

ignorance of everything beyond the sacred pale. And what is more, it hindered any knowledge of the true nature of those things which were allowed a place within the sacred pale. It led to a cutting off of so-called 'classical' studies from all ordinary human pursuits and human interests."

#### A REPROACH HERE.

To a very considerable extent this reproach, if it is a reproach, is likewise American. The opportunities, the honors, the pleasures and the rewards of a liberal education were opened during the first half of this century to those only who had been disciplined in the ancient languages, and this discipline was continued through the greater part of the subsequent non-elective curriculum. To verify this remark it is only necessary to examine the catalogues of the leading colleges of this country during the first five decades of this century or to read the defense of classical studies annually printed by Yale College for twenty-five years prior to 1854. Spasmodic efforts were made for the foundation of new courses, but virtually West Point and Troy were the only established places in this country for good technical instruction so late as 1847. Whitney was so conscious that the men of letters, in the group to which he belonged, depreciated the aims and objects of scientific education that he wrote a pamphlet which silenced, if it did not remove, the prejudices of all who read it. Its reproof at this time is invigorating.

#### LIEBIG'S WORK.

But for twenty years previous to 1847 a force had been at work in a little country town of Germany destined to affect the education of Christendom; and at the same time to enlarge the boundaries of human knowledge, first in chemistry and the allied branches, then in every other one of the natural sciences. The place was Giessen; the inventor, Liebig; the method, a laboratory for instruction and research. Dr. Welch has lately reviewed, in an address at Philadelphia, the results which proceeded from this innovation of a genius.

Another event contributed to the expansion of education. About the middle of the century the first World's Fair, held in London, had revealed to English-speaking people the increasing supremacy of continental nations in those branches of industry which depend upon the application of science. The British were alarmed. The papers of the day, and especially the *London Times*, were vigorous in calling for improved methods of public instruction, and especially for the better guidance of chemists, miners, engineers, geologists and manufacturers, for all who aspired to be leaders in the technical pursuits upon which the prosperity of the British Empire depended. Hence in close connection, though not in this order, came the department of science and art and the museums at South Kensington, the great provincial colleges of science, the Cavendish laboratory at Cambridge, the new museum at Oxford, and other noteworthy advances. From that day to this scientific education in England has been making progress, although Germany and France and other continental states still hold their ascendancy; for now, as then, the laboratories of those countries and the abundant encouragement given to scientific research by their governments excite the admiration of our mother country and ourselves.

Is it not apparent that in the middle of this century responsibility for the advancement and diffusion of knowledge was wider and deeper than ever before? Imbued by this spirit of the times, Smithson made his famous bequest, soon to be followed by similar and greater gifts from others, a splendid line of endowments, which has spread with advancing civilization from Massachusetts Bay to the land of the Golden Gate.

#### GEOGRAPHICAL STUDIES.

Geographical discoveries, previously confined to islands and coasts, or to narrow lines in desert or barbarous countries, now began to assume continental magnitude. Earth, air and sea, and even celestial space, were called upon to reveal their secrets. The importance of accurate measurements hav-

ing now been completely established, instruments of precision became more perfect, complex and varied, produced by a noble army of inventors who never dishonored the drafts which were made by science on the bank of mechanical ingenuity. Mathematics formed a close alliance with construction and invention. Astronomy, physics, mechanics and engineering renewed their strength. National history went beyond the limitations of system. Publications were multiplied: new associations were formed, national and international. Specialization took the leadership and before Humboldt died, the era of general scholarship was past, the new era was fairly under way.

In all this progress the dominant note has been the advancement of science and not the accumulation of wealth; truth and not personal gain. Why did Darwin and Dana engage in intellectual toil in the intervals of physical disability? Why did Faraday abandon "commercial work" at the moment when it promised great returns? Why had Agassiz "no time for money making"? Certainly not because they despised the ease of life, but because personal gain was nothing compared with the study of nature and the advancement of knowledge. Wisdom was more than gold. Nevertheless it is greatly to their credit that an unselfish desire to enlarge the welfare of mankind has been a powerful stimulus to the ablest men. If I name the discoveries of anæsthetics and antiseptics, with the subordinate yet very significant evolution of cocaine, the applications of electricity, the improvements in hydrography and in navigation, and the growth of preventive medicine and the science of hygiene, and the alleviations of surgery, you will be reminded that science repays with ample usury the advances made to her account.

In this splendid epoch of intellectual progress, brilliant and memorable as the revival of letters, the early days of the Sheffield School were passed. An alchemist looking on might have asked what philosopher's stone could produce that amount of the precious metals which would be indispensable for the success of a school devoted to such aims; but his brother, the astrologer, casting the horoscope, would have replied that resolution can do more than gold, and enthusiasm than much fine silver.

#### THIS CELEBRATION'S SIGNIFICANCE.

Thus we reach the conclusion that this celebration is significant because among the institutions created during the last half-century for the promotion of scientific research and education, the Sheffield Scientific School of Yale College has held an honorable place. It is this relation to the progress of human development that gives importance to the day of small things and dignity to transactions, which by themselves might be insignificant were they not governed by enlightened views so presented, advocated and maintained that their influence has been powerful.

#### THE SCIENTIFIC NESTOR OF YALE.

As I proceed to speak of the organization of this school I shall not attempt to distribute the laurels among those who took the leading parts, but one of them, Benjamin Silliman, long the scientific Nestor of this community, dear "Uncle Ben," revered and honored, is entitled to our first grateful mention, not only because of his power of interesting the public, and his perseverance in maintaining the *American Journal of Science*, but for his personal instruction, during many years, of unenrolled young men who enjoyed the limited opportunities of his primitive laboratory and the benefits of a great, then unrivaled, collection of minerals. Silliman had prepared the way for the School of Applied Chemistry, and Woolsey becoming President of the college, fresh from studies abroad, caused the scheme to be so broadened that it became the Department of Philosophy and the Arts, akin in scope and spirit, though not equal in resources to the great foundations of Europe, like Bonn, Göttingen and Berlin, with which he was familiar. It must have been a great satisfaction to the revered ex-president, nearly thirty years afterwards, to utter, on a public occasion, these words, doubly valued by his hearers, because they came from one who knew the circumstances and

from one who was always guarded in the bestowal of praise. "From the first," he said, "the professors have struggled against probabilities. They have worked by faith. They have aimed to have a school, sink or swim, worthy of the science of this country. As a result, I think there is, confessedly, no other school of this character, in this country, which is on a level with this. I would give equal honor to the devotion of the professors and to the munificence of the giver."

#### BEGINNING OF GRADUATE STUDIES.

Here let me remind you of a fact not generally known though clearly recorded. As far back as 1814 resident graduates were enrolled as a distinct class on the Yale catalogue, and in 1819 and 1820 the members so enrolled were thirty and thirty-one. This shows that the beginning of graduate studies in this University antedates by more than thirty years the Department of Philosophy and the Arts.

#### "UNIVERSITY PROFESSORS."

In 1846, two young men, devoted to applied science and ready for careers, were made by Yale "university professors." It is a striking coincidence, that Harvard and Yale, generous and friendly aspirants for the leadership, caught the laboratory quickstep at almost the same time. The gift of Abbott Lawrence, made in 1847, led at once to the appointment of the great Agassiz and almost immediately to the opening of a chemical laboratory, organized by Professor Horsford, a pupil of Liebig. One of the young professors at New Haven having an inherent love of agriculture, and an excellent preparation in Edinburgh and Utrecht, was qualified to direct a chemical laboratory and to give instruction in the sciences pertaining to agriculture. Professor John P. Norton was fully possessed by the spirit of modern science and soon gathered around him a company of young chemists, some of whom were destined to win the highest distinctions, three of them still students, colleagues and teachers, now present with us, strong in attainments, influence and character, stronger still in the affection of their pupils.

The second of the original appointments was that of Benjamin Silliman, Jr., a man of enthusiasm and energy, and of boundless hospitality, intellectual and social, whose name and address, quick sympathies and interest in applied science gave promise of great usefulness. The labors of both these men were soon interrupted. One was diverted to other fields of activity in Louisville and New York; the other died at the threshold of his fame. I have often thought what a difference it would have made if the school had then been endowed. Norton, trying to do double work at Albany and New Haven, fell a victim to the exposures of Winter and travel; and Silliman was led to seek remunerative occupations elsewhere. Those were the days of which Lounsbury thus speaks: "The college had no money to give, but even if it had it is more than doubtful if it would have given it. No one at that time, however enthusiastic, ever dreamed of the supreme importance which the natural sciences were soon to assume in every well devised system of education. The impression prevailed that chemistry, like virtue, must be its own reward."

#### A FOUNDLING'S YOUTH.

The youth of this school was spent like a foundling's, its future was precarious. At length, new forces came to its support. Certain obstacles, elsewhere encountered, made it easy for Professor William A. Norton to bring to Yale his classes in civil engineering, and he was followed by his colleague, Professor John A. Porter, then devoted to chemistry. These appointments were invigorating. Norton was an admirable teacher, well trained at West Point, painstaking, accurate, thorough, well acquainted with the progress of his favorite science and always commanding students of ability. Porter, who had been a pupil of Liebig, was a man of letters as well as of science, a poet, philosopher and patriot, thoroughly believing in the New Education, as President Eliot named it, and ready to enlarge by the various influences at

his command the scope of the Scientific School, of which he became for several years the able and eloquent exponent.

Rapid growth followed, due chiefly to one man whose name, before all others, is on our lips as the founder of this school, Joseph E. Sheffield. It is needless to recount the steps from a gift of five thousand dollars to the amount of a million, with which we are familiar. Naturally, the school looked up to him as a father, and asked permission to bear his name. He consented with reluctance, but he never forgot the child once adopted, and in the final distribution of his estate, made it equal with his sons and daughters. The year of christening was 1860, or the child's third year.

#### OF MR. SHEFFIELD.

Mr. Sheffield was a man whom future generations, like the present, may delight to acknowledge and honor as a founder. Nothing will ever be revealed about him that his school will wish to cover. On the contrary if those who knew him best would utter what they know, the world would admire even more than it does now the sagacity, the modesty, the consideration and the unselfishness of our great benefactor. His liberality grew with the growth of the school. It was shown in little things and in great; in the payment of current bills, in the provision of large funds. "I get my reward every day as I look out upon that workshop," was the answer that he made to an expression of gratitude. "No investment pays me so well," was another of his remarks. "I wish you to bear in mind," he once said to Professor Brush, "that you have never asked me for a dollar." Yet with all this growing interest, and with his readiness to listen to all the inside history of the school, he never to the slightest degree interfered with its affairs. He trusted the governing board. He knew more intimately than any member of the Corporation, the plans, the wants, the success and the limitations of the school, and to the utmost of his ability he contributed to its maintenance. An intimacy for more than thirty years between the chief executive of the school and its nearest friend was never clouded by a moment's disagreement. His only regrets were the limitations of his resources. To all these engaging traits must be added the remembrance of his strong intellect, his comprehensive charity, his integrity, gentleness and faith. Happy the school that can bestow love as well as gratitude upon the memory of its chief benefactor.

#### OTHER BENEFACTORS.

Such example was contagious. No one was surprised when neighbors, townsmen and friends at a distance, one after another, in many successive years, enlarged the endowment. Farnam, the life-long colleague of Sheffield; Norton, the father of the agriculturist; Wheeler, an enthusiastic graduate; English, senator and governor, promoter of studies in law, history and science; Phelps, whose gateway adorns the campus; Winchester, founder of the Astronomical Observatory, who, like "the embattled farmers" at Concord, has "fired a shot heard around the world," and whose widow has given to the school one of its most important halls; Collier, who perpetuated, by a fund, the memory of his departed brother; and a lady of Liverpool, Mrs. Higgin, who established a professorship; besides Fellowes, Boardman, Sampson, Dodge, and many more. By their encouragement the school was doubly strengthened, for during the lifetime of its chief benefactor every such gift brought another from him. Since his day, the munificence of Mrs. Winchester and the bequest of Mr. Fayerweather are indications that new friends have arisen to strengthen these foundations.

#### RELATIONS TO THE STATE.

The relations of the school to the State began after the Federal Government, by the Morrill Act of 1863, distributed among all the states a certain amount of land-scrip for the promotion of scientific education. Connecticut gave the income of its portion to the