and no well-defined course in the subject was formulated for several years, though the curriculum of 1831 included elements and applications of civil engineering. In 1835 the trustees created a department "for the purpose of giving instruction in Engineering and Technology" and in the same year the first class in civil engineering was graduated. The course in civil engineering was reorganized in 1849–50 by Director B. Franklin Greene, one of the ablest men ever connected with the faculty. Departments of mechanical and electrical engineering were established in 1907 and that of chemical engineering in 1913.

It will be noticed that this sketch has had reference almost entirely to a few of the early years in the life of the school. Much of interest, even of those days, has had to be omitted. Van Rensselaer's first orders for the government of the institute, the rugged character and original methods of instruction of Amos Eaton, sidelights on the lives of the students, all would be of interest to the historian. Nor have I touched upon the influence of the school upon the development of scientific education and the practice of engineering in this and other countries. These phases of its influence, admittedly great, will be considered to-morrow by Dr. Ray Palmer Baker, distinguished in letters, professor of English in this institution.

PALMER C. RICKETTS

AFTER ONE HUNDRED YEARS[1]

WE are met to celebrate the hundredth anniversary of the foundation of Rensselaer Polytechnic Institute. It is therefore fitting that we should ask ourselves how far the aspirations of its founders have been justified by its fruits.

To-day the first fruits seem remote indeed. As President Ricketts explained yesterday, Stephen Van Rensselaer proposed to establish in Troy a school for the "sons and daughters of farmers and mechanics." Nominally, therefore, the institute was devoted to the education of both sexes. Actually, it existed for men only. Nevertheless, it exerted a profound and lasting influence upon the colleges and universities which opened their doors to women during the nineteenth century. Before its incorporation, Eaton had conducted courses in botany, zoology, physics and chemistry throughout the eastern states; and not a few of the women who had attended these courses followed him to Troy. One, Mary Lyon, who had been a student in Northampton, became the founder of Mount Holyoke College. Others, also, profited directly by the facilities provided by the authorities of the institute. Naturally, however, its greatest services were rendered by its sons who had been moulded in the spirit of the senior professor. One of them, Eben Norton Horsford ('38), believing, like him, that the failure of women to achieve intellectual distinction was due to lack of opportunity and not to the "perversion of female genius," endowed the laboratories of Wellesley College. Others were active in the state universities. In two at least they were largely responsible for the inclusiveness of which they rightly boast; and in many others they upheld that equality of privilege which we now accept as a matter of course. To the education of women, therefore, Rensselaer made no slight contribution.

Not only was it the first institution to provide—though unofficially—for the scientific education of women, but it was also the first to offer a curriculum in agriculture leading to a degree. Of the interesting features of that curriculum, which it maintained for ten years, I can not speak to-day. Suffice it to say that the young men who enjoyed its advantages established the first state department of agriculture, the first state bureau of entomology and one of the first state experimental stations. The influence of the institute was not limited, however, to governmental departments, bureaus and stations; for in the universities of Alabama, California, Iowa and Wisconsin, as well as in a number of smaller institutions, its alumni served as first professors of the sciences in their relation to agriculture. As in its provision of educational facilities for women, Rensselaer was thus a pathfinder in a field which it has long since abandoned.

Somewhat similar has been the history of its influence upon the academic college. Rensselaer was the first institution to offer the degree of bachelor of arts to students who had completed a course of study in the natural, mental and social sciences. The curriculum leading to this degree—a curriculum embracing mathematics, the sciences, public speaking, literature, rhetoric, composition, government, political economy and philosophy—foreshadowed, in many ways, the type toward which instruction has tended in the last two decades. More significant, however, than this fact, striking as it is, is the theory on which it was based. "Things, not words," was Eaton's motto; and this touchstone he applied to every subject which he professed. As a result of his success, he lived to see the experimental methods which he advocated introduced into many of the colleges which had attacked his proposals. Indeed, before his death he was generally recognized as the originator of field work and laboratory practice in the United States. In themselves these two contributions, rich in result and richer in promise, would almost justify the foundation which we are met to commemorate.

There are other reasons, however, for this celebra-

[1] Address at the centennial celebration of Rensselaer Polytechnic Institute, Saturday, October 4, 1924.

tion. Although Eaton was inclined to challenge the value of the disciplines inherited by the colleges which had scouted his efforts, he soon realized that they were destined to play an essential part in the system which he was attempting to develop; and he was not slow to accept their assistance. 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. Somewhat later Eaton added that the courses at Rensselaer were intended primarily for those who had completed their academic education; and, in 1832, he asserted that it had become *"the common workshop* for all colleges, academies and other literary and scientific seminaries of learning." What he visualized, therefore, was a graduate school with distinct professional standards; and such a school—the first of its kind—existed in this city for nearly three decades. At times almost half of those enrolled were college graduates—alumni of older institutions, like Amherst, Columbia, Dartmouth, Harvard, Pennsylvania, Princeton, Yale, Union and Williams, represented here to-day. In all, the institute drew in this way upon nearly one hundred centers of higher learning in Europe and America. In the variety of its contributions to educational practice it has not been surpassed.

Nevertheless, in all the enterprises which I have mentioned its achievements were restricted by the years apportioned to them. Indeed, it might almost seem as if its history is a history of lost causes and as if its greatest glory has been due to its renunciations. No such supposition is justified; for each of the developments of which I have spoken—by-products, as it were—bore a definite relation to the ideal which actuated its founders. From the beginning Rensselaer had been devoted to the advancement of science and engineering. In science and engineering it has contributed most to the progress of humanity; and it is because of its primacy in science and engineering that we are met to-day. It is therefore proper that we should attempt to evaluate the fruits of its leadership in these two fields.

I have already stressed Eaton's interest in science. In botany and zoology, physics and chemistry, geology and mineralogy, he was a pioneer; and in all these subjects Rensselaer was a pathfinder.

Of its contributions to botany and zoology I have given you at least an inkling. From the institute came the first text-books in the vernacular. From it came many of the earliest reports, especially those on the flora and fauna of the northwest. Moreover, the young men educated here were the first to establish departments and bureaus for the application of botany and zoology to the needs of agriculture. It is interesting, too, to recall that in a dozen institutions they dealt with them in their relation to medicine as well. Nor, in view of those assembled here to-day, ought we to forget that they not only served such colleges as Middlebury, Rutgers and Williams, but that they also introduced these subjects at such universities as Iowa, Michigan and Wisconsin.

Nevertheless, distinguished as is the record of the institute in the biological sciences, it was terminated at an early period by another shift of emphasis. Only in the physical sciences has it maintained its traditions of achievement. With what it has accomplished since 1885, a date that marks approximately the beginning of a new era in the scholarship of America, I shall not deal. Instead, I shall carry you back to the days when it was still a pioneer, a source of inspiration to the men who laid the foundations of the physical sciences in the universities of the United States. Of the physicists, who have first claim to attention, I can mention only two—De Volson Wood ('57) and Henry Augustus Rowland ('70). In Michigan, Wood instituted the policy of separating the pure and applied sciences which has been adopted by most, or all, of the state universities. At Rensselaer, and later at Johns Hopkins, where he became first professor of his subject, Rowland conducted the researches which gave such a striking impetus to the development of physics during the last fifty years. In the old main building which stood not far from the head of the Approach, he completed his investigations of the maximum magnetization of iron, nickel and steel; and there, too, he formulated the principles governing his classic researches on the magnetic effect of electrostatic charges in motion. To those of us who are entrusted with the advancement of knowledge, it is a sobering reflection that the results of these studies can be compassed by the narrow span of a single generation; for there are not a few here to-day who remember as students the little corner room which Rowland abandoned for his famous "shop" in the city of Baltimore.

In speaking of the contribution of the institute to the development of chemistry, I can not do better than follow the plan which I have adopted in the case of physics. If I had time, I would like to describe the emphasis placed upon the subject in the curriculum. It was this emphasis which made it possible for the alumni to establish departments of chemistry in many institutions of high rank. It was this emphasis, also, which drew them—the first Americans—to the universities of Europe. With the name of one of these adventurers, Eben Norton Horsford, to whom I have previously referred, the campaign now being conducted by Harvard University has made many of you familiar; for it was Horsford, who, as

Rumford professor, induced Abbott Lawrence to establish a school devoted to analytical and practical chemistry in which he conducted the first laboratory courses of any importance given in Cambridge. Of the influence of those courses upon the fortunes of President Eliot, the Massachusetts Institute of Technology and countless other men and institutions you are all aware. The name of another, James Curtis Booth ('31), is also not unknown to some of you. Booth, the most eminent chemist of his day, who founded in Philadelphia the first commercial laboratory devoted to analysis and research, performed for the University of Pennsylvania a service not unlike that rendered by Horsford for Harvard. I might well speak, too, of other men—with no training except that which they received here—who served with no less distinction at smaller institutions such as Rutgers and Williams. Nevertheless, it is to the west that I must turn again in conclusion; for to the great universities like Michigan and Wisconsin they carried the new learning of the school founded by Stephen Van Rensselaer. In the two which I have mentioned, as well as in the universities of Alabama and California, they also led in the application of chemistry to the needs of agriculture. Moreover, in the medical departments of half a dozen universities and a dozen medical colleges, such as Rush and Pennsylvania, they were professors of chemistry in its relation to medicine and sponsors of new and revolutionary methods of analysis and diagnosis.

In geology and mineralogy, of course, Rensselaer was long supreme. From those connected with the institute came the first standard texts—the first, you may be interested to know, in which figures and plates were used to supplement the text—and from them also come the first epoch-making reports. Indeed, approximately half of all the notable developments in these two subjects before 1850 were due to graduates of the institute. They were responsible for the official surveys of Alabama, Delaware, Iowa, New Jersey, New York, North Carolina, South Carolina, Michigan and Wisconsin. In other states their advice and assistance were hardly less useful. Moreover, in a number of colleges and endowed universities as well as in the state universities of Alabama, Iowa, Michigan and Wisconsin, they established a tradition of research which has been honorably maintained by their successors. Among them were many who deserve to be remembered; and yet I must hurry on with a passing reference to two who have special claim to consideration—Ebenezer Emmons ('26), junior professor at the institute and discoverer of the Taconic System, and James Hall ('32), professor of geology and "father of American stratigraphy."

If time served, I would like to speak of other subjects such as astronomy—long stressed at Rensselaer—in which it was able to aid the universities, like Cornell, which were founded after it. In mathematics, also, handmaid of both science and engineering, its graduates were pathfinders at half a dozen institutions. Of necessity, however, I must turn to engineering, a field in which the institute was a pioneer and in which it was long without a rival. In the beginning, however, it did not offer a distinct course in engineering. Not until 1835, as President Ricketts has indicated, was the first class graduated with the degree of civil engineer. Of more immediate result from an educational point of view was the reorganization of 1850 effected by Benjamin Franklin Greene ('42), who became director in 1847. His report is the most significant event in the history of engineering education. It is doubtful whether any other document of similar character has exerted such a profound and far-reaching influence. Aside from local variations in content and method, the scheme formulated by Greene has remained the norm throughout the United States. It is no exaggeration, therefore, to say that by 1850 the essential features of every technical school had appeared at Rensselaer. Nor is it an exaggeration to say that, during the next thirty years, it impressed them, through its alumni or its curricula, upon every institution dedicated to similar aims.

Lafayette and Swarthmore, Cornell and Princeton, Michigan and Minnesota—such are the types—colleges, endowed universities and state institutions—in which the graduates laid the foundations of the departments and colleges of engineering. Columbia and Pennsylvania, Missouri and Texas—such are the types in which they have done valiant service. Nor, above all, ought we to forget the great technical schools—of which Massachusetts and Stevens are symbolic—which drew on Rensselaer not only for some of their first and most eminent professors but also for the curricula which it had evolved. And yet I would lead you astray if I were to suggest that the influence of the institute has been limited to the states of the Union. For a century it has drawn students from other lands, and for a century they have returned to duplicate in them the departments and colleges established by their classmates in the Republic. In Canada they have left their mark on several of the provincial universities. In Mexico, in the countries of Central and South America, in China and in Japan they have also been explorers, carrying the sacred fire from the altars of this modern city with its ancient name to the temples of learning which they have helped to rear. Such is the tradition of achievement which we are met to commemorate.

Though it seems fitting that, on an occasion like

this, we should emphasize the part which the institute has played in the republic of education, we should remember that the majority of its graduates have spent their lives in the world of affairs and that there is no field of activity which they have not made their own. The mechanisms which they have invented; the structures which they have designed; the canals which they have dug; the railroads which they have constructed; the ships which they have launched; the mines which they have sunk; the ores which they have treated; the businesses which they have organized; the industries which they have directed—these, the final fruits of its endeavor, are subjects to which I can not do justice to-day. Emory, Gurley, Riddell, Thacher—figures inseparately associated with the development of exact standards of measurement and calculation! Do I need to remind you, the legatees of their success, of the services which they rendered to their generation? Murphy, Roberts—pioneers in design and manufacture, workers in iron, spanners of floods! Do I need to mention them? Boller, Buck, Cooper, Hodge, Macdonald, Roebling—a brilliant galaxy—craftsmen in steel, conquerors of chasms! Shall I remind you, the inheritors of their traditions, of the achievements which you have so faithfully emulated? Ferris, Shankland—intrepid experimenters in a new architecture! Menocal, Fuertes—explorers, linkers of seas! Evans, Kneass; Cassatt, Crocker; Roberts, Voorhees—trailbreakers and executives whose names are grooved across the continent! Babcock, Mallory; Hopkins, Morse—shapers of ships, masters of men! Pardee, Rothwell; Metcalf, Reeves; Cogswell, Wallace; Lewis, White—spoilers of earth, moulders of metal, generals of organization, conservers of humanity—with their careers I can not deal.

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.

This is their story and this is yours—no bleak record of chill materialism but a single-minded devotion to the "common purposes of life" that men may find in them the essence of those higher purposes which are the goal of existence. Such is the ideal which Rensselaer, in every decade, has held before those to whom it has been the mother of learning; and this ideal, realized in the life of its sons, gathered here to do it homage, is not the least of the contributions which it has made to the civilization of America.

RAY PALMER BAKER

TRENDS IN MODERN GEOGRAPHY

GEOGRAPHY formerly was held to be the science which treats of the earth and its people. Considered in this broad sense the field included the subject-matter of many associated sciences, but with little or no correlation. The subject dealt with an infinitude of details; it was scarcely more than a scrap bag into which went a mass of unrelated material. Its methods were almost wholly descriptive; it lacked a unifying principle. Under these conditions it is no wonder that many people conceived the idea that geography was made up of the remains of various subjects and that little interest was manifested in it by the children who were burdened with a mass of facts and with the laborious, thought-deadening reproduction of maps from books.

A significant change has taken place in the scope and content of the subject of geography during the last two decades. For some years before the outbreak of the World War lecturers frequently spoke of the "new geography." The leaders of geographical thought recognized the shortcomings of descriptive geography, of fact geography and of place geography. Emphases were shifting to relational and interpretative geography. Its scope was becoming restricted and concentrated. The subject was defined as dealing with *the influence* of earth features and earth resources on the distribution, character and activities of life—plant, animal and human. This new delineation of the field emphasized the relation of earth features and earth resources to life. However, geographic topics were organized according to a standard outline: (1) Location, (2) area, (3) topography and soils, (4) climate, (5) life forms and (6) human activities. Each section, in most cases, was treated as a unit in itself, and as a result human relationships in the earlier chapters were few. No central theme pervaded these so-called geographic discussions. Moreover, in proceeding from the environment to life responses, geographers frequently assigned to environmental factors a determinant or controlling influence which they do not exert. The whole procedure was characterized by the synthetic rather than the analytic method. Furthermore, this definition called for the relation of the environment to all life, including in the field the subjects of plant and animal ecology. These fields are being developed or cultivated not by geographers but by biologists and zoologists, to whom they rightfully belong. The recognition of this situation and the insistent demands that geography be humanized have led to a clearer statement of the scope and content of the subject.

Geographers in increasing numbers define their subject as dealing solely with the mutual relations between man and his natural environment, physical