

**A CHAPTER IN
AMERICAN EDUCATION**

**RENSSELAER POLYTECHNIC INSTITUTE
1824-1924**

BY RAY PALMER BAKER

ENGINEERING EDUCATION

**A HISTORY OF ENGLISH-CANADIAN
LITERATURE TO THE CONFEDERATION**

**Its Relation to the Literature of Great
Britain and the United States**

THE PREPARATION OF REPORTS

Engineering, Scientific, Administrative

SAM SLICK

**Edited with a Critical Estimate and a
Bibliography**

A CHAPTER IN AMERICAN EDUCATION

RENSSELAER POLYTECHNIC INSTITUTE

1824-1924

BY

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~~DEPARTMENT OF ELECTRICAL ENGINEERING
RENSSELAER POLYTECHNIC INSTITUTE~~

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PROLOGUE

IN the beginning I planned this sketch—for it is little more—as a slight memorial of the hundredth anniversary of the foundation of Rensselaer Polytechnic Institute. Before I had delved far in its history, however, I realized that I was dealing with a subject of no parochial concern; that, for half a century, the institute was one of the intellectual centres of America; and that no one can understand the growth of educational facilities for women, the development of agriculture, the transformation of the college of liberal arts, the emergence of the graduate school, or the progress of science and technology who is not familiar with conditions in Troy during the second and third quarters of the nineteenth century. I have tried, therefore, to marshal the achievements of Amos Eaton and Stephen Van Rensselaer in proper perspective and to indicate the national significance of much that has seemed of mere local interest.

PROLOGUE

Few historians are aware that the traditions fostered by the Institute had become so generally recognized by 1850 that, with others, several of its graduates—James Hall ('32), the "father of American stratigraphy"; George Hamill Cook ('39), a naturalist of note, who afterward became vice-president of Rutgers College, and Ebenezer Emmons ('26), the founder of agricultural science in the United States, incorporated at Albany a university which they believed would challenge, in due time, the supremacy of Berlin. Among the scholars at Harvard who in "utter disgust at the way things were done in Cambridge," offered to associate themselves as professors in this great enterprise in the Capitol District were Louis Agassiz, professor of natural history; Joseph Lovering, professor of mathematics; Benjamin Pierce, professor of astronomy, and Jeffries Wyman, professor of anatomy. From Yale were to come such leaders as James Dwight Dana, professor of natural history, and John Pitkin Norton, professor of agricultural chemistry and vege-

PROLOGUE

table and animal physiology. Among others who were to lend their aid were Ormsby McKnight Mitchell, professor of astronomy in Cincinnati; Josiah Dwight Whitney, afterward professor of geology at Harvard, and Benjamin Hall Wright, of West Point. Though the institution as a whole never materialized for lack of funds; though Agassiz, Cook, Emmons, Hall, Mitchell, and Norton were evidently the only members of the group who actually delivered lectures; and though the Dudley Observatory, established by Pierce, Mitchell, and Norton, is to-day the only monument of this attempt to found a national university with generous provision for research, the proposal is illustrative of the influence which Rensselaer, through its curricula or its alumni, has exerted throughout the Americas.

For obvious reasons I have not, except in the case of those who have been canonized, as it were, by the dormitories erected in their honor, referred specifically to the graduates who to-day are adding to the fame of their

PROLOGUE

alma mater. Nor have I attempted to trace the careers of the students—six or seven thousand in all—who, in the last century, did not proceed to a degree but who, in some instances, left their mark on the civilization of their time.

R. P. B.

CONTENTS

	PAGE
PROLOGUE	v
CHAPTER I. ORIGINS AND AIMS	3
II. CURRICULA AND TRADITIONS	27
III. THE NATURAL SCIENCES	48
IV. THE LEARNED PROFESSIONS	75
V. THE NEW HUMANITIES	82
VI. THE PUBLIC SERVICES	92
VII. CANALS AND RAILROADS	100
VIII. STRUCTURES AND MECHANISMS	113
IX. BUSINESS AND INDUSTRY	130
X. ENGINEERING EDUCATION	152
EPILOGUE	162

CHAPTER I

ORIGINS AND AIMS

IN the history of education in the United States there have been two outstanding events—the founding of the college which is the nucleus of Harvard University and the establishment of the school which has become Rensselaer Polytechnic Institute. Though it may seem strange to link in this way two institutions one of which—with less than one-third as many students—is only one-third the age of the other, each began a tradition in literature or science of immeasurable consequence. Moreover, since the courses at Rensselaer between 1824 and 1834 dealt with both the farm and the factory, it was from one point of view—though its life as such was short—the first college of agriculture as well as the first college of technology. In addition, it anticipated in many ways the preliminary training now required for pro-

A CHAPTER IN

fessional study; and, for those who had already enjoyed a liberal education, it provided many of the advantages of a graduate school. Nor were its activities confined entirely to men. For these reasons—because of its influence upon the position of women, because of its contribution to rural life, because of its reaction upon academic routine, because of its provision for advanced and, in the light of the time, highly specialized research—because of these reasons and, particularly, because of its primacy as the first college devoted to the sciences which has existed continuously for a hundred years, its history is a subject of universal interest.

The qualification in the last sentence is necessary because, in point of time, it was not the first institution of its kind in the United States. In half a dozen colleges instruction in the sciences had been offered before 1800. In others, provision of an elementary character had been made by 1820. Moreover, as President Ricketts has explained in the second edition of his admirably

AMERICAN EDUCATION

comprehensive *History of Rensselaer Polytechnic Institute*,¹ the Gardiner Lyceum, which survived for a decade, was opened in 1823. By 1824, therefore, many educators evidently realized that a change in policy was imperative. In fact, recognition of the need seems to have been fairly general. At Cambridge, Joseph Story, chairman of a special committee appointed at the instance of George Tichnor, presented a report advocating the establishment of a department in which students would be permitted "to pursue particular studies to qualify them for scientific and mechanic employment and the active business of life." When a group of citizens met at White's Hotel, in Easton, to discuss the organization of a college, they voted to include in the curriculum not only the "dead languages . . . usually taught" but also "civil and military engineering." Neither Harvard nor Lafayette, however, was able to carry out its plans until, a generation later, it was able to draft the graduates

¹New York, 1895, 1914.

A CHAPTER IN

of the Institute who had been trained in the disciplines which these gentlemen had advocated. Though their proposals led to no immediate results, the current opinion that Rensselaer sprang meteor-like from pedagogical chaos does not appear to be justified by the facts. Like every striking development, it was the climax in a process of evolution. It was unique only in finding a benefactor and a leader who accomplished what others had merely suggested.

The first of these two men was Stephen Van Rensselaer. President Ricketts has called attention to the example set by Count Rumford in the establishment of the Royal Institution. He has also pointed out that Van Rensselaer may have been stimulated by its success. At any rate, in a letter to Samuel Blatchford announcing the foundation of the school, the latter used the terminology of Thompson's prospectus,—“the application of science to the common purposes of life.” Whether this phrase was borrowed or not, it describes exactly the object which

AMERICAN EDUCATION

he had in view. What he planned was an institution to provide teachers to instruct "the sons and daughters of farmers and mechanics" in "agriculture, domestic economy, the arts, and manufactures." And this idea he seems never to have dropped. In due time, he wrote, every district might enjoy "such a course of instruction about once in two or three years." Moreover, in 1827, evidently at his instigation, the faculty were authorized to establish branches in any part of the state which could make adequate provision for them. Later in the same year he suggested to Blatchford the propriety of offering the school to the legislature. Since nothing came of this suggestion, he announced that he would meet the expenses of a student from every county on condition that those accepting his aid should return to their homes to teach for one year. Afterward, also, he adopted the same plan in special cases. The whole scheme, therefore, bore a definite relation to Van Rensselaer's position in the community.

A CHAPTER IN

As Patroon of Rensselaerwick, he was naturally interested in the progress of the three counties into which it had been divided. Consequently, when the Central Board of Agriculture was organized, in 1820, he was elected president. When it engaged Amos Eaton to conduct an agricultural survey of the district, he provided the necessary funds. Moreover, as a member of Congress, during this time, he served as chairman of the Committee on Agriculture. Under these circumstances, it is not difficult to understand his attitude. There is no reason to believe that it was not immediately utilitarian. Except in its most rudimentary form, the Dutch settlers on the Hudson had never been impressed by the value of education for its own sake. According to William Smith, the historian of New York, there were in the province in his youth only fifteen laymen who had enjoyed a collegiate training; and they were mostly graduates of Yale or Cambridge. As a class the comfortable burghers east of the Palisades were "so intent upon

AMERICAN EDUCATION

gain" that they were seldom disturbed by the stings of intellectual ambition. At any rate, when the establishment of a college was mooted in New York, they objected strenuously to any arrangement which would require their support. In the end, it was founded privately by English families whose sons had been educated in Massachusetts or Connecticut. From Van Rensselaer's paternal ancestry, therefore, little information can be derived. The source of his interest in education evidently lay elsewhere. Since his father died early, the influence of his mother, a daughter of Philip Livingston, must have been especially powerful. To her, doubtless, he owed his matriculation at Princeton and his graduation from Harvard. Nevertheless, in spite of these advantages, his eyes seem to have been fixed primarily upon the nine hundred farms which he had brought under cultivation on his estate. Useful as his life unquestionably was, it does not appear to have been marked by either force or originality. Neither as soldier nor statesman did

A CHAPTER IN

he impress his generation as especially virile or prophetic. As his portrait indicates, he seems to have been a kindly, well-intentioned gentleman differing little from others of similar training and environment except in his wise, generous, and untiring devotion to the institution which he founded.

Amos Eaton, however, was an original genius of profound and far-reaching intellect. Local tradition, well authenticated, credits him with the inception of the Institute; and certainly Van Rensselaer's letter announcing the organization of the school bears evidence of his hand. In fact, until 1840 his influence was supreme. His career is therefore a matter of interest. Educated at Williams, the first of its alumni to achieve distinction, he studied at Yale under Benjamin Silliman, who lived to see his pupil transcend the barriers which had inhibited his labors in New Haven. Returning to Williamstown in 1817, he conducted a series of extra-collegiate lectures on botany, geology, and mineralogy which were attended by all the seniors and

AMERICAN EDUCATION

juniors and by all but four of the sophomores and freshmen. So popular were these lectures that the undergraduates of their own volition published the manuscript of the first group. Because of the success, Eaton determined to offer experimental courses wherever he could find an audience. As a result, over seven thousand students—in his day, an unprecedented number—attended his classes in natural history. In addition to those treated in this sketch, many of the most eminent scientists of the day—pioneers like James Dwight Dana, professor of natural history at Yale; Chester Dewey, professor of chemistry at Rochester; Asa Gray, professor of natural history at Harvard; Joseph Henry, professor of natural history at Princeton; Albert Hopkins, professor of astronomy at Williams, and John Torrey, professor of chemistry at Columbia—began their work under his direction.

Now that it is possible to view his achievements in true perspective, it is clear that he is one of the great figures in the history of

A CHAPTER IN

science in the United States. Though his botanical nomenclature has often been modified, the value of his researches has become increasingly apparent; and recent investigations by the Geological Survey have strengthened his position as the "father of American geology." Nevertheless, striking as were his discoveries and monographs, they were surpassed by his services to the cause of education. The first to introduce field work and laboratory routine into the American college, the founder, in Troy, of the first popular museum of natural history, a pathfinder in many fields, he illuminated by his personality the city which he made his home. Devoted to the practical affairs of life, he still worshipped truth for its own sake; and it was this rare union of intellectual curiosity and rough-and-ready utilitarianism which made Rensselaer at once a centre of "pure" scholarship and a school of engineering.

As Van Rensselaer's letter shows, he planned to establish in Troy an institution to serve the needs of young women as well as

AMERICAN EDUCATION

young men. The inclusion of "domestic economy" in the list of subjects to which the natural sciences were to be applied is proof that he contemplated a type of school which did not emerge until the twentieth century. Why the authorities did not carry out this part of the scheme, it is impossible to say. Since the students at Rensselaer lived and studied in the same building; since both sexes could not be accommodated under such circumstances; and since the Patroon found the burden of one establishment increasingly irksome, it is fairly obvious that the expense of setting up a complementary organization was responsible for the abandonment of half the programme suggested by the prospectus. Certainly there was no lack of sympathy among those who were connected with the Institute. In spite of the fact that they did not attempt to provide a complete curriculum, they nevertheless helped to advance the education of women in the United States. Eaton especially was a persistent advocate of their claims. So far as it is pos-

A CHAPTER IN

sible to judge from the records which have been preserved, his influence was due to his knowledge of botany and chemistry—two subjects which evidently appealed to the taste or imagination of his auditors.

As a botanist, he had translated Richard's *Dictionary*; he had published half a dozen original treatises; he had established the Botanical Institution at Catskill; and he had appeared before the New York State Legislature at the invitation of Governor Clinton, who had attended some of his public lectures. It was through these lectures, delivered at Amherst, Northampton, and elsewhere, that he influenced a number of women who were to become conspicuous in the first half of the nineteenth century. "You can generally," he remarked, "persuade ladies to go out in small parties to the nearest open fields" and collect plants for the next day's study. And evidently many did go; for, in 1819, Jane Welsh, who had been a member of his class in Northampton, where he conducted the first courses in science ever opened to women,

AMERICAN EDUCATION

issued her *Botanical Catechism*. Ten years afterward Almira Lincoln, a sister of Emma Willard, published her *Familiar Studies in Botany*, a volume based upon Eaton's manuscripts. Finally, in 1840, Laura Johnson, who had been a member of his family for five years, put forth, under his supervision, the second edition of her *Botanical Teacher*, a companion to the eighth edition of Eaton's *North American Botany*. So far as I am aware, the movement culminating in this literature—a movement designed to “promote knowledge and magnify the Creator”—was the first of its kind on the continent. Nor was it limited by any means to botany. Among Eaton's students at Northampton was Mary Lyon, the founder of Mount Holyoke College. Apparently, if her letters can be accepted as evidence, she was more interested in chemistry than in botany. At any rate, she became an ardent disciple of the senior professor, following him to Troy, and, like Laura Johnson, living in his home, “as he could tell me many things that would

A CHAPTER IN

be useful to me." "Accordingly," she confided naïvely in a letter to one of her friends, "I packed up all as soon as possible and arrived here this morning." Through such informal contacts the faculty of the Institute exerted no little influence upon the development of educational facilities for women.

All their contacts, however, were not so informal. Emma Willard, who had been associated with Mary Lyon, relied upon them for instruction in the sciences at the Troy Female Seminary, now, under its modern name, the oldest school for girls in the United States. Moreover, though the Institute itself never offered any courses for women, Eaton apparently did so "in his private capacity." In fact, he seems to have developed some kind of organization; for, in 1828, the authorities announced that "a lady, well qualified for the duty," would conduct experimental courses in chemistry and natural philosophy similar to those "proposed for gentlemen," and, in 1835, he requested an

AMERICAN EDUCATION

examination in "practical mathematics" for a class of eight. As late as this, ten years after the Institute had been established, he reiterated in the synopsis of one of the courses in the curriculum his belief that the failure of women in the sciences was due to incompetent teachers and poor text-books and not to "the perversion of female genius" to which it was usually credited. Since he held such advanced views, it is small wonder that educators like Mary Lyon and Emma Willard turned to Eaton for encouragement and advice.

Though the Institute was never able to carry out its plans regarding "domestic economy," it made some provision at least for agricultural education. Before its establishment there had been proposals at Columbia and Pennsylvania for departments adapted to the needs of farmers; but it organized and maintained, for nearly ten years, the first curriculum of this kind. It was, therefore, the first school of agriculture in the United States, antedating the Michigan State Agri-

A CHAPTER IN

cultural College, founded in 1857, by almost thirty-five years. Because of this fact, its methods are historically important. So far as can be gathered, instruction was conducted in classrooms, laboratories, and field gardens, and on "well cultivated farms." In the classrooms such topics as plant and animal physiology were treated at length. The laboratories were devoted to the analysis of soils, manures, plants, and vegetables and to the dissection of animals. In the school gardens, students were required to make "experiments upon nutritious matter proper for vegetables," or, again, to apply "active substances," such as acids and alkalies, to the plants provided. Moreover, they were expected to "observe the operations of the agriculturists on the school farms" and the "progress of cultivated grains, grasses, fruit trees. . . ." In addition, they were supposed to learn the "art of inculcating and engrafting trees, transplanting by roots . . . and pruning. . . ." In view of the complementary studies which were provided, it is clear

AMERICAN EDUCATION

that the Institute offered a useful training to the "sons of farmers" who might apply to it. However, agriculture, which stood first in 1825 in the list of vocations to which the natural sciences were to be related, stood last in 1847 and, a little later, disappeared altogether. Although the life of Rensselaer as an agricultural college was thus of short duration, it made possible the work of men like Ebenezer Emmons ('26), who established in New York the first department of agriculture; Asa Fitch, Jr. ('27), "the father of economic entomology" and the first official entomologist of the United States; James Hall ('32), who helped to pave the way for the Iowa State Agricultural College; Ezra Slocum Carr ('38), the first professor of chemistry as applied to agriculture in the Universities of Wisconsin and California; and George Hamill Cook ('39), director of one of the earliest experiment stations. Even to agricultural education, therefore, the Institute made no slight contribution.

On the other hand, its effect upon the

A CHAPTER IN

academic colleges is by no means certain. Eaton, whose mind ranged far beyond that of most of his contemporaries, and who evidently wrote most, or all, of the early notices, attacked their methods without stint. "The aspiring energies of youth," he remarked, "had been chained down to a kind of literary bondage." Their "native curiosity" had been stifled, and their masters had depended on "the rod in their early years" and on "fines, rustications, and expulsions" in their latter. All this he would change. There was no reason, he insisted, why interest could not be "successfully excited" in "every department of human learning" if "things, not words," were studied. For this reason he advocated the introduction of experimental methods in every field of instruction. As might be expected, he incurred the hostility of conservative educators. To-day, when the sciences are universally recognized, it is hard to understand the bitterness of their attack. Bitter, however, it must have been; for Eaton, on more than one occasion, referred

AMERICAN EDUCATION

to the pain occasioned by their attitude. Though this attitude lingers in a few institutions which have not yet learned that tolerance is the finest fruit of scholarship, Eaton lived to see his ideas "borrowed" by many of the colleges which had been the most persistent critics of his scheme. Whether the example set by the Institute reacted as powerfully as he believed, it is evident that it offered to students preparing for the established professions a group of subjects—mathematics, the sciences, public speaking, law, literature, rhetoric, composition, government, political economy, and philosophy—that to-day, after the lapse of a hundred years, represents more accurately than any other curriculum of 1824 the type which has taken shape in the average college of liberal arts. In a crude but, nevertheless, prophetic manner, Eaton undoubtedly anticipated the correlation of the natural and social sciences which has become so characteristic an element of modern education. Few educators—even the most conservative—would now care to

A CHAPTER IN

challenge his conception of the college in its relation to life and learning.

Though it is possible—notwithstanding the number of students who have entered the church, the law, dentistry, or medicine—that his conception of this relationship did not crystallize into an integrated unit, there can be no doubt that he envisaged clearly the modern graduate school with its professional standards. Within a decade he made Rensselaer—founded as an academy for the sons and daughters of farmers and mechanics—the first institution of the kind in America. This transition is one of the most striking phenomena in the history of education. At first the Institute merely offered to students who had received a classical education an opportunity for special study. Before long, however, Eaton arrived at a clearer idea of its dependence upon the arts colleges. Its function, he pointed out, was entirely different from theirs. In no sense could it be called a rival; for it relied upon them to fashion its students as gentlemen and to

AMERICAN EDUCATION

provide them with the knowledge of literature and the polish of manner essential to professional success. As early as 1827, the authorities announced that graduates of recognized colleges and of the United States Military Academy could complete the requirements for a degree in half the usual time. A little later Eaton added that the courses at the Institute were intended primarily for those who had completed their academic education; and, in 1832, he boldly proclaimed that it might "be considered the *common workshop* for all colleges, academies, and other literary and scientific seminaries of learning." Even to clergymen, lawyers, and physicians it professed to offer opportunities that were not provided elsewhere. What Eaton visualized was a graduate school not unlike that proposed fifty years afterward by President Gilman at Johns Hopkins.

Not only did he visualize such a school, but he made Rensselaer one in fact as well as in name. For three decades, therefore, Troy was to the aspiring youth of America

A CHAPTER IN

what Germany became in the succeeding period. At times nearly half of those enrolled were college graduates. In the early years it drew constantly upon older institutions such as Amherst, Bowdoin, Columbia, Dartmouth, Harvard, Pennsylvania, Princeton, Yale, Union, Wesleyan, and Williams. From some, like Yale, where there were teachers interested in the sciences, there was a considerable stream of students. As a result, many of those whose names are mentioned in this volume—men like Ebenezer Emmons ('26), from Williams, and James Curtis Booth ('31), from Pennsylvania—came to the Institute, at which they sometimes remained for several years, prepared to make the most of its facilities. Moreover, after the Civil War, it attracted men from the newer colleges as well as from the technical institutions which had sprung up in the East. In all it served in this way nearly one hundred centres of higher learning. Since Rensselaer was thus the first graduate school of America, and since its authorities stressed persistently

AMERICAN EDUCATION

the need of research, it was natural that its alumni—often college graduates—should have been the first to adventure into the great universities of Europe. In view of this fact, the reorganization of the graduate courses which has just been completed links the present celebration with developments in the last century that now appear highly significant.

In its influence upon the education of women, upon instruction in agriculture, upon the development of the college curriculum, and even upon the character of the graduate school, the Institute soon surrendered its position of leadership. In the pure sciences, however, it remained supreme for thirty years; and for more than twice that time it maintained a similar supremacy in the applied sciences. Though it now shares its rank with several institutions of high merit, their existence is a tribute to its success. In the interpretation of the forces of nature and their adaptation to the exigencies of civilization, it has been the most vital force in the

AMERICAN EDUCATION

history of the continent. In 1850 the majority of the naturalists and engineers who were teachers or practitioners in the United States were alumni of the Institute. Without them to man the new departments and to direct the construction and operation of railroads and factories, the Industrial Revolution would have been postponed for twenty-five years. Those aspects of life which to-day seem most characteristic of America can therefore be traced in many instances to the foundation of Stephen Van Rensselaer.

CHAPTER II

CURRICULA AND TRADITIONS

ONE of the most fascinating studies in the realm of scholarship is the evolution of the curricula at the Institute. Since their development is inextricably associated with the directorships of Amos Eaton and Benjamin Franklin Greene ('42), it may well be considered from their points of view.

In the last chapter, I suggested a few of the ideals which Eaton attempted to realize in Troy. Though his interest in the education of women is not reflected in the courses which he established at Rensselaer, his attitude toward scientific, agricultural, and industrial training is indicated in the early bulletins. In them it is easy to trace his conception of the college and the graduate school.

Before turning to the first curriculum leading to a degree—that of bachelor of arts—it seems advisable to describe the character of

A CHAPTER IN

the preparation advocated by the senior professor. Though the requirements emphasizing the necessity of mathematics and rhetoric and the usefulness of history, English literature, and Latin can be found elsewhere, the subjects offered by the Preparation Branch, announced in 1826, are excellent criteria. Those mentioned as occurring in the forenoon in one of its five divisions are practical mathematics, botany, geography, history, moral philosophy, logic, rhetoric, etymology (including derivations from Greek, Latin, and French), government, law, and parliamentary rules. As in the advanced course, instruction was carried on by means of "extemporaneous dissertations" from "concise written memoranda." The afternoons were devoted to "scholastic amusements" consisting, in the summer, of field work, and, in the winter, of laboratory practice. These "amusements" included botany, entomology, mineralogy, physics, chemistry, and the rudiments of agriculture and civil, electrical, and mechanical engineering. In general, therefore, the

AMERICAN EDUCATION

curriculum of the Preparation Branch was an elementary duplicate of that leading to a degree.

A review of the subjects required for graduation shows that Eaton regarded the sciences as the core of the "Rensselaerian Plan." Around them he grouped whatever studies he felt necessary to complete the kind of education which he believed to be best adapted to the needs of modern life. As he came to understand these needs more fully, he altered materially the content of the courses offered by the Institute. As a result, the degree of bachelor of arts was superseded, in 1835, by one in natural science. By this time the requirements in botany, zoology, physiology, geology, mineralogy, mathematics, physics, and chemistry had been moulded into an organic unit which was undoubtedly superior in many respects to any other curriculum of the day. It was this superiority which made possible the epoch-making achievements of the alumni enumerated in the next chapter.

Many of these achievements were con-

A CHAPTER IN

nected with the development of agriculture. Since I have already referred to the character of the courses in this field, it is possible to turn to those which were connected with industry, and which therefore anticipated the present curricula in engineering not only at Rensselaer but also at all other institutions in America. As President Ricketts has pointed out in his *History*, these courses grew up gradually within a decade. In 1825, surveying and the elements of hydrostatics and hydrodynamics were listed among the subjects taught. A year later "general engineering" appeared, and, in 1828, "civil engineering." In 1835, when the degree of civil engineer was introduced, four young men presented themselves for examination. They were the first in any English-speaking country to receive a diploma in engineering.

By 1835, then, the Institute had developed a closely integrated course in technology which was distinctly professional in character. The alternate course in natural science, which had also become a well-rounded unit, repre-

AMERICAN EDUCATION

sented Eaton's contribution to the curriculum of the American college. The subjects listed in the last chapter indicate the manner in which he attempted to relate students to their physical and social environment. Notable as was the advance made by the Institute in this connection, its emphasis upon the value of graduate study was even more striking. During the first twenty-five years of its history, the requirements for a bachelor's degree were crowded into a single year. Though this fact may seem to contradict what I have said regarding the wide and profound influence which it exerted throughout the United States, it should not be forgotten that the Preparation Branch laid an admirable foundation for mature scholarship and that many students who had not enjoyed its advantages were already college graduates. Since fourteen was the age set as advisable for entrance to this branch, with its various divisions; since twenty was the average age of matriculation, and since the examiners included such men as Chester Dewey and

A CHAPTER IN

Joseph Henry, the standard must have been reasonably high. Moreover, regarding the importance of research the authorities evidently held advanced views; for graduates—even if they did not proceed to a master's degree—were expected to communicate at least once in three years the results of their investigations and discoveries. The establishment of such a tradition was not the least of the services which Eaton rendered to his generation.

More than any other educator of his day, he stressed the importance of research. In fact, the whole routine of the Institute tended to develop initiative. The emphasis upon skill in manipulation, accuracy in observation, and efficiency in reporting results bore many rich and varied fruits. Even in the Preparation Branch students were thrown largely upon their own resources in that they were expected to perform many of the exercises “with apparatus made with their own hands.” Since candidates for a degree were required to complete over sixteen hundred

AMERICAN EDUCATION

experiments, and since theory was almost invariably based upon generalizations drawn from practice, most of the early graduates acquired a familiarity with scientific methods which it is not difficult to trace in their work. Moreover, since Eaton's primary aim was the popularization of knowledge, the authorities threw the burden of instruction largely upon the students themselves; and it was this system of daily lectures followed by informal discussions of their field studies or laboratory investigations which led so many of the alumni into public affairs.

In rounding out his scheme, which was characterized, as I have intimated, by due emphasis upon social and moral values, Eaton did not overlook the necessity of physical development. It must be confessed, however, that to the average undergraduate his ideas would now appear somewhat antediluvian. It must be confessed, also, that even from the point of view of physical education they were not particularly advanced. In fact, toward any provision for

A CHAPTER IN

“sport” he was persistently hostile. “Corporal exercise,” he admitted, was “not only necessary for the health of students but for qualifying them for the business of life.” On the other hand, “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.” “In lieu of mischievous tricks, degrading contortions, called gymnastics, and profane language,” he proposed the kind of “amusements” on the “school farms” or in the “school shops” which I have already described. In view of the weary hours now spent in every laboratory, these “amusements” must seem to many an ironical travesty of the term. Nevertheless, to Eaton they offered an opportunity for symmetrical development unhampered by the attractions suited only to the “parasites of Europe,” which unfitted students “for either literary or scientific pursuits.” Though such an attitude will doubtless seem amusing to the successors of the “free-born Americans” who have been

AMERICAN EDUCATION

“corrupted” by the customs of the Old World, there are probably a few benighted educators who, even to-day, will sympathize in secret with the antiquated ideas of the republican professor.*

By 1850, however, these ideas seemed old-fashioned even at Rensselaer; for the report of Greene, who had become director in 1847, anticipated, in a striking way, the modern point of view regarding physical education. A paragraph will give some idea at least of the boldness and originality of his proposals:

“Finally, it may be said that, although the methods of the Institute afford considerable opportunity for physical exercise in connection with the various field operations . . . still this incidental advantage is far from being sufficient to take the place of a course of systematic gymnastics as a means of rational physical culture. There is nothing more needed in these days of bodily insufficiency. . . . Even where gymnastics constitutes a part of the programme of educational courses—as it does in some of our schools for boys and

A CHAPTER IN

girls—it embraces little else in most cases than a room or yard, provided with a few of the commoner forms of apparatus, to be used *ad libitum* by the pupils. . . . This, even, is worth something; and we would not wish to estimate it below its just value. But gymnastic training, worthily so called, is a much more serious matter; for it implies an array of means for the complete and harmonious development of the whole muscular system—of the entire physical man; results which require a systematic disciplinary drill, under competent direction, of several years' duration, regularly filling up certain hours of each week set apart for this kind of culture. The resources gained by such a system of culture are not alone of a physical kind; they are largely intellectual and moral. Presence of mind, consciousness of physical capacity, power of command, and promptness of action in moments of critical and trying circumstances as well as on ordinary occasions are among the mental gains. While desirable for all persons—men and *women*—such a train-

AMERICAN EDUCATION

ing is especially called for in the education of professional technists, who, besides needing the physical powers and mental control conferred by such culture for the most efficient conduct of professional duties as well as for self-preservation in times of personal danger, are sometimes suddenly confronted by an array of circumstances where the safety of the lives and limbs of hundreds of workmen and others may be, in a measure, dependent upon their possession of just such resources as those here described. Much might be said in respect to the favorable influence upon the general health of such culture; and very many reasons might be urged why it should form a parallel and contemporaneous system in all intellectual education of the young of both sexes. . . .”

This passage is indicative of the mastery with which Greene, who discussed such subjects as deanships and dormitories in the same enlightened manner, grappled with the complexities of reorganization at the Institute.

A CHAPTER IN

In preparation for the task he analyzed the curricula of the leading institutions of France and Germany, from which he drew certain conclusions, which appear in his report. To-day, after the lapse of nearly seventy-five years, his recommendations seem as sound as when they were first presented. Though they have been modified in detail through invention and research, their implications have remained unchallenged. For this reason a review of Greene's proposals, which included the whole range of elementary and collegiate education, is of more than local interest.

Since he aimed at a type of training which should be closely integrated, he systematized, in the first place, the courses in the Preparation Branch. In this school, as reorganized, an "elementary class," extending over a year, was followed by a series of "general classes," three years in duration, which were devoted to the languages—Latin, Greek, French, German, and English—to mathematics, to descriptive and experimental science, and to

AMERICAN EDUCATION

the graphic, vocal, and gymnastic "arts." Greene's greatest contribution to the theory of secondary education, however, is to be found in the curriculum of the "special class," covering a year, in which the nature of the instruction in the mathematical and classical sections was adapted to the character of the college which the student proposed to enter. This differentiation, which is reflected to-day in the curricula of every secondary school, is one of the numerous instances of the manner in which the Institute anticipated changes with which its name is never associated.

Greene's chief claim to distinction, however, lies in his proposals for a polytechnic institute as comprehensive as its title. Though Eaton had insisted that most colleges attempted to teach so many subjects that they could teach none of them well, and that Rensselaer should limit its activities primarily to the sciences, progress in them had been so rapid that Greene believed that it was again time to narrow its field. While pointing out that a school of forestry and a

A CHAPTER IN

school of agriculture might well be considered, he eliminated them because "as a matter of expediency" they would probably have to be administered independently. While suggesting, also, that a school of commerce "with elevated aims" ought to be included in a polytechnic organization, he nevertheless restricted his recommendations to "matters immediately cognate to architecture and engineering." Because of its historic significance, his treatment of these "matters" is worthy of note.

As I have already intimated, Greene's point of view was remarkably catholic. While emphasizing those "matters" which seemed "immediately cognate" to his purpose, he did not overlook those which are more remote but no less essential. In the "general school," as he styled it, which dealt with such subjects as languages—English, French, and German—philosophy, botany, zoology, geology, mineralogy, physics, chemistry, mathematics, and the geodetic, graphic, plastic, and gymnastic "arts," his aim was

AMERICAN EDUCATION

to offer a system of general *disciplinary culture*—scientific, literary, philosophic, artistic—prior to entrance upon a “study of any form of applied science or art.” In the “technical schools,” leading to professional preparation, courses were grouped under “general studies” and “special studies,” according as they were common to the needs of all groups of students or were applicable to those of one group only. Within the boundaries of the time limit—three years—which he had set, Greene attempted, therefore, to provide a complete liberal and professional education.

In his report, written practically twenty years before Huxley’s famous essay, he emphasized the cultural value of the disciplines which he advocated. While expressing his appreciation of the ideals which had illuminated the universities of Europe and his readiness to accept in their own place those which had been borrowed by the colleges of America, he nevertheless insisted upon the validity of his own point of view. Not the least of the misconceptions regarding the pur-

A CHAPTER IN

pose of the Institute, according to him, was the prevalent idea that its object was distinctly vocational and that it was unable to provide its students "with that completeness of scholarly culture which is comprehended in the idea of a liberal education." Actually, however, he added, its courses were neither "partial" nor "one-sided" but "*adapted to the complete realization of true educational culture,*" ministering to all the "powers of perception, of thought, of feeling, of expression, of action" and aiding the undergraduate to meet "the demands and circumstances of the age in which he lives." Such was the wise and tolerant definition with which Greene began his plan of reorganization.

Though it was subject to attack from those who misunderstood his attitude toward the classics, it was also subject to attack by those who would sink "all learning to the level of the merest empiricism." Regarding their onslaught he remarked:

"The question may be raised as to the utility of such studies as rhetoric, philosophy,

AMERICAN EDUCATION

etc., to the architect, engineer, and other technists. It is a natural question, and one not unfrequently asked in these days, when the element of *time* which is spent in connection with education is estimated at so high a value. Experience has shown conclusively enough to all observers that in a course so largely—in its very necessities—*material* as that which obtains in a polytechnic institution there should be introduced compensating or balancing elements. And what studies so suitable as those which cause us to turn from the observation of *things* without to the contemplation of the wonderful phenomena and resources within the human mind! Apart from all consideration of the practical advantages which accrue even to the technist—and they are not only manifold in fact but *ought to be obviously so* to all intelligent and discriminating observers—from this class of studies, we repeat that, viewed as a mere *equipoise* to the study of the mathematical, physical, and technical sciences, we believe they should find a prom-

A CHAPTER IN

inent place in the educational system of every polytechnic institution."

As I have explained, Greene had envisaged an institution which would deal with all "matters immediately cognate to architecture and engineering." Within the limits of these terms, he included not only "schools" of "civil architecture," "civil engineering," and "mining engineering" but also "schools" of "pure art" and "ornamental art." Because of lack of funds, however, only the "school of civil engineering," offering the degrees of civil engineer and topographical engineer, was actually organized during his directorship. Though he was unable to introduce many of his recommendations, he charted the trail which others have followed. With the exception of local divergencies in content and method, engineering education to-day may be interpreted almost entirely in terms of his report. So sound were his conclusions that Dr. Charles Ribourg Mann's study for the Carnegie Foundation consists of little more than a reinforcement of his

AMERICAN EDUCATION

views as modified by conditions at the time when it was made.

In the leadership of both Eaton and Greene, therefore, Rensselaer was peculiarly fortunate. Since their administrations, also, it has found others to further their ideals. Seven years after Greene's resignation, the course leading to the degree of topographical engineer was changed to one leading to the degree of mining engineer. In 1862, when the "special class" leading to the curriculum of three years in civil engineering became the first year of the new four-year course, which has remained the norm in the United States and Canada, a curriculum in mechanical engineering was added. Both of these courses, which, with that in natural science, were abolished in 1871, represented departures which were afterward elaborated in other institutions. Not until 1907 were courses in mechanical and electrical engineering placed upon a permanent footing, and not until 1913 was a similar course in chemical engineering differentiated from that in science. In keep-

A CHAPTER IN

ing with the traditions of the Institute, the curriculum in civil engineering had been distinctly general in character, and the new curricula were moulded in similar form. Many other improvements advocated by Greene have also been introduced. Though Rensselaer to-day offers no course in commerce such as he proposed, it has not been oblivious to the growing correlation of science and industry. Nevertheless, development has proceeded on other lines. In recent years the chief contribution of the president and the trustees has been to the life of the Institute as a whole. To make possible the most thorough instruction within the limits of the eight semesters leading to a degree has been their principal concern. To this end they have bent all their energies to provide buildings, laboratories, and professorships as they have been needed. Though the proper utilization of the equipment which they have provided has depended upon the members of an able faculty, some of whom have been distinguished in their special subjects, prog-

AMERICAN EDUCATION

ress has depended no less upon the efforts of the alumni. While they have rallied generously to the support of their *alma mater*, their most notable services—those on which its reputation finally rests—have been their achievements in the fields which they have made their own.