establishment and support of national experiment stations in connection with the colleges organized under the Act of Congress of 1862. A committee was appointed by the convention, charged with the duty of securing, if possible, early action by Congress upon the Cullen bill, or one that shall contain its essential features. The importance of this measure, it is believed, will insure for it favorable action when it can be considered by that body.

STATE EXPERIMENT STATION.

Although the State Experiment Station is under different management from the College, both in its Board of Control and in its officers, yet the fact of its establishment at the College has rendered its work of especial interest to all connected with this Institution.

The re-arrangement of the Chemical Laboratory, by which a portion of it was devoted to the purposes of the Station, has proved of no disadvantage to the College, and the space assigned, I believe, has proved adequate for the analytical work of the Station and satisfactory to its officers. Besides the room formed by partitioning off a part of the Analytical Laboratory, the Station also controls room No. 7, in White Hall, which is used as an office.

Each year since the organization of the College, a certain amount of experimental work on the farm has been accomplished, and the results have been reported. The amount, necessarily, has been small from the limited expenditures which the College could make in this direction. Enough, however, has been done to demonstrate the value of such experimentation. The demand for carefully-conducted farm

experiments, and for other investigations promising to be of value to the farmer, has constantly increased. It is gratifying to know that this demand, in larger measure than hitherto, can now be satisfied; and that the work of the College as an educational institution can now be supplemented on a fairly liberal scale by the important experimental and scientific work committed by State law to the Experiment Station.

BUILDING FOR THE DEPARTMENTS OF AGRICULTURE AND NATURAL HISTORY, NEEDED.

In the report of last year, the need of a building for the Departments of Agriculture and Natural History was fully set forth, and the necessity for such a building was recognized by the committee from the Legislature which visited the College. This necessity is realized more and more each year by those whose duty it is to give instruction in these departments, and is obvious, also, to all who are conversant with the conditions and limitations under which instruction is now given in the important lines of study involved.

Of so much consequence do I regard this building to the future development of the course in agriculture and to the teaching of allied branches, that I am unwilling its importance shall be lost sight of in the time intervening between legislative sessions.

Most earnestly, therefore, do I ask that, on all suitable occasions, you urge the necessity of this building, to the end that, at the next session of the Legislature, provision shall be made for its construction.

There is no question that money devoted to needed buildings and to needed apparatus in an institution in which the scientific and practical elements predominate, is money well applied, and that it will bring returns of permanent value.

VARIOUS ITEMS.

The accessions to the College at the beginning of the present (autumn) term were twenty-seven in number, and other new students are expected at the beginning of the next term.

The Coburn Cadets passed the several days of the State Fair at Lewiston, tenting on the fair grounds. They are indebted to the kindness and favor of Payson Tucker, Esq., General Manager of the Maine Central Railroad, for free transportation to Lewiston and return.

The new paper by the students of the College, "The Cadet," published monthly during term-time, gives evidence of good management, and promises to be of interest and value.

Meetings by the branch of the Young Men's Christian Association established at the College have been maintained regularly throughout the year.

CONCLUSION.

Specific information in regard to the farm and the experiments still continued by its Superintendent, in regard to the library, also in regard to the shop with its increase of equipment, and other facts of interest, will be found in the accompanying reports submitted by a few of the officers of the college. Reports from all have not been deemed necessary.

A good degree of earnestness in study and work has been manifested on the part of students, and commendable progress in the several lines of study has been made.

My associates in the Faculty have exhibited their accustomed zeal and devotion to all the interests with which they have been entrusted.

Grateful that the College has been blessed with a fair degree of prosperity during the year, I sincerely trust the future holds in store still better things for it, in the way of the means and conditions of yet greater usefulness.

Regarding with pride its substantial work in the past as evidenced by the important and responsible positions to which its graduates are attaining, it will be the endeavor, I am confident, of all who have to do with the administration of its affairs, to render it still more worthy of the confidence and support of all good citizens.

Respectfully submitted.

M. C. FERNALD, *President.*

LIBRARIAN'S REPORT.

President Fernald:

The number of books and pamphlets in our library has been considerably increased during the past year by accessions from various sources.

Our thanks are due to the Hon. E. C. Allen of Augusta, for a generous donation of books; we are also indebted to Senator Hale, Representative Boutelle, Senator Blair of New Hampshire, and the Executive Departments at Washington, for public documents; from the State Librarian we have received about twenty volumes of the Maine Law Reports, making our set nearly complete; catalogues and reports have been received from various colleges and associations. Senator Hale has presented the library with a hundred dollars, which will be used as a nucleus for a library fund. Our warmest thanks are extended to him for this liberal gift.

The standing shelves in the room used for library purposes have been removed, necessitating the packing away of several hundred books, but I think that, by this means, those remaining will be rendered more available.

I cannot refrain from urging the necessity of better library accommodations; they are indispensable. We have now a large number of books and pamphlets and no means of caring for them properly or making them useful; for an institution doing the work that this College does and having its possibilities, the present arrangement is entirely inadequate.

Very respectfully,

A. E. ROGERS.

Department of Mechanical Engineering.

President Fernald:

I desire to report to you at the present time, the improvements made the past year in the facilities for teaching Mechanical Engineering theoretically and practically.

The appropriation granted by the Legislature last spring, for the purchase of new machinery and apparatus, has been nearly all expended and with good results. A recitation-room, drawing-room, and office have been finished in the second story of the shop building and equipped with the necessary tables, cases, blackboards, etc. The rooms are well lighted, convenient, and furnish ample accommodation for the classes at present using them.

Two lathes for the wood-shop were purchased of Fay & Scott of Dexter. A circular saw and table, and all the shafting, pulleys, hangers, and belting, were purchased of Benjamin & Allen of Oakland, another Maine firm. This machinery is all creditable to the skill and enterprise of Maine manufacturers and has given excellent satisfaction.

We have also added to our stock of machinery a small drill press, and set of drills, a Boston portable forge, a feed pump for the boiler, and a set of pipe-fitter's tools. These have been in almost daily use since their purchase, and will soon pay for themselves.

Under Mr. Flint's supervision, the shafting was hung and the machinery set up by the students themselves, giving them a practical drill in mill-work.

The shop now furnishes considerable work for the students outside of the regular course of instruction. During the

spring term twenty drawing tables were made for the large drawing-room and eight stationary tables for the mechanical drawing-room. This term, an apparatus for taking blue prints, designed by Mr. Flint, has been made in the shop, and several more drawing tables are in process of construction. A certain amount of miscellaneous work has been done in the making of tables, shelves, etc., and in gas and steam fitting. For such extra work students receive pay in proportion to their skill and ability. While the Russian system of shop-work is adhered to for the purpose of teaching the use of the various tools, it is intended to supplement this system as far as possible by giving each student a chance to make some articles of practical use, paying him for the labor if the articles are salable.

It has been found by actual experience that any student will take more pains and do better work when actually making something than when merely working to learn some process or with the object of attaining good rank. Instruction in wood-turning will hereafter be given to the mechanical students during the spring term.

Few additions have been made to the apparatus for instruction as yet, since it is desired to use the money to the best advantage. I intend to have as much of the apparatus as possible constructed in the shop. The Brown & Sharpe Manufacturing Company of Providence have presented us with an accurately-constructed model of the involute gearing made by them. We have also received from the Ball Engine Company of Erie, Pennsylvania, a full set of blue prints of the working drawings of their engine. I have the promise of another gearing model from the Champion Machine Company of Springfield, Ohio. These will all be valuable additions to our somewhat meager stock of apparatus.

Respectfully submitted.

C. H. BENJAMIN.

DEPARTMENT OF AGRICULTURE.

President M. C. Fernald:

In addition to my College work, I undertook the management of the Agricultural Experiment Station from the time of its establishment, in March, until the arrival of Professor Jordan, in the latter part of June, receiving, therefor, the regular salary of the director of the station during the time I was thus employed. The money received from this work has been paid over to the College authorities, believing that the time which I devoted to the station work properly belonged to the College.

Three students graduated from the Course in Agriculture, in June, of the present year, presenting theses on Maine Grasses, Business Farming, and Vitality of Agricultural Seeds, of whom one is engaged in farming, one is taking a course in Veterinary Science in the American Veterinary College of New York City, and one is, at present, engaged in teaching.

The only change that has been made in the instruction given in the Department of Agriculture, during the past year, has been in the addition of instruction in practical farm management to the regular theoretical work of the course. Students in Agriculture will, in the future, spend four hours per week, for at least one year, studying the details of farm management, under the direction of the Farm Superintendent.

The defects in the reference library of the department, to which I called attention in my last report, have been in part removed by the addition of some twenty volumes bearing on scientific agriculture, and provision has been made for a much larger outlay in this direction.

The pressing need felt by this department, and to as great an extent, also, by the Department of Natural History, is a building which shall afford better facilities for teaching the various branches in these departments.

The instructors in both departments are occupied, at times, in class-room work throughout the entire morning, and each hour brings with it a different subject. In order to do work that will be in any way satisfactory to ourselves, it is often necessary to prepare material before meeting the class. The preparation of this material requires both time and space. While the afternoons may be utilized in preparation, it is useless to attempt to do much in this direction where it is necessary to do the work in a room common to all the classes. What are needed are lecture rooms with small laboratories attached, provided with movable tables, on which prepared material may be arranged and brought into the general room when needed, and afterwards readily and quickly removed. A cabinet is also necessary, in which material that may be used from year to year can be stored, thus saving time and expense.

It is also desirable that a large room or hall be provided, in which agricultural machinery may be exhibited. I have reason to believe that such a hall could readily be filled without expense to the College, and an exhibition of this kind could not fail to be of great value to all agricultural students and the community at large. It is to be hoped that the time is not far distant when the financial condition of the College will admit of an extension of the Agricultural Course in various directions. Horticulture has never received the attention at this Institution that its importance demands. It is a large and growing interest in the State, and as soon as circumstances will permit, in my opinion, it is desirable to establish a professorship of horticulture and to secure the necessary facilities for giving thorough instruction in this department.

Respectfully submitted.

WALTER BALENTINE.

Farm Superintendent's Report.

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

GENTLEMEN :—I herewith present an account of farm transactions for the year ending November 30, 1885.

FARM STATEMENTS.

APPRAISAL OF PROPERTY BY TRUSTEES November 30, 1884.

Live Stock	$3,924 00	
Crops	2,789 00	
		$6,713 00

APPRAISAL OF PROPERTY BY TRUSTEES November 30, 1885.

Live Stock	$4,744 00	
Crops	2,450 00	
		$7,194 00
Cash receipts for the year ending November 30, 1885		$4,417 66
Cash expenditures for the year ending November 30, 1885		3,921 37
Liabilities November 30, 1884		4,825 73
Liabilities November 30, 1885		6,195 36

Farm Credits.

Cash on hand	$496 29	
Cash due from various parties	316 00	
Machinery and implements purchased during the year, less 20 per cent	85 70	
Draining and clearing land	183 25	
New work on buildings	170 73	
Lumber provided for new barn	245 00	
Excess of appraisal of November 30, 1885, above appraisal of November 30, 1884	481 00	
		$1,977 97

Farm Debits.

Excess of liabilities of November 30, 1885, above liabilities of November 30, 1884	$1,369 63
Net earnings of the farm for the year	$608 34

The areas of crops and their yields were as follows:

Grass	86 acres	127	tons
Mensury barley	9 "	143	bushels
Hulless barley	9 "	128	"
Oats	7½ "	513	"
Oats without manure	10½ "	418	"
Potatoes	1 "	154	"

Much of the grass on land that was seeded down last year suffered severely from the dry autumn and the freezing and thawing of early winter, the fields being bare until the middle of January. As a result, the crop was very light compared with that of previous years, when fields in similar condition of fertility yielded, upon an average, about two tons per acre.

The appearance of the grass lands now, is in marked contrast with it one year ago.

All of the fields, both old and newly seeded, are covered with a good growth of aftermath, and the plants are well set and vigorous.

If there are any particulars in which the correctness of the course pursued in the management of our grass lands are evident, they are in the varieties of seed used and methods of application. After the soil is in fine mechanical condition and the grain harrowed in, the surface is left as smooth as possible by the smoothing and bush harrows.

Upon this smooth, even surface, the seed is sown and rolled down with a heavy roller. By this process, the seed is left near the surface and plants are produced from a much greater part of it than when applied upon the harrow-furrows and deeply covered, as is quite commonly done.

In seeding upon this clay soil we use one bushel of Redtop, one peck of Timothy and five pounds of Alsike clover per acre. This mixture gives a growth of fine hay and clover, that for cattle feeding I have never seen excelled. Alsike, from its fineness of stalk, and consequent ease in curing, and the readiness with which its stalks are eaten by animals, has such advantages over Red clover that we have discontinued the use of the latter, except for experimental purposes.

The eighteen acres of new valley land that were grubbed and broken two years ago were put in fine condition last spring, a good coat of cattle manure being applied, and seeded to barley and grass-seed. The wet season injured the grain but secured us an excellent stand of grass, which, in September, stood quite knee high.

The ten and one-half acre oat-field was old sod land, plowed up and seeded to oats for the purpose of rotting the sod and improving its condition, no manure being applied.

The seven and one-half acres of oats were grown upon rich land that had potatoes upon it one year ago. May 23, fifteen bushels of Hogan oats were sown and the lot seeded to grass. The oats were very good, standing shoulder high and very even. Severe winds and rain laid the crop flat just before harvest. When drawn to the barn the crop weighed twenty-six tons, and at threshing, produced five hundred and thir teen bushels, or sixty-eight bushels per acre. "Beauty of Hebron" potatoes yielded well, but many of them were lost by rot.

The field containing twelve acres directly in front of the farm buildings, has been in rather an unpromising condition — wet, rough and unproductive. This season, by the removal of stones, plowing, draining and manuring, it is changed into a dry, smooth, fertile tract, which will be seeded to grass permanently next spring.

An elevated floor has been placed in the stock barn, over the driveway and twelve feet above it. One of the central sections was left without flooring, which gave a space sixteen feet long and the width of the driveway, open from the driveway to the roof. From this point the hay fork was operated in connection with a car or carrier, suspended upon a wooden track near the roof and extending the entire length of the barn.

The economy of this arrangement over that previously adopted was manifest from the first. It is a most valuable addition to the machinery of the farm, and, considering its cheapness, should be in the possession of every hay producer.

Preparations for the reconstruction of the long barn have been made—lumber provided, and a heavy basement wall, resting entirely on the solid ledge, completed. It is designed to have it ready for occupancy early next summer.

ANIMALS.

There are upon the farm forty-six cattle, forty of them being thoroughbred. Of these eight are Shorthorn, sixteen are "Cattle Club" Jerseys and sixteen are "Maine State" Jerseys. Approved bulls are at the heads of these herds, and the young animals produced are of much excellence. Twenty-six cows and heifers are now in milk. The average number in milk during the year was twenty-three. From these, 126,784 lbs. of milk were produced. Of this amount, 110,636 lbs. were manufactured into butter, producing 5,730 lbs.; an average of 19 5-16 lbs. of milk for each pound of butter.

The calls for Shropshire sheep by farmers have been such that the flock is reduced in number to fifteen animals.

As in previous years, Chester pig breeding has received attention, young animals for breeding purposes having been sent into many sections of the State.

Representatives of the different classes of stock were exhibited at the New England Fair at Bangor last September, where they were awarded seven first and two second premiums.

EXPERIMENTS.

Experiment No. 13—Continued.

The question :—Can profitable crops be grown continuously by use of commercial fertilizers, but without aid from animal manure,—presses itself forward for examination.

A field of five and one-half acres of uniform clay loam soil, underlaid by compact clay subsoil, offered opportunities for this experiment upon plots sufficiently large to show their products and costs, in actual field culture.

Previous to 1882, this field had been in grass many years, and was much reduced in fertility. It was used in 1882 and 1883 as a fertilizer test field, with the plots running in an opposite direction to those of the present plan, and cropped with beans each year.

In 1884, it was divided into nine plots, each one of which contained one-half acre or more, and received the kind and quantity of fertilizing material as indicated in the accompanying plan. The field was sown to barley, using two and one-half bushels of seed per acre, and seeded to Timothy and Red clover.

The grass seed came up finely but was badly killed by the drouth of August and the severe freezing of the following fall and spring. In March last, Timothy and clover were again sown upon the surface, and at this date, November, the entire field is covered with well-established Timothy and clover plants.

This young grass was not sufficiently advanced to add much to the crop of hay harvested in July, which cannot be regarded as indicating the fertility of the soil of the different plots, as much more of the grass was killed on some plots than on others. The hay was quite clean Timothy and of good length.

Probably the appearance of the plots at the present time, when all are evenly set in grass, is a better indication of their state of fertility than either the grain or grass crops harvested are.

Plot No. 2 (ashes) has quite a good growth of clover aftermath.

Plot No. 7 (potash) has a very fair second crop of clover upon it.

Plots 2 and 7 show much more clover than other plots do.

Plot No. 8 (ammonia) is, and has been throughout the season, deeper in color than any other plots, but has very little clover upon it.

There is some difference in the appearance of the other plots, but it is not so marked as in those indicated.

PLOT.	FERTILIZER PER ACRE IN 1884.	Cost of Fertilizer per Acre in 1884.	Yield of Barley per Acre in 1884.	Yield of Hay per Acre in 1885.
No. 1.	Bradley's X. L. Superphosphate, 500 lbs.	$10.00	37. bush.	2316 lbs.
No. 2.	Unleached Ashes from mixed wood, 75 bushels.	$15.00	38.8 "	3520 "
No. 3.	Rockland Lime, 12 casks.	$12.50	22.5 "	2288 "
No. 4	Raw Bone, 500 lbs.	$9.50	27.8 "	1185 "
No. 5.	Dissolved Bone, 500 lbs.	$10.00	25.2 "	2275 "
No. 6.	Nothing.	-	22.5 "	2352 "
No. 7.	Muriate of Potash, 200 lbs.	$5.00	31.5 "	2208 "
No. 8.	Sulphate of Ammonia, 200 lbs.	$9.00	18. "	2828 "
No. 9.	Bradley's X. L. Superphosphate, 500 lbs.	$10.00	38.2 "	2336 "

No fertilizers were applied in 1885.

Each plot will be supplied as often as is thought necessary with the same kind of fertilizing material that it has already received.

The experiment offers opportunities for the study of other questions besides the leading one.

First: The comparison of raw bone with dissolved bone.

Second: Are the results of ashes upon this soil to be attributed to the lime, or potash which they contain? The products from the lime plot and the potash plot must settle this point.

Third: What will be the plant-producing capacity of the unmanured plot, after a series of years? or, will a clay soil become entirely exhausted of its fertility when subjected to thorough mechanical working, and crop rotation?

Experiment No. 14.

Relating to the Feeding Value of Purple Hulless Barley.

In the spring of 1882 a few quarts of Purple Hulless barley were received from the Department of Agriculture, and grown with favorable results. In 1883 its yield in field culture, on rich heavy clay, was forty-two bushels per acre. In 1884, on fairly fertile soil, our entire crop averaged upwards of thirty-five bushels per acre.

Having no knowledge whatever of its feeding value, the following trial was made, comparing it with common six-rowed barley of good quality, and also with good mixed corn meal.

Four thrifty Chester pigs, five months of age, with a united weight of 597 lbs., whose feed had been corn meal and wheat bran, were fed for thirty days with twenty-five pounds of common six-rowed barley, ground and moistened with water. At the end of the period they weighed 743.5 lbs., a gain of 146.5 lbs., and had consumed 750 lbs. of meal; 5.12 lbs. of barley meal being required to produce one pound of growth.

The feed was then changed to Purple Hulless barley, ground and moistened with water as before. Twenty-five pounds of this was fed daily for thirty days, at the end of which time they weighed 913 lbs., having gained 169.5 lbs. from 750 lbs. of meal; 4.425 lbs. of Hulless barley being required for each pound of live weight gained.

The feed was then changed to corn meal, moistened as before, thirty pounds being fed daily. At the end of this

thirty-day period their weight was 1078 lbs., a gain of 165 lbs. for the 900 lbs. of corn meal fed; 5.45 lbs. of meal being required to produce each pound of live pork.

In the first period the amount of food furnished was greater in proportion to the total live weight of animals than it was in either of the others, and should have been more productive of gain than a smaller ration of twenty pounds, which would have corresponded in volume with 25 lbs. of food for 750 lbs. of animal weight in the second period, and 30 lbs. of food for 900 lbs. of animal weight in the third period.

One bushel of common six-rowed barley, weighing 48 lbs., produced 9.37 lbs. of live pork.

One bushel of Purple Hulless barley, weighing 62 lbs., produced 14 lbs. of live pork.

One bushel of mixed corn, weighing 56 lbs., produced 10.27 lbs. of live pork.

The results of this test, although covering a period of ninety days, cannot be accepted as establishing the comparative feeding values of these grains, but they do indicate very strongly that Hulless barley has a high feeding value, and if sustained by future trials at stall and pen, must be regarded —from its vigor, productiveness and heavy weight—as a valuable crop for the stock-raising farmer.

Experiment No. 15.

Difference Between Live and Dressed Weight of Pigs.

Thirteen Chester pigs were taken from their dams at eight weeks of age, and fed upon skimmed milk, corn meal and wheat bran, in moderate quantities. After five months of age they were given all they would readily consume of a mixture of four parts of corn meal and one part of wheat bran, by weight, moistened with water and skimmed milk. Two months of this feeding showed that 4.78 lbs. of meal and bran were required to produce each pound of live pork, and that the food required to produce each pound of live pork cost just six cents. At seven months of age they were in fine condition,

but not excessively fat, with the exception of No. 11. He had been, throughout the whole time, larger and fatter than his mates. They were weighed and immediately slaughtered. Eighteen hours afterwards the weights of the carcasses, tongues and rough fat were taken. Had their feeding been continued an additional sixty days, I have no doubt the average shrinkage of the entire lot would not have exceeded ten per cent of their live weights.

Pig.	Live Weight.	Dressed Weight.	Shrinkage.	Per Cent Shrinkage.
No. 1	247.5 lbs.	207 lbs.	40.5 lbs.	16.3
" 2	252 5 "	212 "	40.5 "	16
" 3	221 "	191 "	30 "	13.5
" 4	230 "	188 "	42 "	18.2
" 5	252 "	209 "	43 "	17
" 6	258 "	208 "	50 "	19.3
" 7	245 "	201 "	44 "	17·9
" 8	249 "	209 "	40 "	16
" 9	266 "	219 "	47 "	17.6
" 10	237 "	202 "	35 "	14.7
" 11	330 "	303 "	27 "	8.18
" 12	293 "	242 "	51 "	17.4
" 13	283 "	241 "	42 "	14.8

EXPERIMENT NO. 16.

Oat Seeding.

A tract of somewhat worn grass land—soil, clay loam—was plowed in November, 1884, and in May, 1885, prepared for seeding to oats, by thorough pulverization and an application of five hundred pounds of superphosphate per acre.

Five uniform plots, each containing one-twentieth of an acre, were sown with varying quantities of seed. Upon five other plots of like areas and conditions the work was repeated. The accompanying table shows the results.

	Seed per Acre.	Yield per Acre.
Plot No. 1	2 bushels	56.3 bushels
" 2	4 "	58.6 "
" 3	6 "	63.4 "
" 4	8 "	56 "
" 5	10 "	55.7 "
" 6	2 "	56.6 "
" 7	4 "	66 "
" 8	6 "	67.3 "
" 9	8 "	69.4 "
" 10	10 "	55.6 "

EXPERIMENT NO. 17.

Beef Production.

The importance of many phases of the subject of beef production, among which are—early and late maturity; cost at different ages; amounts of food required to produce growth during the monthly periods from birth to maturity, and others, seemed to require practical illustration here upon the farm, and this experiment is intended for that purpose.

The conditions under which it is conducted are somewhat different from those which govern beef production on most farms, and shows the raising of steers by stall-feeding throughout their whole lives, without material aid from pasturage. It is not intended in any way to compare the economy of the two processes of stall-feeding and pasturage. Many farms have not the advantage of cheap lands for pastures, and necessarily stall-feeding is resorted to. This applies to the management of our dairy cows here, where they receive most of their food from their stalls each day, and also to the heifer grown from calfhood to places in the dairy herd.

Two full-blood Shorthorn bull calves: "Berry," calved September 25, 1884, weighing sixty-five pounds, and "Bright," calved December 2, 1884, weighing seventy-five pounds at birth, were taken from their dams at two days of age, and fed new milk until their digestive powers were sufficiently strong to take skimmed milk.

Berry scoured very badly for several weeks, notwithstanding very light rations, which accounts for the protracted use of new milk in his case. They were fed separately from each other, and in uniform periods of thirty days each.

The food for each animal was weighed, and much care exercised to prevent waste. At no time were they over-fed.

The milk was given in equal parts, morning and night; the grain was fed dry twice daily, and the hay in three equal feeds per day. All feeding was done in the barn.

They were given an hour or two in the open yard daily, when the weather would admit, and from July to October, inclusive, they had access to a small pasture run that was fed down closely by other stock. The amount of food obtained in this pasture can only be estimated. This is unfortunate, but there is no bare run on the farm, of sufficient size to give them an opportunity for the exercise required for full development.

During September and October, both animals were badly worried by flies, which partially explains the cause of the low gain made by each animal during these periods.

BERRY.

FIRST MONTH—October.			
Weight, 89 lbs. Gain, 24 lbs.			
Feed—New milk	130 lbs.	$2 27	
Cost of each pound of growth, 9.45 cents.			
SECOND MONTH—November.			
Weight, 131 lbs. Gain, 42 lbs.			
Feed—New milk	310 lbs.	5 43	
Cost of each pound of growth, 12.92 cents.			
THIRD MONTH—December.			
Weight, 177 lbs. Gain, 46 lbs.			
Feed—New milk	400 lbs.	7 00	
Hay	10 "	06	
Cost of each pound of growth, 15.34 cents.			$7 06
FOURTH MONTH—January.			
Weight, 237 lbs. Gain, 60 lbs.			
Feed—New milk	150 lbs.	2 62	
Skimmed milk	300 "	75	
Barley meal	45 "	51	
Hay	22 "	13	
Cost of each pound of growth, 6.68 cents.			4 01
Castrated during this period.			

BERRY—Continued.

FIFTH MONTH—February.			
Weight, 295 lbs. Gain, 58 lbs.			
Feed—Skimmed milk	600 lbs.	$1 50	
Barley meal	68 "	76	
Hay	48 "	28	
Cost of each pound of growth, 4.37 cents.			$2 54
SIXTH MONTH—March.			
Weight, 335 lbs. Gain, 40 lbs.			
Feed—Skimmed milk	600 lbs.	1 50	
Bran	72 "	81	
Cotton seed meal	26 "	39	
Hay	62 "	37	
Cost of each pound of growth, 7.67 cents.			3 07
SEVENTH MONTH—April.			
Weight, 413 lbs. Gain, 78 lbs.			
Feed—Skimmed milk	600 lbs.	1 50	
Bran	80 "	1 01	
Cotton seed meal	45 "	67	
Hay	90 "	54	
Cost of each pound of growth, 4.76 cents.			3 72
EIGHTH MONTH—May.			
Weight, 472 lbs. Gain, 59 lbs.			
Feed—Skimmed milk	600 lbs.	1 50	
Bran	87 "	98	
Cotton seed meal	51 "	76	
Hay	125 "	75	
Cost of each pound of growth, 6.76 cents.			3 99
NINTH MONTH—June.			
Weight, 540 lbs. Gain, 68 lbs.			
Feed—Skimmed milk	600 lbs.	1 50	
Bran	60 "	68	
Barley meal	35 "	39	
Cotton seed meal	50 "	75	
Hay	240 "	1 44	
Cost for each pound of growth, 7 cents.			4 76
TENTH MONTH—July.			
Weight, 599 lbs. Gain, 59 lbs.			
Feed—Skimmed milk	600 lbs.	1 50	
Bran	68 "	77	
Cotton seed meal	50 "	75	
Hay	150 "	90	
Cost of each pound of growth, 6.64 cents.			3 92
ELEVENTH MONTH—August.			
Weight, 663 lbs. Gain, 64 lbs.			
Feed—Skimmed milk	600 lbs.	1 50	
Bran	70 "	79	
Cotton seed meal	50 "	75	
Hay	140 "	84	
Cost of each pound of growth, 6.06 cents.			3 88

BERRY—Concluded.

TWELFTH MONTH—September.			
Weight, 708 lbs. Gain, 45 lbs.			
Feed—Skimmed milk	300 lbs.	$0 75	
Bran	80 "	90	
Cotton seed meal	54 "	81	
Hay	121 "	73	
Cost of each pound of growth, 7.08 cents.			$3 19
THIRTEENTH MONTH—October.			
Weight, 735 lbs. Gain, 27 lbs.			
Feed—Skimmed milk	300 lbs.	75	
Bran	89 "	1 00	
Cotton seed meal	54 "	81	
Hay	239 "	1 43	
Cost of each pound of gain, 14.77 cents.			3 99
FOURTEENTH MONTH—November.			
Weight, 779 lbs. Gain, 44 lbs.			
Feed—Bran	82 lbs.	92	
Cotton seed meal	14 "	21	
Linseed meal	27 "	51	
Hay	278 "	1 66	
Cost of each pound of gain, 7.04 cents.			3 30

During the first fourteen months of his life, "Berry" ate food to the value of $55.08, and gained in weight 714 pounds, making the gain cost 7.71 cents per pound.

BRIGHT.

HALF MONTH.			
Weight, 97 lbs. Gain, 22 lbs.			
Feed—New milk	144 lbs.	$2 52	
Cost of each pound of growth, 11.45 cents.			
FIRST MONTH—January.			
Weight, 143 lbs. Gain, 46 lbs.			
Feed—New milk	210 lbs.	3 67	
Skimmed milk	210 "	52	
Cost of each pound of growth, 9.1 cents.			$4 19
Castrated during this period.			
SECOND MONTH—February.			
Weight, 200 lbs. Gain, 57 lbs.			
Feed—Skimmed milk	600 lbs.	1 50	
Barley meal	24 "	27	
Cost of each pound of growth, 3.1 cents.			1 77

BRIGHT—Continued.

THIRD MONTH—March.			
Weight, 160 lbs. Gain, 60 lbs.			
Feed—Skimmed milk	600 lbs.	$1 50	
Bran	36 "	40	
Cotton seed meal	22 "	33	
Hay	21 "	12	
Cost of each pound of growth, 3.91 cents.			$2 35
FOURTH MONTH—April.			
Weight, 317 lbs. Gain, 57 lbs.			
Feed—Skimmed milk	600 lbs.	1 50	
Bran	52 "	58	
Cotton seed meal	45 "	68	
Hay	52 "	31	
Cost of each pound of growth, 5.38 cents.			3 07
FIFTH MONTH—May.			
Weight, 372 lbs. Gain, 55 lbs			
Feed—Skimmed milk	600 lbs.	1 50	
Bran	82 "	92	
Cotton seed meal	50 "	75	
Hay	85 "	51	
Cost of each pound of growth, 6.69 cents.			3 68
SIXTH MONTH—June.			
Weight, 455 lbs. Gain, 83 lbs.			
Feed Skimmed milk	600 lbs.	1 50	
Bran	61 "	68	
Barley meal	35 "	39	
Cotton seed meal	50 "	75	
Hay	125 "	75	
Cost of each pound of growth, 4.9 cents.			4 07
SEVENTH MONTH—July.			
Weight, 514 lbs Gain, 59 lbs.			
Feed—Skimmed milk	600 lbs.	1 50	
Bran	68 "	74	
Cotton seed meal	50 "	75	
Hay	100 "	60	
Cost of each pound of growth, 6.08 cents.			3 59
EIGHTH MONTH—August.			
Weight, 603 lbs. Gain, 89 lbs.			
Feed—Skimmed milk	600 lbs.	1 50	
Bran	70 "	79	
Cotton seed meal	50 "	75	
Hay	88 "	52	
Cost of each pound of growth, 4 cents.			3 56
NINTH MONTH—September.			
Weight, 635 lbs. Gain, 35 lbs.			
Feed—Skimmed milk	600 lbs.	1 50	
Bran	70 "	79	
Cotton seed meal	54 "	81	
Hay	87 "	53	
Cost of each pound of growth, 10.37 cents.			3 63

BRIGHT—Concluded.

TENTH MONTH—October.			
Weight, 662 lbs. Gain, 24 lbs.			
Feed—Skimmed milk	600 lbs.	$1 50	
Bran	90 "	1 01	
Cotton seed meal	52 "	78	
Hay	135 "	81	
Cost of each pound of growth, 17.08 cents.			$4 10
ELEVENTH MONTH—November.			
Weight, 725 lbs. Gain, 63 lbs.			
Feed—Skimmed milk	300 lbs.	75	
Bran	84 "	95	
Cotton seed meal	14 "	21	
Linseed meal	28 "	53	
Hay	233 "	1 40	
Cost of each pound of growth, 6.06 cents.			3 84

This steer increased in weight during the first eleven and one-half months of his life, 650 pounds. The cost of the food required to produce this growth was $40.37. Cost of growth per pound, 6.21 cents.

If these animals are not interfered with by accident, their feeding will be continued until full maturity is attained.

Respectfully,

G. M. GOWELL.

TREASURER'S REPORT.

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

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

RECEIPTS.

GENERAL.		
Balance on hand December 4, 1884	$2,026 95	
State of Maine appropriation	8,350 00	
Tuition of students	1,945 00	
		$12,321 95
ENDOWMENT.		
Interest on State of Maine bonds	7,098 00	
" city of Bangor "	180 00	
" loan to College farm	77 88	
		7,355 88
Total		$19,677 83

DISBURSEMENTS.

GENERAL.		
A. M. Robinson, Trustee expenses 1884	$15 00	
C. E. Keyes, " " "	47 50	
G. M. Gowell, balance of experiment appropriation	250 00	
W. P. Dickey, paint and oil for farm buildings	147 22	
H. Latno, painting farm buildings	214 40	
M. C. Fernald, on work shop account	1,000 00	
" on apparatus "	1,250 00	
" for periodicals	49 05	
" for fire grenades	30 60	
" repairs on sidewalks	22 61	
" paid for instruction	36 50	
J. S. Kimball & Son, insurance	70 00	
G. M. Gowell, repairs on barn	282 50	
A. M. Robinson, Trustee expense	20 00	
L. S. Moore, " "	17 50	
W. D. Haines, " "	16 40	
C. W. Keyes, " "	12 00	
D. H. Thing, " "	30 20	
E. E. Parkhurst, " "	34 00	
Z. A. Gilbert, " "	29 30	
Lyndon Oak, " "	47 45	
		3,622 23

ENDOWMENT.

G. M. Gowell, Farm Superintendent, salary	$1,000 00	
The Faculty, salaries	11,861 12	
		$12,861 12
Total		16,483 35
Balance on hand December 4, 1885		3,194 48
		$19,677 83

SUMMARY.

RECEIPTS.

Balance on hand December 4, 1884	2,026 95	
Interest	7,355 88	
General account	10,295 00	
		19,677 83

PAYMENTS.

Salaries	12,861 12	
General account	3,622 23	
Balance on hand	3,194 48	
		19,677 83

ENDOWMENT FUND.

6 per cent State of Maine bonds	118,300 00
6 " City of Bangor bonds	3,000 00
*6 " Hallowell C. and S. Academy bonds	4,000 00
Deposit in Augusta Savings Bank	2,000 00
" Hallowell " "	1,000 00
Loaned to College farm	1,000 00
Cash in Treasury	2,000 00
	$131,300 00

*Suspended payment of interest.

J. FRED WEBSTER, *Treasurer.*

ORONO, December 11, 1885.

Having examined the foregoing account of the Treasurer, I find the same properly vouched and cast.

By direction of the Trustees.

A. M. ROBINSON.

SUMMARY OF

METEOROLOGICAL . OBSERVATIONS,

TAKEN AT THE

MAINE STATE COLLEGE of AGRICULTURE and the MECHANIC ARTS,

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

FROM JANUARY, 1869, TO JANUARY, 1886,

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., local time.

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 1885 was July 25th, when the mean temperature was 76°.4, and the coldest day was January 22nd, when the mean temperature was 11°.5 below zero.

The highest temperature (86°.0) recorded during the year was on the 25th of July, and the lowest temperature (22°.3 below zero) on the 31st of January.

The range of temperature between the two extremes is 108°.3, which is less by 5°.9 than the average range between the extremes for the last seventeen 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) occurred 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 1885, with the mean temperature of corresponding months for seventeen years, is given below:

Months.	Mean temperature from 1869 to 1885, inclusive.	Mean temperature for 1885.	
January	15°.28	15°.98	0°.70 warmer.
February	19° 02	13° 33	5°.69 colder.
March	26°.81	19°.17	7°.64 "
April	39° 83	40°.83	1°.00 warmer.
May	52°.22	51°.92	0°.30 colder.
June	62°.38	61°.82	0°.56 "
July	67°.53	67°.79	0°.26 warmer.
August	65°.82	63°.26	2°.56 colder.
September	57°.54	54° 44	3°.10 "
October	46°.29	46°.49	0°.20 warmer.
November	33°.24	36°.36	3°.12 "
December	20°.91	25°.03	4°.12 "

The year 1885 (mean temperature 41°.37) averaged 0°.87 colder than the mean temperature of the seventeen years under notice.

A light summer frost occurred on the morning of June 3d, but slightly destructive to vegetation. The earliest autumnal frost was on the morning of September 12th, followed by others on September 20th and 24th, and then a mild period extending to October 6th

The principal thunder storms of the season were on April 2d and 4th, May 19th and 27th, June 26th and 27th, July 9th, 10th and 31st, August 13th and October 3d, 14th and 30th.

The rainfall and melted snow of 1885 amounted to 52.99 inches, a quantity larger by 8.94 inches than the average for seventeen years; the snowfall was 108 inches, a quantity greater by 16.68 inches than the average for the same period.

The number of days in 1885 on which the sky was at least eight-tenths covered with clouds was 81 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 131, or 36 per cent of the whole number; the number of days, therefore, without any considerable quantity of rain or snow, was 234, or 64 per cent of the whole number.

On May 2nd, eight inches of snow fell, of which there remained on the morning of May 3d, five inches, furnishing good sleighing.

During the months of May, June, July and August, the prevailing wind was S. W. and S.; during the other months of the year, N. W. and W. Heavy winds prevailed on January 12th, 26th and 27th, February 10th, June 9th, September 23d, October 30th, and December 26th and 27th, the wind of January 12th rising to a strong gale.

The prevailing wind for the seventeen years, from 1869 to 1885, inclusive, was from the north-west and west. 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 1885 were on the evenings of May 13th, August 2nd, 6th and 29th, September 3d, October 11th, November 11th and December 1st, 7th and 8th; the aurora of May 13th being especially brilliant from broad streamers extending to the zenith.

The principal luna halos were on February 24th, March 29th, April 20th and 23d and December 25th, and the most marked solar halo, on March 10th.

The barometer indicated the greatest pressure in the month of January, and the least in September. The range between the two extremes was 1.808 inches. The least mean pressure was during February and the greatest during October, when the average height of the mercury in the barometer, at an elevation of 129 feet above the sea level, was 29.934 inches. The mean humidity of the air for the year was .79.

SUMMARY BY MONTHS—1885.

Months.	Thermometer in the Open Air.										Rain and Snow.		Clds	Winds.				Barometer.			Relative humidity or fraction of saturation.		
	Mean of warmest 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—inches.	Amount of snow—inches.	Mean percentage of cloudiness	Per cent of direction and force.				Barometer height reduced to freezing point of water.					
	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.
		°		°		°		°	°	°	°													
January	12	45.4	22	-11.5	12	53.1	31	-22.3	25.60	9.43	15.98	4.73	31.0	.61	.47	.36	.04	.13	30.608	29.139	29.875	100	37	83
February	10	37.5	2	- 5.3	10	40.6	12	-17.4	23.61	-0.36	13.33	4.45	22.0	.45	.54	.19	.17	.10	30.285	29.316	29.780	100	44	79
March	27	38.8	13	- 3.1	28	49.2	13	-20.6	28.30	7.71	19.17	2.78	15.0	.45	.52	.21	.13	.14	30.368	29.200	29.847	100	39	81
April	21	56.9	9	27.8	24	75.5	10	19.5	49.54	32.60	40.83	2.34	3.5	.48	.42	.31	.05	.22	30.375	29.375	29.865	100	28	72
May	26	66.4	2	33.1	26	79.4	3	28.7	62.98	42.23	51.92	3.38	8.0	.39	.29	.49	.11	.11	30.211	29.392	29.901	100	28	69
June	16	73.6	2	45.5	16	86.0	3	38 8	71.19	52.46	61.82	4.60	–	48	.36	.51	.10	.03	30.105	29.300	29.805	100	34	72
July	25	76.4	3	59.6	25	86.0	3	54.2	77.45	61.42	67.79	4.70	–	.54	.32	.40	.23	.05	30.090	29.490	29.828	100	40	79
August	12	73.5	27	52.1	12	84.2	28	43.7	72.65	54.60	63.26	7.36	–	.40	.29	.46	.14	.11	30.131	29.469	29.865	100	46	79
September	14	67.8	24	44.4	14	78.0	11	34.5	65.32	45.50	54.44	2.52	–	.42	.45	.37	.06	.12	30.245	28.800	29.880	100	42	86
October	4	63.8	31	29.7	1	70.3	13	23.4	55.39	38.12	46.49	5.12	–	.56	.39	.23	.16	.22	30.254	29.277	29.934	100	38	82
November	8	50.8	28	26.1	9	59.0	29	14.0	42.84	29.77	36.36	5.37	.5	.54	.44	.13	.07	.36	30.279	29.438	29.809	100	24	82
December	10	45.3	26	5.3	10	55.8	26	2.0	31.65	14.16	25.03	5.64	28.0	.56	.45	.20	.07	.28	30.481	28.822	29.797	100	44	84
	J'ly		Jan.		J'ly		Jan.																	
Year	25	76.4	22	-11.5	25	86.0	31	22.3	50.54	32.30	41.37	52 99	108.0	.49	.41	32	.11	16	30.608	28.800	29.849	100	24	79

SUMMARY BY YEARS—From 1869 to 1885, Inclusive.

Year	Temperature in the Open Air.										Rain and Snow.		Cl'ds.	Winds.				Barometer.									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.	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.							
	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	48.54	113.00	.53	.37	.28	.13	.22	30.446	28.712	29.706	.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	.240	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	.40	.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	.250	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	.280	100	20	78
1879,	July 16	77 8	Dec. 21	-11.7	Aug 2	88.0	Dec 27	-26.0	50.10	31.67	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	33.50	43.85	33.81	69.00	.50	.39	.23	.18	.20	30.644	29.090	29 874	.790	.015	.269	100	23	75
1881,	Aug. 5	78.1	Feb. 2	- 9 1	Aug. 5	91.0	Jan. 2	-18.2	52.11	34 98	43.87	42 80	54 50	.54	.45	.18	.14	.23	30.647	28.919	29 862	.891	.019	.281	100	21	77
1882,	Aug. 6	80.7	Jan. 24	-10.0	Aug. 5	92.0	Jan. 25	22.4	50.76	33.10	42.54	41.26	110.00	.49	.46	.18	.12	.24	30.724	29.121	29.885	.819	.016	.261	100	24	75
1883,	July 6	75.1	Dec 23	-13.1	July 7	85.6	Jan. 6	-25.0	50.04	31.79	40.72	40.60	53 00	.48	.41	.30	.13	.16	30 641	28.750	29 904	.860	.015	.259	100	18	78
1884,	Aug. 18	77.2	Dec 20	10.4	Aug. 18	86.0	Jan. 28	-29 0	51 57	33.23	42 85	44.95	90.00	.56	.35	.33	.14	.18	30.716	28.768	29.875	-	-	-	100	16	81
1885,	July 25 1876.	76.4	Jan 22 1878.	-11 5	July 25 1876.	89 2	Jan. 31 1878.	-22.3	50.54	32.30	41.37	52.99 Mn.	108.00 Mean.	.49	.41	.32	.11	.16	30.608	28.800	29.849	-	-	-	100	24	79
17 yrs	Aug. 7	85.3	Jan. 8	-17.2	Aug. 6	96.7	Jan. 8	-35.6	50.86	33.64	42.25	44.05	91.32	.52	.40	29	11	.20	30 783	28.423	29.831	-	-	-	100	13	76

CATALOGUE

OF THE

Maine State College of Agriculture and Mechanic Arts.

ORONO, MAINE, 1885-86.

TRUSTEES.

HON. LYNDON OAK, GARLAND, *President.*
HON. LUTHER S. MOORE, LIMERICK.
HON. A. M. ROBINSON, DOVER.
HON. DANIEL H. THING, MT. VERNON.
CAPT. CHARLES W. KEYES, FARMINGTON.
WM. T. HAINES, ESQ., WATERVILLE, *Secretary.*
HON. E. E. PARKHURST, PRESQUE ISLE.
GEN. R. B. SHEPHERD, SKOWHEGAN.
HON. Z. A. GILBERT, EAST TURNER,
Secretary of Maine Board of Agriculture, *ex-officio.*

TREASURER:

J. FRED WEBSTER, ORONO.

EXECUTIVE COMMITTEE:

HON. LYNDON OAK.
HON. A. M. ROBINSON.
WM. T. HAINES, ESQ.

EXAMINING COMMITTEE:

HIS EXCELLENCY FREDERICK ROBIE.
REV. CHARLES F. ALLEN, D. D.
JOHN F. ANDERSON, C. E.

FACULTY.

MERRITT C. FERNALD, A. M., PH. D., 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.

ALLEN E. ROGERS, A. M.,
Professor of Modern Languages, Logic and Political Economy, and Librarian.

WALTER BALENTINE, M. S.,
Professor of Agriculture.

CHARLES H. BENJAMIN, M. E.,
Professor of Mechanical Engineering, and Registrar.

LIEUT. CHARLES L. PHILLIPS, 4th U. S. ARTLLERY,
Professor of Military Science and Tactics.

WALTER FLINT, M. E.
Instructor in Shop-work.

GILBERT M. GOWELL,
Farm Superintendent.

JESSE G. JOHNSON,*
Steward.

*Aaron E. Spencer, Steward after January 1st, 1886.

STUDENTS.

POST GRADUATE.

Merrill, Lucius Herbert, Washington, D. C.

SENIOR CLASS.

Allan, Bert John,	Pembroke.
Ayer, Josiah Murch,	Freedom.
Barker, George Greenleaf,	Rockland.
Black, George Fuller,	Palermo.
Blagden, John Decker,	Carmel.
French, Heywood Sanford,	Bangor.
Graves, Edwin Dwight,	Orono.
Jones, Ralph Kneeland, Jr.,	Bangor.
Lenfest, Elmer,	Bradley.
Lockwood, James Frederic,	Brewer.
Merriam, Charles Herbert,	Houlton.
Merriam, Willis Henry,	Houlton.
Merritt, Elmer Ellsworth,	Houlton.
Page, Arthur Dean,	Orono.
Ray, Irving Burton,	Harrington.
Sears, Cassius Almon,	Fort Kent.
Twombly, Sydney Smith,	Enfield.

JUNIOR CLASS.

Adams, Alton Dermont,	Biddeford.
Burleigh, John Henry,	Vassalboro'.
Cilley, Luis Vernet Prince,	Rockland.
Clark, Bert Elmer,	West Tremont.
Clark, Irving Mason,	Bethel.
Colby, David Wilder,	Skowhegan.
Coffin, Edward Voranus,	Harrington.
Hicks, Alice Albur,	Hampden.
Houghton, Austin Dinsmore,	Fort Fairfield.
Kirkpatrick, Fred Hudson,	Bangor.
Lazell, James Draper,	Rockland.
Leavitt, Hannah Ellis,	Norridgewock.
Mason, Charles Ayers,	Bethel.
McNally, Henry Allen,	Fort Fairfield.
Merrill, Fenton,	Orono.
Nowland, James Martin,	Ashland.
Ruth, Alfred Smith,	Linneus.
Saunders, Addison Roberts,	Hanover.
Stevens, Charles Hildreth,	Fort Fairfield.
Trask, Frank Ellsworth,	Bethel.
Vose, Charles Thatcher,	Milltown, N. B.
Webb, Howard Scott,	Skowhegan.
Williams, John Sumner,	Guilford.

SOPHOMORE CLASS.

Andrews, Hiram Bertrand,	Cape Elizabeth.
Bachelder, George Stetson,	Exeter Mills.
Blanchard, Charles DeWitt,	Oldtown.
Boardman, John Russell,	Augusta.
Brick, Francis Stephen,	Biddeford.
Buker, Albion Henry,	Rockland.
Butler, Harry,	Hampden.
Campbell, Dudley Elmer,	North Harpswell.
Chamberlain, James Kent,	Bangor.
Eastman, Fred Langdon,	Fort Fairfield.
Elwell, Edward Henry, Jr.,	Deering.
Gould, Charles Benjamin,	Orono.
Hancock, Willie Jerome,	Saco.
Hatch, John Wood,	Presque Isle.
Howes, Claude Lorraine,	Boston, Mass.
Lincoln, Harry Foster,	Dennysville.
Lord, Thomas George,	Skowhegan.
Marsh, Ralph Hemenway,	Bradley.
Miller, Seymore Farrington,	Burlington.
Page, Frank Jackson,	Orono.
Philbrook, William,	Shelburne, N. H.
Rogers, Seymour Everett,	Stetson.
Rolfe, Charles Collamore,	Presque Isle.
Seabury, George Edwin,	Fort Fairfield.
Small, Frank Llewellyn,	Freeport.
Smith, Frank Adelbert,	East Corinth.
Sturtevant, Charles Fremont	Bowdoinham.
True, Joseph Sumner,	New Gloucester.

FRESHMEN CLASS.

Briggs, Fred Percy,	Hudson.
Coffin, Alphonso John,	Harrington.
Edgerly, Joseph Willard,	Princeton.
Freeman, George Gifford,	Cherryfield.
Gay, George Melville,	Damariscotta.
Johnson, Lewis Fuller,	Bangor.
Leavitt, Cora Annie,	Norridgewock.
Lyford, Albert Lewis,	Corinna.
Mathews, Maude Arnold,	Stillwater.
Reed, Nellie Waterhouse,	Stillwater.
Rogers, Clara,	Hampden.
Stevens, Fred,	Gouldsboro'.
Thompson, Frederick Lincoln,	Augusta.
Tripp, Norman,	Unity.
Vickery, Gilbert Scovil,	Bangor.
Wilson, Mottie Frank,	Orono.

SPECIAL COURSE.

Benjamin, Alice,	Oakland.
Collins, Frank Percy,	Fort Fairfield.
Grosvenor, Temple,	Canterbury, N. B.
Harris, William John,	Groton, Mass.
Lull, George Frederic,	West Great Works.
Marsh, Alfonso Frank,	Bradley.
Sargent, Abram Woodard,	Bangor.

SUMMARY.

Post Graduate,	1	Sophomores,	28
Seniors,	17	Freshmen,	16
Juniors,	23	Special,	7
		Total,	92

PRIZES FOR 1885.

Prentiss Prize, for best Junior Essay, awarded to J. Fred Lockwood of Brewer.

Prentiss Prize, Sophomore Declamation, first rank, awarded to A. R. Saunders of Hanover.

Prentiss Prize, Sophomore Declamation, second rank, awarded to H. A. McNally of Fort Fairfield.

MILITARY DEPARTMENT.

COBURN CADETS.

Field and Staff—

Second Lieutenant CHARLES L. PHILLIPS, 4th U. S. Artilery, Commanding.

Cadet H. S. FRENCH, Lieutenant and Adjutant.

Cadet I. B. RAY, Lieutenant and Quartermaster.

Cadet D. W. COLBY, Sergeant Major.

	Co. A.	Co. B.
Captain	R. K. Jones, Jr.	G. F. Black.
1st Lieutenant	B. J. Allan.	C. A. Sears.
2d "	E. Lenfest	E. E. Merritt.
3d "	J. F. Lockwood.	E. D. Graves.
1st Sergeant	E. V. Coffin	L. V. P. Cilley.
2d "	B. E. Clark	C. T. Vose.
3d "	A. S. Ruth	J. S. Williams.
4th "	H. S. Webb	F. E. Trask.
1st Corporal	H. Butler	C. L. Howes.
2d "	G. S. Bachelder	C. B. Gould.
3d "	A. H. Buker	T. G. Lord.
4th "	W. Philbrook	J. S. True.

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 a 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 agricultural 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 Freshmen 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 this 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 at the College.

Arrangements have been made by which applicants accommodated by the plan may pass examination for admission without incurring the expense of coming to Orono. The gentlemen named below have been appointed examiners for the sections of the State in which they severally reside:

C. P. Allen, B. S.,	Presque Isle.
H. M. Estabrooke, B. S.,	Gorham.
E. S. Danforth, B. S., S. W. Gould, B. S.,	Skowhegan.
Principal F. E. Parlin,	Greeley Institute, Cumberland.
O. C. Farrington, B. S.,	Cape Elizabeth.
S. K. Hitchings, B. S.,	Biddeford.
Henry K. White, A. M.,	Newcastle.
Wm. W. Allen, A. B.,	Dexter.
Charles A. Black, A. M.,	East Machias.
Rev. W. R. Cross,	Milltown, N. B.
Henry W. Johnson, A. B.,	Bethel.
I. C. Phillips, A. B.,	Wilton.
Hon. N. A. Luce,	Augusta.
W. R. Whittle, A. B.,	Ellsworth.
W. E. Sargent, A. M.,	Freeport.

Examiners will indicate by postal card to parties applying, the time and special place of examination. Arrangements have also been made with the Seminary at Bucksport, by which students from that institution may be admitted to the College on certificate of qualification by the Principal, Rev. A. F. Chase.

All candidates, wherever they may arrange to be examined, should make early application to the President of the College. Applications will be recorded and regarded in the order of their reception.

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 year, 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 succeeding 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 the 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 successfully. 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.	Descriptive Astronomy 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.*
Agricultural Engineering, including Farm Implements, Farm Drainage and Mechanical Cultivation of the Soil, Physics.	Agricultural Chemistry, Landscape Gardening, Horticulture and Arboriculture.
Agricultural Chemistry.	Zoology and Entomology.
English and American Literature.	German.
German.	P. M. Laboratory Work and Experimental Farming or *Analysis of English Authors.
P. M. Laboratory Work or *Analysis of English Authors and Translations from the French.	

FOURTH YEAR.

First Term.	*Second Term.*
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 *Translations from German.	

*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:

Agricultural Engineering.—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, on the construction of roads, culverts and masonry, and on 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.

Agricultural Chemistry.—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, the composition of cattle foods, their changes and uses in the animal system, and the value and economic use of the various kinds of fodders.

Landscape Gardening.—The object of this study is to furnish correct ideas of the manner of laying out and beautifying grounds. This subject is followed by lectures on Horticulture and Arboriculture.

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

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—Following recitations and practical work in Botany, lectures are given upon fungi injurious to the farmer.

Chemistry.—One term is devoted to General Chemistry, two terms 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 kinds 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 instruction in 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.*
Trigonomety.	Descriptive Geometry.
General Chemistry.	Descriptive Astronomy and Surveying.
French.	
P. M. Free-Hand Drawing.	Physics.
Mechanical Drawing.	P. M. Mechanical Drawing and Field Work.

THIRD YEAR.

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

FOURTH YEAR.

First Term.	*Second Term.*
Civil Engineering.	Civil Engineering, Designs and Specifications.
Stereotomy.	Mineralogy and Geology.
Practical Astronomy.	Zoology.
Logic.	U. S Constitution and Political Economy.
P. M. Topography and R. R. Surveying.	P. M. Analytical Chemistry, Designing and Thesis 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 and care of the ordinary engineering instruments and in the application of the 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, so far as can be, the education required to prepare the graduate for a responsible position among *men*, as well as among engineers.

In this course the work is identical with that of the other courses during the first year. During the fall term of the Sophomore year, students in this course work two hours each afternoon, in the drawing room, on free-hand and mechanical drawing. In the last term of this year, the subject of land surveying is taken up. The first eight weeks are devoted to tinting, shading, etc., in water colors, while the remaining twelve weeks are given to practical surveying. Besides an hour's recitation each day, the class is engaged two hours, either in the field or drawing room, becoming familiar with the use and care of instruments, putting into practice the problems found in the text-book, and making actual surveys.

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 levelling, preliminary and final surveys and on the resistance to trains offered by grades and curves, together with the theory and construction of country roads, streets and pavements. These methods of the text-book, so far as possible, are applied in the field and the drawing room, each student in the course being required to work two 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 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 material 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.

Six weeks of this term are devoted to sanitary engineering; especial attention being given to ventilation, heating, purity of water supply and the proper drainage of houses and towns.

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 cost 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 a short course in Analytical Chemistry, 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 preparation of a satisfactory thesis, completes the work in the course of Civil Engineering.

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 of the Sophomore Class, and Practical Astronomy during the larger part of the first term, Senior year.

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 Engineer 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.	Descriptive Geometry.
French.	Free-Hand Drawing.
General Chemistry.	Descriptive Astronomy.
P. M. Carpentry.	Physics.
	P. M. Mechanical Drawing and Forge Work.

THIRD YEAR.

First Term.	*Second Term.*
Kinematics.	Mechanics and Machine Design.
Analytical Geometry.	Calculus.
Vise Work, Physics.	Elements of Mechanism.
P. M. Machine Drawing.	Link and Valve Motions.
	P. M. Isometric and Cabinet Projection and Machine Drawing.

FOURTH YEAR.

First Term.	*Second Term.*
Steam Engineering.	Wood Turning.
Practical Astronomy.	Steam Engineering.
Logic.	Hydraulic Engineering.
P. M. Machine Drawing and Designing.	U. S. Constitution and Political Economy.
	P. M. Machine Drawing, Designing and Thesis Work.

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 carpentry and forge work are taken the second year in place of part of the drawing. In the Junior year, 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 subject of the geometry of machinery is continued by lectures on other methods of transmitting motion, as by belts, cams, couplings, and links. Considerable time is given to the study and designing of the various valve and link motions used on the steam engine. During the same term instruction is given in mechanics and the laws of the strength of materials, the student being required to design machine details in accordance with those laws.

The first part of the first term, Senior year, is employed in studying the laws of the expansion of steam, and their influence upon the construction of steam engines and boilers, the subject being illustrated by experiments on the shop engine, with the aid of an indicator. During the remainder of the term, the students are engaged in designing engines and other machines, and in making detail drawings of the same, such as would be required to work from in the shop.

During the last term, Senior year, the study of steam engineering is continued in its application to compound engines, and the subject of hydraulic engineering is taken up briefly, by lectures on the storage of water for power and the theory and construction of modern water wheels.

TEXT-BOOKS AND BOOKS OF REFERENCE.

Weisbach,	Mechanics of Engineering	Smith,	Steam Engine.
Goodeve,	Elements of Mechanism.	Smith,	Steam Boilers.
MacCord,	Kinematics.	Trowbridge,	Steam Boilers.
MacCord,	Slide Valve.	Zenner,	Valve and Link Motions.
Van Buren,	Strength of Machinery.	Auchincloss,	Valve and Link Motions.
Knight,	Mechanical Dictionary.	Clark,	Manual.

SHOP WORK.

There are now three shops equipped according to the Russian system, and work in these is required of all students in this course. The first term of the Sophomore year, two hours of each day are devoted to work in carpentry, special attention being given to accuracy of workmanship.

During the second term of the same year, the student receives instruction in forge work, including the welding and tempering of steel. A course in vise work during the first term of the Junior year, gives the student practice in the various methods of shaping and fitting metals by the use of the chisel, hack-saw and file. During their second term, the Junior students in this course take turns in running the shop engine, and are taught the rules of safety and economy in this branch of engineering. Hereafter, instruction in wood-turning will be given during the last term of the Senior year.

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 spends the time allotted to drawing in working out practical problems on the construction of gear teeth, cams, etc., and in elementary practice in line-shading and tinting.

The second term of this year is devoted to isometric projection, and the making of finished drawings in ink and in water colors. In the first term of the Senior year, the student prepares an original design of some machine, makes working drawings of its details on tracing cloth, and finally prepares copies by the blue print process. The afternoon work of the spring term consists of making calculations for designs of engines and boilers, the construction of the necessary working drawings, and making thesis drawings.

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

Theses 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 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.	Physics.
French.	Descrip. Astronomy 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.
English and American Literature.	P. M. Laboratory Work.
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 advanced Inorganic Chemistry. In the Senior year, advanced Organic Chemistry is 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 and Naquet's Principes de Chimie. In the Laboratory are used: Craft's Qualitative Chemical Analysis, Fresenius' Quantitative Chemical Analysis, Caldwell's Agricultural Chemical Analysis, Wohler'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 Bachelor 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.

Local Time.	Seniors.	Juniors.	Sophomores.	Freshmen.
8.00 A. M.	Chapel Services.	Chapel Services.	Chapel Services.	Chapel Services.
8.15 A. M.	History of Civilization, I, IV, V. Civil Engineering, II.	German, I, II, IV, V. Kinematics, III.	General Chemistry.	Physical Geography.
9.10 A. M.	Stock Breeding and Veterinary Science, I. Advanced Chemistry, IV. Practical Astronomy, II, III, V. (F. of T.)	Analytical Geometry, II, III. English and American Literature, I, IV, V.	Botany, I, IV, V.	Algebra.
10.05 A.M.	Stereotomy, II. (F. of T.) Sanitary Engineering, II. (L of T.) Comparative Anatomy, I, IV, V. Steam Engineering, III.	Farm Drainage and Mechanics, I. Physics, I, II, III, IV, V. (L. of T.) Vise work, III. (F. of T.)	French.	
11.00 A.M.	Logic, I, II, III, IV, V.	Agricultural Chemistry, I. (Optional for V.) Vise work, III. Advanced Chemistry, IV. (Optional for V.) Field Book, Roads and Railroads, II.	Trigonometry.	Physiology.
P. M.	Laboratory and Farm Practice, I. Designing and Drawing, III. Topography and R. R. surveying, II. Laboratory work, IV. Translations from German, V. Military Drill.	Laboratory work, I, IV. Field work and Drawing, II. Machine Drawing, III. Translations from French and English Literature, V. Military Drill.	Free-hand Drawing, I, II, IV, V. Mechanical Drawing, II. Carpentry, III. 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.

LOCAL TIME.	SENIORS.	JUNIORS.	SOPHOMORES.	FRESHMEN.
8.00 A. M.	Chapel Services.	Chapel Services.	Chapel Services.	Chapel Services.
8.15 A. M.	Mineralogy and Geology, I, II, IV, V.	Calculus, II, III. Agricultural Chemistry, I, (Optional for V.) Advanced Chemistry, IV. (Optional for V.)	Descriptive Astronomy. (F. of T.) Surveying, (L. of T.) I, II, IV, V. History of England, [L.] (L. of T.)	Rhetoric. (F. of T.)
9.10 A. M.	Mental and Moral Science, I, V Civil Engineering, II. (F. of T.) Lectures on Designs, Contracts and Specifications, II. (L. of T) Laboratory work, IV. Drawing and Wood-turning, III.	German, I, II, IV, V. Mechanics and Machine Design, III.	Qualitative Analysis, I, IV, V. Free-hand Drawing, (F. of T.) III.	Book-keeping. (F. of T.) Botany. (L. of T.)
10.05 A.M	Cultivation of Cereals, Care and Feeding of Animals, etc., I. Laboratory work, IV. Zoology, II. Steam Engineering & Hydraulics, III	Applied Mechanics, II. (F of T.) Graphic Statics, II. (L of T.) Zoology and Entomology, I, IV, V.	Qualitative Analysis, I, IV, V. Descriptive Geometry, II, III.	French.
11.00 A.M.	U. S. Constitution and Political Economy, I, II, III, IV, V.	Zoology and Entomology, I, IV, V. Link and Valve Motions, III. (L of T.) Elements of Mechanism, III. (F. of T)	Physics.	Algebra and Geometry.
P. M.	Machine Drawing, Designing and Thesis work, III. Laboratory work, IV. II, (F of T.) Chemistry, IV. Designing and Thesis work, II. Translations from German, V. Military Drill.	Laboratory work and Garden Practice, I Isometric and Cabinet Projection, and Perspective, II, III. Laboratory work, IV. Translations from French, V. Military Drill.	Mechanical Drawing, Forge work, III. Field work, I, II, IV, V. (L. of T.) Military Drill.	Labor. Military Drill.

LABOR.

It is a characteristic feature 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 maximum price paid is ten cents an hour. In arranging for compensated labor, it should be understood that the College does not engage to furnish opportunities for such labor continuously, but rather as the farm and other interests require.

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

MILITARY INSTRUCTION.

Thorough instruction in Military Science is given by an officer detailed by the Secretary of War from the active list United States Army, and is continued throughout the entire course. All able-bodied male students receive instruction in the school of the soldier, company and battalion drill. Arms and equipments are furnished by the United States Government. The uniform, furnished by students, is a cadet gray; the blouse similar to the regulation blouse of an army officer, but with State of Maine buttons, and for officers with chevrons of dark blue; the pants with dark blue stripes, one and one-fourth inches wide, on outside seams; the cap gray, with dark blue bands and brass crossed rifles in front. The uniform is required to be worn during military exercises, and it is recommended that it be worn at recitations and at other class and general College 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 Maine Central Railroad, over which trains pass many 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 respects admirably adapted to the wants of the chemical and mineralogical departments.

The shop, built during the summer of 1883, is equipped for instruction in three departments of mechanical work, viz: filing, forging and working in wood.

APPARATUS.

The College is furnished with valuable apparatus for the departments of Physical Geography, Chemistry, Physics, Surveying, Civil Engineering and Mechanical Engineering, to which additions are made as the exigencies 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 nearly five thousand volumes, a large part of which has been obtained through the generosity of the late Ex-Governor Coburn. Valuable additions have also been made to it by other friends of the College, only a small number of the volumes

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.

The following periodicals are supplied by the College to the library:

American Journal of Science and Art, Popular Science Monthly, National Live Stock Journal, American Agriculturist, Journal Royal Agricultural Society (England), Journal Franklin Institute, Eclectic Engineering Magazine, Century Magazine, Atlantic Monthly, Harper's Monthly Magazine, North American Review, Education, American Machinist, Science.

READING ROOM.

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

American Cultivator, American Sentinel, Aroostook Republican, Gospel Banner, Home Farm, Kennebec Journal, Lewiston Journal, Maine Farmer, Maine Industrial Journal, New England Farmer, Oxford Democrat, Piscataquis Observer, Portland Transcript, Somerset Reporter, Whig and Courier (Daily and Weekly), Zion's Herald, Official Gazette U. S. Patent Office, Bangor Daily Commercial, Farmington Chronicle, Phillips Phonograph, Springvale Advocate, Mount Desert Herald, Maryland Farmer, Dexter Gazette, Eastport Sentinel, Bee Journal, American Garden, Manufacturer and Builder, Mirror and Farmer, Temperance Record.

The following papers are furnished by subscription, principally by the students:

American Machinist, Cultivator and Country Gentleman, Colby Echo, Bowdoin Orient, Scientific American, Scientific American Supplement, Eastern Argus (furnished by S. W. Gould), American Naturalist, Blackwood's Magazine, Lewiston Evening Journal, Journal of Education, Sanitary Engineer, Science, Popular Science News, Boston Journal, Washington Post.

CABINET.

The natural history collections of the College include about nine hundred named and mounted species of the flowering plants of Maine; a collection of sections of tropical species of wood presented by the Department of Agriculture at Washington, and a similar collection of the United States species from the Census Bureau.

The College also has a working collection of carefully selected forms representing the prominent groups of the animal kingdom; a large and valuable collection of Maine insects, carefully mounted and authentically named, and a fine collection of marine animals in alcohol, mostly from the coast of Maine, donated to the College by the United States Fish Commissioner. The above collections, together with charts, diagrams, skeletons, models, microscopes and other apparatus for illustrating the studies in natural history, are on exhibiton in White Hall.

In the Laboratory are a good series of the more common minerals and ores supplemented by a collection presented by the National Museum; a collection of building stones from many of the Maine quarries, and a collection presented by the Smithsonian Institution, together with a series of microscopical sections of building stones, given by G. P. Merrill, M. S. In the same room is exhibited a series of typical fossils which illustrate the various geological horizons, together with a collection of Indian stone implements, and various curiosities presented by the friends of the Institution.

The extensive private cabinet of Prof. C. H. Fernald is on exhibition in the above-named rooms, and is constantly used in the instruction in Natural History.

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 thirty dollars a year, divided equally between the two terms. The cost of material and repair of tools for the course of instruction in the vise shop, is ten dollars; in the forge shop, nine dollars; in the wood shop, four dollars.

Laboratory expenses are at cost of glass ware broken, injury to apparatus and chemicals used. A deposit of five dollars is required of students entering upon a term's work in Qualitative Analysis, and of seven dollars per term from students in Quantitative Analysis. Room rent is four dollars for the first term and five dollars for the second term of the college year.

Students residing too far from the College to *live* at home are required to room and board at the College, unless special permission to live elsewhere be granted by the President. Students receiving such permission pay room rent and fuel rent as though residing at the College.

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 six years about eleven 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 about 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.

As security for the payment of College bills, a bond of one hundred and fifty dollars with satisfactory securities is required. A blank form of bond will be given with the ticket of admission.

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.

SCHOLARSHIPS.

The trustees make provision for the establishing of free scholarships by the following action:

Voted, That any individual or society paying to the Treasurer a sum not less than seven hundred and fifty dollars, shall be entitled to one perpetual free scholarship in the College.

GRADUATES.

CLASS OF 1872.

Name and Occupation. *Residence.*

Benjamin F. Gould, C. E., Farmer ..... San Juan, California
George E. Hammond, C. E., Civil Engineer,
Navy Yard, Portsmouth, N. H.
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1886—Feb.	9.	Tuesday, Second Term commences.
June	24, 25.	Thursday and Friday, Examinations.
"	26.	Saturday, Prize Declamations by Sophomores.
"	27.	Sunday, Baccalaureate Address.
"	28.	Monday, Prize Essays by Juniors.
"	30.	Wednesday, Commencement.
July	1.	Thursday, Examination of Candidates for Admission.
		Vacation of five weeks.
Aug.	10.	Tuesday, Examination of Candidates for Admission.
		First Term commences.
Nov.	22, 23.	Monday and Tuesday, Examinations.
		Vacation of eleven weeks.
1887—Feb.	8.	Tuesday, Second Term commences.

APPENDIX.

THE

SPHINGIDÆ

OF

NEW ENGLAND.

C. H. FERNALD, A. M.

Orono, February, 1886.

AUGUSTA:
SPRAGUE & SON, PRINTERS TO THE STATE.
1886.

The Sphingidæ of New England.

INTRODUCTION.

The following paper contains an account of all the species of the SPHINGIDÆ known to occur in New England, most of which have already been discovered in Maine, and when the south-western part of the State shall have been fully explored by entomologists, it is not improbable that they will all be found to occur more or less frequently in this State.

It is not intended in this paper to discuss the classification of these moths, for that would require a larger amount of material and a more complete literature of the subject than we have at hand. There is need, however, of an entire revision of the species of this group, from all parts of the world, and this revision should be based on an exhaustive study of all their structural characters, a study which we do not think they have yet received as a whole.

The SPHINGIDÆ of North America have been studied by Harris, Clemens, Walker, Butler, and by Grote, who has written more than all others and to whom we owe very much for the knowledge we possess of these moths. Lintner has published some papers on the early stages, which are models of fullness and accuracy. J. B. Smith has recently given a short preliminary paper on these moths, in the Entomologica Americana Vol. 1 p. 81, which is very suggestive, and we have adopted many of his conclusions.

Names and Habits.

The species of this family of insects, usually located next below the butterflies, were placed by Linneus in his genus Sphinx, and are known by the common name of Sphinx moths, because of the curious habit which their caterpillars or larvæ have of raising the anterior segments of their bodies and remaining motionless in this position for some time, thus bearing a fancied resemblance to the fabled Sphinx, and from this, the family name, Sphingidæ, has been derived. They are sometimes called hawk moths, because of the strength and velocity of their flight; and they are also called humming-bird moths, because they poise on the wing before the flowers while drawing up the nectar, in the same manner as humming birds. The insects of one group have the middle portion of the wings transparent and on this account are called clear-wings.

The larvæ of some of these moths feed on the leaves of shrubs or trees which are of no special value except for ornamental purposes, while others attack our more valuable plants, and although parasitic insects, fungoid diseases and the birds — their natural enemies — generally hold them in check so that the amount of damage they do is comparatively small, yet they become so numerous at times that the amount of damage done by them far exceeds anything we could imagine. Some of these moths may be seen flying around flowers in the hot sunshine, while others hover around them in the twilight, or even later in the evening.

Early Stages.

The female moth lays her eggs singly on the leaves of those plants which serve as food for the young. These eggs are more or less globular, varying, in the different species, from pale green to creamy white, and have a smooth surface, though in some, they are finely reticulated or granulated. These eggs hatch in from one to two weeks, and the young

caterpillars or larvæ of some of the species at least, make their first meal on the egg-shell, after which they wander about for a short time till they find a place to their liking, usually on the edge of a leaf, when they begin to feed. When first hatched they are usually of a pale or yellowish green color, and the surface of their bodies is covered with short, erect hairs. The head is much larger than any of the following segments, and there is a stout, straight or curved spine in most of the species, arising from the top of the twelfth segment, inclining backwards, which is called the *caudal horn*. After feeding for a few days, the larva *molts* or casts off the old skin, which act takes place four times before it reaches maturity. After the first molt, the future markings of the mature larva begin to appear and these become intensified after each molt. The caudal horn is wanting in a few species after the first molts, but its place is indicated by a tubercle.

The body of the mature larva is cylindrical, naked, usually smooth, but sometimes more or less granulated over the surface. In some species the segments following the head are divided into eight transverse wrinkles called *annulets*, and in some, the anterior segments of the body as well as the head are smaller and are retracted when at rest. There is great variation in the ground color of many species, and in some, a radical change occurs in this color just before they enter the ground for their final transformations.

After they have reached maturity and have done feeding, they descend to the ground and work their way down into the soil, where they construct or hollow out their cells in which they transform to pupæ. Some, however, transform on the surface of the ground in imperfect cocoons composed of leaves drawn together with silk. These pupæ are dark brown and cylindrical, except the posterior part, which tapers to the end and terminates in a short, stout, blunt spine called the *cremaster*. The covers to the wings, legs and other parts are distinct, and the cover to the proboscis or tongue-case is sunken nearly level with the surface of the body in some cases, while in others it stands off from the body, touching it

only at the end and resembles a jug handle. The pupæ remain in the ground till the following summer, and sometimes till the second summer, before the moths emerge.

The moths comprised in this family are from medium to large size, with stout bodies, comparatively long and narrow fore wings and much smaller hind ones. The head is well developed and clothed with hair-like scales which are generally appressed, though in some species they form a tuft or ridge along the top of the head between the antennæ. The eyes are large, hemispherical and naked, with the scales overhanging in the form of lashes between the base of the antennæ and the front, in some species, but others are without lashes. The ocelli are absent in all the species; the palpi are densely clothed, comparatively short and curved upwards, the second joint usually being the longest and more or less swollen. The third joint is very short in most of the species, and sometimes sunken more or less into the outer end of the second. The proboscis is short and rudimentary in one group, but long in the others, as long or even longer than the body, and when not in use it is coiled up like a watch spring between the palpi. The antennæ are fusiform in some of the species, or largest near the outer end in others, and the tip is bent more or less into a hook or ends in a ciliated seta. The antennæ of the female are very finely ciliated on the under side, and a cross section is nearly circular; while the males have a high ridge along the under side of the antennæ, and are strongly ciliated or pectinated on each side of this ridge.

The thorax is well developed in all the species, and has the scales appressed over the surface, or there is a short, stout, erect tuft from each side of the metathorax, while some species have a central ridge of scales along the middle. The abdomen is stout and tapering to the apex, and there are fine spines along the edge of the segments in some of the species, which are concealed by the scales. Some species have anal tufts more or less fan-like, and small tufts along each side. The female ovipositor consists of two short pieces, one on each side, rounded at the outer end and clothed with short

hairs. The external organs of generation in the male are quite complex, and besides the intromittent organ, consist of a clasper on each side, and a central plate above, to which is attached a hook curving downward, and beneath this is a projection which is generally shorter than the hook and curves up somewhat at the end. These two may be represented by the thumb and finger separated from each other by a little space and slightly bent. They vary much in form and in their relative length in different species. The side pieces or claspers also vary much in form and size, and often have a variously shaped spine, hook or clasping organ connected with the lower and inner side. These appear to be only a modification of one part of the side piece and not a distinct body.

The legs are well developed and of moderate and nearly equal length. The fore tibiæ have a stout spur called the *tibial epiphysis* on the inside, and in some species there are more or less spines over their surface. The middle tibiæ have a pair of unequal spurs at the outer end, and are also spinose in some species. The hind tibiæ are rarely spinose but have a pair of spurs at the end, and in most species, a second pair near the middle. The tarsi of all the legs are five jointed, spinose, and are armed with a pair of simple claws at the end.

The fore wings are generally long and narrow with an oblique and entire outer margin in some, and a sinuous, scalloped or angulated margin in others. They have either eleven or twelve veins, according to whether number 10 is present or wanting. Vein 1 is forked at the base, and ends at the anal angle; vein 2 arises from near the middle of the median vein; 3, from the outer fourth, and 4, from the end of the median which extends only to about the middle of the wing. The cross vein which joins the outer ends of the subcostal and median, is more or less oblique and often bent inward near the middle, from which point vein 5 arises. Veins 6 and 7 arise from one point or from a common stem which is a prolongation of the subcostal, and 8 arises from 7, a little

before the middle, and ends at or near the apex of the wing. Vein 9 arises from the subcostal a little before the end of the cell and ends in the costa a little before the apex. At its outer fourth it sometimes gives off vein 10 from its upper side. This vein lies so close to 9 that it is not easily detected, but its presence or absence does not seem to be a constant character, for in some examples it is present in one wing but absent in the other. It is very doubtful, therefore, if it will prove of any assistance in classification. Vein 11 arises from the subcostal vein a little before the base of 9, and vein 12—the costal vein—arises from the base of the wing and ends near the outer fourth of the costa. The costa itself is thickened so as to appear like a vein, and veins 9 to 12, together with the subcostal, are crowded near the costal margin, thus making this part of the wing very strong.

The hind wings are much shorter than the fore wings, and have their outer margin entire or more or less denticulate. Most of the species have the margin produced into a more or less prominent angle at the end of vein 1 b. There are five veins arising from the base of the wing; the one nearest the costa is called the costal vein and ends in the costa near the apex; the next behind this is called the subcostal and is connected with the costal, by a short, oblique intercostal vein. The third vein, arising from the base of the wing, is called the median, and reaches scarcely to the middle of the wing, where it meets the cross vein extending back from the end of the short subcostal. The two remaining basal veins are numbered 1 a, and 1 b, the former being the one nearest the anal angle of the wing. Vein 2 arises from near the middle of the median, 3 from the outer fourth, and 4 from the end of the median. Vein 5 arises from near the middle of the cross vein, and 6 and 7 arise from one point or from a stem at the end of the subcostal. A *frenulum* is attached to the basal part of the costa of the hind wings, and passes through a membranous loop on the under side of the fore wings. This frenulum consists of a single curved bristle in the males, but of a cluster of six very short fine bristles in the females, and the loop is wanting in this sex.

SYNOPTICAL TABLE OF THE SPHINGIDÆ.

1 { Tongue long and horny 2
  { Tongue short and membranous.....SMERINTHINÆ..16

2 { Abdomen with a well-developed anal tuft; flight usually diurnal .....MACROGLOSSINÆ.. 4
  { Abdomen untufted; flight crepuscular or nocturnal... 3

3 { Thorax tufted; outer margin of the wings obliquely rounded .....SPHINGINÆ.. 7
  { Thorax untufted; outer margin of the wings more or less excavate.....CHAEROCAMPINÆ..12

4 { The middle of the wings transparent ....HEMARIS.
  { The middle of the wings opaque 5

5 { Outer margin of the fore wings entire....LEPISESIA.
  { Outer margin of the fore wings angulated 6

6 { Fore tibiæ spinose.....AMPHION.
  { Fore tibiæ not spinose.....THYREUS.

7 { Eyes strongly ciliated..... 8
  { Eyes scarcely or not ciliated.....10

8 { Fore tibiæ spinose..... 9
  { Fore tibiæ not spinose..... DOLBA.

9 { First joint of fore tarsi with a row of three or four stout curved spines on the outside....HYLOICUS.
  { First joint of fore tarsi without stout curved spines on the outside.....SPHINX.

10 { Head prominent; eyes large; palpi well developed, PHLEGETHONTIUS.
   { Head sunken into the thorax; eyes small; palpi short 11

11 { Outer margin of fore wings excavate on vein 2, CERATOMIA.
   { Outer margin of fore wings entire, rounded, DAREMMA.

12 { Outer margin of fore wings angulated ..DEIDAMIA.
   { Outer margin of fore wings entire or sinuous.....13

13 { Antennæ straight; largest near the outer end, DEILEPHILA.
Antennæ largest in the middle; hooked at the outer end 14

14 { Spurs of the middle and hind tibiæ short; legs weak, 15
Spurs of the middle and hind tibiæ long; legs stout, PHILAMPELUS.

15 { Scales of the head lying smooth and flat, CHAEROCAMPA.
Scales of the head in a ridge or tuft between the antennæ ..... EVERYX.

16 { Outer margin of the fore wings evenly rounded and entire ..... ELLEMA.
Outer margin of the fore wings scalloped or more or less angulated 17

17 { Fore tibiæ with a stout spine at the tip; large species, TRIPTOGON.
All the tibiæ spinose; medium sized species, CRESSONIA.
Tibiæ not spinose; medium sized species; hind wings with an eye-spot 18

18 { Outer margin of the fore wings scalloped, PAONIAS.
Outer margin of the fore wings more or less angulated, SMERINTHUS.

SYNOPSIS OF THE LARVÆ.

The following table may be of some assistance in determining the full grown larvæ, but it must be understood that there is so much variation in this stage that, until our knowledge of the larvæ is more complete, no entirely satisfactory synopsis of them can be given.

1 { Larva without a caudal horn 2
Larva with a caudal horn 7

2 { Green, with three longitudinal white stripes on each side 3
Not marked as above 4

3 { Dorsal stripe spotted with red.....*E. harrisii.*
{ Dorsal stripe not spotted with red, *E. coniferarum.*

4 { With six light-colored oval spots in a row on each side 5
{ Without oval spots on the sides.....*T. abbotii.*

5 { Body green.....*P. pandorus.*
{ Body pale straw to reddish brown 6

6 { Three inches or more long.....*P. achemon.*
{ Less than three inches long.....*P. vitis.*

7 { Without seven oblique stripes on each side..... 8
{ With seven oblique stripes on each side 14

8 { Larva without stripes or spots.....*D. inscripta.*
{ Larva with stripes or spots..... 9

9 { Light green, with a large crimson eye-spot on the side of the 4th segment .....*C. tersa.*
{ Without these characters.....10

10 { Chocolate brown, with amber stripes along the sides, *A. nessus.*
{ Ground color green 11

11 { Body with even longitudinal stripes.....12
{ Body with longitudinal stripes composed of more or less confluent spots..... 13

12 { Dorsal line, a brownish shade.....*H. diffinis.*
{ Dorsal line, pink, bordered with white ..*H. thysbe.*

13 { Olive green, with a row of yellowish spots along the sides..... .....*D. chamaenerii.*
{ Yellowish green or black, with a row of confluent spots along the sides.....*D. lineata.*

14 { With four short thoracic horns.....*C. amyntor.*
{ Without thoracic horns 15

15 { With a subdorsal longitudinal stripe 16
{ Without subdorsal longitudinal stripes 18

16 { With a dorsal row of red or lilac spots, *E. myron.*
{ Without a dorsal row of red spots.....17

17 { Subdorsal line extending from the head to the caudal horn ..... *E. versicolor.*
Subdorsal line not extending forward to the head, *E. chœrilus.*

18 { Top of the head more or less angulated; body granulated 19
Top of the head rounded; body rarely granulated.... 23

19 { Caudal horn nearly obliterated ..... *T. modesta.*
Caudal horn well developed 20

20 { Sides of the body with one or two longitudinal rows of reddish brown spots 21
Sides of the body not spotted with reddish brown.... 22

21 { Caudal horn green, tinged with yellow on the sides, *S. myops.*
Caudal horn light brown at base and tip, green in the middle ..... *S. astylus.*

22 { Caudal horn apple green and granulated, *C. juglandis.*
Caudal horn violet and granulated... *S. geminatus.*
Caudal horn bluish green ..... *P. excœcatus.*

23 { Black spots or marks on top of the thoracic segments.. 24
Without black marks on thoracic segments..... 25

24 { Caudal horn nearly obliterated..... *S. eremitus.*
Caudal horn of usual size ..... *P. cingulata.*

25 { Oblique stripes, white or yellow margined above with crimson ..... *D. hylaeus.*
Oblique stripes, white and margined above with violet, *S. gordius.*
Oblique stripes, white and margined above with purple or mauve..... *S. drupiferarum.*
Oblique stripes, white and margined above with dark blue ..... *S. kalmiœ.*
Oblique stripes, white or yellow and margined above with black..... *H. plebeius.*
Oblique stripes not colored as above..... 26

26 { Last segment dotted with black..... *D. undulosa.*
Last segment not dotted with black..... 27

27 { Caudal horn reddish, tipped with black .. *P. celeus.*
Caudal horn bluish, tipped with black, *P. carolina.*

Family—SPHINGIDÆ.

Sub-Family—MACROGLOSSINÆ.

Genus I, HEMARIS, Dalman, Vet. Akad. Handl. p. 207 (1816).

He-ma'-ris.

Head small but not sunken into the thorax, without a ridge or tuft of scales on the top; proboscis horny and nearly as long as the body; palpi closely scaled and forming a more or less complete cone in front of the head; eyes of medium size and lashed; antennæ not more than two-thirds as long as the costa, clavate or swollen near the outer end and terminating in a minute and bent seta, biciliate in the males but simple in the females; thorax smooth, tapering in front and prolonged in front of the fore wings; abdomen well developed, somewhat flattened beneath, with a broad fan-like anal tuft. The posterior edge of the segments above is armed with minute flattened spinules.

The fore wings have eleven veins, an entire and rounded outer margin, and the middle of the wings is transparent and crossed by the dark veins. The hind wings are also transparent in the middle, and the outer margin is somewhat excavated between veins 1b and 2.

The species of this genus fly around flowers during the middle of the day in the hot sunshine. The larvæ undergo their transformations in an imperfect cocoon on the surface of the ground.

Four species occur in New England and may be separated by the following table:

1 { Discal cell of the fore wings crossed by a longitudinal bar of scales resembling a vein.....*H. thysbe.*
Discal cell of the fore wings not crossed by a longitudinal bar of scales..... 2

2 { Transparent part of the hind wing crossed by five veins ..... *H. gracilis.*
  { Transparent part of the hind wing crossed by six veins 3

3 { Apex of fore wings with a rust red spot.. *H. diffinis.*
  { Apex of fore wings without any rust red spot, *H. tenuis.*

1. HEMARIS TENUIS, Grote.

He-ma'-ris ten'-u-is.

"Expanse of wings, one inch and a half.

Pale yellowish and black. The two bluish white lateral abdominal spots evident against the blackish hairs of the basal segments, which latter are dorsally yellow. Anal tuft black, divided by yellow central hairs. Beneath, some sparse yellow hair overlies the usual black abdominal vestiture. Legs black; pectus pale yellowish white; palpi above black, beneath pale yellowish.

Wings largely vitreous, with very narrow, dull blackish borders; blackest at base, as usual, and partially overlaid with yellowish scales. Costal edging narrow; the band along external margin is even on its inner edge and narrower throughout than in any species hitherto described from the Atlantic District. There is no perceptible red apical shading. The body squamation is rather rough, and in size it is the smallest of our species yet described. The external margins of the wings are more rounded and full than in any of our other known species of Hemaris."

This species occurs in New York and is reported from Maine, but as it is unknown to me I give the original description. The early stages and food plants are unknown.

2. HEMARIS DIFFINIS, Boisduval.

He-ma'-ris dif-fi'-nis.

Expanse of wings, one inch and three-fourths.

The fore wings are transparent, with dark brown veins, and have a narrow, dark brownish opaque border along the costa, a similar one on the outer margin, which is wider at

the apex, where there is a rust-colored spot on it; and there is also a brown patch on the base of the wing with a narrow prolongation along the hinder border.

The hind wings are transparent, with dark brown veins, a narrow outer border and a broad inner one which extends around on the costa, where it grows narrower as it extends outward. These borders are dark brown and opaque, and marked more or less with rust color.

Head above, and front part of the thorax, olive green inclining to yellowish on the sides. A broad band of brown, bordered on each side with pale yellow, extends along the top of the thorax and abdomen. Upper side of palpi, legs and under side of thorax and abdomen, black, marked with pale yellow on the under side of the palpi; sides of the thorax beneath the wings, front of the fore coxæ, a few hairs on the fore femora and on the middle and hind tibiæ, also on the sides of the middle segments of the abdomen. The lateral tufts at the end of the abdomen are black, while the central one is pale brown. There are a few blue scales on the hinder edge of the sides of the first two abdominal segments.

The mature larva is one inch and three-fifths in length, slightly tapering towards each end. The head is oval, of an apple green color and sprinkled with minute whitish granulations. The body appears to vary in color from blue to green and greyish pink above, green to yellowish brown on the sides, deepening into reddish brown on the under side. The upper surface is thickly granulated in transverse lines, of a yellowish color on the second segment, but white elsewhere. A brownish shade extends along the middle of the back on each side of which, half way down to the spiracles, there is a pale yellow line extending from the second segment to the base of the caudal horn which is of a reddish color and acutely granulated. The caudal horn is sometimes said to be black.

This larva feeds on the leaves of Bush Honeysuckle (*Diervilla trifida*), Snowberry (*Symphoricarpus racemosus*), and Fever-wort (*Triosteum perfoliatum*).

3. Hemaris gracilis, Grote and Robinson.

He-ma'-ris grac'-i-lis.

Expanse of wings, one and three-fourths inches. All the wings are transparent and crossed by the dark brown veins, but with an opaque border all around, of a dark reddish brown above and lighter beneath. A broad pale yellow band extends from the anal angle on the under side of the hind wings, to the transparent part. Six veins cross the transparent part of the fore wings and five cross that of the hind wings.

The upper side of the head, thorax and first two segments of the abdomen are olive green. The remaining segments are dark reddish brown, with olive green on the sides of the last two segments. The anal tuft is reddish brown in the middle and black on the sides. The under side of the head and thorax are cream yellow, with a stripe extending backwards from the eyes, all the legs and the under side of the abdomen, reddish brown. There are four small tufts of cream-colored hairs along each side of the abdomen beneath and a row along the middle.

This rare species has been taken occasionally in Maine in the early part of June, flying around flowers, like *H. diffinis*, but the food plant and early stages are as yet unknown.

4. Hemaris thysbe, Fabricius.

He-ma'-ris thys'-be.

Expanse of wings, two inches. All the wings are transparent and crossed by the dark brown veins. The fore wings have a narrow costal border, a wide outer border dentate inwardly on the interspaces, and a basal patch extending along the hinder margin, of a dark reddish brown color, and overlaid on the basal portion with olive green hairs. The cell is divided through the middle by a line of brown scales which appear like an inward prolongation of vein 5. The hind wings are bordered all around, narrowly on the costa, more widely on the outer margin, with dark reddish brown, while

the hinder margin and base of the wing have a very wide border of rust red. All these borders are of a lighter color on the under side of the wings.

The upper side of the head, palpi and thorax is of a bright olive green color. The sides of the palpi are blackish and they are cream colored beneath. The breast and legs, except the hind tarsi and lower ends of the tibiæ which are brown, are also cream colored. The upper side of the abdomen has the first two segments yellowish brown, the next two, deep reddish brown and the terminal segments yellowish brown with reddish brown patches in the middle. The anal tuft is reddish brown in the middle and black on the sides.

Variety *uniformis*, G. and R. differs in not having the inner edge of the outer border dentate on the interspaces. This variety is common at Orono.

The mature larva is nearly one inch and three-fourths in length, tapering towards the head, which is dull green and granulated. The body is clear green, lighter above and shading darker below. The under side is of a dull rose red color from the third pair of legs to the end of the body, and this color is bordered on each side with a buff stripe. A pinkish stripe extends along the middle of the back, bordered on each side with a whitish line which ends in front of the caudal horn. A white or yellowish line runs along each side from the second segment to the base of the caudal horn, which is curved, light blue, tipped with yellow, granulated with white on the sides and black in front.

The pupa is about one inch long, of a blackish brown color, with the entire surface shagreened. The terminal spine is broad at the base, prominent, flat, rounded at the tip and armed with about ten very fine hooks and a central stouter double hook by which the pupa is attached to some threads of silk in its cocoon.

The larva of this species feeds on Snow-ball (*Viburnum opulus*), Arrow-wood (*Viburnum dentatum*), Sheep-berry (*Viburnum lentago*), Snow-berry (*Symphoricarpus racemosus*), and Hawthorn (*Cratægus*).

Genus II, AELLOPOS, Hübner, Verz. bek. Schm. p. 131 (1818).

5. Aellopos titan, Cramer.

A-el'-lo-pos ti'-tan.

This species, which is unknown to me, is said to occur rarely in the southern part of New England.

Expanse of wings, two inches and three-tenths. Dull blackish with a slight olivaceous tinge; discal spot black and scarcely visible; a straight, semi-transparent, whitish band crosses the middle of the fore wing, followed by another which is much narrower. A somewhat arcuated, similarly colored band formed of a double series of semi-vitreous, lunate spots extends from the costa nearly across the wing. The terminal space is paler and has purplish reflections. The under side is dark brownish, and the whitish markings of the upper side are distinctly reproduced.

The hind wings are blackish, paler at the base and shaded with yellowish along the costa. Head and thorax above, dull brownish with a slight olivaceous tinge. Abdomen olivaceous, with the third abdominal segment white above; fourth segment with a large dark brownish lateral shade which is much reduced on the fifth, but extends entirely across the sixth. Anal hairs, brown on the sides and olivaceous in the middle.

The early stages and food plant are apparently unknown.

Genus III, LEPISESIA, Grote, Proc. Am. Ent. Soc. V, p. 38 (1865).

Lep-i-se'-si-a.

Head somewhat sunken into the short and square thorax; proboscis horny and nearly as long as the body; palpi closely scaled, ascending; eyes of medium size and ciliated; antennæ not more than two-thirds as long as the costa, swollen near the outer end and terminating in a ciliated seta; thorax and abdomen smoothly scaled, the latter with an anal tuft. The

legs are comparatively long and slender; the fore tibiæ are armed with stout spines; the middle tibiæ have one pair of long unequal spurs, the hind tibiæ have two pairs.

The fore wings have eleven veins, the costa is somewhat depressed in the middle, the outer margin is entire and rounded but with a slight excavation between veins 2 and 3. The outer margin of the hind wings is straight and entire. These insects fly around flowers in the hot sunshine.

6. LEPISESIA FLAVOFASCIATA, Barnston.

Lep i-se'-si-a fla-vo-fas-ci-a'-ta.

Expanse of wings, one inch and three-fourths. Head and thorax above, pale yellow; palpi black, yellowish beneath; abdomen black, with the first segment above, and the side tufts on the last segment but one, pale yellow. Under side of the body and the legs, black.

Fore wings blackish, with a pale or whitish oblique band across the wing beyond the cell, and crossed by the black veins. Discal spot small and black. Hind wings black, with a broad central band of bright orange yellow. Under side of the wings marked as above, but paler, and the basal part of the fore wings is bright orange yellow.

The early stages and food plant of this exceedingly rare moth are unknown. It has been taken in Canada, Massachusetts, Belfast and Orono, Maine. Mr. Thaxter informs me that he saw one at Kittery, Maine, flying around the flowers of Larkspur in June. It flies in the middle of the day in the hot sunshine, around the flowers of apple, lilac, shad-bush (*Amelanchier canadensis*), etc. It appears to be one of our earliest day-flying sphinx moths.

Genus IV, AMPHION, Hübner, Verz. bek. Schm. p. 135 (1818).

Am-phi'-on.

Head rather small but not sunken into the thorax, the scales on the upper side turned towards the central line but scarcely forming a ridge; proboscis nearly as long as the body; palpi moderate, closely scaled, the scales forming a

cone in front of the head; eyes provided with numerous long lashes above; antennæ fusiform, prominently hooked at the end; thorax well developed, the scales lying smooth over the surface, except at the posterior part, where they are inclined to turn up; abdomen with a broad fan-like anal tuft; segments provided with several series of scale-like spinules along the posterior edge of the segments above; fore tibiæ spinose on the outside near the lower end; middle tibiæ with one pair of medium-sized spurs, hind tibiæ with two pairs.

Fore wings with eleven veins, the outer margin excavate below the apex and above the anal angle; the hinder margin concave before the anal angle. Hind wings with the outer margin slightly dentate and somewhat produced at the end of vein 1 b.

7. Amphion nessus, Cramer.

Am-phi'-on nes'-sus.

Expanse of wings, from one inch and three-fourths to two inches.

The upper side of the head, thorax, abdomen and fore wings is of a dull dark rusty brown. The middle of the fore wings is crossed by a rich dark brown oblique band within which there are two lines of the same color, and beyond the central band is another line followed by several shade spots of the same color. These markings are not very clearly defined. The fringes are of the same color as the wings, except at the middle of the excavations, where they are pale yellow.

The hind wings are of a rich dark brown color, with an oblique, central reddish band which, starting from the costa, gradually changes its color and merges into the ground color of the wing, and is lost before reaching the hinder margin of the wing. The fringes are pale yellow, broken in places with brown. The hinder edge of the fourth and fifth segments and the base of the fifth, on the upper side of the abdomen, are of a bright sulphur yellow color. The under side of the head, body and wings is of a rust red color, shaded and

marked more or less with brown. A pale yellow stripe extends from the base of the antennæ along the side under the wings.

The newly-hatched larva is cylindrical, except a slight enlargement of the third and fourth segments, increasing at each molt. Body pale yellow green, with two light, longitudinal, subdorsal lines, straight from the head to the eleventh segment, thence curving to the caudal horn which is short, black, ocherish or reddish brown at the base, tapering abruptly, and often carried in a line with the back. (Miss Sanders.)

The mature larva is from two and a half to three inches long, tapering from the fourth segment to the head. The color is of a uniform chocolate brown, thickly dotted with dark amber especially along the line of the back, and there are stripes along the sides, of the same color. (Andrews.)

Boisduval has described it from an excellent drawing by Abbot, as follows: "Of a yellowish green color, with a longitudinal band running along each side and ending at the base of the caudal horn, which is red and slightly rosy. Feeds on the Rubiaceæ and sometimes on vines" (*Ampelopsis quinquefolia*). It is said, by Dr. Jewett, to feed on *Epilobium coloratum*.

This species is very common in Maine and flies from the first to the middle of June, around flowers in the bright sunshine. It is also reported as being on the wing occasionally, early in the evening.

Genus V, THYREUS, Swainson, Zool. Ill. Vol. 1, p. 60, *Thy'-re-us* (1821).

Head well developed, with the scales forming a low ridge between the antennæ; proboscis nearly as long as the body; the palpi densely scaled; eyes with numerous lashes; antennæ fusiform, the end bent into a long hook; thorax well developed, somewhat tufted on the hinder part; abdomen somewhat flattened beneath and provided with anal and lateral tufts, the

segments without spinules along the hinder edge; tibiæ not spinose, the middle with one pair of very unequal spurs, the hind tibiæ with two pairs.

The fore wings have eleven veins and sometimes twelve. They are rather long and narrow, and are angulated on the outer margin. The hind wings are somewhat dentate on the outer margin, and produced on vein 1 b.

8. THYREUS ABBOTII, Swainson.

Thy'-re-us ab-bot'-i-i.

Plate IV, Fig. 4.

Expanse of wings, about two and a half inches.

Head, palpi and thorax, dull chocolate brown. The hinder edge of the collar is blackish, and there are two parallel lines of the same color on each side, starting from near the middle of the thorax and extending obliquely down and back along the edge of the patagiæ. The abdomen is dark chocolate brown, lighter across the middle and with blackish bands across the basal and outer segments. The anal brush is dull yellowish brown, with the central part lighter.

The fore wings are dull chocolate brown, lighter beyond the middle, even yellowish brown in the female. There is a series of four or five dark, strongly toothed lines crossing the outer part of the wing, beyond which it is colored like the base and has several dark brown marks on it. The basal part of the wing is separated from the lighter portion beyond by a heavy dark brown line which, starting from the basal third of the hinder margin, extends obliquely up and out, gradually growing finer till it is lost just within the small, dark discal dot. The outer margin of the wing has five rounded excavations of unequal size and depth.

The hind wings are lemon yellow, with a dark brown terminal band which is broken into a series of short lines above the anal angle. The under side of the insect is much lighter than above.

The newly-hatched larva is cylindrical, of a uniform light bluish green with a powdery bloom, and the body is finely

striated transversely. The caudal horn is long and very slender, erect, of a blackish color and yellow at the base.

The mature larva (Plate IV, Fig. 4) is a little over two inches in length, and has no caudal horn, but its place is taken by a polished, black tubercle with a yellow ring around it. The larva varies in color from dull yellow to reddish brown, each segment being marked transversely with six or seven fine black lines, and longitudinally with dark brown patches, but these markings are subject to great variation.

This species has not been taken in Orono but occurs rarely at Kittery, Maine, and is common in Massachusetts and has a wide distribution through the United States.

Sub-Family—SPHINGINÆ.

Genus VI, CERATOMIA, Harris, Sill. Jour. Vol. XXXVI. *Cer-a-to'-mi-a.* p. 293 (1839).

Head small and somewhat depressed, the scales forming an ill-defined tuft between the antennæ; proboscis reaching nearly to the end of the thorax; palpi short, slender and slightly ascending; eyes small, scarcely lashed; antennæ fusiform and ending in a small ciliated hook; thorax short and but little advanced beyond the base of the fore wings, with short, stout post-thoracic tufts and scale ridges along the inner edge of the patagiæ; abdomen cylindrical and tapering to the end without anal or side tufts, the segments armed with round spinules on the hinder edge; tibiæ not spinose, middle tibiæ with one pair of long spurs, hind tibiæ with two pairs; first joint of fore tarsi with a row of three stout, curved spines on the outside.

Fore wings ample, usually with twelve veins (sometimes with eleven), outer margin oblique, nearly entire but slightly excavate at the end of vein 2. The outer margin of the hind wings is entire except a slight rounding out on the end of vein 1 b.

Pupa smooth, tongue-case not apparent, transformations subterranean.

9. Ceratomia amyntor, Hübner.

Cer-a-to'-mi-a a-myn'-tor.

Expanse of wings, three and three-fourths inches.

Palpi, under side of the head and all the legs dark coffee brown. Upper side of the head, collar and sides of the thorax, whitish, the head and collar stained on top, more or less, with clay color and edged with brown. Upper side of the thorax clay color, with the patagiæ edged with dark brown, and another line of dark brown follows the upper edge of the white on the sides. The lateral thoracic tufts at the posterior part of the thorax are marked with clay color, dark brown and white. The abdomen above and beneath is clay colored, with a dorsal line and two lateral stripes on each side, of dark brown.

The costa of the fore wings is light brownish gray, and a stripe of clay color extends from the base of the wing along the cell, widening outwardly to the apex. The central part of the wing below the cell, and between the inner and outer cross lines, is dark coffee brown. The discal spot is small and white, and there are several heavy black dashes between the veins and parallel with them, below the median and beyond the cell. A triple dark brown line starts from the costa near the base and runs very obliquely towards the end of the cell, giving off one tooth in its course, then turning sharply back, runs to the hinder margin near the base of the wing in a somewhat wavy course. A similar triple line more separated on the costa, starts from the outer fourth and runs down as far as vein 5, at nearly right angles with the costa, thence obliquely and parallel to the hinder margin. This line is several times angulated in the first part of its course, then wavy to near the hinder margin, where it forms a sharp outward angle. The portion of this line which is parallel with the outer margin is bordered on the outside with a gray shade.

Hind wings clay colored, shaded with brown in the form of a central and a subterminal ill-defined brown band. All the fringes above and beneath are brown, cut by ochre yellow between the veins. Under side of all the wings, pale brownish gray, lighter on the costal margins. The outer cross lines of the fore wings are reproduced, and there are three brown lines crossing the middle of the hind wings, which give out sharp angles on the veins.

The eggs of this moth are of an oblate spheroidal form, the lateral diameter being about one-twentieth of an inch, and the vertical diameter somewhat less. They are pale green with very fine granulations over the surface, and hatch in from seven to ten days, leaving the shells colorless and transparent.

A newly hatched larva is about one-fifth of an inch long, pale green, with a straight caudal horn about half the length of the body, dotted and tipped with brown. There is a pair of minute thoracic horns on the top of the third segment and another pair on the top of the fourth, and there is a row of minute fleshy teeth along the middle of the back, which are scarcely visible. Before the first molt the larva has nearly doubled its size and has a white vascular line, a faint line on each side of the middle of the back and seven oblique stripes on each side of the body, all of the same color. The head is smooth and the thoracic horns are barely visible.

They molt their skins in about five days after they hatch, after which the head and caudal horn are granulated, the thoracic horns prominent, the fleshy teeth along the middle of the back with the stripe on each side of it, the oblique stripes on the sides and the thoracic lines are plainly visible.

The second molt is made in from five to eight days after the first, when the row of teeth along the middle of the back is prominent, the lateral oblique stripes are granulated and the caudal horn is pale yellow with granulations in front and behind. The third molt is made in from six to eight days after the second, when the larva is light green with the teeth along the back and the granulations on the side, of a whitish

color. The caudal horn is now curved, of a yellowish green color, and covered with brown granulations on the forward side. The thoracic horns are tipped with yellowish.

The fourth and last molt is made in from six to eight days, and in six days more they reach maturity, leave their food plant, descend to the ground which they enter for the purpose of spending the winter and passing their final transformations. The mature larva is from two and three-fourths to three and one-fourth inches long, pale green or reddish brown, head and body strongly granulated, a dorsal row of fleshy teeth, one on each wrinkle, tipped with whitish or pink, extends from the fourth segment to the caudal horn. There is a pair of short, straight, tuberculated horns on the top of the third segment and a similar pair on the fourth. A line of granulations connects the thoracic horns. Seven oblique stripes of whitish granulations occur on each side, each of which crosses one segment and a part of the one before and the one following. The last stripe extends to the caudal horn.

This species feeds on the leaves of the Elm, Bass-wood and *Betula alba*.

Genus VII, DAREMMA, Walker, Lep. Het. Part. 8. p. 230 (1856).

Da-rem'-ma.

Head, small and sunken into the thorax, with a slight tuft on top; proboscis not longer than the thorax; palpi short and small; eyes small and without lashes; antennæ fusiform, ending in a small ciliated hook; thorax short and but little advanced beyond the base of the fore wings, with short, stout post-thoracic tufts and scale ridges along the middle and inner edge of the patagiæ; abdomen cylindrical and tapering to the end without anal or side tufts; the segments armed with round spinules on the hinder edge; tibiæ not spinose; middle tibiæ with one pair of long spurs, hind tibiæ with two pairs; first joint of the fore tarsi with a row of three stout curved spines on the outside.

The fore wings have twelve veins (sometimes eleven), and the outer border is oblique, rounded and entire. The outer margin of the hind wings is nearly entire.

10. Daremma undulosa, Walker.

Da-rem'-ma un-du-lo'-sa.

Expanse of wings, three and one-half inches.

Head and palpi, brownish gray, the latter being darker on the middle joint, and the head darker above and lighter on the sides. The thorax is gray with two black lines edged with yellowish, crossing the prothorax. These lines meet two similar ones on each side, which run backwards, one on each edge of the patagiæ and meeting behind where the patagia is tipped with white. There is also a curved black line preceded by white and followed by yellowish across the hinder part of the thorax. The abdomen is gray with a dark brown line along the middle and two stripes of the same color on each side, and the segments are edged with yellowish scales. The whole under side is gray with the breast of a pale coffee brown color.

The fore wings are gray, mixed with yellowish scales and crossed by four pairs of wavy or angulated dark brown lines more or less distinct, which start from the costa at about equal distances apart, and divide it into five nearly equal parts. The pair nearest the base of the costa, runs obliquely as far as the cell, giving off one tooth, then it takes a somewhat wavy course to the hinder margin nearly at right angles with it. The second pair is distinct on the costa but crosses the wing a little within the discal spot, as a dark brown shade. The third pair starts at right angles with the costa, and curving around the end of the cell, ends near the middle of the hinder margin. The inner of these two lines is slightly angulated while the outer one gives off quite long and sharp teeth, and the space between them is filled in somewhat with ochre yellow scales. Between this and the outer pair of lines the space is filled in somewhat with whitish. The outer pair of lines starts at right angles with the costa, curves evenly around

to vein 2, and then runs straight to the hinder margin. The outer one of this pair is the darkest and most prominent of all, and is neither undulated nor toothed, while the inner one gives off acute angles on each vein. A black shade line starting from the apex obliquely, extends in to the third pair of cross lines. A parallel dash crosses the outer pair just below, and there are two parallel black dashes near the middle of the wing extending from the median vein out to the outer pair of lines between the veins. The fringes are white, marked on the veins with dark brown spots from which brown dashes extend nearly half way across the terminal space.

The hind wings are dark smoky brown, lighter on the hinder margin, and crossed by three parallel darker brown wavy lines. The fringes are white and marked with brown on the veins. The under side of the wings is gray. The fore wing is crossed on the outer part by a dentate line, and the oblique apical line is partly reproduced. The hind wings which are somewhat lighter, are crossed by two dentate yellowish brown lines, one a little before the middle, the other a little beyond.

The eggs are pale green or aqua marine in color, spheroidal in form, the vertical diameter is four-fifths of a millimeter, one lateral diameter is two millimeters and the other is one and two-fifths millimeters. The surface is very finely granulated and has pearly reflections. The eggs hatch in eight days.

The young larva is one-fifth of an inch long, of a very pale greenish yellow color with fine hairs scattered over the surface. The caudal horn is large, straight and pointed obliquely up and back at an angle of 45 degrees with the line of the body, and is covered with a fine pubescence. It is smoky brown at the tip only, but before the first molt the brown extends nearly over the whole surface of the horn.

The first molt occurs in from four to six days, after which the larva is one-third of an inch long, of a pale green color, the head being a little lighter than the body, and having the surface granulated and a pale vertical stripe on each side.

There are seven oblique stripes on each side of the body, and a longitudinal stripe of a whitish color but not plainly visible.

The second molt is made in from three to five days, after which the larva is three-fifths of an inch long, of a pale green color and with the stripes as before the molt but plainer, and there is added a series of reddish spots on the forward side of the oblique stripes where they cross the longitudinal stripe. The caudal horn is of a pale watery pink color and covered with short, blunt spines, from which arise short fine hairs. The surface of the body is somewhat granulated, especially on the forward segments and behind the caudal horn.

The third molt is made in from four to six days, after which the larva is about one inch long, of a light green color, rather lighter than the under side of the lilac leaf on which it feeds. There is some variation of the ground color at this stage; some are yellowish green while others incline to a bluish green. The longitudinal stripes are now obliterated and the oblique stripes are as in the preceding molt. The legs and caudal horn are pink or pale vinous red, the latter beset with short, stout spines as before. The head and three following segments have whitish granulations above, while the last segment has black granulations on the upper side. The head has a broad vertical stripe of a dull whitish color on each side. The spiracles are pale pink with a white dot at each extremity.

The fourth and last molt is made in from seven to ten days, after which the larva is about one inch and three-fourths in length and of the same color as in the preceding molt. The stripes on the side of the face, the caudal horn and the legs are pale pink or flesh color. The last segment is sprinkled with black granulations on the upper side, and the spiracles are bright vermillion with a vertical white slit in the middle. The oblique stripes are greenish white. The larva reaches maturity in from eight to twelve days from the fourth molt, and is nearly three inches long. It now changes to a dull brownish color which somewhat obscures the markings, when it descends to the ground and working its way down into the

soil, transforms into a dark brown pupa one inch and three-fourths long, with the tongue-case sunken to a level with the surface.

This species feeds on the leaves of the White and Black Ash, Lilac and Privet (*Ligustrum vulgare*).

Rev. G. D. Hulst has written me that *Diludia jasminearum*, B. & Le C. has been taken on Long Island, but as I do not know the species I have not included it in this paper, though it may occur in southern New England.

Genus VIII, PHLEGETHONTIUS, Hübner, Verz. bek. Schm. p. 140 (1818).

Phleg-e-thon'-ti-us.

Head prominent, untufted; proboscis longer than the body; palpi long, ascending and pressed against the front. The basal joint is unusually long, the third joint minute, and the scaling of the second joint gives the palpi the appearance of being enlarged at the outer end; eyes large and scarcely lashed; antennæ fusiform and ending in a short ciliated seta; thorax stout and much advanced beyond the base of the fore wings, with short, stout erect post-thoracic tufts; abdomen cylindrical, tapering to a point, without anal or side tufts, the posterior edge of the segments armed with round spinules; tibiæ not spinose (*celeus* has a few near the end of the fore tibiæ), the middle tibiæ with one pair of long spurs, the hind tibiæ with two pairs. The first joint of the fore tarsi has a row of three or four stout curved spines on the outside.

The fore wings are ample and have eleven veins, an oblique, rounded and entire outer margin. The outer margin of the hind wings is slightly scalloped and produced on vein 1 b.

The species of *Phlegethontius* occuring in New England may be separated by the following table:

1 { Abdomen with rose red spots along the sides, *P. cingulata*.
{ Abdomen with yellow spots along the sides 2

2 { Fore wings pale gray with brownish lines, *P. celeus.*
Fore wings dark brownish gray with darker lines, *P carolina.*

11. PHLEGETHONTIUS CAROLINA, Linneus.

Phleg-e-thon'-ti-us car-o-li'-na.

THE TOBACCO WORM.

Expanse of wings, from four to five inches.

Upper side of the head, thorax, abdomen, and fore wings, dark brownish gray. Palpi a little lighter beneath and in front. Thorax with a few short black dashes on the forward part, and there are also some irregular black spots edged with white on the posterior part. The abdomen has five bright orange colored quadrate spots along each side, decreasing in size towards the apex and surrounded with black. There is a trace of a black line along the middle, and the segments are partly edged with white.

The fore wings have a small white spot at the base, and a small whitish triangular discal spot edged with dark brown. There are nine more or less evident wavy or angulated dark brown lines crossing the wing, four of which are inside of the discal spot at nearly equal distances apart, and so arranged as to give the basal field a long acute outward angle on the cell; three more cross the wing a little beyond the cell giving off acute angles on the veins, and fusing together below the discal spot, and forming a more or less evident dark brown patch. The space following these three lines inclines to wood brown in color. Two more wavy or angulated lines cross the wing, the inner one being dark brown or black and heaviest towards the hinder margin, the outer one which is whitish, crosses the wing just within the outer margin but is obsolete towards the apex. A dark brown line, shaded above with lighter gray than the ground color of the wing, extends somewhat irregularly obliquely in and down from the apex and across the wood brown space. Fringes dark brownish gray, cut with white between the veins.

The hind wings are gray with a small, dark smoky brown spot at the base, a line extending nearly across the wing outside of the spot, two more across the middle, all of the same color as the basal spot, while the marginal band, widest at the apex, is dark brownish gray edged on its inner side with smoky brown and shaded with brown through the middle. The under side of the fore wings is of a uniform dark gray, and crossed by two parallel lines a little beyond the cell, which give off angles on the veins, while the wing beyond is somewhat clouded. The under side of the hind wings is of a lighter gray than the fore wings, and they are crossed, near the middle, by three lines which form acute angles on the veins. A shade band crosses the wing beyond this, and the anal portion is whitish. The under side of the body and abdomen is gray, and there are three or four black spots in a row along the middle of the under side of the abdomen. The legs are somewhat darker, and the middle and hind tarsi are tipped with whitish.

The larva when first hatched is of a greenish color with a faint dusky streak along the back, and the head and last two segments of the body are covered with short sparse hairs, and the caudal horn is finely serrated. After the first molt, the body is green with its dorsal line as before, but the whole surface of the head and body is granulated. The caudal horn is thorny, and there are only a few hairs which are confined to the head and last segment. After the second molt the body is about an inch long, green and without hairs except a few on the last segment which are directed backwards. The spiracles are black with a faint purplish tinge surrounding them. The body now has the markings of the full grown larva. After the third molt, the body is about one inch and one-fourth in length; the head loses its rough points and becomes obscurely shagreened; the spiracles are pale straw color surrounded by a ring of jet black, and this again by purplish which is distinctly edged with black.

The full grown larva is green (of varying shades), with seven oblique white stripes bordered above with bluish or

dark brown, on each side; the first begins on the front edge of the fifth segment on a line with the spiracles, and passing obliquely up and back, crosses this segment and the greater part of the sixth. The second stripe begins at the same place on the sixth segment and crosses this and the greater part of the next, and so on with the rest, the seventh and last ending at the base of the caudal horn. The last segment is edged with white, and there are minute circular white dots edged with purplish brown, each with a minute hair, scattered over the upper surface of the body, especially on the anterior segments. The caudal horn, somewhat curved backward, is reddish or bluish and white on the sides, and studded with short black spines, or the whole horn is sometimes black. At maturity the larva descends into the ground where it transforms into a dark reddish brown pupa with a detached cylindrical tongue-case bent like a jug handle, but not so much arched nor so long as that of *P. celeus*. It is somewhat swollen or bulbous at the end where it is applied to the body not quite half way to the end of the wing cases.

They feed on the leaves of the Tomato and Tobacco plants, and at times do a great deal of damage. They also feed on Jamestown weed (*Datura stramonium.*)

12. PHLEGETHONTIUS CELEUS, Hübner.

Phleg-e-thon'-ti-us ce'-le-us.

THE POTATO-WORM OR TOMATO-WORM.

Expanse of wings, from four to five inches.

The whole surface of the body and wings above and beneath is ashy gray. The top of the thorax is tinged with brownish and has several short transverse black lines on the prothorax, one along the edge of the patagiæ and another through the middle of it, of the same color. The metathoracic tufts are bluish, and followed by a large black patch which extends across the whole width of the thorax, and this is followed by a whitish stripe. The abdomen has a fine black line along the middle, a row of fine orange colored spots surrounded with

black along each side, and the segments above and below these spots are edged with white. A row of four or five black spots runs along the middle of the abdomen beneath.

The fore wings are somewhat shaded with brown beyond the middle and near the apex, and crossed by three or four parallel brown lines which extend from the basal third of the costa out to the small obscure discal spot, then across the wing to the hinder margin near the base. Three nearly parallel, much angulated, brown lines start from the outer fourth of the costa and cross the wing to the middle of the hinder margin. A less angulated and stronger dark brown line starts from the costa a little beyond the last and crosses the wing, ending a little inside of the anal angle. A subterminal brown line edged with whitish on the inside, runs near and parallel to the outer margin, but does not reach either the costa or the hinder margin. There is a slightly curved, black, double line between the veins outside of the discal spot, above the outer part of which is another, curved up at its outer end, and nearly reaching the inner end of one extending obliquely inward from the apex. Fringes brownish, marked between the veins with sordid white.

The hind wings are pale gray, bordered exteriorly with ashy gray, on the inside of which there is a dark brown band widest towards the costa. The middle of the wing is crossed by a pair of dark brown lines dentate on the veins, and within these there is a curved line of the same color, and a small spot resting on the base of the wing. Fringes, brownish marked between the veins with whitish. A brown line crosses the outer fourth of the under side of the fore wings, dentate on the veins, within which one or two more lines are more or less distinctly visible. The apical and intervenular black lines are reproduced. Three nearly parallel dark brown lines, dentate on the veins, cross the middle of the under side of the hind wings, and the outer margin is shaded.

The young larva is of a delicate green color, acutely granulated, especially when it has recently molted. The mature larva is from three to five inches long, and is very variable in

its ground color which is usually some shade of green, with a darker head, and seven oblique whitish or greenish yellow beaded stripes on each side. The caudal horn is nearly black, and spiny. Occasionally the ground color is dark brown and they are even said to be black sometimes. At maturity they descend into the ground where they transform into dark brown pupæ with the tongue-case detached, cylindrical and bent like a jug handle, the enlarged or bulbous end touching the body at about the outer third of the wing cases.

This species feeds on the leaves of Tobacco, Tomato, Jamestown weed (*Datura stramonium*), Matrimony Vine (*Lycium vulgare*) and Ground Cherry (*Physalis viscosa*).

13. PHLEGETHONTIUS CINGULATA, Fabricius.

Phleg-e-thon'-ti-us cin-gu-la'-ta.

Expanse of wings, from four to four and one-half inches.

Head and thorax above, grayish brown. Palpi brownish gray above and whitish beneath. The prothorax has two transverse black lines, and there is one of the same color through the middle patagiæ. The metathoracic tufts are black, edged in front with blue, and behind with yellow. The abdomen is brownish or ashy gray, with five rose pink quadrate spots along each side, which diminish in size towards the apex. These spots are separated by black bands. The sides of the thorax, abdomen and all the legs are of a lighter gray color, while the under side of the body is whitish with a row of three or four black spots along the middle of the under side of the abdomen.

The fore wings are brownish gray with a small gray spot at the base. The discal spot is small, kidney-shaped, pale gray and encircled with black. A pair of dark brown angulated lines crosses the wing just within the discal spot, and three similar lines cross outside of the discal spot. These two sets of lines are joined by a dark brown shade with two black dashes in it below the cell, thus forming with the upper and darker parts of the lines, a large quadrate dark area which rests on the middle of the costa, and extends rather

more than half way across the wing, containing the reniform or discal spot. A row of gray circlets rests on the veins along the outer margin, their inner sides being formed by the outer dentate line. An irregular black line, shaded above with gray, extends obliquely inward from the apex. The fringes are brown and marked with white between the veins. The hind wings are rose pink at the base and are crossed by three black bands. The terminal space is ashy gray, and the space between the outer black bands is whitish or pale gray. Fringes, brownish gray, marked with white between the veins. The under side of the fore wings is mouse colored with a faint trace of three cross lines beyond the cell. The under side of the hind wings is brownish gray, whitish between the median and terminal bands and along the hinder margin. The middle of the wing is crossed by three dentate brown lines which unite at the middle, forming a black band the rest of the way.

The larva presents a number of varieties, as shown by Prof. Lintner, which reduce themselves to two principal types; those having the ground color green, and those having the ground color brown; and he has described three varieties under each type. The first is of a dark green ground color with seven oblique black bands on each side, which terminate above in a longitudinal stripe of the same color, often indistinctly marked and always interrupted between the segments, extending from the fourth segment to the caudal horn, and bordered on the under side with white. There are two black spots on the top of the third and also of the fourth segments, and four very small ones on the tenth, and a large one on the side between the first and second segments. The head is green, slightly yellowish, with five perpendicular black lines, of which the middle one is divided near the lower end. Legs blackish, caudal horn smooth, yellow or ferruginous and with a black tip. The caudal shield is orange yellow.

The second variety differs in being of a clearer green, and in having the oblique stripes white and the longitudinal stripes reduced to two rows of black dots. The third variety dull

green with six rows of blackish or brownish spots, and the head and caudal horn are ferruginous.

The first of the brown varieties is of a dead leaf brown color on the back, white on the sides and flesh colored underneath. There are seven oblique lateral stripes of a deeper brown, and a lateral stripe of straw color which is continuous on the first three segments and which, beginning on the next segment, is interrupted on the middle of each of the following. The head is pale fawn colored with the same black lines as in the first green variety. The legs are blackish, the caudal horn entirely black and the caudal shield orange yellow. The second brown variety has four longitudinal lines of a dirty white on the first three segments, of which two are dorsal and two lateral, with two points of the same color on these four segments placed near the incisures. The third variety is entirely earthy brown with the back and oblique stripes of a deeper brown. Intermediate forms between these varieties are met with, but in all those of a brown ground color, the body is annulated with numerous blackish furrowed lines which are cut by others longitudinally, forming small squares.

The pupa is yellowish brown, with the tongue-case very long, detached from the breast and doubled upon itself, reaches more than half way back to the head. The returning portion rests on the breast.

This species feeds on the leaves of the Sweet Potato and other species of the Convolvulus family; also on Jamestown weed (*Datura stramonium*). The moth has been taken on flowers in Orono late in August.

Genus IX, SPHINX, Linneus, Syst. Nat. ed. X, Vol. 1, p. 489 (1758).

Head prominent; proboscis as long as the body or longer (sometimes a little shorter); palpi moderate in size, closely scaled and pressed against the front of the head; eyes of medium size and lashed; antennæ fusiform, ending in a short, curved, ciliated seta; thorax well developed, somewhat ad-

vanced in front of the base of the fore wings; with short, erect metathoracic tufts; abdomen cylindrical and tapering, without anal or side tufts, the posterior edge of the segments armed with round spinules; fore and middle tibiæ spinose, the middle tibiæ with one pair of long spurs, the hind tibiæ with two pairs.

The fore wings have twelve veins (sometimes only eleven), and are of medium width, with very oblique and entire outer margins. The outer margins of the hind wings are nearly entire, being but slightly produced on vein 1 b.

The New England species may be separated by means of the following table:

1 { Fore wings dark smoky brown with the costa broadly marked with whitish or pale gray, *S. drupiferarum*.
  { Fore wings not colored as above 2

2 { Fore wings pale ferruginous brown with a small darker brown discal spot..... *S. kalmiæ*.
  { Fore wings not colored as above 3

3 { Hind wings ochre yellow with dark brown or black terminal border..... *S. luscitiosa*
  { Hind wings without any yellow..... 4

4 { Patagiæ gray, edged with black but without a central stripe..... *S. chersis*.
  { Not marked as above..... 5

5 { Discal spot white..... 6
  { Discal spot not visible..... *S. canadensis*.

6 { Thorax above, dark brown..... *S. gordius*.
  { Thorax above, brownish gray ..... *S. eremitus*.

14. Sphinx drupiferarum, Abbot and Smith.

Sphinx dru-pif-e-ra'-rum.

Plate I, Fig. 2.

THE PLUM-TREE SPHINX.

Expanse of wings, three and a half to four inches.

The head, palpi and thorax are blackish brown with a broad light gray or whitish stripe along each side. These stripes meet on the front of the upper part of the head and

the tip of the palpi. The middle of the posterior part of the thorax is brownish gray with black tufts on each side. The abdomen is brownish gray with a black line along the middle and a broad black band along each side, which contains a row of four or five whitish spots. The under side of the abdomen is gray with a dark line along the middle and one on each side. The under side of the thorax is darker gray and still darker in front.

The fore wings are dark smoky brown with light gray or whitish on the costa from the base nearly to the apex, and extending in width to the median vein. The outer margin is of the same color, being widest behind and not reaching to the apex. The brown portion of the wing is covered by several very oblique blackish brown wavy or angulated lines which appear on the costal portion as reddish brown streaks. The gray space along the outer border has a white line through the middle of it, parallel with the border, and the space is limited within by a fine black line with white on the inside, and angulated between the veins. The discal spot is represented by an oblique fine black line, from which a double line of the same color extends in along the middle of the cell, and a single one outward on vein 5. An oblique apical streak extends in across the intervenular space, and is nearly connected with another in the space below. There are also black dashes on the dark brown portion of the wing between veins 1 and 2; 2 and 3; 3 and 4, and also between 5 and 6.

The hind wings are dark brown with a whitish base, narrow central band and a brownish white outer border. All the fringes are smoky brown. The under side of the wings is dark gray, with the outer border and a central band toothed on the veins in the hind wings, smoky brown. The under side of the fore wings is crossed on the outer part by a smoky brown line which is toothed on the veins, and the line is shaded with lighter on each side. The oblique apical line is reproduced on the under side.

The eggs are of a pale yellowish green color, smooth, slightly oval in outline and about one-fifteenth of an inch in diameter. They hatch in six or eight days, and the young larva is about one-fifth of an inch long, pale yellowish green, with a few whitish tubercles over the surface, which are surmounted with fine short hairs. The caudal horn is one-tenth of an inch long, nearly erect, black and thickly covered with short black hairs.

The full grown larva, Plate I, Fig. 3, is about three inches and a half long and of a bright apple green color. The head has a vertical dark brown or black stripe on each side, and there are seven oblique white stripes on each side of the body, which are bordered on the upper side with light purple or mauve. The spiracles are of a bright orange color. The caudal horn is dark brown with yellow at the base of the sides.

The pupa, Plate I, Fig. 4, is about an inch and a half long, of a dark reddish brown color, and the short tongue-case is free from the body and swollen at the end. This insect feeds on the leaves of Apple, Plum and Lilac.

15. Sphinx kalmiæ, Abbot and Smith.

Sphinx kal'-mi-æ.

Expanse of wings, from three and a half to four inches.

Head and thorax, chestnut brown on top, whitish or yellowish along the sides. A chestnut brown stripe extends from beneath the wings forward including the eyes and the middle of the palpi, leaving these last whitish beneath and at the end. The patagiæ are edged above with black, and a line of the same color runs through the middle of them, separating the brown above from the light color of the sides. The metathoracic tufts are black. The top of the abdomen is chestnut brown, or pale brown, with a black central line, and a broad black band broken by a whitish cross stripe on the edge of each segment, runs along each side. Under side of thorax and abdomen, dull white with three or four black points along the middle of the latter.

The fore wings are pale yellowish brown, stained and marked with coffee brown, especially on the outer part. The extreme costal edge and the hinder margin, a small oblique discal spot, a pair of very oblique cross lines visible only on the basal fourth of the costa, and near the base of the hinder margin, are all coffee brown, and the veins and dashes between are of the same color. Just within and parallel to the outer margin is a whitish line shaded on its inner side with blackish, broken by the veins. An oblique black line edged above with whitish, extends inwardly from the apex. All the fringes are marked alternately with reddish brown and whitish. The hind wings are whitish or pale yellowish white with a central and terminal dark brown band. The under side of all the wings is reddish brown with an indistinct terminal darker brown band, and an indistinct central band on the hind wings appears in some specimens.

The full grown larva is three inches long, with a rather small flat head of a clear apple green color, yellowish on the sides and with a lateral black stripe. The body is apple green in color, lighter above and darker on the sides. There are seven oblique stripes on each side, confined to one segment each, which are whitish through the middle, yellowish on the lower side and dark blue, almost black on the upper side. The caudal horn is light blue thickly studded with shining black tubercles, and is quite curved. The caudal shield and anal plates are yellowish green and dotted with small black elevated points. Spiracles, pale orange, their upper portion extending into the yellow of the bands. Legs, black and pearly at the base. Prolegs with two black spots on the outside separated by yellow, or connected posteriorly by a black line.

The pupa is dark brown, and the tongue-case, which reaches to about one-fourth the length of the wing cases, is free from the body, touching it only by the swollen or bulbous outer end.

This species feeds on the leaves of Ash, Lilac and Mountain Laurel (*Kalmia latifolia*).

16. Sphinx chersis, Hübner.

Sphinx cher'-sis.

Expanse of wings, from four to five inches.

Head, palpi and thorax, ashy gray. A brownish stripe extends from the apex of the palpi to the eyes, and is continued as a black line along the side, under the wings. The patagiæ are edged above with black, and the metathoracic tufts are of the same color. The abdomen is ashy gray with a central black line and a broad black band on each side, broken by four or five white cross stripes. The under side is paler than above, and has a row of small black spots along the middle of the abdomen.

The fore wings are ashy gray with a dark smoky brown cluster of hair-like scales at the base behind the origin of vein 1. The discal spot is not usually perceptible, but a black line runs along the middle of the outer part of the cell crossing the position of the discal spot. There are black dashes between all the veins below the apex, the last two nearly uniting in an oblique apical streak. There are two or three light and dark subterminal shade lines which do not reach the costa. The hind wings are pale gray with dark smoky brown median and terminal bands. The fringes are all pale ashy gray. The under side of all the wings is ashy gray with an ill-defined terminal band, a dentate central band on the hind wings continued on the fore wings, all a little darker than the ground color.

The mature larva is from three to three and a half inches long, greenish or bluish white, paler above than below. The head has a vertical yellowish stripe on each side, and there are seven oblique stripes on each side which are pale yellow and edged on the upper side with dark green. These stripes cross one entire segment and three-fourths of the one behind it. The spiracles are black, surrounded with white. The caudal horn is rose colored, and sometimes tipped with blue. Caudal shield edged with light green. Legs, rose color.

The pupa is two inches long, of a chestnut brown color, and the tongue-case touches the body only at the slightly bulbous tip.

This species feeds on Ash and Lilac.

17. SPHINX CANADENSIS, Boisduval.

Sphinx can-a-den'-sis.

Expanse of wings, three and one-half inches.

Head, thorax and abdomen, light brownish gray. The patagiæ are edged above with black, and there is a dark line through the middle, below which the sides of the thorax and head above the eyes are paler than above. Metathoracic tufts, black. The abdomen has a central black line and a broad black band more or less broken by sordid white on the edges of the segments, along each side. The under side is lighter than above, and has a central black line and a similar one on each side of the abdomen.

The fore wings are light brownish gray with a cluster of blackish hair-like scales at the base below the origin of vein 1. The wings are crossed by several very oblique cross lines, visible only on the costa and near the base of the hinder margin. A subterminal black line edged with whitish extends nearly to the apex, followed by another within. Black dashes occur between the veins as far as the apex. Hind wings, pale gray with a spot at the base, a central and a subterminal band, dark smoky brown. The terminal space is brownish gray. The under side of all the wings is brownish gray with a darker, dentate central band on the middle of the hind wings.

This very rare moth was taken at flowers in Bangor, Maine, early in July, by Prof. Carl Braun, who kindly loaned me specimens for study. The early stages and food plant are unknown, but Mr. Roland Thaxter, from whom I have received many valuable notes on the Sphingidæ of New England, wrote me as follows: "I found two small sphinx larvæ ready for their last molt, last summer [1885] on the 'bake apple' marshes in Newfoundland, as the high, open peat bogs there are called. One was on bake apple (*Rubus chamæmorus*),

the other creeping among the low Ericaceous plants, and both fed in confinement on low bush blueberry. They were much like *S. drupiferarum* and *S. gordius*, but differed noticeably from either. Unfortunately I lost them before taking a description. Near by, on the marsh, I found a battered dead female *S. canadensis* and have little doubt that this larva was of the same species."

18. Sphinx gordius, Cramer.

Sphinx gor'-di-us.

Plate I, Fig. 1.

THE APPLE SPHINX.

Expanse of wings, three inches and one-half.

Palpi, reddish brown except the apex which, with the head, sides and sometimes central part of the thorax are gray. The rest of the thorax is blackish brown with black metathoracic tufts. The abdomen is ashy gray with a central black line and a broad tapering black band on each side, broken by four or five dull whitish cross stripes. Under side of thorax and abdomen, gray.

The fore wings are gray, clouded with brownish. The discal spot is small, white and triangular, and from it two fine black lines extend in along the cell and finally unite. The median vein and veins 2, 3, 4, 5 and 6 are marked with black, and there are black dashes between all the veins below the apex, the last forming the oblique apical streak. A curved ashy brown shade crosses the wing at the basal fourth, another, from the costa a little beyond the middle, ends at the middle of the hinder margin, and a third, crossing a little beyond and parallel to the last, is somewhat toothed on the veins. Outside of this a blackish shade line, bordered on each side with gray, is visible only on the hinder half of the wing. An ashy brown spot rests on the costa a little before the apex, leaving a gray shade on the upper side of the oblique streak. Fringes, brown at the ends of the veins, and white between.

The hind wings are sordid white with a central and broad terminal band nearly black. Fringes, pure white. The

under side of the fore wings is brownish gray, and the fringes are as above. The under side of the hind wings is gray with a narrow central, and broad terminal band of dark brownish gray.

The mature larva is about two inches and a half long, of a bright apple green color, with a brownish vertical stripe on each side of the head, and seven oblique stripes on each side of the body, which are white and margined above with violet. The caudal horn is reddish brown. The pupa has a very short, detached tongue-case.

This species feeds on the leaves of Apple, Ash, *Myrica gale* and *Myrica cerifera*.

19. Sphinx luscitiosa, Clemens.

Sphinx lus-cit-i-o'-sa.

Expanse of wings, from two and a half to three inches.

Head and sides of thorax, gray. Back part of the head above and the upper part of the thorax, black, the latter with a few blue and gray scales on the back part. A broad brown stripe extends from the middle of the palpi back under the wings. The abdomen is dull ochre yellow (gray in the females), with a black line along the middle and a black band broken by dull yellowish white on the edges of the segments, along each side. The under side of thorax and abdomen is pale gray.

The fore wings are pale brown with the margins sooty black. The band on the outer margin is narrower towards the apex, and has the inner edge wavy. More or less of the veins are black, and a black line extends in along the middle of the cell from the small whitish discal dot. This line is double at first, but the two parts unite inwardly. A short black dash rests on the intervenular spaces as far as the apex, the last forming the oblique apical streak. Fringes, black. The hind wings are bright ochre yellow (grayish in the females), with a broad black terminal border and a faint indication of a central band. Fringes, yellowish. The under side of all the wings is dull ochre yellow with broad terminal

black bands. In the female, all the yellow is replaced by dull gray.

Rev. G. D. Hulst, who has sent me some valuable notes of the Sphingidæ, wrote me that this rare species had been bred near Newark, New Jersey, on Willow.

20. Sphinx eremitus, Hübner.

Sphinx er-e-mi'-tus.

Expanse of wings, from two and a half to three inches.

Head, palpi and thorax, brownish ash colored. A brown stripe extends along the outer side of the palpi, and a black line extends from the eye along under the wing. A broad black stripe extends through the middle of the patagiæ, and they are edged above with black. Metathoracic tufts, black. The abdomen is brownish ash colored with a black line along the middle, and a broad black band broken by white on the edges of the segments, along each side.

The fore wings are brownish ash colored with a white discal spot set on a black longitudinal dash, and there are black dashes between the veins from the first to the oblique apical streak, which has a lighter shade on its upper side. A pair of blackish brown stripes starts from the costa a little outside of the base, runs out to the median vein where they form an acute angle, then across the wing to the hinder margin near the base. Another pair crosses the wing a little outside of the last, and a third pair starts from the outer fourth of the costa and crosses to the hinder margin a little inside of the anal angle. The hind wings are white with a black spot on the base, a median, and a broad terminal black band. The under side of the fore wings is dark ashy gray with a faint subterminal line slightly paler. The under side of the hind wings is whitish with the bands of the upper side reproduced.

The young larva before its final molt, is one inch and a quarter long, of an apple green color, with a horn-like projection on the forward part of the third segment, on each side of which there are two light purple blotches, the forward one of which is the largest. There are one or two similar spots

on each side of the caudal horn, and a few purplish dorsal dots. The caudal horn is short, blunt and slightly curved.

The mature larva is from two inches and a quarter to two and three-quarters long, as stated by Prof. Lintner, while Prof. Snow gives three inches and a half for the length. The head is rather small and dark brown with a whitish, vertical stripe on each side. The abdominal segments are reddish brown with numerous tan colored or whitish ocellated spots on the annulations. The second segment is light brown above, olive brown on the sides, and the collar is light brown, outlined with black. The anterior of the third segment is triangular as seen from above and laterally, with the apex slightly rounded—extending horizontally and beyond the head when at rest—olive brown on the sides with a small black velvety spot anteriorly on the incisure of the second and third segments, not visible when contracted. The third and fourth segments are olive brown on the sides, and have a black velvety spot extending over one-half of the former and two-thirds of the latter—acutely pointed in front and rectangulated on the sides near its base which is one-half of its diameter, in general shape resembling that of a spear head—bordered, except behind, by white or light buff, shading into the brown of the body. Seven lateral bands of whitish ocellated spots, crossing one segment, and bordered posteriorly with darker brown, which is continued nearly across the following segment. The caudal horn is dark brown, one-tenth of an inch long, curved, granulated and shriveled as if about to disappear. Legs and prolegs black. Before pupating, its color changes to dull purple, and the caudal horn becomes nearly obsolete. The pupa is an inch and three-fifths long and of a chestnut brown color. The exserted tongue-case is two-fifths of an inch long and the end is swollen into a bulb. (Lintner).

Mr. Thomas W. Fyles gives the following brief description of the larva. "Sepia-colored — slightly granulated like shagreen'— having a varnished appearance. Anal horn black, rather small. The first two segments (i. e., those to which

the prolegs (?) are attached), horn-colored and semi-transparent, having *two black shield-shaped blotches upon them, of which the hinder is much larger than the former.* Prolegs, black. Transverse side lines whitish, the hindermost of them broader than any of the others. Spiracles, black. Head with two longitudinal whitish lines."

This species feeds on Spearmint (*Mentha viridis*), Wild Bergamot (*Monarda fistulosa*) and several species of *Salvia.*

Genus X, DOLBA, Walker, Lep. Het. part 8, p. 289 (1856).

Dol'-ba.

Head rather small, roughly scaled, inclining to form a tuft between the antennæ, not sunken into thorax; proboscis longer than the body; palpi extended horizontally in front, roughly scaled; eyes moderate in size and lashed; antennæ fusiform, somewhat bent at the end; thorax short and stout; but little advanced beyond the base of the fore wings, with short, stout and erect metathoracic tufts; abdomen conical, without anal or side tufts; segments armed with round spinules on the posterior edges; tibiæ not spinose, the middle tibiæ with one pair of long spurs, the hind tibiæ with two pairs.

The fore wings have eleven veins, an entire outer margin, but slightly excavated on the end of vein 2. The hind wings have an entire outer margin, somewhat produced on vein 1 b.

21. DOLBA HYLÆUS, Drury.

Dol'-ba Hy-læ'-us.

Expanse of wings, from two inches to two inches and one-half.

Palpi whitish beneath, dark brown above. Head, thorax and abdomen dark rusty brown. The thorax is white on the sides with two white dots on top, while the metathoracic tufts are black. The abdomen has a central row of dark brown spots, a row of small white spots on each side, and a dark brown band along each side, broken by white on the edges of the segments. The under side of the thorax and abdomen is white.

The fore wings are dark rusty brown with a white spot on the base, and one at the end of the disk. Three dark brown lines cross the wing from the basal third of the costa, the inner ones accompanied by two diffused white ones. There are four dark brown lines, dentate on the veins, which cross the wing from the outer fourth of the costa, the outer ones with more or less white between them. A white spot rests on the apex, and there are some indistinct shadings of white along the outer margin. Fringes, dark brown cut with white between the veins.

The hind wings are dark smoky brown with two parallel, dentate, white lines across the middle, the inner one scarcely visible except near the hinder margin. There is also a whitish band near the base of the wing, divided along vein 1 b. Fringes, pure white, cut with brown at the end of the veins. Under side of all the wings, dark ashy gray with the outer lines faintly reproduced on the fore wings, and there are three dentate lines followed by a whitish shade across the middle of the hind wings. These lines unite near the anal angle.

Abbot and Smith figure the larva of this species, feeding on Ink berry (*Ilex glabra*), and the description of Clemens taken from this figure is as follows: "Head green, with a pale blue line on each side. Body pea green, with lateral oblique pink bands edged below with white; caudal horn crimson." "Pupa reddish brown; tongue-case not apparent."

Mr. S. H. Scudder gives a description of the larva of one of the *Sphingidæ* which he says, "very probably belongs to this species," and as it is so complete we give it here.

"*Penultimate stage.* General color, green. Head scabrous, and, like the body, thickly covered with raised yellow dots; a narrow yellow stripe on each side, the two nearly meeting on the summit and extending to the base of the antennæ; just behind its lower extremity a black dot; mouth-part, black. The seven oblique sphingial bands extend each from the anterior edge of the segment, a little below the spiracle, over that whole segment and two-thirds of the succeeding, upon which they are less oblique; these bands vary from yellow,

much paler and fainter on the posterior segment, to red, deepening to crimson anteriorly and changing posteriorly to a slightly rosy white, and upon the succeeding segment to greenish yellow; the last band, however, extends with double width upon the eighth abdominal segment, and, with a color as deep as upon the anterior segment, one-third way up the caudal horn; these bands are all bordered above by a band of equal breadth, of a crimson color, which dies out just before reaching the posterior border of the segments, excepting on the eighth segment, where it continues, as a delicate edging of the lower band, to the extremity of the horn, which is tipped with dark brown, while the basal third of the horn above, between these edgings, is green; the rest of the horn not covered by these markings is black, Edges of the last segment pale yellow; spiracles testaceous with white areola. Length 28 mm., breadth 5 mm.

Mature larva. Head scabrous; color and bands as in previous stage, excepting that the latter are parti-colored, being yellowish green in front and black behind; antennæ and labrum yellowish; other mouth-parts black. The sphingial bands occasionally do not pass to the succeeding segment, but usually they do, and they may be either yellow or white (in the latter case with a yellow tinge posteriorly), edged as before with crimson, and this crimson often followed above by a narrow margin of black, sometimes broken, and extending on the eighth abdominal segment as an edging of the yellow stripe (which here is always yellow), and on this segment never wholly wanting. The horn is black on the sides, with a slight lateral yellow stripe; green above and beneath. The whole body profusely sprinkled with circular white dots having a black areola, but the areola often wanting on the upper surface and sides of the abdominal and first thoracic segments, or the spots may be wanting altogether on the upper surface of the same segments. Spiracles testaceous, changing afterwards to a bright reddish color; prolegs light brown. Length 57 mm. Feeds on Sweet Fern (*Comptonia*

asplenifolia). Collected on Cape Cod and at Princeton, Mass., and in Connecticut."

Besides the food plants already mentioned, Mr. G. R. Pilate states that it feeds on Papaw (*Asimina triloba*).

Genus XI, DILOPHONOTA, Burmeister, Abhandl. nat. Gesellsch. Halle, p. 69, gen. 6 (1885).

22. DILOPHONOTA ELLO, Linneus.

Dil-o-pho-no'-ta el'-lo.

I have seen a single example of this southern species which was captured by Mr. E. F. Hitchings in Warren, Mass., but think it very doubtful whether it is to be considered a New England species, nevertheless, I give the following description of it.

Expanse of wings, three inches and a half.

Head, thorax, abdomen and fore wings, gray, sometimes with a purplish luster. The abdomen has cross bands on each side, of black and gray alternately. The under side of the thorax and abdomen is a little lighter than above. The fore wings are excavate between the veins on the outer margin, and there are faint indications of cross lines showing only on the costa at the base, middle and outer fourth. The hind wings are rust red with a broad dark brown or black terminal band which does not reach to the anal angle. The under side of all the wings is brownish gray tinged more or less with rust red.

The mature larva has the head purple; body obscure brown, with a black dorsal line, and spotted irregularly with white on the sides; caudal horn purple. (Merian).

The food is said to be leaves of a species of *Psidium* or Guava.

Genus XII, HYLOICUS, Hübner, Verz. bek. Schm., p. 139 (1818).

Hy-loi'-cus.

Head prominent with a slight tuft between the antennæ; proboscis about the length of the body; palpi close to the front, densely scaled on the second joint so that it appears enlarged at the end; eyes large, slightly lashed; antennæ fusiform, slim and bent near the tip; thorax stout, considerably advanced in front of the fore wings, with short, stout metathoracic tufts; abdomen cylindrical and tapering, without anal or side tufts, the segments with round spinules along hinder edge; tibiæ unarmed except the fore tibiæ which have a few spines near the lower end, middle tibiæ with one pair of long spurs, hind tibiæ with two pairs. The first joint of the fore tarsi has a row of three or four stout curved spines on the outer side.

The fore wings have twelve veins and entire, rounded outer margins. The hind wings have the outer margin produced on vein 1 b, otherwise entire.

Is this genus structurally distinct from *Phlegethontius?*

23. Hyloicus plebeius, Fabricius.

Hy-loi'-cus ple-be'-i-us.

Expanse of wings, three inches.

Head, palpi, thorax and abdomen, dark gray. The palpi are whitish beneath, and have a brown stripe across the outside, which extends back, including the eyes, under the wings. The collar is edged behind with black, and a black stripe extends through the middle of the patagiæ, below which the side of the thorax is paler. The abdomen has a central dark line and a broad band of the same color enclosing a row of four or five whitish spots along each side. The under side is pale yellowish or sordid white.

The fore wings are gray with a white discal spot encircled with black, and there are heavy black dashes between the

veins from the base along below the median vein to the apex. The usual cross lines on the basal part of the wing appear as a pair of oblique brown faint stripes from the basal fourth of the costa to the cell, and there are three indistinct brown lines across the outer part of the wing, dentate on the veins. The fringes are alternately white and brown, the latter color resting at the ends of the veins which are also marked with brown at their extremities. The hind wings are dark smoky brown, grayish towards the base and on the anal angle. Fringes alternately brown and white. The under side of the fore wings is ashy brown with a darker, dentate line across the outer part. The under side of the hind wings is paler than that of the fore wings, but has a dark gray terminal band and dentate line continuous with that on the fore wings. Sometimes there is a second line crossing the middle of the wing.

The mature larva is nearly three inches long. The head is light pea green, somewhat scabrous, with a black band on each side, passing from near the top of the head to a point behind the antennæ. Antennæ and labrum white; the other mouth-parts black. Body light pea green; the seven oblique sphingial bands are formed of a narrow white stripe, edged posteriorly with lemon-yellow and anteriorly with black, in front of which the green of the body is darker than elsewhere; the black does not quite reach the edges of the segments, the white dies out a little sooner than the black, while the yellow reaches both edges, and in the last stripe extends over the base of the caudal horn; the spiracles, which are faint brownish red, are half immersed in the yellow stripes. The caudal horn curves only on its apical half, and is light blue, covered with black tubercles irregularly, and so thickly that the terminal third is entirely black. Last segment and proleg dotted with black warts, and the edges furnished with a few very short hairs. First joints of jointed legs white, with a black spot on the outer surface; the others black, and all furnished with a few white hairs. Prolegs green, the tip furnished exteriorly with a large black spot; the hooks black. Length

75 mm., breadth 11 mm. Feeds on *Syringa vulgaris*. Collected on Cape Cod, Mass. (S. H. Scudder).

Mr. William Beutenmüller, Jr., has given me the following food plants of this species. Trumpet Creeper (*Tecoma radicans*) and *Tecoma grandiflora*. He also informs me that the larvæ hide away during the day, on the under side of the stems they feed on, and that it is rather difficult to find them.

Sub-Family—CHŒOCAMPINÆ.

Genus XIII, DEILEPHILA, Ochsenheimer, Schm. v. Europa, Band IV, p. 42 (1816).

Dei-leph'-i-la.

Head of moderate size, not sunken into the thorax, smoothly scaled; proboscis as long or nearly as long as the body; palpi ascending close to the front, the clothing giving the end a swollen appearance; antennæ gradually and uniformly enlarging outwardly to near the end, when they are constricted suddenly into a minute bristly hook; eyes moderate in size and lashed; thorax stout, untufted and produced considerably in front of the fore wings; abdomen smooth, cylindrical, tapering rather suddenly at the terminal segments, without anal or side tufts, the hinder edge of the segments armed with spinules; tibiæ not spinose, middle tibiæ with one pair of long unequal spurs, hind tibiæ with two pairs; fore tarsi with a row of stout curved spines along the outside.

The fore wings have eleven veins (sometimes twelve), with the outer margins rounded and entire. The outer margin of the hind wings is entire except at the end of vein 1 b, where it is somewhat produced.

The New England species may be distinguished as follows:

{ Veins of the fore wings lined with white, *D. lineata*.
{ Veins of the fore wings not lined with white, *D. chamœnerii*.

24. DEILEPHILA CHAMÆNERII, Harris.

Dei-leph'-i-la cham-æ-ne'-ri-i

Plate II, Fig. 1.

Expanse of wings, nearly three inches.

The upper side of the head and thorax is olive brown with a white stripe along each side, which is edged with black on the upper side along the thorax. The palpi are whitish beneath and olive brown above. The abdomen is olive brown with a row of small white spots along the middle. The first and third segments are marked with black on the sides; the second, fourth and following segments, with white, some of them more or less suffused with pink. The under side of the thorax and the legs are of a dull yellowish brown, and the abdomen is darker brown with white lines along the edge of the segments. The fore wings are olive brown with a buff colored band extending from the hinder margin near the base, to the apex of the wing. The lower edge of this band is slightly sinuous and the upper is irregularly indented. There is a black patch on the base of the wing and another at the end of the cell, and the terminal space and fringes are olive gray. The hind wings are black with a rose red central band which ends in a white spot on the hinder margin. The outer margin is narrowly edged with dull brown which is sometimes stained with reddish. Fringes, white.

The mature larva is from two and a half to three inches long. The head is dull red with a black stripe across the face. The upper side of the body is deep olive green and polished, with a pale yellowish line along the middle of the back, terminating at the base of the caudal horn; and there is a row of pale yellow spots on each side from the third to the twelfth segments inclusive. These spots are placed on a wide blackish band which crosses the forward part of each segment, and the sides of the body below the spots are thickly sprinkled with minute yellowish dots. The caudal horn is long, curved backwards, red, tipped with black and

with the surface rough. The spiracles are oval, yellow, and margined with black. The under side is pale pinkish green with black legs, while the prolegs are pink with a black spot on the outside of each. Transformations subterranean.

This larva feeds on the leaves of Grape, Evening Primrose (*Œnothera biennis*), Great Willow-herb (*Epilobium angustifolium*) and *Epilobium coloratum*.

This is a very common species at Orono and flies about flowers in the twilight, in June and July.

25. Deilephila lineata, Fabricius.

Dei-leph'-i-la lin-e-a'-ta.

Plate II, Fig. 2.

Expanse of wings, nearly three inches and a half.

The upper side of the head, thorax, abdomen and fore wings is olive brown. There are three parallel white stripes along each side of the thorax; the first over the base of the wings and extending forward over the eyes to tip of the palpi; the second through the middle of the patagiæ, and the third along the upper edge of the patagiæ. There is also a white line running from the top of the head back through the middle of the collar. There is a double row of elongated black spots with a central row of small white ones, along the middle of the abdomen, and on each side is a row of alternate black and white spots, decreasing in size towards the end of the abdomen, below which the sides are tinged with reddish.

The fore wings have a buff stripe extending from near the base of the hinder margin to the apex, overlaid on the basal part with whitish hairs. The hinder margin is narrowly edged with white, and veins 1 to 7, as well as the discal or cross vein, are marked with white as far as the terminal space which is purplish gray. The fringes are somewhat lighter. The hind wings are black with a central reddish band which encloses a whitish spot near the hinder margin. The outer margin is narrowly edged with brownish tinged with reddish. Fringes, white. The entire under side is paler than above,

and the lighter portions of the wings are more or less sprinkled with brown.

The mature larva is about three inches long and quite variable. The most common form (Plate II, Fig. 3) is of a yellowish green color with a row of prominent spots along each side, each spot consisting of two curved black lines enclosing a crimson patch above and a pale yellow line below, the whole being connected by a pale yellow stripe edged with black. In some instances these spots are disconnected and the space between the black crescents is of a uniform cream color. The other form of the larva (Plate II, Fig. 4) is black with a yellow line along the middle of the back and a double series of yellow spots and dots along the side. Caudal horn yellowish orange towards the extremity, and rough.

The pupa is light brown, the head-case compressed laterally and prominent; tongue-case not apparent. (Clemens).

The larva of this species feeds on the leaves of Apple, Grape, Plum, Currant, Gooseberry, Buckwheat, Turnip, Watermelon, Chickweed (*Stellaria*), Bitter Dock (*Rumex obtusifolius*), Evening Primrose (*Œnothera biennis*), Common Purslane (*Portulaca oleracea*).

Genus XIV, PHILAMPELUS, Harris, Am. Jour. Sci. Vol. XXXVI, p. 299 (1839).

Phi-lam'-pe-lus.

Head rather large, free and prominent, smoothly scaled; proboscis as long as the body; palpi ascending, pressed close to the front; eyes large, not lashed; antennæ slender, fusiform and hooked at the end; thorax stout, moderately extended in front of the base of the fore wings; abdomen large, cylindrical and tapering to a point without anal or side tufts, the segments armed with spinules on the hinder edge; tibiæ not spinose, middle tibiæ with one pair of long, very unequal spurs, the hind tibiæ with two pairs.

Fore wings with eleven veins, and the outer margin is entire and rounded, or more or less excavate between the apex and

the end of vein 4. Hind wings slightly produced on vein 1 b, elsewhere entire.

The New England species may be distinguished as follows:

1 { Thorax with an olive green spot on each side..... 2
  { Thorax with a deep reddish brown spot on each side, *P. achemon.*

2 { Hind wings marked more or less with rose red, *P. vitis.*
  { Hind wings without any rose red markings, *P. pandorus.*

26. PHILAMPELUS VITIS, Drury.

Phi-lam'-pe-lus vi'-tis.

Expanse of wings, about three inches and a quarter.

The head, thorax and abdomen are pinkish gray above and beneath. A diffuse line along the middle of the head and thorax, and a large triangular spot on the patagiæ, olive green. A spot on each side of the base of the abdomen and a longitudinal stripe on each side of the middle above, pale cinnamon brown.

The fore wings are bright olive green with a pale flesh colored stripe extending from the middle of the base to the apex, and crossed by a similar one which extends from the middle of the hinder margin to the outer fourth of the costa, leaving a triangular spot of olive green on the outer part of the costa. This oblique stripe has two imperfect brown lines running through it. The terminal space and costa as far as the triangular green spot, are purplish flesh color. The discal spot, and veins 2, 3, and 4 are of a light flesh color where they cross the green. From the basal fourth of the hinder margin, a flesh colored line, shaded within, extends directly up to the central stripe.

The inner part of the hind wings is rose red with two black spots on it. The costal and middle part is covered with long whitish hairs which have a greenish tinge. The outer margin of the wing from the apex down to vein 2, is rose red with a black band on the inside. The rose red terminal band is ended by a greenish brown quadrate spot.

"*Young Larva.* Green, with yellow lateral stripes edged with black, and a long, recurved, slender, reddish horn."

"*Mature Larva.* Head, reddish brown. Body, pale reddish brown on the dorsum, with a darker vascular line, and pale reddish subdorsal line on each side, and the general color deepened laterally. Six lateral, short, irregularly-oval white patches bordered with black, containing spiracles. The anterior wings are dotted with blackish. The lenticular tubercle is black, and contained in a brown patch edged with adjacent black and white lines.

Food Plant. The grape." (Clemens.)

This southern species has been taken as far north as Massachusetts.

27. PHILAMPELUS PANDORUS, Hübner.

Phi-lam'-pe-lus pan-do'rus.

Plate III, Fig. 1.

Expanse of wings, from four inches to four inches and a half.

Color above and beneath, greenish white, marked with spots and shades of rich olive green. A line along the middle of the head and thorax, a large triangular spot on the patagiæ and one across the hind part of the thorax and on the base of the abdomen, are all of a rich olive green color.

The fore wings have a large olive green spot on the middle of the hinder margin and a lighter shade connecting it with the base of the wing. A triangular spot of green rests on the hinder margin just within the anal angle, and there is a similar one, somewhat diffuse, on the costa a little within the apex. There is also a triangular greenish shade on the outer third of the costa extending down to vein 3. The wing is crossed by several shade lines, and there are two or three small black spots at the end of the cell. The hind wings have a large dark smoky brown spot near the hinder margin, and a broad band of the same color a little within the outer margin, which changes into lines and black spots towards the anal angle.

When first hatched and for some time afterwards, the larva is green with a tinge of pink along the sides, and with a very long, straight, pink caudal horn. This horn soon shortens and curls up like a dog's tail (Plate III, Fig. 2, *c*). As the larva grows older it changes to a reddish brown, and after the third molt, entirely loses the caudal horn, leaving only a glassy tubercle in its stead.

The mature larva when in motion (Plate III, Fig. 2, *a*) is nearly four inches in length, but when at rest it draws in the forward segments so that it is an inch or more shorter (Plate III, Fig. 2, *b*). It is pale green above and grows darker on the sides. Mr. Saunders states that as it approaches maturity it changes to a reddish brown color. There are six somewhat oval, cream colored spots tinted more or less with pink, on each side from the sixth to the eleventh segments inclusive, in which are situated the black spiracles, and there are numerous black dots sprinkled over the anterior segments.

"When the larva is done feeding it descends from the vine and buries itself in the ground where it forms an oval cell, and changes to a chestnut brown pupa with the segments roughened with impressed points, and there is a long thick spine at the end of the abdomen." The tongue-case is sunken.

This species feeds on the leaves of the Grape and Virginian Creeper (*Ampelopsis quinquefolia*). It has not been found at Orono, but occurs at Portland and in Kittery, Maine, and further south.

28. PHILAMPELUS ACHEMON, Drury.

Phi-lam'-pe-lus ach'-e-mon.

Plate IV, Fig. 1.

Expanse of wings, nearly four inches.

The upper side of the head, thorax, abdomen and fore wings is of a reddish ash color. There is a large triangular spot on each side of the thorax over the base of the wings, another on the costa before the apex, one on the hinder margin near the anal angle, and a large nearly square spot on the middle of the hinder margin, all of a deep rich reddish brown

color; and there is also a small spot of the same color near the middle of the base of the wings. The veins are lighter in color; and there are several dark lines crossing the wing, one near the base, two more beyond, which end at the inner side of the square spot, one from the middle of the costa, strongly angulated in its course, and two or three from the outer fourth of the costa which are angulated on vein 4.

The hind wings are pink with a reddish ash colored outer border which has a row of elongated dark brown spots along its inner edge, not very clearly defined through a part of its course, and there is a diffuse dark reddish spot above the anal angle. The under side is roseate.

The newly hatched larva is of a pale apple green color with a distinct yellowish dorsal line, and light, perfectly straight subdorsal lines. Caudal horn, about half as long as the body, slender, recurved and reddish. After the second molt the color sometimes changes to a clear, light cherry-color growing brighter for several days. The mature larva is about three inches long when at rest (Plate IV, Fig. 2, represents the mature larva at rest with the head and anterior segments retracted), and three and a half when in motion. It varies in color from pale straw to reddish brown, growing darker on the sides and becoming dark brown beneath. An interrupted line of brown runs along the middle of the back and an unbroken one extends along each side; beneath which there are six cream colored oblique spots, one on each segment from the sixth to the eleventh inclusive. The surface is sprinkled with dots which are dark on the back but lighter and annulated on the sides. The head and two following segments are small and partially withdrawn into the fourth when at rest. The caudal horn disappears before the larva reaches maturity and its place is represented only by a polished tubercle with a central black dot.

After it is done feeding it burrows into the ground to the depth of several inches, where it forms a cell or earthy sort of a cocoon within which it changes to a dark, shining mahogany colored pupa with a prominent head-case, the tongue-case

sunken to a level with the surface of the body and extending to the end of the wing covers. The abdominal segments have their surface thickly punctured except on the posterior edge. (Plate IV, Fig. 3.)

This species feeds on the leaves of Grape and Woodbine (*Ampelopsis quinquefolia.*)

Genus XV, CHŒROCAMPA, Duponchel, Hist. Nat. Suppl. II, p. 159 (1835).

Chœ-ro-cam'-pa.

Head of medium size and smoothly scaled; proboscis as long as the body; palpi ascending, close to the front; eyes large, scarcely lashed; thorax smooth, moderately advanced in front of the fore wings; abdomen very long and gradually tapering to a point without anal or side tufts, the segments not armed with spinules on the hinder edge; tibiæ not spinose, the middle tibiæ with one pair of very unequal spurs, the hind tibiæ with two pairs.

Fore wings long and narrow, with twelve veins, and they have the apex somewhat produced; hind wings with the outer margin sharply produced on vein 1 b, otherwise entire.

29. CHŒROCAMPA TERSA, Linneus.

Chœ-ro-cam'-pa ter'-sa.

Expanse of wings, from two and a half to three inches.

The upper side of the head and thorax is olive brown with a whitish roseate stripe along each side. The patagiæ are edged with rust brown, and the abdomen has a broad brownish band along the middle, which contains five darker parallel lines, and the sides are rusty yellow.

The fore wings are light brownish yellow, somewhat purplish on the base except below the origin of vein 1, where there is a dark smoky brown spot, with seven or eight nearly straight brown lines extending from the apex to the hinder margin. These lines diverge so much that the inner ones extend nearly to the base of the wing, while the outer ones

are nearly parallel with the outer margin. Discal spot dark brown and minute. The hind wings are black with a terminal brown band and a subterminal row of wedge-shaped yellow spots, and a large spot of the same color rests on the anal angle.

The mature larva is described as light green, with a large subdorsal crimson ocellus on the fourth segment, containing a blue ring and edged with black and white rings, with six others smaller and similar, placed on a white subdorsal line which begins on the second segment and extends to the crimson caudal horn. The back is sprinkled with brown points. The spiracles are yellow, dotted with black points above and below. It is said to feed on Button-weed (*Spermacoce glabra.*) The larval transformations take place in an imperfect cocoon on the surface of the ground.

This southern species has been taken in Massachusetts and further south.

Genus XVI, EVERYX, Boisduval, Hist. Nat. Ins. Sphingides, *Ev'-er-yx* p. 208 (1874).

Head small, with the scales forming a central ridge or tuft between the antennæ; proboscis about half the length of the body; palpi of medium length, curving up and pressed against the front; eyes of medium size and slightly lashed; antennæ slim, fusiform, prominently hooked at the end, biciliate in the males but simple in the females; thorax short and stout, but little advanced in front of the base of the fore wings, vestiture smooth; abdomen large, cylindrical, tapering rather suddenly on the last segments; without anal or side tufts, segments without spinules along the hinder edge; tibiæ not spinose (fore and middle tibiæ spinose in *E. chœrilus*); middle tibiæ with one pair of comparatively long, unequal spurs, the hind tibiæ with two pairs.

The fore wings have eleven veins, the apex falcate or the outer margin excavate from the apex to vein 4, and rounded beyond. The hind wings have the outer margin excavate

between veins 1 b and 3, but nearly straight beyond this to the apex.

The species may be separated as follows:

1 { Thorax reddish brown ..... *E. chœrilus.*
  { Thorax greenish 2

2 { Under side of fore wings, reddish and gray, without yellow markings ..... *E. myron.*
  { Under side of fore wings, bright green, with yellow markings ..... *E. versicolor.*

30. Everyx chœrilus, Cramer.

Ev'-er-yx chœ'-ril-us.

Expanse of wings, from two and a half to three inches.

The upper side of the head and thorax is of a rust red color, varying to a brownish red, with the tips of the patagiæ and a spot on the side of the thorax at the base of the fore wings, pale gray. The abdomen is fawn colored, and the segments are narrowly edged with pale yellowish.

The fore wings are reddish brown with purplish reflections. The basal half is sprinkled with grayish scales and crossed by four curved brownish lines, and there is a discal dot of the same color. The outer part of the wing is of a darker reddish brown color and crossed by several indistinct paler lines, the inner edge being oblique and straight. The terminal space is colored like the base of the wing. The hind wings are rusty brown. The entire under side is pale rusty brown with indistinct terminal bands on the wings and two faint cross lines on each.

"The full grown larva has the head very small, as in all the genus, pale yellow green, with a darker median line; second segment, yellow green with numerous irrorations. The spiracles in this segment are orange in the center, pale yellow above and below. In the other segments they are orange, white above and below. Segments three, four and five are also pale yellow green—the two latter swollen into a hump. The remaining segments are all bluish green, covered with white dots, and with a darker dorsal line. On segments five,

six, seven and eight are oblique whitish bands; but on the posterior segments these are lost in a continuous line to the base of the caudal horn, which is bluish at the base, pale green at the tip, and white in the center. The anal segment is yellow green, as also are the abdominal legs. The thoracic feet are green, with the sides orange red. Previous to change, the caterpillar assumes a purplish leaden hue, the dorsal and lateral lines becoming blackish. One specimen is pinkish, with the four anterior and the anal segment of a brownish cast, and with a dark dorsal stripe. The lateral line is also brown."

"The pupa is purplish brown, with a pink tint over the whole surface, slightly mottled. Wing-cases also mottled with black, spaces between the segments pitchy brown." Hy. Edwards and Elliot.

This species feeds on the leaves of Grape, Virginian Creeper (*Ampelopsis quinquefolia*), Sheep-berry (*Viburnum lentago*), Arrow-wood (*Viburnum dentatum*), Cranberry-tree (*Viburnum opulus*), Sour-gum (*Nyssa multiflora*), Clammy Azalea (*Azalea viscosa*), Purple Azalea (*Azalea nudiflora*).

31. Everyx myron, Cramer.

Ev'-er-yx my'-ron.

Plate V, Fig. 1.

Expanse of wings, about two inches and one-fourth.

The head, palpi and thorax are of a dark olive green color, with a dull reddish triangular spot on the back part and a pale ash colored stripe on the side over the base of the wings. The abdomen is dull greenish with dull reddish reflections.

The fore wings are of an olive gray color with a curved olive green oblique band crossing at the basal third; a discal point, and a second oblique band starting from the outer third of the costa crosses to the middle of the hinder margin. This band is nearly obliterated in the middle. The outer part of the wing is shaded with olive green at the apex and the anal angle, leaving the rest of the terminal space olive gray. The hind wings are dull red with a darker more or

less complete terminal band which is greenish towards the anal angle. The under side of the fore wings is pale reddish except the costa and outer border, which, together with the under side of the hind wings and body, are greenish gray, and there is a central slightly darker band on the middle of the hind wings.

The females deposit their eggs singly or in groups of two or three on the under side of the leaves of their food plants. These eggs are nearly globular, about one-twentieth of an inch in diameter, of a pale yellowish green color but changing to reddish before hatching which occurs in five or six days. The young larva makes its first meal on the shell and then attacks the softer parts of the leaf. When first hatched it is about one-fifth of an inch long, of a pale yellowish green color, and has a long black caudal horn nearly half as long as the body. The markings of the larva change with each molt, and the caudal horn becomes relatively shorter.

The mature larva (Plate V, Fig. 2) is a little more than two inches long, with a rather small, pale green head sprinkled with yellow, and with a pale yellow vertical stripe on each side. The body is green, slightly darker than the head, and sprinkled with yellow dots. There is a row of seven spots varying in color from red to pale lilac, each set in a patch of pale yellow, along the middle of the back. A white stripe with a dark green margin, extends along the side from the head to the caudal horn, and below this are seven oblique stripes. The caudal horn is one-fifth of an inch long and varies in color from reddish to bluish green, granulated with black in front, and it is sometimes yellow behind and at the tip. A short time before transforming, the larva changes to a dull rose color throughout, with the stripes of a clearer rose color.

It transforms to a pale brown pupa on the surface of the ground, within a rude cocoon which it makes of leaves drawn together by a few silken threads (Plate V, Fig. 3).

This species feeds on the leaves of Grape and Virginian Creeper (*Ampelopsis quinquefolia*).

32. EVERYX VERSICOLOR, Harris.

Ev'-er-yx ver-sic'-o-lor.

Expanse of wings, two inches and three-fourths.

The head and thorax are dark green varied with greenish yellow, and the abdomen is greenish yellow or buff varied with darker green especially along the middle and on the hinder edge of the segments. There is a whitish line along the side of the head and thorax over the base of the wings, and one extending along the top of the head and thorax to the end of the abdomen, and the collar and patagiæ are edged with white.

The fore wings are dark green shading into lighter green and crossed by a number of whitish lines, three of which start from near the basal third of the costa and curve down and into a smoky white patch on the lower part of the base of the wing, and into which there runs a narrow, curved whitish band which starts from the middle of the costa. Three whitish wavy lines cross the wing from the outer fourth of the costa, and a subterminal line, starting from the apex and crossed by two strong white dashes on veins 6 and 7, runs irregularly down to the anal angle. The hind wings are rust red, grayish on the hinder margin and indistinctly greenish on the outer margin. The under side of the fore wings is dull reddish in the middle, while the costa and outer margin are green and marked with yellow and white somewhat indicating the markings on the upper side. The under side of the hind wings is shaded with green, yellowish and white.

The egg is round and slightly flattened—about the size of rape seed. It is at first light green and translucent, afterwards milky and opaque. The eggs hatch in about seven days. The larva, just emerged, is one-fourth of an inch long and of a whitish color. The caudal horn changes to a dark purple color in several hours after the hatching, and the larva gradually becomes pale green. The first molt is made in about five days after hatching, and the larva is then half an inch long, with a nearly spherical greenish head and a

light green body. A lateral whitish line extends from the mouth to the caudal horn, which, as the age advances and size increases, is revealed to be composed of several lines as follows: a subdorsal line extending from each side of the mouth to the upper part of the eyes, and thence back to the rear of the fourth segment of the body; a similar line runs obliquely from the lower part of the fourth segment, under and just including the spiracle point, upwards and backwards to the rear of the fifth segment, meeting it just below the dorsal line. This is followed by five other and parallel lines, each beginning and ending one segment further back, except the last which extends across the last three segments up to the base of the caudal horn. There are faint indications of other lines on the lower part of the tenth and eleventh segments. The caudal horn is violet purple.

The second molt is made in four days, after which the head and body are of a light green color. The body is finely granulated and the markings are as before, but more distinct. Spiracles, marked with red points. The caudal horn, reddish, darker in front and behind than on the sides. The third molt is made in four days, after which the body is green, the markings as before, the fore legs, pink, spiracle points red, the body covered with granulations and much swollen at the fourth and fifth segments. The caudal horn is straight, greenish in front and behind, almost white on the sides. The fourth molt is made in six days, after which the head is small and with the four following segments is yellowish green while the rest of the body is pea green. Markings as before, without granulations, which have become white specks with which the body is more heavily marked on either side of the back, leaving the dorsal line green. Spiracles oval and red, with a yellow point at each end. Caudal horn stout, curved backward, sharply pointed, black in front and at the end, red on the sides. Some examples vary in having the ground color of the body pinkish brown instead of green, and with pinkish white shadings. At maturity the larva is from two and a half to three inches in length, and becomes bluish black

before transforming which is done on the ground under leaves, in a slight cocoon made by drawing together leaves and grains of dirt with silk. The pupa is of a dirty light brown color, with dark chocolate brown spots. This account of the early stages is somewhat condensed from the studies of Rev. G. D. Hulst.

This rare species feeds on the leaves of Button-bush (*Cephalanthus occidentalis*), and Swamp-loosestrife (*Nesæa verticillata*).

Genus XVII, DEIDAMIA, Clemens, Syn. N. Am. Sph. p. 137 (1859).

De-i-da'-mi-a.

Head small, with a tuft between the antennæ; proboscis rather more than half the length of the body; palpi short and shaggy; eyes small and lashed; antennæ fusiform and slightly hooked at the end; thorax stout, but little extended in front of the base of the fore wings; abdomen moderately long, conical and provided with a slight anal tuft, segments armed with spinules on the hinder edge; tibiæ not spinose, middle tibiæ with one pair of very short spurs, hind tibiæ with two pairs.

Fore wings long and narrow, with twelve veins and angulated on the outer margin. Hind wings slightly denticulate on the outer margin and produced on vein 1 b.

33. DEIDAMIA INSCRIPTA, Harris.

De-i-da'-mi-a in-scrip'-ta.

Expanse of wings, two inches.

The head and thorax are grayish brown with a double, curved, white line edged with brown across the prothorax, behind which are two other curved lines, one on the middle and the other on the hinder part of the thorax. The abdomen is ashy and has two rows of dark brown spots.

The fore wings are ashy gray at the base, in the middle and towards the apex. Three brownish bands cross the wing

before the middle, another angulated band crosses beyond the end of the cell, and the outer border of the wing has two dark brown lunules on the margin below the apex, before the second of which is a third spot with more or less white between. The discal spot is paler than the ground color of the wing. The hind wings are of a dull reddish brown color with a dusky terminal band which grows narrow towards the anal angle. Fringes, white.

The mature larva is two inches long, of a fine green color, and the body tapers from the third segment towards the head. The caudal horn is whitish at the tip. They go into the ground (not very deep), and transform into very dark brown pupæ, with the tongue-case a short elevated ridge; a short central spine at the end of the head and a spinous tubercle on each of the eye-cases.

This species feeds on the leaves of Grape and Virginian Creeper (*Ampelopsis quinquefolia*).

Sub-Family—SMERINTHINÆ.

Genus XVIII, TRIPTOGON, Bremer, Bull. de l'Acad. Imp. St. Petersb. III. (1861).

Trip'-to-gon.

Head small and sunken with a central ridge of scales along the top; palpi very short and curving upward; proboscis membranous and about as long as the palpi; eyes small and without lashes; antennæ fusiform without a terminal hook, biciliate in the males, simple in the females; thorax short, stout and untufted, scarcely extended in front of the base of the fore wings; abdomen stout, cylindrical and tapering to a point in the females but blunt in the males, without anal tufts, the segments not armed with spinules on the hinder edge but with numerous very fine spinules scattered uniformly over the upper surface of the abdomen, not visible till the scales are removed; tibiæ not spinose, the fore tibiæ with a single, stout, slightly curved spine at the end; middle and hind tibiæ, each with one pair of short spurs.

Fore wings ample, with twelve veins and with a regularly scalloped outer margin. Hind wings ample, the outer margin somewhat produced on vein 1 b, and slightly scalloped beyond.

34. TRIPTOGON MODESTA, Harris.

Trip'-to-gon mo-des'-ta.

Expanse of wings, from three and a half to four inches.

The head, thorax and abdomen are pale gray or olivaceous. The basal third of the fore wings is pale gray with faint shades crossing it. A broad olive band with wavy outlines crosses the middle of the wings, within which there is a small pale discal spot. The outer part of the wing is olivaceous and crossed by three lighter shade bands. The hind wings are dusky rose color in the middle, pale gray on the costal and

hinder margins and olivaceous on the outer margin. There is a bluish gray patch with a curved black streak over it, near the anal angle. The under side of the wings is pale olive gray and crossed by several shade lines, and a large triangular patch of dusky rose color rests on the basal half of the fore wings.

The following account of the early stages is taken from Mr. Robert Bunker's paper in the Canadian Entomologist, Vol. IX, p. 210. The egg is one-eighteenth of an inch in diameter; light green, translucent, smooth, circular, oblate or depressed. The eggs hatch in nine days and the young larva is one-fourth of an inch long, light green, slender; head large, round, slightly depressed medially; face pink, with a purplish tinge; extremity of the body dark sea-green, with a large wart or tubercle, pyramidal in form, upon which rests the horn.

After the first molt the larva is half an inch long, of an apple green color, with a light yellow longitudinal subdorsal stripe, yellowish white diagonal lines and a very short, straight and purple caudal horn. After the second molt the larva is seven-eighths of an inch long, of a rich dark green color, finely granulated, giving it a beautiful velvety appearance. The thorax has two transverse crests or collars studded with fine points tipped with white.

After the third molt the larva is one inch and one-fourth long, thickest in the middle, light green and otherwise unchanged. After the fourth molt the larva is one inch and seven-eighths in length, light green, coarsely granulated, granules studded with fine white points, giving the skin a frosted appearance; crests on thorax much reduced in size. After the fifth molt the larva is three inches long, the hind crest is lost and the anterior one is much reduced; the spiracles are small and rust red, the true legs brown, the prolegs brownish yellow, and the yellow longitudinal stripes are very obscure. The caudal horn is reduced to a mere rudiment. [Does it really molt five times?]

The pupa is two inches long, cylindrical and dark chestnut brown.

This species feeds on the leaves of Poplar and Cotton-wood.

Genus XIX, PAONIAS, Hübner, Verz. bek. Schm. p. 142 (1818).

Pa-o'-ni-as.

Head small and sunken, with a prominent ridge or tuft of scales between the antennæ; palpi short and curved upwards against the front; much shorter in the females than in the males; proboscis membranous, about as long as the palpi; eyes large and without lashes; antennæ fusiform, biciliate in the males, simple in the females, hooked at the end; thorax short and of medium size, scarcely extended in front of the base of the fore wings; abdomen long, cylindrical and tapering, without anal or side tufts; segments not armed with spinules on the posterior edges; tibiæ not spinose, the middle and hind tibiæ, each with a single pair of very short spurs at the end.

Fore wings comparatively long, with twelve veins and the outer margin quite regularly scalloped, while the hinder margin is deeply excavate before the anal angle. The hind wings have the outer margin somewhat scalloped and the costal margin straight to near the end of vein 8, where there is a prominent rounded angle extended forward.

35. PAONIAS EXCÆCATUS, Abbot and Smith.

Pa-o'-ni-as ex-cæ-cā'-tus.

Plate VI, Fig. 1.

Expanse of wings, from two and a half to three inches.

The entire surface of the head, thorax and abdomen is of a rich brown or fawn color, except a band of dark chestnut brown along the middle of the thorax, a line of the same color along the middle of the abdomen, and a light colored line on each side.

The basal third of the fore wings is yellowish brown or fawn colored, with one or two wavy dark brown lines. Beyond

this part, the wing is chestnut brown, and crossed beyond the cell by three wide sinuous lines of the same color as the base of the wing. Discal dot dark brown. The hind wings are rosy red with a black spot containing a round blue center, and a wide chestnut costal border crossed by several whitish lines. The under side of the fore wings is rosy red, except the narrow costa and outer part, which are fawn colored and shaded with brown, and there is a patch of yellow before the anal angle. The under side of the hind wings is brownish, rosy on the hinder margin, and crossed by several lighter lines, outside of which the wing is shaded with yellowish.

This species lays over three hundred eggs which are somewhat globular but much depressed, and of a pale dull green color. The eggs hatch in seven or eight days, and the young larva is about one-fifth of an inch long, of a yellowish green color with a darker dorsal line. The head is pale green and much larger than the following segments, and the caudal horn is long and dull red.

The mature larva (Plate VI, Fig. 1) is about two inches and a half long, of an apple green color, lighter above and darker beneath, and covered with white-tipped granulations. There is a vertical white stripe on each side of the head, and seven oblique, pale yellow stripes on each side of the body, the last one being of a brighter yellow than the others, and extending upon the sides of the caudal horn, which is bluish green. There is also a short stripe on the side of the forward segments.

The pupa, which is chestnut brown, smooth and with a short obtuse terminal spine, remains under ground during the winter.

This species has a long list of food plants comprising Apple, Plum, two species of Wild Cherry, *Spiræa opulifolia*, *Rubus odoratus*, *Wistaria sinensis*, four species of *Ulmus* or Elm, two species of Oak (*Quercus*), Hazel-nut, Hornbeam and Hop Hornbeam. Two species of Birch (*Betula*), five species of Willow (*Salix*), four species of Poplar (*Populus*), *Tilia*, and *Rosa Carolina*.

Genus XX, SMERINTHUS, Latreille, Hist. Nat. Ins. III, p. 431 (1802).

Sme-rin'-thus.

Head small and sunken into the thorax, more or less tufted between the antennæ; palpi small and curving upward, shortest in the females; proboscis membranous, shorter than the palpi; eyes of medium size, without lashes; antennæ fusiform, generally hooked at the end, simple in the females, biciliate in the males (bipectinate in the male of *geminatus*); thorax of medium size or very stout, scarcely advanced beyond the base of the fore wings; abdomen cylindrical, tapering, short or median in length, without anal or side tufts, segments not armed with spinules; tibiæ not spinose (the fore tibiæ of *cerisii* has a short blunt spine at the end); middle and hind tibiæ each with a single pair of short spurs at the end.

Fore wings with twelve veins (sometimes eleven), with the outer margin more or less angulated and the hinder margin excavate before the anal angle. The hind wings have the outer margin somewhat produced on vein 1 b, and the costa rounded or excavate.

The species may be separated by the following table:

1 { Hind wings yellow in the middle..... 2
  { Hind wings rosy red in the middle..... 3

2 { Thorax with a central yellow stripe.....*S. myops.*
  { Thorax with a central rust red stripe....*S. astylus.*

3 { Pupil of spot on hind wing composed of two dashes; male antennæ bipectinate.....*S. geminatus.*
  { Pupil of spot on hind wing horse-shoe shaped; male antennæ biciliate.....*S. cerisii.*

36. SMERINTHUS MYOPS, Abbot and Smith.

Sme-rin'-thus my'-ops.

Plate VI, Fig. 3.

Expanse of wings, two inches and a half.

The entire surface of the body and upper side of the fore wings is chocolate brown with purple reflections. The thorax

has a central yellowish ridge, and there is a brown line along the middle of the abdomen.

The fore wings are crossed by a number of dark brown lines and shades. A narrow, oblique, dark brown band crosses from the basal fourth of the costa to a purplish brown shade on the middle of the hinder margin. The outer border is shaded with dark brown, and the discal spot is of the same color. There is a small yellow spot just within the anal angle, and another on the costa inside of the apex. The hind wings are yellow, broadly margined with brown on the costa, and extending around narrowly on the outer margin. Two or three light purplish lines cross the costal band of brown, and there is a black eye spot enclosing a blue pupil near the anal angle. The under side of the wings is yellowish, variegated with brown shades on the outer part and pale purplish cross lines.

The mature larva is about two inches long, of a bluish green color, with a bright yellow stripe on each side of the head, a row of reddish brown spots along the side of the back, and another row near the spiracles. There are six (?) oblique, bright yellow stripes on each side, and two short yellow lines on the forward segments. The caudal horn is green, tinged with yellow on the sides.

This rare species feeds on the leaves of Wild and Cultivated Cherry.

37. SMERINTHUS ASTYLUS, Drury.

Sme-rin'-thus as'-ty-lus.

Expanse of wings, two inches and a half.

The head, thorax, abdomen and fore wings are of a reddish brown or cinnamon color, much suffused with a lilac tint. There is a rust red ridge along the middle of the thorax, and a yellowish stripe along each side of the abdomen.

An ill-defined bluish black stripe rests on the greater part of the hinder margin, above the middle of which the wing is shaded with yellowish, and there is a yellow spot just within the anal angle, and another on the costa within the subterminal pale lilac shade line. Three cross lines of the same color

start from the outer part of the costa but are soon obliterated. The hind wings are bright ochre yellow at the base which shades off into light cinnamon color on the costa and outer margin. There are two pale lilac cross lines visible only on the costa, and a round black eye-spot with a blue pupil rests on the wing near the anal angle. The under side of the wings is bright ochre yellow shaded with brownish, and crossed by several diffuse pale lilac lines.

The mature larva is about two inches long, "of a pale green color, beautifully variegated with dorsal and lateral yellow and red stripes and spots, somewhat in the manner of *myops*." The caudal horn is light brown at the base and tip, and pale green in the center.

The food plant of this very rare species is the Swamp Blueberry (*Vaccinium corymbosum*), Low Huckleberry (Miss Morton) and Rosaceæ.

38. SMERINTHUS GEMINATUS, Say.

Sme-rin'-thus gem-i-na' tus.

Expanse of wings, two inches and a half.

The head and thorax are pale gray, the latter with a rich dark brown triangular spot on the middle, which is rounded in front and widened out behind. The abdomen and under side of the body are brownish gray. The fore wings are gray with a faint rosy tint in some specimens. The discal spot is whitish and bordered with dark brown, and a dark brown line edged on the inside with whitish starts from the basal third of the costa at right angles with it, and runs about half way across the wing where it forms nearly a right angle, and then runs across to the hinder margin. The lower part of this line is wider and shades off on the outer side. A broad, dark brown, oblique stripe, starting from this line, occupies the space between veins 2 and 3, and ends at a narrow, somewhat wavy, pale band which crosses the outer part of the wing, within which is a darker shade band with a straight but still darker inner edge. Outside of the pale band there are several indistinct, sinuous lines crossing the wing, a dark brown spot just inside of the anal angle, a lunulate spot of

the same color edged on the inside with white at the apex, and the outer border has a wide dark brown shade from the lunulate spot down to near the anal angle.

The hind wings are rosy red with gray costal and outer borders. There is a large black spot with two blue spots on it, near the anal angle and connected with it by a narrow black stripe. Occasionally a third blue spot appears on the black, and sometimes there is but a single one giving the variety *Jamaicensis*, Drury, which Rev. G. D. Hulst has bred from eggs laid by *geminatus*. The under side of the fore wings has the basal half rosy red, the entire costa and outer half, gray with the markings of the upper side faintly reproduced. The under side of the hind wings is gray and crossed by alternate bands of brown and whitish. The males have the antennæ strongly bipectinate.

The eggs are globose, somewhat flattened, of a pale green color, about one-fifteenth of an inch in diameter, and hatch in seven days. The larva when first hatched is about one-fifth of an inch long, of a pale green color, and the caudal born is fuscous. The mature larva is about two inches and one-fourth long, of an apple green color somewhat lighter above, with pale green or whitish granulations over the surface. The head has a yellow stripe on each side, and there are seven oblique stripes on each side of the body, of a pale yellow color except the last which is bright yellow. There is also a stripe on the side of the forward segments. The anal shield and plates are granulated, and of a darker green than the rest of the upper surface, but of the same color as the under surface. The caudal horn is slightly curved, of a violet color and granulated.

This species feeds on the leaves of Apple, Plum, Elm, Ash and Willow.

39. Smerinthus cerisii, Kirby.

Sme-rin'-thus ce-ris'-i-i.

Expanse of wings, three inches.

The head, abdomen and under side of the body are brownish gray. The upper side of the thorax is of a rich dark

reddish brown, except the collar and patagiæ which are pale gray.

The fore wings are pale gray with two or three wavy brownish lines across the base of the wing; and a darker brown line, starting at right angles from the basal third of the costa, extends a little more than half way across the wing, where it turns, forming nearly a right angle, and runs to the basal third of the hinder margin. This line is shaded broadly with brown on the outside, from the hinder margin up to, and into the cell, and outside of the cell it extends faintly to the costa. This brown shade is bounded on the outer side by four lines which cross the wing parallel to the outer margin. These lines are curved between the veins forming acute angles pointing inwards on the veins, and they are alternately of a pale gray and brown color. There is a pale gray spot on the hinder margin within these lines, and a brown spot on the outside which is followed by a pale shade on the anal angle. A pale, scalloped subterminal shade line extends across the pale brownish gray of the outer part of the wing, up to the pale gray or whitish lunulate spot near the apex. The veins are paler than the ground color of the wings.

The hind wings are dull rosy red in the middle and bordered all around with dull clay yellow, and there is a black spot connected with the anal angle, on the hinder part of the red, which contains a horse-shoe shaped spot of blue, the open part towards the anal angle. Sometimes the outer side is nearly or quite open, thus presenting two lunules facing each other. The under side of the fore wings is dull rosy red on the disk, but shaded with brown and gray over the rest of the surface. The under side of the hind wings is brownish gray crossed by three more or less distinct bands; one on the middle and the other two at equal distances apart between this and the outer margin.

The early stages and food plants of this exceedingly rare species are entirely unknown. It has been taken in Orono at light, about the middle of May.

Genus XXI, CRESSONIA, Grote, Proc. Ent. Soc. Phil. Vol. V, p. 186 (1865).

Cres-so'-ni-a.

Head small and somewhat sunken into the thorax, with a ridge of scales between the antennæ; palpi slim, of medium length in the males, much shorter in the females, ascending and divaricating at the tip; proboscis about as long as the palpi; eyes of medium size and without lashes; antennæ rather short, fusiform, simple in the females but bipectinate in the males; thorax short and stout, scarcely advanced beyond the base of the fore wings; abdomen slender and elongated with minute anal tufts in the males, segments without spinules; all the tibiæ spinose, the middle tibiæ with one pair of medium-sized spurs, the hind tibiæ with two pairs.

The fore wings have eleven veins, and the outer margins are somewhat dentate, and the apex is somewhat produced. The hind wings are evenly rounded and dentate on the outer margin.

40. CRESSONIA JUGLANDIS, Abbot and Smith.

Cres-so'-ni-a ju-glan'-dis.

Expanse of wings, from two and a half to three inches.

Palpi, cinnamon brown. Head, thorax and abdomen above, pale gray or fawn colored with a brown stripe along the middle of the thorax.

The fore wings are pale gray or pale fawn colored, with a nearly straight brown line crossing the wing from the basal third of the costa to the basal fourth of the hinder margin. A second line crosses the wing near the base and is more nearly perpendicular to the costa. The discal spot is brown, and there are two parallel oblique lines from the outer fourth of the costa where they are much curved, running nearly straight to the hinder margin, the inner one of which ends near the middle. Between this inner one and the first line

described above, a more or less conspicuous brown spot rests on the hinder margin. A brown shade line is sometimes visible within and parallel to the two outer lines. The outer part of the wing is more or less shaded with brown. The apex has a lighter shade on the costa, and a diffuse more or less wavy line extends from it down to the anal angle.

The hind wings are colored like the fore wings, and have three nearly parallel somewhat wavy brown lines across the middle, followed by a brown shade on the outside. The whole surface of the body and wings is sometimes shaded with lilac purple.

The under side of the body and wings is brown with the outer oblique lines reproduced.

The young larva is yellowish green with the surface of the body covered with pale irrorations. The head is truncate in front, conical, the apex of the cone being furnished with two rough brownish projections, and there is a yellowish stripe on each side of the head. The lateral streaks of the body are very indistinct. The caudal horn is rough, pinkish at the base, and has black points on the surface.

The mature larva is about two inches and a half long, tapering from the seventh segment towards the extremities, light apple green, granulated with white, and with seven oblique stripes on each side formed by the whitish granulations which are more numerous there than elsewhere. The caudal horn is one-fifth of an inch long, brownish and covered with black spinules. The head is quite pointed and bifid at the top. Abbot and Smith give a figure of this larva, which is of a ferruginous color.

The pupa is blackish brown and roughened over the entire surface. There are four little prominences on the head-case, and the terminal segments are flattened on the ventral surface and have lateral, toothed appendages.

This species feeds on the leaves of Hickory (*Carya alba*), Black Walnut (*Juglans nigra*), and Iron Wood (*Ostrya Virginica*). Dr. Packard says it also feeds on Wild Cherry, but Mr. Strecker thinks he must be mistaken.

Genus XXII, ELLEMA, Clemens, Syn. N. Am. Sph. p. 187 (1859).
El-lé'-ma.

Head small and somewhat sunken into the thorax, with a tuft or ridge between the antennæ; palpi rather short and slender; proboscis membranous and about equal in length to the palpi; eyes of medium size and scarcely lashed; antennæ fusiform, largest beyond the middle and ending in a somewhat bent, ciliated seta, simple in the females, biciliate in the males; thorax very short and stout, rounded in front and scarcely advanced in front of the base of the fore wings; abdomen cylindrical and tapering, without anal or side tufts; segments armed with round spinules on the hinder edge; fore and middle tibiæ spinose, middle tibiæ with one pair of medium sized spurs, hind tibiæ with two pairs.

Fore wings with eleven veins and an oblique, evenly rounded outer margin. Hind wings with an entire and rounded outer margin but slightly excavated between veins 1 b and 2.

41. ELLEMA BOMBYCOIDES, Walker.
El-lé'-ma bom-by-coi'-des.

Expanse of wings, from two inches to two inches and one-fourth.

There appear to be two forms under this name; the first, *bombycoides*, Walker, is exceedingly rare, while the variety *harrisii*, Clemens, is not uncommon. *Bombycoides* was described by Walker in his Lepidoptera Heterocera, part 8, page 233 (1856), where he established the genus *Lapara* for it and described the species as follows. "Cinereous. Fore wings with a zigzag oblique black line, and with several lanceolate black marks. Hind wings brownish, paler toward the base; ciliæ white. Length of the body 10 lines; of the wings 24 lines. Canada."

Mr. Herman Strecker has given a colored illustration of the insect on Plate XIV of his Lepidoptera Rhopaloceres and Heteroceres, from a figure executed by Prof. Westwood from the type which is in the Museum at Oxford, England.

Mr. Roland Thaxter informs me that he has taken at Kittery(?) an *Ellema* "which is practically the same with Strecker's figure of *bombycoides*," and as far as he can judge is that species. He also expresses the opinion that it is a variety of *harrisii*.

Variety *harrisii*, Clemens.

har-ris'-i-i.

Expanse of wings, two inches.

Head, palpi and thorax, umber brown. The tips of the patagiæ are white, and the disk has more or less white hairs mingled with the brown.

The fore wings are umber brown with whitish scales scattered over the surface, but leaving a discal spot, a pair of cross lines angulated on the cell, and a pair of cross lines beyond the cell, all of umber brown. The first line starts from the basal fifth of the costa, the second from a point on the costa twice as far from the base. These two lines extend obliquely out, the second one to the dark brown discal dot, then turning, they run to the hinder margin near the base, where they are lost in an indistinct reddish brown spot. The third line starts from the costa a little beyond the middle, curves outward around the cell and ends near the middle of the hinder margin. This line is sharply toothed on each vein. The outer line, which is the darkest and is followed on its outer side by a narrow brown shade, starts from the outer fourth of the costa, and runs across the wing parallel to the last, and is equally toothed on the veins. The space between these two lines is more heavily overlaid with white scales than any other part of the wing. Two black dashes rest on the wing, one between veins 2 and 3, the other between veins 3 and 4, and extend from the median vein out to the outer line. The fringes are white, cut with brown on the veins which are also marked with the same color on their outer ends.

The hind wings are umber brown, lighter at the base, and sometimes show a faint trace of a median band. The fringes are marked alternately white and brown. The under side of

all the wings is grayish brown with a darker colored line, scarcely visible, crossing the outer part. Fringes colored as above.

The mature larva is from two inches to two inches and one-half long, and tapers from the middle towards each end. The ornamentation consists of alternate green and white longitudinal stripes. The dorsal stripe is green, spotted with red, and when the larva is in repose these red spots sometimes form a continuous stripe. The head is red in front with a white or pinkish white border. The collar and legs are green, the prolegs red, and the last segment is bordered with red. Caudal horn entirely wanting.

The pupa is chestnut brown with the tongue-case buried.

This species feeds on the leaves of White Pine (*Pinus strobus*).

42. Ellema coniferarum, Abbot and Smith.

El-le'-ma co-nif-e-ra'-rum.

Expanse of wings, two inches and one-fourth.

Head and collar, umber brown; thorax and abdomen, ashy gray and unspotted. The fore wings are ashy gray with an inconspicuous, brown line, dentate on the veins, preceded by a pale shade, crossing the wing from the outer fourth of the costa to the outer fourth of the hinder margin. This line is considerably rounded out beyond the cell, and curving in between veins 2 and 3, runs from this place to the hinder margin at right angles with it. Three cross lines starting from and visible only at the costa, divide the portion inside of the outer line into nearly equal parts. Two dark brown dashes rest, one between veins 2 and 3, the other between veins 3 and 4, and extend out to the outer cross lines. The fringes are white, cut with brown at the ends of the veins. The hind wings are brownish gray, paler at the base. Fringes white, cut with brownish at the ends of the veins. The under surface is pale brownish gray. Mr. Thaxter has taken what he regards as this species at Kittery, Maine.

Mr. Albert Koebele, who has bred this species in Georgia, states that they vary much. The fore wings vary in width,

and many are uniform ash gray in color. Many have the two black dashes near the middle of the fore wing while some have but one. Some have a band of lighter gray across the wings, and others have dark lines and markings, while still others exactly resemble *Sphinx pinastri* of Europe, except that the abdomen is unspotted.

The eggs of this species are very dark green and hatch in eight days. The young larva has a round head, but it changes at the first molt to an angular form, running up to a sharp point at the top. There is no caudal horn at any stage of its history.

The mature larva is about three inches long, of a light yellowish green color with three white longitudinal stripes; one just below the dorsum, a second along the spiracles, and a third between these two at equal distances. The head is of medium size, light yellowish green and edged along the collar with a blue line. A black line runs from each corner of the mouth to the summit of the head where they unite. The head is somewhat conical and flattened in front. The spaces between the posterior spiracles and the under part of the body are strongly marked with red. Abbot and Smith represented the mature larva checkered with light and dark gray squares. This form was found by Mr. Koebele, but far less common than the other.

This species feeds on *Pinus palustris*, (A. & S). All kinds of pine, (*Koebele*).

INDEX OF GENERA.

INDEX OF SPECIES AND VARIETIES.

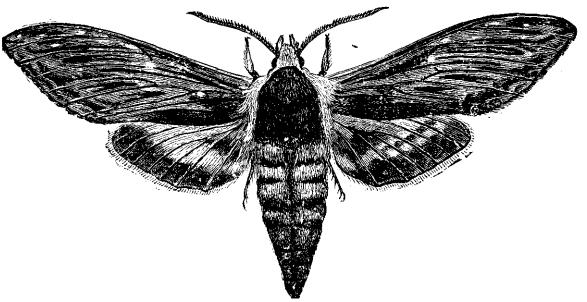

Fig. 1.—SPHINX GORDIUS.

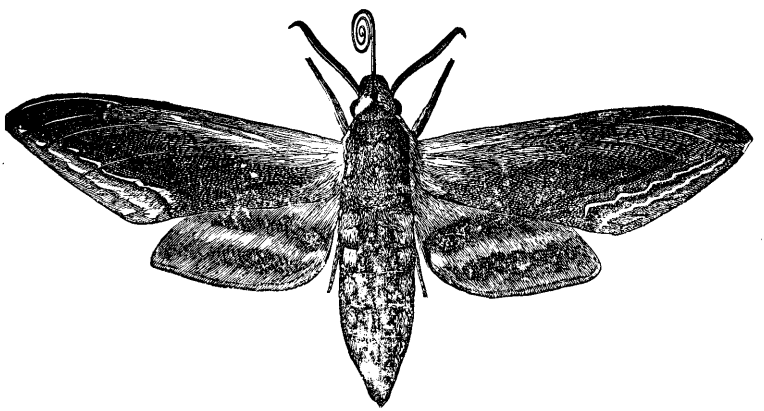

Fig. 2.—SPHINX DRUPIFERARUM.

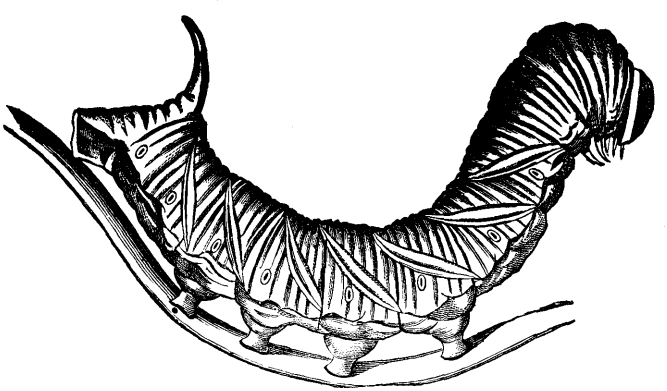

Fig. 3.—SPHINX DRUPIFERARUM, larva.

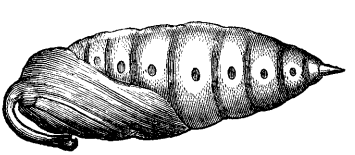

Fig. 4.—SPHINX DRUPIFERARUM, pupa.

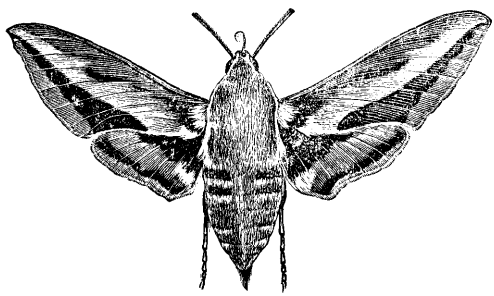

Fig. 1.—DEILEPHILA CHAMÆNERII.

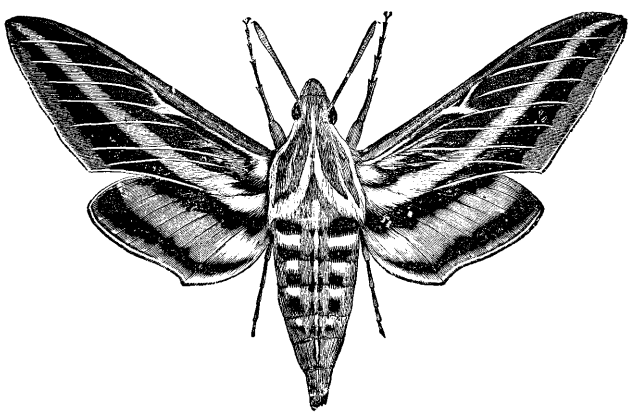

Fig. 2.—DEILEPHILA LINEATA.

Fig. 3—DEILEPHILA LINEATA, larva.

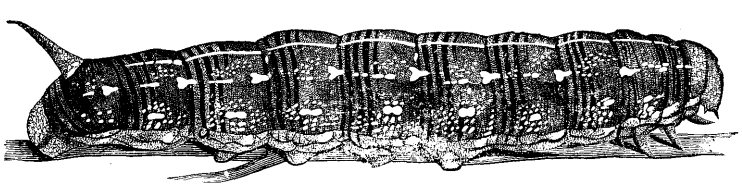

Fig. 4.—DEILEPHILA LINEATA, larva.

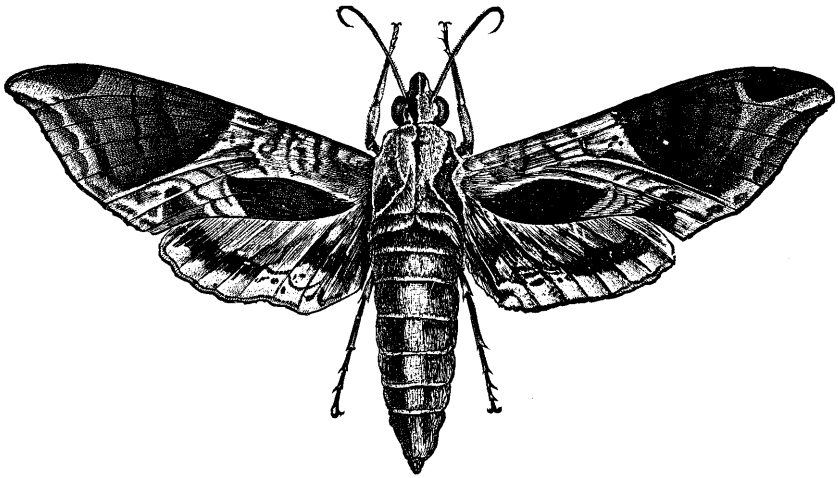

Fig. 1.—PHILAMPELUS PANDORUS.

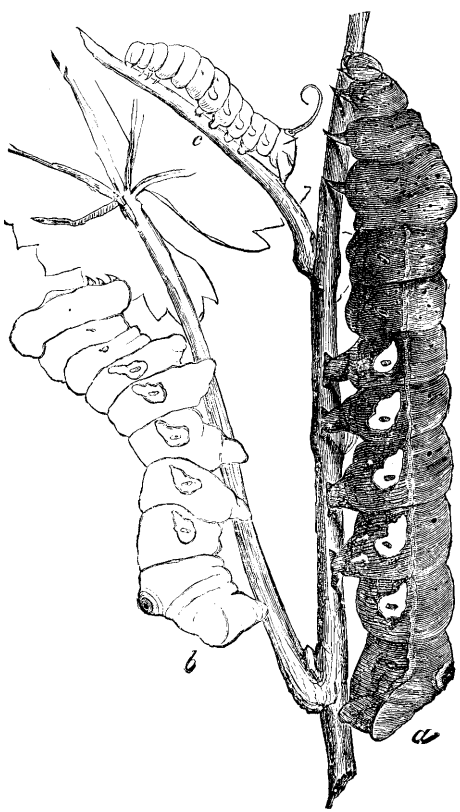

Fig. 2.—PHILAMPELUS PANDORUS.

a. Adult larva in motion.
b. Adult larva at rest.
c. Young larva.

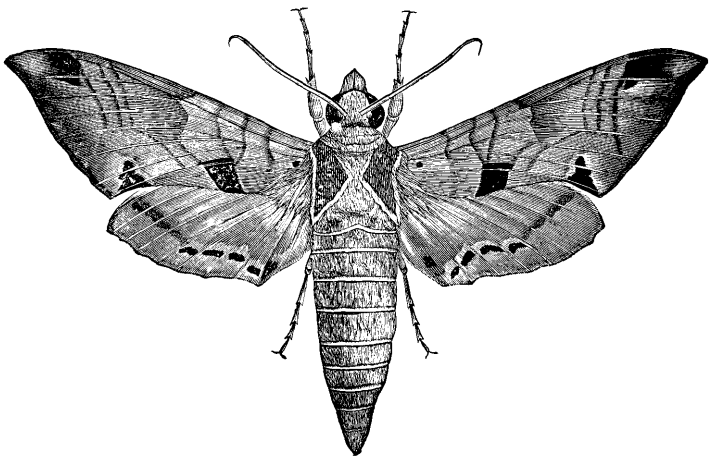

Fig. 1—PHILAMPELUS ACHEMON.

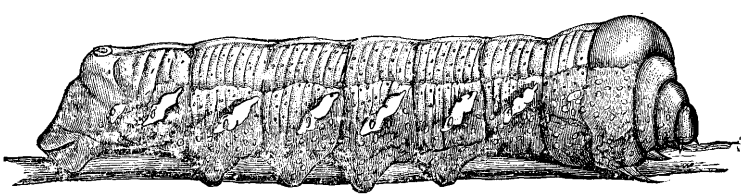

Fig. 2.—PHILAMPELUS ACHEMON, larva.

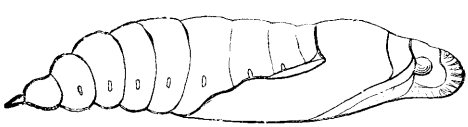

Fig. 3.—PHILAMPELUS ACHEMON, pupa.

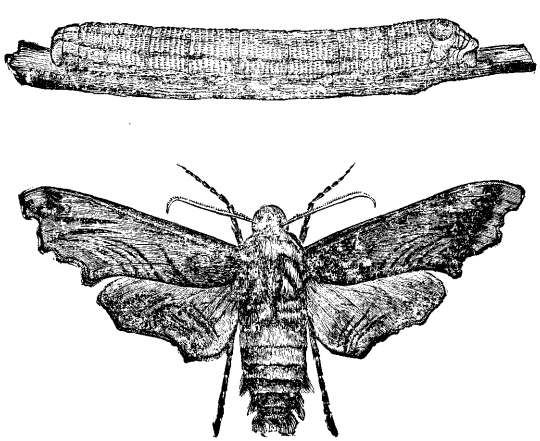

Fig. 4.—THYREUS ABBOTII, larva and imago.

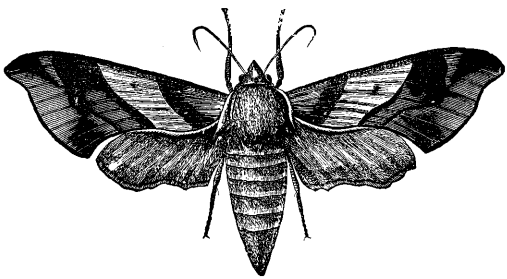

Fig. 1.—EVERYX MYRON.

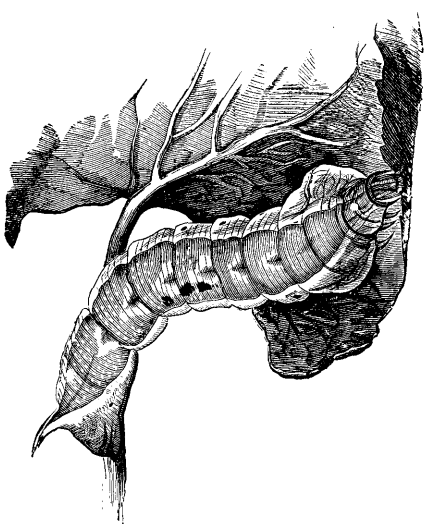

Fig. 2.—EVERYX MYRON, larva.

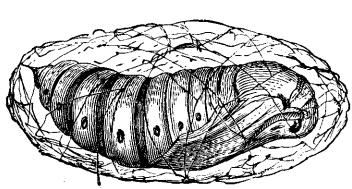

Fig. 3.—EVERYX MYRON, pupa in the cocoon.

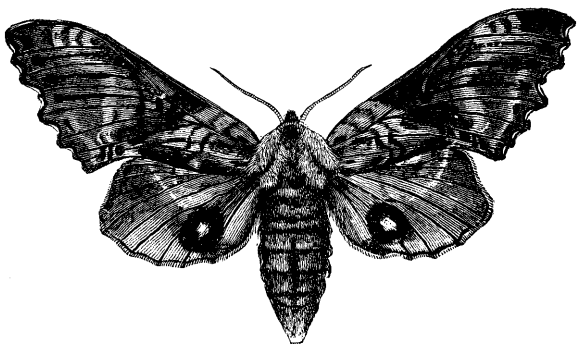

Fig. 1.—PAONIAS EXCAECATUS.

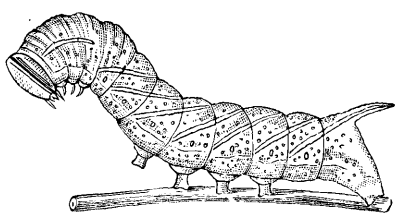

Fig. 2.—PAONIAS EXCAECATUS, larva.

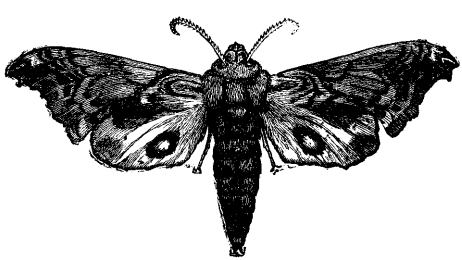

Fig. 3.—SMERINTHUS MYOPS.