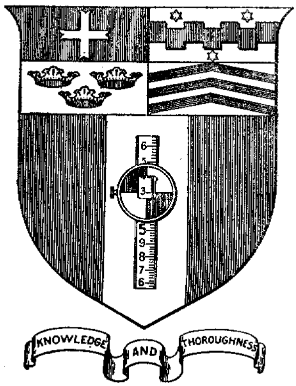

Coat of Arms, 1904

Old Bank Place. Occupied, 1824–34 and 1841–44

HISTORY

OF

Rensselaer Polytechnic Institute

1824-1934

BY

PALMER C. RICKETTS

PRESIDENT AND DIRECTOR

THIRD EDITION

New York

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TO THE MEMORY

OF

Stephen Van Rensselaer

Amos Eaton

AND

Benjamin Franklin Greene

PREFACE TO THE THIRD EDITION

THE first edition of this history was published about forty years ago and the second edition about twenty. In the preface to the second edition attention was called to the many changes for the better which had taken place during the preceding twenty years. The same thing may be said of the changes since 1914. The additions to our corps of instructors, number of courses given, and facilities for instruction have been marked. We now have more than twice the number of instructors, more than twice the number of students, more than twice the number of courses given, and more than twice the number of buildings. The value of our property is now more than five times its value twenty years ago.

It is satisfactory to note this progress in the last edition of this history which will appear.

RENSSELAER POLYTECHNIC INSTITUTE,
TROY, N. Y., June, 1, 1934.

PREFACE TO THE SECOND EDITION

TWENTY years have elapsed since the appearance of the first edition of this history. Many changes have taken place in the Institute during this period. It has become a larger school; more courses of instruction are given; there are more teachers and more students, more buildings and larger ones, a far better equipment, and a larger endowment. Its field has been broadened and its standards for graduation have been raised.

In the first preface, the Institute is said to be the first school of science and the first school of civil engineering to be established in any English-speaking country. In the first chapter of this edition it is shown that this statement should be modified; that there was one school established, as the Rensselaer School was, primarily for the teaching of science, which antedated it by about two years, but which soon passed out of existence. It is, therefore, more correct to say that the Institute is the first school of science and the first school of civil engineering, which has had a continuous existence, to be established in any English-speaking country.

P. C. R.

RENSSELAER POLYTECHNIC INSTITUTE,
TROY, N. Y., November, 1914.

PREFACE TO THE FIRST EDITION

HAVING recently been compelled to write several brief historical sketches of the Institute, the writer became interested in its early history. In preparing these narratives he found the official publications giving the characteristics of the School at the time of its foundation to have become very rare. In fact, very few of them antedating 1840 are known to be in existence. For these reasons he determined to expand the sketches and publish a short history of the institution which should consist largely of a description of the development of its curriculums.

The student of the history of education will recognize the importance of an account of the early methods of instruction pursued in an institution which was, at once, the first school of science * and the first school of civil engineering to be established in any English-speaking country, and if the conceded originality of these methods be also considered, it is believed that no excuse for the appearance of this somewhat condensed narrative will be thought necessary.

Interesting information has been obtained from the recently discovered original minutes of the board of trustees for the twenty-five years immedi-

* See Preface to the Second Edition.

ately following the founding of the School, which were believed to have been destroyed in the fire of 1862, and the thanks of the writer are due the president and secretary of the present board for placing at his disposal the minutes covering the period from 1862 until the present time.

The author is also under obligation to Professor Henry B. Nason for the loan of a number of the early circulars, to A. J. Weise, Esq., for the picture of the Van der Heyden mansion, to James Irving, Esq., for that of the building on the Infant School Lot, and to Professor William G. Raymond for the two photographs from which the pictures showing railroad and hydrographic work of students were taken. The Bibliography at the end of the last chapter shows other sources whence information has been obtained.

P. C. R.

RENSSELAER POLYTECHNIC INSTITUTE,
TROY, N. Y., January 1, 1895.

FOREWORD

Few persons, even those most interested in the history of education in this country, are cognizant of the great part Rensselaer School, afterwards Rensselaer Polytechnic Institute, has taken in the development of scientific education. To break down the tradition of centuries in a system of education is no easy task. Established in 1824 at a time when there was little popular information regarding the principles of science, and not much more knowledge of this kind among the faculties of the colleges, an organization existing for the diffusion of scientific knowledge was regarded with little enthusiasm by most of those who had been educated under the classical aegis.

Stephen Van Rensselaer, able and altruistic, a man of wealth and position, was wise enough to discover the genius of Eaton and employ him to deliver a course of popular lectures on natural science, afterwards appointing him head of Rensselaer School. Amos Eaton, geologist, botanist, chemist, called the "Father of American Geology," was one of the great men of science of his time. He was the first to give systematic instruction in field work in any school and, before Liebig and Lord Kelvin, was the first to establish (in 1824), in this or any other country, laboratories for the systematic individual instruction of students in chemistry and in physics. He developed in the school the first engineering curriculum to be created in the country and the school gave the first engineering degree—that of civil engineer, in 1835.

Later when B. Franklin Greene, the then director, re-organized the course in 1849–50, the civil engineering curriculum he inaugurated formed the basis of courses of that kind in almost every engineering school afterwards established in this country. Forty years before the departments of architecture were created, in the universities of Pennsylvania, Harvard, and Columbia, he published, in his classic pamphlet entitled "The True Idea of a Polytechnic Institute," a curriculum for an architectural course which want of funds alone prevented him from establishing at that time.

A pupil of Eaton, he fully appreciated the value of laboratory work and research so carefully instilled in the minds of his pupils by Eaton. In enunciating his ideas on this subject he wrote that in chemistry and in physics each student was furnished with all needful facilities for making his own experimental demonstrations, this being essential to success in the "business of research." Thus these two men, before there was any other school of engineering in this country, recognized the value of research and, as far as they were able, developed a love of it in their students.

Surely this school, for its primacy in almost everything found to be of value in methods of instruction in the scientific schools of this country today, must justly be recognized as the pioneer in schools of engineering and technology, and even of architecture.

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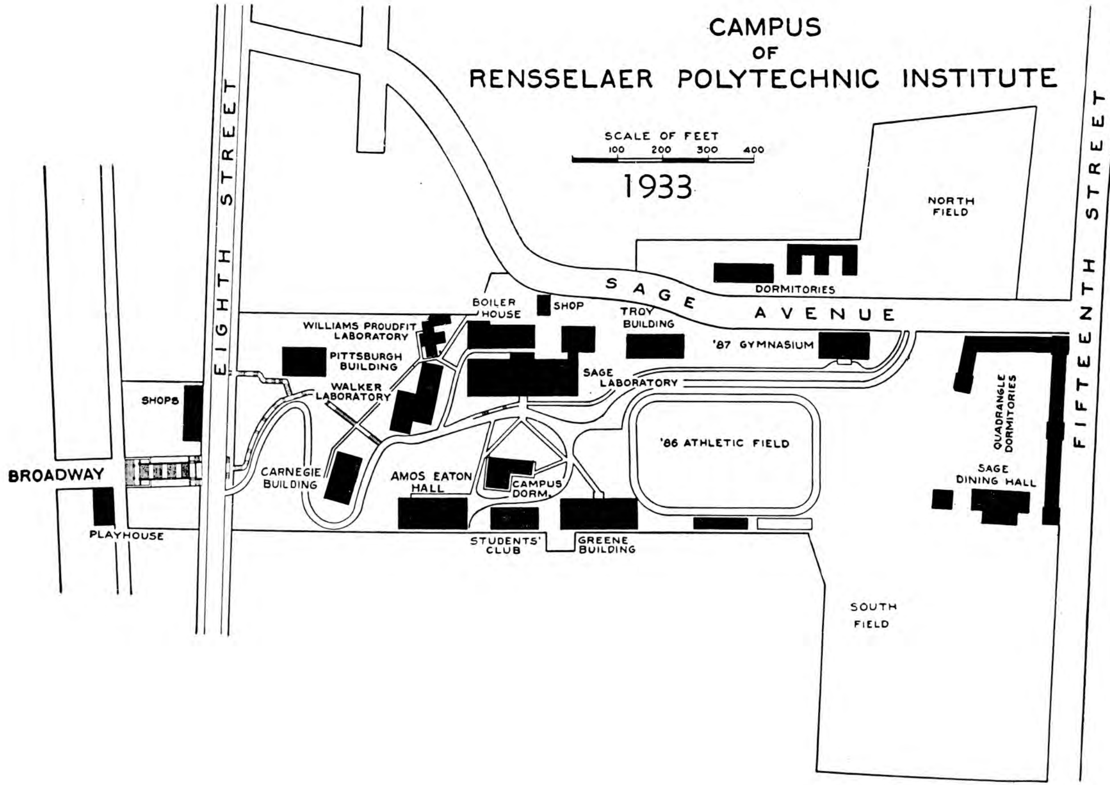
CAMPUS
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PLAYHOUSE
STUDENTS' CLUB
GREENE BUILDING
SOUTH FIELD

HISTORY
OF
RENSSELAER POLYTECHNIC INSTITUTE
(1824–1934)

CHAPTER I

THE FOUNDATION OF THE SCHOOL

AT the beginning of the nineteenth century the study of the physical sciences in the United States was in its infancy. All branches were included under the terms natural philosophy and natural history. Their meaning was not well defined, although under the former was generally included all of what was then known of astronomy, physics, chemistry, botany, and geology. Scarcely any provision was made for scientific instruction in any of the colleges of the country. Astronomy, physics, chemistry, and botany had indeed been taught during the preceding century in a few institutions of learning, a department of mathematics and natural philosophy having been created at Harvard College as early as 1727, a professorship of botany in Columbia College in 1792, and a chair of chemistry at Princeton in 1795. Instruction had also been given in physics and chemistry at the University of Pennsylvania and Dartmouth College, and in physics at Union College. This short list, however, includes all the colleges which had given the physical sciences more than an insignificant place in their curriculums. Even in these the instruction was given by lectures, supplemented at times by experiments which the teachers performed; and anything approaching laboratory work by the student was almost wholly unknown. When Professor Silliman was elected, in 1801, to the chair of chemistry, geology, and mineralogy at Yale College, he visited Dr. Maclean, who was professor of chemistry at Princeton, and then for the first time saw experiments in chemistry performed.* Considering the state of scientific knowledge at this period and the general lack of opportunity for the study of science even in Europe, it is not remarkable that this should have been the case in a new country the total population of which in the year 1800 did not exceed that of the city of London today.

With the general awakening to the value of the natural sciences, during the first quarter of the century, came provision for their study in other of the academic schools of the country. Within that time courses in various branches were inaugurated at Yale, Williams, Bowdoin, Dickinson, William and Mary, and Hobart Colleges, and in the universities of Georgia, North Carolina, and South Carolina. Facilities for practical work by the students were still wanting in nearly all of them, though the appa-

* "Education in the United States," Richard G. Boone.

ratus used for illustration had grown in quantity and variety. A chemical laboratory, already mentioned, was in existence at Princeton, one was fitted up at Williams College in 1812, and one at Harvard shortly after this date. A few others were also to be found. They were all, of course, crude and unpretending compared with those thickly scattered over the country today. Nor were the steps taken in the study of science always forward. Thus there was organized in the University of Pennsylvania, in 1816, a department of natural science "with five professors; and annual courses of lectures, to be publicly delivered, were required by the regulations. The courses of instruction embraced natural philosophy, botany, natural history, mineralogy, chemistry applied to agriculture and the arts, and comparative anatomy. The support given by the public, however, was not sufficient to compensate for the efforts put forth, the professors were badly paid, and the department soon fell into neglect. It was abolished shortly after the establishment of the Franklin Institute, in 1824, which rendered, it was said at the time, such a department in the university 'unnecessary.' " *

The time had now come, not only for the addition of scientific courses to the curriculums of the institutions of learning, but for a general diffusion of scientific knowledge among those who could not have the advantage of an education higher than that afforded by the common schools. Attempts in

* "Historical Sketch of the University of Pennsylvania," John L. Stewart. Circular 2, 1892, of the U. S. Bureau of Education.

this direction had already been made in Europe. When Count Rumford returned from Munich to London in 1795 he endeavored to interest the people of England, as he had those of Germany, in his plans for public and domestic economy, more particularly in the economical consumption of coal, improvements in the construction of fireplaces, and the heating of buildings by steam. In 1799 he issued in London a prospectus entitled "Proposals for forming by subscription, in the metropolis of the British Empire, a public institution for diffusing the knowledge and facilitating the general introduction of useful mechanical inventions and improvements, and for teaching, by courses of philosophical lectures and experiments, the application of science to the common purposes of life." The result was the establishment, in the year 1800, of the Royal Institution of Great Britain, which had for its object the purposes outlined in his prospectus.

Other men had not been blind to the benefits which would accrue to civilization if the people generally could be instructed in the application of science to the common purposes of life. Franklin's opinions upon this subject are well known. John Adams believed that the state should make provision for this purpose, as is shown by the following extract from the Constitution of Massachusetts, of 1780, of which he was the principal author: "to encourage private societies and public institutions, rewards and immunities for the promotion of agriculture, arts, sciences, commerce, trades, manufactures, and a natural history of the country." Jefferson also proposed a school of technical philosophy, to be maintained wholly at public expense, where certain of the higher branches should be taught in abridged form to meet practical wants. "To such a school," he wrote, "will come the mariner, carpenter, shipwright, pump-maker, clock-maker, machinist, optician, metallurgist, founder, cutler, druggist, brewer, vintner, distiller, dyer, painter, bleacher, soap-maker, tanner, powder-maker, salt-maker, glass-maker, to learn, as much as shall be necessary to pursue their art understandingly, of the sciences of geometry, mechanics, statics, hydrostatics, hydraulics, hydrodynamics, navigation, astronomy, geography, optics, pneumatics, acoustics, physics, chemistry, natural history, botany, mineralogy, and pharmacy." *

The influence of such opinions gave impetus to the diffusion of scientific knowledge among the people of this country. Although, as before shown, opportunities had been offered in various colleges and universities for the study of natural science and the Royal Institution for popular lectures on its various branches had been founded in England, there had not been in existence in either country a school originated avowedly for purposes of scientific instruction. During the first quarter of the nineteenth century, however, three schools were established here for each of which the distinction has

* "Early History of the University of Virginia, as Contained in the Letters of Thomas Jefferson and Joseph C. Cabell," edited by J. W. Randolph, Richmond, 1856.

been claimed of being the first school created in any English-speaking country for the purpose of teaching science. The earliest was established in Norwich, Vermont, in 1819, by Captain Alden Partridge, a graduate of the United States Military Academy and its superintendent during the years 1815–7. It was called the American Literary, Scientific, and Military Academy, and it appears * to have been more of a military academy than a school of science. It was evidently modeled after the West Point school. The cadets lived in barracks, and were taken at as early an age as nine years. The curriculum included various languages, English literature, science, as much as was then known of engineering, and many military subjects, including military exercises. The Academy was moved from Vermont to Middletown, Connecticut, in 1825, and was incorporated in that state, but was disbanded in 1829. In the meantime, Captain Partridge had left the Academy in 1827 and had opened in Norwich a small preparatory school. When the Academy was disbanded in Connecticut, he took its name again for his school, which in 1834 was chartered by the legislature of Vermont as Norwich University, and, in 1866, the University was moved to Northfield, in the same state.

The second school was incorporated under the name of the Gardiner Lyceum, in Gardiner, Maine, in 1822, and opened in 1823 by Benjamin Hale, who was graduated from Bowdoin College in 1818

* "History of Norwich University," by William A. Ellis. Vol. I, pp. 4–6, 13, 19–51.

and who afterwards became president of Hobart College. In his inaugural address * delivered January 1, 1823, he said: "It is the object of this institution to give instruction in those branches which are most intimately connected with the arts, and to teach them as the foundation of the arts. . . . It is not sufficient for them, as for the general scholar, to be taught the general laws of chemistry; they must be instructed particularly in the chemistry of agriculture and the arts. It is not sufficient for them to be able to repeat and to demonstrate a few of the general laws of mechanics; they must be taught the application of the laws. They must be made acquainted with machines." The curriculum included various branches of pure mathematics, and natural science, mensuration, surveying, navigation, and theoretical and practical mechanics. The Lyceum existed for about ten years. It was discontinued in consequence of the withdrawal of a legislative appropriation.

The third school, which is the subject of this history, was founded in Troy, New York, by Stephen Van Rensselaer, of Albany, New York, in 1824. It was called the Rensselaer School, and was originated for the purpose of teaching the "application of science to the common purposes of life." Detailed information regarding it, including its early

* "An Inaugural Address delivered at Gardiner, Me., January 1, 1823," by Benjamin Hale, principal of the Gardiner Lyceum, and lecturer on natural philosophy. Hallowell. S. K. Gilman, Printer, 1823. A copy of this address, together with several other pamphlets relating to Gardiner Lyceum, is in the Bowdoin College Library.

curriculums, will be given in due course in this history, but reference is made here to give the date of its foundation and its object, in order that a comparison may be made with the two schools previously mentioned.

The primary object of the Norwich Academy was really not the teaching of applied science. It seems to have been a mixture of boarding-school, military academy, classical school, and scientific school. Evidently more applied science, and even engineering, as it was then known, was taught than was taught in the classical colleges of that day. But even if, after all the changes in name and place, Norwich University may be said to be the same school as the American Literary, Scientific, and Military Academy, it is more than doubtful whether it has any right to be called the first school of science to be established in this country. If it has a claim to this distinction, the West Point Military Academy, after which it was modeled, has a greater claim; and this has never been made for it.

Whatever honor may accrue from being the first school established in this country specifically for the purpose of teaching science belongs, I believe, to the Gardiner Lyceum, which was originated about two years earlier than the Rensselaer School, but which soon ceased to be. The Rensselaer Polytechnic Institute is, therefore, I believe, the first school of science and engineering, which has had a continuous existence, to be established in any English-speaking country.

That the founder had definite ideas not only in relation to the purposes of the institution, but also in regard to its general management and the methods of instruction to be pursued, is attested by a letter dated November 5, 1824, to the Rev. Samuel Blatchford, of Lansingburgh. It forms the first official notice of the foundation, and reads as follows:

Dear Sir: I have established a school at the north end of Troy, in Rensselaer county, in the building usually called the Old Bank Place, for the purpose of instructing persons, who may choose to apply themselves, in the *application of science to the common purposes of life.* My principal object is, to qualify teachers for instructing the sons and daughters of farmers and mechanics, by lectures or otherwise, in the application of experimental chemistry, philosophy, and natural history, to agriculture, domestic economy, the arts, and manufactures. From the trials which have been made by persons in my employment at Utica, Whitesborough, Rome, Auburn, and Geneva during the last summer, I am inclined to believe that competent instructors may be produced in the school at Troy, who will be highly useful to the community in the diffusion of a very useful kind of knowledge, with its application to the business of living. Apparatus for the necessary experiments has been so much simplified, and specimens in natural history have become subjects of such easy attainment, that but a small sum is now required as an outfit for an instructor in the proposed branch of science; consequently, every school district may have the benefit of such a course of instruction about once in two or three years, as soon as we can furnish a sufficient number of teachers. I prefer this plan to the endowment of a single public institution for the resort of those only whose parents are able and willing to send their children from home or to enter them for several years upon the

Fellenberg plan. It seems to comport better with the habits of our citizens and the genius of our government to place the advantages of useful improvement equally within the reach of all.

Whether my expectations will ever be realized or not, I am willing to hazard the necessary expense of making the trial. Having procured a suitable building advantageously located among farmers and mechanics, and having furnished funds which are deemed sufficient by my agent in this undertaking for procuring the necessary apparatus, etc., it now remains to establish a system of organization adapted to the object. You will excuse me if I attach too much consequence to the undertaking. But it appears to me that a board of trustees to decide upon the manner of granting certificates of qualifications, to regulate the government of students, etc., is essential. I, therefore, take the liberty to appoint you a member and president of a board of trustees for this purpose. I appoint the following gentlemen trustees of the same board: The Rev. Dr. Blatchford and Elias Parmalee, of Lansingburgh; Guert Van Schoonhoven and John Cramer, Esqs., of Waterford; Simeon DeWitt and T. Romeyn Beck, of Albany, John D. Dickinson and Jedediah Tracy, of Troy. And I appoint O. L. Holley, Esq., of Troy, and T. R. Beck, of Albany, first and second vice-presidents of said board.

As a few regulations are immediately necessary in order to present the school to the public, it seems necessary that I should make the following orders, subject to be altered by the trustees after the end of the first term.

Order 1. The board of trustees is to meet at times and places to be notified by the president, or by one of the vice-presidents, in the absence or disability of the president. One-half of the members of the board are to form a quorum for doing business. A majority of the members present may fill any vacancy which happens in the board; so that there may be two members resident in Troy, two in Lansingburgh, two in Waterford, and two in Albany. The powers and duties of the trustees to be such as those exercised by all similar boards, the object of the school being always kept in view.

Order 2. I appoint Dr. Moses Hale, of Troy, secretary, and Mr. H. N. Lockwood, treasurer.

Order 3. I appoint Amos Eaton, of Troy, professor of chemistry and experimental philosophy, and lecturer on geology, land surveying, and the laws regulating town officers and jurors. This office to be denominated the senior professorship.

Order 4. I appoint Lewis C. Beck, of Albany, professor of mineralogy, botany, and zoology, and lecturer on the social duties peculiar to farmers and mechanics. This office to be denominated the junior professorship.

Order 5. The first term is to commence on the first Monday in January next, and to continue fifteen weeks. For admission to the course, including the use of the library and reading-room, each student must pay twenty-five dollars to the treasurer, or give him satisfactory assurances that it will be paid in one year. In addition to this, each section of students must pay for the chemical substances they consume and the damage they do to apparatus.

Order 6. All the pay thus received by the treasurer, as for parts of courses of instruction, is to be paid over to said professors as the reward of their services.

Order 7. In giving the course in chemistry, the students are to be divided into sections, not exceeding five in each section. These are not *to be taught by seeing experiments and hearing lectures, according to the usual method. But they are to lecture and experiment by turns, under the immediate direction of a professor or a competent assistant.** Thus by a term of labor, like apprentices to a trade, they are to become operative chemists.

Order 8. At the close of the term each student is to give sufficient tests of his skill and science before examiners, to be appointed by myself, or by the trustees, if I do not appoint. The examination *is not to be conducted by ques-*

*tion and answer, but the qualifications of students are to be estimated by the facility with which they perform experiments and give the rationale;** and certificates or diplomas are to be awarded accordingly.

Order 9. One librarian, or more, to be appointed by the professors, will be keeper of the reading-room. All who attend at the reading-room are to respect and obey the orders of the librarian in regard to the library and conduct while in the room.

Order 10. Any student who shall be guilty of disorderly or ungentlemanly conduct is to be tried and punished by the president or vice-president and two trustees. The punishment may extend to expulsion and forfeiture of the school privileges, without a release from the payment of fees. But a student may appeal from such decision to the board of trustees.

This instrument, or a copy of it, is to be read to each student before he becomes a member of the school; and he is to be made to understand that his matriculation is to be considered as an assent to these regulations.

STEPHEN VAN RENSSELAER.

ALBANY, Nov. 5, 1824.

This document shows the aim of the founder of the Rensselaer School to have been substantially that of the originator of the Royal Institution, though the methods pursued in attaining the object sought were different. He was doubtless familiar with the work and writings of Rumford, and it will be noticed that he has used in his description of the purpose of the school the same expression found in the London prospectus of 1799—"the application

* The italics are mine. P. C. R.

of science to the common purposes of life." * Attention will be given later to the peculiar methods of instruction outlined in this letter, and before proceeding with the history of the school a short account will be given of the lives of its founder and of another to whose talent as a teacher and scientific investigator the success of the school was largely due.

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* See the address of President James Forsyth in *Proceedings* of the Semi-Centennial Celebration of the Rensselaer Polytechnic Institute, 1874.

CHAPTER II

STEPHEN VAN RENSSELAER AND AMOS EATON

STEPHEN VAN RENSSELAER was the fifth in direct line of descent from Killian Van Rensselaer, a merchant of Holland, who obtained by purchase from the Indians, about the year 1637, a district about twenty-four miles in breadth by forty-eight in length, comprising the territory which has since become the counties of Albany, Columbia, and Rensselaer, in the State of New York. He named it the Colony and Manor of Rensselaerwyck, and was its first patroon. Stephen was born November 1, 1764, in the City of New York. His father was Stephen Van Rensselaer, the seventh proprietor or patroon of Rensselaerwyck, and his mother was Catharine, the daughter of Philip Livingston. Upon the death of his father in 1769, the care of the estate, which fell exclusively to him by the law of primogeniture, devolved upon his uncle, General Ten Broeck, who also acted as guardian during his minority. He was at first sent to a school in Albany and afterwards to one in Elizabethtown, New Jersey. At the beginning of the Revolution he was removed to Kingston, New York, and acquired the elements of a classical education at the Kingston Academy. He was later sent to Princeton College, but in consequence of its proximity to the seat of war, it was thought advisable to send him to Harvard College, where he was graduated as a Bachelor of Arts in 1782, in the nineteenth year of his age. Returning to Albany he married, in 1783, a daughter of General Philip Schuyler, and upon reaching his majority settled down in the Manor House and took charge of his estates. By offering leases for long terms at a very moderate rent, he succeeded in bringing a large portion of his land into cultivation, but little of which had, until then, been converted into farms, and thus secured for himself a competent income.

He was made a major of infantry in 1786, and when, in 1801, Governor Jay formed the cavalry of the state into a separate corps he was placed in command with a commission of major-general of cavalry. He was elected, as a federalist, to the Assembly of the state in 1789, and the next year became a state senator, which position he held until 1795, when he was chosen lieutenant-governor at the same time that John Jay was elected governor. He was lieutenant-governor for six years, and was nominated for governor in 1801, but was defeated by DeWitt Clinton. In the same year he was a member of the constitutional convention, and presided over it during the greater part of its deliberations. He was again elected to the Assembly in 1807, and when, during this term, a project was agitated to appoint a commission for exploring a route for a western canal, he was strongly in favor of it. Having been appointed, in 1810, to serve on this commission, he, in company with the other members, made an exploration of the route for a canal from the Hudson River to Lake Erie.

When war with Great Britain was declared in 1812, he was given the command of the state militia, and on the thirteenth of October of that year assaulted and took the Heights of Queenstown, Canada, from which, however, he was compelled to withdraw by the refusal of the state militia, under the plea of constitutional scruples, to leave the state. His services in the field ended with this campaign, and in 1813 he was again nominated for governor, but was defeated by a small majority. In the meantime, the canal commission had continued its existence, and in 1816, when the Legislature directed the construction of the Erie Canal and committed the execution of the work to a board of canal commissioners, he was made a member of that body, and was its president from April, 1824, until his death. He was again elected a member of Assembly in 1816, in 1819 became a regent of the State University, of which he was chancellor from 1835 until his death, and was a member of the constitutional convention of 1821.

From his position as patroon and because of the great extent of territory he possessed, as well as on account of his great intelligence and the benevolence of his nature, Stephen Van Rensselaer had always been strongly in favor of the encouragement of farmers and the improvement of agriculture. When, therefore, in 1819, an act for the encouragement of agriculture was passed by the

Legislature of the state, under the provisions of which delegates from county societies formed a Central Board of Agriculture, he was elected its president at the first meeting in Albany, in January, 1820. Although the life of the board was brief, it was long enough to permit a geological and agricultural survey of the counties of Albany and Rensselaer to be made under its direction, though at the expense of its president. This survey was executed by Professor Amos Eaton with the aid of two assistants, and was the first attempt made in this country to collect and arrange geological facts with a direct view to the improvement of agriculture. Analyses of soils were included, as well as a consideration of the proper methods of culture adapted to them, and the results were published in three volumes of "Transactions and Memoirs." Imbued with strong opinions as to the value of such scientific investigations, when the board ceased to exist Stephen Van Rensselaer was unwilling to discontinue work of this character, and in the years 1822 and 1823 he caused to be made, at his own expense, under the direction of Professor Eaton, a geological survey extending from Boston to Lake Erie, a distance of about five hundred and fifty miles. It embraced a belt fifty miles in width, which covered, in this state, the line of the Erie Canal.

The intelligence and benevolence of the subject of this sketch were now, when he had reached the age of sixty years, to be directed into a new channel. He had long been interested in the instruction of the poorer families of his tenantry, and had reached the conclusion that the most valuable education to be given the masses engaged in the ordinary occupations of life was one which would enable them to apply the principles of science to the "business of living." His first step in this direction was to secure the services of Professor Eaton, with whose qualifications he was thoroughly familiar. He employed him, in the summer of 1824, to traverse the state on or near the line of the Erie Canal, provided with sufficient apparatus and specimens to deliver, in all the principal towns where an audience of business men or others could be collected, a series of lectures, accompanied with experiments and illustrations, on "chemistry, natural philosophy, and some or all the branches of natural history." This undertaking was entirely successful. Encouraged by it, he determined to establish an institution one of the principal objects of which should be "to qualify teachers for instructing the sons and daughters of farmers and mechanics, by lectures or otherwise, in the application of experimental chemistry, philosophy and natural history to agriculture, domestic economy, the arts, and manufactures"; and there resulted the foundation at Troy, New York, in 1824, of the school which is the subject of this historical sketch. He at first intended to sustain the school for three years only, expecting that, if at the end of this period it were successful, the public would maintain it. However, besides the expense of its original establishment, he bore, until his death fourteen years later, about one-half the cost of its maintenance. As will be seen hereafter, the course of instruction was considerably enlarged, during his life and with his approval, to meet the growing demand for educated engineers and scientific men.

In the meantime, in 1823, General Van Rensselaer had been elected to Congress as a representative from Albany County, and some of his instructions in relation to the new school were forwarded from Washington. He continued in Congress for six years, and was during this period chairman of the Committee on Agriculture. During a part of his active public life, from 1793 until his resignation in 1819, he was a trustee of Williams College. In 1825 the degree LL.D. was conferred on him by Yale College. He died at the old Manor House in Albany on the twenty-sixth day of January, 1839, in the seventy-fourth year of his age.*

Although distinguished because of his position and character, and on account of many years of successful public service in important positions, the memory of Stephen Van Rensselaer will be perpetuated chiefly by means of the school which he established for the benefit of his fellow-men.

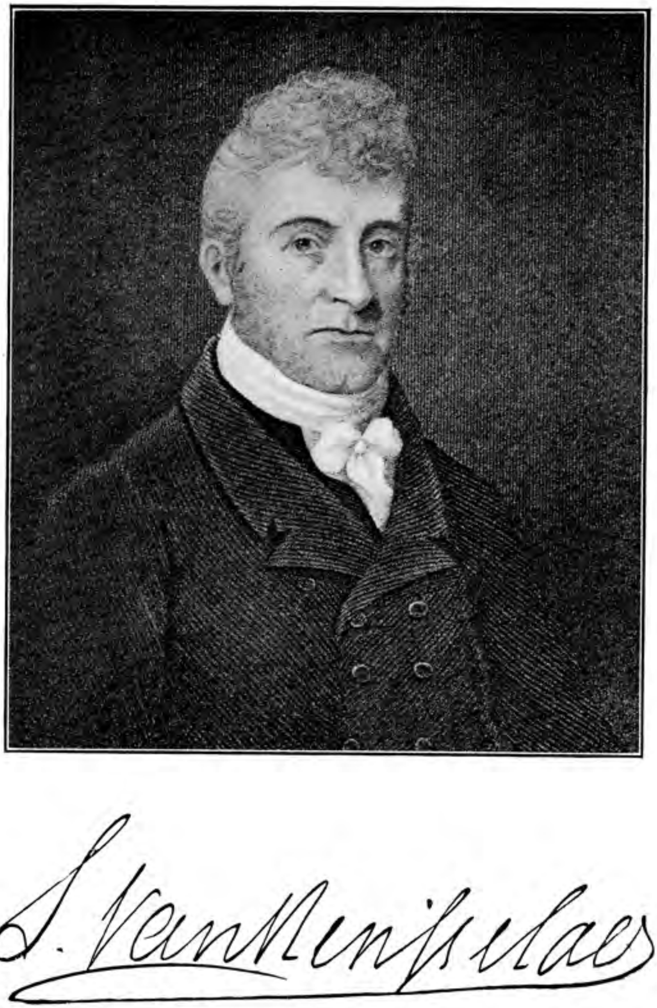
In an article on the Institute, one of an interesting series on the engineering schools of the United States, written in 1892 for *Engineering News,* A. M. Wellington says: "The founder was not of the class of rich men who found colleges only from a vague philanthropic instinct and to perpetuate his

* See "A Discourse on the Life, Services and Character of Stephen Van Rensselaer," by Daniel G. Barnard, Albany, 1839.

name. He had distinct and very original and decided views as to proper methods of instruction, which he took great pains to provide for and enforce at length. His love of thoroughness, his determination that the instruction should be of the best, if there was any, and that the school should take a high rank among the kindred institutions of the world, crop out constantly in his letters and deed of foundation. . . . He was no common founder, and he founded no common school. The cause of engineering education owed much to him indeed."

It will be noticed in the account just given of his life that in all his efforts for the advancement of scientific knowledge, whether by agricultural and geological surveys or by the more direct method of instruction, he employed one individual as his agent. That no error was made in the choice is proved by the uniform success of his endeavors.

Amos Eaton was indeed no ordinary man. The history of the last seventeen years of his life is identical with that of Rensselaer Institute. The importance of his work, however, not only in the early development of the school but as a scientific investigator and author of works on the natural sciences, renders it advisable to give, in this connection, a sketch of his earlier history. He was a native of Chatham, New York, and was born May 17, 1776. His father, Abel Eaton, was a farmer in comfortable circumstances. Amos early manifested superior abilities, and was selected to deliver an oration on the Fourth of July, 1790, when but




Amos Eaton

fourteen years of age. About this time, having acted as chainman during a land survey, he determined to become a surveyor. Not having the requisite instruments, he interested a skilful blacksmith in his behalf, who agreed to work for him at night if he would "blow and strike" by day. A needle and a good working chain were the result of several weeks' work. This circumstance in his life doubtless gave rise to the remark, found in *Silliman's Journal,* that "in 1791 he was an apprenticed blacksmith." The bottom of an old pewter plate, well smoothed, polished, and graduated, served as a compass-circle, so that Eaton, when sixteen years old, was in the field with his home-made instruments, doing occasional surveying in the neighborhood. He aspired, however, to higher attainments and, encouraged by his parents, was fitted for college at Spencertown, New York, and was graduated at Williams College, in 1799, with a high reputation for scientific knowledge. In the same year he began the study of law at Spencertown, and subsequently continued his studies in New York.

At this time he first became interested in the study of botany and other natural sciences. While in New York, in 1802, he borrowed Kirwan's "Mineralogy," then a scarce book, and made a manuscript copy of the entire work. He was admitted to the bar, at Albany, in 1802, and soon after established himself as a lawyer and land agent in Catskill, New York. Here he remained several years, his position affording him excellent opportunities for cultivating his growing taste for the natural sciences. In May, 1810, he made in Catskill, it is believed, the first attempt in this country at a popular course of lectures on botany, compiling for the use of his class a small elementary treatise. For this Dr. Hosack, who had formerly taught him in New York, complimented him as being the "first in the field."

Having found his love for the details of his profession diminishing and his interest in the natural sciences increasing, he finally resolved to abandon the practice of law and to fit himself more thoroughly for scientific pursuits. With this end in view he went to New Haven, in 1815, to avail himself of the advantages found at Yale College. He placed himself under the instruction of Professor Silliman, who threw open to him his lectures on chemistry, geology, and mineralogy, as well as his own library and the cabinet of minerals of that institution. Here, also, he found a good botanist in Dr. Eli Ives, professor of botany and materia medica in the medical department of the college, who had accumulated a good library, to which he gave Eaton free access. With these advantages and his already advanced acquirements he was soon well qualified as an explorer and teacher. Returning to Williamstown in 1817, he gave courses of lectures in botany, mineralogy, and geology to volunteer classes of students. His influence in the college was remarkable, and he awakened there an interest in the natural sciences which has never died out. His pupils published, in 1817, the first edition of his "Manual of Botany," a 12mo of 164 pages, which, as the late Dr. Lewis C. Beck wrote in 1852, "gave an impulse to the study of botany in New England and New York, as the only descriptive work which was then current was that of Pursh, an expensive one with Latin descriptions." This work was improved by repeated revisions and additions, and became, in the eighth edition, published in 1840, a large octavo volume of 625 pages, which was entitled "North American Botany," and contained a description of 5,267 species of plants.

An idea of his labors as an author and investigator may be obtained from a list of his works. He published an "Elementary Treatise on Botany," 1810; "Manual of Botany," 1817; "Botanical Dictionary," 1817; "Botanical Exercises," 1820; "Botanical Grammar and Dictionary," 1828; "Chemical Note Book," 1821; "Chemical Instructor," 1822; "Zoological Syllabus and Note Book," 1822; "Cuvier's Grand Division," 1822; "Art Without Science," 1800; "Philosophical Instructor," 1824; "Directions for Surveying and Engineering," 1838; "Index to the Geology of the Northern States," 1818; "Geological and Agricultural Survey of the County of Albany, N. Y.," 1820; "Geological and Agricultural Survey of Rensselaer County," 1822; "Geological Nomenclature of North America," 1822; "Geological and Agricultural Survey of the District adjoining the Erie Canal," 1824; "Geological Text Book," prepared for popular lectures on North American geology, 1830; "Geological Note Book for Troy Class,"

1841. Of most of these works a number of different editions were published.

In after years his memory as a botanist was honored by Professor Gray, who named for him two species of plants, the *Eatonia obtusata* and *Eatonia Pennsylvanica.*

The encouragement received by Eaton at Williams College determined him to give courses of popular scientific lectures, accompanied with practical instructions, to such classes as he might be able to organize in several of the larger towns of New England and New York. These met with great success, and in the course of two or three years he diffused a great amount of scientific knowledge, and there sprang up as the result of his labors an army of young botanists and geologists. According to Professor Albert Hopkins, of Williams College, he was one of the first to popularize science in the Northern States, and was one of the first in this country to study nature in the field, with his classes.

In 1818, in compliance with a special invitation from Governor DeWitt Clinton, he went to Albany and delivered a course of lectures before the members of the Legislature. Here he became acquainted with many of the leading men of the state, interesting them especially in geology and its application, by means of surveys, to agriculture. A train of causes was thus set in operation which resulted in giving to the world that great work, "The Natural History of New York," so creditable to the state and to the scientific men who executed it, of whom several had been Professor Eaton's pupils. In this year he published the first edition of his "Index to the Geology of the Northern States," which was the first attempt at a general arrangement of the geological strata in North America. In his "Education in the United States," Boone says: "Among the older geologists, and one of the first to study nature in the field, was Professor Amos Eaton of Williams College. He has been called the 'Father of American Geology,' was the instructor of Hall, Dana and Williams, and initiated the interest in a half dozen States."

He afterwards delivered several courses of lectures in the medical college at Castleton, Vermont, in which he was appointed professor of natural history in 1820. In this year and the following one he made the geological and agricultural surveys of Albany and Rensselaer counties to which reference has been made in the sketch of the life of Stephen Van Rensselaer. Of these surveys Professor Silliman remarked, in his *Journal,* "The attempt is novel in this country"; adding, "We are not aware of any attempt on so extensive and systematic a scale, to make them subservient to the important interests of agriculture." There has also been mentioned previously the geological survey of the district adjoining the Erie Canal, made by Professor Eaton in 1822 and 1823. A report of this survey, consisting of 160 octavo pages, with a profile section of rock formations from the Atlantic Ocean, across the states of Massachusetts and New York, to Lake Erie, was published in 1824. In relation to this work Governor Seward, in his introduction to the "Natural History of the State of New York," said: "This publication marked an era in the progress of geology in this country. It is in some respects inaccurate, but it must be remembered that its talented and indefatigable author was without a guide in exploring the older formations, and that he described rocks which no geologist had, at that time, attempted to classify. Rocks were then classified chiefly by their mineralogical characters, and the aid which the science has since learned to derive from fossils, in determining the chronology and classification of rocks, was scarcely known here and had only just begun to be appreciated in Europe. We are indebted, nevertheless, to Professor Eaton for the commencement of that independence of European classification which has been found indispensable in describing the New York system." He also said: "Professor Eaton enumerated nearly all the rocks in western New York, in their order of succession; and his enumeration has, with one or two exceptions, proved correct. It is a matter of surprise that he recognized, at so early a period, the old red sandstone on the Catskill mountains, a discovery the reality of which has since been proved by fossil tests."

Such was the man chosen by Stephen Van Rensselaer to take charge, as senior professor and agent, of the institution which he established in 1824. Eaton's enthusiasm and remarkable powers as a teacher doubtless had their influence in determining him to bear the expense of the series of lectures in towns along the Erie Canal, and afterwards to undertake the creation of the school. And it does not detract from the credit of the founder to say that the methods and the object of the institution, as set forth in his letter to Dr. Blatchford, were, if not wholly, at least partly due to its first senior professor.

The last seventeen years of his life were passed in Troy as senior professor in Rensselaer School or Rensselaer Institute, the name by which it was known after 1833. He died on the tenth day of May, 1842, in the sixty-sixth year of his age. His remains are buried in Oakwood Cemetery in Troy. A great rough-cut granite block, symbolic of his work and character, marks his last resting-place. In the minutes of the board of trustees, of that time, we find this tribute to his memory: "It is but simple justice to say that Professor Eaton was, under its distinguished patron and benefactor, the founder of this school of the natural sciences; that he was a faithful and successful instructor in these studies, and that he contributed, by his labors in the Institute and by his geological survey of the State of New York, more than any other man in our country to the cultivation of geological science. While the trustees consider the experiment, as to the mode of communicating knowledge adopted in the Rensselaer Institute, as a successful one, they are fully persuaded that much of this success is due to the industry and enthusiasm of Professor Eaton. Few men were ever more devoted to the peculiar duties of his profession than he, and his perseverance was equal to his devotedness. His removal may be considered not only as a loss to our city, but to our country."

Eaton was a genius; a man of uncommon intellectual power and capacity for work with very unusual gifts as a teacher and investigator. Reference has been made to his work as a man of science in the field and as an author. He was not less original as a teacher. The unusual method of instruction outlined in the first "regulations" of the founder, and more fully explained at another point in this history, was due to him. He originated the method of instruction by which the student himself experimented and gave lectures and for this purpose he created the first laboratories for the systematic individual work of students themselves to be used in any country. This short sketch of his life will be closed by tributes from men well qualified to judge his work. Rev. Calvin Durfee in his history of Williams College (1860), from which most of this account of the life of Eaton is taken, says: "The history of natural science, on this continent, can never be faithfully written without giving the name of Amos Eaton an honorable place. It was he, more than any other individual in the United States, who, finding the natural sciences in the hands of the learned few, by means of his popular lectures, simplified text-books and practical instructions, threw them broadcast to the many. He aimed at a general diffusion of the natural sciences, and nobly and successfully did he accomplish his mission."

Van der Heyden Mansion, 1834–41

Building on the Infant School Lot, 1844–62

Main Building, 1864–1904

Ranken House, 1877–1910

Charles R. Mann wrote: "Thus the first American Engineering School owed its existence to the fact that a man of rare power as a teacher had been found to conduct it. Following the inspiration embodied in it by Amos Eaton, the Rensselaer School was for forty years a Mecca for teachers of applied science. The published works of Professor Eaton prove that he was also a scientific investigator of rare merit." *

James Hall, of the class of 1832, a pupil of Eaton's, said of him, "a man capable of interesting young men, having a brain one fourth larger than that of the mass of mankind and that brain devoted to the service of science. If we, with great means, do what he did with small, we shall deserve well of coming generations." †

Dr. Ray Palmer Baker in "A Chapter in American Education" says, "Eaton was one of the great figures in the history of science in the United States. . . . An original genius of profound and far reaching intellect." §

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* "A Study of Engineering Education," by Charles Riborg Mann. Published by the Carnegie Foundation for the Advancement of Teaching. Bulletin 11, 1918.

† "Celebration of the Semi-centennial of the Establishment of Rensselaer Polytechnic Institute," 1874. Oration by James Hall, New York State Geologist and Paleontologist.

§ "A Chapter in American Education," by Ray Palmer Baker. Charles Scribner's Sons, New York, 1925.

CHAPTER III

ACT OF INCORPORATION AND EARLY BY-LAWS

SHORTLY after the receipt of Stephen Van Rensselaer's letter, given in the first chapter, the Rev. Dr. Blatchford called together the board of trustees of the new school. The first meeting was held December 29, 1824, and the institution was then named the "Rensselaer School." An outline of the method of instruction to be pursued may be gathered from the minutes of the proceedings of this meeting, during which it was:

Resolved, That persons attending the courses of instruction at Rensselaer School be distributed into three classes, viz.: a Day Class, an Afternoon Class and an Evening Class.

The exercises of the Day Class, for six hours in each day, except Sunday, shall consist of experiments in chemistry, performed by themselves, and in giving explanations, or the *rationale* of the experiments; and they shall undergo daily examinations and alternately become examiners themselves. Each member of this class shall pay $25 a term (as prescribed by the founder in the orders promulgated by him), and at the end of each term shall be examined for his certificate.

The Afternoon Class shall consist of those who may have previously attended one or more courses of lectures on chemistry at some public institution. They will hear no afternoon lectures; but their exercises will consist of a course of experiments in chemistry, performed by themselves, as above, with the *rationale*, conducted under the superintendence of the senior professor. These exercises will occupy three hours in the afternoon of each week-day except Saturday. Each member of this class shall pay $10 a term, and at the end of each term undergo an examination for his certificate.

The Evening Class will attend lectures, on three evenings of each week, for ten weeks. This course of lectures will embrace chemistry, experimental philosophy, and the outlines of mineralogy, geology, botany, and zoology. The charge for attendance will be $5. Members of this class will not be examined at the end of the term, but may have certificates of attendance.*

The opening of the school on Monday, January 3, 1825, was announced by a notice, signed by the president, printed in the Troy *Sentinel* of December 28. The announcement reads, in part, as follows:

The Hon. Stephen Van Rensselaer having established a school near the northern limits of Troy for teaching the physical sciences with their application to the arts of life; having appointed Profs. A. Eaton and L. C. Beck to give courses of instruction particularly calculated to prepare operative chemists and practical naturalists, properly qualified to act as teachers in villages and school districts; having appointed an agent and furnished him with funds for procuring apparatus and fitting up a laboratory, library-room, etc.; and the agent having given notice to the president of the institution that the requisite collections and preparations are completed, it seems proper to give public notice of these circumstances.

Accordingly the public is respectfully notified that everything is in readiness at the Rensselaer School for giving instruction in chemistry, experimental philosophy and

* Troy *Sentinel*, January 4, 1825.

natural history, with their application to agriculture, domestic economy, and the arts; and also for teaching land surveying. . . .

During the day no lectures will be given by the professors, but under their superintendence the students, divided into sections, will perform all the experiments and give the explanations, the students thus acting as lecturers and the professors as auditors. . . .

Students who wish for *extra* accommodations will pay from $1.75 to $2.00 a week for board and lodging. But any number of students can have good plain board and lodging near the school for $1.50 a week.

The courses and methods thus set forth are seen to be those outlined in the letter of the founder, with the orders accompanying it; and the trustees, instructors, and other officers were the persons named by him in the same document. Being at this time a member of Congress, Mr. Van Rensselaer wrote from Washington another letter to Dr. Blatchford, dated February 11, 1825, in which a draft of by-laws for the further government of the institution was enclosed:

WASHINGTON, February 11, 1825.

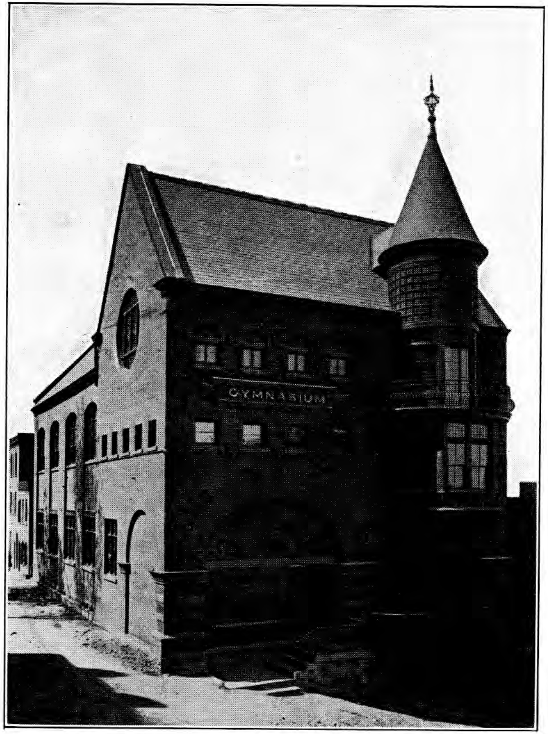
Dear Sir: I offer my acknowledgements for the interest you have taken in promoting the school over which you preside. I have enclosed a draft, hastily drawn up, of by-laws, for the government of the school, which I beg to submit to yourself and the gentlemen associated with you for consideration and amendment. I flatter myself that the school will succeed and that the advantages I anticipated will be realized.

With respect, yours sincerely,

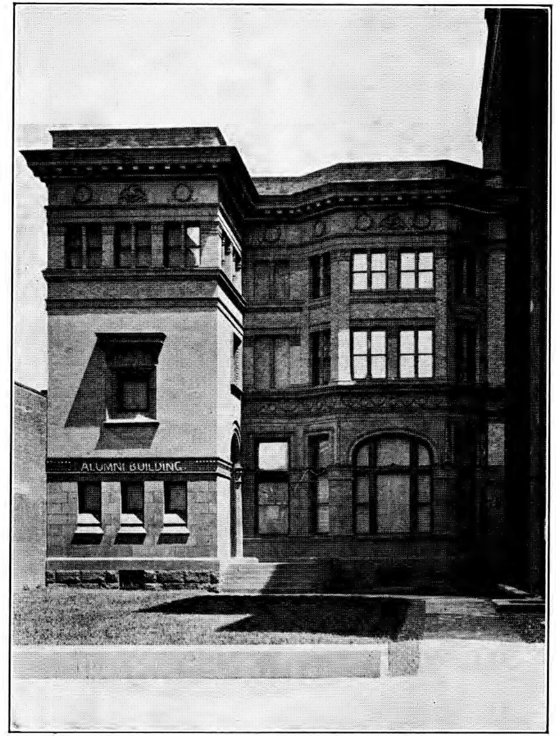
S. V. RENSSELAER.

Winslow Chemical Laboratory, 1866–1902

Winslow Laboratory, 1902–06; Shop, 1907–



Old Gymnasium, 1887–1913
Now the Students' Play House



Alumni Building, 1892–1912

[ENCLOSED DRAFT]

1. That there be two terms in each year, of twelve or fifteen weeks each, to be called the summer term and winter. The summer term to commence in May, the winter term to commence in January—say, the last of May and January.

2. That during the summer term the students shall be taught the elementary principles of the science of chemistry, experimental philosophy, natural history, land surveying, etc., with their application to agriculture, manufactures, and the arts.

3. That, with the consent of the proprietors, a number of well-cultivated farms and workshops in the vicinity of the school be entered on the records of the school as places of scholastic exercise for students, where the application of the sciences may be most conveniently taught.

4. That during the winter term students be exercised in giving lectures, by turns, on all the branches taught in the summer term, under the direction of the professors or their assistants, in order to qualify them for giving instruction in these branches. And that a course of evening lectures be given in the winter term, by the professors, so as to embrace elementary views of the whole course of instruction given at the school.

5. That an annual commencement be held in April at the close of the winter term, for conferring diplomas on those qualified.

This letter, and the previous one from Mr. Van Rensselaer dated November 5, 1824, are important documents in the history of the School. They, with the draft enclosed with the last one, were adopted as its constitution at a meeting of the board of trustees held at the Old Bank Place, March 11, 1825.*

* The Constitution and Laws of Rensselaer School in Troy, New York. Adopted by the board of trustees, March 11, 1825. Printed

After about fourteen months of successful trial the school was incorporated by the following act, passed March 21, 1826:

AN ACT TO INCORPORATE THE RENSSELAER SCHOOL †

Whereas, the honorable Stephen Van Rensselaer has procured suitable buildings in the city of Troy, in Rensselaer county, and therein set up a school, and at his own private expense has furnished the same with a scientific library, chemical and philosophical; instruments for teaching land surveying and other branches of practical mathematics, which are useful to the agriculturist, the machinist, and to other artists, has caused to be prepared and furnished separate and commodious rooms for instruction in natural philosophy, natural history, the common operations in chemistry, and an assay-room for the analysis of soils, manures, mineral and animal and vegetable matter, with the application of these departments of science to agriculture, domestic economy, and the arts: *And whereas,* said Van Rensselaer has employed teachers, and caused an experimental system of instruction to be adopted by them, whereby each student is required to observe the operations of a select number of agriculturists and artists in the vicinity of said school, and to demonstrate the principles upon which the results of such operations depend, by experiments and specimens performed and exhibited by his own hands, under the direction of said teachers: *And whereas,* one important object of said school is to qualify teachers for instructing youths in villages and in common-school districts, belonging to the class of farmers and mechanics, by lectures or otherwise, in the application of the most important principles of experimental

by Tuttle and Richards, 1825. The By-Laws were also printed in this pamphlet together with a description of the library, apparatus, and natural history specimens and an estimate of the cost of board and lodging for the students.

† Laws of the State of New York, 1826, Chap. 83.

chemistry, natural philosophy, natural history, and practical mathematics to agriculture, domestic economy, the arts, and manufactures: *And whereas,* the trustees of said school, who were appointed to take charge thereof, by said Van Rensselaer, by an instrument in writing dated November the fifth, in the year eighteen hundred and twenty-four, have represented to this Legislature, that after having tested the plan of said school by a trial of one year, they find it to be practicable and in their opinion highly beneficial to the public: *And whereas,* the Legislature considers it to be their duty to encourage such laudable efforts and such munificent applications of surplus wealth of individuals: Therefore

1. *BE it enacted by the People of the State of New York, represented in Senate and Assembly,* That Simeon De Witt, Samuel Blatchford, John D. Dickinson, Guert Van Schoonhoven, Elias Parmalee, Richard P. Hart, John Cramer and Theodore Romeyn Beck, shall be and hereby are constituted a body corporate and politic, by the name of "the president and trustees of Rensselaer School," and by that name they shall have perpetual succession, and shall be capable of suing and being sued, pleading and being impleaded, answering and being answered unto, defending and being defended, in all courts and suits whatsoever; and may have a common seal, with power to change or alter the same from time to time, and shall be capable of purchasing, taking possession of, holding and enjoying to them and their successors any real estate, in fee simple or otherwise, and any goods, chattels, and personal estate, and of selling, leasing, or otherwise disposing of the said real and personal estate, or of any part thereof, at their will and pleasure. *Provided however,* That the funds of said corporation shall be used for and appropriated to the objects contemplated in the preamble of this act; *And provided also,* That the clear annual income of such real and personal estate shall not exceed the sum of twenty thousand dollars.

2. *And be it further enacted,* That the said trustees shall, from time to time, forever hereafter have power to make,

constitute, ordain, and establish such by-laws and regulations as they shall judge proper, for the election of the officers and prescribing their respective functions, for the government of the officers and students of said school as to their respective duties, for collecting fines, impositions, and term fees, for suspending, expelling, and otherwise punishing students, so that it shall not extend further than expulsion and retaining term fees, and collecting the amount of any damage done by students to the property of said school; for conferring on students such honors as they may judge proper, having relation to the object of said school as expressed in the said preamble, and for managing and directing all the concerns of said school; also for confirming the constitution and by-laws, or any part thereof heretofore adopted by said trustees, provided such by-laws and regulations have relation to the subjects of the preamble of this act exclusively.

3. *And be it further enacted,* That the officers of said school shall consist of a president, two vice-presidents, a treasurer and secretary, two professors, and such a number of adjunct professors and assistants as the trustees may from time to time appoint or authorize the appointment of, a librarian, monitor and steward. That whenever any vacancy shall happen among the trustees of said school, such vacancy or vacancies may be filled by a quorum of the remaining trustees, so that two trustees shall reside in Albany, two in Troy, two in Lansingburgh, and two in Waterford.

4. *And be it further enacted,* That there shall be one annual meeting of the trustees of said school on the last Wednesday in April, at which meeting four members of the board of trustees shall constitute a quorum, and that four members shall also constitute a quorum at all special meetings, to be called by the president at any time after the passing of this act, provided a written notice of such meeting, signed by the president or by one of the vice-presidents, shall be left at the dwelling-house or place of

residence of such member of the board seven days previous to such special meeting.

5. *And be it further enacted,* That Samuel Blatchford shall be president, and that he, together with all the other officers of the said school, shall remain as heretofore, until a special meeting of a quorum of said trustees shall be assembled at such school, by the president, or by a vice-president, as prescribed in the fourth section of this act or until the annual meeting on the last Wednesday in April next, then to be permitted to continue in their respective offices, or their places to be filled at the pleasure of the trustees.

6. *And be it further enacted,* That the Legislature may at any time modify or repeal this act.*

Upon the passage of the act of incorporation the trustees named in it held a meeting at the school on April 3, 1826, and, after reappointing all the officers who had been serving at the time the bill was passed, they resolved that the constitution previously adopted, consisting of the two letters of Mr. Van Rensselaer, should continue to be the constitution of the school, with certain amendments. These amendments provided that there should be three terms in each year, to be called the fall term, winter term, and spring term; that the fall term should be an experimental term commencing on the third Wednesday in July and continuing fifteen weeks; that the winter term should be a recitation term commencing on the third Wednesday in

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* This Act of Incorporation was amended, from time to time, as will be shown later. As amended, to this date, it is given in Appendix VII; and with it is given a résumé of all Acts of the Legislature relating to the Institute.

November and continuing twelve weeks; that the spring term should be an experimental term commencing on the first Wednesday in March and continuing until the last Wednesday in June, and that the last-mentioned day should be the annual commencement.

At the same meeting a code of by-laws consisting of eleven articles was passed. These replaced the fourteen by-laws, passed March 11, 1825, which are referred to in the new code as "having been intended for the temporary government of the school in its incipient state." Some of these articles which embody the curriculum of that day will be given in full.

Article 1. The course of exercise at said school in the Fall Term shall be, as nearly as circumstances will permit, as follows: Each student shall give five lectures each week on systematic botany, demonstrated with specimens, for the first three weeks, and shall either collect, analyze and preserve specimens of plants, or examine the operations of artists and manufacturers at the school workshops, under the direction of a professor or assistant, who shall explain the scientific principles upon which such operations depend, four hours on each of six days in every week, unless excused by a professor on account of the weather, ill-health or other sufficient cause. For the remaining twelve weeks, each student shall give fifteen lectures on mineralogy and zoology, demonstrated with specimens; fifteen lectures on chemical powers and substances not metallic; fifteen lectures on natural philosophy, including astronomy; and fifteen lectures on metalloids, metals, soils, manures, mineral waters, and animal and vegetable matter—all to be fully illustrated with experiments performed with his own hands; and shall examine the operations of artists at the school workshops, under the direction of a professor or assistant, four hours on every Saturday, unless excused as aforesaid.

Article 2. During the Winter Term students shall recite, to a professor or to a competent assistant, the elements of the sciences taught in the fall and spring terms; and shall study and recite, as auxiliary branches in aid of these sciences, rhetoric, logic, geography, and as much mathematics as the faculty shall deem necessary for studying land surveying, common mensuration, and for performing the common astronomical calculations.

Article 3. The course of exercises in the Spring Term shall be, as nearly as circumstances will admit, as follows: Each student shall, during the first six weeks, give ten lectures on experimental philosophy; ten lectures on chemical powers and on substances not metallic; and ten lectures on metalloids, metals, soils and mineral waters. For the remainder of the term each student shall be exercised in the application of the sciences before enumerated to the analysis of particular selected specimens of soils, manures, animal and vegetable substances, ores, and mineral waters; and shall devote four hours of each day, unless excused by one of the faculty, to the examination of the operations of the agriculturists on the school farms, together with the progress of cultivated grains, grasses, fruit-trees, and other plants, to practical land-surveying and general mensuration, to calculations upon the application of water-power and steam which is made to the various machines in the vicinity of the school, and to an examination of the laws of hydrostatics and hydrodynamics which are exemplified by the locks, canals, aqueducts, and natural waterfalls surrounding the institution.

Article 4 relates to the admission of students. It provides that no candidate shall be admitted as an annual student under the age of seventeen years. The conditions under which examinations are to be held and degrees given are set forth in Article 5.

The degree conferred was bachelor of arts in Rensselaer School, A.B. (r.s.). After the expiration of three years from the receipt of this degree, or of one year, if the student attended a second annual course at the school and proved his capacity, the degree master of arts in Rensselaer School, M.A. (r.s.), was conferred. No degree could be conferred on any one less than eighteen years old; and in using the abbreviation for bachelor or master of arts the letters (r.s.) had to be added. It is provided in Article 6 that, after receiving a degree, a person ever after remained a member of the school, and must, every three years, report his occupation to the trustees. We learn from Article 7 that at this time the tuition was $15 for each experimental term and $6 for the recitation term. The student also had to pay extra for breakage and chemicals consumed and his proportion of the cost of fuel and lights and the services of the monitors. Article 8 relates to weekly reports from professors, Article 9 to the times of meeting of the board of trustees, Article 10 makes void all previous rules and by-laws, and Article 11 provides for temporary rules to be made by the faculty.

Much of the information above given in relation to the founding of the school is taken from the original minutes of the meetings held by the board of trustees and from a pamphlet entitled "Constitution and Laws of Rensselaer School in Troy, New York; adopted by the board of trustees April 3, 1826; together with a Catalogue of Officers and Students," which was published in Albany in

1826. Among "Notices and Remarks" found in it, there is a paragraph containing an itemized account of the necessary expenses of a student. This will be quoted to show the difference between the cost of education at that time and the outlay required at the present day:

The expenses for a student of ordinary prudence will be about $100, if he is absent during the winter term:

Board, 30 weeks at $1.50	$45.00
Washing, about 18 cents per week	5.62
Chemical substances, etc., about	4.00
Proportion of fuel and lights, about	6.00
Text-books, about	4.00
Experimental term fees, $15	30.00
Total	$94.62

The catalogue contains the names of the professors and twenty-five students. Amos Eaton is entitled professor of chemistry and natural philosophy and lecturer on geology, land surveying, etc., and Lewis C. Beck, professor of botany, mineralogy and zoology. Eighteen of the students came from the State of New York, two from New Hampshire, two from Massachusetts, one from Vermont, one from Ohio and one from Pennsylvania. The fact that students were drawn from states, in those days so distant from Troy, is a tribute to the reputation of Eaton, for it will be remembered that this was before the construction of railroads. The Erie Canal had been built, but roads were poor and much of the travelling was done on horseback. Douglass Houghton, of the class of

1829, who came from the western part of New York State, wrote home: "After seven days and nights riding I arrived in Albany almost completely worn out; from that place I came here and presented my credentials on the 14th. The school more than equals my expectations."

CHAPTER IV

METHODS OF INSTRUCTION—PREPARATION BRANCH ESTABLISHED

ALTHOUGH a general knowledge of the mode of instruction pursued at the Rensselaer School may be obtained from the letters of the founder and especially from the by-laws adopted by the board of trustees at the early meetings, the novelty of the system of teaching and the fact that the institution was established at such an early date render advisable a more detailed account of its methods at that time. The peculiarities of the school are described in several of the pamphlets published, under the auspices of the board of trustees, during the first years of its existence. Its three distinct characteristics will be given in the words of one of these publications.

1. The most distinctive character in the plan of the school consists in giving the pupil the place of teacher in all his exercises. From schools or colleges where the highest branches are taught to the common village schools, the teacher always improves *himself* more than he does his *pupils*. Being under the necessity of relying upon his own resources and of making every subject his own, he becomes an adept as a matter of necessity. Taking advantage of this principle, students of Rensselaer School learn by giving

experimental and demonstrative lectures, with experiments and specimens.

2. In every branch of learning the student begins with its practical application, and is introduced to a knowledge of elementary principles, from time to time, as his progress requires. After visiting a bleaching-factory he returns to the laboratory and produces the chlorine gas and experiments upon it until he is familiar with all the elementary principles appertaining to that curious substance. After seeing the process of tanning he enters the laboratory with most ardent zeal for a knowledge of the principles upon which the tanner's operations depend. He can now apply the experiment for making an insoluble precipitate of tannin and animal gelatin, also the soapy compound of animal oil and alkaline earth, etc. After seeing buhr millstones consolidated by a gypsum cement, he is anxious to try the experiment of disengaging the water of combination in the gypsum, to observe the effect of reabsorption. By this method a strong desire to study an elementary principle is excited by bringing his labors to a point where he perceives the necessity of it and its direct application to a useful purpose.

3. Corporal exercise is not only necessary for the health of students, but for qualifying them for the business of life. When such exercises are chosen by students they are not always judiciously selected. Such exercises as running, jumping, climbing, scuffling, and the like are calculated to detract from that dignity of deportment which becomes a man of science. Therefore a system of exercises is adopted at this school which, while it improves the health, also improves the mind and excludes those vulgarisms which are too often rendered habitual among students. Such exercises as land surveying, general engineering, collecting and preserving specimens in botany, mineralogy and zoology, examining workshops and factories, watching the progress of agricultural operations, making experiments upon nutritious matters proper for vegetables in the experi-

mental garden, etc., are made the duties of students for a stated number of hours on each day.

To further illustrate the methods employed an account will be given of the routine work during the three terms which composed the year. Each term was divided into sub-terms three weeks in duration. Students were admitted at the beginning of any sub-term and their annual course was completed at the end of a year from the time they commenced. The exercises were so arranged that it was a matter of indifference at which sub-term they began. The fall term opened on the third Wednesday in July. The first sub-term was devoted wholly to botany, and each student gave fifteen extemporaneous lectures on this subject before his fellow-students and one or more professors. At the end of the first sub-term the class was distributed into four divisions. The first division was placed in the natural history room for one sub-term, the second in the common laboratory, the third in the natural philosophy room, and the fourth in the assay room.

The equipment of these laboratories, as first established, is interesting:

The natural history room is furnished with sufficient specimens for illustrating mineralogy, botany, and zoology, a large furnace, a goniometer, a megascope, a blowpipe, scales, tests, etc., sufficient for investigating subjects in natural history.

The common laboratory is furnished with a cistern, furnace, and everything necessary for performing chemical experiments, excepting those which teach the analysis of metalloids, metals and animal and vegetable matter.

The natural philosophy room is furnished with a small observatory, skylights, mechanical powers, hydraulic instruments, optical instruments, mathematical instruments, pneumatical apparatus, etc., sufficient for demonstrating every principle in experimental philosophy.

The assay room is furnished with skylights, a forge, large bellows, and other conveniences for the analysis of minerals, mineral waters, and animal and vegetable matter.*

Each of the four divisions was wholly employed with the subjects assigned to the room occupied by it during one sub-term. Then all the divisions moved on "in a circle." The first took the place of the second, the second that of the third, the third that of the fourth, and the fourth that of the first. At the beginning of the next sub-term all the divisions moved on in the circle again as before, and so on, until each division had devoted a sub-term to each department.

There was a regular daily routine for the work. The first bell rang at sunrise and the second twenty minutes later. Five minutes after this the students gathered in the reading-room for an examination on the exercises of the preceding day. At nine o'clock a lecture was given by a professor to all of the students, and at ten o'clock the daily assistant, called the officer of the day, gave a lecture before all of them in the presence of the professor. The place of daily assistant was filled by the students in rotation. At the close of the lecture the students criticized his style, manner, and experimental illustrations. Ten minutes after the close of this exer-

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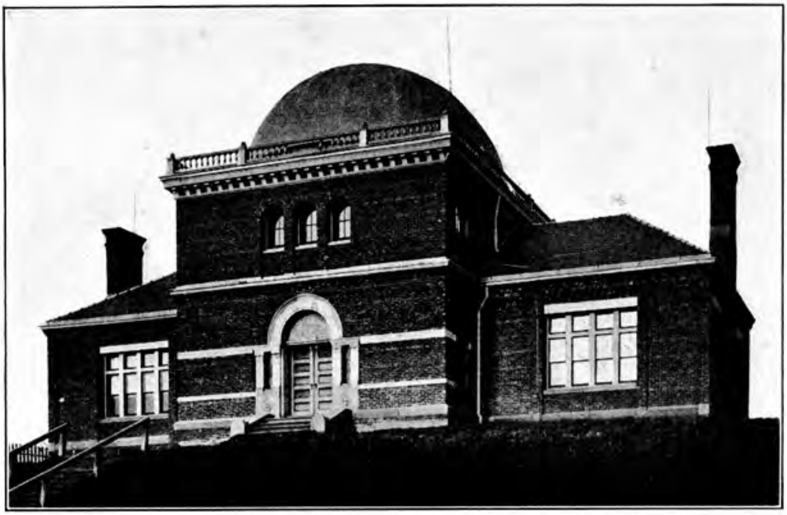
* A more detailed list of this apparatus is given on page 65.

cise, two sub-assistants gave lectures in separate rooms, each before two divisions, in the presence of a professor or assistant. Every one took notes, for use at the meeting held for purposes of general criticism at the close of the exercises of the forenoon. At the expiration of ten minutes from the end of these lectures the four divisions separated, each going to its respective department, where every student in turn lectured before the others and a professor or assistant. They then all met in the reading-room and each criticized all the lectures he had heard. These exercises closed at one o'clock. After dinner the divisions went to their respective departments to prepare for the experiments and demonstrations of the next day. After this preparation, which was generally completed by four o'clock, the students met in the reading-room to receive directions for the "afternoon amusements." They were then arranged in divisions and led by professors or assistants to workshops, factories, etc., "for the purpose of applying the principles of mechanical philosophy and chemistry to the various operations of artists," or to the field to collect plants. Five days of each week were occupied as above described. Every other Saturday, and also Friday and Saturday evenings, were devoted to parliamentary exercises. The students represented the different states and formed a parliament for purposes of debate. On the alternate Saturdays not devoted to debate, after the morning examinations were over, they were free for the rest of the day.

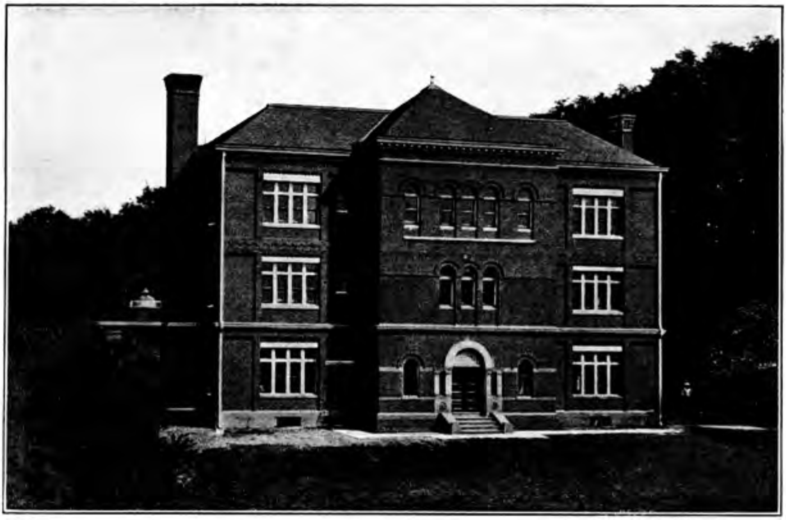
The exercises of the winter term, which was twelve weeks in duration, were conducted on the same plan as that described for the fall term. Rhetoric, logic, etymology, history, geography, and mathematics were taught. The afternoon amusements, adopted according to the state of the weather and without systematic order, were: use of the sextant, compass, goniometer, blowpipe, telescope, and other optical instruments, construction and use of ice lenses and prisms, map-drawing, and the dissection of animals.

The first six weeks of the spring term were devoted to a review of the subjects of the fall term, and the last nine weeks, or three sub-terms, were employed in the practical application of the work of the fall term. Instruction was given in the analysis of selected specimens of minerals, mineral waters, soils, manures, and animal and vegetable matter, animal and vegetable physiology, origin and nature of the nutritious substances necessary for the growth of plants, microscopic examination of the structure of organized substances, principles of astronomical calculations, with practical application to eclipses and matter found in the common almanac; taking latitude and longitude, lunar observations, etc. The afternoon amusements for the last nine weeks were: collecting and preserving plants, animals, and minerals; land surveying and levelling; calculating water pressure in locks, aqueducts, mill flumes, dams, raceways, penstocks, and pumps; applying the principles of "mechanical philosophy" to the machinery of steamboats, mills,

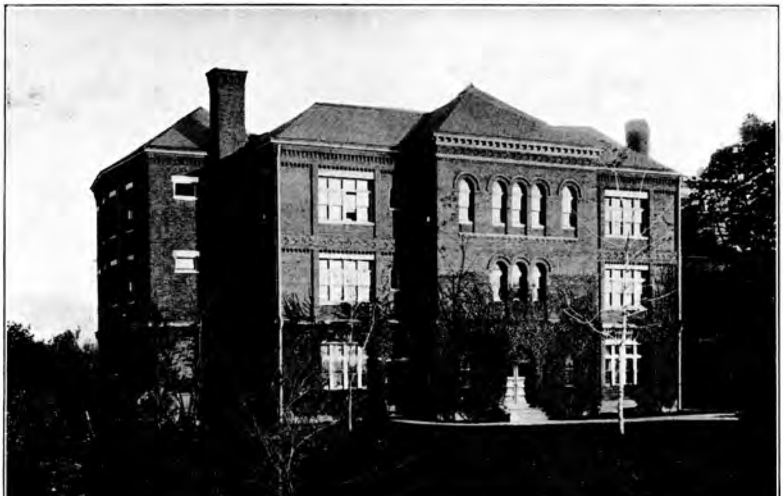


Proudfit Observatory, 1878–1900

Proudfit Laboratory, 1900–03



Proudfit Laboratory, 1903–04



Proudfit Laboratory, 1904–

factories, etc.; application of mathematics to cask and ship gauging and to other cases of practical mensuration; examination of the progress of agricultural and horticultural operations; application of active substances to plants in the experimental garden, such as the strong acids and alkalies, the various gases, free and combined, and the effects of the atmospheric gases where all other active agents are excluded.

Examinations were held at the end of each term; and at the annual examinations in June candidates for degrees gave lectures on the application of the sciences to the common purposes of life. Degrees were conferred annually on the last Wednesday in June.

The system of instruction thus outlined was undoubtedly novel in certain particulars. Its author or authors stoutly maintained that this was the case. Claims for its originality were made in a number of the early circulars. It is believed that Professor Eaton was responsible for the composition of most of these. We find under the head of "remarks," in a prospectus issued in 1827: "It will appear from a perusal of this pamphlet that this school is not Fellenbergian nor Lancastrian, but is purely *Rensselaerean.* The unwillingness to admit the *possibility* of an American improvement in the course of education which generally prevails, and the universal homage paid to everything European, has caused much effort to trace the Rensselaerean plan to some supposed shade of it on the other side of the Atlantic. Hitherto these invidious efforts have totally failed." Also: "These principles have now been practically applied for three years, to the full satisfaction of the patron and trustees. The method of teaching by lectures is original; though Capt. Basil Hall, of the British Navy, who is now making a tour of the United States, told me that Professor Pillans, of Edinburgh, had accidentally fallen upon that method in some degree, though he had received no account of this school, and that he set a high value upon it." Again, in a circular issued in 1833 there appears the paragraph: "It is well known that numerous colleges (literary and medical), academies, male and female seminaries, etc., now adopt the experimental method to a greater or less extent. Their not acknowledging the origin of these improvements can never affect the feelings of the patron. It is sufficient for his purpose that the cause of education is improved and improving by his silent efforts, without show or loud pretentions."

Eaton's method of teaching was certainly original. He was the *first one to provide systematic individual instruction by means of laboratories used by students themselves.* The method of instruction, for which Eaton was surely responsible, given in Order 7 and Order 8 of the first letter of the founder dated November 5, 1824, page 9, *required* the use of laboratories and *required* the student himself to use them. In fact, in his final examinations his qualifications were estimated by the facility with which he performed experiments. And these laboratories were well supplied with apparatus for individual use. This is shown by the list of apparatus given on page 45 and also, in more detail, on page 65.

The creation of laboratories for the individual systematic use by students themselves is considered of importance. This has been claimed both for Liebig at Giessen and also by Lord Kelvin for Professor Thomas Thomson of Glasgow, for chemical laboratories, and Lord Kelvin believed that he had originated the first laboratory of this kind for the teaching of physics. None of these claims is correct. Eaton originated the first laboratories of this nature not only for systematic instruction in chemistry and in physics but in botany and in zoology as well. More complete and detailed information on this subject is given in Appendix I.

The method of instruction pursued by Eaton was certainly neither that of Lancaster nor that of Fellenberg, though it had points of similarity to both. His "officer of the day" performed some of the duties of the monitor in the Lancastrian system, both having charge of the classes for a certain period of the day; but here the similarity between the two methods ended. A short sketch of Fellenberg's efforts in the cause of education will indicate the difference between his schools and that of Van Rensselaer. Both men were actuated by the same motives—the education of those who could not afford to pay much for the privilege.

Emanuel de Fellenberg was a Swiss nobleman who, after taking part in the public affairs of his country during its occupation by the French, determined to devote his life and fortune to the instruction of the poor. In 1799 he purchased an estate at Hofwyl, in the canton of Berne, upon which he established his schools for this purpose. His "Agricultural Institution" or "Poor School" was founded in 1808. The fundamental principles in its government were the employment of agriculture for the moral education of the poor and the defrayment of the expense of their education by means of their own labor. About the same time a school of "Theoretical and Practical Agriculture" for all classes was formed. These were very successful, and he soon afterwards commenced the formation of a normal school or seminary for teachers at his own expense. Forty-two teachers of the canton of Berne came together the first year and received a course of instruction in the art of teaching.

In 1827 he established his "Intermediate or Practical Institute," designed for the children of the middle classes of Switzerland. The course of instruction included all the branches which were deemed important in the education of youths not intended for the professions of law, medicine, or theology. The pupils belonged to families of men of business, mechanics, professional men, and persons in public employment whose means did not allow them to give their children an education of accomplishments. In addition to an ordinary scholastic course all the pupils were employed two hours each day in manual labor on the farm, in a garden plot of their own, in the mechanic's shop, and in household offices, such as taking care of rooms, books, and tools.* It is evident, therefore, that a marked difference existed between any of Fellenberg's institutions and the Rensselaer School.

The practical demonstration of the success of the system adopted in the experimental school determined the patron and trustees to extend its usefulness by the establishment of what was called a "preparation branch," to accommodate those who were disqualified for entrance to the school proper either by want of education or because they were under seventeen years of age. It was a preparatory school for the regular course, and the exercises were of the same character though more elementary than those of the latter. A special laboratory was provided for this class. The studies to be pursued and other information relating to it were given in a circular dated September 14, 1826, which will be quoted in full.

PREPARATION BRANCH RECENTLY ESTABLISHED AT RENSSELAER SCHOOL

From a respect for the frequent solicitations of many gentlemen in the Southern States, and of some in the Northern, and from a desire expressed by the patron, to see the results of an extension of his plan, a *preparation branch* was this day established at this school, to go into operation on the third Wednesday in November.

The following is an outline of the Plan

1. The original method of instruction which has produced such unexpected results, called the Rensselaerean method,

* *American Journal of Education,* Henry Barnard, Vol. III, Hartford, 1857.

will be extended to this branch; to wit, that of exercising the student, on the forenoon of each day, by causing him to give an *extemporaneous dissertation* or *lecture* on the subject of his course, from concise written memoranda; and to spend the afternoon in *scholastic amusements.*

2. The circle of instruction is divided into five parts; and to each part is attached a course of *summer* and *winter* afternoon amusements. The following order will be observed in the fall and winter terms. In the spring term it will be inverted.

First Division. BOTANY and ETYMOLOGY. (The latter branch will extend to so much knowledge of the structure of the Latin, Greek, and French languages as will enable the student to trace scientific terms to their themes, which are derived from those languages.) AMUSEMENTS. For *summer.* Collecting and preserving minerals, plants, and insects. For *winter* none, as this division will not be studied in the winter.

Second Division. GEOGRAPHY and HISTORY. AMUSEMENTS. For *summer.* Selecting specimens for illustrating the physiology of vegetation, and examining them under the common, and the solar, microscopes, and making drawings of their internal structure. For *winter.* Each making a globe of plaster of Paris, and drawing the chief subjects of geography upon it.

Third Division. Elements of PRACTICAL MATHEMATICS and of MORAL PHILOSOPHY. AMUSEMENTS. For *summer.* Land-surveying, taking the latitude, and performing simple hydraulic experiments. For *winter.* Making and using a set of mechanical powers, exercises in percussion with suspended balls, gauging, measuring cordwood and timber.

Fourth Division. LOGIC and RHETORIC. AMUSEMENTS. For *summer.* Experimenting upon the most common gases, as oxygen (obtained from vegetables by the action of light), nitrogen, hydrogen, carbonic acid (with its combination in soda-water), testing their specific gravities, etc., and experimenting upon aqueous exhalations—all to be performed with apparatus made with their own hands. For *winter.* Making and using galvanic batteries and piles, electrometers and magnets; and disengaging combined caloric by compression and affinity.

Fifth Division. Elementary principles of GOVERNMENT and LAW, and PARLIAMENTARY RULES. AMUSEMENTS. For *spring* and *fall.* Constructing dials, fixing meridians, constructing and using air-thermometers and hygrometers, taking specific gravities, using the blow-pipe and constructing the three elementary musical chords to illustrate the science of tones. For *winter.* Making camera-obscura boxes; producing focal images by a pair of common burning glasses and ice lenses, and illustrating the microscope and telescope by the same; illustrating the laws of refraction and reflection by cheap mirrors and vessels of water, and separating the colored rays by ice cut into triangular prisms.

Candidates are admitted to the preparation branch who are deemed of sufficient discretion for going through the course, provided they have been successfully taught in reading, writing, common arithmetic, and English grammar. The Faculty of Rensselaer School are to judge upon their qualifications; but the Trustees have, in the second article of the by-laws of this branch, expressed an opinion that "the age of thirteen or fourteen years, and upwards, is best adapted to this course."

EXPENSES. *Tuition,* $1.50 for every three weeks, which constitutes a step in the circle. Students may enter either step in the circle at the commencement of every three weeks, reckoning from the beginning of each term. The terms or sessions of this branch correspond with the other terms of the School. *Board,* in commons with the other students, never to exceed $1.50 per week. Rooms will be furnished at or near the school, to be under the inspection and control of the faculty, at a small expense. No charge is made for the use of public rooms, library, chemical and philosophical apparatus, tools of the workshop, or the cabinet. And each student will attend the daily lectures of the

Professors, free of charges. A student of strict prudence may pay all his expenses for the 42 weeks in each year, at this branch, with $120, as follows: Tuition, $21; board, $63; fuel and lights, $10; washing and lodging, $10; text books, $6; amusement apparatus, $10.

As this circular may fall into the hands of some who have not read the new code of by-laws passed April 3d, 1826, and the legislative act of incorporation, passed March 21st, 1826, it may be advisable to state as follows:

The Rensselaer School was founded by the Honorable Stephen Van Rensselaer, solely for the purpose of affording an opportunity to the farmer, the mechanic, the clergyman, the lawyer, the physician, the merchant, and in short, to the man of business or of leisure, of any calling whatever, to become *practically scientific*. Though the branches which are not taught here are held in high estimation, it is believed that a school attempting every thing makes proficients in nothing. The Rensselaer School, therefore, is limited to an EXPERIMENTAL COURSE in the NATURAL SCIENCES. The studies of the preparation branch are extended no farther than is necessary, as auxiliaries to the experimental course.

The FALL TERM commences on the third Wednesday in July, and continues 15 weeks.

The WINTER TERM commences on the third Wednesday in November, and continues 12 weeks.

The SPRING TERM commences on the first Wednesday in March, and continues until the last Wednesday in June; which is the day of the annual commencement.

EXPENSES. All the same as in the preparation branch, with the addition of double the charge for tuition in the fall and spring terms, on account of the great additional labor required for teaching the student to perform with his own hands about sixteen hundred experiments in chemistry and natural philosophy. But students who have gone through a course in the preparation branch with success will not be required to attend the winter term. This will reduce the necessary expenses to about $95 for the whole experimental course.

Many unsuccessful attempts have been made to render science amusing to the youthful mind. They have generally proved very unprofitable, by diverting the attention of the student from literary pursuits, and by creating an attachment to useless, and often demoralizing, sports. By the plan adopted at this school, the objections to scholastic amusements are effectually obviated; and it will appear, by this circular, that those have been selected which will give due exercise to both body and mind. The muscular powers of the body will be called into action, and their forces will be directed by mental ingenuity, until the student becomes familiar with the most important scientific manipulations, and particularly with those which will be most useful in the common concerns of life.

The Rensselaerean scheme for communicating scientific knowledge had never been attempted on either continent, until it was instituted at this school, two years ago. Many indeed mistook it, at first, for Fellenberg's method; but its great superiority has now been satisfactorily tested by its effects. As the *experimental school,* as well as the *preparation branch,* were founded solely for the public benefit by its disinterested patron, it is the particular desire of the trustees, that its excellences should be understood and imitated at other schools, as set forth in a former circular. Like other useful inventions, much expense was required for making the first experiment. Fortunately for science, the trial has been fairly made at the expense of many thousands, advanced by a single individual. Now it may be followed, in its chief advantages, by every school district; while the parent school at Troy will prepare competent teachers.

By order of the Trustees.

SAMUEL BLATCHFORD, *President.*

RENSSELAER SCHOOL, TROY, N. Y., Sept. 14, 1826.

CHAPTER V

THE NAME CHANGED TO RENSSELAER INSTITUTE. REMOVAL TO THE VAN DER HEYDEN MANSION

IT HAS been seen that from its beginning an essential part of the educational system of the school consisted in an examination of workshops and factories in the neighborhood of Troy and in botanical and geological excursions in its immediate vicinity. It was determined to extend such excursions to more distant points in order to afford better facilities for the practical study of mineralogy and geology. At a meeting of the board of trustees held February 12, 1827, a by-law was passed requiring each student to make "a tour of about three weeks along the transition and secondary district of the Erie Canal immediately after commencement and across the primitive district in an eastern direction immediately after the close of the fall term." In a circular of six pages, written by Amos Eaton, entitled, "Rensselaer School Flotilla for the Summer of 1830," the program of a proposed travelling tour for that year is given in detail. It was to begin on the twenty-third of June and to last ten weeks. Students taking it were to meet at the dock at the lower end of Cortlandt Street in New York City and to proceed by steamboat to Albany, whence a flotilla of canal-boats was to take them through the Erie Canal to Lake Erie. They were to return by the same route. Daily lectures were to be given in the morning, and in the afternoon botanical and geological excursions were to be made. The boats were to move slowly so that specimens could be obtained at any point along the route. There is a list of twenty-nine places to be visited, Trenton Falls, Niagara Falls, and Lockport being included. This trip was not obligatory, and in succeeding publications three excursions which might be substituted for it are enumerated: one to the Connecticut River, one to the Helderberg, and the third to Carbondale, Pennsylvania, and Amboy, New Jersey.

At this time the total cost of attendance for one year, including excursions, was said to be $230, though it was observed that a young gentleman of tolerable economy could reduce this to $170.

At the trustee meeting to which reference has just been made there was also added to the curriculum the requirement that students should speak extemporaneously once a week during the winter term and twice a month during the other terms.

At the same time the first "Prudential Committee," consisting of the president and two trustees, was appointed. Succeeding boards have retained this committee, which has the power to perform, between the regular meetings of the board, such duties as can not properly be delayed.

To increase the usefulness of the institution further, the faculty were authorized, May 24, 1827, to establish district branches in any part of the state when application was made and assurance given by responsible persons that suitable rooms and sufficient apparatus would be supplied. The object was to accommodate those who wished to be educated and yet were unable to leave home for the whole or even a part of the year. It was provided that the branch students were to be taught that part of the annual course which did not require expensive apparatus; "for more than three-fourths of an experimental course of scientific instruction may be taught with apparatus worth but one hundred dollars; whereas the remaining fourth requires apparatus worth three or four thousand dollars." Should they desire, they might then come to the school, and after devoting nine weeks to that part of the course requiring expensive apparatus, they would be received as candidates for the Rensselaer degree on an equal footing with those who had spent the whole year at Troy.

Complete directions for introducing experimental science in academies and common schools were also given at this time. Besides information in relation to the regular work to be pursued, advice was given regarding the "amusements." Under this head occurs the clause: "A level sufficiently accurate may be made by any one, with the cost of a spirit-level tube of but a few shillings' value. Such students may then be taught the general outlines of civil engineering, land surveying, etc., in lieu of mischievous tricks, degrading contortions called gymnastics, and profane language." The circular from which this quotation is taken was dated September 19, 1828. There is added to it a note in which we are informed that forty mechanics, members of the Mechanics' Institute of Troy, placed themselves under the direction of the Rensselaer School during the winter of 1827, and that most of them became tolerably proficient in experimental chemistry as applied to the arts and manufactures. They were not regular members of the school but paid one of the professors to teach them.

All these efforts show the active interest displayed by the founder and the officers of the school in the extension of the experimental system and the diffusion of scientific knowledge. To extend still further the benefits of the institution, Mr. Van Rensselaer, while in the House of Representatives, wrote from Washington the following letter to the president of the Institute. It was dated December 31, 1827:

Dear Sir: I take the liberty of suggesting to you and the trustees the propriety of offering the school (over which you preside with so much dignity and usefulness) to the Legislature, to educate teachers, as proposed by Governor Clinton in his message at a former session of the Legislature—perhaps an amendment to the charter, extending the power of the trustees to change the location of the School, if they deem it necessary.

Nothing having come from this suggestion, he caused, in 1828, an invitation to be given to each county of the state to furnish a student, selected by the clerk of the county, for gratuitous instruction at Troy. This invitation was accepted by nearly all the counties. The students thus instructed were required to teach the experimental and demonstrative method in their own counties for a period of one year.

The authorities of the school seem also to have had, for those days, advanced ideas in regard to the education of women, for we find, as an addendum to a circular dated October 29, 1828, the following

Notice by A. Eaton, in His Private Capacity

At the urgent solicitations of several judicious friends, a lady, well qualified for the duty, will take charge of two experimental courses in chemistry and natural philosophy, in each year, for ladies: similar to the courses proposed for gentlemen in the annexed circular. They will be nine-week courses, at the same times and for the same charges. But no extemporaneous lectures will be required, excepting of those ladies who wish to prepare for giving instruction.

And in the minutes of the board there is a copy of a letter from Professor Eaton to the examiners, dated February 11, 1835, in which he requests them to give an informal examination to eight young ladies, who had been instructed for one quarter in practical mathematics, "so far as to be enabled to draw a fair comparison between the study of speculative geometry and algebra as generally practised in female seminaries and this mode of applying mathematics to the essential calculations of geography, astronomy, meteorology, necessary admeasurements, etc." The examiners complied with his request and were highly gratified at the progress made by the class.

It may be explained that all examinations, in the early period of the school's history, were made by boards composed of three to six qualified persons appointed by the trustees. None of the members of these boards was connected with the school.

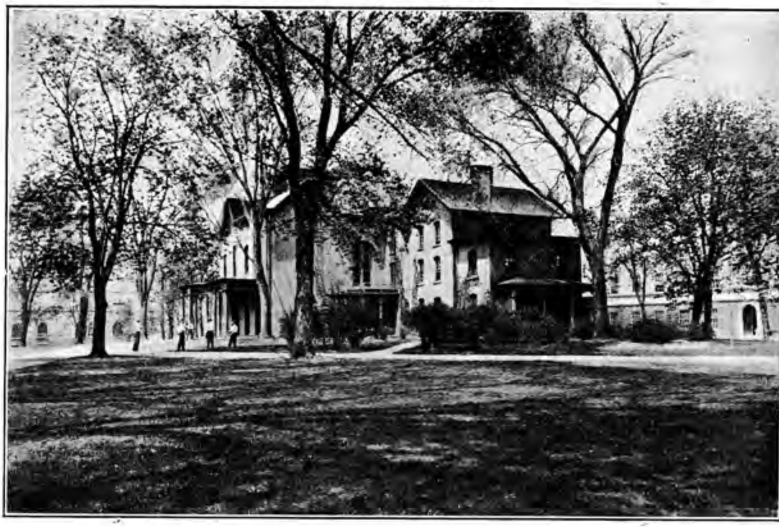
Professor Eaton's pronounced opinions upon the educational methods generally pursued in schools for young men have been illustrated in preceding pages. These extended to the education of women as well, and the manner in which he expressed them was quite as forcible in the one case as in the other. He remarks, at the end of a printed synopsis of the mathematical course for the year 1834–5: "The waste of time in many female schools, by the fashionable mummery of algebra, half-learned and never applied, has caused many to ascribe the failure in mathematics to the perversion of female genius, when it is drawn from elegant literature, music, painting, etc., to the severe sciences. The true cause is to be found in parsimony, which excludes competent teachers, badly selected subjects and wretchedly compiled text-books. Our country is inundated with wild schemes of learning; while the speculating book-sellers are sending their harpie-like pedlars to rob our youth of the last fragments of common sense."

Although by the year 1829, after a trial of four years, it had been conclusively proved that the experimental and demonstrative method, as they called it, was successful as a system of instruction, the institution had not been self-supporting. Its founder paid each year more than one-half of its expenses. This was becoming burdensome to him, and he signified to the trustees his desire to discontinue it, and especially his intention of discontinuing the gratuitous education of county students after October, 1829. He did not, in fact, cease to contribute to the support of the school, but in consequence of this declaration it was "farmed out" in November, 1829, to Amos Eaton for a period of one year. He was constituted the "Agent" of the trustees to transact all the pecuniary business of the institution, which, however, was to remain under the control of the board. He relinquished all claim for compensation, and in consequence was authorized to receive and expend all moneys at his discretion and to retain all profits for his own benefit. An inventory of the property was made and he was permitted to use it for purposes of instruction. This arrangement was continued for one year only, as he terminated it in September, 1830, although he still acted as agent and retained his position as senior professor.

In spite of pecuniary embarrassments, improvements were continually being made both in the instruction and the equipment of the laboratories. The prospectus for the eighth annual course shows that in 1831–2 the year had been divided into seventeen sub-terms of three weeks each, of which, however, three, called "reading terms," might be used either to visit friends or for a course of reading in the library. The fifteenth and sixteenth

Carnegie Building, 1906–

Russell Sage Laboratory, Front View, 1909–



Warren Residence. Dormitory, 1905– 1935

Students' Club House, 1908–1932

sub-terms were occupied in the travelling tours to which reference has been made.

During the morning exercises of the year, each student had to give one hundred and eighty extemporaneous lectures, upon which he was closely criticized. These lectures were illustrated by about twelve hundred experiments performed by himself, and by "suits" of minerals, plants, and animals.

At this time the equipment included a reading-room, a natural history room, a philosophy room, and three laboratories. Considerable additions had been made to the apparatus as described in the circulars of 1826. The philosophy room now contained an air-pump, a force-pump, barometer, thermometers, pluviometer, solar microscope, megascope, standing microscope, magic lantern, telescope, lenses, convex and concave mirrors, prisms, electrical machine, galvanic battery, electromagnetic instruments, magnets, sextant, theodolite, compass and chain, mechanical powers, hydrostatic bellows, hydrostatic and hydraulic cylinders and tubes, hydrometers, and glass pumps.

The laboratories were furnished with the necessary forges, furnaces, bellows, lead-pots, Argand lamps, common lamps, iron retorts, or gun-barrels for gases, anvils, anvil hammers, cisterns, pipes for conducting gases from the barrels, gas-pistol, iron stand, iron mortar, and mercurial bath.

In the meantime, the Rev. Samuel Blatchford, after earnest and successful labor in behalf of the school, died March 27, 1828, and was succeeded by the Rev. John Chester, a clergyman of Albany, who was appointed June 25, 1828. His term was a short one, however, as he was compelled, on account of ill health, to resign in about six months. He was succeeded by the Rev. Eliphalet Nott, appointed September 2, 1829, who was at the same time president of Union College.

During the first seven years of its existence the school had been situated at the corner of Middleburgh and River streets, in the building formerly occupied by the Farmers' Bank, and known, at the time of its establishment, as the Old Bank Place. Partly because it had not yet become self-supporting and partly because it was, in some respects, not conveniently situated, it was determined to obtain authority from the Legislature to change its location if satisfactory arrangements could be made. An act was consequently passed April 26, 1832, which gave the trustees power, after October 23, 1832, if the patron consented, to remove to the site of the Greenbush and Schodack Academy, in the town of Greenbush, in Rensselaer County, and to unite with this academy if its trustees consented. In this case the united institution was to be called the Rensselaer Institute. If, however, the patron or the trustees of the academy objected, the trustees of Rensselaer School were given authority to remove the institution, after the consent of Stephen Van Rensselaer had been given, to any part of Rensselaer County and to continue as an experimental and classical school under the name of the Rensselaer Institute.

The inquiries and negotiations made in relation to the removal to Greenbush were not satisfactory, as may be seen from the following letter written by the patron to the Rev. Dr. Nott and read at a meeting of the board of trustees held November 18, 1833:

ALBANY, November 18, 1833.

To the President and Trustees of the Rensselaer School:

Gentlemen: Sufficient provision for the support of said school not being offered to its location at Greenbush, according to the first section of the amendment of April 26, 1832, I feel bound in duty to object to its removal to Greenbush. But under present circumstances, I cheerfully consent to a removal to the Van der Heyden mansion, or to any other suitable building near the central part of said city of Troy.

Respectfully your humble servant,

S. V. RENSSELAER.

Among the by-laws passed at this meeting was one by which the name of the school was changed to the "Rensselaer Institute," which was to include an "experimental and classical department." At the same time, the scholastic year was divided into two terms instead of three, the winter term, sixteen weeks in duration, to commence on the third Wednesday in November; and the summer term, of twenty-four weeks, to begin on the last Wednesday in April. Each term was divided into subterms of four weeks each. It was also resolved to remove to the Van der Heyden mansion in or before April, 1834. This building was selected on account of its size and convenience of access. It was situated on the southwest corner of Eighth and

Grand Division streets, and the removal took place in April, 1834.

During the occupation of the Old Bank Place the number of students at any one time had never exceeded and was generally less than twenty-five. The number of teachers was regulated by the number of students, one being assigned to each section of five or six. The triennial catalogue for 1832–3–4 gives a list of twenty-five instructors who had already been connected with the school. The small number of students was partly due to the standard required for entrance to the regular course; at one time twelve of the twenty-five present were graduates or members of colleges. In the notices for the ninth annual course, 1832–3, during the time that the change of location was being considered, it is remarked: "None are received but those whose minds are disciplined to habits of study. Hence it is that the patron has already advanced over twenty-two thousand dollars in support of the school for eight years. To improve the plan of education is his object; not to establish a school at any particular location. Therefore, patronage is not asked. These terms are printed, not for the benefit of the school, but for the benefit of those who wish to profit by the improvements made by trials which cost the patron many thousands."

The first clause of the preceding quotation could hardly have referred to the junior members of the school, in the Preparation Branch; as Rule 8 of the by-laws of 1835 reads: "In case of any disobedience of any juniors to orders of teachers, after being particularly called to obey, it shall be the duty of said professor to lay hands on such disobedient student and remove him from the premises, or confine him (in such a manner as to cause no personal injury) for a time not exceeding two hours. But no beating or flagellation shall in any case be permitted at the Institute."

CHAPTER VI

ESTABLISHMENT OF THE DEPARTMENT OF CIVIL ENGINEERING

THE preceding pages show that the original intention of the founder was to establish a school for the diffusion of scientific knowledge, and that his object more particularly was to disseminate among farmers, mechanics, and the poorer classes generally information in relation to the application of scientific principles to their various occupations which would enable them to improve their material condition. At the same time, the management of the institution was of too broadminded a character to permit its benefits to be confined to any particular branch of practical science, and, although many of those who had up to this time been graduated afterward became eminent in various departments of pure and applied science, the renown of the school is principally due to the work of its alumni in the field of engineering—a course in which was about to be added to the curriculum.

Some of the principles of certain branches of the science now broadly called civil engineering had been known, of course, since the earliest historical times. Besides various branches of natural science some of these principles were taught, in this country, in the early-founded schools and colleges to which reference already has been made. They were taught, also, in the Military Academy at West Point, which was established in 1802, though it was a school in name only until its reorganization after the War of 1812. No school of civil as distinguished from military engineering, however, had yet been established in any English-speaking country, although on the continent of Europe a number of technical institutions had been founded, most of which were maintained partly or wholly at the expense of the state. The École des Ponts et Chaussées was established in France as early as 1747, though it did not become of importance as a school for engineers until a much later period, and the Königliche Sächsische Bergakademie (Freiberg) was founded in 1765. Among other continental technical schools of early date which afterwards became well known may be mentioned the École Polytechnique (Paris, 1794), a school of general science, having for its principal object the preparation of students for several special government technical institutions, including the School of Bridges and Roads above mentioned; the Polytechnisches Institut (Vienna, 1815), intended for the education of engineers, architects, and manufacturers; and the Königliches Gewerbe Institut (Berlin, 1821), which at the time of its foundation and for twenty-five years thereafter was, as its name indicates, a trade rather than an engineering school. The Technische Böhmische Ständische Lehranstalt (Prague) came into existence in 1806.

Beside these, which depended largely upon government aid, a private institution, the École Centrale des Arts et Manufactures (Paris, 1829), attained prominence as a school of engineering immediately upon its establishment. Before 1835 a few other technical schools of less importance, containing trade-school features, had been founded in the German states.

The continental schools of science antedated those of Great Britain. Among the English schools in which scientific instruction was early given, may be mentioned University College, London, which was opened in 1828 under the name of the University of London, and King's College, London, established by royal charter in 1829. In the University of London engineering subjects were first taught in 1840, and in the same year a chair of civil engineering and mechanics was established by Queen Victoria in the University of Glasgow. The School of Engineering in Dublin University (Trinity College) was founded in 1842. The other well-known British schools of science were established at still later dates. Among them are Owens College, Manchester (1851); the Department of Engineering in the University of Edinburgh (1868); the Royal Indian Engineering College, London (1871); and Mason College, Birmingham (1875).

Although science and some branches of engineering were taught in the early foreign schools, at the time of the foundation of Rensselaer School there were few engineers other than military engineers. The term civil, in distinction from military, engineer had been coined during the last quarter of the eighteenth century, it is believed by Smeaton,* but it did not come into general use until about the end of the first quarter of the nineteenth century. Of course, there had been inventors and constructors of genius throughout all the ages. Great ruins on more than one continent attest the skill of forgotten engineers. During the Renaissance, Brunelleschi, Michael Angelo, and the great Leonardo da Vinci lived and builded, and for the later period about which we have been speaking such names as Smeaton and Watt and Fulton come to our minds. But these men had not had an engineering education in the schools.

There were no schools of engineering in the United States because civil engineering had hardly yet been recognized as a profession. A consideration of the condition of the country and of the state of scientific knowledge as applied to the constructive arts towards the beginning of the nineteenth century shows why this was the case. In comparison with the European states, in which the early schools of science above mentioned had been established, the country was new and sparsely settled. In the year 1800 the total population of the United States was only 5,300,000. In the same year the State of New York contained 589,000 and New York City only 60,000 inhabitants. In 1830 the country had 12,866,000 inhabitants, New York

* Address of J. C. Inglis, president of the Institution of Civil Engineers of Great Britain, November 2, 1909. Published by the Institution, London, 1909.

State had 1,919,000, and New York City 203,000. Troy was a village of 1,800 people at the former period; in 1830 this number had increased to 11,500. Methods of communication were primitive, and travelling was expensive.

No canal of considerable length (and canals were the first engineering works of great magnitude to be built here) was begun until after the conclusion of the second war with England, that of the Schuylkill Coal and Navigation Company, 108 miles in length, being commenced in 1816 and finished in 1825. Others in Pennsylvania were commenced about the same time, and both the Erie and Champlain canals were begun in 1817. By the end of the first quarter of the century about 1,400 miles of these waterways had been built; but no steam railroads existed, locomotives not becoming practically successful until about 1830. The first ones used weighed only three or four tons, although in the years 1836–7 Baldwin of Philadelphia built eighty weighing from nine to twelve tons each.

Steam navigation was in a more forward state: the *Clermont,* a steamer one hundred and thirty-three feet in length, built by Fulton and Livingston in 1807, having made the trip up the Hudson River from New York to Albany in thirty-two hours. A steam ferry-boat ran between Jersey City and New York in 1812, and in 1815 there were steam-boats running between New York and Providence. In the year 1830 there were eighty-six steamers on the Hudson River and Long Island Sound. The first steamship to cross the Atlantic was the *Savannah,* of 350 tons, built at Corlears Hook, New York. However, the engines were used only eighteen out of the twenty-five days required for the passage from Savannah to Liverpool, and sails had to be depended upon for the remainder of the trip. It was not until 1838 that the transatlantic voyage was made wholly by steam. In this year the *Sirius,* of 700 tons, crossed from Cork to New York in nineteen days, and the *Great Western,* of 1,340 tons, made the passage from Bristol to New York in fifteen days.

In the early days of the country the small amount of power required for manufacturing purposes was obtained principally from wind- and water-wheels. Of the latter, undershot, overshot, and breast wheels were employed; and Francis says that until 1844 high breast wheels were considered the most perfect water-wheels that could be used. Although Fourneyron had erected his first turbine, in France, in 1827, and Elwood Morris of Pennsylvania had shortly afterwards built and put two of them in operation in this country, other wheels of this type were not used here until about the middle of the century. Boyden designed his turbine in 1844; and the Manufacturing Companies at Lowell, which had begun to improve the water-power of the Merrimac in 1822, purchased the right to use it in 1849.

The practical application, in Great Britain, of the steam-engine to pumping water from mines led to the introduction of the first one of any size ever used in America. All its principal parts were imported from England, and a mechanic was sent over to erect and run it. It was put together in 1763 at the Schuyler copper-mine on the Passaic River, a few miles above Newark, New Jersey. Frederick Graff says * that in 1803 there were in use in the United States six steam-engines beside the one referred to above: two at the Philadelphia water-works, one just about being started at the Manhattan water-works in New York, one in Boston, one in Roosevelt's sawmill in New York, and quite a small one used by Oliver Evans to grind plaster of Paris, in Philadelphia. The first steam-engine built in America is said to have been constructed in 1772 by Christopher Colles for a distillery in Philadelphia, but it was very defective. Those of the Philadelphia water-works were built in 1800 at the Soho Works of Roosevelt, near Newark, New Jersey. From this time onward the application of steam as a source of power for manufacturing purposes increased with the demands of the times. Improvements—dictated by experience, for little was known of the theory—were continually made, and by the middle of the century the various types had assumed practically the proportions used at the present time.

One of the first tunnels built in the United States was on the Allegheny Portage Railroad in Pennsylvania. It was built in 1831 and was 900 feet long. The Black Rock tunnel on the Reading Railroad was built in 1836. It was 1,932 feet long.

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* Notice of the Earliest Steam-engines used in the United States, by Frederick Graff, in *Journal* of the Franklin Institute, 1853.

In 1820 one of the first cast-iron water-mains in the country was laid for the Philadelphia water-works.

Bridges of wood and stone had, of course, been built almost from the time of settlement of the country. Some of the former were of long span and reflected the greatest credit upon the genius of their constructors, who, however, had only empiric methods of proportioning the parts. Palmer, Burr, and Wernwag were the most noted builders at the beginning of the century. The Piscatauqua bridge, built by Palmer, near Portsmouth, New Hampshire, included an arch span 244 feet in length; and his Schulykill River bridge had two arch spans 150 feet and one 195 feet long. Between 1804 and 1808 Burr built his Waterford, Trenton, and Schenectady bridges, with spans ranging from 150 to 203 feet, and, from 1812 to 1816, the Harrisburg bridge, with twelve spans of about 210 feet each. Wernwag built his "Colossus" over the Schuylkill at Philadelphia in 1812. The span was 340 feet. Town patented his lattice truss in 1820; Howe's patent was not taken out until 1840. The era of iron bridges did not begin until 1840. Between 1796 and 1810 Finley had built a number of small suspension bridges of chain cables; and in 1810 Templeman replaced the 160-foot span of Palmer's Essex-Merrimac bridge by one of chain cables. Paine's memoir on cast-iron bridges was printed in 1803, and Canfield took out the first patent for an iron truss bridge in 1833; but the first iron truss bridge built in this country is believed to be the one erected in 1840 by Trumbull over the Erie Canal at Frankford.* In the same year Whipple built his first iron bridge.

The few historical facts above given serve to indicate the condition of engineering science at the period of the school's history which we are now considering. Although many of the fundamental principles of applied mechanics were known as well then as now, the development of the science, particularly in its application to structures and machines for the production of useful work, had taken place largely upon empiric lines. Most of the eminent men to whom this development had been due were self-taught—mechanics whose results had been obtained by successive experiments and with little knowledge of the resistance of materials or of the principles of the design of engineering constructions as practiced today. And if with these conditions there are taken into consideration the comparative smallness of the population and its extended geographical distribution, the wise forethought and liberality of mind displayed by the authorities of the school in establishing at such an early date a department of civil engineering will be thoroughly appreciated.

In the pamphlet published in March, 1825, giving the constitution and laws of the school, an outline of the course of study was printed among the by-laws. This included instruction in land surveying, mensuration, measurements of the velocity of flow

* "American Railroad Bridges," by Theodore Cooper, in *Transactions* of the American Society of Civil Engineers, July, 1889.

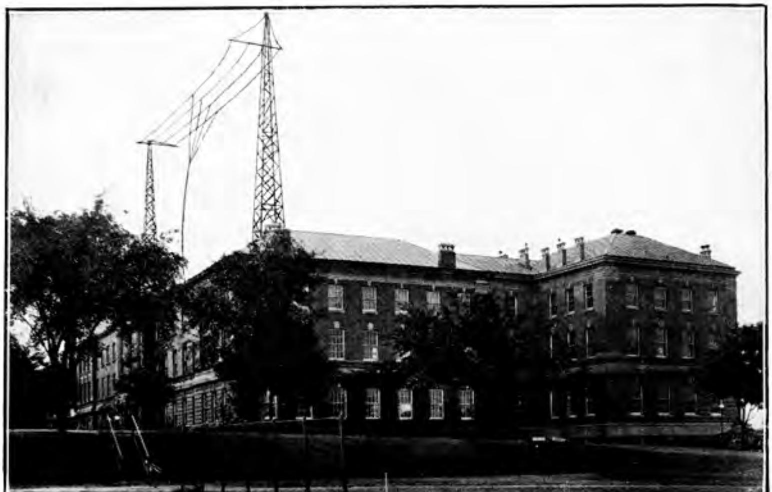
of water in rivers and aqueducts, and other subjects now to be found in the curriculum of a course in civil engineering. These by-laws were elaborated in the circular of April, 1826, and Article 3, printed on page 39 of this history, shows that instruction was given in hydrostatics and hydrodynamics, including calculations upon the application of water-power, as well as steam, to various machines. The catalogue published in 1828 gives the duties of the senior professor. Besides other subjects he was required to give lectures on land surveying and civil engineering. This is the first appearance of the term "civil engineering" in any of the circulars, and no well-defined course in the subject was formulated for several years. In the "Notices for the Eighth Annual Course" (1831–2), to which reference has previously been made, the first sub-term, beginning November 16, was devoted to "Practical Mathematics, including mensuration applied to land surveying, timber and cordwood measure, excavations, docks, etc.," and the second sub-term, from December 7 to December 28, to "Trigonometry, Navigation and the elements of Civil Engineering." The fifteenth and sixteenth sub-terms, from September 12 to October 24, were occupied in the "application of Engineering and Natural History to the occurrences of four travelling tours—to Connecticut River, to the Helderberg, to Carbondale coal beds and to New Jersey." These quotations include all references to the subject; and in the "Notices" for the ninth annual course civil engineering is not specifically mentioned, though this was an octavo circular containing only three printed pages.

In 1833 the curriculum in the experimental department contained "Practical Mathematics, including Surveying, Engineering, Navigation, Latitude and Longitude, etc., from the 3rd Wednesday in November, 12 weeks." In the original minutes of the board of trustees we find a record of the examinations of fourteen students in surveying and in engineering. These were held February 11 and 12, 1834.

Up to this time the degree of bachelor of arts, A.B. (r.s.), was the only one conferred by the institution, and although the course in engineering had been gradually developing it had not yet been differentiated from that in general science. Preparatory to the separation of these two branches the Legislature was petitioned to amend the charter of the school. This was done by an act dated May 9, 1835. The second section of this law reads as follows: "The said board of trustees shall have the power to establish a department of mathematical arts, for the purpose of giving instruction in engineering and technology, as a branch of said institute; and to receive and apply donations for procuring instruments and other facilities suitable for giving such instruction in a practical manner, and to authorize the president of said institute to confer certificates on students in said department in testimony of their respective qualifications for practical operations in the mathematical arts."

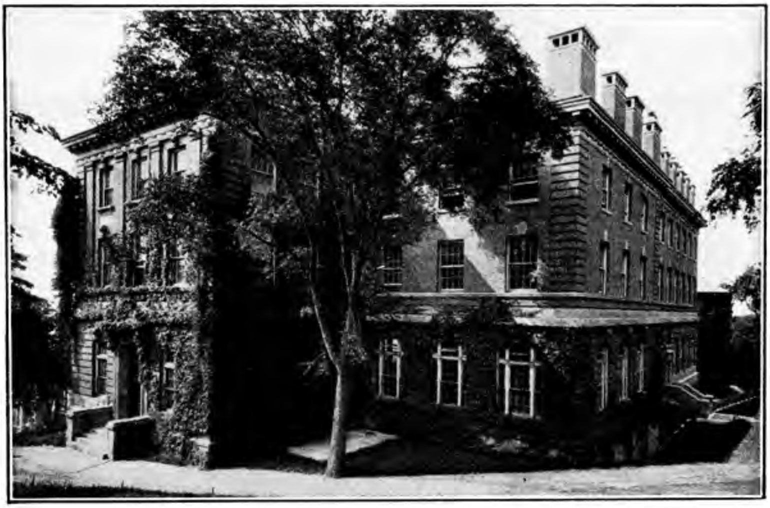
At a meeting of the board of trustees held May

Russell Sage Laboratory, Rear View; Boiler House, 1908–



Addition to Russell Sage Laboratory, 1924–

Walker Chemical Laboratory, 1906–



Addition to Walker Laboratory, 1921–

22, 1835, their number was increased, in accordance with a provision of the above-mentioned act, by the addition of the mayor, recorder, and alderman of the Fourth Ward of the city of Troy; and it was resolved that "A department of Mathematical Arts is hereby established as a branch of the Institute for the purpose of giving instruction in Engineering and Technology." At the same meeting it was decided that the degree of bachelor of natural science, B.N.S., should thereafter be conferred instead of bachelor of arts, and that graduates in the department of mathematical arts should receive the degree of civil engineer. Also that "no one shall receive the last-mentioned degree until he shall have been regularly disciplined at this school at least two quarters, after being well taught in elementary mathematics here, or elsewhere."

The first class in civil engineering was graduated in 1835. The first four candidates for the degree were recommended in the following letter from the examiners, dated October 14, 1835:

To the Revd. E. Nott, D.D., President:

We have examined Edward Suffern, William Clement, Jacob Eddy, and Amos Westcott as candidates for the degree of Civil Engineer. We find them acquainted with the theory of practice. But as this is the first class proposed to be graduated, their own honor and the honor of this institution demand great caution in conferring degrees. We therefore recommend as follows: that they receive the degrees but that the diplomas be left with the Secretary until the President shall receive satisfactory certificates that they have reviewed their text books (outlines Gregory), that they can read algebraic equations, and have a general knowledge of Perspective generally.

A. R. JUDAH, *Chairman.*
P. H. GREEN, }
HARVEY WARNER, } *Examiners.*

By this time a complete curriculum in civil engineering had been established. It was printed in a circular which will be given in full, as it is believed to be the first prospectus of a school of civil engineering ever printed in English. It is well worth perusal, not only because the curriculum outlined contains much information regarding the most advanced scientific instruction given in this country at that period, but also because the concluding paragraphs throw a curious light upon the expenses of students and the general requirements necessary for graduation.

NOTICES OF RENSSELAER INSTITUTE

TROY, N. Y., October 14, 1835
[Being the answer to letters of inquiry.]

HON. STEPHEN VAN RENSSELAER, Patron, with the right to appoint the Annual Board of Examiners.

ACTING FACULTY

Rev. E. NOTT, D.D., President—also President of Union College.

Judge DAVID BUEL, Jr., Vice President.

AMOS EATON, Senior Professor, and Professor of Civil Engineering; also holding the Agency and Supervision of the Institute.

EBENEZER EMMONS, Junior Professor.

JAMES HALL, Professor of Chemistry and Physiology.

Assistants—Edward Suffern and D. S. Smalley.

Instruction, wholly practical, illustrated by Experiments and Specimens, is given 40 *weeks in each year.* Five days in each week the forenoon exercises are from 8 A.M. to 1 P.M.

WINTER SESSION commences the third Wednesday in November, and continues 16 weeks. During the first 12 weeks, each forenoon is devoted to practical Mathematics, Arithmetical and Geometrical. This is a most important course for men of business, young and old. During the last 4 weeks of the Winter Term, extemporaneous Speaking on the subjects of Logic, Rhetoric, Geology, Geography, and History, is the forenoon exercise. Throughout the whole session the afternoon exercises are Composition, and in fair weather, exercises in various Mathematical Arts. A course of Lectures on National and Municipal Law is given by the Senior Professor.

SUMMER SESSION commences on the last Wednesday in April, and continues 24 weeks: ending with Commencement.

Students of the Natural Science Department are instructed as follows:

Three weeks, wholly practical Botany, with specimens.

Four weeks, Zoology, including organic remains; and Physiology, including the elements of Organic Chemistry.

Three and a half weeks, Geology and Mineralogy, with specimens.

Three weeks, traveling between Connecticut River and Schoharie Kill, for making collections to be preserved by each student, and exhibited at examinations; also for improving in the knowledge of Natural History and Mathematical Arts.

Ten weeks, Chemistry and Natural Philosophy.

Half a week, preparing for examinations and Commencement.

The afternoons of all fair days are devoted to Surveying, Engineering, and various Mathematical Arts—also to

Mineralizing, Botanizing, and to collecting and preserving subjects in Zoology.

Students of the Engineer Corps are instructed as follows:

Eight weeks, in learning the use of Instruments; as Compass, Chain, Scale, Protractor, Dividers, Level, Quadrant, Sextant, Barometer, Hydrometer, Hygrometer, Pluviometer, Thermometer, Telescope, Microscope, etc., with their applications to Surveying, Protracting, Leveling, calculating Excavations and Embankments, taking Heights and Distances, Specific Gravity and Weight of Liquids, Degrees of Moisture, Storms, Temperature, Latitude and Longitude by lunar observations and eclipses.

Eight weeks, Mechanical Powers, Circles, Conic Sections, construction of Bridges, Arches, Piers, Rail-Roads, Canals, running Circles for Rail-Ways, correcting the errors of long Levels, caused by refraction and the Earth's convexity, calculating the height of the atmosphere by twilight, and its whole weight on any given portion of the Earth, its pressure on Hills and in Valleys as affecting the height for fixing the lower valve of a Pump; in calculating the Moon's distance by its horizontal parallax, and the distances of Planets by proportionals of cubes of times to squares of distances.

Four weeks, in calculating the quantity of Water per second, etc., supplied by streams as feeders for Canals, or for turning Machinery; in calculating the velocity and quantity effused per second, etc., from flumes and various vessels, under various heads; the results of various accelerating and retarding forces of water flowing in open raceways and pipes of waterworks, and in numerous miscellaneous calculations respecting Hydrostatics and Hydrodynamics.

Four weeks, study the effect of Steam and inspect its various applications—Wind, as applied to Machinery; also Electro-Magnetism—inspect the principal Mills, Factories, and other Machinery or works which come within the province of Mathematical Arts; also, study as much Geology as may be required for judging of Rocks and Earth concerned in construction.

Fees for instruction, including all Lectures, Experiments, etc.; also for use of Instruments, Apparatus, Library and Specimens, $4 for each sub-term of four weeks. No student received for less than a sub-term. No extra charge excepting $8 for the course of Experimental Chemistry, where each student gives a course of experiments with his own hands.

Students furnish their own fuel, light, and text-books. Each boards where he pleases; but the Professors will aid strangers in the selection of boarding houses. A small number of strangers are boarded at the School at $2 per week; they furnishing their own bedding, washing, etc.

The Rensselaer degree of Bachelor of Natural Science is conferred on all qualified persons of 17 years or upwards. The Rensselaer degree of Civil Engineer is conferred on candidates of 17 years and upwards, who are well qualified in that department. This power was given to the President, by an amendment to the Charter, passed last session of the Legislature. Candidates are admitted to the Institute who have a good knowledge of Arithmetic, and can understand good authors readily, and can compose with considerable facility.

After a trial of two seasons, it is found to be inexpedient to enter young lads in the regular divisions, before they have sufficient pride of character to govern their conduct when preparing for their exercises in the absence of a teacher; arrangements will, therefore, be made for having a teacher always present with them, when they are not in the immediate charge of a Professor or Assistant.

Students in any one department have the right to attend one Experimental Lecture each day in the other departments, free of expense.

One year is sufficient for obtaining the Rensselaer degree of Bachelor of Natural Science, or of Civil Engineer, for a candidate who is well prepared to enter. Graduates of

Colleges may succeed by close application during the 24 weeks in the Summer term.

Candidates may commence the course at the beginning of any sub-term; but the third Wednesday of November to be preferred, unless the candidate is a graduate of a regular College or otherwise well instructed in general Mathematics and Literature. In such cases the last Wednesday in April is the most suitable time of entering. His theoretical views may then be reduced to practice during the Summer course.

The degree of Master of Arts is conferred after two years of practical application.

Gentlemen wishing to learn the outline of the terms of the Rensselaer Institute are requested to pay postage on their letters; and they will receive this printed notice. If this appears to be a *"narrow notice,"* I will state that I paid $54.28 in one year in postage for letters on others' business: some for our school course, more for advice about mines, minerals, and visionary projects.

AMOS EATON, *Agent.*

RENSSELAER INSTITUTE, Troy, Oct. 14, 1835.

A better understanding of the scope of the instruction given about this time may be obtained from an examination paper covering the work of the winter term in the department of mathematical arts. This was submitted to fifteen students; and the results of the examination are given in a report of three examiners, dated February 23, 1836. There were fifty-three questions, which will be found in Appendix II.

A "Periodical Notice" of Rensselaer Institute dated 1838 and 1839 is addressed "To Principal Engineers and Commissioners of Rail-Roads, Canals, Topographical Surveys, Milling-Works, Water-Works, etc. Also, to Teachers of Scientific Institutions, where practical instruction is required, in Chemistry, Geology, Botany, etc." Several paragraphs from it are quoted as follows:

This Institute has been in full operation for fourteen years. It has furnished numerous practical men in the above departments, including Geological Surveyors, etc., to many States of the Union, to the West Indies, Mexico, Peru, Chili, etc. . . .

As Engineering Schools are advertised in many cities, villages, etc., where the instruction promised does not agree, in scarcely a single item, with what is understood by the officers of this Institute to be essential to the Engineer, it seems to be a duty to state definitely what qualifications are demanded of students, to entitle them to certificates in particular departments, and to full degrees in Civil Engineering. . . .

Practical civil engineering, according to the meaning attached to the expressions at this Institute, includes all the above qualifications,* *at the very least.* Students are taught all these things and many others, with the appropriate instruments in their hands, accompanied by short lectures of their own. And still they find themselves in need of years of labor in the field as assistants, before they are willing to come forward as *chief engineers.* How other schools manufacture engineers, as set forth in various advertisements, is a mystery not yet developed here.

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* The qualifications referred to in the second paragraph, twenty-three in number, are given in Appendix II.

CHAPTER VII

REORGANIZATION OF THE SCHOOL. THE RENSSELAER POLYTECHNIC INSTITUTE

THE fourth act of the Legislature relating to the Institute was passed May 8, 1837. It permitted the Troy Academy to be revived and united with the school. The new institution was to be named the Rensselaer Institute and was to consist of two separate branches, one to be called the department of experimental science and the other the department of classic literature. No such combination resulted, however. By the same act the school was made subject to the visitation of the regents of the university of the state and was declared to be entitled to the same privileges, government funds, and other advantages as the academies, colleges, and other schools of the higher order when it complied with the terms required by law and the rules of the regents.

At a meeting of the trustees held September 25, 1841, the prudential committee was empowered to place the institution under the supervision of the regents. Nothing was done in this direction, however, and on April 30, 1845, this committee was again authorized to consider the question. An application dated January 29, 1846, which contained a complete inventory and valuation of the property, was accordingly presented, and, in consequence, on the fifth of February of the same year the school was made subject to the visitation of the regents, being classed as an academy until after its reorganization in 1849–50. Annual reports were made for eight years, and during this time it received a small amount of money, $744 in all, as its share of the literature moneys distributed to the academies of the state. In 1854 the authorities declined to make further reports, on the ground that the school had little in common with the academies. They were again made in 1869 and 1870, the institution being then classed as a scientific school. Another is found in the Report of the Regents for 1880, and since 1882 they have been made annually. They are now compulsory.

Upon the removal of the Institute, in May, 1834, from the Old Bank Place to the Van der Heyden mansion, for which a five years' lease was made, the patron caused a laboratory and study rooms to be built upon its grounds in order to provide proper facilities for the students. After his death, which occurred January 26, 1839, the lease was renewed for two years. During this period the school suffered by the mutilation and final destruction, under the orders of the road commissioners of Troy, of the buildings erected by Mr. Van Rensselaer, and, as the agent of the property refused to restore them, at the expiration of the lease on May 1, 1841, a return to its original location was effected. Its second occupation of the Old Bank Place was only three years in duration.

In 1843 the infant school lot situated on the northeast corner of State and Sixth streets, with a frontage of one hundred feet on Sixth Street and of ninety-eight feet on State Street, was offered as a gift by the city to the trustees, with the condition that William P. Van Rensselaer, a son of the founder, should give to the institution a sum of money equal to the value of the property. There was upon the lot a brick building fifty by thirty feet in size which was valued at $2,500. The property was appraised at $6,500, and, the condition being accepted by Mr. Van Rensselaer, was deeded to the trustees June 1, 1844. The $6,500 in money thus obtained was invested as a permanent fund, and at the same time $1,260 was raised by subscription for the purpose of building a laboratory. This was a one-storied brick building fifty by twenty-six feet in size, and was built upon the lot in 1844. It cost $1,150. In the same year these two buildings were occupied by the school.

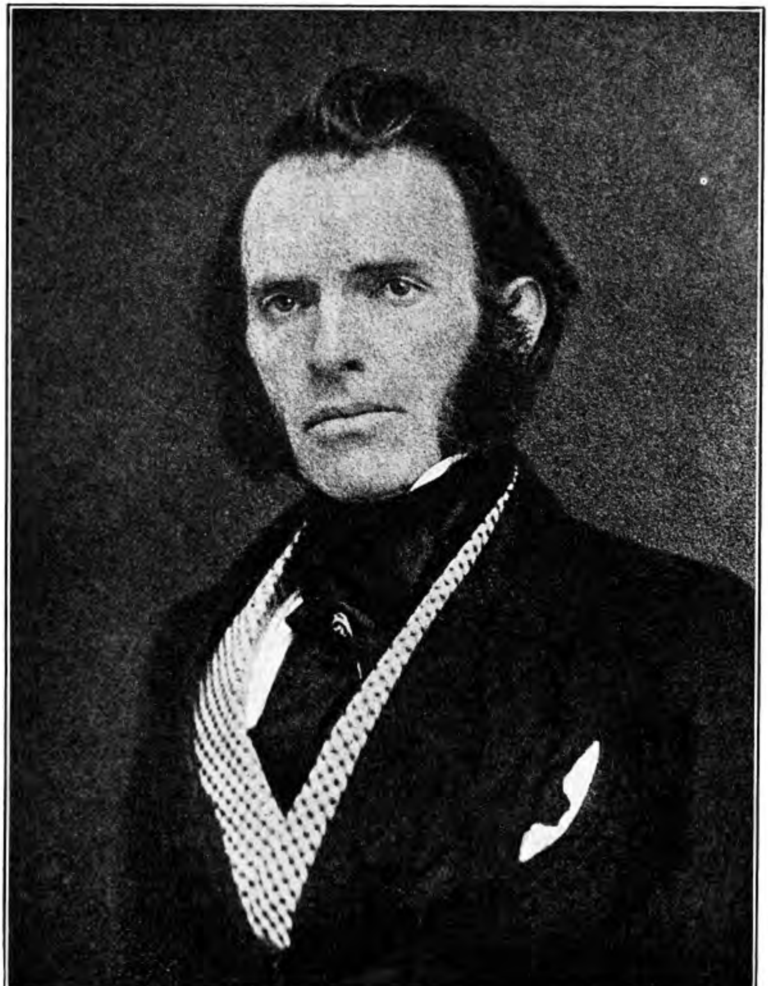
In the complete inventory contained in the application to the regents made January, 1846, the buildings and lot were valued at $7,650; the library of three hundred and ninety-six volumes at $973.45, and the surveying instruments, apparatus, and specimens at $537.63. The money in possession of the trustees amounted to $6,690, so that the total estimated value of the property of the institution was $15,851.08. The total debts at the same time amounted to $1,050.

In the catalogue for the thirty-fifth semi-annual session, published in 1841–2, during the second occupancy of the Old Bank Place, is given a list of students for the years 1839, 1840, and 1841, with their ages and addresses. During these three years there were seventy-seven students, most of whom came from the State of New York. Twelve of them, however, came from Connecticut, Maryland, New Hampshire, New Jersey, Pennsylvania, Tennessee, Vermont, and Canada. Their ages varied generally between seventeen and twenty-five years, the average being twenty years. The list for the years 1840, 1841, and 1842, given in the catalogue of 1842–3, contains the names of seventy-five students of whom ten were not residents of the state. One of them came from the territory of Wisconsin. During the next few years, until the extension of the course of study, the number varied between thirty-five and sixty-five annually, with an average age of about nineteen years. These numbers include students, of whom there was always a considerable number, who took partial courses and stayed only part of the year.

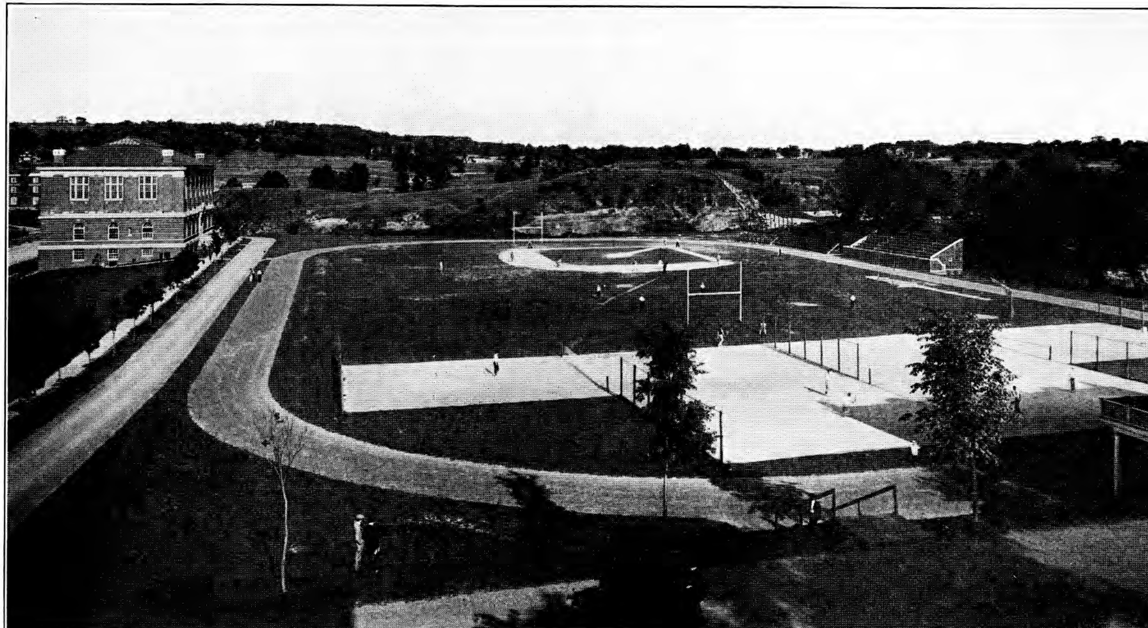
Amos Eaton having died May 6, 1842, George H. Cook, of the class of 1839, afterwards widely known for his work as state geologist of New Jersey, was appointed senior professor and agent, September 19, 1842. He had previously been appointed assistant professor in March, 1840; adjunct professor of civil engineering in October, 1840, and professor of chemistry, mineralogy, and zoology in September, 1841. His duties as senior professor included the delivery of courses of lectures on geology, chemistry, and civil engineering. After somewhat extending the courses of study he resigned in 1846. His resignation was accepted by the board of trustees, with resolutions of regret, at a meeting held November 30, 1846, and on the same date B. Franklin Greene, professor of mathematics and natural philosophy in Washington College, Maryland, was appointed senior professor. He was graduated from the Institute in the class of 1842 with the degrees of civil engineer and bachelor of natural science, and had been teaching at Washington College since 1843. In assuming the duties of senior professor he became at the same time professor of mathematics and physics.

In the meanwhile the resignation of Dr. Nott had been accepted April 30, 1845, and Rev. Dr. N. S. S. Beman, who had been vice-president since 1841, was elected president in his place.

The acceptance of the direction of the Institute by B. Franklin Greene marks an epoch in the history of the school. With the exceptions of its founder and Amos Eaton, it owes more to him than to any other person. Up to this date the course had been one year in duration, and although this length of time spent at the school did not necessarily insure the acquirement of either of the degrees, which were given only after satisfactory examinations had been passed, the average student who came reasonably well prepared could complete either of the courses in this period. After a careful study of the scientific and technical institutions of Europe, Professor Greene thoroughly reorganized the curriculum. This reorganization, which



B. Franklin Greene
Director of the Institute, 1847–1858



'86 Athletic Field and '87 Gymnasium, 1912–

included a material enlargement of the course of study and the requirement of a more rigid standard of scholarship from candidates for degrees, took place in the years 1849–50.

Professor Greene, who in the meanwhile had become director of the institution when that office was created by act of Legislature in 1850, published in 1855 a pamphlet of eighty-seven pages, entitled "The Rensselaer Polytechnic Institute. Its Reorganization in 1849–50; Its Condition at the Present Time; Its Plans and Hopes for the Future." This, as its title indicates, was descriptive of the reorganization. Quotations from it will show more clearly the character of the changes and the intentions of the authorities:

> The managers of the Institute therefore resolved that *their field should be narrowed and more thoroughly cultivated;* that, indeed, their educational objects should be restricted to matters immediately cognate to Architecture * and Engineering; that, moreover, for a somewhat irregular and for the most part optional course, requiring but a single year for its accomplishment, they would substitute a carefully considered curriculum which should require at the least three full years of systematic and thorough training; and that, finally, they would demand the application of the strictest examination tests to the successive parts of the course prescribed, not only in respect to the translation of students from lower to higher classes, but, especially, in all cases of ultimate graduation with professional degrees. It was in accordance with such views as these that, in

* *He developed a curriculum for a course in architecture forty years before the establishment of the courses in the universities of Pennsylvania, Harvard, and Columbia.* Want of funds alone prevented its establishment.

1849–50, this institution was wholly reorganized upon the basis of a general polytechnic institute, when it received the distinctive addition to its title, under which it has since been more or less generally known. Its objects were thenceforward declared to be "The education of architects and civil, mining, and topographical engineers, upon an enlarged basis and with a liberal development of mental and physical culture."

But it is proper to remark that, with the comprehensive statement and formal announcement then made, of what was proposed to be the future work of the Institute, there was associated in the minds of its managers no immediate expectation of realizing more than a very partial development of their plans, with the comparatively limited resources in *matériel* of every kind at their command. Accordingly it was resolved that, of the entire Institute curriculum, they would at first proceed to develop the General Course—the common scientific basis of the four professional courses—and the two specialties of Civil and Topographical Engineering to as good a degree of excellence as should be practicable under the existing circumstances; while they would defer any attempt to effect the more complete development of their plans, including the important specialties of Architecture and Mining Engineering, to a period when they might hope to be able to invoke effectively the aid of conditions more favorable to realizations so desirable.

As indicated in these extracts, no attempt was made to develop at once all the special technical courses which it was intended to establish eventually. The course in natural science was made two years in length and that in civil engineering required three years. The first year was common to both. The degree given for the former course was bachelor of science, B.S., and for the latter civil engineer, C.E. The highest or senior class was called Division A and the others Divisions B and C. In 1852 a "preparatory class," in which students were fitted to enter Division C, was inaugurated.

An examination of the new curriculum shows the effect upon its formation of the study of the French scientific schools. Its object was practically that of L'École Centrale des Arts et Manufactures, which, in a three-years' course, was intended to train civil engineers, directors of works, superintendents of manufactories, professors of applied science, etc., and the reorganized course bears considerable resemblance to that of the same school. That part of it which forms the groundwork for the higher technical studies also resembles the curriculum of L'École Polytechnique, which, it will be understood, does not furnish a complete system of instruction, but has for its object the preparation of students for entrance to certain government technical institutions.

It was the intention to obtain, as far as the conditions would admit, the same end here in a single school that was obtained in France from L'École Polytechnique and the special schools combined. As a matter of fact, with the same high aim in view, the curriculums of such institutions, wherever situated, must necessarily bear a resemblance to each other. In relation to this subject the circular of February, 1851, informs us that "In the essential features of its design and intentions, the Institute may be said to occupy a position between L'École Polytechnique and L'École Centrale des

Arts et Manufactures, of Paris. It claims no other resemblance to these celebrated and *richly endowed* institutions. To its peculiar mode of study *there is no known counterpart.*"

The mode of study at this time contained the essential features of that which characterized the beginnings of the school. The students took full notes of the lectures delivered by the professors and afterwards studied the subjects by the aid of their notes, their own practical exercises, and books of reference. The next day they were interrogated by the instructors and after the interrogation were divided into small sections which assembled in different rooms. Each student then delivered an extemporaneous lecture upon the subject under consideration, which was afterwards criticized by the other members of his section and by an officer styled a "repeater," who, under the direction of the professor at the head of the department, took charge of the several sections.

The repeaters were generally resident graduates or students who were members of the highest class in the institution. The term seems to have been taken from the name *répétiteur,* given in L'École Centrale to a class of instructors with similar duties. It was used only a few years and appears for the last time in the catalogue of 1859, in which, among twelve instructors, there is found only one, the repeater of mechanics, who was at the same time assistant professor of mathematics. In that of 1855, among eleven instructors there is no repeater. The practice of requiring daily lectures from each student was gradually dropped with the use of this title, and the present method of strict interrogations and of blackboard demonstrations which partake of the nature of the lectures was as gradually introduced. This change was largely and almost necessarily the result of the increased attendance at the school.

The "Notices" of 1835 and the examination questions of the succeeding year, together with the qualifications required of candidates for degrees in 1838 and 1839, all of which are found in the preceding chapter and Appendix II, give a reasonable knowledge of the character of the work done at that period of the school's history. As it is now proposed to set forth the curriculum after the reorganization, it will be well to preface it with the remark that, although the limited time given to the course naturally restricted its value, gradual improvements had been made in the intermediate years, as required by the advances in natural and applied science. In fact, the reorganization itself was not immediately completed. Although it may be said to have taken place in 1849–50, and the courses were extended at this time, a departure, in most respects so decided, from its previous methods necessarily could not be immediately accomplished. By the year 1854 the courses in civil engineering and natural science had been well developed. The curriculums of these courses, taken from the *Annual Register* of that year, give outlines of the subjects studied and the order of their distribution. They will be found in Appendix III.

In the curriculums, as published in the *Register,* after the title of each subject appears a detailed description in an exhaustive schedule. This gives in minute detail the scope of each subject taught and the text-books and works of reference used. It covers forty pages, containing thirty-one main and two hundred and two subdivisions.

Both lectures and text-books were used in most of the courses. Among the text-books may be mentioned: Davies' "Legendre's Geometry," Davies' "Bourdon's Algebra," Chauvenet's "Trigonometry," Church's "Analytical Geometry," Church's "Calculus," Mahan's "Industrial Drawing," Davies' "Shades, Shadows, and Perspective," Davies' "Descriptive Geometry," Jopling's "Isometrical Perspective," Davies' "Surveying," Simms' "Mathematical Instruments," Gummere's "Astronomy," Hitchcock's "Geology," Dana's "Mineralogy," Gray's "Botany," Gregory's "Elements of Chemistry," Mill's "Qualitative Analysis," Fresenius' "Quantitative Analysis," Morfit's "Chemical Manipulation," Bird's "Natural Philosophy," Bartlett's "Acoustics and Optics," Bartlett's "Analytical Mechanics," Weisbach's "Mechanics of Machinery and Engineering," Pambour's "Theory of the Steam Engine," Moseley's "Mechanical Principles of Engineering and Architecture," Morin's "Aide-mémoire de mécanique pratique," Haupt's "Bridge Construction," Mahan's "Civil Engineering," and D'Aubuisson's "Traité d'hydraulique." A list of one hundred and twenty-nine works of reference in English, French, and German is also given.

The practical part of the work of the school included surveys, chemical and physical laboratory work, botanical and geological excursions, visits to factories, etc.

Individual laboratory work for students, continued since the beginning of the school, was of course provided for in the reorganized curriculums. From the catalogue of 1852: "Beside the manipulations requisite to the preparations of general Chemistry and Physics, the student is instructed in the Laboratory, in the processes of chemical manufactures, in connection with excursions to Chemical and other Works for examination and special studies." From the catalogue of 1854: "The remarks made respecting instruction in chemistry apply in similar terms to the courses in general and industrial physics. In both facility in experimental manipulations is regarded as only second in importance to a knowledge of principles—indeed the latter can scarcely be well grasped without a command of the former." And from the same catalogue: "In chemistry and physics, the student is expected to avail himself of the resources of experiment and observation. The study of chemistry with its facts and philosophy is made a school of mental and mechanical training of fundamental importance, not for the acquirement of chemical knowledge, only, but as presenting a most favorable introduction to the general study of experimental science and as constituting an element of preparation essential to success in the *business of research.* To this end each member of the class is furnished with all needful facilities for making his own experimental demonstrations, and is accordingly expected to exhibit them in every lecture he pronounces on these and kindred subjects. Beside the manipulations requisite to the preparations of general chemistry and physics, the student is instructed in the laboratory in the processes of chemical manufactures in conjunction with excursions to chemical and other works, for examination and special studies."

These quotations from the catalogues are made to show Greene's opinions regarding the importance of laboratory work in chemistry and physics and its application to research.

At the time of the reorganization only three schools of engineering, beside Rensselaer Institute, were in existence in the United States: "In spite of the widespread recognition of the need, the Rensselaer Polytechnic Institute remained for twenty-three years the only school of its kind. At length, in 1847, through private benefactions, the Lawrence Scientific School was established at Harvard and the Sheffield Scientific School at Yale. The University of Michigan also voted, that same year, to offer a course in civil engineering. These were the only additional engineering schools opened before the Civil War, and they had a hard struggle for existence because their aims seemed dangerous to academic traditions." *

The curriculums of almost all of the large num-

* "A Study of Engineering Education," by Charles Riborg Mann. Bulletin 11, Carnegie Foundation for the Advancement of Teaching. 1918.

ber of schools of engineering established after the Civil War, largely on account of the passage of the Morrill Land Act by Congress, show evidence of the effect of Greene's influence; almost all of them were similar to those developed by him in 1849–50. Mann in his "A Study of Engineering Education" says of the schools in general, "The present curricula are thus the natural result of two well defined influences: namely, the original curriculum that was imported from France in 1849 by Professor B. F. Greene of Rensselaer, and the phenomenal expansion in science and industry." Greene, however, did much more than "import" the curriculum. He developed the "True Idea of a Polytechnic Institute," different from that of any existing before that time, and it was *such a broad idea that it covered almost all questions since raised in the development of such institutions. His pamphlet is a classic in the history of scientific education in this country.*

At this time applicants for admission were required to be at least sixteen years old. The majority were over eighteen. They were required to be well prepared in geography, English composition, arithmetic including the metric system, plane geometry, and algebra to equations of the second degree.

The first *Register* to appear after the reorganization was a pamphlet of sixteen pages dated August 15, 1851. The second, which was published in October, 1852, contained after the names of the students their grades in the different departments and their class standing. After some of them the letters "d" and "a," meaning respectively "deficient" and "not examined," were placed. To this there was decided objection on the part of the students, who republished this register in December of the same year, leaving out the objectionable features. The grades were in consequence omitted from succeeding registers, though the "order in general standing" upon graduation was published until 1855, since which year all names of undergraduates have appeared in alphabetical order in the different divisions.

About this time students were advised to wear a "uniform dress," and many of them did so. The suit, including a cap, was made of dark-green cloth. The coat was a single-breasted frock with a black velvet collar, and the cap had an ornamental symbol in gold placed on the band in front. The custom did not continue very long, and the uniform was officially mentioned for the last time in the *Register* of 1855.

Shortly after the extension of the course of study the name of the school was changed from the Rensselaer Institute to the Rensselaer Polytechnic Institute. In a "Programme" issued in 1851 it is called by its former name, but in the *Register* published in August of the same year the latter title is used. Although henceforth known as the Rensselaer Polytechnic Institute, the change was not ratified by act of Legislature until April 8, 1861. The name *Annual Register* was first given to the official catalogue in 1854.

The improvement of the curriculum was followed by an increase in the number of students and instructors. The report to the regents of the university of the state, made in 1848, shows that on September 29 of that year there were twenty-two students, and that during the year ending on that date there had been a total attendance of fifty-one. The number of instructors was five, including the president, who lectured once a week on mental and moral philosophy. In 1855 there were one hundred and fourteen students, of whom fifty-one were from the State of New York, forty-eight from fourteen other states, including Maine, Louisiana, and California, and fifteen from foreign countries. The number of instructors had increased to eleven, including Dr. Beman. In consequence of the extension of the course no class was graduated in 1852.

In 1848 the tuition was $20 for each term of five months, or $40 a year. Those who worked in the chemical laboratory paid $8 a term more. In 1851 the corresponding fees were $60 a year and $5 a term. In 1857 the tuition was $100 a year, with no extra charges. This was increased to $150 a year in 1864 and again in 1866 to $200, at which price it remained until 1912, when, after the erection of the '87 gymnasium, it was increased to $205 a year. In 1919 the charge was $250; in 1924, $300; in 1928, $350; and in 1931, $400. These charges included every item of tuition except breakage in the laboratories.

The fifth act relating to the institution passed by the Legislature of the state was dated March 8,

1850. Besides creating the office of director this law reorganized the board of trustees. It was enlarged to nineteen members, and the only *ex officio* member left in it was the mayor of Troy. All restrictions as to place of residence of members were abolished. The act of April 8, 1861, which legalized the change of name of the Institute made ten years before and consolidated the several previous laws relating to it, also gave the board power to increase its number to twenty-five members, including the mayor of Troy. No further change has since been made in this number. By the same law the trustees were given the power to confer the degree of civil engineer, topographical engineer, bachelor of science, and such other academic honors as they might see fit. This was merely a more explicit definition of their power to grant certificates than was given by the act of 1835, under which they had been annually conferring degrees. The act of 1861 was amended by a law passed March 26, 1866. Only two sections were amended, one by leaving out a clause that three days' notice of a trustee meeting must be given and the other by adding a clause to the effect that any member of the board of trustees failing to attend meetings for a year could be dropped by the board. Two other sections relating to the appointment and removal of instructors and the duties of the director were changed by an act dated May 4, 1887. The next act passed was dated April 22, 1898. It relates to the admission of students and the conferring of degrees, and reads as follows: "The Rensselaer

Polytechnic Institute shall have exclusive power to regulate and prescribe the terms of admission of students to the courses of instruction prescribed from time to time to candidates for its degrees, and on the satisfactory completion of such courses of study to confer degrees as authorized by Chapter one hundred and fifty-one of the laws of eighteen hundred and sixty-one and the several laws amendatory thereof and to award suitable diplomas or certificates thereof."

In pursuance of the plan outlined at the time of the reorganization a course in topographical engineering was added, in 1857, to those already existing. Upon its satisfactory completion the candidate received the degree of topographical engineer, T.E. Like the course in natural, or, as it was then called, general science, it was two years in length, whereas that in civil engineering required three years. A special course in land surveying, only one year in duration, was also inaugurated. The first year of the topographical curriculum was identical with that in civil engineering. In the second year pure mathematics, graphics, physics, chemistry, and geology were taught, and especial attention was given to general surveying, practical astronomy, and topographical drawing.

It will be remembered, in considering the time given to the three principal courses, that the preparatory class increased their length for some of the students by a period of one year. Since the first year of its establishment its members had varied in number from twenty-two to thirty-two. They were treated as members of the Institute, and their names were printed in the *Register*, after Division C, under the heading "Preparatory Class." In 1858 "Division D" was prefixed to this title, and after 1862 it was no longer called the preparatory class but simply "Division D."

In 1860 the special course in land surveying was abolished and the courses in general science and topographical engineering were made three years in length, the same as that in civil engineering. In 1862, when the preparatory class became Division D, the latter course was made four years in length and the two former each three years. These two, however, began with Division C, the course in topographical engineering being identical with that in civil engineering, throughout the work of Divisions C and B, and the course in general science coinciding with both of the engineering courses in Division C.

At this time candidates for admission to Division D were required to be not less than fifteen years old, and they were examined in geography, English grammar, arithmetic, and algebra (through equations of the first degree).

During the scholastic year 1862–3 still other changes were made, a course in mechanical engineering was added, and each of the four courses was made four years in length, the first two years being identical in all. The last two years in mechanical engineering contained, of course, more of the theory and practice of machine construction than those leading to the other two professional degrees. *This was the first curriculum of a course in mechanical engineering to be created in any institution in this country.* Besides the Institute there were only three schools of engineering in this country at that time and none gave a course in mechanical engineering. (See page 100.) No one was graduated with the degree, mechanical engineer, at that time. The curriculum was printed for the last time in the catalogue of 1870. The course was reestablished in 1908.

Courses in structures and hydraulics were more largely developed in the civil engineering curriculum, and geodesy and general surveying in that of topographical engineering. The improvements in these various courses, made annually during the preceding years, are given in detail in the *Annual Registers.*

In 1866 the course in topographical engineering was replaced by one in mining engineering. The number of students in the former had never been great, and of these only five had been graduated, all in the class of 1860. The first two years in mining engineering were identical with those of the other courses. The distribution of the subjects in the last two years is given in Appendix III.

In July, 1859, B. Franklin Greene severed his connection with the Institute, after a service of more than twelve years. At first senior professor with the chair of mathematics and physics, his title was changed in 1850 to director and professor of physics, chemistry, and geology. In 1852 he became professor of physics, mechanics, and constructive engineering, and in 1855 professor of mechanics, machines, and constructions. The change in the character of the course while he was at the head of the faculty gives evidence of his efficiency and great ability.

Ever since he had been elected vice-president in 1841, Rev. Dr. Beman had delivered lectures on mental and moral philosophy at the Institute, and since 1854 he had been professor of mental philosophy as well as president of the board of trustees. Upon the resignation of B. Franklin Greene he was made director as well, and the title of senior professor was revived and conferred upon Charles Drowne, who became at the same time professor of civil engineering. Professor Drowne was graduated in the class of 1847 with the degree of civil engineer, and in the same year became assistant in mathematics and physics. In 1850 he was adjunct professor of theoretical and practical mechanics, and from 1851 to 1855 professor of mathematics, astronomy, and geodesy. Dr. Beman remained director only one year, and in 1860 Charles Drowne became director and professor of theoretical and practical mechanics. The term senior professor was then dropped and has not since been used.

Although resigning as director, Dr. Beman continued president of the board of trustees until advancing years compelled him, in 1865, to terminate his long and useful connection with it. He was succeeded, March 20, 1865, by John F. Winslow, one of the proprietors of the Rensselaer Iron Works of Troy. He had been a trustee since 1860.

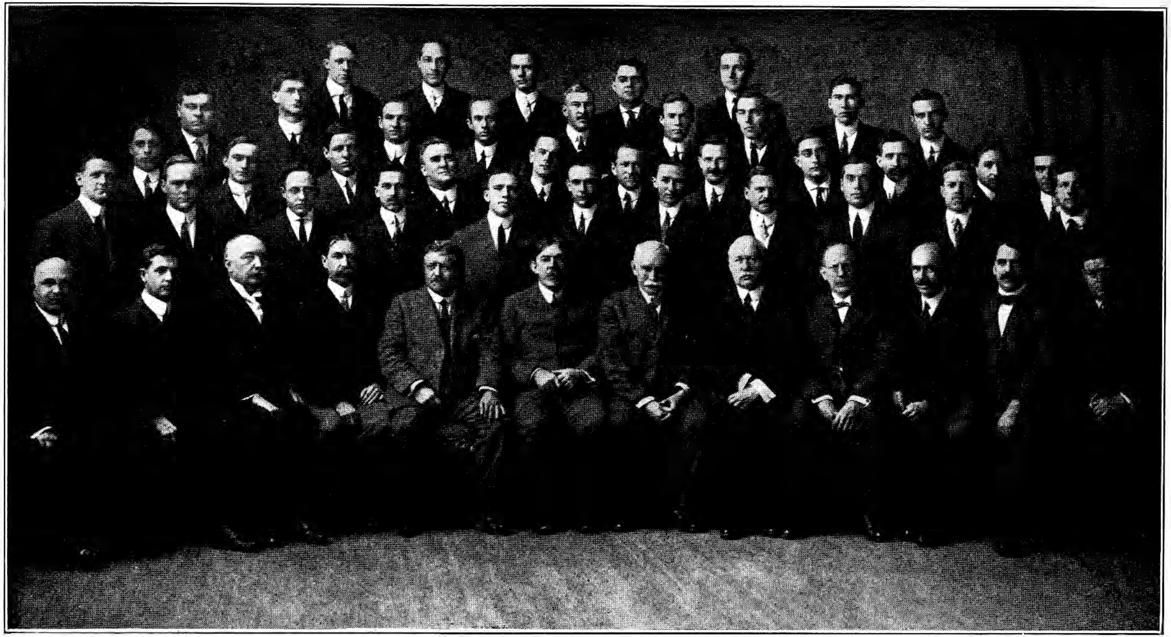
Mr. Winslow retained his position only three years, his removal to Poughkeepsie causing him to resign on April 9, 1868. On May 7 of the same year the sixth president, Dr. Thomas C. Brinsmade, was elected. He was a physician of Troy who had been a trustee for twenty-four years, having been elected March 4, 1844, during the second occupation of the Old Bank Place. His term of office was short. Whilst reading a paper on the condition of the Institute at a public meeting, held in the evening of June 22, 1868, for the purpose of raising funds for the school, he died suddenly of heart disease. James Forsyth, a lawyer of Troy, was made president on December 15, 1868. He had not previously been connected with the institution.

CHAPTER VIII

DESTRUCTION BY FIRES. MORE LAND AND NEW BUILDINGS. ATHLETICS

A GREAT fire which swept over many blocks and destroyed property valued at nearly three millions of dollars occurred in the city on May 10, 1862. It burned the buildings of the Institute, which, besides the two already described, included one adjacent to them, obtained shortly before the fire for a mineralogical and geological museum. The furniture, geological specimens, and a part of the chemical apparatus were also destroyed, though a portion of the apparatus and the library were saved.

Temporary quarters were immediately obtained in the University Building on the hill, now called the Provincial Seminary, and the course was resumed on the following Wednesday. Accommodations for the next year were secured in the Vail Building, on the northeast corner of Congress and River streets; and the school remained there until the completion, in May, 1864, of the structure on Eighth Street, at the head of Broadway, which, under the name of the Main Building, was used for purposes of instruction until it in turn was destroyed by fire, June 9, 1904. It was built of brick, and was one hundred and fifteen feet long by fifty



Some Members of the Faculty, 1912

Left to Right in Front Row; Touceda, Lawson, de Pierpont, Crockett, Thompson, Ricketts, Mason, Robb, Murdoch, Cary, Greene, Wellington.

Pittsburgh Building, 1912–

'87 Gymnasium, 1912–

feet wide, with a central portion five stories in height, and two wings each of four stories. The land upon which it was situated, as well as that occupied by the Winslow Laboratory, now called the Shop, was given by Joseph M. Warren, who had been a trustee of the school since 1849. The building was situated on the site of the existing granite approach between Eighth Street and the alley west of it.

The construction of a chemical laboratory was begun in 1865 on that part of the grounds north of the Main Building. It was named the Winslow Laboratory, in honor of President John F. Winslow. He had always been deeply interested in the prosperity of the school, and had contributed largely toward the construction of the Main Building. The laboratory, which was completed during the summer of 1866, was built of brick and was sixty feet long by forty feet wide and three stories in height. This building was three times partially destroyed by fire. Once, on August 27, 1884, when the upper story was burned together with much apparatus and a library of a thousand volumes; again on October 29, 1902, when the loss was about $6,000; and once more on May 5, 1904, at which time the loss was about the same. After the first fire the building was improved and enlarged, and after the fire of 1902 a south wing was added, the repairs and additions costing $10,500. The structure was thus made ninety feet in length. It was continued in use as a chemical laboratory until 1907, when it was converted into a shop for the instruction of students in the mechanical and electrical engineering courses. At this time a foundry, and a forge, a pattern shop, and a machine shop were installed in it. In 1930–31 it was enlarged until its size was one hundred and forty-two feet by forty feet and new electrically driven machines costing about $20,000 were added to the equipment. The building is now valued at $110,000 and the contents at $43,000.

In 1871 it was determined to improve the course in civil engineering and concentrate the efforts of the school upon it. The three courses in natural science, mechanical engineering, and mining engineering were, therefore, abolished. The number of students taking the first two had been small, and, although more had taken the last, between the years 1868 and 1871 only twenty-three had been graduated with the degree of mining engineer. No one was graduated with the degree of mechanical engineer. Metallurgy and free-hand drawing were added to the civil engineering curriculum, and the courses in chemistry, physics, and geology, as well as those in a number of the practical engineering subjects, were extended and improved. In the course as developed a wide significance was given to the term civil engineering, as is shown by the inclusion in the courses of such subjects as metallurgy, thermodynamics, the theory and construction of engines and other machines, etc.

There was at this time, as there always has been, a considerable number of students who took special courses and were not candidates for a degree.

After a lapse of fourteen years the course in natural science was re-established at a meeting of the trustees held September 23, 1885, and this was continued until 1924 as a separate department, though its name was changed, in 1909, to the course in general science. It was discontinued when the separate courses in physics, in chemistry, and in biology were established in 1925.

The semi-centennial celebration of the foundation of the school was held at Troy, June 14 to 18, 1874. Besides the usual commencement exercises there was a largely attended alumni meeting, three days in duration, at which historical and other addresses pertinent to the occasion were made by the president, graduates, professors, and others. A monument to Amos Eaton, which had recently been placed in Oakwood Cemetery, was dedicated, and sketches were given of the lives of five graduates and students who had served in the Civil War and for whom memorial windows had recently been placed in the Main Building. These were Major James Cromwell, C.E., Colonel Charles Osborn Gray, Major Otis Fisher, Lieutenant Henry W. Merian, C.E., and Major Albert Metcalf Harper, C.E. Shortly after the meeting a sixth window, to the memory of Captain James R. Percy, C.E., was added. These six memorials, however, did not represent all the graduates and students who had been in the war. More than seventy-five had served in the army and navy of the United States, in various capacities, during that period.

In 1874 memorial windows to Amos Eaton and to Professors John Wright and William Elderhorst were also placed in the assembly hall of the Main Building. Professor Wright had held the chair of botany and zoology from 1838 to 1845, and William Elderhorst had been professor of chemistry from 1855 to 1861.

A leave of absence was granted Professor Drowne, in November, 1875, on account of ill health. He did not recover sufficiently to enable him to return, but resigned December 9, 1876, on which date William L. Adams was appointed director. President Forsyth had been acting in this capacity from December 11, 1875, until the appointment of Professor Adams, who was a graduate of the class of 1862. After some experience in the field he became acting professor of geodesy, road engineering, and topographical drawing from September, 1864, to February, 1865, when he resumed the active practice of his profession. In September, 1872, he returned to the Institute to take charge of the department in which he had previously been acting professor. He again left, in 1878, to return to the profession of railroad engineering, and on September 10 of the same year David M. Greene, of the class of 1851, was elected director. Professor Greene had been for a short time after his graduation assistant in mechanics and physics at the Institute, and had occupied the chair of geodesy and topographical drawing from 1855 to 1861.

The third building to be erected for purposes of instruction was an astronomical observatory which was finished in 1878 at a cost of $15,000. It was presented by Mr. and Mrs. Ebenezer Proudfit of Troy as a memorial to their son, Williams Proudfit, a student of the class of 1877, who, in 1875, was fatally injured by being thrown from his carriage. The trustees received a letter from the donors November 6, 1875, in which they signified their intention to erect the observatory. In consequence, a suitable site was found in the Ranken property, situated on the east side of Eighth Street, nearly opposite to the Winslow Laboratory. This was bought by the board January 25, 1877. It had a frontage of one hundred and fifty feet on Eighth Street and extended eastward about five hundred feet to the brow of a hill which has an elevation of about two hundred feet above the Hudson River. It is now merged into the larger plot, south of it, since bought by the school. The property included a dwelling-house and stable, both built of brick. The house, known as the Ranken House, forty feet square and two stories in height, was used for a long time for recitation rooms for the department of mechanics, and contained the first machine for testing materials of engineering owned by the Institute. It was an Olsen machine, and had a capacity of 50,000 pounds. There was also a Fairbanks cement-testing machine. The house and barn were both removed in 1910 when the Pittsburgh Building was erected. The site of the latter building partly covers that of the Ranken House.

The Williams Proudfit Observatory, of brick with stone trimmings, was built on the brow of the hill.

It consists of a central part thirty feet square, with three wings, the total length being seventy-six feet and breadth sixty feet. The main part was two stories high, with a dome twenty-nine feet in diameter, under which was the main pier intended for an equatorial telescope. The wings were each one story in height, that to the east containing the transit instrument and other apparatus used for astronomical purposes.

No large telescope was placed under the dome, and the observatory was never of great benefit to the Institute, and so, at the meeting of the Alumni Association held in Troy, in June, 1899, when a fund was begun for the erection of an electrical and testing laboratory, Mrs. Proudfit gave $6,500 to change the observatory into a building suitable for such a purpose. Accordingly, in 1900, the three wings were each made two stories in height, the dome was replaced by an ordinary roof, and a two-story building resulted. The Westinghouse Electric and Manufacturing Company and the General Electric Company, together, gave about $6,000 worth of electrical machinery, and J. J. Albright, of the class of '68, gave $2,500 and also $1,500 a year for five years to help maintain the laboratory. The Alumni also raised $36,000 as an endowment fund. The building was partially destroyed by fire December 17, 1902. The insurance obtained on building and apparatus amounted to $13,300. In 1903 advantage was taken of this fire to put a third story on the structure and deepen the basement, so that it now has four useful stories. At the same time a boiler-house, containing two 75-horsepower boilers and a steam turbine for experimental purposes, was added at the north end. Its roof was on the level of the second story of the building. The improvements cost about $20,000.

By 1904 the number of students had become so large that it was decided to enlarge the laboratory by the addition of two stories to the boiler-house, thus making it of the same height as the other parts of the building. This improvement was completed early in 1905 at a cost of about $4,000. After the change in 1900 all the building, except two rooms, was devoted to electrical work. The electrical laboratories contained direct- and alternating-current motors and generators, rotary converters and transformers altogether numbering fifteen, as well as other instruments and apparatus necessary for well-equipped laboratories. The remaining two rooms were used for laboratories for the tests of materials of engineering. The first floor of the east wing contained a testing-machine of 300,000-pound capacity, one of 100,000 pounds, and one of 50,000 pounds, and one of 10,000 pounds for testing wire. The second floor of the north wing was equipped as a cement-testing laboratory.

When the boiler-house, described later, was finished in 1908, the boilers were taken from the Proudfit Laboratory and the space formerly occupied by them was converted into janitor's quarters. The electrical laboratories were also removed to the Russell Sage Laboratory in 1909 and the entire building was then given over to the Department of

Rational and Technical Mechanics. The equipment of this department was then materially increased by the addition of a 1,200,000-pound machine for compressive tests, an automatic and autographic machine of 150,000-pound capacity, a torsional machine of 125,000 inch-pounds, and machines for testing paving brick, road metal, cement, and other materials. A very completely equipped cement-testing laboratory was also installed. The 600,000-pound testing-machine in the Russell Sage Laboratory also formed a part of the equipment of the same department.

But the varied purposes to which this very useful building had been and were to be put did not cease with this change. When the Troy Building was erected, in 1924–5, for the department of civil engineering, the machines in the Proudfit Laboratory were transferred to it and the laboratory was again changed for the use of the department of arts, science, and business administration including the courses in English and biology. When the Greene Building was erected in 1930–31, the English department was removed to it. The laboratory is now used principally for instruction in the social sciences and in biology, containing not only classrooms and offices for these purposes, but also a museum, technical, dark, and storage rooms, and laboratories for comparative anatomy and experimental morphology, comparative physiology, embryology and histology, general and plant biology, and bacteriology. The present value of the building and its contents is about $150,000.

During the alumni meeting held at Troy in June, 1881, a committee of graduates was appointed to solicit funds for the endowment of the institution. Francis Collingwood, '55, was made chairman. This action was approved at the meeting held in New York City in January, 1882, and was officially sanctioned by the board of trustees, February 24, 1882. On this date the board appointed James P. Wallace, '37; E. Thompson Gale, '37, and Charles Macdonald, '57, as a committee to receive and manage the funds. About $22,000 was raised, after which the work was interfered with by solicitations for subscriptions for the gymnasium. The amount collected was due largely to the efforts of Mr. Collingwood.

The year 1883 is made memorable by the endowment of the chair of rational and technical mechanics; the first to be endowed. Sixty thousand dollars was given for this purpose by Mrs. Mary Elizabeth Hart, as a memorial to her husband, with the condition that the chair should be designated the William Howard Hart Professorship of Rational and Technical Mechanics. The communication to the board of trustees offering the endowment was dated June 11, 1883. Mr. Hart was the son of Richard P. Hart, who had been a trustee of the school in its earlier days (1825–43). He had always been interested in the school, and in her letter Mrs. Hart informed the board that the endowment was "in furtherance of his views and as a fitting memorial of his interest in the prosperity and success of the Institute."

It has been stated that the geological and mineralogical specimens belonging to the school were destroyed by the fire of 1862. Another collection was immediately begun by H. B. Nason, at that time professor of natural history. A thousand dollars was given for this purpose, and by the fall of 1862 more than a thousand specimens of minerals, rocks, and fossils had been obtained.

From the time of completion of the Main Building, and for nearly thirty years thereafter, this collection, to which additions were constantly being made, together with the cabinets of natural history, was kept in a large hall on the top floor and the library was in a room on the second floor. The erection of a fireproof building in which both could be safely kept was urged by Professor Nason at the alumni meeting in Troy, June 13, 1888. The state geologist of New York, Professor James Hall, of the class of 1832, had promised to give a valuable collection of fossils if such a building were provided. Part of the amount required for its construction was raised by subscription from graduates at the meeting, and at the Pittsburgh meeting of the association of graduates held January 31, 1889, enough was pledged to insure its erection. A lot on the east side of Second Street, between State Street and Broadway, immediately north of the Savings Bank Building, was purchased June 2, 1890, with a fund raised by subscription among the trustees, and the building was completed in 1893. The lot cost $10,000 and the building $35,000. Wilson Brothers & Co., of Philadelphia, provided the plans, the three brothers from whom the firm took its name being graduates of the Institute. The structure is fireproof, fifty feet square and three stories in height. The lower portion is faced with brown stone and the upper with yellow brick and terra-cotta. The library, a room for the trustees, and the office of the director were on the first floor, and the other two contained the geological and mineralogical collections which at that time numbered about ten thousand specimens. There was also a lecture room for the department of geology on the second floor. This building was used until the completion of the Pittsburgh Building in February, 1912, at which time everything was removed from it. It was sold November 15, 1915, for $11,000.

In May, 1883, a petition was received by the trustees from the students, who asked that steps be taken by the board to provide a suitable gymnasium for their use. The subject was again agitated later in the year, and in 1884 a lot on the south side of Broadway, at the foot of the property containing the Main Building, was purchased by the trustees. Upon this site a gymnasium of brick, trimmed with stone and terra-cotta, eighty feet long by forty-four feet wide and two stories in height, was erected. It was opened March 11, 1887. The building cost $20,000. About half of this amount was contributed by alumni, trustees, students, and residents of Troy, and the remainder was appropriated from the funds of the institution. The structure was used as a gymnasium until the completion of the '87 Gymnasium in November, 1912. It was rented to the Troy Academy during the years 1914 and 1915, after which it remained vacant until 1924 when the Masonic Order was permitted to use it until 1929. The Dramatic Club was then given permission to convert the upper story of the building into a theater and it is now called the Rensselaer Playhouse. About $4,000 has been used to make this little theater, seating about four hundred persons, very complete. The floor below the auditorium is used for dancing.

President Forsyth, who, besides his official duties as president of the board of trustees, had lectured on the law of contracts since 1873, died August 10, 1886. Upon his death, William Gurley, of the class of 1839, the vice-president of the board, became acting president and remained so until his death, January 11, 1887. On June 1 of the same year Albert E. Powers, a banker and manufacturer of Lansingburgh, who had been a trustee since 1861, was elected vice-president and acted as president until May 2, 1888, when John H. Peck, a prominent lawyer of Troy, was elected to that office. Mr. Peck had been a member of the board of trustees since June 1, 1887. He resigned from the presidency and from the board of trustees, January 16, 1901.

After a service of thirteen years David M. Greene resigned September 15, 1891, and Professor Dascom Greene, at the head of the department of mathematics and astronomy, was appointed temporary director. He held this position until the election, January 15, 1892, of Palmer C. Ricketts, of the class of 1875, who had been assistant in mathematics and astronomy from that year until 1882 and assistant professor in the same department from 1882 until 1885, when he became William Howard Hart Professor of Rational and Technical Mechanics. He is still director and also has been president of the board of trustees since February 13, 1901. The duties incident to these positions compelled him to relinquish all his work as teacher except a course in rational mechanics which he continued to teach until 1912, the last six years under the direction of Professor Thomas R. Lawson, who became professor and the head of the department of rational and technical mechanics in 1906.

Reference has already been made to the fires which occurred in the Main Building and Chemical Laboratory in 1904. The former was almost completely destroyed and the latter was badly damaged. In consequence of the destruction of the Main Building recitations were held in the Ranken House and in the State Bank Building on the southwest corner of River and Fulton streets, a floor of which was rented for this purpose. This was continued until the Carnegie Building was ready for occupancy in September, 1906.

At a meeting of the board of trustees held December 7, 1904, a committee was appointed to consider the site and kind of building to replace the Main Building. Architects were employed, and at a meeting held January 4, 1905, it was resolved to replace it by a new building on or near the old site, and to build a new chemical laboratory on the Ranken property. These plans were changed, however, when the suggestion was made by J. J. Albright, of '68, that the property of Walter P. Warren, adjacent to and south of the Ranken plot, be bought. He offered to give $50,000 toward the erection of a new chemical laboratory if this property were bought. It was finally acquired June 1, 1905, upon the payment of $125,000. It had a frontage of 315 feet on Eighth Street, extending easterly for a distance of 1,300 feet and containing 10½ acres of land. There were a dwelling house and stable on it, the dwelling being valued at $40,000. During the next two years more land was bought. When the new boiler-house was projected in 1907 the site determined upon for it rendered advisable the purchase of a small piece of land from the Troy Hospital, and in 1907 about 0.81 acre was bought. In the same year 1.41 acres were bought in two parcels from the Warren and Tibbits estates. These two parcels bordered on Fifteenth Street. They were separated from the main plot by land belonging to St. Joseph's Seminary, and 10.6 acres were bought from the Seminary in 1907. The Ranken House property contained 1.7 acres; so that the total acreage in the plot was 25 and the total cost was $164,620. This included two houses and two stables on the Ranken and Warren properties. A ravine ran east and west through the land, which was very irregular in surface. There were a stream and a pond of considerable size upon it. A fill, of fifteen feet in places, was necessary to make the athletic field. The pond, which was north of the present driveway, was filled by cutting the top off a hill east of the site of the carpenter shop and by removing clay to a depth of ten feet from the rocks about two hundred feet westerly. In 1908 a street called Avenue B, now Sage Avenue, was cut through the ravine from Ninth to Fifteenth streets. This took 1.37 acres from the plot, leaving 23.67 acres divided into two parts. The main plot, upon which most of the buildings are now situated, has a frontage of 472 feet on Eighth Street, one of 444 feet on Fifteenth Street, and a length of 1,765 feet between the two streets. It contains 19.5 acres. The plot north of Sage Avenue contains about 4 acres.

Small parcels south of the Dining-Hall and north of the Proudfit Laboratory were bought in 1922. These totalled 0.53 acre and cost $3,400. In 1927 three lots, extending along Fifteenth Street to Public School 14, were bought from different owners, and also 4.33 acres west of them from St. Joseph's Seminary. These four pieces totalled 6.2 acres and cost $63,000. In 1929, at a cost of $18,200, the school bought 18.2 acres east of Burdett Avenue to be used, in the future, for athletic purposes. The total acreage now owned by the Institute is 48.7, costing $296,000. The roads, fences, steps, lighting system, etc., on this land cost about $65,000.

Before the purchase of the Warren property was consummated it was known that Mr. Andrew Carnegie was to give the school $125,000 for the erection of a building to take the place of the Main Building, that is, to provide recitation and drawing-rooms. This gift was due to the efforts of Captain Robert W. Hunt, who had known Mr. Carnegie for a long time and who had been a trustee of the Institute since 1886. The site chosen for the structure was on the winding road which extends from Eighth Street to the main plateau of the property. Its center is on the center line of Broadway produced, the front face is about 200 feet east of the street, and the second story is about on the level of the main campus. The building was finished in September, 1906, at a cost, including grading and sidewalks, of $133,000. It is 60 by 100 feet in plan, with four stories and a basement, and is built of Harvard brick trimmed with Indiana limestone, with concrete and steel floors and partitions. The halls have terrazzo floors with walls tiled in white to a distance of 7 feet above the floor. The style adopted for this building has been continued for all others, intended for purposes of instruction, erected since. All are built of the same kind of brick and stone, though their architectural features have been varied to prevent monotony. The lighting is by electricity, and the heating is by steam from a central station. This central station or boiler-house was finished in 1908. It is situated on a low spot in the grounds east of the Proudfit Laboratory and north of the Russell Sage Laboratory, with which it is connected by an underground passageway. The chimney forms a part of the latter laboratory, the gases from the boilers passing through a horizontal tunnel, between the two buildings, to reach the chimney. Boilers aggregating 1,100-horsepower are now installed. The house cost $37,300 and the contents $35,400.

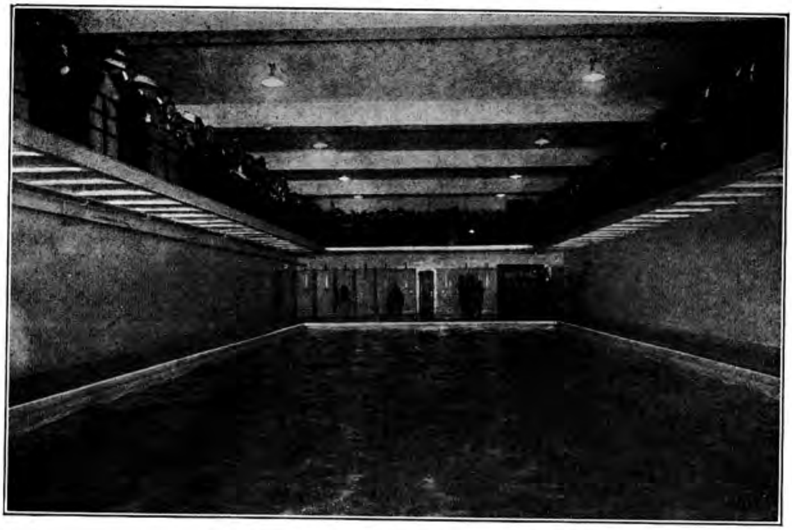
On account of the increase in the number of students, the old chemical laboratory became too small, and in 1905 it was determined to build a larger one. After the purchase of the Warren property it was decided to place it on this property at the same level as the Proudfit Laboratory and between it and the Carnegie Building which was about to be erected.

The new chemical laboratory was built at the same time as the Carnegie Building, and was finished towards the end of 1906 at a cost of $110,000. Of this amount, J. J. Albright, according to his promise, gave $50,000.

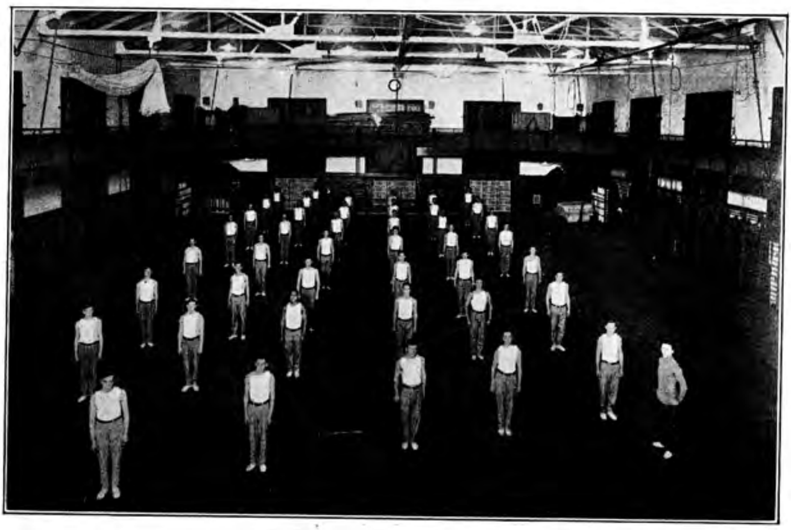
The architects were Messrs. Lawlor and Haase. Mr. Lawlor was graduated from the Institute in the class of '88. The firm acted as architects also for all buildings subsequently constructed for the Institute, except the Troy Building, until the death of Mr. Haase after the design of Eaton Hall. Since then Mr. Lawlor has been the Institute architect.

The laboratory is built of the same materials as the Carnegie Building though it is somewhat more ornate. It had twenty-two rooms, among them five large laboratories for various specialties. In 1913, changes costing about $20,000 were made, and much more room for special laboratories was obtained. The increase in the number of chemical engineering students made it evident in 1917 that the chemical laboratory must soon be enlarged. Accordingly it was doubled in size by an addition on its east side which was finished in January, 1921. The total cost was $169,200, of which $112,400 was paid by a fund raised for the purpose and $56,800 came from the current funds of the school. It cost $1,800 to make changes outside the building. Shortly after the structure was erected it was decided to name it the William Weightman Walker Laboratory, in memory of Dr. William Weightman Walker, of the class of '86, and in gratitude to the mother of Dr. Walker, who had been a great benefactress to the school.

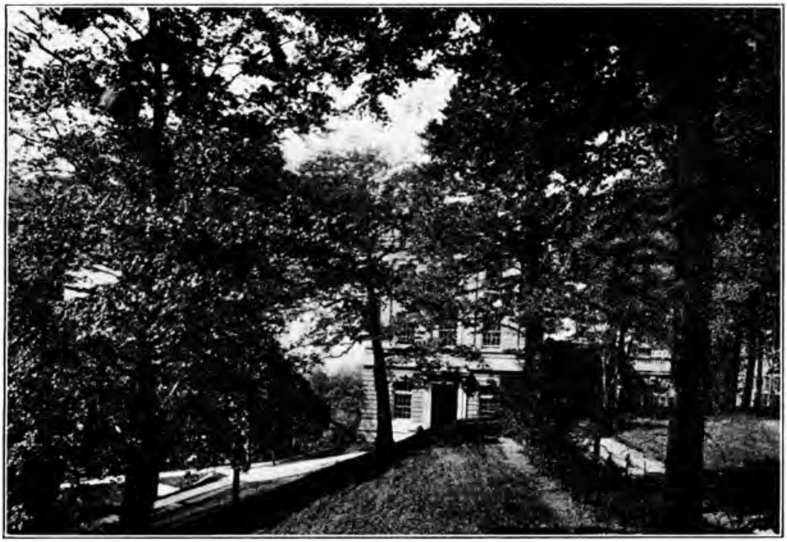
After the Warren property had been purchased and the determination made to place the Carnegie Building and new chemical laboratory upon it, the question of the disposition of the wreck of the Main Building arose. One suggestion was that it be made into a dormitory. During this period the citizens of Troy had been appealed to for aid to the institution, and the Chamber of Commerce had begun to raise money for this purpose. During one of the meetings of the Chamber, Edward F. Murray, of Troy, strongly advocated the appropriation by the city of Troy of a sufficient amount, which he estimated at $50,000, to extend Broadway over the site of the old building to Eighth Street, and to build a series of granite steps on this site, thus forming a handsome approach to the new buildings of the school from the center of the city. This suggestion was carried out by the municipality, and a simple, very handsome granite approach was com-



'87 Gymnasium. Swimming Pool



'87 Gymnasium. Main Floor



View South of Walker Laboratory

View on Main Roadway

pleted in 1907, at a cost of $40,000. The Institute donated the land for the width of Broadway, and, in order to protect the approach, in 1910 it donated to the city all the land it owned between the alley and Eighth Street south of the approach and for a distance of 15 feet north of it.

A winding road, about 2,100 feet in length, leads up the hill through the Institute property from Eighth Street to a point in Sage Avenue near the '87 Gymnasium about 300 feet west of Fifteenth Street. Altogether there are about 3,600 feet of roadway on the grounds and about 7,500 feet of sidewalks paved mostly with flagstones. The surface of the main campus is about 100 feet above the sidewalk at Eighth Street at the head of Broadway. Successive flights of granite steps with bronze railings lead from this street to the campus. The road winds up the hill in front of the Pittsburgh Building, around the Carnegie Building, and in front successively of the Walker Laboratory, Sage Building, Troy Building, and the '87 Gymnasium. The Sage Building is on the level of the main campus, and the '87 Gymnasium is situated on the level of the athletic field near the point where the road meets Sage Avenue. At this end of the road there is a handsome gateway with columns and walls of Harvard brick with limestone trimmings and gates of ornamental iron. It was presented by Mrs. C. W. Tillinghast and erected in 1914 at a cost of $4,300.

The dwelling house on the Warren property was of brick and very large. The number of rooms was increased by partitions, and in 1907 it was converted into a dormitory accommodating thirty students. As the number of students increased, the need for more dormitories became more apparent. At the beginning of the year 1915, Alfred T. White of the class of '65, of New York City, intimated that he wished to celebrate the fiftieth anniversary of his graduation by presenting the Institute with a dormitory costing about $50,000. Plans were accordingly drawn for a dormitory quadrangle of separate houses, joined together, however, to form a continuous line—the typical house to be three stories in height with two suites of rooms on each floor, each suite to consist of a study and two bedrooms, that is, each house to provide for twelve students. This plan was adopted though a few of the houses have some single rooms and quarters for more than twelve students. Mr. White built four of these units along Fifteenth Street at a cost of $67,500. When Mrs. Russell Sage heard of this donation, she gave $100,000 for the construction of a Dining-Hall which forms the south side of the quadrangle. It is named the Russell Sage, 2nd, Dining-Hall, after a nephew of Russell Sage, who was graduated in the class of '59. Captain Robert W. Hunt, a trustee of the Institute, built the next three at a cost of $57,200. All these buildings were finished in 1916. The Institute was put to an expense of about $26,500 in connection with their installation, the two largest items being $7,800 for furniture, and $11,000 for grading, sidewalks, etc. The line of dormitories along Fifteenth

Street was completed in 1923 by the erection of four units for which $136,000 had been raised by contributions from graduates. The cost of the four was $143,700, and the furniture cost $9,100 more. These buildings were named for four very distinguished structural engineers, all graduates of the Institute: Leffert L. Buck, '68, chief engineer of the Niagara Highway Bridge and the Williamsburg Bridge across the East River; Theodore Cooper, '58, renowned as a consulting engineer; Charles Macdonald, '57, of the Union Bridge Company, which constructed the cantilever bridge at Poughkeepsie and the Hawksbury Bridge in Australia; and Washington A. Roebling, '57, who was the chief engineer of the Brooklyn Suspension Bridge during its construction. The three members of the Roebling family who were graduates of the Institute, Washington, '57, Charles G., '71, and John A., '88, subscribed $55,000 to the dormitory fund. The Roebling building is on a corner and is larger than the typical ones. It houses twenty-nine students. The next dormitory was built from a legacy of $40,000 left by Calvin Pardee, '60, supplemented by a donation of $27,000 from members of his family. It is called the Pardee dormitory and is situated on Sage Avenue adjoining the Roebling building. It was finished in 1925 and cost $57,000 including furniture. James H. Caldwell, '86, vice-president of the board of trustees, gave $56,000, in memory of his son, John C. Caldwell, '16, for the erection of the Caldwell dormitory west of Pardee and adjoining it. On account of the configuration of the rock upon which it stands, the Caldwell dormitory is four stories in height. The preparation of the rock for the foundation of the building and of the Church dormitories west of it, together with fences, sidewalks, etc., cost $20,000. Townsend V. Church, '81, who died in 1930, left the Institute $205,000 with which six buildings, called the Church dormitories, were erected. Five of these continued the line along Sage Avenue and turning southward formed part of the west side of the quadrangle, which was left open on this side for a distance of about 200 feet. The sixth Church dormitory was then built at the end of this distance, forming the first of a line to be continued southward in the future. This was the nineteenth dormitory of the line; the cost of all of them furnished was about $635,000. They will house 274 students, and the Campus dormitory, 37, a total of 311.

All these dormitories, and the Campus dormitory, were used to house members of Division D only, and they are so used at present. A student need not room in any of these buildings, but if he does he must take his meals in the Dining-Hall. The charge for rooms is from $147 to $180 a year, and the board is $7 a week.

No dormitories were provided for members of the three upper classes until the completion of the two buildings north of Sage Avenue in 1932. These two dormitories are divided into ten separate units, each one being named after a deceased graduate who had been president of a railroad company:

A. J. Cassatt, '59, Pennsylvania; W. H. Clement, '35, Cincinnati Southern; F. J. Hearne, '67, Colorado and Wyoming; S. Hirai, '78, Imperial Government of Japan; S. Matsmoto, '76, Imperial Government of Japan; L. S. Miller, '85, New York, Westchester, and Boston; G. B. Roberts, '49, Pennsylvania; T. Voorhees, '69, Philadelphia and Reading; C. C. Waite, '64, Columbus, Hocking Valley, and Toledo; and A. Walter, '72, Lehigh Valley. These buildings are fireproof, colonial in type, of pink brick in color like those of old West dormitory at Williams College. They will house 171 students, the rooms, mostly single, costing from $108 to $165 a year.

A Young Men's Christian Association was established at the Institute in 1883. This was the third students' Y. M. C. A. to be established in the state. It never was very successful, and each year only a comparatively small number of students were interested in its work. In 1906 a committee of graduates in New York City, composed of Messrs. N. P. Lewis, '79; Henry W. Hodge, '85; M. E. Evans, '95; G. A. Soper, '95; and F. de P. Hone, '97, organized the Rensselaer Students' Association. It was intended to form a well-organized club as a central meeting-place for all students, where all would be welcome. The object was to form a closer bond of union among the students as a whole, without regard to fraternity or other affiliations, than had existed up to that time. It was not intended to make it a Christian Association, though it was intended to have a religious committee among other committees in charge of matters of interest to students. The graduate committee began by raising money to pay the salary of a secretary of the association for three years, beginning in 1906. At the same time, they attempted to collect funds for a clubhouse, but succeeded in raising only $3,600 for this purpose. In the meantime the trustees had authorized the expenditure of $10,000 for a clubhouse, and this was completed in 1908 at a cost, furnished, of $19,000, of which the trustees paid $15,500. The house, of wood, of handsome Colonial type, was situated at the west end of the '86 athletic field. It was the headquarters of all student extra-curriculum activities until the completion of the new clubhouse in 1932, when it was razed. The new building was erected on the south line of the campus, south of the Warren house. It is built of the same materials as the other new buildings, costing, furnished, $125,000. It is very complete with lounge and billiard, card, reading, and many other rooms for the use of committees, the Rensselaer Polytechnic newspaper, the *Transit* committee and the book committee. The top floor, 120 by 40 feet, is used for general meetings of students and for dancing. Until the erection of the first clubhouse there had been no headquarters for the student activities of the school. Nearly eighteen years before, on October 25, 1890, the Rensselaer Polytechnic Institute Union had been formed for the purpose of encouraging and promoting athletics and other student activities, and it had been in existence ever since. The relation of the Rensselaer Polytechnic Institute Union to the new Rensselaer Students' Association had now to be seriously considered. The absorption of the Union by the Association resulted in 1908, and the combined organization took the name of the Rensselaer Union.

According to the constitution of the Union its object is "to unite all students in a common desire to promote loyalty toward the Institute; to stand for high character, truth and justice; to build for true manhood by every form of individual and organized effort; to increase the percentage of graduates; and to provide an effective means of furthering the social life of the Institute and all lines of student activities." It is governed by an executive committee composed of the president of the Union, the grand marshal, the editor-in-chief of the *Rensselaer Polytechnic,* the managers of football, basketball, baseball, minor sports, track, and swimming, president of the musical clubs, and a member of the faculty chosen by the prudential committee—eleven members altogether. All except the faculty member are students. There is a paid secretary who keeps the books and looks after the clubhouse. The grand marshal is regarded as the leader of the student body. He has jurisdiction over all interclass contests, and is an *ex officio* member of all standing committees of the Union. The first one was elected from the class of 1866, and there has been one for each succeeding class except those from 1891 to 1894, inclusive. The names of all of them, and of all the presidents of the Union, are given in Appendix IV.

The executive committee has control, under direction of the board of trustees of the Institute, not only of the clubhouse but also of the '86 athletic field, the athletic games, and the student activities generally. In 1912 it took *The Polytechnic* under its charge. At first an annual fee of five dollars was charged for membership in the Union, and although all students had the right to use the athletic field, only those who paid this fee were permitted to use the clubhouse and vote for the grand marshal and other officers of the Union. This was continued until the erection of the '87 Gymnasium, when the tuition fee was increased by five dollars a year for all students and all became members of the Union without any other payment.

There are seven governing committees: the athletic, managerial, house, *Rensselaer Polytechnic,* hop, musical, and rifle club.

The Union now has control of the football, basketball, hockey, and track teams, the Glee Club, the Orchestra and the Band, the Union hops, the *Rensselaer Polytechnic,* the "Students' Handbook," and the book committee.

The book committee, composed of four students, sells text-books to students who receive, at the end of each term, a percentage of the amount they have paid the committee. The business done generally amounts to between $30,000 and $40,000 a year.

The formation of the Rensselaer Union had a very beneficial effect upon athletics at the Institute. The various branches have been placed upon a much more businesslike basis. However, in order to prevent some of the students from neglecting their work in order to play on the teams, an athletic committee of the faculty was appointed in 1909 and rules were inaugurated and are enforced which prevent students in poor standing from taking part in intercollegiate games. Many games are played each year by the athletic teams both intercollegiate and intramural. The intercollegiate teams play games, in seven sports, with the teams of adjacent colleges and scientific schools. The number in each sport follows: football, 8; soccer, 4; basketball, 10; tennis, 4; swimming, 6; cross-country, 6; and track, 4. There had been a baseball team since 1885, but it was abolished in 1933. Since 1882 the Institute teams have won 44 per cent of their contests. Members of Division D also have contests with teams of preparatory schools and freshman teams of adjacent colleges in five different sports. Intramural games are encouraged by the authorities, the aim being to have each student take part in some form of athletic exercise every day. Such exercise is compulsory for all members of Division D. Many interclass and interfraternity games are played. Contests in ten different interfraternity sports are held each year. A trophy is given the fraternity winning the greatest number of points in the contests. Contests in fourteen different sports are held between the classes. Small medals are given to each member of each class team winning a championship. A boxing class, a Red Cross life-saving class, and a rifle club are included in the athletic programs. The gymnasium is used at times by preparatory school students in their annual swimming and basketball championship contests. Each year the Institute holds two contests for preparatory school students: a cross-country run, and a track meet. In the last cross-country run there were 360 contestants from 57 schools in seven states, and in the track meet there were 371 contestants.

CHAPTER IX

RUSSELL SAGE. TEN NEW COURSES. GRADUATE COURSES. '87 GYMNASIUM. NEW BUILDINGS

MR. RUSSELL SAGE, a well-known financier of New York City, was elected a trustee of the Institute June 24, 1896. He died July 22, 1906. In November of the same year the writer had an interview with Mr. Robert W. DeForest, the counselor and confidential adviser of Mrs. Sage, during which he asked for a donation of $1,000,000 to establish a Russell Sage School of Mechanical Engineering. Later in the month he had an interview with Mrs. Sage, and afterwards received a letter dated January 21, 1907, which reads as follows:

Dear Mr. Ricketts:

I have told you of my intention to give one million dollars to the Troy Polytechnic, and I know, from my conversation with you and from what Mr. Robert W. DeForest has reported to me of his interview with you, the general purposes for which you intend to use it.

I will immediately send you my check for $100,000. If it does not accompany this letter it will follow it, and I shall be ready to pay the balance upon your request whenever it may be needed, at any time after May 1st, 1907.

I write this letter so as to make my gift, to which I attach no conditions, a personal obligation upon me, and in the event of my death before consummating it, upon my estate.

It is right that you should have such a letter before you begin to make your plans.

I am quite willing that this gift should be announced pursuant to your desire, at the meeting of your Trustees and of your Alumni, to be held, as I understand, some ten days hence, and to leave the form of announcement to you, except that in making the announcement I should like to have the fact of my own and Mr. Sage's previous relations to and interest in the Polytechnic made apparent, as a reason for the gift, and as differentiating the Polytechnic from other institutions who have made applications to which I have not responded, and with which neither Mr. Sage nor myself had any personal or official relations.

Sincerely yours,

MARGARET OLIVIA SAGE.

A check for $100,000 was enclosed with the letter, and the remainder of the million dollars was given later in the year.

Both Mr. and Mrs. Sage had been interested in Troy institutions for many years. Mrs. Sage was graduated at the Emma Willard School, and Mr. Sage's nephew, Russell Sage, 2nd, was graduated at the Institute in the class of 1859. A considerable part of Mr. Sage's life was spent in Troy. His early business experience was obtained here. He was elected to the United States House of Representatives from this district and served two terms, from 1854 to 1858. In 1863 he moved to New York City and began the business career which afterwards placed him amongst the great financiers of the country.

During the last part of the year 1906, the advisability of the establishment of schools of mechanical and electrical engineering had been thoroughly discussed by graduates, faculty, and trustees. There was a diversity of opinion among the graduates, a considerable number of them maintaining that, as the Institute had been a school of civil engineering for such a long time and had made its name as a school of civil engineering, it should remain so; that its course should be broadened and that no specialization should be permitted. They declared that civil engineering covered all branches of engineering other than military and that graduates of the Institute were fully equipped to begin the practice of their profession in any branch. This did not agree with the practice of other schools. In fact, as has been recorded in this history, three engineering courses other than civil had once been established in this school, but they had been discontinued on account of want of funds. The truth is that the field of engineering had been broadening very rapidly and that it was not possible to present in one course, four or even five years in duration, all the fundamental principles necessary to equip a student to begin the intelligent practice of his profession in civil or mechanical or electrical engineering as he might choose. In order to include all the subjects in the four engineering courses given here at that time (1914) it would have been necessary for a student to remain in the Institute between eight and nine years.

After a careful consideration of this question the faculty, at a meeting held January 26, 1907, unanimously passed the following set of resolutions:

Resolved, That in the opinion of this faculty the establishment of schools of Mechanical and Electrical Engineering would be advisable and would be of great benefit to the school, provided the Board of Trustees have at their disposal sufficient money to properly inaugurate such schools.

Resolved, That in the opinion of the faculty the usefulness of the school would be enlarged if it were a true polytechnic institute and not as at present practically only a school of Civil Engineering.

Resolved, That we believe the establishment of well-equipped schools of Mechanical and Electrical Engineering would be a long step towards changing the school into a true polytechnic institute; and

Resolved, That in passing these resolutions it is the opinion of the faculty that such schools, if established, should be quite similar in character to the school of Civil Engineering at present existing; that they should decidedly not be only special schools either of Mechanical or Electrical Engineering, but that they should be general schools of Engineering similar to the existing school of Civil Engineering, but with some of the Civil Engineering subjects replaced in each by others more necessary for the education of a Mechanical or an Electrical Engineer.

On February 6, 1907, the board of trustees held a meeting at which resolutions of thanks to Mrs. Sage were passed, and at which the faculty was directed "to submit to the Board an outline of the scheme proposed, giving such information as is obtainable regarding the courses of instruction and number of new professors necessary." And at a meeting on March 14, the board, after considerable discussion,

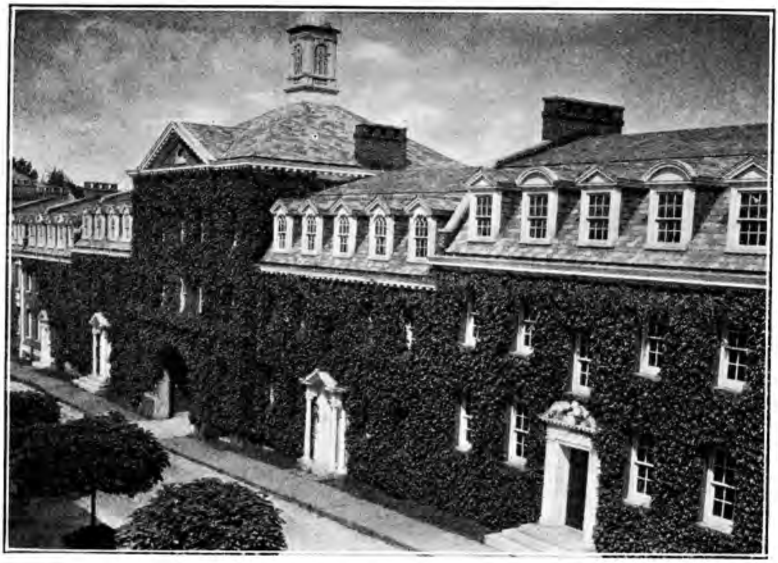
Resolved, That courses in Mechanical and Electrical Engineering, leading to the degrees of Mechanical and Electrical Engineer, be established at the Institute, and that a committee consisting of the Prudential Committee, Vice President, and Treasurer of the Board be appointed with power to do whatever may be necessary to inaugurate such courses.

The course in civil engineering at the Institute had been, ever since the reorganization in 1849–50, a very general one. The fundamental principles of all branches of engineering had been taught in it—as much as had been possible in a course four years in duration. The courses in mechanical and electrical engineering established by this resolution of the board were each also four years in length and were likewise very general in their character. The first two years in all were nearly identical, the principles of all were taught in each, and the greatest divergence took place in the last year. Each term of all the Institute courses is divided into three parts: the advance course, from fourteen to fifteen weeks in duration; the review, about three weeks; and the examination, which takes from a week to ten days.

After careful study the faculty concluded that the differences between the courses in mechanical and electrical engineering and that in civil engineering should be about 26 per cent of the time given to instruction during the advance period and that the difference between the course in mechanical and that in electrical engineering should be about 12½ per cent. The greatest difference between the courses occurred naturally during the last two years. In Division A the difference between the civil and the other two courses was about 50 per cent.

For the use of the two new departments the trustees determined to erect, at a cost of about $300,000, a building to be known as the Russell Sage Laboratory. The remaining $700,000 of Mrs. Sage's gift was set apart as a fund for the endowment of the department of mechanical engineering. The contract for the building was signed February 11, 1908, and it was completed in March, 1909. It was formally opened June 15 of the same year, at which time addresses were made by Robert W. De Forest, of New York City, who represented Mrs. Sage; Jesse M. Smith, then president of the American Society of Mechanical Engineers; and Lewis B. Stillwell, at that time president-elect of the American Institute of Electrical Engineers.

The building was erected on a hillside, with its front face on the main campus at its highest level. It is constructed of Harvard brick with Indiana limestone trimmings and fireproof floors. The interior layout of the east wing with its machinery was made by Dr. W. L. Robb, who had been the professor of electrical engineering and physics since 1902, and that of the west wing with its machinery, by Professor Arthur M. Greene, who had come to the school from the University of Missouri, in 1907, as professor of mechanical engineering. The structure is 246 feet long and 80 feet in depth, except the central portion of 50 feet, which is 100 feet in depth. It has eighty-three rooms. The west wing contains the department of mechanical



Some of the Dormitories, 1916–

In the Dormitory Quadrangle, 1932–

Russell Sage, 2nd, Dining Hall, 1916–

In the Dining Hall

engineering and the east wing the department of electrical engineering. The central portion, containing a lecture-room seating four hundred persons, a large drawing-room, and a laboratory for a 600,000-pound machine for testing materials of construction, is used by both departments.

The actual cost of the building and furniture was $312,000. The machines and apparatus for the department of mechanical engineering cost about $40,000, and the value of those in the department of electrical engineering, including the material moved from the Proudfit Laboratory, was about the same. The 600,000-pound materials-testing machine and the impact-testing machine, which are a part of the equipment of the department of rational and technical mechanics, cost $13,000. Thus the total cost of the machines and apparatus in the building was $93,000 and that of the building, furniture, and apparatus was $405,000. The increase in the number of students necessitated an addition to the Sage Laboratory. This was built to the north and east of the Sage Laboratory, becoming a part of it. It was finished in 1923 at a cost, furnished and equipped, of $235,000, the building itself costing $186,000, all paid for from current funds and investments. It is 52 by 72 feet in plan, four stories in height, and is built of the same material as the Sage Building. A description of the apparatus in the Sage Building and the Annex is given in Appendix V. Although the cost of both buildings without contents was only about $477,000, both were built when prices were low and they are worth much more than this amount. Much machinery and apparatus have also been added, and the buildings and their contents are now probably worth more than $800,000.

In 1909 a fund was raised among the alumni to purchase portraits of Mr. and Mrs. Sage. Mrs. Sage, however, presented the two handsome portraits which are now hung in the lecture-room on the first floor of the Sage Laboratory. Besides these oil paintings, twenty-four others are owned by the school and hung in different buildings. In the trustees and faculty room are those of the Founder, presidents Blatchford, Chester, Nott, Beman, Winslow, Brinsmade, Forsyth, and Peck, and of three directors, Amos Eaton, B. Franklin Greene and David M. Greene. A portrait of Williams Proudfit, whose parents gave the building, hangs in the Proudfit Laboratory. In Eaton Hall are paintings of Amos Eaton, Professor H. B. Nason, A. G. Menocal, '62, J. C. Cobb, '31, and Professor John Wright, who was a professor of botany in the school from 1836 to 1846. A number of portraits of persons in some way connected with the school are hung in the Dining-Hall; one of Russell Sage, 2nd, in whose memory the building was given by Mrs. Sage; those of two former presidents of the board of trustees—Nathan S. S. Beman and James Forsyth; one of Robert W. Hunt, a trustee who gave the Hunt dormitories; another of W. W. Walker, '86, whose mother gave $220,000, part of which was used to help build the Walker Laboratory; one of Athol M. Miller, '95, the donor of the Miller Fund; and one of Williams Proudfit, whose connection with the Institute is referred to above.

Though the act of Legislature of 1861, which consolidated the previous laws relating to the school, had been amended twice, and the special act of 1898 had been passed, there remained in Section 1 a clause to the effect that the trustees had the power "to purchase, take, and hold, by gift, grant, or otherwise, and to dispose of any real and personal property, the yearly income of which shall not exceed ten thousand dollars." At the time of the receipt of the Sage gift the annual income of the Institute from gifts and investments already exceeded ten thousand dollars, and the gift showed the necessity of a change in Section 1. Accordingly this was amended by a law dated February 16, 1907, by which the income of the school was not limited to any specific sum.

The fourth course to be inaugurated was that in chemical engineering. The general science course contained much chemistry; it was intended to prepare chemists rather than engineers. After the establishment of the courses in mechanical and electrical engineering the faculty began to consider seriously the advisability of recommending to the trustees a course which would contain a considerable amount of chemistry, much more than was given in the engineering courses already in operation, and also much more engineering, particularly mechanical and electrical engineering, than was given in the general science course. The object was to give a course which would better prepare a young graduate to take up work leading to the management of industrial plants than would any of the engineering courses or the course in science already established. Such a course was then being given in about ten of the leading schools of engineering. The recommendation was made in May, 1913, and in September of that year the course was in operation.

The course in general science, established in 1885, had never been very satisfactory. It was made up from some of the subjects given in the various engineering courses and it attracted very few students. In 1924 the faculty determined to recommend to the board the abolishment of the course in general science, as previously given, and the establishment of four courses leading to the degree bachelor of science: one in which chemistry predominated; one in which physics, including electricity, was the major subject; one, a pre-medical course, in which much biology was included; and one in arts, science, and business administration. Dr. Ray P. Baker, then professor of English, was responsible for the development of the last course, and at the meeting of the board held December 4, 1924, he was made head of the department of arts, science, and business administration. In 1931, in recognition of his ability and efficient work for the school, he was made assistant director. In developing these distinct courses in science in each of which, as in the engineering courses, all subjects are required and none is elective, the Institute did not, in any sense, depart from either its customs or its ideals. It had always been a school of science as well as of engineering. In its earliest years science predominated, and its early reputation was made mostly by men whose specialty was applied science in other branches than the then little-practiced profession of engineering. In later years emphasis had been laid more on engineering than on the subjects ordinarily classified under "Science," but it had never been in the minds of the trustees to confine its courses to engineering alone and so change the object and restrict the influence of the school: to throw away one of the great opportunities for usefulness which was intended to be and always had been one of its functions.

The object of the establishment of the course in arts, science, and business administration was not only to provide a cultural and business course for those who did not intend to become engineers but to arrange a course for those who intended also to take the last two years of any of the engineering courses and thus be graduated in six years with the science and engineering degrees. In other words, without interfering in any way with the four-year engineering courses, which probably would remain the backbone of the school for many years, a six-year undergraduate course of the highest type was provided.

A five-year course for those who desired to take a year of instruction in business subjects after having been graduated with one of the engineering degrees was also arranged. This was an ideal solution of the six-year engineering school problem: providing a more general education, business subjects, and instruction in public speaking, in connection with an engineering course, for those who desired it, without in any way interfering with the four-year engineering curriculums. The course in chemistry was intended for those who wished to become chemists rather than chemical engineers, the course in physics for those who wanted to do advanced work in physics, including electricity, and the course in biology for those who desired to enter medical or dental schools or pursue research in biology.

At this time, 1924, eight special courses were provided leading to degrees in engineering and science. The next course to be created was the architectural, organized in 1929, the first class beginning work in September of that year. When the curriculums were re-organized, in 1849–50, Director Greene laid special emphasis upon the advisability of establishing a department of architecture as well as one in engineering and he developed, at that time, *the first curriculum for a course in architecture to be created in any institution of learning in this country.* Lack of funds prevented the organization of this course. Every course previously established had, up to this time, a beneficial effect upon those previously existing and there was no reason to think otherwise of the architectural course. As architecture is a science as well as an art, it was appropriate that such a course should be available in a school of science and engineering, particularly the latter, since criticisms of engineering works on account of their want of architectural beauty were then, as now, common and often quite just. As a result most of the engineering curriculums now contain courses in architecture.

At a meeting of the board of trustees held February 16, 1933, three new courses in aeronautical, in industrial, and in metallurgical engineering were authorized, and these were begun in September of the same year. The first two years of all are practically the same as those of the other engineering courses. Most of the divergence in them begins in Division B. All three courses had been demanded more and more by entering students, and had been successfully inaugurated in other similar schools. The aeronautical course was especially in demand, and thirty-one students were enrolled in the first class established in the school.

Twelve courses are now given, of which seven are in engineering—civil, mechanical, electrical, chemical, aeronautical, industrial, and metallurgical—all leading to engineering degrees. The other five are in chemistry, in physics, in biology, in arts, science, and business administration, and in architecture.

The establishment of the architectural course made necessary the erection of a building for that department, and this structure, built of Harvard brick with limestone trimmings, 165 feet by 65 feet, in plan, five stories in height, was constructed along the south line of the campus adjacent to the athletic field. It was completed in 1931, built with money accumulated in the Bankers Trust Fund, at a cost of $400,000. The furniture cost $25,000. It is called the Greene Building in memory of B. Franklin Greene. The three upper stories are devoted to the architectural department, and the others are used by other departments. It is very suitable for its purpose. One drawing room, with a north light, is 168 feet long and 25 feet wide. The names of fifteen of the most renowned deceased American architects are cut in stone above the second-story windows: Bulfinch, Burnham, Goodhue, Hooker, Hunt, Jefferson, Latrobe, McComb, McIntyre, McKim, Mills, Renwick, Richardson, Sullivan, and Upjohn.

Commencement exercises were held in the '87 Gymnasium for the fifteen years following its erection in November, 1912, though, as a stage had to be erected each year and movable chairs provided, it was not a very convenient place for such a purpose. In 1926 the trustees began to consider the advisability of erecting a building to contain a large auditorium. They had not thought it advisable, before that date, to build a large hall because such a structure is the most uneconomical of all school buildings on account of the comparatively few occasions on which it is used. But the largest lecture-room, that in the Sage Building, would seat only four hundred persons, and there were at that time more than twelve hundred students. Also the number of volumes in the library had been increasing, of course, and there was room in it for only about 2,500 more. It would not have been necessary or advisable to erect a large building for the library alone. It probably will be always a more or less technical one, and a general library of many hundreds of thousands of books will not be needed for a great many years, if ever. But since there were these two needs, of a library and lecture hall, the trustees decided to erect a building to contain both the library and the hall—the library to have stacks for about 200,000 books and a reading-room large enough to seat 240 students, the hall to have a seating capacity of about 1,400, the stage to be arranged so that the hall might be used by the student musical and dramatic clubs as well as for commencement exercises, alumni meetings, and general lectures. In the course of time the whole building could be used as a library and another hall erected. The building, finished in 1928, is situated on the same level as the Campus dormitory, west of it, along the south line of the campus; it was so placed on account of ease of access to the library and reading-room.

At the meeting of the board, held May 6, 1926, it was resolved that the building should be called Amos Eaton Hall in memory of the great teacher and scientific man who was the first senior professor and director of the school. The structure, completed and furnished, cost about $320,000. The board decided to finance it without asking the alumni to subscribe towards its cost.

Before 1870, classes were graduated either on Tuesday or Thursday. From 1871 to 1920 commencement day was Wednesday. In 1921 it was changed to Friday and alumni day was Saturday. In 1926 another change was made and classes were graduated on Monday, alumni day remaining on Saturday. In 1929 and since then Saturday has been commencement day. The alumni meeting is held at half past ten in the morning, with lunch at half past twelve, and the commencement exercises are at two o'clock in the afternoon. The alumni dinner occurs at half past six, so that all the exercises take place on one day, though there is an informal smoker Friday evening.

At the annual meeting of the board of trustees in May, 1913, graduate courses leading to master's and doctor's degrees were established. The former were one year in duration and at that time were conferred in the five subdivisions corresponding to the undergraduate courses then given. That is, they led to the degrees M.C.E., M.M.E., M.E.E., M.Ch.E., and M.S. Three years, two of which must be spent in residence, were required for the doctor's degrees, of which three were given: doctor of science, Sc.D.; doctor of philosophy, Ph.D.; and doctor of engineering, Eng.D. These courses could be taken only by graduates of higher institutions of learning whose undergraduate courses and the character of whose undergraduate work fitted them, in the opinion of the faculty, to take them. The major work might be taken in any one of the eleven subdivisions in engineering or science given at that time: railroad engineering, highway engineering, hydraulic engineering, sanitary engineering, structural engineering, steam and gas engineering, machine design, electrical engineering, chemical engineering, chemistry, and pure and applied mathematics.

After 1916 the degree doctor of science was no longer given in course but was used as an honorary degree. Doctor of philosophy, Ph.D., was then given all students taking graduate courses leading to a doctor's degree in mathematics or pure science, and doctor of engineering, D.Eng., for those taking the engineering courses. The master's degree, M.S., remained as given in 1913 and has so remained to the present time. In 1933 it was decided that after 1936 the bachelor's degree for all undergraduate engineering courses should be given, as it had been, since their inception, for all other undergraduate courses. At the same time it was determined that for graduate students the degrees master of civil engineering, M.C.E., etc., and doctor of civil engineering, D.C.E., etc., should be given engineering students, keeping the general term, doctor of engineering, D.Eng., as an honorary degree. The degrees given in course in civil engineering are now C.E., M.C.E., and D.C.E., but after 1936 the C.E. will not be given at graduation. The bachelor's degree, B.C.E. will then be given and the "professional degree," C.E., will be conferred, three years after graduation, upon those graduates who have been practicing the profession. From the time graduate degrees were first given in 1916 to the year 1933 inclusive, the number of master's degrees given in course was one hundred and thirteen and the number of doctor's degrees was thirty-six.

The first honorary degree, that of civil engineer, was conferred by the trustees in 1882 upon Charles H. Fisher, chief engineer of the New York Central and Hudson River Railroad Company, who had been a student in the class of 1853. The same degree was conferred upon Luiz daR. Dias, chief engineer of the Bahia and Caribbean Railroad Company, Brazil, who had been graduated in the class of 1860 as a topographical engineer. In 1884 the degree of civil engineer was given William B. Cogswell, formerly of the class of 1851, chief engineer and general manager of the Solvay Process Company of Syracuse, New York. At the same time the degree doctor of philosophy was conferred upon James C. Booth, director of the United States Mint at Philadelphia, who, in 1831, had been a student at the school and an assistant to the senior professor. No other honorary degree was conferred for thirty-three years—not until 1916 when Robert W. Hunt, president of Robert W. Hunt and Company, Engineers and Inspectors, was made doctor of engineering. At the centennial celebration in 1924, thirteen honorary degrees in engineering or science were conferred upon eminent men who attended. Included in this number were three delegates from France, Italy, and England, each of whom received the degree doctor of engineering. A complete list of all those upon whom such degrees have been conferred by the board of trustees is given in Appendix VI.

In 1930, the question having arisen regarding the right of the trustees to confer honorary degrees, since the laws relating to the school did not specifically give them that power, it was thought best to ask the Legislature to settle the matter, and accordingly an act was passed, which became a law February 26, 1931, giving the school that right. The text of this act will be found in Appendix VII. At this time the regents confirmed the right of the board to give the honorary degrees doctor of engineering, doctor of science, and doctor of laws. The only doctor of laws, LL.D., yet conferred was given in 1931 to William Leland Thompson, regent of the University of the State of New York. The total number of honorary degrees conferred, including those in the year 1933, is thirty-eight, as follows: C.E., 3; M.C.E., 1; Ph.D., 5; Sc.D., 3; LL.D., 1; and D.Eng., 25.

In 1932 it was decided to appoint a committee of three members of the board, one of whom should be changed annually, to suggest, each year, to the board names of those who, in their opinion, were worthy of the honor of having such degrees conferred upon them. The first committee was composed of Thomas Earle, '87; Morris R. Sherrerd, '86; and John N. Shannahan, '94.

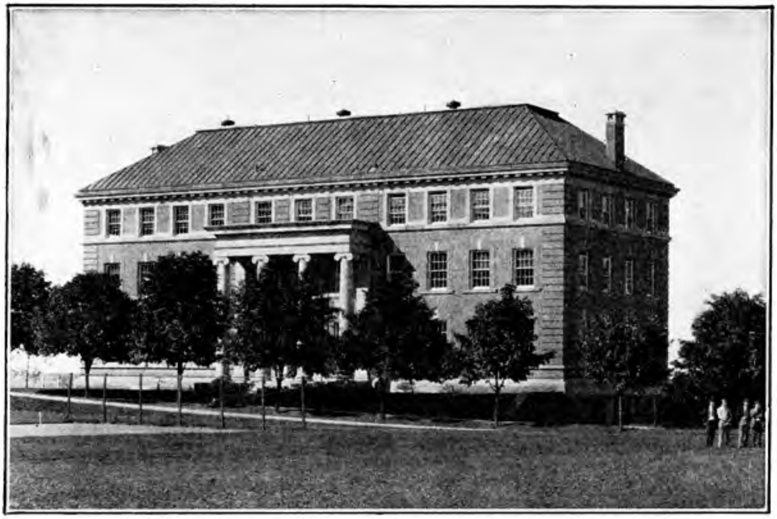
In 1910 the Institute offered scholarships giving free tuition to the five male graduates of high schools and academies in the State of New York who, of all applicants, obtained the highest marks in examinations held by the Regents, in the subjects necessary for entrance. Not more than two scholarships could be obtained by candidates from any one county. This practice has been continued each year since then. Each year there are twenty students holding these scholarships.

In recognition of the interest taken in the Institute and the aid given it by the Pittsburgh Alumni Association, the trustees, in 1911, created a Pittsburgh Scholarship giving the Association the privilege of keeping one student from Pittsburgh always at the Institute without the payment of tuition.

The value of a perpetual scholarship, which permits one student to be kept constantly at the Institute without the payment of tuition, was fixed by the trustees in 1910 at not less than $7,500. In 1930 the price was fixed at $8,000. The first of these scholarships was established in 1913 by Charles Wiggins, of the class of '78, and the board gave it his name. Since then the following perpetual scholarships carrying free tuition, $400 a year, have been established: In 1914 the Alfonzo Bills, by the will of Mrs. Charlotte H. Knight, for students from the Troy High School; in 1916, the Graham and Emmeline H. Blandy, by Isaac C. Blandy, '87, for students from Washington County, New York; in 1922, the Julia Buchman, by Edwin Buchman, for students from the Lansingburgh High School; in 1925, the Helen G. Williamson scholarships, two in number, by a bequest of Helen G. Williamson, for students from Troy; in 1928, the Lewis Neill Hopkins, Jr., by Mrs. Alfred H. Renshaw; in 1929, the Edward F. Murray, by Mrs. Edward F. Murray, for students from St. Joseph's Parish, Troy, or any Roman Catholic student from the city of Troy; in 1930, the John S. Cronin, by Frances H. Cronin, for students from the public or parochial schools of Troy.

In 1913 the sum of $30,000 was given by Mrs. Russell Sage to establish two fellowships of $15,000 each, with the understanding that the interest from each was to be used for the support and instruction of a graduate of the Institute, or of some similar institution, who should pursue his studies for the master's or doctor's degree at the school under rules formulated by the board of trustees. She stipulated that they should be called the Russell Sage, 2nd, Fellowships, in memory of Russell Sage, 2nd, who was graduated from the Institute in the class of 1859. In 1923 the trustees established ten graduate fellowships in engineering and science to be awarded under rules laid down by the faculty, each one to carry with it free tuition and a stipend of $600 a year in cash. No special fund has been given for these fellowships. The payments are made from the general funds of the school. The Sage Fellowships, of the same value, make the total number twelve. A student on one of these fellowships is given a master's degree after one year's satisfactory work and a doctor's degree, if he fulfills the requirements, in three years. Only graduates from institutions of high grade and only those who have taken high rank in their studies are given these fellowships. While holding them students must remain in residence at the Institute the entire year for the master's degree and at least two of the three years for the doctor's degree.

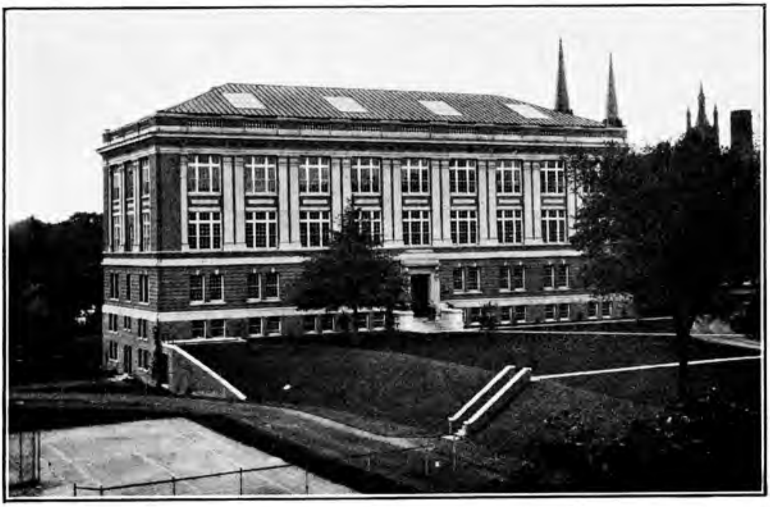
No good reason has ever been given for the erection of the Alumni Building on Second Street, so far away from the other buildings and so far below them. Its use as the office of the director was extremely inconvenient. The library, while in it, was almost useless. The collections housed in it compelled its use for the teaching of geology and mineralogy, to the great inconvenience and loss of time of students all of whose other recitations were conducted in the buildings half a mile away from the Alumni Building and on the hill about one hundred feet above it. When the Warren property was bought and buildings began to be erected still farther up the hill and the number of students began to increase greatly, the inconvenience became still greater and the trustees exercised great self-restraint in not using a part of the Sage gift for a new administration building. They wisely decided to wait for a time and see whether a building, of such value and importance, would not be presented. It was presented toward the end of 1909 by the Pittsburgh Alumni Association, which decided to give $125,000 for this purpose. Appropriately named the Pittsburgh Building, it is perhaps unique among buildings owned by institutions of learning in this country in the fact that it was presented by the alumni of a single city. It was designed by W. G. Wilkins, '79, of Pittsburgh, who gave his ser-



Troy Building, 1925–

The Terrace Dormitories, 1932–

Amos Eaton Hall, 1928–



Greene Building, 1931–

vices as an architect without compensation. Built of Harvard brick and Indiana limestone like the others, it was completed in 1912.

Situated on the winding road through the grounds, partly on the site of the Ranken House, which was razed to make way for it, two of its five stories are below and two above the main floor, which is on the road's level. At first the library, book-stacks, and reading-room were housed in it, but these were removed to Eaton Hall upon its completion in 1928. The main floor now contains a room for the meetings of the trustees and of the faculty, the offices of the president, treasurer, and registrar, and a drawing-room which is also used by the department of geology and mineralogy. This department has its museum, offices, and a lecture-room on the floor above. The rest of the building is occupied by the publicity department and recitation rooms. The structure was formally presented and dedicated on alumni day, June 13, 1911, the presentation speech being made by George S. Davison, '78, of Pittsburgh, a trustee of the school. The total value of the building, including an allowance for the architect's fee, is $132,400. The contents, including books and specimens, is valued at $80,000.

In the description of the Pittsburgh Building it is seen that the whole floor above the main one is devoted to instruction in geology and mineralogy. More than half of the space is taken up by the museum. When the collection was moved from the Alumni Building the floor space was doubled, new cases, valued at $20,000, were provided, and new specimens were bought to round out and complete the minerals as well as the rocks and fossils. There are altogether about 15,500 specimens, in the museum, valued at $25,000, besides 9,000 more used for class instruction. These collections compare very favorably with those of the larger universities. The mineralogical collection is in some respects better than that of the state.

When the number of students began to grow larger, and especially after the purchase of the Warren property and the land between it and Fifteenth Street, an agitation began for an athletic field and a gymnasium on the upper level of the campus. The gymnasium on Broadway was much too small, was not of modern design, and was nearly 150 feet below the level of the surface of most of the new land. Members of the class of '86 agreed to bear the expense of filling in a depression in a part of the new land, and thus in the summer of 1906 the '86 Athletic Field was constructed at a cost of about $7,000.

In 1910 the trustees appointed a committee of the board, consisting of Messrs. W. F. Gurley, J. H. Caldwell, and A. H. Renshaw, to investigate the feasibility of the establishment of a department of physical culture. They employed Dr. Sargent, of Harvard University, who reported that the gymnasium on Broadway was entirely inadequate for the use of the number of students then in the school. The committee concluded, after careful investigation, that a completely equipped, modern gymnasium was necessary for the establishment of a department of physical culture. In June, 1910, the Alumni Association appointed a committee consisting of Tracy C. Drake, '86; R. B. C. Bement, '69; E. V. Z. Lane, '75; F. C. Osborn, '80; and P. W. Henry, '87, to solicit funds for a new gymnasium. At the next June meeting the committee reported that about $25,000 had been subscribed. This could not be considered a very small amount when it is remembered that the alumni had contributed hundreds of thousands of dollars to the Institute in the five years preceding this time. It was not necessary for the committee to continue its work, however, for at this meeting Stewart Johnston, of the class of '87, a member of the board of trustees, announced that his class would give $150,000 for the erection and equipment of the building. The erection was begun in August of the same year, but the construction was delayed and the structure was not ready for use until November, 1912.

The building is situated toward the northeast end of our main plot adjacent to the athletic field and near Sage Avenue. In outside measurement it is 126 feet long and 73 feet wide. In appearance it is similar to the other new buildings, having faces of Harvard brick with trimmings of Indiana limestone. Fireproof construction is used throughout. The basement contains a swimming pool 30 by 75 feet in size. There are four bowling alleys in a room beside the pool. Most of the 1,204 lockers are in the room containing the shower baths on a mezzanine floor above the alleys. The first floor, which is entered from the athletic grounds, contains a basketball room, a squash court, a room for wrestling and fencing, a room for inside baseball practice, rooms for measuring and weighing students, and the office of the professor of physical training. The main floor, for gymnastic practice, is above the first floor, and is 120 by 67 feet in size. There is a running track of twenty laps to the mile, supported on wall brackets and suspended from the roof trusses, around the sides of this room. The building cost $145,000, and the apparatus and furniture $16,600, a total for both of $162,000. The class gave $163,000. The formal presentation to the trustees took place on June 13, 1911, though the structure was not finished at that time. The presentation address was made by Stewart Johnston.

The trustee committee, in the meantime, had recommended compulsory athletics for members of Division D. This was carried into effect, and the class of 1916 was the first class to use the gymnasium in this way. A lecture course on hygiene, three weeks in duration, is given members of Division D as soon as they matriculate. In the meantime each member of the class is subjected to a careful physical examination and at the end of the lectures his compulsory exercise, of an hour a day for three days one week and two the next, begins and lasts for the remainder of the year. Field athletics at certain seasons may take the place of this exercise. Naturally many students besides the members of Division D use the gymnasium.

When the class of '87 agreed to give this building, many of the subscribers to the Gymnasium Fund changed their subscriptions to a Library Fund, the interest of which is to be used to help maintain the library. The sum of $2,400 originally subscribed for the Sage portraits was also placed in this fund, which amounts to $22,400. The library is first mentioned, in the earliest pamphlet containing the constitution and laws of the school, which is dated March 11, 1825, as "a very ample scientific library, to which the members of the institution will have free access." Ample, in this case, certainly must have been a relative term, though Douglass Houghton of the class of 1829 wrote of the "reading room which contains a fine library." * As has been noted before, there were, in 1846, three hundred and ninety-six volumes of an estimated value of $973.45. After the fire of 1862 the library was placed in a room on the second floor of the Main Building when it was finished in 1864. This remained the faculty room and library until the completion of the Alumni Building in 1893, when the books were moved to the first floor of this building. In 1894 it contained about six thousand volumes and three thousand pamphlets. The professional library and drawings of Alexander L. Holley, formerly a trustee of the Institute, were bequeathed to it in 1882. In February, 1912, the books were transferred to the Pittsburgh Building. Up to this time the school could scarcely be said to have had a

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* See Appendix I.

library of much use to the students. It had been catalogued only imperfectly and for twenty years had been almost inaccessible to the students on account of its distance from the other buildings. In 1912, however, the librarian and assistant began a card catalogue which has been continued to this time. The library is composed, with few exceptions, of volumes and pamphlets relating to science and engineering. The books remained in the Pittsburgh Building only sixteen years. In 1928 they were removed to Eaton Hall, before described, which was built especially for them and for an auditorium for commencement exercises. At the present time the library contains 24,896 books and 24,527 pamphlets. Two hundred and ninety-four periodicals are received. The number of cards in the catalogue is 64,362.

Through the generosity of Mr. Seymour Van Santvoord of Troy the Institute has been made a member in perpetuity of the Archaeological Institute of America and will hereafter always receive all its valuable publications.

In 1912 the Institute was admitted to the list of accepted institutions of the Carnegie Foundation for the Advancement of Teaching. By this arrangement certain members of the faculty, now only eighteen in number, may be retired upon reaching the age of sixty-five years, if the school desires it. The retiring allowance depends upon the salary received by the teacher. If the teacher dies while upon a retiring allowance, his wife, if she has been married to him for ten years, may receive one-half of his allowance during her life. In 1931 the trustees of the Foundation closed the list for all institutions until 1985, so that no teachers of the Institute not now on the list can enjoy this benefit of the Foundation.

The celebration of the hundredth anniversary of the establishment of the Institute took place on October 3 and 4, 1924. Arrangements were made for the reception of guests on the afternoon of October 2, and fraternity, society, and class reunions were held that evening. On Friday morning, October 3, addresses were made by Honorable Herbert Hoover, Secretary of Commerce, who brought the congratulations of the president of the United States, and by the governor of the State of New York, the mayor of Troy, the president of the University of the State of New York, and by representatives of engineering societies of England, France, and Italy. In the afternoon a large bronze tablet was unveiled commemorating the occasion, on the granite Approach, at the head of Broadway, on the site of the Main Building destroyed by fire in 1904. Also a tablet to S. Wells Williams, '32, the Orientalist, placed in the Carnegie Building, was unveiled by the Chinese Minister to the United States. In the evening a dinner, of about a thousand covers, was given to delegates and alumni, and a pageant, representing events of interest in the history of the school during the hundred years, was enacted on the campus at the rocks near the east end. On October 4, in the morning, short addresses were made by presidents of universities and schools of engineering, by the presidents of four national engineering societies, and by the president of the National Academy of Science. In the afternoon there was an alumni meeting and in the evening an alumni smoker and a repetition of the pageant. During the ceremonies thirteen honorary doctorates were given. The institutions, associations, and societies sending delegates numbered 250. Seventy-two of these organizations were in 23 foreign countries. The number of foreign organizations sending formal congratulations but not delegates was 98 in 29 political subdivisions. Some of the engrossed congratulations were very handsome, and many were in foreign languages. Thirty of them were framed and hung in the reading-room of the library. The list of delegates contains the names of 76 presidents of organizations. Beside the above, 19 of the Institute's alumni associations and 64 classes were represented on the list of delegates. The pageant was very beautiful. The proceedings were published, in April, in a book of 192 pages a copy of which was sent to each delegate, to the library of each organization sending congratulations, to certain other libraries in this country and abroad, and to each alumnus of the Institute.

CHAPTER X

ALUMNI AND STUDENT ORGANIZATIONS. PUBLICATIONS. STATISTICS OF GRADUATES

EVER since the reorganization of the Institute by B. Franklin Greene each candidate for a degree has been required to present a thesis on some subject germane to his course. Such theses are read at commencement, and one of the conditions for graduation is that they must be approved by the faculty. In order to improve their quality Charles Macdonald, of the class of 1857, established, in 1890, a prize consisting of the net annual income from $2,000, to be given to that member of Division A, in each year, who should, on graduating, present the best thesis involving a design for an engineering work or an investigation of a process or natural product, or of a natural law of especial interest to civil engineers. It has proved of much value as it increases the interest taken in their theses by those students competing for it, and incidentally has been effective in improving the character of all which are presented. When the other engineering departments were established it was concluded that the Macdonald prize must still be competed for only by students from the department of civil engineering. However, in 1928, Palmer C.

Ricketts, of the class of 1875, established three prizes, each of the same value as the Macdonald prize, and with the same requirements, but with the proviso that one be awarded to a student from each one of the departments of mechanical, electrical, and chemical engineering. The names of the successful competitors for these prizes for each year since 1891 are given in Appendix VIII.

In 1927 the class of 1902 established a research prize, which consists of the net annual income from $3,000. It is awarded at commencement to the student, from any department, who presents the best graduating thesis involving an experimental research in any branch of engineering or science. The names of the successful competitors are printed in Appendix VIII.

The Alumni Association of the Institute was organized at Troy on June 22, 1869. Annual meetings are held on commencement day of each year at Troy, and winter reunions, some time during February, in one of the larger cities of the country containing a considerable number of resident graduates. Such meetings have been held in New York, Philadelphia, Pittsburgh, Buffalo, Kansas City, Cleveland, Rochester, and Albany; a most successful one was held in Havana in 1930. A summer meeting was held during the Columbian Exposition in Chicago in August, 1893, and one during the Century of Progress Exposition in Chicago in 1933. The first general reunion was held February 18, 1881, in New York, at the residence of Hon. Clarkson N. Potter of the class of 1843. The names of graduates who have been presidents of the Association, with their terms of office, are given in Appendix IX.

Twenty-four local alumni associations have been formed, of which twenty-two are still in existence. The names of these with the years of their formation follow: Pittsburgh, 1888; Chicago, 1889; New York, 1893; Rochester, 1911; Eastern New York, 1911; Central New York, 1915; Philadelphia, 1918; Buffalo, 1919; District of Columbia, 1920; Schenectady, 1920; Central Hudson, 1922; Hartford, 1922; Southern California, 1922; Troy, 1923; Utica, 1923; Cleveland, 1924; Cuba, 1924; Western Massachusetts, 1925; Detroit, 1926; Albany, 1929; Boston, 1930; and Central New Jersey, 1932. One formed in Kansas City in 1888 and the New Jersey in 1917 are no longer in existence. The latter has been replaced by the Central New Jersey, 1932.

In past years a number of attempts were made by undergraduates to publish periodicals in the interest of the students and alumni of the school. The first number of the *Rod and Leveller* appeared November 18, 1865; and in May, 1884, the *Rensselaer Polytechnic Institute Quarterly* was issued for the first time. These failed shortly after their inception. A successful effort in this direction, however, was made by Tracy C. Drake of the class of 1886, and the first number of the *Polytechnic,* with him and A. R. Elliott as editors, appeared February 16, 1885. It was issued as a monthly, quarto size, during the scholastic year, until September 13, 1921, when it was changed to newspaper form, eighteen by twelve inches in size, of eight pages, and called *Rensselaer Polytechnic.* It is well supported by students and alumni. Since 1908 the paper has been under the management of the Rensselaer Union and has its headquarters in the club-house. It is published by a board of editors from different classes, and each issue contains scientific and literary articles and news items relating to the school and its graduates.

The *Transit,* an annual issued under the auspices of the fraternities by a board of editors selected from members of Division B, has been published for sixty-eight consecutive years. The first number, dated December, 1865, was issued by the class of 1867. Beside the roll of members of the classes, fraternities, and societies, it contains lists of members of the athletic, glee, and other clubs, and miscellaneous organizations. The *Transit* of the class of 1934 is a profusely illustrated book of 392 pages. Lately each edition of these books about 500 in number has cost around $4,000.

The "Hand Book," a little pocket-book giving information about the Institute of value to new students, was first issued by the Young Men's Christian Association of the school in 1893. When this association became a part of the Rensselaer Union the publication was continued by the Union and it is now published by the *Polytechnic* board. It now contains about 150 pages and is distributed free to incoming students.

In 1912 and 1913 the *Polytechnic* board compiled a book of "Songs of Rensselaer." It is a quarto of 120 pages of songs set to music. About a dozen were written especially for the school, and the others are college songs popular at the Institute. The first, "Old Rensselaer," was written by Mrs. E. S. Jarrett in 1908, and was dedicated to the class of 1889. The music, an old Welsh air entitled Ar Hyd y Nos, was selected by E. S. Jarrett, '89. The words follow:

Thou hast sent us forth to labor,
    Old Rensselaer.
We have wrought to win thy favor
    Year after year.
Steel to wield and stone to shiver,
Sink the mine and span the river,
For thine honor toiling ever,
    Old Rensselaer.

When thy sons are met together
    From far and near,
Scarred with service, worn with weather,
    Old Rensselaer,
Proud they lay their deeds before thee,
Done to show the love they bore thee,
Stronger grown as years pass o'er thee,
    Old Rensselaer.

When they write our nation's story,
    Splendid and clear,
Surely great shall be thy glory,
    Old Rensselaer.
In their works thy sons enshrined thee,
Mighty works to leave behind thee,
Motherland, let these remind thee
    Of old Rensselaer.

This song was so musical and appropriate, so clearly representing the ideals of the school, that the trustees placed a bronze tablet containing its words in the hall of the Pittsburgh Building.

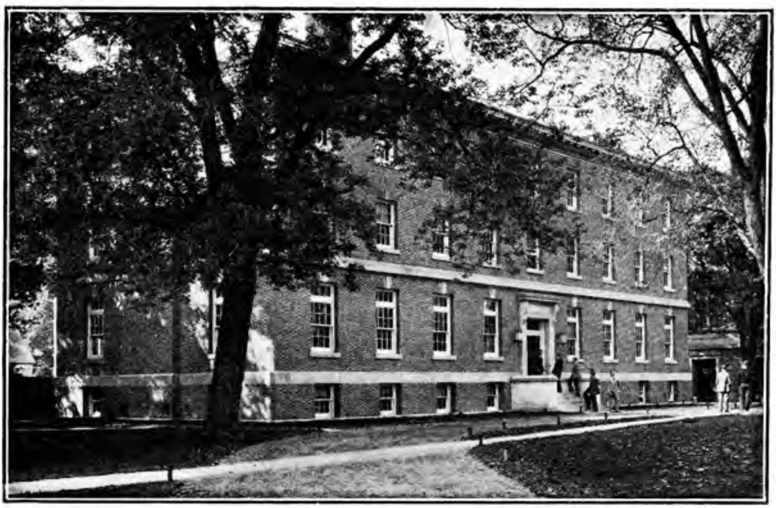
It is believed that the first publication issued by the trustees of Rensselaer School was a pamphlet of twenty-three pages entitled "The Constitution and Laws of Rensselaer School, in Troy, New York; adopted by the Board of Trustees, March 11, 1825." It is dated March 14, 1825. Reference to it and its contents is made in a footnote on a preceding page. There was not much regularity in either the number of pages or the date of issue of the earlier "notices" of the school. Until the reorganization in 1850, after which the *Annual Registers* were published once and often twice a year, the "notices" varied in length from one to forty pages, the latter issue containing a digest of the rules of the school and a triennial catalogue of the students. The names of the students were not regularly published until 1847, after which date they appeared in each issue of the catalogue. The names and addresses of graduates first appeared in the *Register* of November, 1860, in which they occupied three pages. In the catalogue of 1933 they, with the index and geographical index, occupy 230 pages. The index was printed for the first time in the *Register* of October, 1866, and the geographical index in that of June, 1890. The *Annual Register* of March, 1902, was published as Volume I, Number 1, of a series of Rensselaer Polytechnic Institute *Bulletins,* which appear quarterly and are issued in March, June, September, and December. In 1903 the name of the March *Bulletin* was changed from *Register* to *Catalogue,* to make it conform in name to similar publications of other educational institutions. Since then the quarterly numbers have appeared regularly, containing generally either descriptions of the laboratories, methods of instruction, views of the campus and students, or pamphlets describing the work of graduates. One of the latter, no longer published, entitled "A Partial Record of the Work of Graduates," gave the names of many of the alumni who had attained high rank in the profession; another of 144 pages, called "Photographic Reproductions of Work of Graduates," has a preface, only, in text, followed by 264 half-tone illustrations, showing some of the great engineering constructions with which graduates have been connected as designers or constructors. The number of each issue varies generally from 15,000 to 20,000 though 250,000 copies of the December *Bulletin* describing the grounds, buildings, and curriculums, are sometimes printed. The Commencement number of Volume VI, 1907, contains a description of the dedication of the Carnegie Building; that of Volume VIII, 1909, is entitled "The Formal Opening of the Russell Sage Laboratory"; the dedication of the Pittsburgh Building is described in an extra to No. 2, Volume XI, 1912, and that of the '87 Gymnasium in No. 4 of the same volume.

A number of editions of an illustrated pamphlet in the Spanish language, entitled "Boletin del Instituto Politécnico de Rensselaer," have been issued in recent years. These are sent to applicants for catalogues in Spanish-American countries.

A list was published in 1930 of the names of all students of every character who attended the school as much as half a term from 1824 to 1929 inclusive, except those who were present only during the existence of the Student Army Training Corps, in 1918, during the World War, and who left immediately after the Corps was disbanded. The *Register* is in three parts: the names and addresses by classes, the geographical index, and the alphabetical list. The names, taken from the records, are correct. Not all the addresses are correct, and the necrology cannot be complete. The book of 420 pages contains the names of 9,659 former students, 7,621 listed as alive and 2,038 as dead.

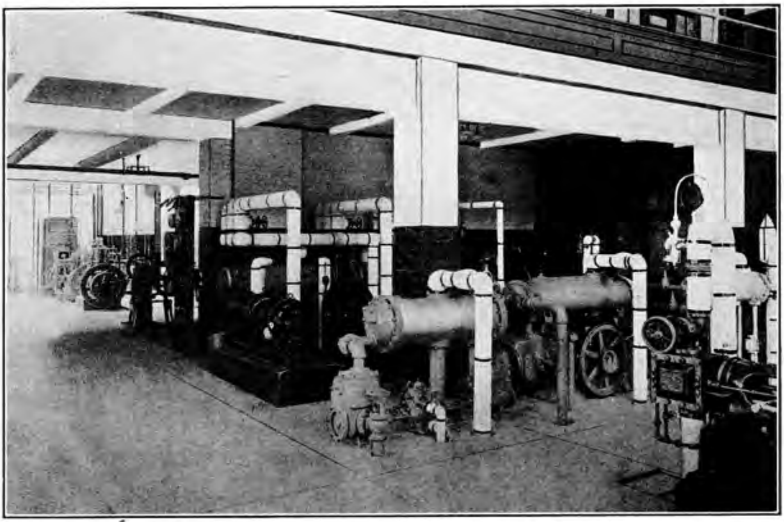
Besides the *Bulletins* there is an "Engineering and Science Series," published by the authorities of the school. The first number appeared in February, 1911, and the others have been published at irregular intervals since that time. The last was No. 45. The results of investigations made in the laboratories of the school, whether by professors or students, are given in these pamphlets. Besides these, researches in the various departments are continually being made and the results are continually being published. In addition to many shorter articles, reviews, and contributions to encyclopedias, handbooks, and journals of various descriptions, the members of the faculty of the Institute published more than two hundred books and major articles during the five years ending with 1933. Contributions have been made to more than fifty leading periodicals. The value of these investigations was recognized by Louis E. Laflin, of the

Lounge Room in Club House



Rensselaer Union Club House, 1932–

Steam Laboratory



View from Steam to Gas Engine Laboratory class of '82, who gave the sum of $10,000, the interest on which is to be used to pay for materials and apparatus used in such work. Of course the Institute appropriates annually very considerable sums to aid in research.

The first college fraternity to establish a chapter at the Institute was the Theta Delta Chi. The Delta chapter was chartered in 1853, remained until 1870, was re-established in 1883, and ceased to exist in 1896. Eighteen exist at present: the Alpha chapter of Theta Xi (1864), Lambda of Delta Phi (1864), Psi Omega of Delta Kappa Epsilon (1867), Theta of Chi Phi (1878), Upsilon of Delta Tau Delta (1879), Beta of Phi Iota Alpha (1931), Delta of Theta Chi (1907), Gamma of Phi Sigma Delta (1913), Delta Mu of Alpha Tau Omega (1922), Kappa of Kappa Nu (1920), Zeta of Alpha Phi Delta (1921), Rho of Phi Kappa Tau (1922), Sigma of Phi Kappa (1925), Lambda of Theta Nu Epsilon (1926), Nu Theta of Phi Mu Delta (1929), Sigma Zeta (1930), Alpha Tau of Pi Kappa Phi (1931), Kappa of Delta Sigma Lambda (1933). The Pi chapter of Zeta Psi was established in 1865 and withdrawn in 1893. Several others were chartered at various times but were withdrawn after an existence of one or two years. Phi Iota Alpha was formerly the Union Hispaña Americana founded by a group of Latin-American students at the Institute in 1898—the first such association to be founded in the United States. Pi Kappa Phi was formerly the Rensselaer Technical Society established at the Institute in 1904.

All these fraternities have chapter houses. Two, the Chi Phi and the Theta Xi, have built houses for themselves. The Chi Phi house was built in 1912 and the Theta Xi in 1931.

There are also four local fraternities, not affiliated with national ones: Beta Psi, Phi Epsilon Phi, Pi Kappa Pi, and Alpha Sigma Tau.

Many times during the past few years general secretaries of some of the national fraternities having chapters at the Institute have asked for the relative scholastic standing of the students in their chapters but the request has always been refused because the rules of the board of trustees prohibit such comparison. In 1931, however, it was decided to investigate the relative standing of the chapters of the fraternities and societies themselves here and publish them in four groups each arranged alphabetically. It is hoped that this will have a beneficial effect upon the scholarship of some of the students.

The Pi Eta Scientific Society, organized in January, 1866, became afterwards the Rensselaer Society of Engineers, which was incorporated by act of legislature in May, 1873. Papers are read by the student members at the meetings throughout the year and scientific lectures are also delivered at intervals by graduate members of the society and others. This society built a house for itself in 1924.

The Zeta chapter of the Sigma Xi Society was established at the Institute May 6, 1887. This society is modelled to some extent after Phi Beta Kappa, though it is not a secret society. Its undergraduate members are chosen only from those who have distinguished themselves in scholastic work.

The Gamma chapter of Tau Beta Pi was established at the Institute in 1908. It is an honorary engineering society. It was soon withdrawn, however, when it was found that it would be necessary to arrange students of Division B in order according to scholarship. This could not be done as it was forbidden by the rules of the board of trustees.

Eight student scientific organizations are in existence at the present time. Each one has a meeting once a month during the scholastic year. Four of them are student branches of the four great national engineering societies; the civil, established in 1915, mechanical (1910), and chemical (1923) engineering societies, and the Institute of Electrical Engineers (1910). The others are the physics (1932) and architectural (1933) societies and the economics (1933) and biological (1927) clubs. Monthly meetings of these organizations are held, at which papers are read and discussed.

An organization called the Student Council was established in March, 1910, with a constitution ratified by the faculty and board of trustees. Its object, as defined by the constitution, is "to furnish a high reward of merit for conscientious effort in furthering the best interests of the Institute and its undergraduate organizations and to provide a representative body of men who, by virtue of their diversity of interest and influence, may be able fairly to represent the sanest phase of undergraduate opinion and form a link between the undergraduate body and the Faculty and Board of Trustees for the purpose of concerted effort along any line where such effort seems necessary and advisable."

The Council is given authority to take into consideration the conduct of any student or body of students detrimental to the best interests of the Institute and to recommend to the authorities such action as it may deem advisable. It is expected particularly to investigate all cases of wilful destruction of property of the Institute. Questions of interest to the student body are referred to it from time to time by the president. It has the power to confer with the faculty and prudential committee of the board of trustees, but it may only recommend and has no executive authority. It consists of the grand marshal, ten members of Division A to serve one year, and two members of Division B to serve two years. One member of Division A is chosen from each of the existing societies and fraternities and two from the neutral members of the class. The two members of Division B are neutrals.

A social relations committee was formed in 1933 to bring the trustees and faculty in closer relations with the students. It has to do generally with the social life of the students. It is composed of three trustees, five members of the faculty, and six students—fourteen altogether. One of the faculty is an advisory member of the Interfraternity Council. The six students include the grand marshal, the president of Rensselaer Union, the president and secretary of the Interfraternity Council, and two students not connected with any fraternal organization. There is an executive committee of the general committee which consists of four professors and four students. The committee cooperates with students in the regulation of social functions such as dances, general meetings, etc., and also in overseeing the operation of the new clubhouse which, however, has been placed directly under the management of the Rensselaer Union. The committee has advisory and not mandatory powers. Its operations do not interfere with those of any other existing creation of the trustees whether of students or faculty.

The Phalanx is a society composed of members of Division A who have distinguished themselves in athletics and other activities. They are selected at the end of the third year, by the outgoing active members. The society was organized in 1912, by members of the Student Council, with the object of creating a body of students who would promote the growth of and encourage all student activities and interests.

Many students' clubs have been formed at the school from time to time. Some are now in existence and some are not. Among them: the K. C. N. Society of Chemists (1903); the Scalp and Blade, organized as the Buffalo Club in 1907; Phi Upsilon, of students in the chemical department (1906); the Williston Club, composed of graduates of Williston Seminary; the Southern Club, organized in 1907, whose membership is confined to students from the southern states; the Scholarship Club, which takes its membership from those holding scholarships (1911); the Aeronautical Society, organized in 1911; the British Club (1912); the Western Club (1912), eligible only to students from States west of the Mississippi River; the Holyoke Club, of students from Holyoke, Massachusetts; the Chess and Checker Club, and the Campus Club (1913); the Connecticut Club, the New Jersey Club, and the Newman Club—composed of Catholic students—all of which were established in 1914; the R Club, composed of students distinguished in extra-curriculum activities having the right to wear the letter R (1917); the B.O.R. Club, the Bachelors Club of Old Rensselaer (1919); the L.C.R. Club (1922); the Rifle Club (1923); the Springfield Club (1923); the Radio Club (1924); the Biological Club (1927); the dramatic club, called the R. P. I. Players (1929); the Commons Club, composed of students who are not members of fraternities, and the Physics, both of which originated in 1932; the Debating Club, the Bridgeport Club, and the Glider Club which were established in 1933. The Press Club was organized in 1913, to collect and disseminate news regarding events of interest occurring in the school, but it was disbanded in 1933.

For a long time there were four musical organizations: the Glee Club, the Orchestra, the Mandolin Club, and the Band. Of these the Glee Club is the oldest, having been organized in 1860; the Orchestra and Mandolin Club originated in 1872. The latter no longer exists. There are now besides the Orchestra two dance orchestras—the Campus

Serenaders and the Collegians. The number of members of each club varies from ten to thirty, depending upon the available material. Each club has its leader and a manager who makes arrangements for the concerts and takes care of the finances. All these organizations broadcast programs from the Institute station WHAZ, from time to time, and occasionally they give concerts in neighboring towns. The Band plays at all the home athletic contests and at different school festivities held throughout the year.

The Institute has had exhibits at six world's fairs. It sent some students' drawings to the World's Industrial and Cotton Centennial Exposition, held at New Orleans in 1884–5, and received a medal and diploma of the "First Order of Merit" for mechanical and free-hand drawing. It also obtained for its exhibit at the Universal Exposition of the French Republic at Paris, in 1889, the only grand prize awarded to any American scientific school. At the World's Columbian Exposition of 1893, in Chicago, it exhibited the work of its students and graduates and received awards for each, worded as follows: "Superior instruction in matter and method, through its long continued service. Marked attainments of its students in all forms of class work, including topography, railroad maps, mechanical drawing and theses"; and "The magnificent work of its graduates, including (*a*) the arches of the Liberal Arts Building, (*b*) the Ferris Wheel, (*c*) the Brooklyn Bridge, (*d*) the Poughkeepsie Bridge, (*e*) the models of their inventions, (*f*) the bibliography of their publications."

No medals were awarded to any exhibitor at Chicago in 1893. At the Pan-American Exposition in Buffalo, in 1901, a gold medal was given for "students' work and results" and one was received from the South Carolina Industrial and West Indian Exposition in Charleston, in 1902, for "educational methods and results." For the same reason a grand prize was awarded for the exhibit at the Universal Exposition at St. Louis in 1904.

The exhibit at the Century of Progress exposition, in Chicago in 1933, was composed principally of framed photographs showing work of graduates, pictures of laboratories and buildings, framed printed data relating to methods of teaching and changes in the curriculums during the hundred years. The exhibit was remarkable not only in itself but also because no other school of science or engineering in the country could show a century of progress. The exposition authorities gave no awards.

Inquiries having been made, from time to time, for the coat-of-arms of the Institute for use in the decoration of rooms in university clubs in various cities, one was originated in 1904. It was designed by R. C. Sturgis, architect, of Boston. He squeezed up the coat of arms of Stephen Van Rensselaer, vertically, to the top of the shield, and below it placed the three vertical strips using the Institute colors cherry and white. As at that time, the civil was the only engineering course given, the surveyor's target was used on the white middle strip. The legend "Knowledge and Thoroughness" was used by the director because these words seemed to cover two characteristics developed by the Institute course. Some time afterward J. J. Albright, of Buffalo, a graduate, wanted a crest for the decoration of a room in a Buffalo club. For this purpose two concentric circles were put around the shield and "Rensselaer Polytechnic Institute, 1824" placed between them. In 1905 enameled pins were made of the shield, and these have since been worn by many graduates. Undergraduates are not supposed to wear them. They use the button resembling a level rod target. Some years afterwards it was thought that we should have a distinctive flag and the Director originated the one now used: a rectangle divided by a diagonal into two triangles, one cherry and one white, with the letters R. P. I. crossing the diagonal, the parts of the letters on the white background being cherry and the parts on the cherry background being white.

The undergraduate degrees have varied from time to time as the courses have been changed. The first one, A.B. (r.s.), was given only until 1834. When the civil engineering course was established in 1835 the engineering degree given was civil engineer, C.E., and the degree for the science course was bachelor of natural science, B.N.S. Between 1835 and 1850, when the courses were reorganized, students quite often took both of these degrees. After 1850 bachelor of natural science was changed to bachelor of science, B.S., and other degrees corresponding to new courses were given. The curriculum for the course leading to the degree topographical engineer, T.E., was printed in the catalogues issued between the years 1857 and 1866 and that for the course leading to the degree mining engineer in the catalogues issued between the years 1866 and 1870. Although a course in mechanical engineering was established in 1862 and a curriculum for it was printed in the catalogue of that year no one was graduated in this course at that time and it was not retained in the catalogue after 1870. After 1870 the two degrees given were civil engineer and bachelor of science and these were the only ones conferred until 1911 when degrees in mechanical engineering, M.E., and electrical engineering, E.E., were also given, courses in these branches having been created in 1907. The chemical engineering degree, Ch.E., was first conferred in 1915. The bachelor of science degree was given for the four courses in arts, science, and business administration, in chemistry, in physics, and in biology, afterwards established (1925); and for the course in architecture (1929) the degree bachelor of architecture was given. In 1933 it was determined to replace, after 1936, the so-called "professional degrees," C.E., M.E., E.E., and Ch.E., by the bachelor's degrees, B.C.E., B.M.E., B.E.E., and B.Ch.E, and bachelor's degrees will also be given for the three newly created courses in aeronautical, industrial, and metallurgical engineering.

In the one hundred and nine years which have elapsed since the foundation of the Institute, from 1824 to 1933 inclusive, there have been 5,054 graduates. Of these 1,005 are known to be dead, so that about 4,049 are living. This number cannot be given exactly, as there are doubtless a few dead, especially in the early years, who have not been so recorded. Of these graduates, 67 received the degree A.B. (r.s.); 77 that of bachelor of natural science, B.N.S.; 2,892 were graduated as civil engineers, C.E.; 23 as mining engineers, M.E.; 5 as topographical engineers, T.E.; 569 as mechanical engineers, M.E.; 909 as electrical engineers, E.E.; and 401 as chemical engineers, Ch.E. The general degree, bachelor of science, was conferred upon 61 students between 1850 and 1926 but this general course was abolished when the four new courses, for each of which the degree bachelor of science is given, were established in 1925. Since then there have been graduated: 37 from the course in arts, science, and business administration; 15 from the course in physics; 13 from the course in biology, and 9 from the course in chemistry. Nine have been graduated from the department of architecture with the degree bachelor of architecture, B.Arch. The degrees given in 1933 are included in these numbers. Five thousand two hundred and thirty-six degrees in course have therefore been conferred upon graduates. One hundred and eighty-two second or third degrees have been given. Fifty-four of those who took two degrees were graduated before the reorganization of 1850, and obtained both C.E. and B.N.S. At the present time any one who takes a second undergraduate degree has to remain two years to secure it.

The total number of students who have attended the Institute cannot be exactly determined though it closely approximates 13,576.

Its reputation as a school of engineering is well known; its fame was early established. Its renown has not been due to its age, but to its methods of instruction, its rigid requirements for graduation and the work of its alumni.

Its requirements for graduation may be indicated in a general way by finding the ratio of the graduates in any class to the total number of students who have been members of it. Such ratios for every decade since the reorganization, beginning with 1860, are as follows: for the class of 1860 the percentage is 45.0; for 1870 it is 31.6; for 1880, 33.3; for 1890, 27.0; for 1900, 32.3; for 1910, 22.1; for 1920, 35.3; and for 1930, 36.7. The highest ratio, 50.0 per cent, is found for the class of 1885. In the class of 1874 it is 17.5 per cent; in that of 1896, 13.0; and in the class of 1914 it is 29.7 per cent. For the past year (1933) it was 40.8 per cent. The average ratio for the last eighty years is about 34.0 per cent.

Students have come to the school from every state and territory of the United States and from forty-one foreign countries, including: Argentina, Australia, Bolivia, Brazil, Canada, Chile, China, Colombia, Costa Rica, Cuba, Ecuador, Egypt, England, Germany, Greece, Guatemala, Haiti, Honduras, India, Ireland, Japan, Java, Mexico, Nicaragua, Palestine, Panama, Paraguay, Peru, Poland, Roumania, Russia, Salvador, Santo Domingo, Siam, Spain, Switzerland, Syria, Turkey, Uruguay, Venezuela, and the West Indies.

It is to the work of its graduates, however, that the reputation of the school is largely due. They have left an imprint on the history of the scientific development, constructive art, and material progress of this and other countries which cannot be effaced. Their success has been marked not only in the profession of engineering and in scientific investigation but also in business pursuits. It has been widespread.

An appendix to the annual catalogue of the school contains the address and occupation of each one of the alumni. The living ones are at present at work in fifty-one of the states and territories of the Union and in twenty-nine foreign countries.

CHAPTER XI

NAVAL STUDENTS. FINANCES. EXPENSES. EQUIPMENT AND METHODS. STATISTICS OF STUDENTS

A CONSIDERABLE number of graduates of the Institute have become naval officers, in the Bureau of Yards and Docks of the United States Navy, by taking examinations. Since 1906 the government has been sending graduates of the Naval Academy, who were to enter the Bureau of Yards and Docks, to the Institute for a two-year course in civil engineering. At first they received the degree civil engineer. After 1924 and until 1932 the Naval Academy graduates stayed there for a one-year graduate course and, coming to the Institute, generally after a cruise of a year or two, for a two-year course, received first the degree civil engineer at the end of one year and the degree master of civil engineering at the end of the second year. Since 1932 three of them have been sent immediately after graduation to receive the degree civil engineer at the end of the first two years and the degree master of civil engineering after taking graduate work for the third year. Three such students come each year.

Six graduates have become rear-admirals in the United States Navy. One, Charles W. Rae, '66, became chief of the Bureau of Steam Engineering.

Five were in the Civil Engineer Corps; one, Frank T. Chambers, '92, director of the Naval Petroleum Reserve, and the other four, Mordecai T. Endicott, '68, Charles W. Parks, '84, Harry H. Rousseau, '91, and Norman M. Smith, '09, became chief of the Bureau of Yards and Docks. Besides these, sixty-five other graduates have served in the Navy in various capacities: among them are two commodores, three captains, seven commanders, twelve lieutenant-commanders and twenty-four lieutenants.

Thirty-two members of the class of 1920 at the West Point Military Academy, who were sent to the World War after they had been at the Academy only two years, were ordered to the Institute in 1921 to obtain further instruction. The faculty concluded that by working six days a week for fifty-one weeks they could cover the remainder of the work required by the Institute for a degree. This they did and received the degree civil engineer in June, 1922. Altogether forty-six graduates have been officers in the regular army of the United States, including three brigadier-generals, one colonel, three lieutenant-colonels, three majors, and five captains.

A unit of the Student Army Training Corps was inaugurated at the Institute, October 1, 1918. The object was to train young men for useful service in the war, and a two-year course was mapped out for that purpose. The curriculum of the course is printed in the catalogue of 1919. There was an army unit numbering 567 students and a navy unit with 121 students. All students in the Corps were privates in the army or navy of the United States. The Corps had a short life; the armistice came and both units were demobilized in December—the army corps after an existence of seventy-five days, and the navy corps after eighty days. Two hundred members of these corps left the Institute the day after demobilization with unperforated skins. All students remaining were immediately returned to their four-year curriculums, which had been discontinued after the establishment of the Student Army Training Corps. The Government paid the actual cost for the subsistence and instruction of these students: for the army unit, $105,200; and for the navy unit, $14,500.

It is not possible to give exact statistics regarding the part taken by Institute men in the World War. At least 838 were in the service. Of these 426 were graduates, 186 were former students, and 226 were students who left the school to enter the service. Of course, members of the Student Army Training Corps are not included in these numbers. The numbers holding commissions in various grades follow: In the army: brigadier-general, 3; colonel, 2; lieutenant-colonel, 5; major, 24; captain, 72; first lieutenant, 140; second lieutenant, 96; besides 49 sergeants and 27 corporals. In the navy: rear-admiral, 4; captain, 1; commander, 6; lieutenant-commander, 11; lieutenant, 24; ensign, 63. The total is 433 commissioned and 69 non-commissioned officers. That is, 53.8 per cent were commissioned officers, 9.1 per cent were non-commissioned officers, and 37.1 per cent were private soldiers or ordinary seamen. The total given above does not include those who were engaged in various war industries such as the manufacture of ships, munitions, automobile trucks, various steel and iron products, etc. Hundreds were engaged in such work, many in very important positions.

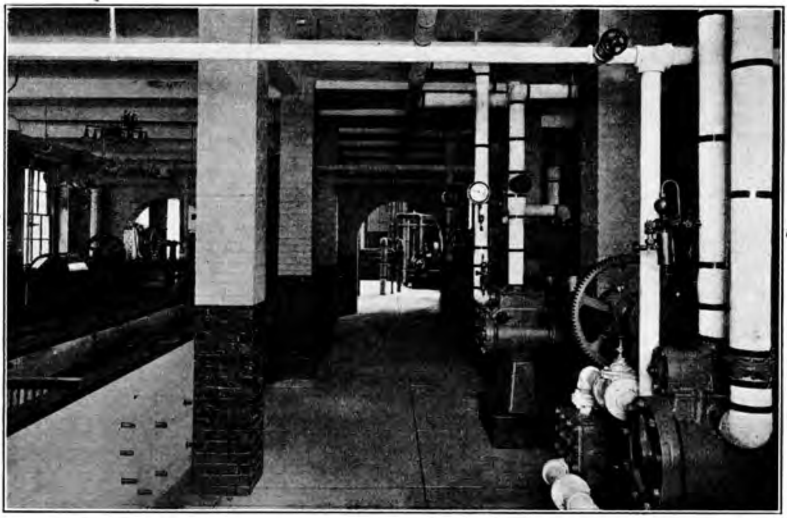
The names of those in the army or navy who were killed in action or otherwise died in service are inscribed on a bronze tablet in the main hall of the Pittsburgh Building. Of the 28 men, 10 were killed in action, 13 died of pneumonia, one was killed in an automobile accident, three while flying, and one was "missing." Thirteen were commissioned officers, 3 non-commissioned, and 12 were privates. Their names follow:

W. H. Baker, ex. '18; W. C. Behan, '14; D. R. Cather, '14; B. V. Day, '19; M. J. Farrell, '08; R. E. Fox, '13; D. W. Gleason, ex. '10; A. Griggs, Jr., '10; J. W. Inglis, ex. '11; T. R. Kerslake, Jr., '15; H. W. Peart, ex. '17; R. M. Raven, ex. '13; H. J. Stretch, '20; H. F. Turner, '21; R. V. Banks, ex. '18; C. A. Bostrom, '01; S. H. Clark, '14; R. H. Ellis, ex. '17; L. H. Forster, '13; F. O. Friedlander, ex. '17; L. T. Griffith, ex. '96; W. A. Higgins, Jr., '20; J. A. Kelly, ex. '17; H. A. Knapp, '20; R. E. Pond, '20; H. J. Raymond, '14; C. H. Tudor, ex. '18; C. A. Wall, Jr., '13.

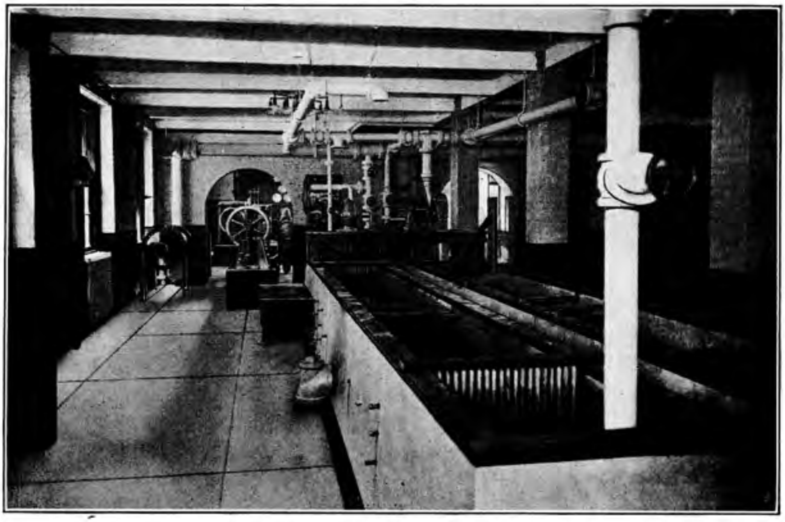
It is to be regretted that the name of Lieutenant Ransom S. Pattison, '08, who left before graduation and who was killed in the Argonne, is not on the tablet.

A number of Institute men were decorated for bravery in the World War. Most of these are believed to be included in the following list: Langford T. Alden, '09, Croix de Guerre, Ambulance Work, 1917; Lieutenant Grant H. Burrows, ex. '20, Croix de Guerre, Aviation, 1918; Captain Paul A. Florian, Jr., '15, Distinguished Service Cross, Signal Corps, 1918; Lieutenant William T. Hopkins, '13, Distinguished Service Cross, Field Artillery, 1918; Lieutenant Lancelot L. Johnson, '07, Infantry, British Military Cross, 1917; Captain Charles N. Morgan, '06, Machine Gun Battery, twice cited for bravery, 1918; Colonel Edgar A. Myer, '01, Infantry, Distinguished Service Cross, 1919; Corporal Horace W. Rinearson, '09, Ambulance Service, Croix de Guerre, Sections wears Fouaggere of the Medaille Militaire, 1918; Lieutenant Frederick De V. Sill, Engineers, Distinguished Service Cross, Military Cross, 1918; William R. Summers, ex. '16, Croix de Guerre, 1918.

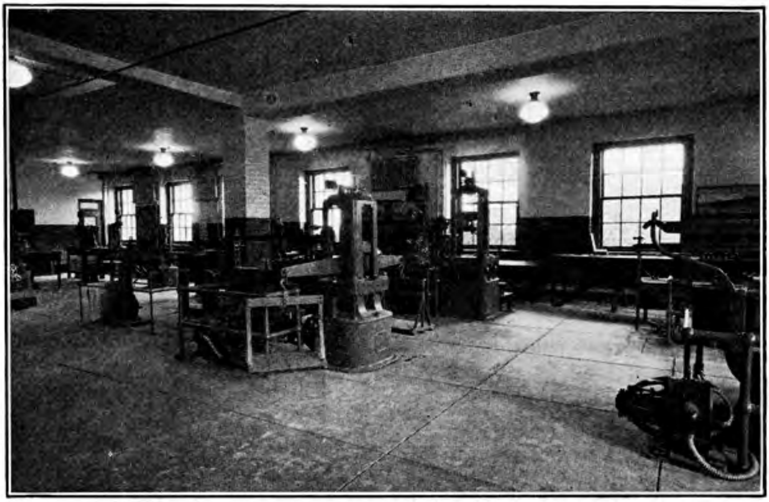
At the meeting of the board of trustees held December 4, 1919, it was determined that a certificate should be presented, at the commencement in June, 1920, to each graduate, former student, and student who had enlisted in the army or navy during the World War. These certificates were very handsome. They were printed from a steel plate with the shields of the United States and of the Institute stamped in colors at the top. The inscription is as follows: "1914–1918. The Trustees and Faculty of Rensselaer Polytechnic Institute: To



View from Hydraulic to Steam Laboratory



Flumes and Water Wheels



Materials Testing Laboratory, 1933–

Measurements in Light

all who respect Valor and uphold Freedom Greeting: Be it known that We, the Trustees and Faculty of Rensselaer Polytechnic Institute, desirous of recognizing the Courage and Patriotism of its Students, Past and Present, who, in the Army or Navy of the United States, took part in the War for Freedom, hereby offer, under the Seal of the Institute, this Evidence of our Desire to Honor ——— who Rightly should be so Considered. God save our Country. Given in Troy, N. Y., in the year 1919." They were signed by the president. About 840 were presented at a cost of around $1,000.

For twelve or more years, E. H. Dion, '12, the efficient secretary and treasurer of the General Alumni Association, has been helping graduates to obtain work. His efforts have been greatly appreciated both by the alumni and the Institute authorities. Until lately, graduates had not had much trouble in obtaining places. Personnel men from great corporations came each year to look for them. But when the recent depression in business came, many young graduates could not obtain positions and some of the older ones lost theirs. In consequence, criticism of the Institute began to be heard to the effect that the school did not try to help its graduates and cared nothing for them. It was therefore thought advisable to create a placement bureau at Troy, not only to show that the authorities did want to assist the alumni, but also to do their best to supplement the work of Mr. Dion in New York City. Other institutions had established such bureaus, operated by their registrars, and were doing their best to aid their alumni. More than nine thousand letters were written to corporations, firms, and individuals asking if they could employ any of the alumni. Mr. Dion was made the head of the bureau, coming to Troy, from time to time, to supervise it. Places were found for a considerable number of the graduates, and as business improves the bureau will be able to help larger numbers.

The trustees have always kept insured those buildings which were not fireproof. When the so-called fireproof buildings began to be erected the fact was understood that they could not be destroyed by fire but that the contents of a room might be ruined. Enough insurance was carried on each one of these buildings to take care of such a contingency. Finally when the insurance companies required that each building be insured to 80 per cent of its value the insurance on all buildings, except the older non-fireproof ones, was cancelled. The advisability of carrying its own insurance, in the meantime, had been considered by the board, and in 1916 it was resolved to set aside $2,000 each year to establish a fund for this purpose, the income from the fund to be used for the general purposes of the school. This fund now amounts to $36,000. Thousands of dollars have already been saved by this self insurance. Insurance is carried against accidents of all kinds to any person on or in property owned by the school, except those occurring to the athletes during athletic games.

Insurance companies will not insure athletes during such games.

In 1932 a questionnaire was sent to all students requesting information regarding their expenses during the scholastic year. The answers showed that the average total annual expense was $1,175, of which the tuition, $400, was 34 per cent; board, $280, was 23.8 per cent; room, $155, was 13.2 per cent; books, $49, was 4.2 per cent; and miscellaneous expenses, $291, was 24.8 per cent. A quarter of the students spent less than $1,000 a year. The minimum expense account was $750 to $800, and the maximum $2,300.

At the suggestion of Professor Rosenholtz there was established in 1925 a bureau of student employment, the object of which was to assist needy students to obtain work to help support themselves whilst at the Institute. Professor Rosenholtz was placed at the head of the bureau. Many students were aided by this organization. The work was of diverse character—taking care of furnaces, shovelling snow, working in stores, typewriting, etc. Since business has been bad the amount of such work has been greatly reduced, but the chance of obtaining such employment will improve with business conditions. Nearly forty students are employed as waiters in the Dining-Hall and helpers in the kitchen. They receive their food for the work they perform.

For many years, notes for all or part of their tuition have been allowed some students. They bear interest and it is understood that they are to be paid after graduation. Until 1929 the amount given in any year never exceeded $4,000, and 78 per cent of the loans were paid. For the past three years the loans have been much greater and it has been the custom to take notes for deferred tuition instead of lending money to pay tuition. The Loan Fund, owing to gifts from graduates and grants from the trustees, amounted in 1930 to about $30,000. As the loans have been paid since then the amounts received have been returned to the general fund of the school, and the Loan Fund has diminished, since deferred tuition is now taken. Henry Colvin, treasurer and trustee, and his son Allan D. Colvin, '06, have given $6,500, the income only to be lent. In consequence, the Colvin Fund will continually increase in amount and will become, in time, very large. The deferred tuition account has increased greatly during the depression, but the amount will be less as business becomes normal, and the interest and principal repaid in the future will increase the annual income of the school.

There are three first-rate hospitals in Troy, one about a quarter of a mile from the campus. It has been unnecessary, therefore, for the trustees to provide a hospital for the students. There is no general fee paid by all students to cover hospital expenses, but in 1932 the trustees determined to provide free hospital service, for a limited time, for students who declare that they are unable to pay for such service. An arrangement was made with one hospital, so that such students could consult its internes any day between three and five o'clock in the afternoon. If the case required it, a more experienced physician would be consulted. And it was agreed that ward service for a period of two weeks would be provided these needy students in any of the hospitals. But no service of this kind is available for those who are able to pay their own bills for medical attendance.

For the first eighty years of its existence the school could be classed, financially, only among the poorer institutions of learning of the country. In its early days a considerable portion of the expense of its maintenance was borne by the founder; during the first eight years he expended more than $22,000 in its support. Upon the removal to the Van der Heyden mansion, in 1834, he built a laboratory and rooms for study upon the new site, and he continued to assist the institution until his death in 1839. Its equipment at first was not great, though it compared favorably with that used for scientific purposes in the oldest and wealthiest colleges. In 1828 the collections and library were valued at $3,615 and the real estate at $1,348. The total value of its property was $5,009. The complete inventory made in 1846, after the removal to the Infant School lot, showed the total value of real estate, invested funds, library, and apparatus to be $15,851 and the debts to amount to $1,050. This value, though small, was not inconsiderable for schools at that period.

In their endeavor to increase their facilities for instruction the authorities of the school at various times, during the first forty years of its existence, made appeals for aid to the Legislature of the state. One such petition, signed by B. Franklin Greene, LeGrand B. Cannon, John B. Tibbits, and D. Thomas Vail, was presented shortly after the reorganization, and in the act making appropriations for general purposes, passed July 10, 1851, $3,000 was given to the Institute. To aid in rebuilding, after the fire of 1862, $10,000 was appropriated April 23, 1863. Another memorial signed by all the trustees and by Director Charles Drowne was presented in 1866. They asked for $50,000. This was not given, but by an act passed April 23, 1864, the state palaeontologist was authorized to select from the duplicate fossils belonging to the state, and present to the Institute, a collection as full and complete as could be made. The fossils were given and an appropriation of $15,000 was also made May 8, 1868. Again, in 1871, by an act passed April 28, $3,750 was donated. These sums, together with the $744 received from the regents between the years 1846 and 1853, while the Institute was under their visitation as an academy, make the total amount of money received from the state, since the foundation of the school, $32,494.

The Institute continued its struggle for increased endowment, and as the years rolled on its assets continued slowly to increase. The gift of the Proudfit Observatory in 1875, the work of the Graduates' Endowment Committee of 1882–4, the endowment of the chair of mechanics by Mrs. Hart, in 1883, the efforts to raise a gymnasium fund in 1885–6 followed by the erection of the gymnasium on Broadway and the construction of the Alumni Building, after the collection of the Alumni Building Fund of 1890, have already been recorded. Neither of the last two funds was sufficient to erect the building, and the board of trustees had to make appropriations to complete them. The Alumni Association, however, continued making remittances to the trustees until they had paid the entire cost of the Alumni Building. An "Alumni Endowment Fund" was begun in 1896 and continued for about two years. The Mechanical Laboratory Fund of 1899–01 and Repair Fund of 1902 followed.

The fires in the Main Building and Chemical Laboratory in 1904 were followed by the purchase of more land and the erection of new buildings—the beginning of a new era for the school. After the fires all the friends of the school worked hard to place it upon a more secure basis. Then followed the purchase of more land, from time to time, and the erection of new buildings as they were needed. All this has been recorded, but it may be well to enumerate these additions here in chronological order: purchase of the Warren property, 1905; the erection of the Carnegie Building, 1906; Walker Laboratory, 1906; Boiler House, 1907; first Club House, 1908; Shop, 1908; Russell Sage Laboratory, 1909; Pittsburgh Building, 1912; '87 Gymnasium, 1912; White dormitories, 1916; Hunt dormitories, 1916; Russell Sage, 2nd, Dining-Hall, 1916; addition to Walker Laboratory, 1921; Buck, Cooper, Macdonald, and Roebling dormitories, 1923; addition to Sage Laboratory, 1924; Troy Building, 1925; Pardee Dormitory, 1925; purchase of land south of campus, 1927; Caldwell Dormitory, 1927; Amos Eaton Hall, 1928; land bought for athletic field at head of Peoples Avenue, 1929; B. Franklin Greene Building, 1931; addition to Shop, 1931; Church dormitories, 1932; new Club House, 1932; upper class dormitories, 1932.

All this time, both before and after the fires of 1904, funds were constantly being solicited for the purchase of land, the erection of buildings, and the improvement of the facilities for instruction.

The names, given below, indicate the purpose for which each fund was to be used, and the years when they were raised are also given: Graduate Endowment, 1882–4; Gymnasium, 1885–6; Alumni Building, 1890–3; Alumni Endowment, 1896–8; Mechanical Laboratory, 1899–01; Repair, 1902; Rebuilding, 1904–06; '86 Athletic Field, 1906; Club House, 1906–07; Pittsburgh Building, 1909–12; Sage Portrait, 1911–2; Dormitory, 1917–9; Chemical Laboratory Addition, 1919–20; Centennial, 1923–5; Troy Building, 1924–5. No fund was raised, by general subscriptions, for the addition to the Sage Laboratory or for Amos Eaton Hall. The Graduate and Alumni Endowment funds together amounted to $100,000; the Rebuilding Fund to $210,000; the Pittsburgh Building Fund to $113,000; the New Dormitories Fund, which helped pay for the Buck, Cooper, and Macdonald dormitories, to $104,000; and the Chemical Laboratory Fund, which helped pay for the addition to the

Chemical Laboratory, to $122,000. All the funds above enumerated were raised by contributions varying in amount from one dollar to many thousands. Many of the buildings have been erected with large sums given by individuals: for instance, the Dining-Hall, the White, Hunt, Roebling, Pardee and Caldwell dormitories, the Sage Building, and the Carnegie Building. The Proudfit Laboratory also when first built, before the additions were made, was erected by a single donor. The Walker Chemical Laboratory was built with large sums given by two individuals, the '86 Athletic Field by the class of '86, and the '87 Gymnasium by the class of '87. These funds were nearly all raised for building purposes.

Large sums given or bequeathed by individuals have been added to the endowment fund. Mrs. R. J. C. Walker, whose son, Dr. William Weightman Walker, was graduated in the class of '86, gave, in September, 1904, as a memorial to him, the sum of $100,000, which was followed in April, 1905, by another gift of $110,000. She had some years before this given $10,000, so that the Institute received from her $220,000. The gifts of J. J. Albright, '68, Andrew Carnegie, and Mrs. Sage have been mentioned already.

Charles G. Roebling, '71, gave $24,000, John A. Roebling, '88, $30,000, and Washington A. Roebling, '57, $142,000, including $50,000 which he bequeathed. Altogether the Roebling family, celebrated in the engineering annals of the country, gave more than $200,000. George O. Knapp, '76, subscribed $30,000 toward the erection of the addition to the Chemical Laboratory and gave altogether about $43,000. Calvin Pardee, '60, gave, during his lifetime, $9,000 and left $40,000, and the Pardee family afterwards gave $27,000, the last two amounts more than paying for the Pardee Dormitory. Athol M. Miller, Jr., '95, left Incas Iron Company stock which with the $100,000 given by his father, A. M. Miller, finally amounted to $291,317. Besides the gifts made by Captain Robert W. Hunt during his lifetime, amounting to about $70,000, his widow left us $164,836. The Wigand estate, left by the widow of Albert A. Wigand, '89, totaled $139,417. Robert Forsyth, '69, willed $100,000. Thomas W. Holmes, a citizen of Troy, not a graduate of the Institute, left the school $50,000, and there is to come from the estate of John F. Cahill, also a citizen of Troy, not a graduate, about $45,000. The Townsend V. Church, '81, legacy of $205,000 was used for dormitories already described. A bequest, yet to be received, amounting probably to between $600,000 and $700,000 will come from the estate, now in trust, of James C. McGuire, '88, who at the time of his death was a trustee of the Institute. And finally there is one graduate, who has never wished his name mentioned, who, for more than forty-five years, has been subscribing large sums, to help pay for land, Pittsburgh Building, dormitories, gymnasium, Chemical Laboratory addition, Architectural Building, Shop addition, and the new Club House, and who has established large funds for the maintenance of the Institute in the future. Altogether his benefactions have amounted to millions of dollars. Without his aid the Institute would be far from the school it is today. Many other bequests are recorded in Appendix X.

Invidious distinction is not meant by the mention of these gifts of particular individuals, but special circumstances where, for instance, gifts have been made for specific purposes render it advisable in order to make the information given more exact. Many other graduates and friends of the school gave large sums and many more smaller sums which evinced as much self-denial and interest in their Alma Mater as any which have been mentioned.

The grounds and buildings and their contents are conservatively valued at $4,900,000, and the invested funds and cash at $6,300,000—a total of $11,200,000. Besides this amount there is a fund probably amounting to at least $650,000 which will come to the school in the not distant future and a trust fund valued at nearly $3,000,000 all of the income of which will be received after a considerable period of time. The values of the property given in Appendix XI are book values and are too conservative.

At the present time the Institute owns thirty-seven buildings, counting each small dormitory as a separate one. There are twenty-two dormitories, each one having its individual name. There is no communication between these dormitories. Eighteen of them form a continuous line from White

No. 1 to Church No. 5. The sixth Church Dormitory is by itself west of the Dining-Hall. All these are east of the athletic field, the Campus Dormitory being by itself, west of the field. The two upper class dormitories, previously described, are north of Sage Avenue. These are divided into ten separate units, each with its own name, so that if these were counted separately there would be thirty dormitories instead of twenty-two. Eight buildings besides the gymnasium are used for purposes of instruction. The remainder of the buildings include Eaton Hall, Club House, Dining-Hall, Boiler House, Carpenter Shop, and the Playhouse which used to be the old gymnasium. Another building, for aeronautical, metallurgical, and chemical engineering laboratories, will be erected between the Troy Building and the '87 Gymnasium in 1934–5. It will be 184 feet long, 60 feet wide, and five stories in height, of the same materials as the other buildings.

The scholastic year is divided into two terms, the first beginning about the middle of September, and the second about the first of February. The latter ends with commencement about the middle of June. The Christmas vacation lasts about ten days, and the mid-term vacation, in February, about a week. Each term is divided into three periods: the advance, the review, and the examination. The advance, during which the student takes up a subject for the first time, lasts about fourteen weeks, the review about three, and the examination period is about one week in duration. In the review no new subject is studied, but those taken during the advance are repeated. Most of the advance courses are seven weeks in length. During both the advance and review, when a subject is once taken up, it is continued until it is finished. Recitations are held on consecutive days until the course is ended. The methods of instruction are similar to those in vogue shortly after the reorganization. Text-books are largely used, though these are almost invariably supplemented by lectures. Sometimes the recitations consist of interrogations only, but generally both interrogation and blackboard work are required every day.

Recitations generally take place on five days of the week only, Saturday being free; but this day has often to be devoted to making up work in drawing and other subjects, and during the review and examination periods it has often, also, to be used for recitations.

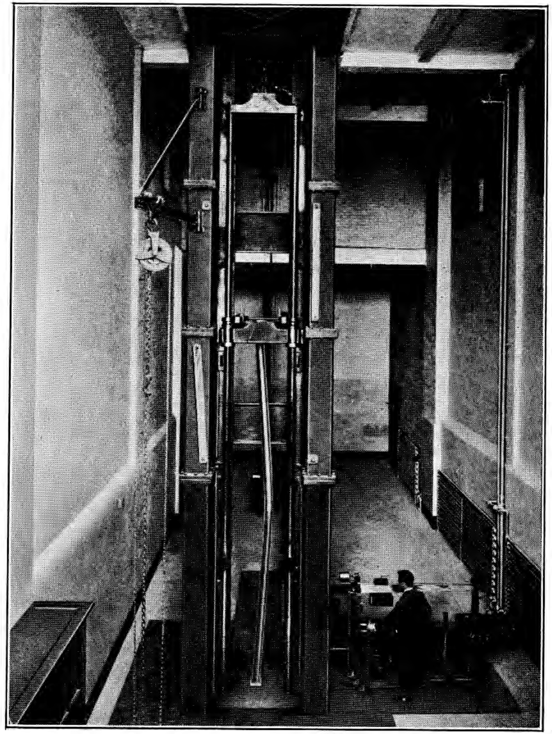
In nearly every class and every subject each student recites each day. This is thought to be a matter of prime importance. The sections are small. For instance, in the department of pure mathematics they generally number from fifteen to eighteen except for lectures. The lectures and interrogations are, together, an hour in length, and the same time is given daily to the problems and topics which are placed on the blackboard by individual students.

In the department of rational and technical mechanics the class is divided into sections of not more than fifteen men. Four or more of these sections constitute a lecture group, two sections an interrogation group, while topic and problem work is limited to single sections. Lectures occur usually about twice a week, and cover ground in advance of the interrogations or topics. On days when there are no lectures interrogations are given. Topic and problem groups recite every day. In these groups the assistant requires each student each day to put an assigned part of the text or solve a problem on the blackboard and explain it. During this explanation he is interrogated upon the principles involved.

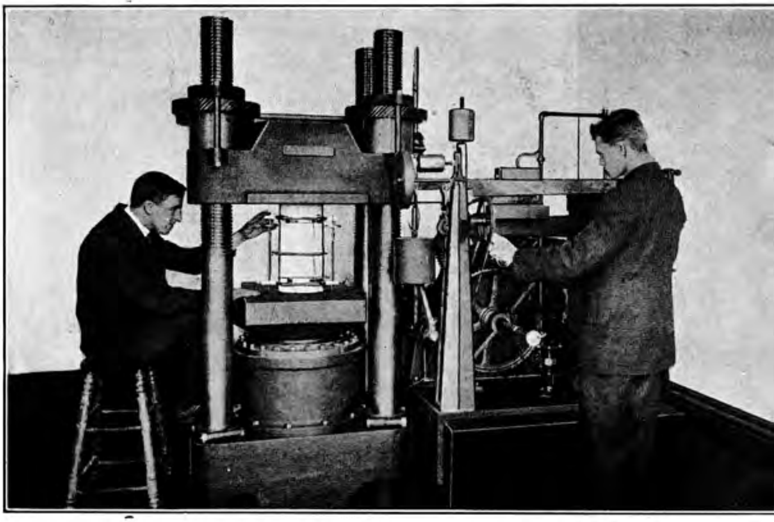
Daily marks are kept of the work of each student, and in general the averages of the three periods—advance, review and examination—are taken to determine whether he has passed in a subject. He would be conditioned, however, if his examination mark were poor, and no matter how good his examination might be he would not be passed with poor work in the advance and review periods. In other words, cramming is useless; the results depend principally on the daily work throughout the term. The marks range from zero to four; and three, or 75 per cent, is the passing mark.

The laboratories are used to illustrate the principles taught in the corresponding courses; the daily periods for undergraduates are two and one-half hours in duration. Original researches are also made in them by instructors and by some undergraduate and graduate students for their theses. They are, of course, of great value and importance

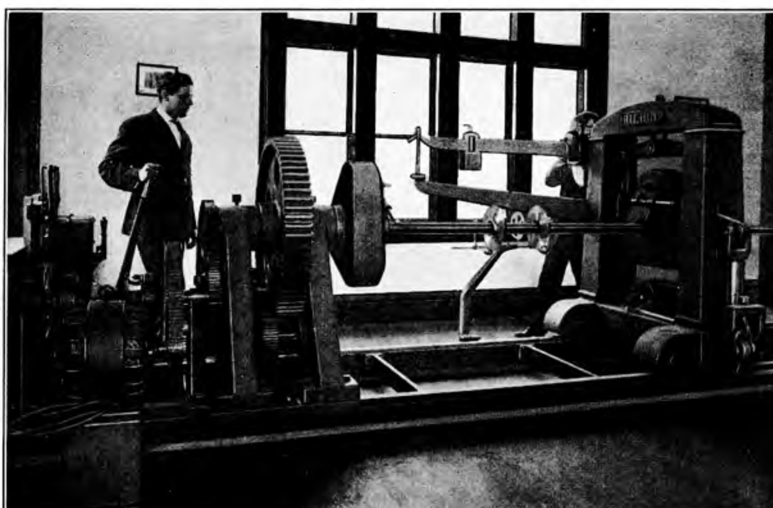
Part of Photometric Laboratory



Testing Machine. Capacity, 600,000 Pounds



Compression Machine. Capacity, 1,200,000 Pounds



Torsion Machine. Capacity, 125,000 Inch Pounds for instruction and research. That the school is unusually well equipped in this respect may be judged from the fact that the apparatus, instruments, and machines in the various departments are valued at $800,000.

Much drafting of various kinds is given in all the courses during the first two years, and design courses, which require drafting, are given in some of them during the last years. The drawing courses, like the laboratory courses, are generally about two hours and a half in duration. The practical surveying not done during the summer vacations is generally scheduled for the afternoon and takes about two and one-half hours each day while the courses last. In fact, drafting, laboratory work, and practical surveying are regarded as "scholastic amusements," to use the term employed by Amos Eaton in his circular of September 14, 1826, and are scheduled for the afternoons where possible, whereas the theoretic subjects are given in the morning whenever the program can be so arranged. Generally two theoretic subjects are given each morning and often two hours are devoted to each one of these subjects: one hour to a lecture, or to a combined lecture and interrogation, and the other hour to blackboard work.

Besides the work which occurs between September 15 and June 15, in the civil engineering department, students who have completed the work of Division C take a three weeks' course in topographical and hydrographical surveying, during June and part of July, in the country within fifty miles of Troy, and those who have completed the work of Division B take a course of the same length in railroad engineering practice during a part of August and September. Students in the mechanical and electrical engineering departments, at the end of the same years, take four weeks' courses in shopwork, including machine and pattern work, during the summer vacations. In all these summer courses the student is employed eight hours a day for six days in the week.

During the same vacation each student in each course is required to write a thesis on some engineering subject approved by the faculty. As heretofore explained, in describing the Macdonald prize, a graduating thesis, also, must be prepared by each candidate for a degree, and this must be read and defended before the faculty. The theses cover a very wide range of subjects and are either designs or investigations of an engineering or scientific nature. A number of them are presented each year for the Macdonald and other prizes, and some of them are printed in the Engineering and Science Series.

Twelve courses are now given: seven in engineering—civil, mechanical, electrical, chemical, metallurgical, industrial, and aeronautical; one called arts, science, and business administration; one in architecture; and three in pure science—physics, chemistry, and biology. In the first year, Division D, the courses in civil, mechanical, electrical, and aeronautical engineering do not differ much from one another; the courses in chemical, metallurgical, and industrial engineering are quite similar to one another and differ somewhat more from the other engineering courses; and the pure science courses do not differ greatly from one another. In the second year, Division C, the difference in the engineering courses is more pronounced, and thereafter a divergence begins which is more marked with each succeeding term. In general, the first two years are preparatory years, and in the last two most of the practical and applied subjects are given. All the engineering courses are intended to be general in their character with many of the principles and applications of each common to all. All the curriculums are constantly being changed in some particulars. A general idea of the subjects taught in each of the twelve courses in 1933 is given in Appendix III. Condensed schedules of the courses in civil engineering and natural science as given in 1854, soon after the reorganization in 1849–50, will be found in the same appendix, as well as those of the last two years of the course in mechanical engineering given in 1866 and the course in mining engineering taught in 1866.

Statistics regarding students are given in Appendix XII. In that appendix, Table I gives the number of students in the school and the number graduated for each year for the past seventy years. In the column headed "Year" the number given is that of the beginning of the scholastic year. Table II shows the number of teachers of each grade for each year for the past thirty years. The number and kind of undergraduate degrees conferred each year since 1911 are given in Table III. The total graduate degrees, in course, amount to 113 master's and 35 doctor's degrees. Table IV includes various matters of interest regarding the students, including the number of the states of the Union and of foreign countries from which they come, the number from the State of New York and the percentage this last number is of the total number of students in the school. Appendix XIII contains a list of all the trustees from 1824 to 1934, including the names of the presidents, vice-presidents, secretaries, and treasurers of the board. It also contains the names of all the professors, in the various departments, since the beginning of the school, including the senior professors, who were the heads of the faculty in the early days, and of the directors of later years. Those with the titles associate professor and adjunct professor are printed in the list under the term professor.

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APPENDIX I

The First Chemical and the First Physical Laboratories for the Systematic Individual Instruction of Students to Be Established in Any Country *

WHEN Amos Eaton at the age of forty-nine was appointed professor of chemistry and experimental philosophy and became the head of the faculty in Rensselaer School, in 1824, he introduced an original method of instruction the character of which is fully outlined in the early catalogues and circulars and, as will be shown later, by the testimony of students who were at the school in the early days. This method *required* the use of laboratories and *required* each student, himself, to use the apparatus in the various laboratories. That laboratory work was to be considered of prime importance is shown by clauses in the letter of the founder, dated November 5, 1824, by which he established the School. See pages 9-12.

That is, the pupil took the place of the teacher during part of each day. The teachers gave lectures and interrogations at times, but the theory was that the students learned more by making their own experiments and giving lectures upon these experiments themselves. This method of teaching presupposed laboratories. These the school had: remarkable for the times. See page 45 and also page 65 on which the equipment is given in more detail.

That these laboratories were equipped at the beginning

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* Reprint, in part, from an article by Palmer C. Ricketts in *A Review of Scientific Instruments*, November, 1933.

of the School in 1824 is shown, not only by the fact that Eaton's method of teaching could not be used without them, but by other evidence. President Blatchford in his circular dated September 14, 1826, wrote,

> The Rensselaerian scheme for communicating scientific knowledge had never been attempted on either continent until it was instituted in this school two years ago.

Other interesting evidence of the character of the teaching exists. In a letter dated August 6, 1827, George F. Horton, of the class of 1827, who afterwards, as a physician, became president of the Pennsylvania State Medical Society, wrote,

> Separate and convenient rooms are prepared and furnished for giving instruction in Natural Philosophy, Natural History, and the common operations in Chemistry, and an assay room for the analysis of soils, of minerals and of animal and vegetable matter with the application of these departments of science to agriculture and the arts. . . . The plan of instruction adopted at this School is different from that of any other. The student takes the place of the teacher in all the exercises of the school. He not only sees experiments performed and hears lectures given by a professor, but actually performs with his own hands and gives lectures himself on all the branches in which he studies. The lesson is marked out in the text-book and proper time given for learning it. The student is then called before a professor to give his experiments and deliver his lecture, the whole being conducted as though he intended to instruct an ignorant audience.

In a letter dated April 25, 1829, Douglass Houghton, of the class of 1829, who afterwards became professor of geology, mineralogy, and chemistry in the University of Michigan, wrote,

> A brief outline of the course pursued would not, perhaps, be uninteresting. In order that you may fairly understand it I will first name the rooms contained in the building independent of the private rooms. They are six:—Reading Room which contains a fine library in which examinations and criticisms are held; The Assay Room with all the apparatus necessary for assaying ores and performing those experiments which require the aid of a high heat; Laboratories numbers one and two which contain all the apparatus appertaining to pneumatic chemistry and also the apparatus for per-

forming those experiments which do not require a high heat; Philosophy room which contains a fine set of philosophical apparatus; Natural History room which contains Botanical, Zoological and Geological specimens. . . . After which each division again takes the room appropriated to that division and each student lectures, experimenting and demonstrating while lecturing.

In 1892, Dr. W. P. Mason, professor of chemistry, wishing to obtain knowledge relating to the chemical laboratory of the beginning of the school, asked for information from James Hall, of the class of 1832, New York State geologist and palaeontologist who had made a great name for himself by his work in geology and palaeontology. Dr. Hall answered,

In regard to systematic laboratory instruction in chemistry, I can only say that when I entered the Rensselaer School, in 1831, there were already laboratories fitted up for giving systematic instruction in chemistry and each student of the class was required to do laboratory work, and to prepare, himself, his material and apparatus, to give each day, during the course, an extemporaneous lecture, illustrated by experiments, and full explanation of the phenomena and the laws governing them. Every student was well grounded in the principles and elements of the science, and by a method of teaching never surpassed, if ever equalled by any other.

These were the first laboratories, designed for the individual use of the students themselves, to be established in this country and, in fact, in any country. Liebig is often given the credit for the establishment at Giessen of the first chemical laboratory of this kind, but on the authority of no less a person than Lord Kelvin his laboratory was not in operation until at least seven years after those created by Eaton. Sir William Thomson, afterwards Lord Kelvin, said,* "A notable development of chemical laboratories with reference to practical education in chemistry was made by Liebig *not many years after 1831.* I fix that date from personal recollection."* Liebig, at the age of twenty-one, was appointed to the chair of chemistry at Giessen in 1824.

* Address entitled "Scientific Laboratories" on the occasion of the opening of the laboratories of University College, Bangor, Wales. *Nature,* **31,** 409 (1885).

"His first care was to persuade the Darmstadt government to provide a chemical laboratory in which students might obtain a proper practical training." * It is extremely likely therefore, even without the direct evidence of Lord Kelvin, that Liebig's laboratory was not completed until after 1831, that it was not completed or even begun in 1824, at which time Eaton's laboratory was in existence.

In his Bangor address Lord Kelvin also said that the first chemical laboratory for students "so far as I know" was founded by Professor Thomas Thomson at Glasgow University "prior to 1831." But 1824 antedates 1831 by seven years, and it is fair to conclude that if Lord Kelvin had had any proof that Professor Thomas Thomson had such a laboratory seven years before 1831 he would have been more specific as to dates. As a matter of fact, "The minutes of the Faculty of Glasgow College show that as early as the first month of 1828 Professor Thomas Thomson began applying for more commodious premises in which to carry on his work in the department of chemistry. For two years he kept his wants persistently before the Faculty until January 1830 when his efforts were crowned with success . . . the buildings seem to have been finished towards the end of the same year." †

Frank P. Whitman in "The Beginning of Laboratory Teaching in America," says of Rensselaer School

> Laboratory methods, in fact, were used throughout, and the school was equipped, so far as possible, with this idea in view. Doubtless the work was not so well systematized as in Liebig's laboratory, *opened several years later,* but it was an original and independent movement in the same direction and that it was efficient may be inferred from the number of well-known men of science who were graduates of this school.‡

The "doubtless the work was not so well systematized" is somewhat gratuitous. Why it should be assumed that a

* Justus von Liebig, Encyclopædia Britannica, Eleventh edition.
† From a note added to Lord Kelvin's address, *Nature,* **31** (1885).
‡ *Science,* **8,** August 19, 1898.

laboratory created by a man forty-nine years of age, who had already made a great name for himself as a man of science, should be "not so well systematized" as one developed by a man of about twenty-eight (in 1831) is not understandable. The work done by Eaton, in this country, was at least as valuable, and as original, as that done by Liebig in Europe. A better witness and one who attended the school is James Hall, of the class of 1832, quoted above, who refers to the systematic instruction, saying that the method of teaching "was never surpassed, if ever equalled by any other." Furthermore the early catalogues show that the instruction was extremely systematic and continuous. It certainly produced many great men in various departments of science. The statement of Charles R. Mann that "Rensselaer School was for forty years a Mecca for teachers * of applied science" † is certainly a true one.

* This footnote is taken from "A Short History" by Palmer C. Ricketts, Engineering and Science Series, No. 29, Rensselaer Polytechnic Institute, 1930.

Note: As a school for teachers the Institute has justified the hopes of Van Rensselaer. There is no place here to tell of the great influence of its graduates in establishing and developing many departments of science and engineering in many of the great educational institutions of this country and abroad. We will have to be content to mention the names of some such institutions in which they have been prominent as professors and directors: Brooklyn Polytechnic Institute, Carnegie Institute of Technology, Catholic University of America, Columbia University, Cooper Union, Cornell University, Harvard University, Johns Hopkins University, Lafayette College, Lehigh University, Massachusetts Institute of Technology, New York University, Princeton University, Rutgers College, Stevens Institute of Technology, Swarthmore College, Trinity College, United States Naval Academy, Washington University, Williams College, Yale University, the universities of Alabama, Arizona, California, Cincinnati, Iowa, Louisiana, Michigan, Minnesota, Missouri, Texas, Vermont, and Wisconsin as well as institutions in China, Cuba, England, Puerto Rico, Japan, and elsewhere abroad.

† Bulletin 11, Carnegie Foundation for the Advancement of Teaching, 1918.

The descriptions and testimony given above prove that there existed in Rensselaer School, in 1824, a well-equipped chemical laboratory, especially designed for the use of students themselves; that each student was required to make experiments in it; that this laboratory antedated that of Liebig at Giessen and that of Thomas Thomson at Glasgow; and that it was the *first chemical laboratory* created for the use of students themselves, in which they made systematic experiments, *in this or any country*.

In his Bangor address Lord Kelvin said, "The physical laboratory in the University of Glasgow is, I believe, the first of the physical laboratories of which there are now so many." He said that, when he became professor of natural philosophy in the University (1845), there was no provision of any kind for experimental investigation, still less for anything suitable for students' practical work. At his request the governing body allotted to him an old wine cellar. "This, with the bins swept away, and a water supply and a sink added, served as a physical laboratory (a name then unknown) for several years." Mendenhall in his address prepared for the Seventh Convocation of the University of Chicago * says that it does not appear that this work formed a part of a prescribed course of study and denies to Lord Kelvin the credit of establishing what he calls the first physical laboratory in which regular courses of experiment were followed. Be this as it may, in this laboratory Lord Kelvin made provision for the individual works of students of physics, as he thought for the first time, for he knew nothing of the work of Eaton; and he deserves to be given all credit for it.

But more than twenty years before this time, as has been shown above, Eaton had established in Rensselaer School a *physical laboratory* for the individual instruction of students under a regular daily schedule. *This was the first to be established in any country.*

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* The Quarterly Calendar, 3, No. 2, August, 1894.

Cement-Mixing Laboratory

Interior View, Chemical Laboratory

Machine Shop

Pattern Shop

And it should not be forgotten that Eaton taught botany and zoology in the same way. All the sciences, including the analyses of soils for agricultural purposes, were taught in the same way from the beginning of the school.

ADDENDUM

Since the above article was written the author's attention has been called to a paper in the *Journal of Chemical Education,* September, 1927, by Professor B. N. Menschutkin of the Polytechnic Institute at Leningrad relating to the work of Michajlo V. Lomonosov (1711–65) the Russian chemist. "It was during this year (1749) that he was able to build a chemical laboratory—the first in Russia for scientific investigations and the first in the world where university students were regularly taught practical chemistry." And again, "Like every modern professor Lomonosov recognized that chemistry cannot be taught without practical work in the laboratory; he instituted the very first known laboratory exercises in physical chemistry, consisting of experiments performed by students under his supervision. The programs of this experimental work were discovered by me among his manuscripts and are amazing. . . ." The erection of this laboratory occurred two years after the establishment of the École des Ponts et Chaussées (1747) in France and sixteen years before the foundation of the Sächsische Bergakademie (1765) at Freiberg. No particulars are given regarding the method of teaching by Lomonosov, and it is not known whether the laboratory work was systematic, but the fact that there was such a laboratory at so early a date should not be overlooked.

APPENDIX II

List of Subjects for Examination

(1836)

See page 86

1. Extract the square root. Illustrate by diagram.

2. Find by the square root the length of a ladder placed against a wall 37 feet high, its bottom being 9 feet from the wall.

3. Demonstrate this application of the square root by trigonometry.

4. Find the distance across a river without instruments, by calculating a base frustum of an isosceles triangle, pointing the apex to an object on the opposite shore.

5. Explain the legs and hypothenuse of a right-angled triangle within a circle; also with the vertical leg outside the circle.

6. Explain, by the rule of three, the proportion between the sides and angles of triangles. In this sines must be used as measures of degrees in working with degrees.

7. Illustrate the table of natural sines by a diagram.

8. Explain parallax generally.

9. Apply trigonometry to finding the moon's distance by its horizontal parallax.

10. Apply trigonometry to finding the sun's distance by the transit of Venus.

11. Apply the root and sines only in finding the height of a mountain, when the distance between the station and foot of the mountain is known, and angle at the base of the mountain between horizontal line and slant of hill.

12. Apply trigonometry to finding the length of a perpendicular of a right-angled triangle, the base and sum of the perpendicular and hypothenuse being given.

13. Scale and dividers with all the lines on the scale.

14. Explain carpenter's sliding rule.
15. Explain sector and its use in perspective drawing.
16. Explain pantograph.
17. Explain spirit levels.
18. Glass thermometer and common ditto.
19. Explain barometer.
20. Hydrometer.
21. Explain hygrometer.
22. Explain quadrant, circular and quarter circle.
23. Explain sextant.
24. Pluviometer applied to rain and snow.
25. Compass, surveyors and navigators.
26. Chains and tallies, and why 9 stakes and 7 tallies are preferable.
27. Explain harbor surveying.
28. Illustrate the manner of working a traverse by sea or land.
29. Traverse about a field; calculate the same by trapezoidal method.
30. Calculate the length of a degree of longitude at any degree of latitude.
31. Explain Mercator's chart.
32. Take the latitude of any place.
33. Take the longitude of any place.
34. Calculate the height of the atmosphere.
35. Calculate the pressure of the atmosphere upon any given surface on the earth by the barometer, say on a square yard.
36. Calculate the height of the lower valve of a pump at a given place by the barometer.
37. Cast the solid contents of a cone.
38. Cast the transverse diameter made by cutting an ellipse through the given frustum of a cone.
39. Finish out a cone from a given frustum.
40. Calculate a cask by assuming each end as a frustum of a cone, without allowing for curvature.
41. Allowing for curvature, also the addition to the

bung diameter of one tenth of the difference between bung and head.

42. Explain the method of calculating the angles of inflection in running a curve on a railroad when run on the periphery.

43. Explain the same when run by chord lines from one station.

44. Explain the method for calculating offsets from a chord line for fixing given equal points on a regular curve.

45. Show the method of calculating the quantity of water per second furnished by a running stream. Describe the best method for ascertaining the average velocity in a deep stream.

46. Illustrate contraction of the vein of water from an aperture.

47. Show that the velocity of effusions of apertures is increased as the square root of the height is increased; taking 4 feet head giving 16.2 feet velocity per second, calculations may be made almost accurately.

48. Apply formula for determining the velocity and cubic feet of effusion per second under a given head.

49. Apply formula for determining the velocity and cubic feet under a given head through given cylinder waterworks.

50. Apply formula for calculating the velocity in open raceways and canals.

51. Apply formula for calculating the velocity and quantity of water pitching over a waste weir or dam.

52. Calculate excavations for canals.

53. Calculate embankments, dykes, docks, etc.

Qualifications Demanded of Students of Civil Engineering in 1838–9

See page 87

1. He must be familiar with the use of the level and compass in laying out roads, McAdam roads, railroads, canals, etc.

2. He must be perfectly familiar with running courses,

staking-out, and calculating for excavations and embankments.

3. He must be familiar with casting and constructing tables of versed sines; also the principles on which tables of natural sines are calculated, constructed, and used.

4. He must be familiar by practice with the calculations for filling and emptying locks, the supply of water by weight and measure which any stream will afford per second as a feeder, or for any hydraulic purpose.

5. He must be perfectly familiar with taking specific gravity of materials for construction.

6. He must be familiar by practice in calculating the power which any stream of water will give per second in propelling mills, factories, or other machinery, by measuring a trunk of it, and its descents.

7. He must be familiar by practice in calculating for waterworks whether conveyed in pipes, boxes, or open raceways.

8. He must be familiar with statics and dynamics, hydrostatics and hydrodynamics, so far as respects application to flumes, undershots and overshots, and descending raceways; also the velocities and efficient powers of spouting fluids, applied to driving machinery.

9. He must be familiar with the calculations of the quantity of grain ground by the rubbing areas of millstones, per minute or second.

10. He must be familiar with calculating the height of the atmosphere (as far as density will reflect), and its pressure on liquids in cases of pumps, and in all other cases where its pressure influences mechanical operations.

11. He must be familiar with casting the heights of nimbose clouds by lightning, also of the cirrose and cirrocumulose by two stations, when the fitting of lightning rods, etc., are concerned.

12. He must be perfectly familiar with taking and calculating latitude by the sun, moon, and north star.

13. He must be familiar with taking longitude by lunar

observations, by eclipses of the sun and moon, and by eclipses of Jupiter's satellites.

14. He must be perfectly familiar with taking the heights of hills and mountains with the barometer and thermometer, also in taking extemporaneous surveys and profiles with the barometer and triangular spans.

15. He must be qualified by practice to fix a transit line whenever required.

16. He must be qualified by practice to determine the variation of the needle at any time and place, very nearly.

17. He must be qualified by practice to make a topographical survey of a State, county, etc., by fixing a base line, on the ice of a lake, river, or a natural plane of earth, also to extend surveys from the base line to the required points, by triangular spans.

18. He must be qualified to change spherical areas of large districts, taken by latitude and longitude, into rectangular areas, by Mercator's method.

19. He must be a practical land surveyor, in theory and practice.

20. He must be a practical geologist, so far as to be able to make a correct report of the rocky and earthy deposits through which he lays out a canal, railroad, etc., also so far as to enable him to judge of inorganic materials for construction.

21. He must be so far a botanist and botanical physiologist as to be able to judge of timber, earthy mould, etc., which (having once been organized) are subject to chemical decomposition—consequently dissolution.

22. He must be so far versed in architecture as to be enabled to direct the construction of bridges and other works of engineering, in a comely style.

23. He must be so far familiar in plotting and business drafting as to perform all ordinary operations required in engineering. The most finished perspective and other ornamental drawings are not required of the engineer, but are very desirable.

APPENDIX III

SCHEDULES OF COURSES IN 1854

Civil Engineering

FIRST YEAR. *First Term.* Algebra, Geometry, General Physics, Geometrical Drawing, Line Surveying, *theory, field work,* English, French. *Second Term.* Trigonometry, Higher Algebra, Non-metallic Chemistry, Topographical Drawing, *maps of farm surveys,* Line Surveying, *theory, office work,* Botany, English, French. SECOND YEAR. *First Term.* Analytical Geometry, Differential Calculus, Electricity, Metallic Chemistry, Mineralogy, Descriptive Geometry, *theory, drawing, architectural drawing,* Practical Trigonometry, English, French, German. *Second Term.* Integral Calculus, Acoustics, Optics, Zoology, Geology, Descriptive Geometry, *shades and shadows, machine drawing,* Topographical Surveying, Hydrographical Surveying, English, German. THIRD YEAR. *First Term.* Mechanics of Solids, Mechanics of Fluids, Practical Astronomy, Physical Geography, Practical Geology, Trigonometrical Surveying, Descriptive Geometry, *perspective,* Topographical Drawing, *maps of trigonometrical surveys,* Machines, Industrial Physics, *practical pneumatics, practical thermotics,* Philosophy of Mind, English. *Second Term.* Theory of Structures, *bridges, hydraulic works, railways,* Prime Movers, Mining, Practical Astronomy, Railway Surveying, Mine Surveying, Descriptive Geometry, *stone cutting,* Topographical Drawing, *maps and plans of railway and mine surveys,* Metallurgy, Architectural Physics, Philosophy of Mind.

Natural Science

FIRST YEAR. The course for the first year is the same as that in Civil Engineering. SECOND YEAR. *First Term.*

General Physics, *electricity,* Metallic Chemistry, Mineralogy, Geology, Physical Geography, Practical Geology, Geometrical Drawing, *architectural,* Industrial Physics, *practical pneumatics, practical thermotics,* Philosophy of Mind, English, French, German. *Second Term.* Zoology, Geology, Physical Geography, Organic Chemistry, Natural History applied to the Arts, Acoustics, Optics, Architectural Physics, Philosophy of the Mind, German.

Schedules of Courses in 1866

Mining Engineering

First Year. Second Year. The course for the first two years is the same as that in Civil Engineering. Third Year. *First Term.* Differential and Integral Calculus, Method of Least Squares, Electricity, Qualitative Analysis, Mineralogy, Geology, Zoology, Palaeontology, Drawing, *perspective, colored topography,* German. Fourth Year. *First Term.* Mechanics, *solids, fluids, practical hydraulics, practical pneumatics,* Machines, Stone Cutting, *theory and drawing,* Qualitative Analysis, Metallurgy, Mineralogy, Geology, Philosophy. *Second Term.* Machines, Quantitative Analysis, Metallurgy, Assaying, Mine Surveying, Practical Mining, *sinking and driving, ventilation and drainage, general management,* Philosophy.

Mechanical Engineering

First Year. Second Year. The course for the first two years is the same as that in Civil Engineering. Third Year. *First Term.* Differential and Integral Calculus, Calculus of Variations, Descriptive Geometry, *shades and shadows,* Electricity, Qualitative Analysis, Blow-pipe Analysis, Determinative Mineralogy, Practical Trigonometry, Topographical Surveying, Geometrical Drawing, *machine drawing,* Topographical Drawing. *Second Term.* Mechanics of Solids, Mechanics of Fluids, Machines, Perspective, Acoustics, Optics, Descriptive Astronomy, Descriptive Geology, Machine Drawing, *elements of machines.* FOURTH YEAR. *First Term.* Method of Least Squares, Spherical Astronomy, Mechanics, *solids, fluids, strength of materials, practical hydraulics, practical pneumatics,* Machines, Machine Drawing, Philosophy. *Second Term.* Machines, *prime movers, estimates for machines,* Structures, Heating and Illumination, Machine Drawing, Philosophy.

SCHEDULES OF COURSES IN 1933

Course in Civil Engineering

FIRST YEAR. Accounting, General Chemistry, Drawing, *lettering, geometrical constructions, plates and tracings,* Economics, English, Advanced Algebra, Plane and Spherical Trigonometry, Plane Analytic Geometry, Physical Training, *hygiene, athletic exercises,* Physics, Projections, *theory, plates, tracings,* Surveying, *theory and practice,* Thesis, *vacation work,* Topographical Drawing. SECOND YEAR. Chemistry, *laboratory,* Descriptive Geometry, *advanced orthographic projections, shades and shadows,* Electricity, Engineering Forestry, English, Freehand Drawing, *sketches of tools, machines, bridges,* Highways, Higher Analytic Geometry, Differential and Integral Calculus, Differential Equations, Perspective, Physics, Slide Rule, Surveying, Surveying Practice, *topographical, hydrographical,* and *plane table surveys,* Thesis, *vacation work.* THIRD YEAR. Astronomy, *descriptive,* Diagrams, Electrical Engineering, Electricity, *laboratory,* Ferrous Metallurgy, Geodesy, Geology, Maps, Drawing, *topographical, hydrographical,* Masonry and Building Construction, Metallography, Physics, Railroad Curves, Railroad Survey, Rational Mechanics, *solids, fluids,* Reinforced Concrete, Resistance of Materials, Specifications, Structures, Testing Laboratory, Thesis, *vacation work.* FOURTH YEAR. Architecture, Astronomy, *spherical and practical,* Bridge Computations, Bridge Drawing, *details,* Bridges, *calculations,* Business

Administration, Electrical Engineering Laboratory, English, Hydraulics, Machine Construction, Mechanical and Hydraulic Laboratory, Patent Law, Power Engineering, Railroad Engineering, Water Supply and Sewers, Thesis, *graduating thesis.*

Course in Mechanical Engineering

First Year. General Chemistry, Drawing, *lettering, geometrical constructions,* Economics, English, Advanced Algebra, Plane and Spherical Trigonometry, Plane Analytic Geometry, Physical Training, Physics, Projections, *theory, plates, tracings,* Steam Engineering, Surveying, Summer Shop Work, *a month's work in use of machine tools, forging,* Thesis, *vacation work.* Second Year. Accounting, Architecture, Chemistry, *laboratory,* Descriptive Geometry, *advanced orthographic projections, shades and shadows,* Electricity, English, Kinematics, Machine Sketching, Higher Analytic Geometry, Differential and Integral Calculus, Differential Equations, Physics, Summer Shop Work, *machine and pattern shop, foundry,* Thesis, *vacation work.* Third Year. Astronomy, Dynamics of Machines, Electrical Engineering, *theory and laboratory work,* English, Heat Engines, Heat Problems, Mechanical Laboratory, Rational Mechanics, Resistance of Materials, Structures, Testing Laboratory, Thermodynamics, Thesis, *vacation work.* Fourth Year. Aeronautics, Business Administration, Ferrous Metallurgy, Hydraulic Laboratory, Hydraulic Machinery, Hydraulics, Machine Design, Mechanical Laboratory, Metallography, Naval Architecture, Patent Law, Power Plants, *electrical equipment,* Power Plants, *mechanical equipment,* Steam Turbines, Ventilating, Heating, and Refrigerating, Thesis, *graduating thesis.*

Course in Aeronautical Engineering

The first two years of this course are the same as those in Mechanical Engineering. Third Year. Aerodynamics,

Dynamics of Machines, Electrical Engineering, *theory, laboratory work,* English, Heat Engines, Mechanical Laboratory, Meteorology, Rational Mechanics, Resistance of Materials, Structures, Testing Laboratory, Thermodynamics, Thesis, *vacation work.* FOURTH YEAR. Aeronautical Laboratory, Aircraft Engines, Airplanes, Airports, Airships, Business Administration, Ferrous Metallurgy, Hydraulics, Machine Design, Mechanical Laboratory, Metallography, Navigation, Patent Law, Thesis, *graduating thesis.*

Course in Electrical Engineering

The first year in Electrical Engineering is the same as that in Mechanical Engineering. SECOND YEAR. Accounting, Architecture, General Chemistry, Descriptive Geometry, *advanced orthographic projections, shades and shadows,* Direct Current Machines, Electrical Engineering, Electricity, *theory, laboratory work,* English, Higher Analytic Geometry, Differential and Integral Calculus, Differential Equations, Physics, Thesis, *vacation work.* THIRD YEAR. Alternating Current Measurements, Alternating Current Machines, Alternating Currents, Direct Current Measurements, Direct Current Machines, English, Heat Engines and Thermodynamics, Kinematics and Machine Design, Railroad Engineering, Railroad Engineering Problems, Rational Mechanics, Resistance of Materials, Structures, Testing Laboratory, *metals, stone, cement,* Vacuum Tube Circuits, Summer Shop Work, *machine shop, patterns, foundry,* Thesis, *vacation work.* FOURTH YEAR. Astronomy, *descriptive,* Business Administration, Communication Engineering, Electric Railways, Cranes and Elevators, Electrical Engineering, *laboratory,* Electrical Machine Design, Electrochemistry, Electron Theory, Hydraulics, Illuminating Engineering, Mechanical and Hydraulic Laboratory, Patent Law, Power Plants, *electrical equipment,* Power Plants, *mechanical equipment,* Transmission and Distribution of Elecrtical Energy, Thesis, *graduating thesis.*

Course in Chemical Engineering

FIRST YEAR. Drawing, *lettering, geometrical constructions,* English, General Chemistry, Inorganic Chemistry, *laboratory work,* Advanced Algebra, Plane Spherical Trigonometry, Plane Analytic Geometry, German, Physical Training, Physics, Projections, *theory, plates, tracings,* Thesis, *vacation work.* SECOND YEAR. Economics, Electricity, English, Geology, Higher Analytic Geometry, Differential and Integral Calculus, Differential Equations, Physics, Qualitative Analysis, Quantitative Analysis, Summer Shop Work, *machine tools, forging,* Thesis, *vacation work.* THIRD YEAR. Chemical Technology, Colloid Chemistry, Electrical Engineering, Electricity, *laboratory work,* Kinematics and Machine Design, Mechanical and Hydraulic Laboratory, Organic Chemistry, Physical Chemistry, Physics, Rational Mechanics, Resistance of Materials, Steam Engines and Thermodynamics, Structures, Surveying, Testing Laboratory, Summer Shop Work, *shop practice, pipe fitting,* Thesis, *vacation work.* FOURTH YEAR. Business Administration, Chemical Engineering, Electrical Engineering Laboratory, Electrochemistry, Electrometallurgy, English, Ferrous Metallurgy, Hydraulics, Industrial Chemistry, Metallography, Non-Ferrous Metallurgy, Patent Law, Thesis, *graduating thesis.*

Course in Metallurgical Engineering

The first year of this course is the same as that in Chemical Engineering. SECOND YEAR. Economics, Electricity, English, General Metallurgy, Higher Analytic Geometry, Differential and Integral Calculus, Differential Equations, Physics, Qualitative Analysis, Quantitative Analysis, Summer Shop Work, *machine work, forging.* THIRD YEAR. Electrical Engineering, Electricity, *laboratory work,* Ferrous Metallurgy, Geology, Kinematics and Machine Design, Mechanical and Hydraulic Laboratory, Metallurgical

Laboratory, Non-Ferrous Metallurgy, Physical Chemistry, Physics, Rational Mechanics, Resistance of Materials, Steam Engines and Thermodynamics, Structures, Surveying, Testing Laboratory, Summer Shop Work, *shop practice, pipe fitting,* Thesis, *vacation work.* FOURTH YEAR. Business Administration, Economic Geology and Metallurgy, Electrical Engineering Laboratory, Electrochemistry, Electrometallurgy, English, Hydraulics, Metallography, Metallurgical Calculations, Physical Measurements, Physical Metallurgy, Patent Law, Thesis, *graduating thesis.*

Course in Industrial Engineering

FIRST YEAR. Accounting, General Chemistry, *theory, laboratory work, industrial chemistry,* Economics, English, Geology, Advanced Algebra, Plane and Spherical Trigonometry, Plane Analytic Geometry, Physical Training, Physics, Summer Shop Work, *machine shop, forging,* Thesis, *vacation work.* SECOND YEAR. Drawing, Economic Geography, Economic History, Electricity, *theory, laboratory work,* English, General Metallurgy, Industrial Architecture, Industrial History, Higher Analytic Geometry, Differential and Integral Calculus, Differential Equations, Physics, Projections, *theory, plates, tracings,* Summer Shop Work, *machine shop, patterns, foundry,* Thesis, *vacation work.* THIRD YEAR. Analytical Chemistry, Business Economics, Electrical Engineering, Industrial Management, Kinematics and Machine Design, Marketing, Mechanical and Hydraulic Laboratory, Organic Chemistry, Rational Mechanics, Resistance of Materials, Steam Engines and Thermodynamics, Structures, Thesis, *vacation work.* FOURTH YEAR. Banking and Finance, Business Statistics, Chemical Technology, Electrical Engineering Laboratory, English, Hydraulics, Industrial Accounting, Industrial Management, Patent Law, Production Engineering, Transportation, Thesis, *graduating thesis.*

Course in Arts, Science, and Business Administration

FIRST YEAR. Accounting, Biology, General Chemistry, English Composition, History of Civilization, History of Fine Arts, Mathematics, *advanced algebra, plane and spherical trigonometry,* Modern European History, Physical Training, Physics, Principles of Business, Thesis, *vacation work.* SECOND YEAR. Accounting, Economic Geography and International Relations, Economic History, Electricity, English Literature, Heredity, Variation and Evolution, Industrial History of the United States, Plane Analytic Geometry, Physics, Principles of Business, Public Speaking and Argumentation, Thesis, *vacation work.* THIRD YEAR. Accounting, Analytical Chemistry, Astronomy, Business Economics, Business Graphics, Business Problems, Economics, Geology, Government, Industrial Hygiene, Marketing and Transportation, Psychology, Summer Work, *two months' work in an approved business organization,* Thesis, *vacation work.* FOURTH YEAR. Accounting, Banking and Finance, Business Reports and Letters, Business Statistics, Comparative Literature, Industrial Management, Higher Analytic Geometry, Differential and Integral Calculus, Differential Equations, Patent Law, Sociology, Thesis, *graduating thesis.*

Course in Physics

FIRST YEAR. Biology, English Composition, General Chemistry, History of Civilization, Advanced Algebra, Plane and Spherical Trigonometry, Plane Analytic Geometry, Modern European History, German, Physical Training, Physics, Summer Shop Work, *machine shop, forging,* Thesis, *vacation work.* SECOND YEAR. Drawing, *lettering, geometrical constructions, plates, tracings,* Economic History, Electricity, *theory, laboratory work,* English Literature, Industrial History of the United States, Higher Analytic Geometry, Differential and Integral Calculus, Differential Equations, German, Physics, Qualitative Analysis, Quantitative Analysis, Thesis, *vacation work.* THIRD YEAR. Astronomy, *descriptive,* Dynamics, Economics, Electrical Engineering, Electricity, Electron Theory, Advanced Calculus, Optics, Organic Chemistry, Physical Chemistry, Radio Communication, Scientific Writing, Summer Practice, *maintenance of apparatus, glass blowing,* Thesis, *vacation work.* FOURTH YEAR. Advanced Physical Chemistry, Atomic Physics, *theory, laboratory,* Banking and Finance, Electrical Engineering, *laboratory,* Electrochemistry, Electrometallurgy, Geology, Industrial Management, Metallurgy, Patent Law, Recent Developments in Biology, Thesis, *graduating thesis.*

Course in Chemistry

FIRST YEAR. Biology, English Composition, General Chemistry, *theory, laboratory,* History of Civilization, Advanced Algebra, Plane and Spherical Trigonometry, Plane Analytic Geometry, German, Physical Training, Physics, Summer Shop Work, *machine shop, forging,* Thesis, *vacation work.* SECOND YEAR. Accounting, Electricity, English Literature, Geology, Higher Analytic Geometry, Differential and Integral Calculus, Differential Equations, Modern European History, Physics, Qualitative Analysis, Quantitative Analysis, Summer Practice, *glass blowing, surveying practice,* Thesis, *vacation work.* THIRD YEAR. Advanced Physical Chemistry, Astronomy, Economics, Electrical Engineering, Electricity, *laboratory,* Advanced Calculus, Metallurgy, Organic Chemistry, Physical Chemistry, Physics, Technical Analysis, *theory, laboratory,* Thesis, *vacation work.* FOURTH YEAR. Advanced Organic Chemistry, Atomic Physics, Colloid Chemistry, Electrical Engineering, *laboratory,* Electricity, *theory, laboratory,* Electrochemistry, Electrometallurgy, Industrial Chemistry, Metallography, Optics, Patent Law, Sanitary Chemistry, Scientific Writing, Thesis, *graduating thesis.*

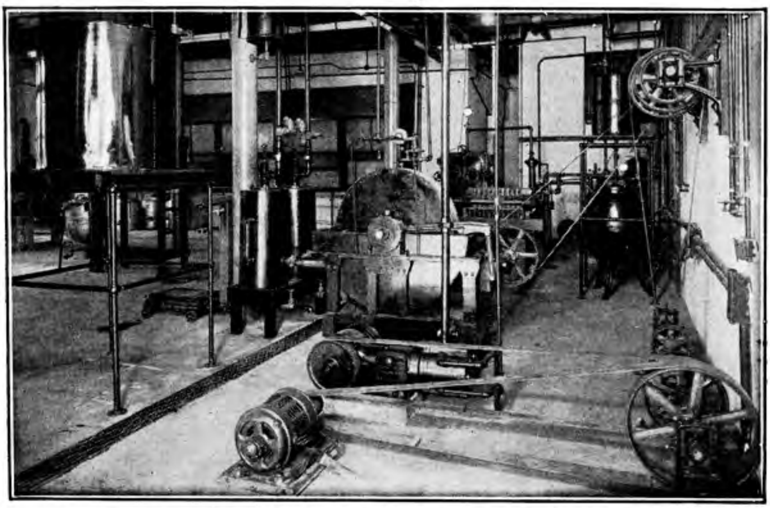
Course in Biology

First Year. Biology, English Composition, General Chemistry, History of Civilization, Advanced Algebra, Plane and Spherical Trigonometry, Plane Analytic Geometry, German, Physical Training, Physics, Thesis, *vacation work.* Second Year. Comparative Anatomy, Electricity, *theory, laboratory,* English Literature, Genetics, German, Organic Chemistry, Physics, Qualitative Analysis, Quantitative Analysis, Zoology, Thesis, *vacation work.* Third Year. English, Histology and Embryology, Higher Analytic Geometry, Differential and Integral Calculus, Differential Equations, German, Optics, Organic Chemistry, Organogenesis, Physical Chemistry, Physiological and Sanitary Chemistry, Physiology, Psychology, Summer Work, *two months' work in an approved office or laboratory,* Thesis, *vacation work.* Fourth Year. Atomic Physics, *theory, laboratory,* Colloid Chemistry, Comparative Literature, Experimental Morphology, Geology, Industrial Hygiene, German, Patent Law, Problems in Geology, Recent Developments in Biology, Sociology, Thesis, *graduating thesis.*

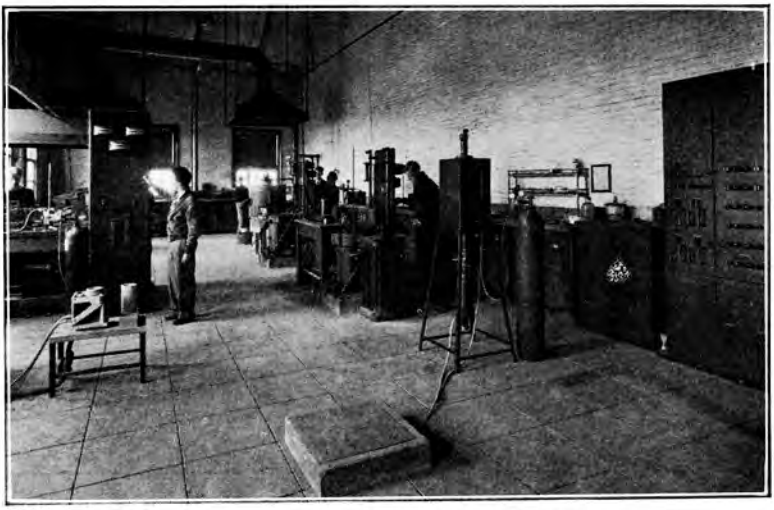
Course in Architecture

First Year. Architectural Design, Chemistry, English, Freehand Drawing, *block compositions and casts,* Graphics, *orthographic projections, shades and shadows,* History of Civilization, Advanced Algebra, Plane and Spherical Trigonometry, Plane Analytic Geometry, Physical Training, Physics, Thesis, *vacation work.* Second Year. Architectural Construction, Architectural Design, Electricity, English, Freehand Drawing, Materials and Building Construction, Higher Analytic Geometry, Differential and Integral Calculus, Differential Equations, Physics, Summer Work, *surveying, testing materials,* Thesis, *vacation work.* Third Year. Architectural Construction, Architectural Design, Economics, Freehand Drawing, History of Archi-

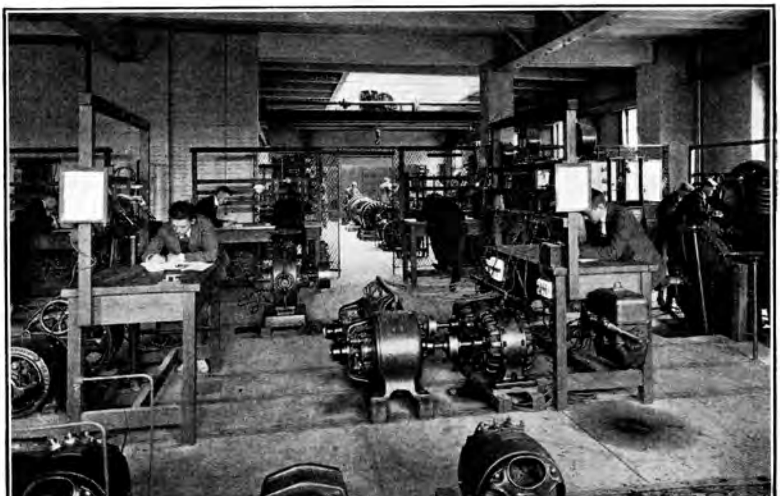
Metallographic Laboratory, 1933–



Chemical Engineering Laboratory, 1933–



Electrometallurgical Laboratory, 1933–



Part of Electrical Laboratory, 1933–

tecture, Office Practice, Rational Mechanics, Reinforced Concrete, Resistance of Materials, Structures, Summer Work, *eight weeks in an architect's office,* Thesis, *vacation work.* FOURTH YEAR. Architectural Design, Business Administration, Electrical Equipment of Buildings, Freehand Drawing, Mechanical Equipment of Buildings, Paints, Oils and Varnishes, Patent Law, Physics, Professional Practice, Thesis, *graduating thesis.*

Graduate Courses

These courses lead to a master's degree at the end of one year and to a doctor's degree at the end of three years of work. In the latter case at least two of the years, including the last, must be spent at the Institute. A graduate student must register for one major and two minor subjects. He has the option of majoring in one of thirteen different departments as follows: civil engineering, mechanical engineering, electrical engineering, chemical engineering, hydraulic engineering, metallurgy and metallography, mathematics, physics, chemistry, biology, geology and mineralogy, economics and business administration, and architecture. There are forty-eight teachers giving the various subjects, of which there are one hundred and fifty-three in the schedules.

Summer Courses

Summer work, from three to eight weeks in duration, is required, for two of the three summer vacations, in each one of the twelve undergraduate departments. It varies for the different departments and includes, Simple Surveying, *with adjustments and use of instruments,* Hydrographical, Topographical, and Railroad Surveying, Shop Practice, *use of planer, lathe, etc., forging, pattern making, foundry, pipe fitting,* Testing Laboratory, *steel, stone, concrete, etc.,* Maintenance of Apparatus, and Glass Blowing. In some cases the student must spend eight weeks in a factory, business office, or architect's office.

APPENDIX IV

Grand Marshals of the Institute Since the Foundation of the Office. There Were No Grand Marshals for the Years '91, '92, '93 and '94

Albert M. Harper, '66, ΔΦ
Frank J. Hearne, '67, ΔΦ
Virgil G. Bogue, '68, ΔKE
John Pierpont, '69, ΔKE
Thomas O'N. Morris, '70, ΔΦ
George C. MacGregor, '71, ZΨ
David Reeves, '72, ΔΦ
Daniel A. Tompkins, '73
James N. Caldwell, '74, R.S.E.
William L. Fox, '75, ΔΦ
Morris S. Verner, '76, ZΨ
Coddington Billings, Jr., '77, R.S.E.
George S. Davison, '78
Robert R. Bridgers, '79, R.S.E.
Frederick S. Young, '80, ΔΦ
Thomas D. Whistler, '81, ΔΦ
Independence Grove, '82, XΦ
Robert J. Pratt, '83, R.S.E.
William A. Aycrigg, '84, XΦ
Leverett S. Miller, '85, ΔΦ
Edward B. Ashby, '86, ZΨ, ΘNE
James E. Larrowe, '86, ΘΞ
Halsey B. Pomeroy, '87, R.S.E., ΘNE
James M. Africa, '88, ΔKE, ΘNE
Paul O. Hebert, '89, ΔTΔ, ΘNE
William Easby, Jr., '90
Athol M. Miller, Jr., '95, ΔΦ, ΘNE
Henry B. Voorhees, '96, ΔKE, ΘNE
Charles J. McDonough, '97, ΘΔX
Thomas R. Lawson, '98, ΘΞ
Gustave A. Keller, '99, R.S.E., ΘNE
Parley L. Williams, Jr., '00, XΦ
James W. Davis, '01, ΔKE, ΘNE
William H. Young, '02, XΦ
Edward W. Banker, '03, ΔΦ
Homer G. Whitmore, '04, R.S.E., ΘNE
Cuyler W. Lush, '05
William S. Lozier, '06, R.S.E., ΘNE
Herman S. Chalfant, '07, ΔΦ, ΘNE
Horace W. Rinearson, '08, R.S.E., ΘNE
Robert A. Searle, '09, ΔKE
Carl W. Schedler, Jr., '10, R.S.E., ΘNE
James T. Ganson, '11, ΔKE
Frank B. Watkins, '12, R.S.E., ΘNE
Edward D. P. Gross, '13, ΔΦ
Philip C. Rummel, Jr., '14, R.S.E., ΘNE
Glenn W. Tisdale, '15, ΔKE, ΘNE
John W. Howard, '16, ΘΞ
Walter I. Johnson, Jr., '17, ΔTΔ
Harry F. Parrott, '18, R.S.E., ΘNE
Newell L. Nussbaumer, '19, ΘΞ
John Van N. Richards, '20, ΘΞ
John S. Thompson, '21, ΔKE
Neal D. Howard, '22, ΘΞ
Gardner S. Staunton, '23, XΦ
William M. Stilwell, Jr., '24, R.S.E., ΘNE
George V. Robbins '25, ΘΞ
H. Fuller Stearns, '26, ΘX
Marvin H. Anderson, '27, R.S.E.
James M. Robbins, '28, ΘX
Bernard F. Wade, '29, R.T.S.
Edward P. Kennedy, '30, R.S.E.
Richard E. Warren, '31, XΦ
Meredith H. Thompson, '32, BΨ
Howard H. Disbrow, '33, ΘX
Carl H. Wunnenberg, '34, ΦEΦ

Presidents of the Rensselaer Union Since the Foundation of the Office

W. C. H. Slagle, '91, ΔΤΔ
George A. Soper, '92, ΔΦ
James W. Frazier, '93, R.S.E.
Athol M. Miller, Jr., '94, ΔΦ, ΘΝΕ
Henry B. Voorhees, '95, ΔΚΕ, ΘΝΕ
Howard W. Mesnard, '96, R.S.E.
Thomas R. Lawson, '97, ΘΞ
James B. Wilson, '98, ΧΦ
William P. Creager, '99, ΘΞ
Luis G. Morphy, '00, ΘΞ
Prentice H. Burlingham, '01, ΧΦ
James R. Fitzpatrick, '02, R.S.E.
John Q. Rankin, '03, ΔΚΕ
Allen van Rensselaer, '04, ΧΦ
William S. Lozier, '05, R.S.E., ΘΝΕ
Herman S. Chalfant, '06, ΔΦ, ΘΝΕ
George Bryan, Jr., '07, R.S.E.
Thorpe T. Walsh, '08, ΧΦ
Harry R. Hayes, '09, ΧΦ
John L. Weber, '10, ΔΚΕ
Henry H. Giles, '11, R.S.E
H. Dutton Smith, '12, ΔΚΕ
Edward P. Abbott, '13, ΔΤΔ
David Adams, Jr., '14, R.T.S.
Thomas E. Dunham, '15
William H. Cravens, '16, ΧΦ
Wisner R. Townsend, Jr., '17, ΔΚΕ
Arnold R. Kamman, '18, ΘΞ
Louis W. Robertson, '18, ΔΚΕ
Stanley L. Burns, '19, ΘΧ
Bruce G. Mackey, '20, R.S.E.
William F. Dewey, '21, R.S.E.
Clifford H. Tyler, '22, R.T.S.
Herbert J. Gatje, '23, R.S.E.
Thomas F. Perkinson, Jr., '24
Townsend Tinker, '25, ΘΧ
William Busch, '26, R.S.E.
Earle K. Smith, '27, ΑΤΩ
Horace K. Church, '28
Roger L. Doran, '29, ΑΤΩ
James W. Gaynor, 30, ΦΜΔ
Robert I. Warnecke, '31, ΦΕΦ
James E. Burdick, '32, R.S.E.
Howard K. Mikkelsen, '33, ΔΦ
Roger P. Fox, '34

APPENDIX V

Laboratories

The various laboratories for accounting, biology, chemistry, chemical engineering, physics, electrochemistry, electrometallurgy, metallurgy, electrical engineering, mechanical engineering, testing materials of engineering, etc., are too extensive to be described in detail here. The contents of all of them are valued at about $800,000. A mere sketch of their contents must suffice.

The accounting and statistical laboratories are equipped with adding machines and calculators of various types. The biological laboratories include those for general biology, plant biology, embryology and histology, comparative physiology, comparative anatomy, experimental morphology and bacteriology, all well equipped for their various purposes. The chemical laboratories are many in number; for general, inorganic, organic, physical, and sanitary chemistry; for metallography, fuels, oils, etc., together with special research rooms. The chemical engineering laboratories are provided with modern industrial equipment, of the first class, for studying, concentration, evaporation, crystallization, drying, filtration, centrifugal separation, fractional distillation, crushing and grinding, leaching and washing, nitration, high-pressure reactions, etc. The laboratories are equipped with all necessary apparatus for making tests upon the machines. The laboratories for teaching physics are particularly complete with apparatus so numerous that it cannot be mentioned here. A dark room for photographic work and facilities for glass-blowing are included. The laboratories for electrochemistry and electrometallurgy are provided with standard apparatus for instruction. The generating plant is equipped to supply any of the usual forms of electrical energy. Many kinds of electrical furnaces are included. The electrical engineering laboratories are of great completeness including about fifty transformers, regulators, rectifiers, motors of various kinds, generators, rotary converters, etc. Four rooms are given to the illuminating engineering department. Ample provision is made for magnetic and electrical measurements. The communication engineering laboratory is very complete. So is the broadcasting station WHAZ. The machine shop used for making and repairing instruments and apparatus for the department is well equipped. All the machines in this department and the innumerable auxiliary apparatus are of the highest grade from the best makers. There are many large machines in the mechanical engineering laboratories; many engines, cross-compound, vertical una-flow, vertical compound, high-speed, gas engines, oil engines, Diesel engines, turbines, engines for valve setting. Installed in the gas engine laboratory are airplane motors and automobile engines. There are many types of pumps: high-service, tank, rotary, electrically driven turbine pumps, and air compressors as well. The hydraulic laboratory contains water turbines, wheels of the Pelton type, cisterns, tanks, flumes for weir measurements, for measuring the resistance of ship models, and calibrating current meters. Other equipment includes a refrigerating and ice-making plant, blowers and fans, apparatus for measuring the efficiency of gearing, belts, ropes, etc. Hundreds of smaller necessary machines, tools, instruments, and apparatus are to be found. A well-equipped special machine shop is attached to this laboratory. The shop for the summer work of students contains a machine shop with planers, lathes, milling machine, drill press, etc., as well as a pattern shop, a blacksmith shop, and a foundry, all suitably furnished with machines and tools. The laboratories for testing materials of engineering are installed with many machines and other apparatus; one machine for testing steel, wood, stone, concrete, etc., is capable of exerting compression up to 1,200,000 pounds; another of 600,000 pounds is used for testing columns up to 24 feet in length and 22-foot beams. The cement-testing machines are various, and there are rotating devices for testing the abrasive resistance of brick, stone, road metal, etc. Valuable auxiliary apparatus of all kinds is included in the equipment of this laboratory.

APPENDIX VI

Honorary Degrees Conferred Since the Foundation of the School

Civil Engineer

*Charles H. Fisher, Chief Engineer, New York Central and Hudson River Railroad, Troy, N. Y.. 1882

*Luiz da R. Dias, Director of Victoria a Minas Railroad, Rio de Janeiro, Brazil 1882

*William B. Cogswell, Vice-President, The Solvay Process Company, Syracuse, N. Y. 1884

Master of Civil Engineering

*Francis E. House, President, Duluth and Iron Range Railroad, Duluth, Minn. 1918

Doctor of Philosophy

*James C. Booth, Director, United States Mint, Philadelphia, Pa. 1884

James R. Angell, Litt.D., LL.D., President, Yale University, New Haven, Conn. 1924

Edward A. Birge, Ph.D., Sc.D., LL.D., formerly President, University of Wisconsin, Madison, Wis. 1924

Livingston Farrand, M.D., L.H.D., LL.D., President, Cornell University, Ithaca, N. Y. 1924

*Samuel W. Stratton, D.Sc., D.Eng., LL.D., President, Massachusetts Institute of Technology, Cambridge, Mass. 1924

Doctor of Science

*Leonard Wood, M.D., LL.D., Major General, United States Army, Governor General, Philippine Islands, Manila, P. I. 1920

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* Deceased.

*Albert A. Michelson, Ph.D., Sc.D., LL.D., Past President, National Academy of Sciences, Chicago, Ill. 1924

Charles Butler, A.B., École des Beaux Arts, Architect, New York, N. Y. 1931

Doctor of Engineering

*Robert W. Hunt, President, Robert W. Hunt and Company, Engineers and Inspectors, Chicago, Ill. 1916

Onward Bates, C.E., LL.D., Consulting Engineer, Chicago, Ill. 1918

William H. Burr, C.E., Consulting Engineer, New York, N. Y. 1918

*Henry W. Hodge, C.E., Consulting Engineer, New York, N. Y. 1918

*Alexander C. Humphreys, M.E., Sc.D., LL.D., President, Stevens Institute of Technology, Hoboken, N. J. 1918

Edwin W. Rice, Jr., A.M., Sc.D., Honorary Chairman, Board of Directors, General Electric Company, Schenectady, N. Y. 1918

Herbert C. Hoover, Sc.D., Ph.D., LL.D., D.C.L., Secretary of Commerce, Washington, D. C 1920

·Arthur M. Greene, Jr., B.S., M.E., Sc.D., Dean and Professor of Mechanical Engineering, Princeton University, Princeton, N. J. 1922

Henri Abraham, Sc.D., Past President, Society of Electrical Engineers of France, Paris, France . . . 1924

*Carl E. Grunsky, Dr. Ing., Past President, American Society of Civil Engineers, San Francisco, Cal. 1924

William Kelly, B.A., E.M., Past President, American Institute of Mining and Metallurgical Engineers, Iron Mountain, Mich. 1924

Frederick R. Low, Past President, American Society of Mechanical Engineers, New York, N. Y. . 1924

* Deceased.

*SENATORE LUIGI LUIGGI, D.Sc., Dr. Ing., Past President, Society of Civil Engineers of Italy, Rome, Italy 1924

SIR CHARLES L. MORGAN, C.B.E., Past President, Institution of Civil Engineers of Great Britain, London, England 1924

FARLEY OSGOOD, Past President, American Institute of Electrical Engineers, Newark, N. J. 1924

ARTHUR SURVEYER, B.A.Sc., C.E., Past President, Engineering Institute of Canada, Montreal, Canada 1924

HENRY FORD, Inventor and Capitalist, Detroit, Mich. 1925

JOHN VAN W. REYNDERS, C.E., Consultant on Steel Properties, New York, N. Y. 1925

GEORGE S. DAVISON, C.E., Sc.D., President, Gulf Refining Company, Pittsburgh, Pa. 1926

RALPH EARLE, D.Sc., President, Worcester Polytechnic Institute, Worcester, Mass. 1926

*WILLIAM LISPENARD ROBB, Ph.D., LL.D., Head of the Department of Electrical Engineering, Rensselaer Polytechnic Institute, Troy, New York 1932

CLARENCE F. HIRSHFELD, B.S., M.M.E., Chief of Research Department, Detroit Edison Company, Detroit, Mich. 1932

DANIEL L. TURNER, C.E., Consulting Engineer, New York, N. Y. 1933

LEONOR F. LOREE, B.S., M.S., C.E., LL.D., President of the Delaware and Hudson Railroad Corporation, New York, N. Y. 1933

CHARLES P. PERIN, A.B., Consulting Engineer, New York, N. Y. 1933

Doctor of Laws

WILLIAM LELAND THOMPSON, A.B., Regent of the University, State of New York, Troy, N. Y. 1931

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* Deceased.

APPENDIX VII

Act of Incorporation

Being Chapter 151, Laws 1861, as amended by Chapter 229, Laws 1866, Chapter 277, Laws 1887, and Chapter 14, Laws 1907.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. The present trustees of Rensselaer Polytechnic Institute and their successors, are hereby constituted a body corporate and politic, by the name of "Rensselaer Polytechnic Institute." By that name they shall have perpetual succession, with power to fill vacancies as they may occur from time to time in their board, to sue and be sued, to complain and defend, to contract and be contracted with, to make and use a common seal, and to alter the same from time to time, at their pleasure; to purchase, take and hold, by gift, grant or otherwise, and to dispose of any real and personal property, and to borrow from time to time such sum or sums, as may be necessary to aid in maintaining this school, and to give proper and sufficient obligations for the same; provided that the funds of said corporation shall be used and appropriated to the object of maintaining a scientific and literary school in the county of Rensselaer. [As amended in 1907.]

Sec. 2. Rensselaer Polytechnic Institute is hereby incorporated for the purpose of continuing and maintaining in the city of Troy and county of Rensselaer, a school for instruction in mathematics, civil engineering, chemistry, mineralogy, geology, botany, literature and the arts and their application to agriculture, domestic economy and manufacturing, as the trustees shall direct; and for the delivery of lectures on such subjects connected therewith as may be deemed necessary by said Board of Trustees.

Sec. 3. The Trustees shall hold an annual meeting on such day as may be prescribed by their by-laws, and such other meetings as may be called by the President of the Board; and a meeting shall be called at any time, at the written request of any three members of the Board. But no meeting shall be held unless notice shall have been sent by mail to, or left at, the dwelling house or place of residence of each member of the Board signed by the Secretary, or in case of his inability by the President or Vice-President. [As amended in 1866.]

Sec. 4. No new Trustee shall be elected, nor shall any real estate be purchased or alienated unless at least ten members of the Board shall be present at the meeting. Seven members shall be a quorum for the transaction of any other business. The Board shall have power in its discretion to increase the number of Trustees, so as to make it consist of twenty-five members, including the Mayor of Troy. If any Trustee shall, for a continuous period of one year, fail to attend the meetings of the Trustees, without reasonable excuse, he may be removed from his office as Trustee at any meeting of the Trustees where there are not less than twelve Trustees present. [As amended in 1866.]

Sec. 5. The Mayor of the city of Troy for the time being shall, ex-officio, be a member of the Board.

Sec. 6. The Board of Trustees shall have power to appoint a President, Vice-President, Secretary and Treasurer, a Prudential Committee, a Director, and such other officers as they may deem necessary; to make such by-laws as they may deem proper for the election of their officers and for defining their duties, and for the regulation and government of the Institute, and the school connected therewith; to appoint professors and teachers in said school, and remove the same, including the Director, at their pleasure, and to prescribe the compensation to be allowed to each for his services; to organize the school under the charge of the instructors, and define their duties in the government and discipline of said school; to fix the amount of term fees and other charges for tuition; the amount of fines and other impositions, including damages for injury done by students to the property of the Institute; and to make such rules and regulations for the suspension or expulsion of students as may be necessary for maintaining the discipline of the school. [As amended in 1887.]

Sec. 7. The Director and professors shall constitute the faculty of said school, and, subject to the by-laws, the Director shall have charge of the course of instruction and discipline in said school, and it shall be his duty to prescribe and pursue such a system of instruction as shall be calculated to make thorough scholars in the several branches of civil engineering and other studies of this Institute. [As amended in 1887.]

Sec. 8. The Board of Trustees shall have power to confer the degrees of civil engineer, topographical engineer, bachelor of science and such other academical honors as they may see fit on such individuals as shall have pursued the course of study prescribed in the Institute, and shall have conformed to the rules and regulations for the government of the same, and who, in a thorough examination, shall have been found qualified for their respective degrees, and been recommended by the faculty for the same.

Sec. 9. The officers of the present Board of Trustees of Rensselaer Institute shall continue to hold their respective offices in Rensselaer Polytechnic Institute until others are appointed in their stead by the Board; and all by-laws and resolutions of the Board as now organized shall remain in full force, as the acts of the new Board until repealed, altered or amended by the Board constituted under this act, and the present Director and professors and teachers shall be continued in office and pursue the present prescribed course of study and instruction, until otherwise ordered by the Board.

Sec. 10. All the real and personal estate of Rensselaer Institute shall belong to Rensselaer Polytechnic Institute; and all liabilities and obligations of the present Board shall be equally binding on the Board as organized by this act; and any suit in law now pending, commenced in the name of Rensselaer Institute, may be continued and conducted in the same name, and for the benefit of Rensselaer Polytechnic Institute, in the same manner as if the corporate name had not been changed by this act.

Sec. 11. Rensselaer Polytechnic Institute shall be subject to the visitation of the Regents of the University, and shall be entitled to the same privileges, government funds and other advantages as the academies, colleges, and other schools of the higher order, on complying with the terms required by law and the rules of said Regents.

Sec. 12. The corporation shall have all such powers, and be subject to such duties and liabilities as are specified or contained in the second and fifth articles of the first title of the fifteenth chapter; and in title third, chapter eighteen, of the first part of the revised statutes, except so far as the same are inconsistent with this act.

Sec. 13. All laws and parts of laws relating to the incorporation of the Rensselaer School, or Rensselaer Institute, inconsistent with this act are hereby repealed.

Sec. 14. This act shall take effect immediately.

Special Act Passed April 22, 1898, Chapter 483

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. Rensselaer Polytechnic Institute shall have exclusive power to regulate and prescribe the terms of admission of students to the courses of instruction prescribed from time to time to candidates for its degrees and on the satisfactory completion of such courses of study to confer degrees as authorized by chapter one hundred fifty-one of the laws of eighteen hundred and sixty-one, and the several laws amendatory thereof and to award suitable diplomas or certificates thereof.

SPECIAL ACT PASSED FEBRUARY 26, 1931, CHAPTER 34

AN ACT empowering Rensselaer Polytechnic Institute to confer honorary degrees.

Became a law February 26, 1931, with the approval of the Governor. Passed, three-fifths being present.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. Rensselaer Polytechnic Institute, a body corporate by virtue of chapter one hundred and fifty-one of the laws of eighteen hundred sixty-one and the acts amendatory thereof and supplemental thereto, shall have the power to confer honorary degrees and to award suitable diplomas or certificates thereof in conformity with the rules of the regents of the university of the state of New York.

§ 2. This act shall take effect immediately.

ACTS OF THE LEGISLATURE OF THE STATE OF NEW YORK RELATING TO THE INSTITUTE

The Rensselaer School was established November 5, 1824. It was incorporated by an Act passed March 21, 1826, Chapter 83. The Act of April 26, 1832, Chapter 327, gave the trustees power to remove to Greenbush if they wished. A law dated May 9, 1835, Chapter 254, differentiated the science from the engineering course and instead of A.B. (r.s.) the degrees B.N.S. and C.E. were in consequence, given. By the fourth Act passed May 8, 1837, Chapter 351, the name was changed to Rensselaer Institute. The office of director was created and the board of trustees enlarged to 19 members by a law dated March 8, 1850, Chapter 49.

July 10, 1851, Chapter 498, the state gave the Institute $3,000. The Act of April 8, 1861, Chapter 151, legalized the change of name to Rensselaer Polytechnic Institute, made ten years before, and gave the board of trustees power to increase its number to 25 members. To aid in rebuilding, after the fire of 1862, the state gave, April 23, 1863, Chapter 210, $10,000, and April 23, 1864, Chapter 320, it gave a collection of fossils. Fifteen thousand dollars were given, May 8, 1868, Chapter 717, and $3,750 by an Act passed April 28, 1871, Chapter 869. The Act of April 8, 1861, Chapter 151, as amended by Acts passed, March 26, 1866, Chapter 229, May 4, 1887, Chapter 277, and February 16, 1907, Chapter 14, constitutes the "Charter" of the school and is printed on following pages as the "Act of Incorporation." A special law passed April 22, 1898, Chapter 483, gave the Institute special powers regarding the admission of students. The text of this law follows that of the "Act of Incorporation."

APPENDIX VIII

Names of the Successful Competitors for the Macdonald, Ricketts, and Class of 1902 Prizes

The Macdonald Prize Awards. 1891, Stacey E. Denny; 1892, *Elmer J. Bucknell; 1893, Ralph H. Chambers; 1894, Paul L. Reed; 1895, *Myron E. Evans; 1896, Henry B. Voorhees; 1897, Howard W. Mesnard; 1898, James A. S. Redfield; 1899, Julius W. Pfau; 1900, J. Herbert Campbell; 1901, *Carl A. Bostrom; 1902, John W. Doty; 1903, C. W. Tillinghast Barker; 1904, Henry R. Beebe; 1905, Cuyler W. Lush; 1906, Jay A. Auringer; 1907, *George M. Ward; 1908, Charles E. Reinicker; 1909, *Byron V. Herden; 1910, Tandy A. Bryson; 1911, Charles J. Seibert; 1912, Charles P. Rumpf; 1913, Ralph W. Hewes; 1914, Agustin Padron;

1915, Francis R. I. Sweeny; 1916, *Roscoe L. Martin; 1917, F. Harper Craddock; (On account of the shortening of the courses due to the World War, no theses were required of members of the classes of 1918 and 1919) 1920, John J. Hall; 1921, Warren K. Eglof; 1922, Ralph E. Cruse; 1923, Harold M. Faigenbaum; 1924, William C. Ellis; 1925, Chang Kan Chien; 1926, William B. Webster; 1927, Henry Horandt; 1928, Horace K. Church; 1929, Joseph C. Federick; 1930, Oscar W. Tyree; 1931, Clayton O. Dohrenwend; 1932, Robert H. Chambers; 1933, James T. Riordan, Jr.

The Ricketts Prize Awards. 1929, Thornton C. Barnes, Norman V. Cargill, Wilbur E. Gemmill; 1930, L. Howard Garnar, John J. Lewis, Raymond J. Anderson; 1931, Joseph A. Ciccolella, Woodman Perine, Russell W. Dayton; 1932, M. Bertram Ottinger, Edwin A. Weinberg, Lewis E. Missbach; 1933, Samuel R. Hollingsworth, Elliott W. Knight, Conrado F. Asenjo.

The Class of 1902 Research Prize Awards. 1928, Earle V. N. Kennedy; 1929, Wilbur E. Gemmill; 1930, John J. Lewis; 1931, Arthur M. Lockie; 1932, Alfred O. Perlenfein; 1933, Albert M. Chambers, Jr.

APPENDIX IX

The General Alumni Association Organized at Troy, New York, June 22, 1869

Past Presidents

*James Hall, '32, 1869–71; *Albert R. Fox, '30, 1871–73; *Strickland Kneass, '39, 1873–74; *William Gurley, '39, 1874–78; *John G. Ambler, '33, 1878–79; *James P. Wal-

* Deceased.

lace, '37, 1879–80; *Francis Collingwood, '55, 1880–81; *Charles Macdonald, '57, 1881–83; *Charles C. Martin, '56, 1883–84; *Joseph M. Wilson, '58, 1884–85; *Joseph C. Platt, '66, 1885–86; *David Reeves, '72, 1886–87; *Theodore Voorhees, '69, 1887–88; *T. Guilford Smith, '61, 1888–89; *Christopher C. Waite, '64, 1889–90; *John J. Albright, '68, 1890–91; *Clark Fisher, '58, 1891–92; *William B. Cogswell, '51, 1892–93; *Theodore N. Ely, '66, 1893–94; *William Metcalf, '58, 1894–95; *William H. Doughty, '58, 1895–96; *Joseph M. Knap, '58, 1896–98; *Alexander J. Cassatt, '59, 1898–99; *Frederick Grinnell, '55, 1899–1900; *Charles C. Martin, '56, 1900–01; *Horace G. Young, '77, 1901–02; *Washington A. Roebling, '57, 1902–03; *Robert Forsyth, '69, 1903–04; Alfred H. Renshaw, '83, 1904–05; *Alfred P. Boller, '61, 1905–06; *Morris R. Sherrerd, '86, 1906–07; *William B. Ridgely, '79, 1907–08; Philip W. Henry, '87, 1908–09; George S. Davison, '78, 1909–10; *Calvin Pardee, '60, 1910–11; Thomas H. Walbridge, '76, 1911–12; *Nelson P. Lewis, '79, 1912–13; *Charles Sooysmith, '76, 1913–14; *Strickland L. Kneass, '80, 1914–15; *Alfred T. White, '65, 1915–16; *Louis E. Laflin, '82, 1916–17; George O. Knapp, '76, 1917–18; *Charles G. Roebling, '71, 1918–19; *Stewart Johnston, '87, 1919–21; *Ralph G. Packard, '64, 1921–28; Daniel L. Turner, '91, 1928–29; Percival M. Sax, '90, 1929–30; George C. Diehl, '94, 1930–31; Edwin G. Adams, '91, 1931–32; Thomas Earle, '87, 1932–33.

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* Deceased.

APPENDIX X

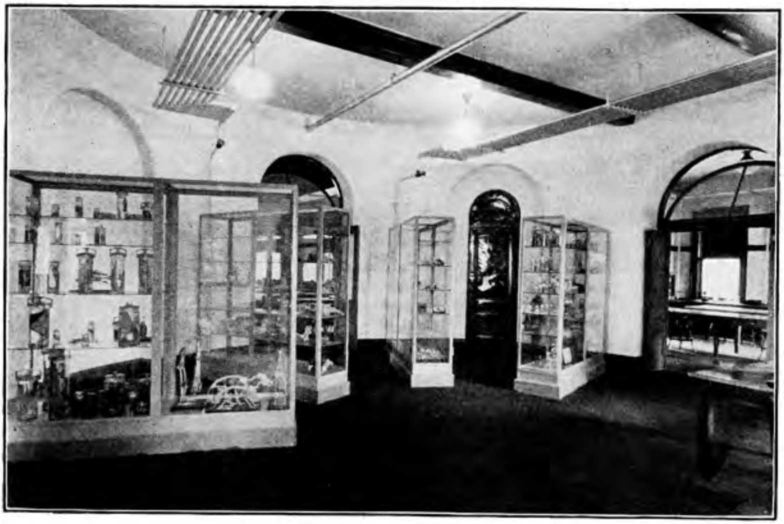
Bequests

As far as is known the bequests received to date are as follows: John A. Wool, of Troy, $15,000 in 1873; A. B. Filer, of Cambridge, N. Y., $10,000 in 1882; Mrs. Jared S. Weed, of Troy, $2,500 in 1889; Joseph M. Warren, of Troy, $10,000 in 1896; John I. Thompson, of Troy, $3,500 in 1901; Richard F. Hall, of Troy, $5,000 in 1911; A. M. Miller, Jr., '95, of Duluth, Incas Iron Ore Stock, fund in 1912 with $100,000 given by his father now amounts to $291,317; George B. Cluett, of Troy, $10,000 in 1913; Thomas W. Holmes, of Troy, $50,000 in 1915; Mrs. E. Proudfit, of Troy, $10,000 in 1916; Hiram F. Mills, '56, of Hingham, Mass., $10,000 in 1922; Henry W. Hodge, '85, of New York, $5,000 in 1922; Calvin Pardee, '60, of Philadelphia, $40,000 in 1924; Helen G. Williamson, of Troy, $21,592.13 in 1926; Mary J. Matthewson, of Yellville, Arkansas, $2,500 in 1927; Washington A. Roebling, '57, of Trenton, $50,000 in 1927; Robert Forsyth, '69, of Chicago, $100,000 in 1928; Strickland L. Kneass, '80, of Philadelphia, $10,000 in 1929; Mrs. Robert W. Hunt, of Chicago, bequeathed $200,000 but the State of Illinois took $35,737.71 of it as a tax on the ground that Mrs. Hunt, a citizen of Illinois, had made a bequest to an educational institution outside of the state, so that the Institute received in 1930, $164,836; Miss Frances H. Cronin, of Troy, $9,500 in 1931; Townsend V. Church, '81, of New York, $205,000 in 1931, used to build the six Church dormitories; Ida M. Wigand, of New London, widow of Albert A. Wigand, '89, left $139,417, received in 1932.

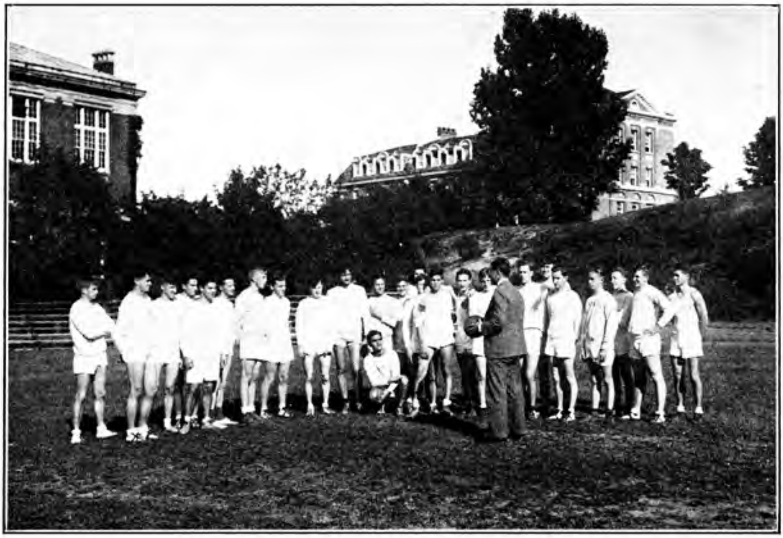
There are also legacies, with lives intervening before the receipt of the bequests, which will be received in due course; for instance, the legacy of Eliza Ricketts, two lives intervening, amounting possibly to $50,000 or more; the legacy of John F. Cahill, one life intervening, amounting probably to about $45,000; that of James D. Hailman, '87, two lives intervening, amounting probably to about $100,000; one of Lamont R. Stroud, '99, one life intervening, which will not be large; and one of James C. McGuire, '88, one life intervening, which ought to amount, if properly conserved, to $600,000 or $700,000 when received.

A number of bequests have been made to the Institute from which there is little probability that anything will be received; for example: the legacy of Alfred B. Jenkins, two lives intervening, which might amount to $200,000; the legacy of McCoskry Butt, '82, four or more lives intervening, which might be a large indefinite sum; that of W. Thomas Wooley, '00, after the death of his wife, a wholly uncertain small amount; and the legacy of Andreas M. Miller, with one life intervening, amounting to about $110,000.

Radio Operating Room, 1933–



Biological Museum, 1933–



Out-of-Door Physical Training, 1932–

'86 Athletic Field, 1932–

APPENDIX XI

Total Assets for the Years 1902 to 1933 Inclusive

Year	Grounds Buildings and Contents	Investments and Cash	Total Assets
1902	$240,000	$248,000	$488,000
1903	245,000	289,000	534,000
1904	280,000	300,000	580,000
1905	247,000	553,000	800,000
1906	383,500	632,800	1,016,300
1907	605,800	724,800	1,330,600
1908	697,000	1,612,100	2,309,100
1909	1,033,200	1,360,100	2,393,300
1910	1,153,000	1,393,100	2,546,100
1911	1,213,500	1,363,300	2,576,800
1912	1,322,600	1,359,400	2,682,000
1913	1,436,500	1,376,700	2,813,200
1914	1,505,100	1,347,400	2,852,500
1915	1,519,500	1,386,200	2,905,700
1916	1,548,200	1,562,200	3,110,400
1917	1,718,800	1,601,900	3,320,700
1918	1,731,600	1,706,000	3,437,600
1919	1,741,100	1,721,300	3,462,400
1920	1,888,600	1,874,300	3,762,900
1921	1,963,900	1,955,300	3,919,200
1922	1,981,500	2,058,100	4,039,600
1923	2,155,800	2,613,300	4,769,100
1924	2,446,100	2,709,900	5,156,000
1925	2,751,200	3,732,100	6,483,300
1926	2,916,900	3,910,800	6,827,700
1927	3,209,800	4,400,800	7,610,600
1928	3,328,700	4,780,600	8,109,300
1929	3,433,500	5,283,800	8,717,300
1930	3,511,000	5,697,500	9,198,500
1931	4,030,300	5,857,500	9,887,800
1932	4,568,300	5,944,300	10,512,600
1933	4,692,900	6,128,500	10,821,400

The years to and including 1923 end the last day of February; for 1924 to 1933 inclusive the year ends June 30. The figures, taken from the reports of the treasurer, are conservative. A recent inventory shows that the value of the contents of the buildings included in the column for the year 1933 might safely be increased by $200,000. And, by a reference to Appendix X, it may be seen that some bequests sure to be received would increase the figures in the investment column by at least $650,000. Again, the Trust Fund in the Bankers Trust Company, referred to in the text, the entire income from which will ultimately come to the Institute, is valued, at present, at nearly $3,000,000.

APPENDIX XII

NUMBER OF STUDENTS AND GRADUATES FOR THE YEARS 1863–1933 INCLUSIVE

TABLE I

Year Beginning	Total No. Students	No. Grad.	Year Beginning	Total No. Students	No. Grad.
1863	96	6	1898	143	19
1864	130	12	1899	175	21
1865	167	17	1900	225	21
1866	155	25	1901	249	21
1867	154	22	1902	314	44
1868	147	20	1903	375	53
1869	135	20	1904	387	35
1870	145	26	1905	426	42
1871	151	17	1906	485	68
1872	178	21	1907	609	57
1873	209	11	1908	667	79
1874	181	24	1909	672	56
1875	181	32	1910	655	71
1876	186	27	1911	643	118
1877	160	33	1912	620	108
1878	160	31	1913	626	88
1879	103	18	1914	647	87
1880	104	20	1915	623	74
1881	108	18	1916	687	92
1882	172	15	1917	623	69
1883	218	22	1918	643	67
1884	233	32	1919	1017	105
1885	234	48	1920	1093	121
1886	164	42	1921	1133	170
1887	154	31	1922	1098	168
1888	164	18	1923	1147	164
1889	174	19	1924	1172	129
1890	189	31	1925	1251	140
1891	183	34	1926	1351	167
1892	206	19	1927	1468	206
1893	188	36	1928	1468	199
1894	165	28	1929	1615	242
1895	135	14	1930	1747	255
1896	137	23	1931	1693	268
1897	138	26	1932	1524	330

Number of Teachers of Various Grades for the Years 1903–1933 Inclusive

Table II

Catalogue of Year	Professors	Assistant Professors	Instructors	Assistants	Temporary Assistants	Lecturers	Total Teachers	Number of Students	Ratio of Students to Teachers
1903	10	4	0	5	3	1	23	314	14
1904	10	3	0	6	1	1	21	375	18
1905	10	3	2	7	1	1	24	387	16
1906	10	3	2	10	2	1	28	426	15
1907	12	3	1	10	3	3	32	485	15
1908	12	3	2	19	3	3	42	609	15
1909	13	5	3	22	4	8	55	667	12
1910	15	4	4	26	0	7	56	672	12
1911	15	5	4	30	0	7	61	655	11
1912	15	5	4	33	0	6	63	643	10
1913	19	4	24	11	0	5	63	620	10
1914	19	5	25	9	0	5	63	626	10
1915	19	6	24	9	0	5	63	647	10
1916	19	6	26	6	0	6	63	623	10
1917	18	7	26	6	0	6	63	687	11
1918	19	6	22	10	0	6	63	623	10
1919	19	7	24	4	0	6	60	643	11
1920	18	8	27	12	0	6	71	1017	14
1921	20	10	47	0	0	6	83	1093	13
1922	20	8	49	0	1	6	84	1133	13
1923	21	10	54	0	0	8	93	1098	12
1924	20	11	56	0	0	8	95	1147	12
1925	19	15	58	1	1	6	100	1172	12
1926	20	18	59	1	0	6	104	1251	12
1927	26	17	57	1	0	6	107	1351	13
1928	27	18	64	1	0	6	116	1468	13
1929	28	21	64	1	0	6	120	1468	12
1930	29	25	68	1	0	5	128	1615	13
1931	31	28	71	1	0	5	136	1747	13
1932	33	28	77	1	0	6	145	1693	12
1933	34	29	67	1	0	6	137	1524	11

Number of Degrees Given Undergraduate Students for the Years 1911–1933 Inclusive

Table III

Year	C. E.	M. E.	E. E.	Ch. E.	B. S.	Arch.	Total
1911	59	3	9	0	0	0	71
1912	96	9	13	0	0	0	118
1913	73	16	18	0	1	0	108
1914	57	10	17	0	3	0	87
1915	58	16	10	1	2	0	87
1916	37	15	18	2	1	0	73
1917	53	12	19	5	0	0	89
1918	27	11	22	8	0	0	68
1919	32	11	9	12	2	0	66
1920	29	20	29	25	0	0	103
1921	34	23	25	29	7	0	118
1922	80	31	30	26	1	0	168
1923	50	49	34	34	0	0	167
1924	49	25	47	41	0	0	162
1925	31	29	43	22	0	0	125
1926	41	26	47	19	2	0	135
1927	51	25	62	18	0	0	156
1928	57	31	83	16	5	0	192
1929	71	32	57	22	5	0	187
1930	74	36	78	26	14	0	228
1931	89	31	84	26	12	0	242
1932	93	43	69	34	12	0	251
1933	68	65	86	35	26	9	289

Besides the 289 from the undergraduate courses in 1933, graduate degrees were conferred as follows: 2 doctor of philosophy; 2 doctor of civil engineering; 1 doctor of electrical engineering; 10 master of civil engineering; 4 master of mechanical engineering; 12 master of electrical engineering; 3 master of chemical engineering; 6 master of science, and 1 master of business administration—forty-one altogether, so that the total number of degrees conferred, in course, was 330.

The total number of master's degrees conferred by the

Institute in course, including those conferred in 1933, is 113, and the total number of doctor's degrees conferred in course during the same period is 35.

NUMBER OF STATES AND FOREIGN COUNTRIES FROM WHICH STUDENTS HAVE COME: 1867, 1877, 1887, 1895–1933 INCLUSIVE

TABLE IV

Catalogue of Year	Whence Students Come		Total Number of Students	Number from State of New York	Percentage the Number from State of New York Is of Total Number
	Number of States and Territories of the United States	Number of Foreign Countries			
1867	19	6	155	52	33.5
1877	24	7	166	66	39.7
1887	23	8	155	55	35.7
1895	25	8	165	85	51.5
1896	20	4	135	80	59.2
1897	19	6	137	84	61.3
1898	18	6	138	86	62.3
1899	20	7	143	87	60.8
1900	18	7	175	101	57.7
1901	27	5	225	123	54.7
1902	32	4	249	136	54.6
1903	33	5	314	180	57.3
1904	34	5	375	223	59.5
1905	27	5	387	227	58.7
1906	27	4	426	255	59.9
1907	32	6	485	302	62.3
1908	34	8	609	402	66.1
1909	33	9	667	458	68.7
1910	37	9	672	458	68.2
1911	37	11	655	424	64.7
1912	37	10	643	406	63.1

TABLE IV.—*Continued*

Catalogue of Year	Whence Students Come: Number of States and Territories of the United States	Whence Students Come: Number of Foreign Countries	Total Number of Students	Number from State of New York	Percentage the Number from State of New York Is of Total Number
1913	39	12	620	366	59.0
1914	38	12	626	372	59.4
1915	39	14	647	406	62.8
1916	35	16	623	377	60.5
1917	35	16	687	395	57.5
1918	30	15	623	397	63.7
1919	28	15	643	425	66.1
1920	33	18	1017	646	63.5
1921	34	21	1093	659	60.4
1922	36	24	1133	658	58.1
1923	32	21	1098	625	56.9
1924	35	18	1147	624	54.4
1925	33	16	1172	633	54.0
1926	34	15	1251	689	55.0
1927	32	19	1351	752	55.6
1928	34	17	1468	792	53.9
1929	34	17	1468	816	55.5
1930	37	20	1615	887	54.9
1931	39	16	1747	970	55.4
1932	39	16	1693	974	57.5
1933	37	16	1524	891	58.5

APPENDIX XIII

Trustees and Professors from 1824 to 1934 Inclusive

* Indicates those *known* to be deceased.

Trustees

Patron

*Hon. Stephen Van Rensselaer, A.B., LL.D.	1824–39

Presidents

*Rev. Samuel Blatchford, D.D.	1824–28
*Rev. John Chester, D.D.	1828–29
*Rev. Eliphalet Nott, D.D., LL.D.	1829–45
*Rev. Nathan S. S. Beman, D.D., LL.D.	1845–65
*Hon. John F. Winslow	1865–68
*Thomas C. Brinsmade, M.D.	1868–68
*Hon. James Forsyth, LL.D.	1868–86
*Hon. John Hudson Peck, LL.D.	1888–01
Palmer C. Ricketts, E.D., LL.D.	1901–

Vice-Presidents

*Orville L. Holley, First Vice-President	1824–41
*T. Romeyn Beck, M.D., LL.D., Second Vice-President	1824–29
*Hon. David Buel, Jr., Second Vice-President	1829–60
*Rev. Nathan S. S. Beman, D.D., LL.D.	1841–45
*William P. Van Rensselaer	1845–65
*Thomas C. Brinsmade, M.D.	1865–68
*Hon. George Gould	1868–68
*E. Thompson Gale, C.E.	1868–72
*Hon. William Gurley, C.E.	1872–87
*Albert E. Powers	1887–00
*William H. Doughty, C.E.	1900–01
*Elias P. Mann, C.E.	1901–18
*Robert W. Hunt, D.Eng.	1918–23
*James H. Caldwell, B.S.	1918–31
Edward C. Gale, C.E.	1931–32
Sanford L. Cluett, C.E.	1932–

Secretaries

*Moses Hale, M.D.	1824–37
*Rev. Mark Tucker, D.D.	1837–38
*Rev. Erastus Hopkins	1838–41
*Hon. Isaac McConihe, LL.D.	1841–42
*Hon. Joseph White, LL.D.	1842–49
*Stephen Wickes, M.D.	1849–54
*Rev. John B. Tibbits, A.M.	1854–61
*Hon. William Gurley, C.E.	1861–71
*William H. Doughty, C.E.	1871–97
*John Squires, C.E.	1897–21
Sanford L. Cluett, C.E.	1922–32
Livingston W. Houston, M.E.	1932–

Treasurers

*Hon. Hanford N. Lockwood	1824–44
*Thomas C. Brinsmade, M.D.	1844–47
*Hon. Day Otis Kellogg	1847–50
*William H. Young	1850–01
*James H. Caldwell, B.S.	1901–05
*Paul Cook, A.M.	1905–23
Henry Colvin	1923–

Trustees

*Rev. Samuel Blatchford, D.D.	1824–28
*Elias Parmalee, A.M.	1824–34
*Hon. John Cramer	1824–49
*Hon. Guert Van Schoonhoven	1824–44
*Hon. Simeon De Witt	1824–28
*T. Romeyn Beck, M.D., LL.D.	1824–28
*Hon. John D. Dickinson, LL.D.	1824–40
*Jedediah Tracy	1824–25
*Hon. Richard P. Hart	1825–43
*Gen. Nicholas F. Beck, A.M.	1828–31
*Judge Jesse Buel	1828–35
*Philip S. Van Rensselaer, A.M.	1833–43
*Rev. Phineas L. Whipple	1833–37
*Hon. George Tibbits, *ex officio* Mayor	1835–36
*William D. Haight, " " Alderman	1835–36
*John P. Cushman, " " Recorder	1835–38
*James Wallace, " " Alderman	1836–38
*Hon. Jonas C. Heartt, " " Mayor	1837–43

*Elias Dorlon, *ex officio* Alderman.......... 1838–39
*Henry W. Strong, " " Recorder........... 1834–44
*Henry Everts, " " Alderman.......... 1839–40
*Livy S. Stearns, " " Alderman.......... 1840–41
*Henry Everts, " " Alderman.......... 1841–42
*Rev. William B. Sprague, D.D.................... 1841–44
*John Holme.. 1841–56
*Rev. Alva T. Twing, D.D......................... 1841–67
*Hon. David Buel, Jr............................. 1842–44
*Rev. Eliphalet Nott, D.D., LL.D.................. 1842–45
*Rev. Nathan S. S. Beman, D.D., LL.D.............. 1842–65
*Hon. Isaac McConihe, LL.D....................... 1842–67
*Daniel G. Egleston, *ex officio* Alderman......... 1842–44
*Hon. Gurdon Corning, " " Mayor............ 1843–47
*Abram B. Olin, LL.D., " " Recorder.......... 1844–50
*Jared S. Weed, " " Alderman......... 1844–45
*Rev. Reuben Smith 1844–47
*Thomas C. Brinsmade, M.D........................ 1844–68
*William P. Van Rensselaer........................ 1845–65
*Luther Tucker.................................... 1845–49
*Hon. Daniel D. Barnard, LL.D.................... 1845–48
*Stephen Bowman, *ex officio* Alderman... 1845–47
*James Dana, " " Alderman... 1847–49
*Hon. Francis N. Mann, A.M., " " Mayor...... 1847–50
*Stephen Wickes, M.D. 1847–54
*W. T. Seymour 1848–49
*Benjamin P. Johnson 1849–66
*Alexander Van Rensselaer, M.D.................. 1849–67
*John Wilkinson 1849–55
*Hon. Joseph M. Warren, A.M..................... 1849–96
*Le Grand B. Cannon.............................. 1849–64
*Hiram Slocum 1849–60
*Orsamus Eaton 1849–59
*Rev. John B. Tibbits, A.M........................ 1849–67
*Leonard McChesney, *ex officio* Alderman........... 1849–50
*Amos Dean, LL.D. 1849–53
*D. Thomas Vail, A.M. 1850–82
*Hon. Joseph White, LL.D......................... 1850–55
*Hon. Day Otis Kellogg, *ex officio* Mayor........ 1850–50
*Hon. Hanford N. Lockwood, " " Mayor........ 1850–51
*Hon. George Gould............................... 1852–53
*Hon. Foster Bosworth............................ 1853–53
*Hon. Elias Plum.................................. 1853–54
*Thomas W. Blatchford, M.D....................... 1854–66
*Hon. Jonathan Edwards........................... 1854–67

*Hon. John A. Griswold, *ex officio* Mayor............ 1855–56
*B. Franklin Greene, C.E., A.M..................... 1855–59
*Hon. William Gurley, C.E......................... 1855–87
*Hon. Jonathan E. Whipple......................... 1856–66
*Hon. Hiram Slocum, *ex officio* Mayor.............. 1856–57
*Hon. Alfred Wotkyns, M.D., *ex officio* Mayor...... 1857–58
*Hon. Arba Read, " " Mayor...... 1858–60
*Hon. John F. Winslow............................ 1860–68
*E. Thompson Gale, C.E............................ 1860–87
*Hon. John A. Griswold 1860–72
*Hon. Isaac McConihe, Jr., *ex officio* Mayor....... 1860–61
*Hon. George B. Warren, Jr., " " Mayor....... 1861–62
*William H. Young................................. 1861–04
*Hon. Lyman Wilder 1861–85
*Hon. Arba Read................................... 1861–63
*Albert E. Powers................................. 1861–10
*Rev. Peter Bullions, D.D......................... 1862–64
*Hon. James Thorn, M.D., *ex officio* Mayor...... 1862–63
*Hon. William L. Van Alstyne, " " Mayor...... 1863–64
*Hon. James Thorn, M.D., " " Mayor...... 1864–65
*Rev. Duncan Kennedy, D.D......................... 1864–67
*Hon. Jonas C. Heartt............................. 1864–74
*Hon. George Gould................................ 1864–68
*David Cowee 1865–87
*Alexander L. Holley, LL.D. 1865–66
*Hon. Uri Gilbert, *ex officio* Mayor................ 1865–66
*Frederick B. Leonard, M.D......................... 1866–71
*James S. Knowlson, A.M........................... 1866–08
*Hon. Uri Gilbert 1866–88
*Hon. David A. Wells, LL.D., D.C.L................. 1866–76
*Hon. John L. Flagg, *ex officio* Mayor.............. 1866–68
*Hon. Charles R. Ingalls........................... 1868–02
*Rev. Marvin R. Vincent, D.D. 1867–69
*William A. Shepard 1867–83
*Hon. James Forsyth, LL.D. 1867–86
*Joseph W. Fuller................................. 1867–89
*Hon. William Kemp 1867–08
*Hon. Francis S. Thayer........................... 1868–80
*Azro B. Morgan................................... 1868–71
*Hon. Miles Beach, *ex officio* Mayor............... 1868–70
*Rev. J. Ireland Tucker, D.D. 1868–95
*Alexander L. Holley, LL.D. 1869–82
*Capt. Clarence E. Dutton, U. S. A.................. 1869–76
*Henry C. Lockwood 1871–90
*William H. Doughty, C.E.......................... 1871–09

*Hon. Thomas B. Carroll, *ex officio* Mayor........ 1871–73
*Hon. Edward Murphy, Jr., " " Mayor........ 1875–82
*Rev. William Irvin, D.D.......................... 1876–09
*John D. Van Buren, Jr., C.E...................... 1876–82
*Charles Macdonald, C.E., LL.D.................... 1880–28
*James P. Wallace, C.E............................ 1880–97
*Joseph C. Platt, Jr., C.E........................ 1882–98
*Elias P. Mann, C.E............................... 1882–18
*Hon. Edmund Fitzgerald, *ex officio* Mayor......... 1882–86
*Hon. Dennis J. Whelan, " " Mayor......... 1886–94
*Stephen W. Barker, C.E........................... 1886–09
*Henry B. Dauchy 1886–03
*Henry G. Ludlow.................................. 1886–01
*Robert W. Hunt, D.Eng............................ 1886–23
*John H. Peck, LL.D............................... 1887–01
*Theodore Voorhees, C.E........................... 1887–16
Edward C. Gale, C.E............................... 1887–
*John Squires, C.E................................ 1888–24
*Horace G. Young, C.E............................. 1888–33
*Paul Cook, A.M................................... 1890–26
*Hon. Francis J. Molloy, *ex officio* Mayor............ 1894–00
*Hon. Russell Sage................................ 1896–06
*James H. Caldwell, B.S........................... 1900–31
*George B. Cluett 1900–05
*John I. Thompson 1900–01
*Hon. Daniel E. Conway, *ex officio* Mayor........... 1901–03
Palmer C. Ricketts, E.D., LL.D.................... 1901–
Alfred H. Renshaw, C.E............................ 1901–
*George B. Wellington, A.M., C.E., LL.B............ 1903–21
*Stewart Johnston, C.E............................ 1903–33
*Edgar K. Betts................................... 1903–08
*Gen. J. Ford Kent................................ 1903–18
*Hon. Joseph F. Hogan, *ex officio* Mayor............ 1904–05
*Robert Cluett 1906–17
*Henry W. Hodge, C.E.............................. 1906–20
George S. Davison, C.E............................ 1909–
*William F. Gurley, A.B........................... 1909–15
*William Bayard Van Rensselaer, A.B............... 1909–09
Henry S. Ludlow, A.B.............................. 1909–24
*Frederick F. Peabody............................. 1909–19
*William B. Cogswell, C.E......................... 1911–21
Philip W. Henry, C.E.............................. 1911–
*Herbert S. Ide, A.B.............................. 1911–31
Hon. Cornelius F. Burns, *ex officio* Mayor.......... 1912–
*Louis E. Laflin, C.E............................. 1916–22

*Charles G. Roebling, C.E. 1918–18
Louis H. Cramer.................................. 1918–19
*William P. Denegre, C.E. 1918–31
*Isaac W. Frank, C.E.............................. 1919–30
Sanford L. Cluett, C.E............................ 1919–
C. W. Tillinghast Barker, C.E...................... 1919–
*Benjamin W. Arnold, A.M.......................... 1921–32
*Strickland L. Kneass, C.E......................... 1921–28
Charles Wiggins, C.E.............................. 1921–
*Ralph G. Packard, C.E. (Alumni, 1923–24) (1926–27) 1926–27
*Edward C. Shankland, C.E. (Alumni, 1923–24)...... 1923–24
Charles S. Weston, C.E. (Alumni, 1923–26)........ 1923–26
Edwin S. Jarrett, C.E. (Alumni, 1924–25)........... 1926–
Henry Colvin 1925–
Livingston W. Houston, M.E........................ 1925–
Percival M. Sax, C.E. (Alumni, 1925–28)........... 1928–
George T. Horton, C.E. (Alumni, 1925–28).......... 1929–
John W. Doty, C.E................................ 1925–
James R. Fitzpatrick, C.E. (Alumni, 1926–29)...... 1926–29
Daniel L. Turner, C.E. (Alumni, 1927–30).......... 1927–30
Thomas Earle, C.E. (Alumni, 1928–31)............. 1931–
*Walter J. Towne, C.E. (Alumni, 1929–30).......... 1929–30
*James C. McGuire, C.E............................ 1930–30
Royal G. Finch, C.E. (Alumni, 1930–31)............ 1931–
John N. Shannahan, C.E. (Alumni, 1931–32)........ 1932–
Allan DeW. Colvin, C.E............................ 1931–
William P. Creager, C.E. (Alumni, 1931–33)........ 1931–33
*Morris R. Sherrerd, C.E. (Alumni, 1931–33)........ 1931–33
James W. Frazier, C.E. (Alumni, 1932–)......... 1932–
Edwin G. Adams, C.E. (Alumni 1933–)........... 1933–

Executive Officers of the Faculty

Senior Professors

*Amos Eaton, A.M.................................. 1824–42
*George H. Cook, C.E., B.N.S....................... 1842–46
*Charles Drowne, C.E., A.M......................... 1859–60

Directors

*B. Franklin Greene, C.E., A.M..................... 1847–59
*Rev. Nathan S. S. Beman, D.D., LL.D.............. 1859–60
*Charles Drowne, C.E., A.M......................... 1860–76

*William L. Adams, C.E. 1876–78
*David M. Greene, C.E. 1878–91
Palmer C. Ricketts, C.E., E.D., LL.D. 1892–

Assistant Director

Ray P. Baker, M.A., Ph.M., Ph.D., LL.D. 1931–

Professors

The names of those only who have attained the title of professor, adjunct professor, or associate professor, are printed in the following list and all these are entitled professor. The year immediately following the names of some of these professors signifies that they began teaching in the Institute, in a grade lower than professor, in that year.

Accounting

Frederick D. Moore, B.A., M.B.A., Professor 1927–

Architecture

Ralph G. Gulley, M.Arch., Professor 1930–
Ralph E. Winslow, B.S., M.Arch., Professor 1930–

Arts, Science, and Business Administration

Ray P. Baker, M.A., Ph.M., Ph.D., LL.D., Head of Department 1924–

Astronomy

*Charles Drowne, C.E., A.M., 1847, Professor 1850–54
*Dascom Greene, C.E., 1853, Professor (Emeritus, 1893) 1856–93
Charles W. Crockett, C.E., A.M., LL.D., 1884, Professor 1893–

Biology

Archie W. Bray, M.A., Professor 1925–

Botany

*Lewis C. Beck, M.D., Professor 1824–29
*John Wright, M.D., Professor 1836–46

*Frederick B. Leonard, M.D., Professor.............. 1846–48
*R. Halsted Ward, A.M., M.D., Professor........... 1869–92
William W. Rousseau, C.E., 1899, Professor........ 1922–

Business Statistics

Edward H. Van Winkle, B.S., M.B.A., Professor.... 1929–

Chemistry

*Amos Eaton, A.M., Professor...................... 1824–35
*James Hall, A.M., LL.D., Professor................ 1835–41
*George H. Cook, C.E., B.N.S., 1840, Professor...... 1841–46
*William Elderhorst, M.D., Professor............... 1855–61
*Charles A. Goessmann, Ph.D., Professor............. 1861–64
*Henry B. Nason, Ph.D., LL.D., Professor........... 1864–94
William P. Mason, C.E., M.D., D.Sc., LL.D., 1875, Professor (Emeritus, 1925).................... 1886–25
Azariah T. Lincoln, M.S., Ph.D., 1909, Professor.... 1912–20
Frederick W. Schwartz, B.S., Ph.D., 1905, Professor. 1919–
Albert W. Davison, B.S., M.A., Ph.D., Professor.... 1921–
Henry S. Van Klooster, Ph.D., 1918, Professor...... 1926–
John B. Cloke, Ph.G., B.S., Ph.D., 1918, Professor... 1931–

Chemical Engineering

Albert W. Davison, B.S., M.A., Ph.D., Professor.... 1925–

Civil Engineering

*Amos Eaton, A.M., Professor...................... 1828–42
*George H. Cook, C.E., B.N.S., 1840, Professor....... 1842–46
*Charles Drowne, C.E., A.M., 1847, Professor........ 1859–60
*William G. Lapham, C.E., Professor............... 1838–39
Edward F. Chillman, C.E., 1888, Professor.......... 1908–
Guy M. Phelps, C.E., 1909, Professor............... 1926–

Descriptive Geometry and Drawing

*G. Gustavus Berger, Professor..................... 1850–51
*S. Edward Warren, C.E., Professor 1853–72
*Dwinel F. Thompson, B.S., Professor (Emeritus, 1916–19) 1873–16
Edward F. Chillman, C.E., 1888, Professor......... 1908–
Guy M. Phelps, C.E., 1909, Professor............... 1926–

Economics and Business Aministration

William F. Spafford, M.A., Professor.............. 1926–

Electrochemistry

Matthew A. Hunter, M.A., D.Sc., 1908, Professor... 1912–

Electrical Engineering

*Edward D. N. Schulte, M.A., E.E., 1902, Professor.. 1909–20
Calvin P. Eldred, S.B., Professor.................. 1920–22
Frederick M. Sebast, E.E., D.Eng., 1916, Professor.. 1926–
Stanley B. Wiltse, E.E., 1919, Professor............ 1933–
Wynant J. Williams, C.E., 1906, Professor.......... 1917–

Electrical Engineering and Physics

*Hugh M. Anderson, C.E., 1889, Professor........... 1901–02
*William L. Robb, Ph.D., LL.D., D.Eng., Professor... 1902–32

English Language

*James T. Allen, B.S., Professor..................... 1855–58
*T. Newton Willson, A.M., Professor................ 1859–59
*John G. Murdoch, M.A., 1888, Professor........... 1902–15
Ray P. Baker, M.A., Ph.M., Ph.D., LL.D., Professor. 1915–

French Language

*Louis Cousin, B.L., Professor..................... 1856–59
*Philip H. Baermann, Professor.................... 1862–66
*J. H. C. L. de Marceleau, A.B., Professor.......... 1869–73
Arthur de Pierpont, B. A., 1896, Professor (Emeritus, 1928)...................................... 1902–28
Marie de Pierpont, 1919, Professor................. 1928–32

Geodesy

*Charles Drowne, C.E., A.M., 1847, Professor....... 1851–55
*David M. Greene, C.E., 1851, Professor.....1856–61; 1878–91
*William H. Searles, C.E., 1862, Professor........... 1863–64
*Charles McMillan, C.E., Professor................ 1865–71
*William L. Adams, C.E., Professor.........1864–65; 1872–78
*William G. Raymond, C.E., Professor.............. 1892–05
Edward R. Cary, C.E., 1888, Professor............. 1904–

Charles E. Smith, C.E., Professor.................. 1871–72
*Thomas M. Cleeman, C.E., Professor............... 1891–92
William W. Rousseau, C.E., 1899, Professor........ 1922–

Geology

*Amos Eaton, A.M., Professor...................... 1824–42
*Ebenezer Emmons, A.M., M.D., Professor.......... 1831–39
*George H. Cook, C.E., B.N.S., 1840, Professor...... 1842–46
*Edward A. H. Allen, C.E., Professor.............. 1850–54
*James Hall, A.M., LL.D., Professor (Emeritus, 1876) 1854–76
*Robert P. Whitfield, A.M., Professor............... 1877–78
*Henry B. Nason, Ph.D., LL.D., Professor........... 1878–94
*John M. Clarke, Ph.D., Sc.D., LL.D., 1894, Professor 1896–99; 1901–22
Amadeus W. Grabau, S.M., 1899, Professor......... 1900–01
Joseph L. Rosenholtz, Ch.E., M.S., Ph.D., 1920, Professor 1926–

German Language

*Philip H. Baermann, Professor.................... 1862–67
Joseph Begue, B.A., 1920, Professor................ 1932–

Heat Engineering

John G. Fairfield, B.S., 1916, Professor............. 1926–

History and Social Science

Samuel Rezneck, M.A., Ph.D., Professor............ 1925–

Hydraulic Engineering

Lewis F. Moody, B.S., M.S., 1908, Professor........ 1912–16
Robert L. Daugherty, A.B., M.E., Professor........ 1916–19
Grant K. Palsgrove, M.E., 1911, Professor.......... 1920–

Hygiene and Physical Education

Paul B. Samson, M.P.E., Professor................ 1912–15
Wilbur C. Batchelor, B.P.E., Professor............. 1915–20
*Guerdon N. Messer, B.P.E., Professor.............. 1920–22
Harry A. Van Velsor, B.P.E., Professor............ 1922–

Law

*James Forsyth, LL.D., Lecturer, Law of Contracts.. 1875–86
*John H. Peck, LL.D., Lecturer, Law of Contracts.. 1888–01
*George B. Wellington, A.M., C.E., LL.B., Lecturer, Law of Contracts.............................. 1901–21
Albert G. Davis, B.S., M.L., Lecturer, Patent Law... 1908–33

Mathematics

*B. Franklin Greene, C.E., A.M., Professor.......... 1847–50
*Charles Drowne, C.E., A.M., 1847, Professor....... 1850–55
*Dascom Greene, C.E., 1853, Professor (Emeritus, 1893) 1858–93
Charles W. Crockett, C.E., A.M., LL.D., 1884, Professor 1893–
James McGiffert, C.E., M.A., Ph.D., 1892, Professor. 1932–

Mechanics

*B. Franklin Greene, C.E., A.M., Professor.......... 1850–59
*Charles Drowne, C.E., A.M., 1847, Professor........ 1850–76
William H. Burr, C.E., Professor................. 1876–84
Palmer C. Ricketts, E.D., LL.D., 1875, Professor.... 1884–12
Thomas R. Lawson, C.E., 1898, Professor.......... 1906–
LeRoy W. Clark, C.E., 1906, Professor............. 1921–

Mechanical Engineering

Arthur M. Greene, Jr., B.S., M.E., Professor........ 1907–22
Edwin A. Fessenden, B.S. in M.E., M.E., Professor.. 1922–

Mental Philosophy

*Nathan S. S. Beman, D.D., LL.D., 1841, Professor.. 1854–65

Metallurgy

*George W. Maynard, A.M., Professor.............. 1867–71
Enrique Touceda, C.E., Professor.................. 1906–

Natural History

*Edward A. H. Allen, C.E., Professor.............. 1854–55
*Henry B. Nason, Ph.D., LL.D., Professor.......... 1858–64

Physics

*B. Franklin Greene, C.E., A.M., Professor.......... 1847–53
*Charles A. Goessmann, Ph.D., Professor............ 1861–64
*Arthur W. Bower, C.E., 1871, Professor............ 1878–80
*Frank P. Whitman, A.M., Professor................ 1880–86
*W. Le Conte Stevens, Ph.D., Professor............. 1892–98
*Hugh M. Anderson, C.E., 1889, Professor.......... 1898–01
*Charles W. Parks, C.E., Professor 1886–93
Robert A. Patterson, Ph.D., Professor.............. 1922–
George H. Carragan, M.E., Ph.D., 1925, Professor.. 1931–

Rhetoric

Homer H. Nugent, M.A., 1916, Professor.......... 1928–

Steam Engines

*David M. Greene, C.E., 1851, Professor............ 1878–91
Harry de B. Parsons, B.S., M.E., Professor (Emeritus, 1907) 1892–07

Steam and Gas Engine Design

*Robert L. Streeter, B.S., M.E., 1910, Professor...... 1915–17
John R. DuPriest, B.S. in E.E., M.E., M.M.E., Professor 1917–20
Robert B. Dale, M.E., Professor.................. 1920–24

As shown in Chapter I, in the early days of the school, the teacher next in rank to the senior professor was called the junior professor, and the other instructors, who were appointed for a term or year, were called assistants to the senior professor or to the junior professor. The names of these professors and assistants are given below.

Junior Professors

*Lewis C. Beck, M.D.............................. 1824–29
*Hezekiah H. Eaton, A.B. (r.s.)................... 1829–30
*Paul E. Stevenson, A.B. (r.s.)................... 1830–31
*Ebenezer Emmons, A.M., M.D.................... 1831–39

Assistants to the Senior Professor

*Fay Edgerton, A.B. (r.s.)	1828
*Thomas C. Ripley, A.B. (r.s.)	1828
*Orlin Oatman, A.B. (r.s.)	1829
*Daniel O. Comstock, A.B. (r.s.)	1829
*James C. Booth	1831
*S. Wells Williams, A.B. (r.s.)	1832
*D. Cady Smith, A.B. (r.s.)	1838
*Alexander Van Rensselaer, A.B. (r.s.)	1833
*Theron R. Hopkins, A.B. (r.s.)	1834
*Edward Suffern, C.E.	1835
*Leman B. Garlinghouse, C.E.	1836
*George Johnson, C.E., B.N.S.	1836

Assistants to the Junior Professors

*Timothy Dwight Eaton, A.B. (r.s.)	1827
*Orlin Oatman, A.B. (r.s.)	1827
*John M. Barrows, A.B. (r.s.)	1829
*Hezekiah H. Eaton, A.B. (r.s.)	1829
*Douglass Houghton, A.B. (r.s.)	1830
*James B. Dungan	1830
*Abel Storrs, A.B. (r.s.)	1830
*Abram Sager, A.B. (r.s.)	1831
*James Hall, A.B. (r.s.)	1833

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