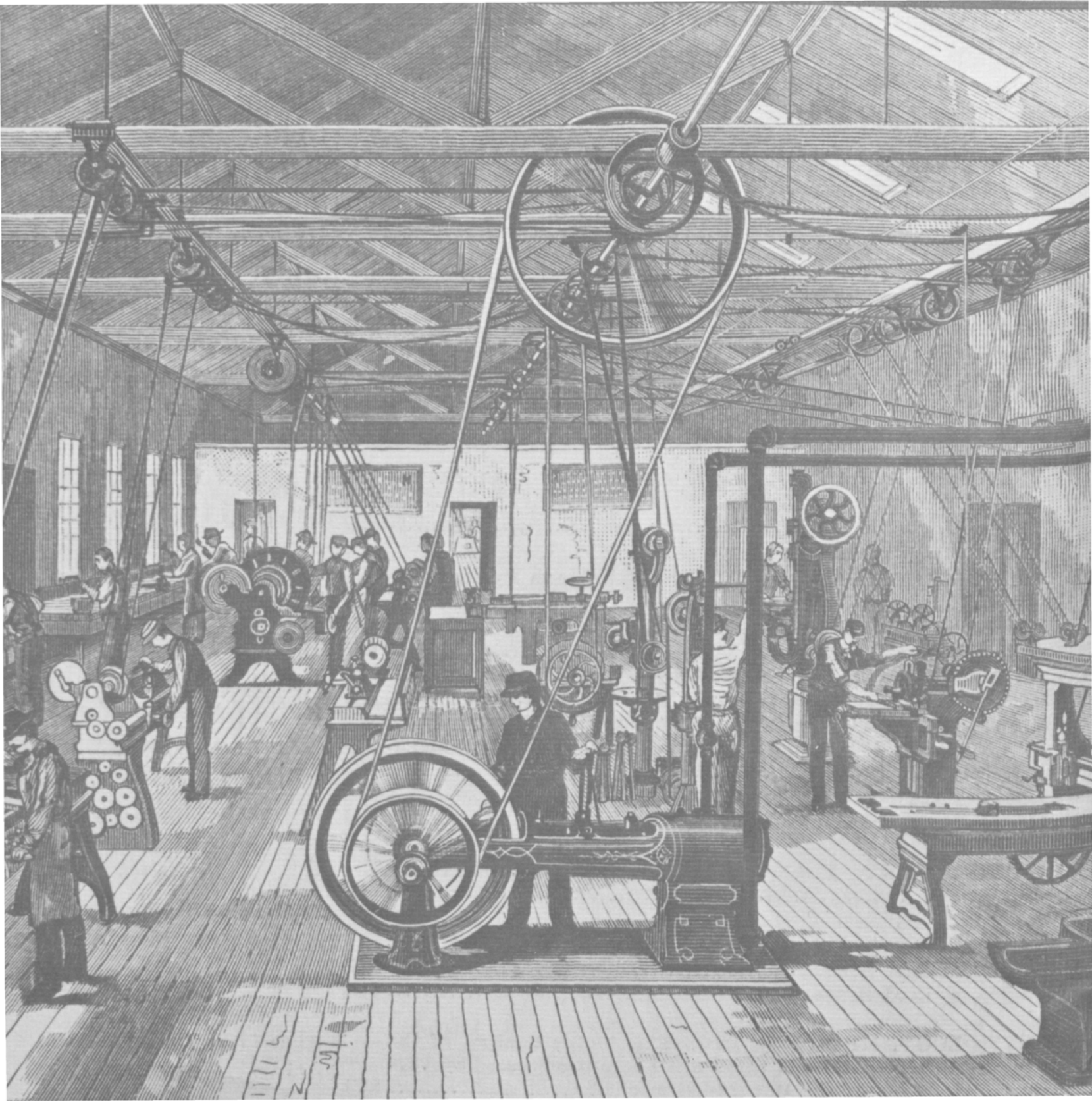
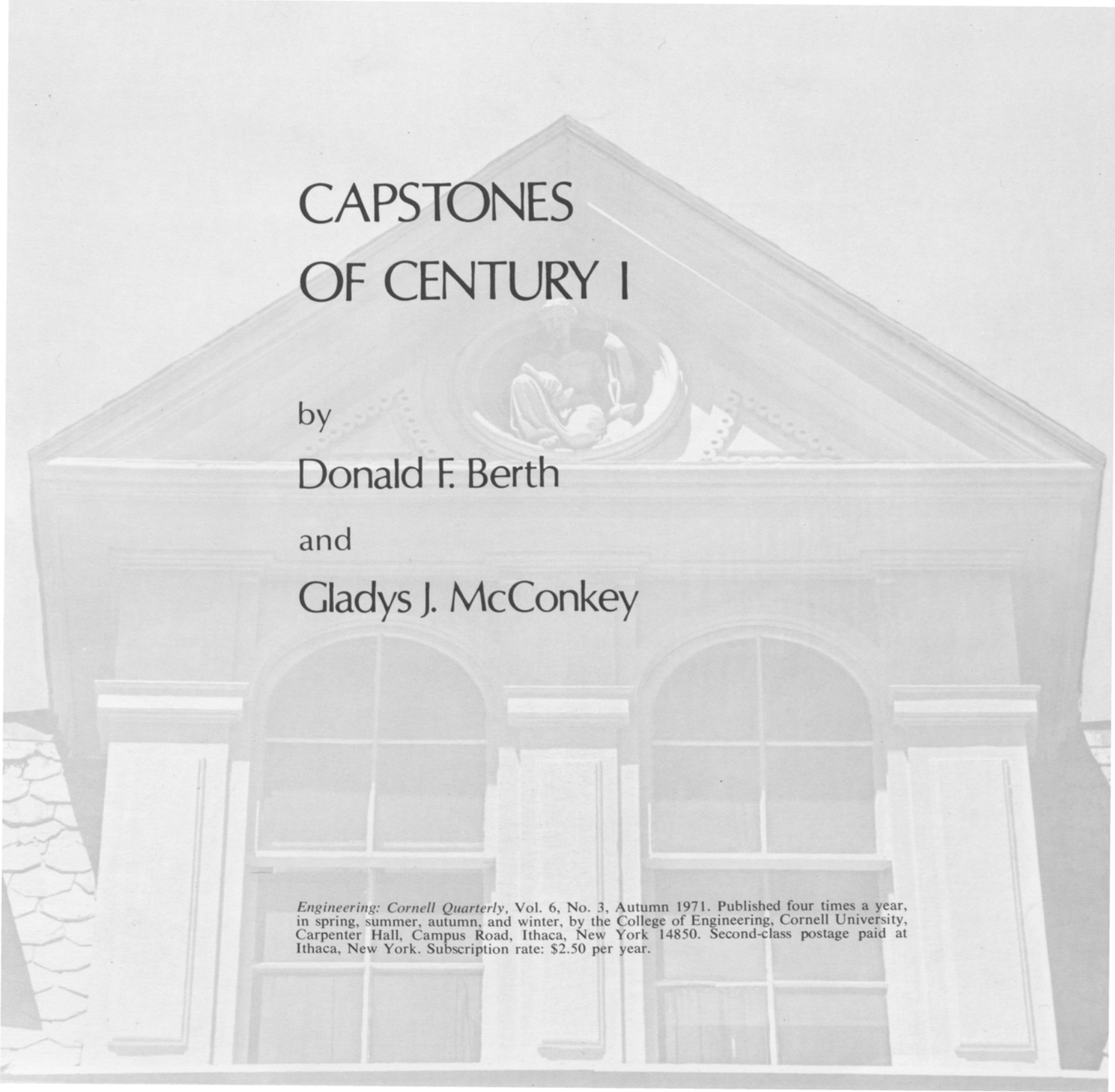
ENGINEERING

CORNELL QUARTERLY

VOLUME 6
NUMBER 3
AUTUMN 1971

CAPSTONES OF CENTURY I





CAPSTONES OF CENTURY I

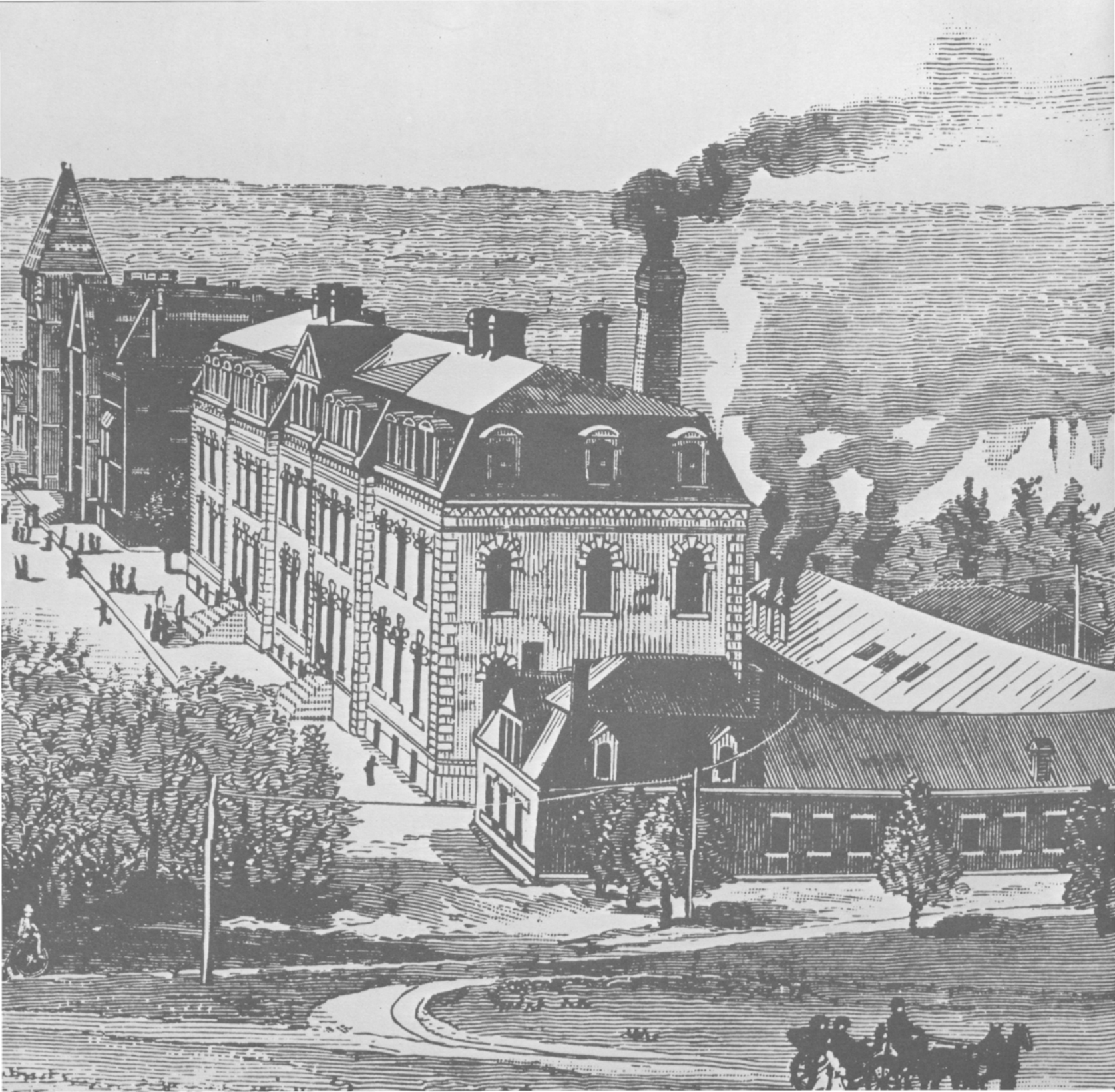
by

Donald F. Berth

and

Gladys J. McConkey

Engineering: Cornell Quarterly, Vol. 6, No. 3, Autumn 1971. Published four times a year, in spring, summer, autumn, and winter, by the College of Engineering, Cornell University, Carpenter Hall, Campus Road, Ithaca, New York 14850. Second-class postage paid at Ithaca, New York. Subscription rate: $2.50 per year.



CAPSTONES OF CENTURY I

August Doerflinger	Brooklyn
Whitfield Farnham	Elmira
Olin Gillett	Medina
Samuel Whitfield Salmon	Budd's Lake, N.J.
Fred Schoff	Newtonville, Mass.
George LaTour Smith	Canandaigua
Miller Armstrong Smith	Brooklyn

It was a small class, this first one in engineering at Cornell University, but the seven Bachelors of Civil Engineering who graduated in June of 1871 were the vanguard of 25,000 Cornell engineers who have contributed to the technological development of the United States and the world during the past one hundred years.

The story of this century of engineering education is a part of the history of a great institution, a compound of noble ideas, imaginative leadership, commitment, hard work, philanthropic support — and a bit of luck from time to time. The record of engineering at Cornell is long and distinguished, and what follows represents only a quick brush stroke over a century of progress.

This first section of Sibley Hall, built in 1871 to house the College of the Mechanic Arts, was designed by John L. Morris, the first professor of mechanics, and financed by Hiram Sibley, first president of the Western Union Telegraph Company and an original trustee of the University. The school was later renamed the Sibley College of the Mechanic Arts. The illustration is from the October 17, 1885 issue of Scientific American.

Ezra Cornell: Founder and Shaper

Ezra Cornell, the founder and first major benefactor of the University, acquired his fortune through an engineering enterprise and was actually one of the University's first practitioners of engineering arts.

The story of his involvement in the new field of telegraphy is an interesting one. It goes back to one of his early ventures, the selling of patent rights to a new kind of plow. One of his business acquaintances, F. O. J. Smith of Portland, Maine, had contracted with Samuel F. B. Morse to lay an underground cable between Baltimore and Washington for demonstrating the Morse telegraph, and was trying to develop a machine that could do the job. Cornell undertook the successful design of a horse-drawn machine that would dig a narrow trench and lay the pipe in one operation, and later he was put in charge of the actual laying of the line. After early disappointing efforts at underground transmission, Cornell applied his ingenuity to the development of an overhead line equipped with workable insulators. And in May of 1844 the first successfully transmitted telegraph message came dotting and dashing over the line: the historic exclamation, "What hath God wrought! "

Communications links began to develop between cities and towns all over the northeast. Most of the links were independently operated and individual dispatchers decided which of several competing companies should handle transmission over given sections of the route. Out of the chaos the concept of a system developed, and the pioneer Western Union Telegraph Company, precursor of modern telephony systems, was formed. Ezra Cornell was a major stockholder and a friend, Hiram Sibley of Rochester, New York, was the first president. Later, Sibley was to figure heavily in the development of engineering at Cornell.

Ezra Cornell, self-taught and entrepreneurial, understood the

I desire that this shall prove to be the beginning of an institution, which shall furnish better means for the culture of all men of every calling, of every aim; which shall make men more truthful, more honest, more virtuous, more noble, more manly; which shall give them higher purposes, and more lofty aims, qualifying them to serve their fellow men better, preparing them to serve society better, training them to be more useful in their relations to the state, and to better comprehend their higher and holier relations to their families and their God. It shall be our aim, and our constant effort to make true Christian men, without dwarfing or paring them down to fit the narrow gauge of any sect. Finally, I trust we have laid the foundation of a University— "an institution where any person can find instruction in any study." — from the address by Ezra Cornell at the Inauguration of the University on October 7, 1868.

Buildings on the Cornell campus of 1871 were, left to right, Morrill, McGraw, and White Halls, and the first part of Sibley.

value of practical education. When he conceived the idea of founding a university, his aim was to blend the classical and traditional aspects of the education of the times with preparation for specific careers. "I would found an institution where any person can find instruction in any study," was his famous statement, and the new university provided fertile ground for the development of engineering programs.

The New University: A Model for Engineering Education

While Cornell was not the first university to offer engineering courses, it rapidly became, through a fortuitous combination of leadership, funding, and successful instruction, the most distinguished university engineering school in America. At that time colleges were opening up all across the country as a result of the Morrill Land Grant Act. This act, introduced by Senator Justin S. Morrill of Vermont (for whom Morrill Hall at Cornell is named), passed by the Congress in 1862, and signed into law by President Lincoln, allowed for the establishment of institutions to teach "agriculture and mechanic arts." On the basis of Congressional representation, each state was allotted lands or equivalent scrip which could be used as capital to finance the colleges. It was this act that crystallized Ezra Cornell's plans for the founding of a university, and his endowment was augmented by the Land Grant funds for New York State. A model for the later development of other institutions was found in Cornell, and the University may, indeed, be regarded as the prototype for many of the great Land Grant colleges to the west.

Cornell has remained one of the leading educational institutions offering engineering in the United States, and as such has had and continues to have an impact on the character and direction of engineering education.

Any student found guilty of intoxication or other gross immorality will be at once dismissed . . . (If any student) absents himself without leave for more than three consecutive days, he is regarded as having withdrawn from the University. — From a statement on "Deportment of Students" in the *Cornell University Register* for 1872–73.

One of the earliest surveying classes at Cornell was conducted on "Upper Libe Slope" on the developing campus. The first civil engineering professor, William C. Cleveland, is left center with beard.

The Beginnings

It was in the fall of 1868 that instruction was commenced at Cornell University. There was a College of Mathematics and Engineering, with Evan W. Evans as a professor of mathematics and dean and William C. Cleveland, a professor of civil engineering, as director of a subsidiary civil engineering school. And there was a College of Mechanic Arts, the forerunner of the Sibley School of Mechanical Engineering, with Eli Whitney Blake, a professor of physics and industrial mechanics, as dean. In charge of the work in practical mechanics and of the machine shops was Professor John L. Morris, who later designed the first permanent structure for the College of the Mechanic Arts, the building now known as West Sibley Hall. Two of these four men, Professors Cleveland and Morris, were the only engineers among the twenty-one resident members of the University's inaugural faculty.

Ithaca, the seat of the University is . . . accessible from the East, South and West by means of the Erie Railway . . . From the North the usual route is to Cayuga Bridge, a station at the foot of Cayuga Lake, on the New York Central Railroad . . . and thence by steamboat to Ithaca. The Ithaca and Cortland Railroad starts from the immediate vicinity of the University buildings, and connects with the Southern Central railroad . . . Two other railroads leading into Ithaca are now in process of construction. — Comments on "The University Town" (which is now without railway passenger service) in the *Cornell University Register* for 1872–73.

It is instructive to look at the early programs for these two divisions in engineering, as set forth in the *Cornell University Register* for the academic year 1868–69. The University was operating on a trimester schedule and the full course in civil engineering was covered in twelve trimesters or four years. The program for the first two years in the School of (Civil) Engineering was the same as the General Course in Science offered at the University; special instruction in civil engineering began with the third year. The program of studies was described as follows:

> . . . descriptive geometry and its applications to shades, shadows and perspective, to masonry and stone cutting in the construction of arches, domes and staircases, and to carpentry in the construction of bridges and roofs; surveying and the use of instruments, with field practice; draughting in its various branches; analytic mechanics and its application to the principles of construction.

This program led to the degree of Bachelor of Science.

The School also conferred the degree of Civil Engineer "upon those who, having taken a Bachelor's degree, shall spend two years

In the 1880s baseball was played on the campus near the wooden structure known as the Old Chem Lab. This building was near the present site of the north wing of Goldwin Smith Hall.

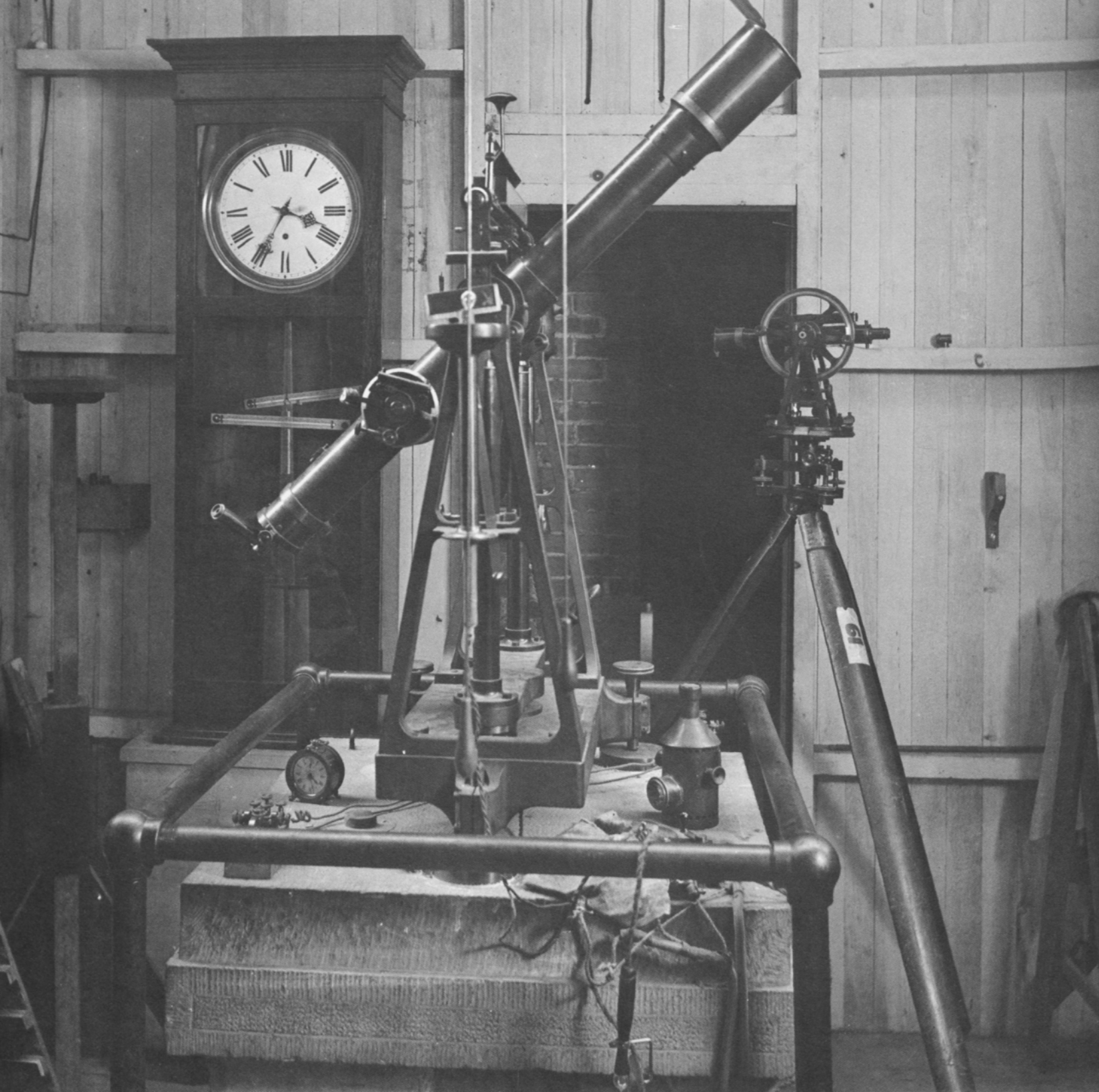
in additional special studies and practice and then pass the requisite examination." This degree, first conferred in 1870, was the first graduate-level degree in engineering awarded by the University. The recipient was Henry Turner Eddy, who held the degrees of Bachelor of Arts and Bachelor of Philosophy from Yale. Later, in 1872, Eddy earned a Doctor of Philosophy degree, the first Ph.D. awarded by Cornell University in any area of study.

For the College of the Mechanic Arts, the statement of purpose read as follows:

> It will be easily understood that the instruction in this College must be at first largely experimental in character. It is not its purpose, however, to teach rudimentary branches — to narrow down its instruction to any single trade or to the ordinary use of simple tools. The schools for this are the myriads of shops scattered throughout the country, and in them this work is done on a much larger scale, in much more varied ways and in places much nearer the homes of students than the University can ever hope to do it. It would be a misapplication of funds to devote them to adding one or two more simple workshops to the thousands on thousands already in existence, and to do at the University what must necessarily be done better elsewhere. The great want of the country in this department is master mechanics who are thoroughly instructed in the most approved science and general practice of the Mechanic Arts. The waste incurred through uninstructed or half instructed master mechanics would more than suffice to endow splendid institutions for this sort of instruction.
>
> When, therefore, the organization of the college shall be completely developed, there will be closely connected with the lecture room, in which the scientific side of the college is presented, other rooms for designing and modelling of machinery, and work-shops fitted with engines and machinery for working in wood and metals, in which the practical side will be conducted.

Like the School of (Civil)Engineering, the College of the Mechanic Arts had a "full course" of twelve trimesters, consisting of an initial two-year program paralleling the University's General Course in Science and a specialized course of study beginning in the third year. Included in the third year's program were such subjects as "draughting, with the study of colors;" Peck's "Mechanics;" the special study of the mechanical relations of heat; building and

James Elijah Vanderhoef became foreman of the Foundry in 1886; this picture dates from around 1910. Foundry work included molding, core-making, mixing of metals, and the operation of a cupola.



building materials; acoustics and optics; mechanics; and the machinery of transmission. In the senior year students studied the "moving forces employed in the arts, with special reference to water wheels and steam engines;" machine "draughting;" and metallurgy. Specialized work such as this was leavened with courses on moral philosophy and political science and balanced out with elementary architecture and rural economy.

At the beginning of the 1871–72 academic year, mathematics and civil engineering were separated and a College of Civil Engineering and Architecture was formed; at the end of the year this was dissolved in favor of separate departments. Another change in 1871–72 was the renaming of the College of the Mechanic Arts to the Sibley College of the Mechanic Arts, in recognition of the munificence of Hiram Sibley, who, with his son, was ultimately to contribute over $300,000 to the development of mechanical engineering facilities and instruction at Cornell.

The growing popularity of the fledgling engineering programs is evidenced by the enrollment figures for the 1871–72 academic year. Of a total of 494 students enrolled at the University, 92 were in (civil) engineering and 23 in the mechanic arts.

Civil Engineering Under Fuertes

In the first of a long line of distinguished and significant appointments made in engineering at Cornell, President Andrew D. White named Estévan Antonio Fuertes to succeed Professor Cleveland, who died in 1873. Fuertes, a native of Puerto Rico and a graduate of Rensselaer Polytechnic Institute, was to remain at Cornell as head of civil engineering until his death in 1903. During his long association with Cornell, he was probably the foremost leader in civil engineering education in the United States.

During Fuertes' tenure, Cornell became known as a center for great teachers in civil engineering – men such as Irving Porter Church, Charles Lee Crandall, Charles David Marx, Henry Sylvester

When Professor Estévan Fuertes got back from Italy in the fall he was still mad about his credentials . . . and he made a scene about it in the very first faculty meeting . . . First, he portrayed the procession of gaily-hooded delegates filing up to the rostrum and unrolling their illuminated Latin addresses . . . And then he depicted Cornell blundering into the Middle Ages in the person of the poor old Mogue wearing his last year's Benny Rich suit and dropping into the font that lousy half-sheet of note paper . . . Professor Fuertes then sat down, glared all around him, put his head in his hands, and burst into a storm of tears. There followed a tense and embarrassed moment . . . until Dr. Law got up and said he . . . was far from agreeing that the University had been disgraced at Bologna. Indeed, he felt that we had brought honor and distinction upon ourselves by departing from custom in this instance; for whereas the other foundations had sent illuminated manuscripts to Bologna we had done a far, far better thing in sending an illuminated MAN! That, of course, fixed everything up . . . The Mogue staggered over to Dr. Law, threw his arms about the little Scot, and wept quarts of Spanish tears upon his vest. — Romeyn Berry, writing in *Behind the Ivy* (p. 81) about events following Professor Fuertes' representation of Cornell at the ceremonies celebrating the University of Bologna's 900th anniversary.

Equipment in "Room No. 1" of the Geodetic Observatory of the College of Civil Engineering in Lincoln Hall included the master clock for the University.

Jacoby, and Henry Neely Ogden. Writing in his autobiographical book, *I Remember,* Dexter S. Kimball commented that Fuertes and his staff "constituted one of the greatest teaching groups I have ever seen." Also, enrollment in civil engineering grew from 82 out of 520 Cornell undergraduates in 1875–76 to 326 out of some 3,000 undergraduates in 1903–04. An indication of Cornell's wide influence in the field is the fact that the class of 1889, a particularly noteworthy year, included three graduates who ultimately headed the engineering programs at other universities. Anson Marston, Frederick E. Turneaure, and John S. Hayford became deans of engineering at Iowa State College, the University of Wisconsin, and Northwestern University, respectively.

The Emergence of the Sibley College of Mechanical Engineering

There was no traditional pattern for mechanical engineering, however. It grew up as a combination of shopwork, drawing, fine arts, chemistry, physics, etc., under the leadership of John Lewis Morris, or "Uncle Johnnie" as he was affectionately known. — Dexter S. Kimball in *I Remember,* p. 67.

During the academic year 1873–74, a program leading to the degree of Bachelor of Mechanical Engineering was introduced. A provision was that "each candidate for the degree . . . will be given an opportunity to design and construct some machine or piece of apparatus, or conduct a series of experiments, approved by the Department, such as promise to be of public utility." In June of 1874 one such degree was awarded.

Over the following decade the College made steady progress, largely because of the munificence of Hiram Sibley and later of his son, Hiram W. Sibley, who provided Sibley College with outstanding facilities, a professorship in mechanic arts, and funds for experimental equipment. An article on Sibley College that appeared in 1885 in the *Scientific American* described the program of studies and the noteworthy facilities, particularly the "dynamo room," the source of electricity which powered two arc lights on the campus. This was a novelty indeed: America's first dynamo, conducting electricity

Cornell civil engineers of the classes of 1884 and 1885 attended summer surveying camp at Hammondsport on Keuka Lake, New York. Professor Church is at extreme left, Professor Crandall ninth from left, and Dean Fuertes leaning against the sextant.

through the first underground transmission system, to supply the nation's first outdoor lighting system. The prevailing popularity of Sibley College at that time was also attributed to the general reputation of the University; the *Scientific American* article described Cornell as a university that ". . . notwithstanding its youth, has already, just twenty years after the date of its incorporation, become one of the distinctively great collegiate institutions in the United States."

By 1885, however, education in the "mechanic arts" had reached a critical point nationally. American technology was in a state of rapid change and engineering schools were feeling the pressure of new demands. Sibley was renamed the Sibley College of Mechanical Engineering and the Mechanic Arts in recognition of the need for an expanded curriculum and outlook, and a new man was brought in as director. This was Robert H. Thurston, who proved to be the greatest single addition to Cornell's engineering faculty during the formative years.

Thurston: A Great Man at a Crucial Time

Robert H. Thurston had a good background in the practical side of mechanical engineering. His father was owner of an engine manufacturing concern in Providence, Rhode Island; he had studied civil engineering, graduating from Brown University in 1859; and he had seen service during the Civil War as a naval engineering officer. He also had knowledge and interest in the more scientific aspects of mechanical engineering, an area that needed strengthening at Sibley College. He had, for example, taught natural philosophy – known today as physics – at Annapolis after the conclusion of the war.

At the time of Thurston's appointment his national reputation was considerable. He had been at the Stevens Institute of Technology since 1871 and was head of the mechanical engineering program there. He had figured prominently in the organization of the

Not only director but lecturer as well was Robert H. Thurston, who headed the Sibley College of Mechanical Engineering and the Mechanic Arts from 1885 to 1903. Here he conducts a class in thermodynamics.

I had been interested, even in my boyhood, in all scientific questions, both at school and in college. During my professorship at the University of Michigan, as early as 1857, while frequently visiting the laboratories of that institution, I began to realize that we were at the beginning of a new epoch, as regarded instruction in the sciences, and I constantly urged there, more provision for science, both pure and applied. When I took my seat in the Senate of the State of New York, I found that the appropriation of lands by the general government was likely to be nullified, as regarded our state, and I exerted myself to the full extent of my power, preaching, early and late, the necessity of more and higher technical education. — Andrew D. White in a note to Robert H. Thurston.

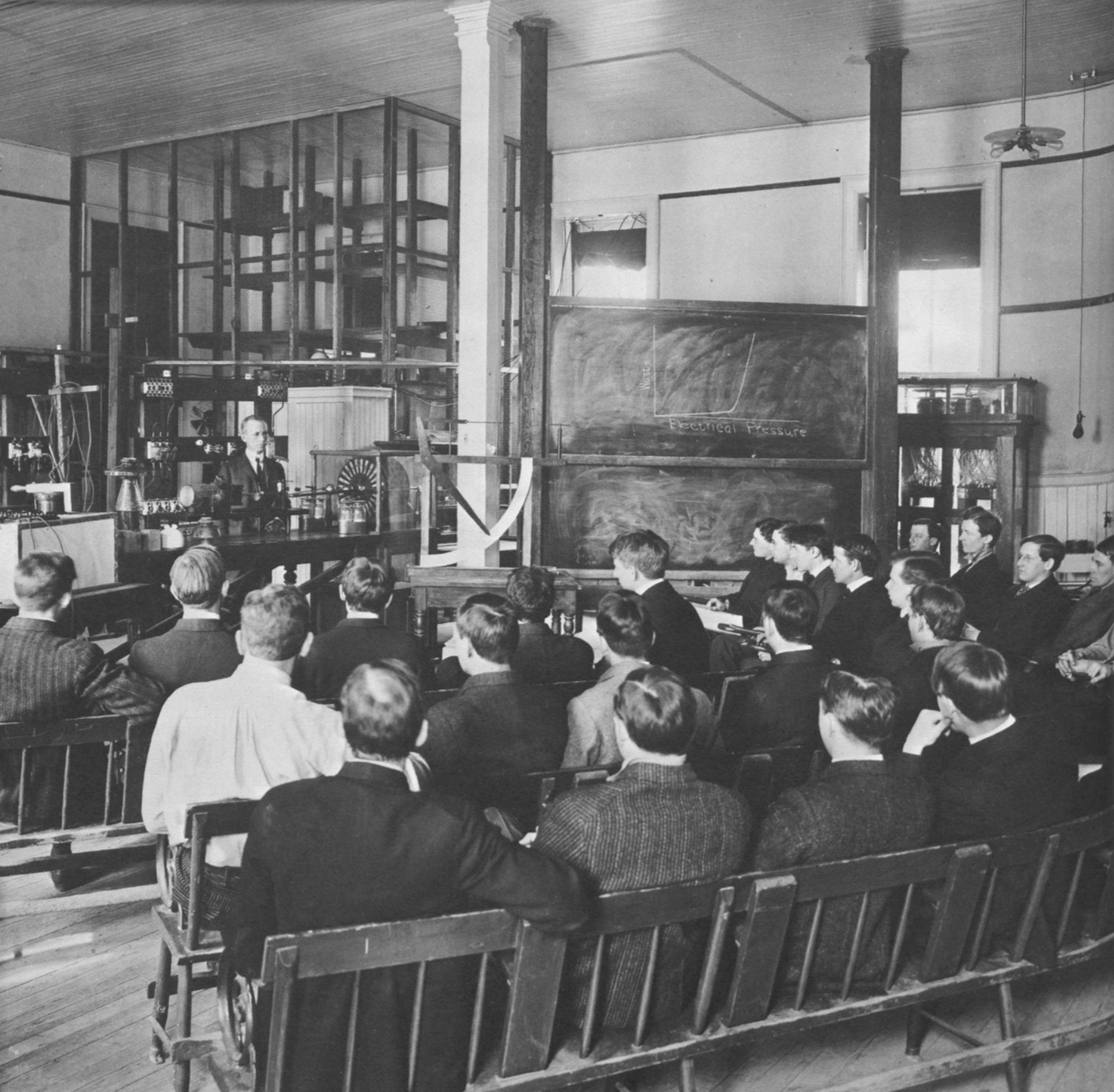
American Society of Mechanical Engineers in 1880 and had served as the society's first president. He was selected for the Cornell position by President Andrew Dickson White himself, at the handsome annual salary of $5,000.

When he arrived at Sibley College, Thurston set about revising the curriculum to make it more "scientific" and "fundamental." His aim was to expand the scope of the College beyond the limits suggested by its former designation as a school of the "mechanic arts." The entrance requirements for students rose steadily during his tenure: solid geometry in 1887, French or German in 1891, and trigonometry and higher algebra in 1894. Electrical engineering was removed from the jurisdiction of the physics department, where it had been introduced in 1883, and a department of electrical engineering, the first in America, was set up in 1889 within Sibley College. A major part of Thurston's program was a development of the faculty, and he assembled many of the great men associated with mechanical engineering at Cornell: John H. Barr, Rolla C. Carpenter, William S. Durand, George R. McDermott, Albert W. Smith.

Under Thurston, Sibley College flourished at a crucial period for mechanical and electrical engineering in the United States. The turn of the century was characterized by a national surge in the development of mass production industries and of electric power systems, and the growth and reputation of the College kept pace. From a total of 63 students in 1885, when Thurston became director, the College's enrollment grew to 1,065 in 1905, amounting to almost a third of the total University student body. In an assessment of engineering education commissioned by the Society for the Promotion of Engineering Education and published in 1929, W. E. Wickenden wrote that "the influence of Cornell in the period of the great growth of the engineering colleges in enrollment and resources, extending from 1870 down to 1900, both by direct example and through its many graduates who went on as organizers and teachers is one of the most notable of the recent chapters in the history of American higher education."

Before entering upon his duties (in 1885) Dr. Thurston outlined very fully the proposed development of Sibley College upon the following lines: —first, *into an efficient school of mechanical engineering for undergraduate students with various allied or special courses in mechanical engineering as applied to the various industrial arts;* second, *in the establishment of a laboratory of mechanical science devoted to the promotion of the useful arts through experimental research; and* third, *the establishment of various graduate schools where students who had graduated in our own course, or in other courses, in mechanical engineering, could perfect themselves by study and research as engineers for the development of the highest scientific and professional work.* — H. J. Ryan and R. C. Carpenter in the *Sibley Journal of Engineering*, Vol. 18 (1903), p. 76.

At work in his private office of the Victorian period is Estévan A. Fuertes, director of civil engineering at Cornell from 1873 to 1902.


Electrical Pressure

Of Thurston himself the Wickenden report said, "His influence on the development of curricula and methods of teaching in mechanical engineering probably exceeded that of any other American educator." Morris Bishop, writing in his recent *A History of Cornell,* comments that Thurston was "a man of wide ranging and original expression, and was one of the most eloquent speakers on this or any campus."

The Advent of Electrical Engineering

Instruction in electrical engineering was introduced at Cornell in 1883 by William A. Anthony, then a professor of physics and experimental mechanics. It was offered with considerable interest; indeed, a special insert in the *Cornell University Register* (the catalog) announcing the new program was written by President Andrew D. White himself. In 1885 four men were granted the degree of Bachelor of Science in electrical engineering and in the following year two received that degree. When Thurston became director of Sibley College in 1885, electrical engineering was organized as a department in that college. From 1886 until the formation of the College of Engineering in 1921, all degrees in electrical engineering were granted by the Sibley College of Mechanical Engineering and thus were mechanical engineering degrees with a speciality in electrical engineering!

One of the "greats" in electrical engineering education in America, Harris J. Ryan, joined the Sibley faculty as an assistant professor of electrical engineering in 1890. A Cornell graduate of 1887, he developed the new program with great enthusiasm. The number of graduates rose from 18 in 1889 to almost 70 in 1897. By the time Ryan left the University for Stanford in 1905, he had nearly single-handedly educated more than 800 Cornell electrical engineers. Ryan was succeeded by Henry H. Norris, a member of the Sibley College faculty, who remained as head of the

SPECIAL NOTICE: The rapid development of the applications of electricity has created a demand for thoroughly trained engineers conversant with electrical science, especially by companies carrying on telegraphy, electrical lighting, electrical supply and transmission of power, electroplating, the manufacture of electrical machinery and apparatus, etc. Recognizing this demand, at the beginning of the next academic year (Sept. 18, 1883), the trustees of Cornell University will receive students who desire to fit themselves to enter this new and constantly extending field. . . . (The) special studies of the course embrace the theory of electricity, the construction and testing of telegraph lines, cables, and instruments, and of dynamo machines, and the methods of electrical measurement, electrical lighting, and the electrical transmission of power. — Andrew D. White, President of the University, in a special statement in the *Register* (catalog) for 1883–84.

Cornell was the first educational institution in the country to introduce the study of electrical engineering. Shown in the lecture room is Professor Harris J. Ryan, who for many years handled all the instruction.

Department of Electrical Engineering until his resignation from the faculty in 1914.

A Peak and a Decline

In the years before and around the turn of the century, Cornell attained a national and, indeed, international reputation in engineering under the leadership of Thurston and Fuertes. Both of these men died in 1903 and were succeeded by Albert W. Smith, an 1879 Cornell graduate, in mechanical engineering, and by Eugene E. Haskell, an 1878 Cornell graduate, in civil.

Cornell's prominence in mechanical, civil, and electrical engineering was maintained up to the pre-World War I years, but then began to experience a decline. Part of the reason was that emerging areas of study, such as agriculture and business, began to attract increasing interest among college students. Also, the improving engineering programs in the Land Grant colleges across the country began to offer attractive alternatives to study in the eastern engineering schools. Enrollment at Cornell dropped off and the possibility of bringing in new faculty blood was slight. Standards for admission to Cornell remained high, but there was little curricular innovation, the buildings and equipment were outmoded, and faculty salaries failed to keep pace with the competition. The simple fact is that with the deaths of Thurston and Fuertes, engineering at Cornell had tended to rest on its reputation while the Land Grant colleges were actively building their programs and faculties. Many potentially great men at Cornell – graduates and faculty members – left to go elsewhere.

Stanford University appears to have been the principal beneficiary of the exodus. When Stanford opened its doors in 1891, the president was David Starr Jordan, a Cornellian. One of the initial faculty of ten members was Charles David Marx, another Cornellian. In 1896 Charles B. Wing went to Stanford as a professor of structural

There are four elements of success in technical education, namely, teachers who can teach, students who can learn, equipment which can be used efficiently, and a curriculum of studies which will economize the student's time, but will at the same time force him to such mental exercise that he will become a clear thinker. — Professor Henry H. Norris in a study of Sibley College that appeared in *The Sibley Journal of Engineering*, Vol. 23 (1908), p. 7.

Sibley Hall was completed with the addition of the Dome in 1902. In the pre-World War I years this building housed the facilities for mechanical and electrical engineering.

engineering; he had previously taught at Cornell. William F. Durand, who had taught at Cornell for many years and was already prominent in his field of marine engineering, joined the Stanford faculty in 1904 as professor and head of the mechanical engineering department. Harris J. Ryan, an 1887 Cornell graduate and head of electrical engineering at Cornell for many years, was wooed to Stanford in 1905 and served as head of electrical engineering there for twenty-six years.

These were all good men, with substantial and productive careers. Marx headed the department of civil engineering during most of his Stanford career and also served as its acting president in the 1920s. During his Cornell years, Durand had been active in naval engineering research and later participated in the formation of the National Advisory Committee on Aeronautics, the predecessor of NASA. Wing designed the Stanford stadium and, together with Marx and Durand, directed the reconstruction of the university buildings after the 1906 earthquake. Ryan has been credited in a Stanford publication for laying the groundwork for the university's present graduate-level strength, particularly in electrical engineering. In a history of engineering education at Cornell, S. C. Hollister comments that "Stanford's reputation in civil, mechanical, and electrical engineering was principally due to these men."

The Cornell-Stanford flow was not entirely one-sided, however. Albert W. Smith, who became director of the Sibley College of Mechanical Engineering in 1904, had been professor of mechanical engineering at Stanford since 1892. And Dexter Kimball, who became the first dean of Cornell's College of Engineering in 1921, graduated from Stanford in 1896.

Educational reputation and leadership are difficult to measure, but a rough estimate may perhaps be derived from enrollment figures. Cornell's impact in engineering education at the turn of the century is reflected in its 1900 enrollment of 750 engineering students out of a total of 13,000 in 110 schools across the country.

Franklin Hall, erected in 1881 and later used for the first instruction in electrical engineering, was "in Honor of Benjamin Franklin, the First American Electrician," according to the inscription on the tympanum.

RULES GOVERNING STUDENTS IN SIBLEY COLLEGE, CORNELL UNIVERSITY: Formulated under the Statutes of the University, which provide that the Director shall control the "whole working" of Sibley College.

(1) Every student in Sibley College is expected to show himself a gentleman, at all times, within or without the precincts of the College.*

(2) Every gentleman attending Sibley College is expected to be a student.

*Gentleman. — *A man of good breeding, courtesy, and kindness; hence a man distinguished for fine sense of honor, strict regard for his obligations and consideration for the rights and feelings of others.* — Century Dictionary.

— Information contained on a printed card issued to students during the tenure of Robert H. Thurston as dean.

The early high-water mark in enrollment was reached in the academic year 1910–11, when there were 1,745 students, more than half the undergraduates in the entire University, enrolled in the College of Civil Engineering and the Sibley College of Mechanical Engineering, as they were then organized and named. From that time, engineering enrollments gradually declined, reaching a low of 789 in 1935. These figures are most significant when seen in terms of the United States as a whole. During the period from 1900 to 1935 engineering enrollment at the national level increased steadily from 13,000 to about 70,000, while the number of schools offering engineering courses of study grew much less rapidly, from 110 to 150.

A Unified College of Engineering

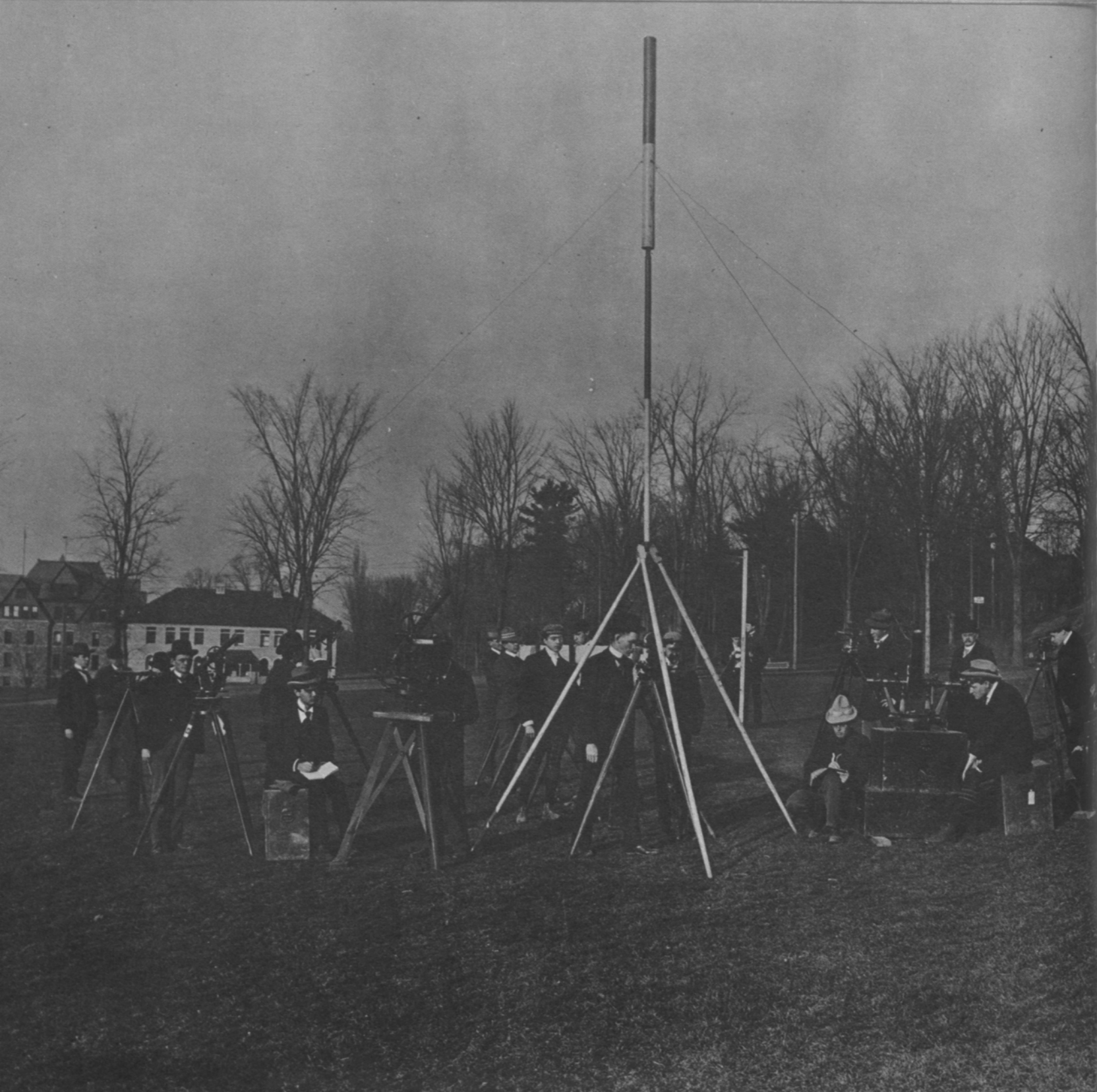
By 1920 nearly all the major institutions in the United States, many of which had developed under the influence of the early pioneering tradition of Cornell, had incorporated the various engineering disciplines into unified colleges. At Cornell, though, the colleges of civil engineering and of mechanical engineering were still going their separate ways, often with considerable duplication of effort but enjoying their autonomy. However, the impending retirement of Albert W. Smith and Eugene E. Haskell as heads of the two colleges created an opportune time for an overdue unification. A number of influential engineering alumni were serving on the Board of Trustees at that time, and they were interested in the idea of establishing Schools of Civil, Mechanical, and Electrical Engineering within a single College of Engineering.

A joint committee of faculty and trustees studied the idea and recommended that the change be made. Although this was a logical porposal, it was not generally well received by the faculty, a group that tends to be highly sensitive to administrative change. Only the faculty in electrical engineering – still a part of the Sibley College of Mechanical Engineering – greeted the plan with enthusiasm.

RESOLVED: That this Board, without committing itself to final action approve in principle the findings of the committee on the Reorganization of Engineering Education as set forth in its preliminary report and the committee is authorized to make necessary expenditures not to exceed $250 for further investigation of the subject with which it is dealing. — Resolution passed by the University Board of Trustees, May 21, 1918.

Be it Resolved, *that the Faculty of the College of Civil Engineering . . . disapproves of those recommendations made to the Committee of the Board of Trustees on the reorganization of the engineering colleges, by the conference committee of the two colleges urging the union, believing that the plan as proposed is one which will prove disadvantageous educationally to the College of Civil Engineering, and thereby, to the University.* — Resolution incorporated into the Faculty Meeting Minutes, 1919.

Lincoln Hall, built in 1888 among the remnants of Ezra Cornell's apple orchard, replaced the early wooden structure used for instruction in civil engineering and architecture.



The feeling of the faculty as a whole seemed to be that at least the leadership of a new college should not fall to an outsider, and a petition was presented to the University president asking that Dexter S. Kimball be named dean. Kimball accepted the subsequent offer of the Board of Trustees and served as first dean of the College of Engineering from 1921 until his retirement in 1936.

Kimball: First Dean of the College

Dexter S. Kimball had a diversified background in engineering, a good qualification for the dean of an inclusive college. He had taken his degree in mechanical engineering at Stanford, but had also studied electrical engineering there and had done some industrial work in that field. As a Cornell professor he had pioneered in the development industrial engineering as a branch of the profession.

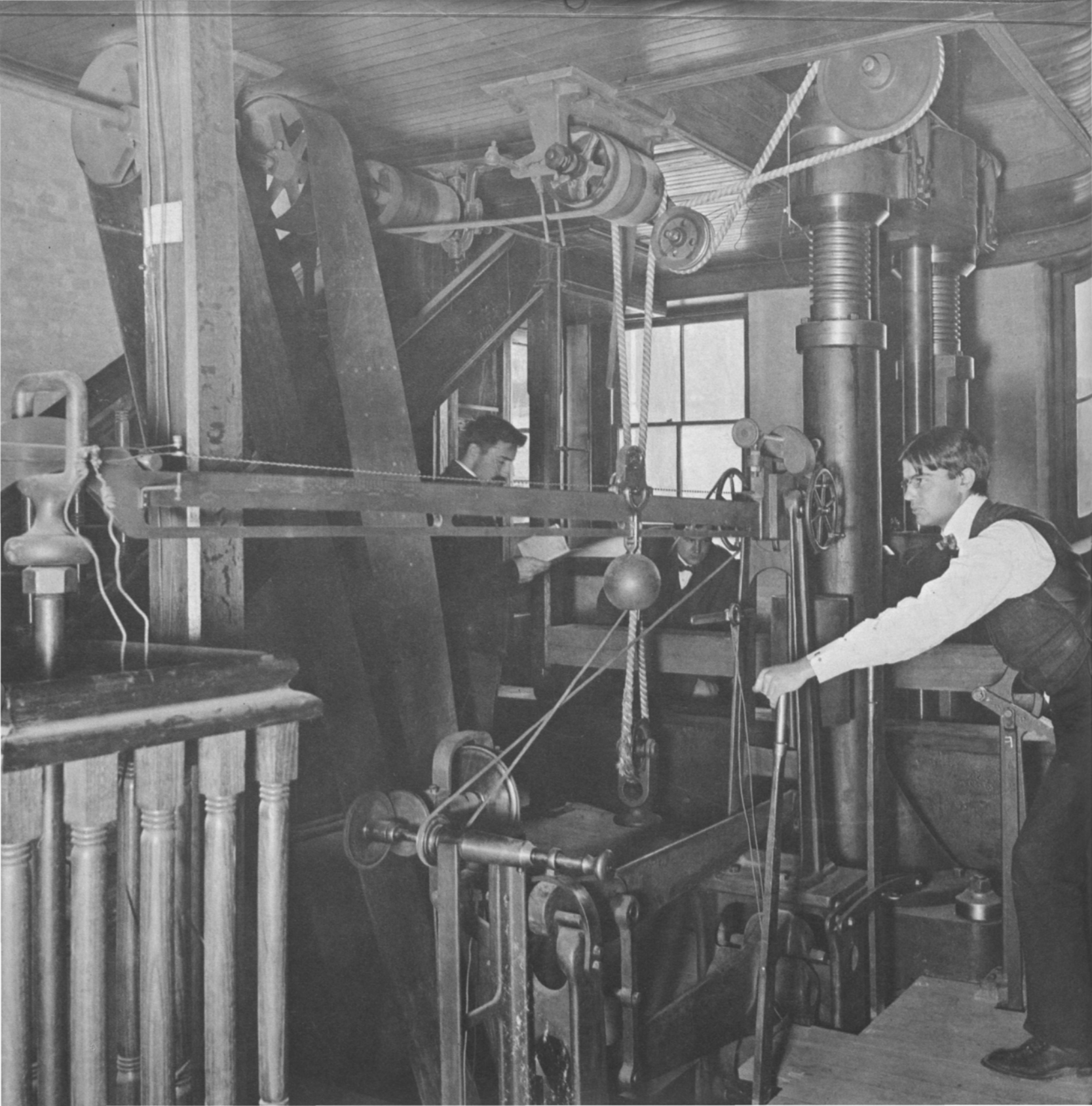
The story of Dexter S. Kimball is related to that of Albert W. Smith at Stanford and at Cornell. Kimball was a draftsman-machinist for the Union Iron Works in San Francisco when he met Smith, then a member of Stanford's mechanical engineering faculty, during a visit to the new university. Smith encouraged Kimball, who was then twenty-eight years old, to enter the university as a special student, and he did this in 1893. After graduation from Stanford, Kimball joined the Sibley faculty for a few years and then left to become works manager for the Stanley Electric Manufacturing Company of Pittsfield, Massachusetts, a predecessor of General Electric, at twice his Cornell salary. The president of the company at the time was Frederick A. C. Perrine, who had been one of Kimball's professors at Stanford. In 1904 Smith returned to Cornell as director of Sibley College, and that same year he brought Dexter Kimball back as a professor of the mechanic arts.

Kimball had developed an interest in industrial engineering that probably stemmed from his industrial experience as a young man on the Pacific coast and later at the Stanley Works in

By the end of the third year, I had begun to think of returning to the Union Iron Works. . . Someone told Professor A. W. Smith that I had decided to return to practice and not wait to receive a degree, and he sent for me. In a kindly way he asked me if this report were true. In reply, I pointed out that I had completed everything in the mechanical-engineering course, that I was not so young, and that there was a good job awaiting me in San Francisco. "Well," he said, "you have earned some extra credits and are entitled to a number of others because of your practical experience. I shall have these credited to you, and that will leave you only six credit-hours to complete for your degree." He added in a rather firm tone, "You are coming to the summer school to get those six hours of credit." He went on to say that the degree would not add to my earning capacity, but, he said, "You might need it some day." . . . Professor Smith's remarks were singularly prophetic. Two years later, I was invited to join the faculty of Cornell University, an invitation I certainly would not have received had I not possessed that degree. By that one kindly act he changed the entire course of my life. It was not the first nor the last kindness which I received at his hands.

— Dexter S. Kimball in *I Remember*, p. 43.

Headgear appears to have been mandatory for fledgling surveyors at the turn of the century. The campus scene shows Lincoln Hall, built in 1888, at the far left, and next to it the first part of Goldwin Smith Hall.



Massachusetts. He was also deeply influenced by a paper on "Shop Management" that he had heard read by Frederick H. Taylor at a meeting of the American Society of Mechanical Engineers in 1903. "The more I studied this philosophy," Kimball said in discussing (in his book, *I Remember)* the impact of Taylor's paper, "the clearer it became to me that it contained certain principles that were a necessary part of the training of engineering students, particularly as a large number eventually become administrative officers in industry."

And so Kimball made a proposal that he be allowed to offer an elective course in Economics of Production to mechanical engineering seniors, and this was approved by Director Smith. In subsequent years courses in elementary economics and accounting were added to the mechanical engineering curriculum, and in 1916 a senior option in industrial engineering was established. Eventually, under the leadership of Kimball and with the support of Smith, a Department of Industrial Engineering, the first in the country, was organized at Cornell.

(John McMullen) was a very impressive person, a huge, forthright man, sometimes of violent temper, with virtually no formal education and no engineering training, but with outstanding ability as a leader and organizer of men. He was a man of few intimates, though genial; extremely self-reliant and with no sense of humor. He admired the arts, but without appreciation, and had no use for conventional thinking. He believed in educating only those persons of exceptional ability, and would have favored unlimited opportunity for the best minds, to the limit of their capacities. — From a speech by DeWitt Barlow, president of the Atlantic, Gulf & Pacific Company, as reported in the *Cornell Alumni News* of January 13, 1938.

Landmarks of the Kimball Years

During Dexter S. Kimball's fifteen-year tenure as dean of the College of Engineering, there were three significant developments that should be noted.

The first of these was the establishment in 1923 of the John McMullen Scholarship Fund, which over the years has helped finance the education of more than 7,000 Cornell engineering students. The bequest was from the estate of McMullen, a native of Norwalk, Connecticut, who had been president of the Atlantic, Gulf, & Pacific Company, engineers and contractors in dredging. One of his partners had been Hermann Krüsi, an 1874 graduate of the College of Civil Engineering at Cornell. McMullen, who was not a college graduate himself, designated that income from the endowment should be used "for the purpose

Equipment at the College of Civil Engineering included a 400,000-pound testing machine which extended into the lower story of Lincoln Hall.


Design of
Street R'y Motors

of creating and maintaining free scholarships for the education of young men as engineers at Cornell." Since 1923, when some $26,000 in dividends were received by the University, the fund has appreciated to a current value of about $7.2 million. It provides the largest single endowed program for scholarship aid known to have been established in any university, and is indeed a worthy memorial of a visionary man who chose to direct his beneficence toward people rather than monuments.

Two other significant developments during Kimball's tenure were the introduction of a curriculum in administrative engineering in the Sibley School of Mechanical Engineering, and the establishment a few years later of one in chemical engineering. The administrative engineering program, set up in 1931, represented a natural evolution of an area in which Kimball himself made significant contributions during his association with the University. The man responsible for much of the growth of this program was John R. Bangs, Jr., a 1921 Cornell graduate in mechanical engineering who served as head of the administrative engineering department from 1931 until his resignation in 1945. The chemical engineering program evolved out of the Department of Chemistry. The establishment of these curricula helped sustain enrollment; soon almost half of the engineering student body was enrolled in one or the other. Without their introduction it is doubtful that the College could have recovered the momentum lost during the difficult times of the 1930s.

After Dexter S. Kimball's retirement in 1936, the position of dean passed to Herman Diederichs, a Cornell graduate of 1897 who had been director of the Sibley School since 1921. Named associate dean was S. C. Hollister, a former Purdue University professor of structural engineering, who had been director of the School of Civil Engineering since 1934. Diederichs died a year after his appointment, and Hollister began his twenty-two-year tenure as third dean of the College of Engineering.

Deed (Herman Diedrichs) had the most even of dispositions. He was always mad! There was once a story of a sophomore Sibley student who was summoned to Deed's office because of unsatisfactory academic progress. It seems that the student was a small footballer of some note, with an Irish tenacity and stubborness to match the director's characteristics. Most students trembled in the presence of the awesome professor, but this sophomore began the interview by announcing, "Sir, I want you to know that you don't scare me one bit." Deed was disarmed and became one of the most sympathetic of the young man's supporters throughout the balance of his college days. — Anecdote recounted in conversation by a 1936 Sibley alumnus.

Electrical engineering instruction under Professor Henry H. Norris, head of the department in the early 1910s, included study of the "Design of Street R'y Motors."

Toward a New Campus

Plans for revitalizing the physical plant were discussed soon after the formation of the College of Engineering in 1921. Sibley Hall, which housed the School of Mechanical Engineering, had been erected in sections between 1871 and 1902. Franklin Hall, where the School of Electrical Engineering was located, had been built in 1881 as a physics and chemistry laboratory. And Lincoln Hall, which housed the School of Civil Engineering, dated from 1888. Yet, in spite of a number of efforts to bring about improvement, these were to remain the facilities of the College until the move to the present Quadrangle.

The poor condition and antiquated equipment of the engineering buildings were detracting from the College's ability to recruit able students. Even as early as 1912, when Kimball was acting director of Sibley College, he deplored the physical state of the College in a quote from the 1910 report of a special study committee. "The impressions of a visitor or prospective patron upon inspecting the low dark rooms and other makeshift shelters which are dignified by the name of laboratory must inevitably be unfavorable," the report read. "Unless he be intimately familiar with the record and the inner workings of the College, one would be repelled rather then attracted to the general aspect of the plant of Sibley College." A good deal of prospective student interest was undoubtedly directed from Cornell to the Massachusetts Institute of Technology, which had received a $50 million gift for building and by 1916 had moved from Boston to its present campus site in Cambridge.

The first plan for a new engineering complex was submitted in 1925 by the architectural firm of York and Sawyer. This plan would have changed the ultimate development of the physical plant, because the proposal was to construct on the site of the old engineering facilities two large neo-Gothic buildings, one for the School of Civil Engineering, and one for the Schools of Mechanical

To many classically educated men of the first faculty, the sight of the early Sibley students crossing the Campus on their way to the shops with their tin dinner-buckets, must have been a strange and incongruous sight. No doubt they wondered inwardly or protested openly regarding the expediency or even desirability of such forms of university activity . . . To the Sibley students of early days, looking southward to the three grey stone buildings which then alone faced the valley, it must have appeared that a chasm yawned between them and some of the older and more dignified forms of study taught therein. Many of them no doubt looked with impatience on some of these studies which apparently led to no definite results and could not assist them in their practical problems. Echoes of these ideas are still to be found in places where the broader view of human life and purpose has never entered, and where utilitarian education has not the modifying influence of contact with learned and farsighted men. Yet students and faculty of both these classes have profited wonderfully by their close proximity to each other.
— Henry Herman Westinghouse, '72, in an address at the dedication of Rand Hall, 1912.

By the end of the nineteenth century the Sibley Shops had elevated to a high level the training of students in machinery practices of the day. Shown here is the "Old Mech Lab."

and Electrical Engineering. They would be designed to accommodate a planned eventual enrollment of 2,000 and would include some 685,000 square feet of floor space. Because a fund-raising campaign for these buildings did not get under way before the stock market crash in 1929, the plan was abandoned.

Dean Kimball made another attempt to instigate a rebuilding program in the 1930s. The firm of Shreve, Lamb, and Harmon, architects from New York, was engaged to draw up a plan for a simpler and less expensive plant than the one envisioned by York and Sawyer. This plan failed to materialize during Kimball's tenure and it was not until after S. C. Hollister became dean in 1937 that the plan was revived and a building program actually implemented. As it happened, the first new building since 1902 was Olin Hall, constructed in 1942 to house the recently organized School of Chemical Engineering.

The critics forget that the collegiate Gothic evolved at a time when the whole undergraduate body was preparing itself for holy orders, and college buildings were designed to close off all sight of the life terrestrial, to the end that the Sophomore Class might concentrate exclusively on the life everlasting. This makes the collegiate Gothic suitable for a divinity school, but grotesque, we submit, for a bull barn, the biological sciences, and even a chemical laboratory. — Romeyn Berry, commenting in 1941 on the architecture of Olin Hall, then under construction *(Behind the Ivy*, p. 321*)*.

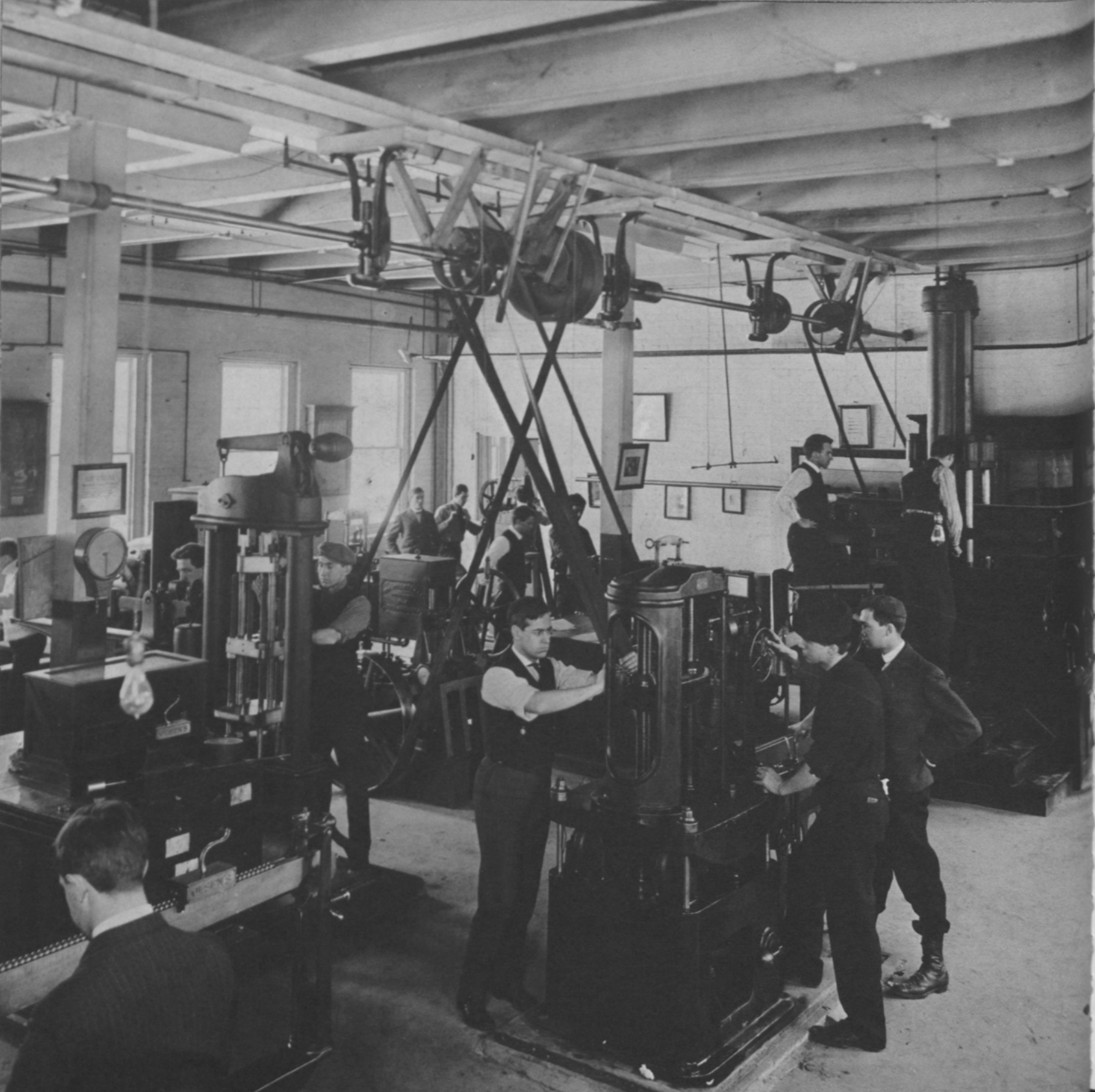
Hollister: Dean in the Years of Rebuilding

When Solomon Cady Hollister assumed leadership of the College of Engineering in 1937, the total annual budget was $360,000. It had been $324,000 some fifteen years earlier. The faculty of eighty-four members had salaries ranging from an average of $4,200 for full professors to $1,800 for instructors. There was virtually no research going on and faculty morale was low.

During Hollister's twenty-two-year tenure as dean, the College began a renaissance which put Cornell once again in a position of preeminence in engineering education. Student enrollment, faculty development and growth, curriculum innovation, the physical plant, and research programs were all involved. Once again Cornell was fortunate in having the right man for the right job at the right time. Hollister's accomplishments were many; here are a few.

The School of Chemical Engineering was established entirely

Among the laboratories of Sibley College was this forerunner of the modern electrical engineering power laboratory. Shown here is the Dynamo Laboratory shortly after the turn of the century.



within the College of Engineering in July of 1938. Prior to that time students had matriculated in the College of Arts and Sciences and received the Bachelor of Chemistry degree at the end of four years, and had then gone on for a fifth year of study leading to the degree of Chemical Engineer. This fifth-year program was under the direction of Fred H. Rhodes, who had been professor of industrial chemistry at the University since 1920 and is regarded as the "father" of chemical engineering at Cornell. When the School of Chemical Engineering was established, with Rhodes as director, the curriculum was set up as a five-year program, but it was organized as a single course of study leading to the degree of Bachelor of Chemical Engineering. It was thus the first five-year degree program within the College of Engineering.

Immediately after World War II two additional units were added: the Graduate School of Aeronautical Engineering (later Aerospace Engineering) and the Department of Engineering Physics (now the School of Applied and Engineering Physics.) The establishment of these disciplines, both highly analytical and scientific, was largely in response to a feeling prevalent among leading engineering educators throughout the country that a more scientific component or thrust was needed. In the 1920s and 1930s the orientation of engineering schools had been toward serving the needs of industry, and educational programs had been shaped accordingly. During World War II, however, it had become apparent that a great deal of engineering development – often work that could not possibly be handled by engineers – was actually being carried out by scientists without engineering training. Engineering colleges had to provide more scientifically oriented engineers, especially in areas such as electronics, aeronautics, and applied mathematics, or their graduates would find themselves outflanked by young scientists.

An innovation of considerable consequence was the adoption in 1946 of a five-year professional program, patterned after the

The living value of any institution is but a projection of its past performance. As the years go by a tradition is built, which at once expresses the achievements, and foreshadows the potentialities of the future. To understand an institution it is necessary to comprehend its origin and growth, its accomplishments and aspirations, and the social environment in which it functions. So it is with the College of Engineering at Cornell. To evaluate its present position and its plans for the future one must understand how it developed, and what qualities it possessed that made it great; what it accomplished in its professional field and what competition developed; and finally what the outlook may be for professional service and what must be done if Cornell's traditional position in the field is to be maintained in the years immediately ahead. — S. C. Hollister in a "Report on the College of Engineering," 1950.

A 1910-era forerunner of today's "strength" lab was this early assembly of machinery for the testing of materials located in the Mechanical Laboratory of Sibley College.

successful one in chemical engineering, for all College of Engineering students. This was a bold and imaginative step, based on the conviction that engineering graduates needed to continue to have both depth of study in a professional field and a broad educational background essential for effective work with others outside the areas of technology. The situation in engineering schools was that as scientific and engineering activity had accelerated, particularly during the war years, more ground had to be covered in the undergraduate programs. For the most part, the response had been to either cram more and more into a four-year curriculum, frequently at the expense of nontechnical areas of study, or else reduce the concentration of courses in a specialty field.

The timing of Cornell's five-year program was good, for at the conclusion of World War II thousands of young veterans were returning to colleges, thanks in part to the GI Bill of Rights, and a large fraction of them were entering engineering schools. In later years, though, the proportion of engineering students who planned to actually pursue professional engineering careers began to decline (many students were using engineering as a modern "general" education) and it became increasingly difficult to hold students to a five-year professional program when many of them were contemplating a move at the graduate level in the direction of science or into other fields such as business, law, and medicine. Consequently, the five-year baccalaureate program at Cornell was dropped in 1965 in favor of a plan by which a preprofessional Bachelor of Science degree is awarded after four years of study and an optional fifth-year course leading to a professional master's degree is offered. In perspective, Cornell's five-year plan was a harbinger of what was to come nationally: the expansion of professional engineering education to a program of at least five years, now generally culminating with a master's level degree.

I have a feeling that this building will be just the beginning of the integrated structure planned for the College of Engineering. This is the spirit in which my father made this gift. It is our feeling that with proper management, and with the proper gathering together of a distinguished staff, there will be developed here at Cornell an institution which has no superior and, if possible, no equal in education in the scientific arts. — John Olin in a speech at the dedication of Olin Hall of Chemical Engineering, 1942.

For most friends of Cornell, Hollister's greatest achievement was the revitalization of the physical plant. Beginning in 1942 with the completion of Olin Hall of Chemical Engineering, the building

The Foundry, an early installation at Sibley College, was built as a temporary structure but still functions as a sculpture workshop.

program progressed steadily through 1963 when Bard Hall was completed. In all, ten new buildings were constructed on a new Engineering Quadrangle, and once again the College was housed in a first-rate physical plant. The new facilities provided three times the amount of floor space in buildings whose insurance value was twenty-four times greater, and the value of equipment increased five-fold. This was an extraordinary achievement for the dean and for those engineering alumni who shared his vision and contributed to the rebuilding.

With the attraction of a modern, well equipped, and spacious plant, the faculty grew from eighty-four to 125 members. Endowed professorships were increased to six. And by the end of Hollister's tenure the number of undergraduate students had risen to 1,961 and the number of graduate students to 222. The College's research budget, which was essentially zero in 1937, had risen to about $800,000.

Solomon Cady Hollister must be ranked with Estévan A. Fuertes and Robert H. Thurston as the greatest of the many great men who have shaped engineering education at Cornell.

Corson: A Scientist as Dean

The new dean who came to Carpenter Hall in the fall of 1959 represented a break with the past. Dale Raymond Corson was not only an engineer, but a physicist – the chairman, in fact, of Cornell's outstanding Department of Physics. Such an appointment then could be counted on to arouse the suspicions of professional engineers, but clearly the choice was made to encourage the development of the College in new directions.

One of Corson's primary concerns was the development of high quality, interdisciplinary programs at the graduate level, and during his first year as dean he presided over the organization of the Center for Radiophysics and Space Research and the Materials Science Center.

The point I wish to make is that for the prospective great engineers of tomorrow, assuming we can somehow identify them in the making, we need unique and flexible programs which will demand all of the imagination, enterprise, enthusiasm, and expertise which . . . faculties can bring to bear on this elite group. And I don't mean just honors courses. An education will have to be provided . . . which will turn out men and women with social conscience and political acumen in addition to their technological skills. There must be some engineers who will see the forest as well as the trees; we shall need engineers who are truly educated persons in a broad sense, nonprofessional as well as professional. — Dale R. Corson in an address at the Sixth Institute for Engineering Deans in Monterey, California (1969).

During World War II Cornell operated a training program in Diesel engines for naval ensigns. The Navy built and equipped a laboratory in a temporary structure on the campus.

Also initiated that year were discussions that ultimately led to a consolidation of the separate underclass academic programs and admissions and financial aid practices of chemical engineering, civil engineering, mechanical engineering, electrical engineering, and engineering physics. After extensive committee meetings and faculty discussions, the College finally established, in 1961, a Division of Basic Studies under the direction of Howard G. Smith, professor of electrical engineering. Since that time the Division has provided a more equitable and logical treatment of freshmen and sophomores by coordinating all admissions, academic actions, scholarship aid, and advising and counseling services. Actually, the Division of Basic Studies represents the first real integration of engineering disciplines into a single college; it finally effected an actual consolidation some forty years after the formal organization of the College of Engineering.

Some of the basic purposes of the Division (of Basic Studies) have been fulfilled. . . We wanted . . . to have a program . . . which would permit deferment of the selection of a specialty in the field of engineering until the student had been on campus for a while. In the past, when students at the age of seventeen applied for admission to the University, they had to decide not only on a profession, but on a specialty within the profession. It was a difficult decision to make. One of the features we have been striving for in DBS has been to give the student experience with the various functions which engineers serve . . . Another . . . was the opportunity for students to meet the senior engineering college faculty people . . . Another thing we wanted to do was to start the student thinking about problems of the engineering type. I know too often, classroom work, especially on the elementary level, is involved with problems that have answers that one looks up in the back of the book, and engineering problems are not like that. — Dale R. Corson in a panel discussion of the first year of the Division of Basic Studies, as reported in the *Cornell Engineer* for October, 1962.

An important coordination of instruction in the area of materials science and engineering followed in 1962. In the post-World War II years these studies had developed in conjunction with three different curricula: chemical and metallurgical engineering, engineering physics, and mechanics and materials. Corson acted to draw together into one department those faculty members who were primarily interested in materials studies. The Department of Engineering Physics and Materials Science formed at that time was later divided and a separate Department of Materials Science and Engineering organized.

A memorable event in April of 1961 was Corson's announcement to the faculty of the College that a grant of $4,350,000 had been received from the Ford Foundation to strengthen graduate education programs and activities. Eleven professorship endowments were to be created, with the Foundation providing $200,000 and another donor providing $300,000 for each of the chairs. Included in the grant was $500,000 for predoctoral fellowships for promising candidates with an interest in academic careers, $250,000 for forgivable loans to graduate students who subsequently followed

In the early 1950s part of the instruction in surveying for civil engineers was conducted at summer camps in the Finger Lakes area. Living conditions were much the same as in the 1880s.

academic careers, $300,000 for faculty development, and a $350,000 discretionary fund. In the past ten years this grant has done for graduate study much of what the McMullen fund has done for undergraduate education. The graduate enrollment went from 283 to 412 during the four-year tenure of Corson, and the undergraduate enrollment from 1,850 to 1,930.

Corson left the College in the summer of 1963 to become provost of the University and he has been president of Cornell since 1969.

Schultz: Dean in Changing Times

The fifth of the Cornell engineering deans, Andrew Schultz, Jr., became the second Cornell-educated engineer to assume the position. He took his undergraduate degree in the administrative engineering program, earned a Cornell Ph.D., and after time out for World War II service returned to Cornell as an assistant professor of mechanical engineering. In 1951 he became head of the Department of Industrial Engineering, a position he held for twelve years.

A long-standing interest of Schultz has been industrial engineering. Before becoming dean he had worked to establish a separate undergraduate program leading to the degree of Bachelor of Industrial Engineering, a curriculum that was approved by the College faculty in 1962. He was instrumental in the development and strengthening of fields that are related to modern industrial engineering practice, or which provide useful or necessary methodologies. Computer Science and Operations Research, for example, were organized as separate departments.

Shortly after becoming dean, Schultz initiated studies designed to find out the most effective ways of incorporating into engineering curricula the growing range and content of pertinent subjects and related research. Establishing a new school for each emerging specialty had become an unwieldy method. Schultz's idea was to

It is clear to me that education must maintain closer technological communication with industry and government. This communication has been adequately sustained in research areas where no proprietary interests are allowed to interfere and where well-developed media of exchange, both in written and associated form, exist. However, a solution to the problem of student motivation and of improving the faculty's ability to do a better job in design depends heavily upon technological communication with industry. — Andrew Schultz, Jr., in *ENGINEERING: Cornell Quarterly* 1 (1967): 3.

Chemical microscopy has been taught at Cornell since 1896. Shown in the modern laboratory in Olin Hall is Clyde Mason, now emeritus professor of chemical engineering.

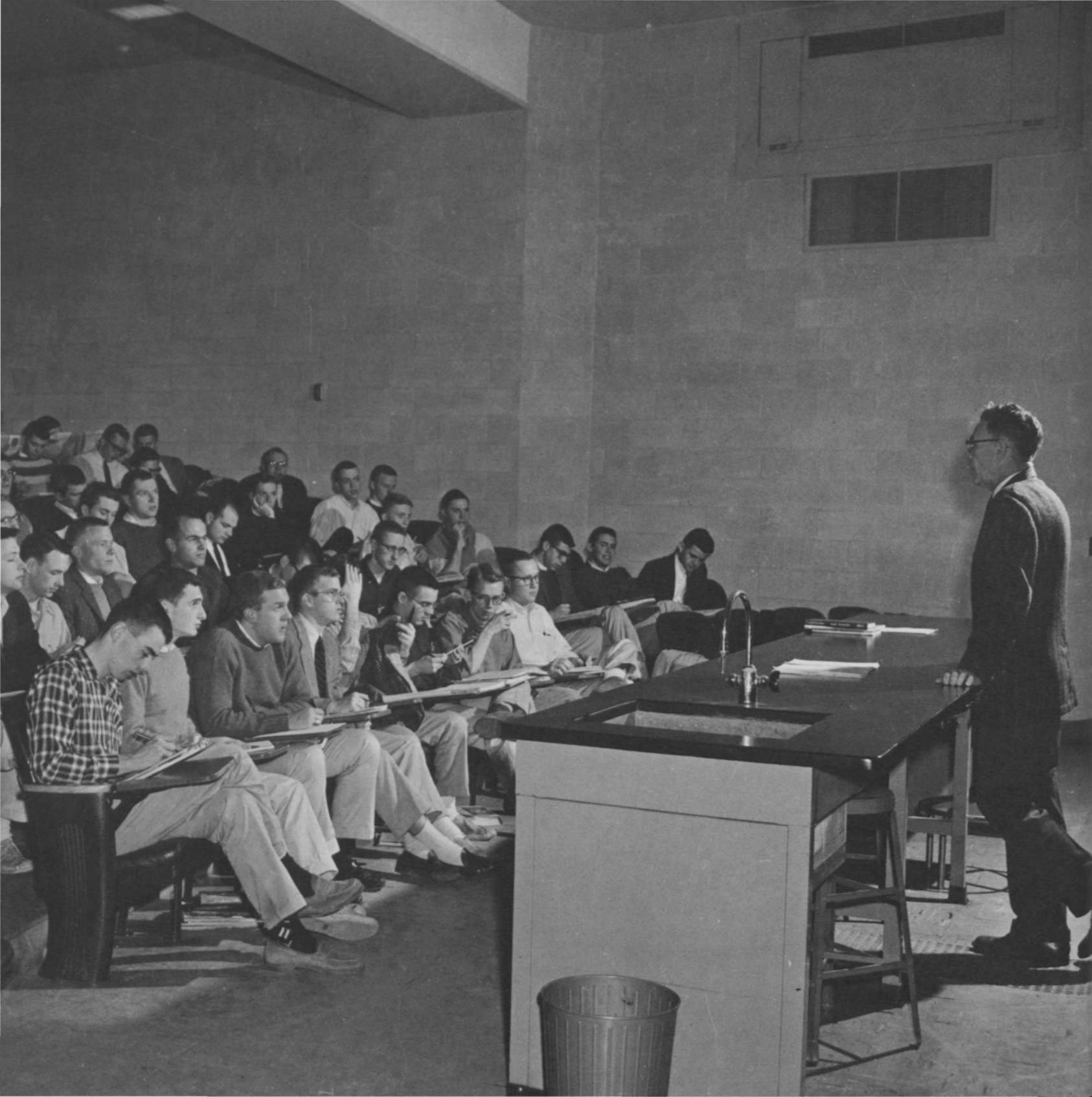
provide instruction in areas that are essential components of modern engineering curricula but are not necessarily engineering specialties, without weakening the traditional interests of engineering fields. The general conclusion drawn from the studies was that the five-year professional bachelor's degree program had served its usefulness and that what was needed was greater flexibility in undergraduate programs. Accordingly, the five-year program was restructured in 1965 so as to consist of a four-year preprofessional curriculum leading to the Bachelor of Science degree and an optional fifth year program at the master's degree level. Under this present plan, the baccalaureate graduate can choose either a program oriented toward engineering practice and leading to the degree of Master of Engineering (with field designation), or a Master of Science degree program oriented toward research. The big advantage of the plan is that a student has a great many more options. After earning his B.S. degree he can continue at Cornell in the professional M.Eng. program, or enter a research-oriented M.S. or Ph.D. program at Cornell or elsewhere, or begin graduate study in a nonengineering field, or simply go to work.

A number of special offices and services were initiated during the years that Schultz has been dean. An Office of Continuing Education arranges off-campus programs and on-campus courses and conferences which annually involve several hundred practicing engineers and scientists. The Cornell Engineering Consortium is being developed to facilitate greater interaction between the College and industry. A College publications office and a guidance and counselling center for undergraduates were organized.

More than half of the current faculty of 190 members has been appointed during Schultz's tenure, and new leadership has been brought in for several areas within the College. Over the eight-year period the research budget has gone from slightly over $2 million a year to nearly $6 million, placing the College among the top half

If we are to educate engineers who can reach out to the real world and contribute to areas having the greatest need of attention, we must be able to recognize and, in some cases, anticipate new fields. It is not enough to merely recognize that an area will grow and conclude that it contributes a viable, useful, and stimulating field appropriate for Cornell. It must also have a solid intellectual content, a scientific or engineering base, and challenging prospects for application to the real needs of society. — Edmund T. Cranch, in *ENGINEERING: Cornell Quarterly* 4 (1969): 3.

The world's largest radar-radio observatory was built in 1963 at Arecibo, Puerto Rico, under the direction of William E. Gordon, then a Cornell professor of electrical engineering. Gordon also received his Ph.D. from Cornell, in 1953. He is now vice president and dean of engineering at Rice University.



dozen engineering schools in the United States in terms of volume of research. Interdisciplinary research has been encouraged, and engineering faculty members and graduate students are working with other University groups in a number of cooperative projects and centers. An example is the recently organized Laboratory of Plasma Studies, a research center involving the participation of fifteen faculty members from various academic areas and operating on an annual research budget of about $600,000.

Capstones of Century I

Now, some one hundred years after the first Cornellians entered the engineering profession, Cornell finds itself once again at the forefront in engineering education in America. In its early years Cornell pioneered in civil, mechanical, electrical, and industrial engineering education; today it finds itself pioneering in such diverse areas as operations research, computer science, biochemical engineering, environmental engineering, materials science, and applied physics. Of the major private institutions offering engineering in the United States, it stands second in overall enrollment; in 1971 about three hundred advanced degrees (Ph.D., M.S., or M.Eng.) were awarded, and more than four hundred bachelor's degrees. While not free of problems, it has momentum and vigor: indeed, nearly half of its faculty members are under thirty-five years of age! The College is in very good shape as it heads toward Century II.

The development of engineering during the fifty years since these colleges opened has shown that the ever increasing kinds of engineering are all closely allied; that the underlying principles are the same, and that an engineer is one who has learned something of the laws of nature, of mathematical methods and of industrial processes; but above all he is one who has learned to apply a brain trained to clear and forceful thinking to problems that may come to him for solution. — From a report by Deans Haskell and Smith to the Board of Trustees, May 31, 1919.

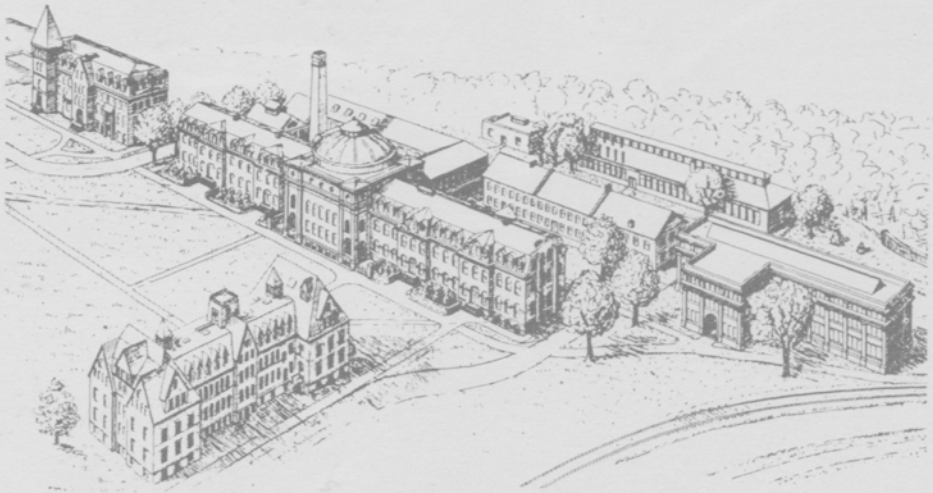
Looking for the Capstones of Century I gives one a sense of sweep, of turning points in educational, political, and technological history, of the vision of great men in troubled times and in years of promise. It is easy to overlook the continuing and fundamental source of any great institution's achievements: the diligence, energy, and capabilities of faculty, staff, and students. Vision must be backed by hard work, ideas must be implemented with intelligence

When he became an emeritus professor in 1969, Joseph O. Jeffrey had completed forty-four years of teaching, one of the longest tenures in College history. Here he lectures on the behavior of materials.

and zeal, plans must be supported. Finally, there is the realization that a school's reputation and, indeed, its impact on society are most essentially a reflection of the achievements and the value of its graduates. Successes of this sort are often difficult to pinpoint, but they are Capstones nonetheless.

If one great truth is to be extracted from this survey of Century I, it is that success comes with vigorous adaption to change – with pioneering, with trying, even though trying might mean failing. The one clear factor in engineering today is the swiftness of change, both technological and in relation to other aspects of society, and it is more necessary than ever that a truly outstanding engineering college not only keep up with the changes but struggle to anticipate them. Graduates emerging from such an institution will be at the forefront of new develoments, among the shapers of change.

Cornell has demonstrated its capacity to move with the times. That is its greatest Capstone of Century I and its key to the future.



A student prepares to extract a molten specimen from the laboratory-sized furnace in the Materials Processing Laboratory that is the modern equivalent of the old Foundry.

BIBLIOGRAPHY

American Society for Engineering Education. "Change and Challenge." 75th Anniversary issue. *Journal of Engineering Education* 58 (1968). (Of interest is the 75th Anniversary Hall of Fame, listing eminent engineering educators dating back to the beginnings of the Society in 1893. Five of the twenty-two men honored were Cornellians.)

Bell, Barbara. "Telegraphs and Telegraphers." *Ithaca Journal,* May 24, 1969, p. 14.

Berry, Romeyn. *Behind the Ivy.* Ithaca, New York: Cornell University Press, 1950. ("The Mogue" and "What goes on in Faculty Meetings," pps. 80–84.)

Berth, Donald F. "Engineering Education: Its Origins and Early Development." *The Cornell Engineer* 30 (1965): 46–53.

Bishop, Morris. *A History of Cornell.* Ithaca, New York: Cornell University Press, 1962.

Cornell in Pictures. Compiled by C. V. P. Young and H. A. Stevenson. Ithaca, New York: Quill and Dagger Alumni Association, 1965.

Cornell University. *College of Engineering Faculty Meeting Minutes.* Ithaca, New York: Cornell University, 1921– .

———. *Exercises Commemorating the One-Hundredth Anniversary of the Birth of Robert Henry Thurston.* Program, October 25, 1939. Ithaca, New York: Cornell University, 1940.

———. *Official Publications of Cornell University.* Catalogs. Ithaca, New York: Cornell University, 1911–40.

———. *A Pioneer in Engineering Education.* Brochure. Ithaca, New York: Cornell University, 1926.

———. *The Register.* Catalogs. Ithaca, New York: Cornell University, 1868–1910.

A seminar at the Graduate School of Aeronautical (now Aerospace) Engineering was conducted in 1959 by visiting professor Theodore von Karman, an internationally known aeronautical scientist.

Corson, Dale R. "Annual Report to the President of Cornell University." Duplicated reports from the dean of the College of Engineering. Ithaca, New York: Cornell University, 1960–62.

Dorf, Philip. *The Builder.* Biography of Ezra Cornell. New York: MacMillan Company, 1952.

Durand, William F. *Robert Henry Thurston.* New York: American Society of Mechanical Engineers, 1929.

Hewett, Waterman T. *A History of Cornell University.* New York: The University Publishing Society, 1905.

Hollister, S. C. "Annual Report to the President of Cornell University." Duplicated reports from the dean of the College of Engineering. Ithaca, New York: Cornell University, 1947–59.

———. "Report on the College of Engineering at Cornell University." Mimeographed. Ithaca, New York: Cornell University, 1950. (An historical review of the evaluation of engineering education in general and at Cornell in particular).

———. "Three-quarters of a Century of Engineering Leadership." In *The Pioneering Nature of Cornell University,* pamphlet, pp. 7–9. Ithaca, New York: Cornell University, 1948.

Kimball, Dexter. *I Remember.* New York: McGraw-Hill Book Company, 1953.

Schultz, Andrew. "Annual Report to the President of Cornell University." Duplicated reports from the dean of the College of Engineering. Ithaca, New York: Cornell University, 1964–71.

———. "Trends in Modern Engineering Education." *The Cornell Engineer* 30 (1965): 9–14.

"Sibley College, Cornell University: the New Schools of Mechanical Engineering and the Mechanic Arts." *Scientific American* 53 (1885): 247–8.

"Sibley College, Cornell University: Five Years of Growth." *Scientific American* 63 (1890): 229.

Sibley College of Mechanical Engineering and the Mechanic Arts. "Dr. Thurston's Work in Sibley College." *Sibley Journal of Engineering* 12 (1898): 255–9.

———. "Electrical Engineering Instruction at Cornell." *Sibley Journal of Engineering* 19 (1905): 383–7.

A new look in equipment and even students characterizes the modern College of Engineering. A course in computer appreciation was offered recently by electrical engineering professor Nelson H. Bryant.

———. "Instruction in Mechanical and Electrical Engineering at Cornell University." *Sibley Journal of Engineering* 23 (1908): 1–9.

———. "The New Sibley College School." *The Crank* (student-developed forerunner of the *Sibley Journal of Engineering)* 6 (1891): 18–20.

———. "Work of the Founders: The Early History of Sibley College" *Sibley Journal of Engineering* 12 (1898): 255–9.

Smith, Albert W. *John Edson Sweet.* New York: American Society of Mechanical Engineers, 1925.

Stambaugh, Ben Franklin, Jr. "The Development of Postgraduate Studies at Cornell: The First Forty Years, 1868–1908." Thesis, Cornell University, 1965.

Stanford University School of Engineering. "Seventy-five Years of Engineering at Stanford." *Stanford Engineering News* no. 58 (1966).

White, Andrew D. *Autobiography of Andrew Dickson White.* New York: Century Company, 1905.

———. *The Diaries of Andrew D. White.* Edited by Robert M. Ogden. Ithaca, New York: Cornell University Library, 1959.

Wickenden, William E. *A Study of Evolutionary Trends in Engineering Education.* Bulletin no. 11 on the Investigation of Engineering Education. New York: Society for the Promotion of Engineering Education, 1927.

The authors wish to thank a number of people who contributed to the preparation of this feature. Historical photographs were supplied by Barbara M. Shepherd of the Cornell University Archives, Professor Dennis G. Shepherd, Professor Arthur J. McNair, and David F. Powers. Judith E. Olson conducted a search in the University library collections for printed historical material. Some biographical information was provided by Elizabeth C. Packer of the College of Engineering staff. Of the many individuals who communicated information, impressions, and anecdotes in informal conversation, special acknowledgments are made to Robert N. Allen, Bartholomew J. Conta, Trevor R. Cuykendall, Joseph O. Jeffrey, John F. McManus, Arthur J. McNair, Donald H. Moyer, Benjamin M. Siegel, Howard G. Smith, Julian C. Smith, Everett M. Strong, and Charles C. Winding.

A generation ago the typical engineering student was pictured as inseparable from his slide rule; for today's student, keypunch operation is a routine skill.

FROM THE PAST . . .

The Cornell Engineering Faculty

In his inaugural address, delivered on October 7, 1868 in the hall of the Cornell Library in Ithaca, Cornell University's first president, Andrew D. White, gave the following charge to the twenty-one members of the resident faculty:

"The task before us is difficult. It demands hard thought, hard work. You will be called upon to exercise skill, energy, and forbearance. The Faculty of this institution is the last place in the world for a man of mere dignity or of elegant ease. But if the toil be great, the reward also is great. It is the reward which the successful professor so prizes — the sight of men made strong for the true, the beautiful, and the good through your help."

To the students that day he said:

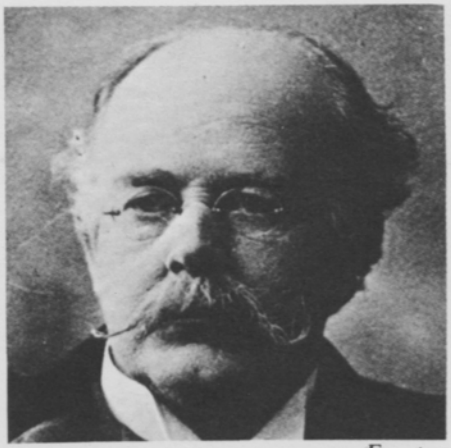
"You have had the faith and courage to cast in your lot with a new institution; you have preferred its roughness to the smoothness of more venerable organizations; you have not feared to aid in an experiment, knowing that there must be some groping and some stumbling. I will not ask you to be true to us. I will ask you to be true to yourselves . . . You are here to help build a University."

The beginnings of the civil and mechanical engineering faculties were represented by William Charles Cleveland in civil engineering, Eli Whitney Blake in physics and industrial mechanics, and John L. Morris in practical mechanics. They must have experienced their full share of the "groping" and "stumbling" alluded to by the president. These men were beginning a long development of engineering as an academic discipline and as a profession.

President White himself was involved in the struggles for an effective engineering program. Out of his personal funds he bought the initial "mechanic arts" equipment, including the very first piece of machinery, a power lathe. Later he initiated the idea of forming a Department of Electrical Engineering. As he noted in his autobiography, this plan met with opposition from one of the trustees, who was "constitutionally averse to what he thought new-fangled education." In order to save the proposed department, White pledged himself to "become responsible for any extra expense."

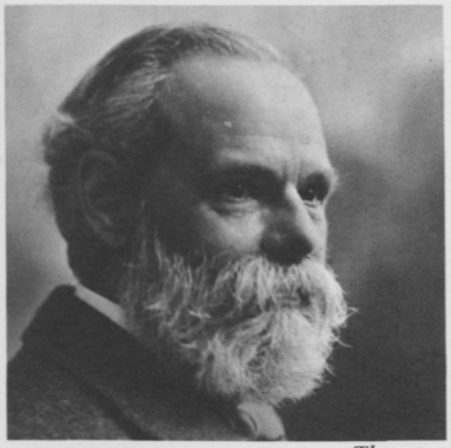
Throughout its history, engineering at Cornell has been characterized by the spirit of enterprise evoked by President White on that day the University opened. Over the years, Cornell engineering has been shaped by a succession of outstanding and innovative faculty members whose influence necessarily has extended to the whole developing nation. Among these men are the professors "from the past" who are pictured and described on the following pages.

Opposite: In 1882 the University faculty consisted of thirty-seven distinguished and properly attired professors. Those on the engineering faculties were Estévan A. Fuertes (third from the left in the second row, with chin partly obscured by the bowler hat); Irving Porter Church (first on the left in the third row, with handlebar mustache and beard also partly hidden); and Charles L. Crandall (top row of hats, second beard from the right). John L. Morris was not present. President Andrew D. White is seated near Fuertes; he is fifth from the left in the second row.



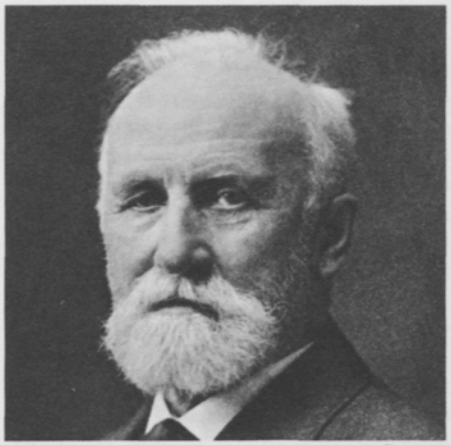
Fuertes

Estévan Antonio Fuertes was the patriarch of civil engineering at Cornell for nearly thirty years. Born in Puerto Rico in 1838, he received his secondary education in Spain and augmented his many European degrees with that of Civil Engineer, awarded by Rensselaer Polytechnic Institute in 1861. By the time he came to Cornell in 1873 he had acquired extensive experience as a consulting engineer and he continued this kind of activity. He headed an expedition to study the feasibility of a ship canal across the Isthmus of Tehuantepec, he served as a sanitation consultant in Brazil, and he was decorated by the Spanish government in recognition of professional services. During his years at Cornell, Fuertes acquired a reputation for enthusiastic educational leadership coupled with an appreciation of the needs of the profession. He was among the first to advocate laboratory work for civil engineering students, but he was also a firm believer in a broad educational background. A man of colorful and engaging personality, he was known as "the Mogue" because of his exotic impression and his Mogul cigarettes. He was a member of many professional societies in this country and abroad, and served as a director of the American Society of Civil Engineers.



Thurston

When Robert Henry Thurston became director of the Sibley College of Mechanic Arts in 1885, he was already an eminent man. He had been a professor at the Stevens Institute of Technology for fourteen years and had been a founder and the first president of the American Society of Mechanical Engineers. A native of Providence, Rhode Island, he was a graduate of Brown University and had taught at Annapolis following Civil War duty with the Navy. Like Fuertes, Thurston had been personally recruited for Cornell by President White. During his tenure at the Sibley College, Thurston succeeded in transforming a highly applied and limited curriculum in mechanic arts into a program that made the Sibley College the nation's foremost school offering mechanical and later electrical engineering. By the time of his death in 1903, the College's enrollment had grown from sixty to 1,000 and the faculty from seven to forty-three. Thurston was remembered as a man of cheerful persistence who "got what he wanted in the end." At a 1939 commemoration of the 100th anniversary of Thurston's birth, Cornell President Edmund Ezra Day remarked that he "belongs to the small group of those to whom Cornell's indebtedness is immeasurably great."



Sweet

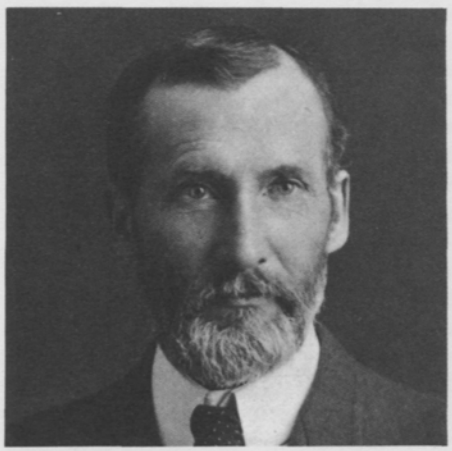
John Edson Sweet was supervising the building of a bridge on the new campus when Ezra Cornell came by and stopped to ask his opinion on shop instruction in the Sibley College. That was the beginning of Sweet's six-year term as professor, master mechanic, and director of the machine shops. He introduced the most advanced training methods, and after leaving the University he made important contributions to industry. Sweet, a farm boy from Pompey, New York, was a "natural" mechanic, self-educated like Ezra Cornell and Hiram Sibley, and although his Cornell tenure was brief he made a lasting impression.

Morris

One of the two engineers on the initial faculty of Cornell University was John Lewis Morris, who was in charge of the Sibley College until 1885 and spent a total of thirty-six years at the University. Morris, a native of Utica, New York, attended Union College and received the degrees of A.B., M.A., and Civil Engineer. Among Cornell students he was known as a friend who always kept a sum of money in his office safe for the aid of those in financial difficulty. And in 1896, when the University was short of funds, he made the singular request (granted) for a decrease in salary. He retired in 1904.

One of the longest records of association with engineering at Cornell University was attained by Charles Crandall, who entered as a freshman student in the very first year of classes, graduated in 1872 at the second commencement of the University, and served on the faculty for forty-one years until his retirement in 1915. From 1902 to 1906 he was in charge of the College of Civil Engineering. With the exception of two years' work as an engineer in the railroad industry immediately after graduation, Crandall devoted his entire career to the teaching of railroad engineering and geodesy.

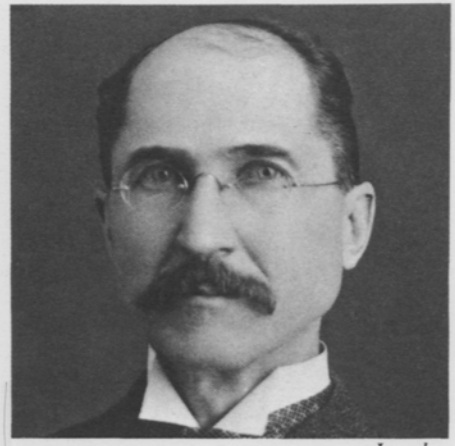
Crandall



Herman Diederichs immigrated from Germany at the age of fourteen, unable to speak English, but he won a scholarship to Cornell and later a post as a professor of experimental engineering. When the College of Engineering was formed in 1921, Diederichs was elected by his colleagues to head the subsidiary School of Mechanical Engineering; in 1936 he was named dean of the College, but died after only a year in office. He was president of the athletic association for many years, and was remembered by his contemporaries as a man of gruff appearance but kindly disposition.

Diederichs

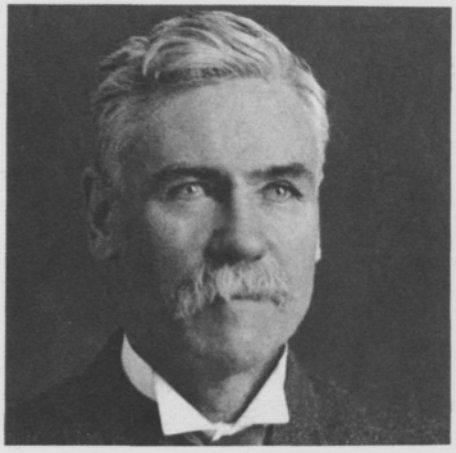
A prolific writer on mechanical engineering subjects and one of the leading patent experts of his time was Rolla Clinton Carpenter, professor of experimental engineering in the Sibley College from 1890 to 1917. Carpenter received his undergraduate education in civil engineering in Michigan, his home state, and came to Cornell for a Master of Mechanical Engineering degree, awarded in 1888. He returned to Michigan to be professor of mathematics and engineering at the Agriculture College (now Michigan State) for several years, and then joined the Cornell faculty as head of the Mechanical Laboratory.



Jacoby

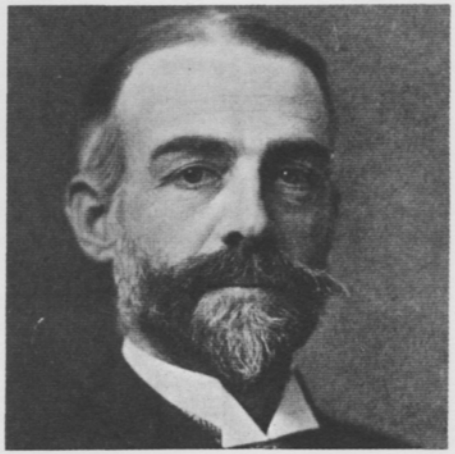
Beginning at Cornell as an assistant professor of bridge engineering and graphics in 1890, Henry Sylvester Jacoby developed over the following thirty-two years a department giving instruction in all branches of structural engineering. He was educated as a civil engineer at Lehigh University, near his home in Pennsylvania, and spent nine years following his 1877 graduation as a surveyor and draftsman for the U.S. Corps of Engineers. He began his teaching career at Lehigh. Jacoby's national reputation was mainly as a major contributor to engineering literature and as a leader in professional organizations.

Carpenter



A notable member of the early faculty was William Frederick Durand, professor of marine engineering from 1891 to 1904. A graduate of the Naval Academy, he taught steam engineering at Lafayette College and mechanics at Michigan State before beginning his Cornell tenure, during which he earned a reputation as a developer of ships' propellers. He left Cornell to become head of mechanical engineering at Stanford, a position he held for twenty-four years. During his career, Durand was active in advisory work for the government and in many professional organizations, and received international recognition.

Durand

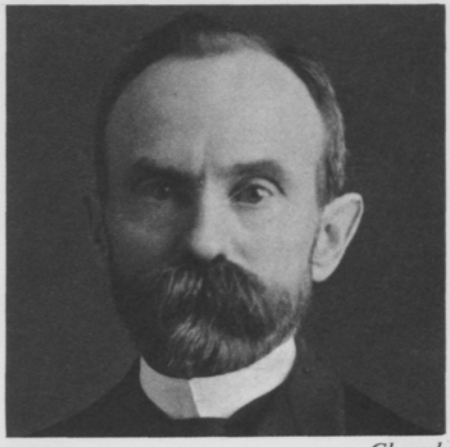


Ryan

An early figure in electrical engineering at Cornell was Harris Joseph Ryan, who graduated in 1887 with one of the University's first degrees in electrical engineering and joined the physics faculty the following year. In 1889 he was transferred to Sibley College, where he became head of a new Department of Electrical Engineering, which appears to have been the first department in this discipline in the United States. For some years he handled all the instruction in electrical engineering, directly supervising the education of some 800 students who graduated as mechanical engineers with a specialty in electrical engineering. The electrical engineering faculty was finally augmented with one additional instructor in 1896, and two more came in 1904. Ryan left Cornell in 1905 to become head of the electrical engineering department at Stanford, a position he held for twenty-six years. Ryan was an engineer-scientist of national and international reputation, mainly in the areas of high-voltage generation and long-distance power transmission, and he began work in those fields during his years at Cornell. He built, in Ithaca, the first American high-voltage transformer, and he invented and developed a great many electrical devices and processes.

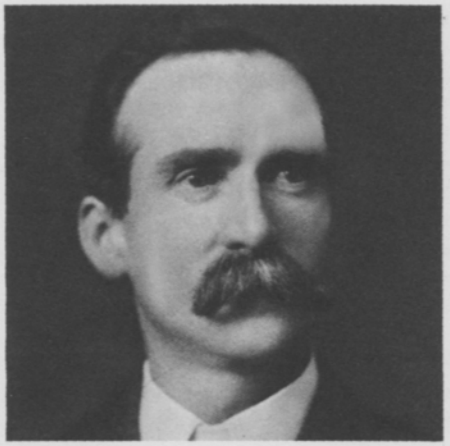
Ogden

Henry Neely Ogden, a specialist in sanitary and public health engineering, was educated at Cornell and served on the civil engineering faculty until his retirement in 1938. Throughout his career he was a productive writer of technical books and articles and was continuously active as a consultant in sanitation and public health engineering on the local, national, and international levels. Among his projects was the planning and supervision of construction of Ithaca's first sewerage system and treatment plant, and he served for many years on the state Public Health Council.



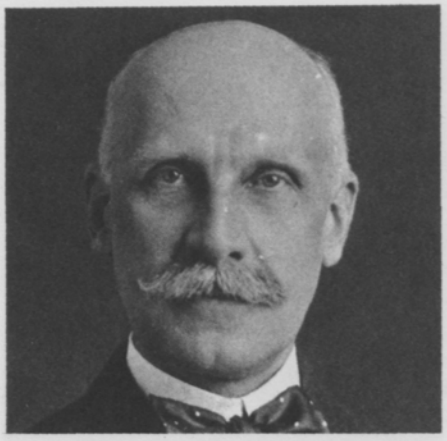
Church

Irving Porter Church had a long and distinguished career at Cornell as a writer and teacher in the field of applied mechanics and hydraulics. He was a member of the Civil Engineering faculty from the time of his graduation from Cornell as Civil Engineer in 1876 until his retirement in 1916. Church was the first of seven Cornellians to be honored with the Lamme Award of the American Society for Engineering Education; and in recent years a professorship at Cornell was named in his honor. A native of Connecticut, he was a descendant of Governor John Winthrop of Massachusetts.



Kimball

When the College of Engineering was established in 1921, Dexter S. Kimball was chosen as its first dean. He had been on the Sibley College faculty for almost twenty years, had developed and headed the innovative Department of Industrial Engineering, and had served as acting president of the University. Kimball spent his early youth on the West Coast, took his degree in mechanical engineering at Stanford, and acquired considerable industrial experience before beginning his teaching career at Cornell as an assistant professor of machine design. He remained at Cornell continuously from 1898 until his retirement in 1936 except for an early three-year period in industry. Kimball's professional activities in addition to teaching and administration included the publication of a great many books and articles, the presidency of the American Society of Mechanical Engineers, and participation in the organization of the Engineers' Council for Professional Development. His special work for the government in two wars included service with the War Production Board during World War II, after his retirement from Cornell. Among his many honors were four gold medals from professional societies, and the first M.E. degree awarded by Stanford to graduates of distinction.



Smith

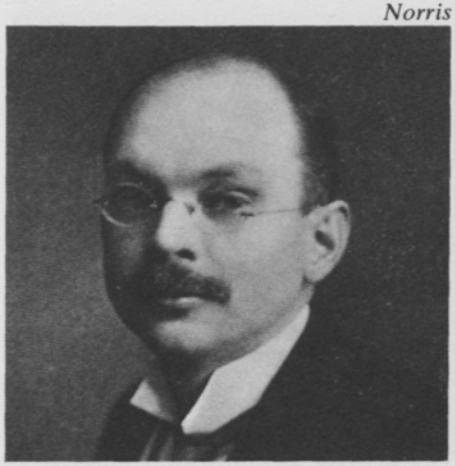
When Albert W. Smith was brought to Cornell as director of the Sibley College of Mechanical Engineering in 1904, he was returning to the university where he had been educated and had begun his teaching career. He had graduated from Cornell in 1878, had earned an advanced Cornell degree in mechanical engineering after several intervening years of industrial work, and had served on the faculty as head of the mechanics laboratory before leaving in 1891 to teach at Wisconsin and then Stanford. Before his retirement from Cornell in 1921, Smith served for a year as acting president of the University.

Haskell

The College of Civil Engineering was headed by Eugene E. Haskell from 1906 to 1921 when Haskell retired and the inclusive College of Engineering was formed. Haskell, a Cornell C.E. and M.C.E., was primarily interested in hydraulics and waterways. Before joining the Cornell faculty he had worked as a civilian with the Corps of Engineers; he directed an innovative U.S. Lake Survey and invented a water current meter that bears his name. Later he served as a consultant in such projects as river system surveys and a reestablishment of the United States-Canadian water border.

Henry Hutchinson Norris succeeded Harris Ryan as head of the electrical engineering department in 1905 after having been a member of the faculty for nine years. Norris was educated at Johns Hopkins and Cornell, from which he graduated in 1896. One of his major interests was in educational and technical publications in engineering. He served as editor of the Society for the Promotion of Engineering Education Journal, *and resigned from Cornell in 1913 in order to devote his full time to two leading journals of the time,* Electric Railway Journal *and* Electrical World.

Norris



Bangs

Largely responsible for the popular curriculum in administrative engineering in the early 1930's was Professor John R. Bangs, who began his career as a specialist in industrial engineering and machine design and later developed major interests in personnel and industrial management. Bangs joined the Sibley School faculty after graduating from Cornell as an M.E. in 1921. He resigned in 1945 in order to continue work begun during World War II with an aircraft manufacturing company. He is currently doing some teaching at the University of Florida and helps coach track, as he did at Cornell.

Rhodes

Fred H. ("Dusty") Rhodes helped initiate the curriculum in chemical engineering at Cornell and served as first head of the chemical engineering school from 1937 until his retirement in 1957. Rhodes first came to Cornell in 1910 to work on his Ph.D. in chemistry after graduation from Wabash College in his native Indiana. After several years as an instructor and industrial chemist he returned to Cornell in 1920 as professor of industrial chemistry. He has been active as an industrial consultant and executive and holds a number of patents. He has also served as a Cornell trustee. His present home is in Florida.

. . . TO THE PRESENT

The Cornell Engineering Faculty

"It demands hard thought, hard work." This assessment of the job of a Cornell professor is as true today as it was more than one hundred years ago when the University's first president made it in his inaugural address.

A century ago three faculty members prepared to offer the beginnings of engineering education at the new university. Today the Cornell College of Engineering has a faculty of nearly 200, but the early spirit of venture and willingness to expend hard thought and hard work is still evident.

Professors now at the College are engaged in creating new courses and programs. They are initiating and directing research that is sponsored by government and industry at a level of more than $6 million a year. They are writing papers and books, giving lectures, participating in conferences, consulting. Professors act as advisers to students from the freshman to the doctoral level, and serve on innumerable campus, professional, and governmental committees. Some of them administer sizable department, school, and college operations. And, of course, they teach — in classrooms, laboratories, and in the field.

This versatility is, of course, a result of the increasing size and scope of the College and of the profession itself. There were sixty-six students enrolled in the "mechanic arts" and in (civil) engineering in 1868; today there are 2,763 undergraduate and graduate engineering students. In place of the simple division into two branches of engineering practice, there are today dozens of engineering specialties. The Cornell College of Engineering is now organized into administrative units, schools, departments, fields of instruction, even a division; many of these are interconnecting within and outside of the College.

A significant factor in the development of faculty strength in these years of growth has been the establishment of endowed professorships. Ten percent of the present faculty hold distinguished chairs. The first endowed professorship was esatablished by Hiram Sibley in the 1870s; now there are more than a score.

How can today's College of Engineering faculty be characterized? Their educational backgrounds can be surveyed: 105 institutions of higher learning have contributed to their preparation and about 85% have earned doctorates. Their positions can be classified: half are full professors and the other half are divided about equally between associate and assistant professors. Their professional bents can be explored: among them are licensed engineers, industrial consultants, specialists in engineering design, specialists in research of all kinds, theoretical scientists, mathematicians, experts in interdisciplinary subjects.

However, none of these summary surveys can yield an accurate or satisfying profile of contemporary Cornell engineering professors. As the College has grown larger and more complex over the years, so has the faculty. Its richness lies in its diversity and cannot be capsulized.

A glimpse of some of the leading members of the College of Engineering faculty and staff is given on the following pages. Pictured are distinguished chairholders, chairmen or directors of departments or schools, and general administrative officers.

Distinguished Chairs in Engineering

Many of the endowed chairs in the College are named for the benefactors who established them. These include the Francis N. Bard Professorship of Metallurgy, the Walter S. Carpenter Jr. Professorship in Engineering, the Willis H. Carrier Professorship in Engineering, the Herbert Fisk Johnson Professorship in Industrial Chemistry, the Joseph Newton Pew Jr. Professorship in Engineering, the Hiram Sibley Professorship (Mechanical Engineering), and the Leon C. Welch Professorship in Engineering.

Chairs named in memory of alumni or professors include the Justine S. Evans Memorial Professorship (Engineering), established by Gordon M. Evans; the Joseph C. Ford Professorship (Mechanical Engineering), endowed by Vera V. Ford; and the John Edson Sweet Memorial Professorship (Engineering), donated by friends and former students of Professor Sweet. Established just this month is the Fred H. Rhodes Professorship in Engineering, funded by contributions of more than 500 former students and associates of Professor Rhodes.

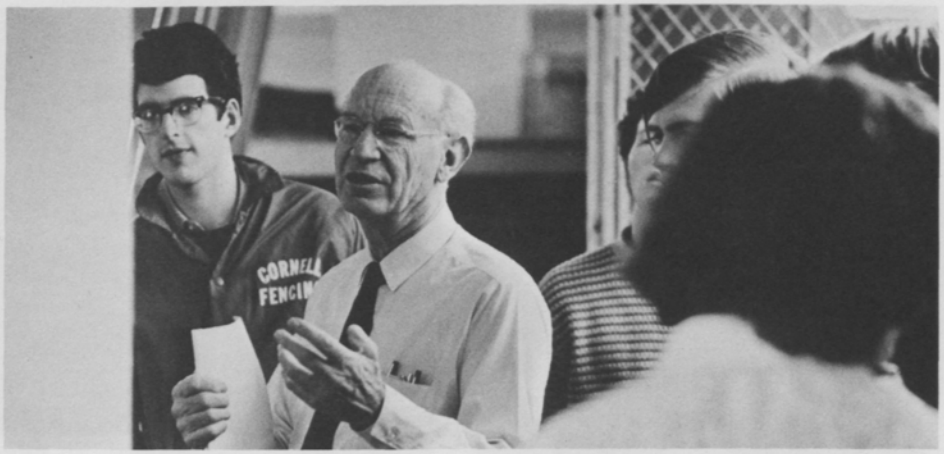
A group of Professorships in Engineering were established in the 1960s under joint funding by the Ford Foundation and private donors. Many of these chairs bear the names of individual benefactors: the J. Preston Levis, Spencer T. Olin, Walter R. Read, and Joseph P. Ripley Professorships. The Mary Shepherd B. Upson Visiting Professorship and the Maxwell M. Upson Professorship were endowed by the estate of Mrs. Upson. Two of these jointly sponsored chairs are named in honor of former professors: the Thomas R. Briggs Professorship (Floyd R. Newman, donor), and the Irving Porter Church Professorship (Nicholas H. Noyes, donor).

Also supported jointly by the Ford Foundation and other benefactors are the Class of 1912 Professorship (contributed by members of the class of 1912); the Given Foundation Professorship (the Irene Heinz Given and John LaPorte Given Foundation, donor); and the IBM Professorship in Engineering and Applied Mathematics (IBM Corporation, donor).

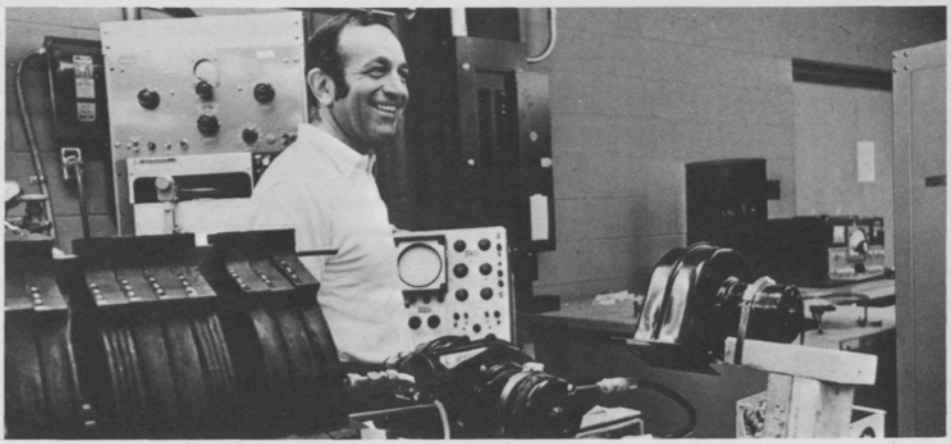
Andrew Schultz, Jr., Dean of the College of Engineering since 1963, confers with members of his administrative staff. Seated next to Schultz is John F. McManus, Associate Dean and chief fiscal officer of the College, who has been on the staff since 1948, during the tenures of Deans Hollister and Corson as well as Schultz. Next to McManus is Donald B. Gordon, Director of Industrial Liaison, who joined the College staff in 1967 after a career in the U.S. Army. All three of these men are Cornell engineering graduates. Schultz received the B.S. and Ph.D. degrees from Cornell in 1936 and 1941 and has been at the College continuously except for World War II service in ordnance. McManus, also a member of the class of 1936, has a degree in civil engineering. Gordon received the degree of Bachelor of Administrative Engineering (with a civil engineering specialty) in 1938.

Schultz and Staff

Burr



Cuykendall



Auer

Distinguished professors in three different fields are, left above, Arthur H. Burr, the Hiram Sibley Professor of Mechanical Engineering; left, Peter L. Auer, professor of aerospace engineering and director of the interdisciplinary Laboratory for Plasma Studies, and above, Trevor R. Cuykendall, the Spencer T. Olin Professor of Engineering. Burr has specialized in machine design and has taught in South America, Australia, and India during his sabbatic leaves. Auer is well known for research on plasmas and lasers. Cuykendall has played a significant part in shaping the engineering physics program.

Balluffi

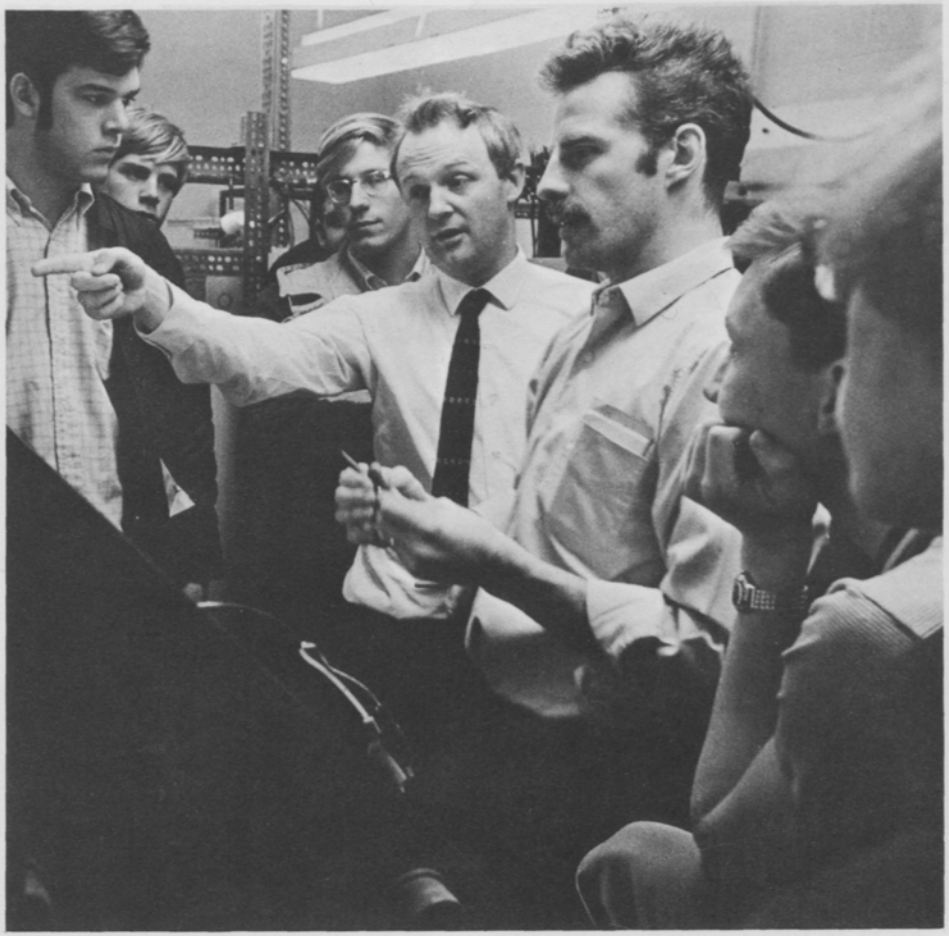
Salton

McManus

Left: One of the College's chairholders is Robert W. Balluffi, the Francis Norwood Bard Professor of Materials Science and Engineering. Balluffi has published extensively and directs a large research program in the area of materials defects. Experimental techniques used in the research include electron microscopy and field ion microscopy. He has been at Cornell since 1964.

Above: Chairman of the University's Department of Computer Science is Gerard Salton, professor of computer science. Salton, a mathematician, has been a member of the Cornell faculty for the past six years. He is a specialist in computer methods for information organization and retrieval and is especially well known for his work with the SMART system for automatic text retrieval and analysis.

Above: Howard N. McManus, Jr., professor of mechanical engineering, is the chairman of the Department of Mechanical Systems and Design. Among his special interests are design optimization and reliability, and heat transfer. McManus has served on the College's Policy Committee and helped develop the Master of Engineering degree program. He has been at Cornell since 1957.



Silcox

Sears

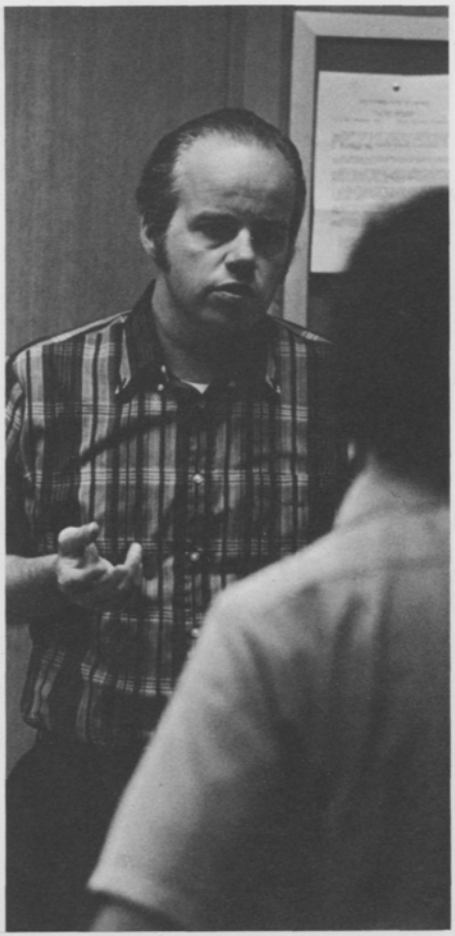
Above: Director of the School of Applied and Engineering Physics, which was organized this year as an integration of separate units, is John Silcox, professor of applied physics. Fields of special interest to Silcox are electron microscopy, imperfections in crystals, superconductivity, and ferromagnetism. Right: The John LaPorte Given Professor of Engineering is William R. Sears, a member of the aerospace engineering faculty since 1946. He received the 1965 Vincent Bendix award from the American Society for Engineering Education, and is a member of the National Academy of Engineering.

Smith

Left: Howard G. Smith, professor of electrical engineering, has served as director of the underclass Division of Basic Studies from the time of its establishment in 1961. The Division administers the academic program of the approximately 1,200 freshmen and sophomores.
Right: Director of the Graduate School of Aerospace Engineering is Edwin L. Resler, Jr., the Joseph Newton Pew Jr. Professor of Engineering. His interests have centered on aerodynamic noise problems and on the development of new concepts for pollution-free engines. Resler joined the faculty after receiving his Ph.D. from Cornell in 1951.

Resler

Winter



Johnson

Bischoff

Fulkerson

Left: George Winter, the Class of 1912 Professor of Engineering, is internationally known for his work on light-gage steel structures. He has been honored by several professional societies, was a Guggenheim Fellow in 1956, and is a member of the National Academy of Engineering. A Cornell Ph.D., he has been on the faculty since 1942.

Above: Director of the Department of Materials Science and Engineering is Herbert H. Johnson, a specialist in the mechanical behavior of solids. His research interests include dislocation mechanics, gases in metals, cyclic deformation, and environment and fracture.

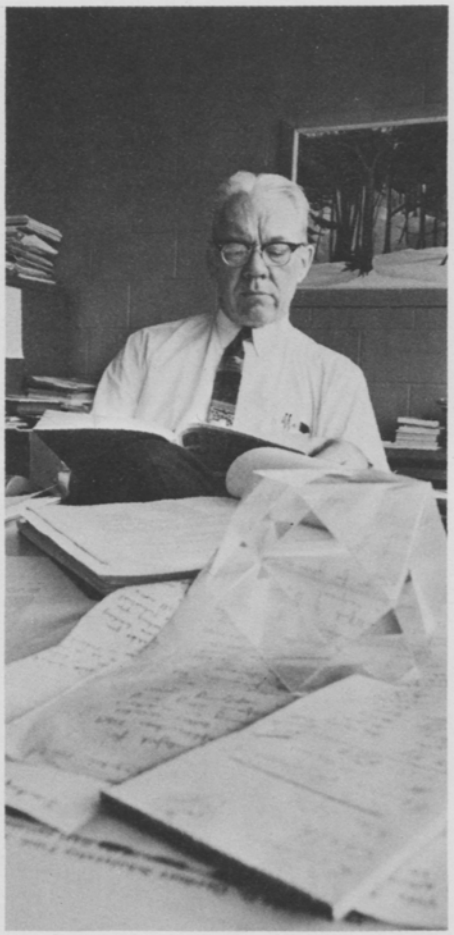
Above: Youngest of the College's distinguished chairholders is thirty-five-year-old Kenneth B. Bischoff, the Walter R. Read Professor of Engineering, who joined the faculty last year as director of the School of Chemical Engineering. His specialties are medical and microbiological bioengineering and chemical reaction engineering.

Right: New this year to the engineering faculty is D. Ray Fulkerson, the Maxwell M. Upson Professor of Engineering and professor of operations research. His special interests are in the areas of network flow theory, combinatorial analysis, and linear programming.

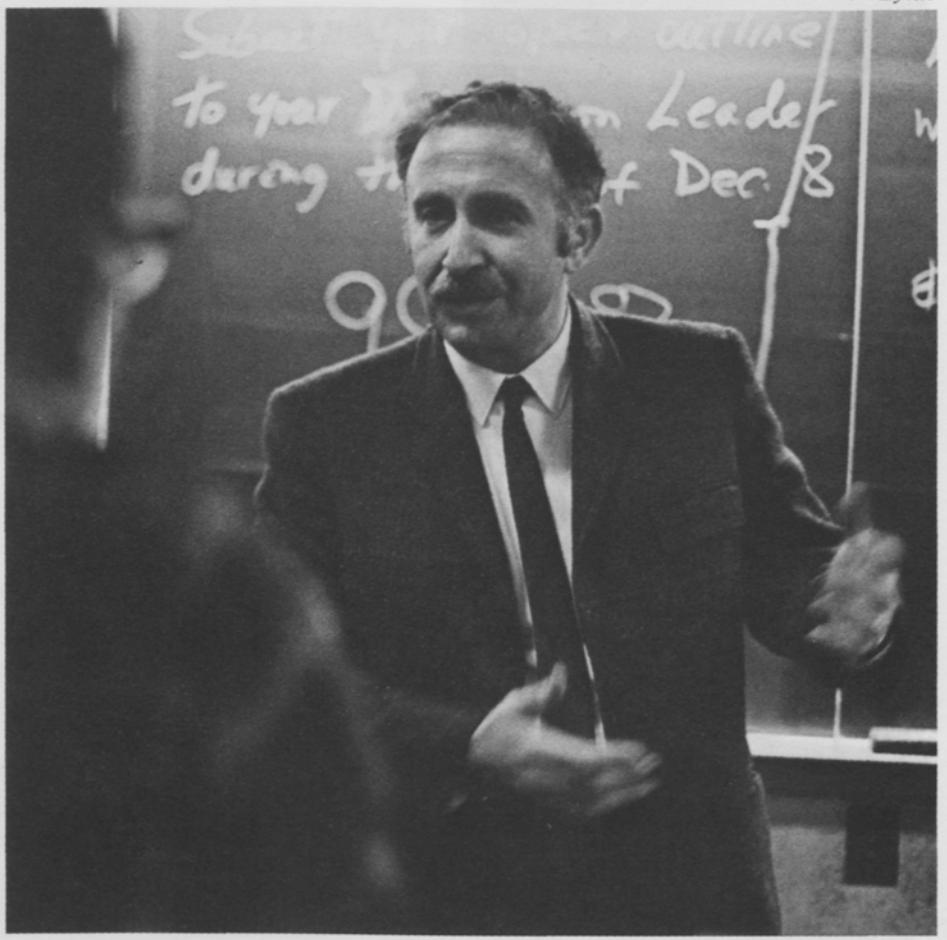
Right: Charles C. Winding, the Herbert Fisk Johnson Professor of Industrial Chemistry, is a specialist in polymer chemistry. A member of the chemical engineering faculty for thirty-six years, he served as director of the School of Chemical Engineering for thirteen years. Below left: Byron W. Saunders is professor and director of the School of Industrial Engineering and Operations Research. In addition, he is serving as director of continuing education. Below: Walter R. Lynn, a specialist in environmental systems, is professor and director of the School of Civil and Environmental Engineering.

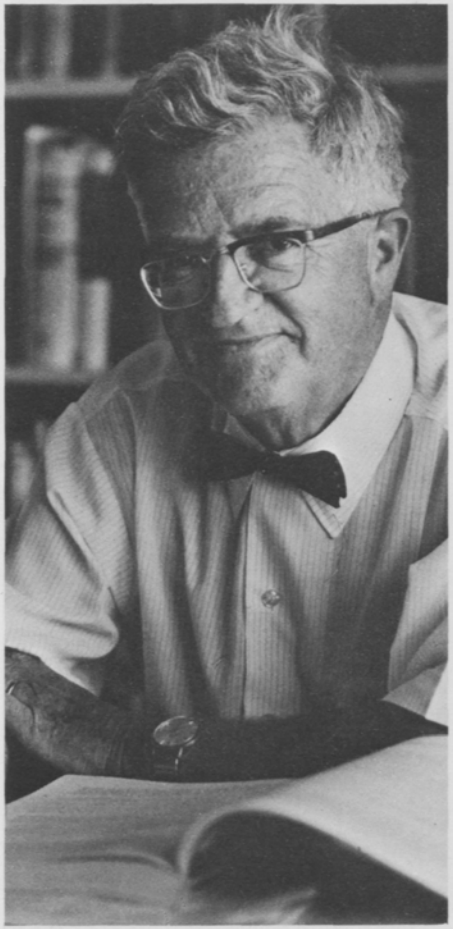
Winding

Saunders



Lynn





Sack

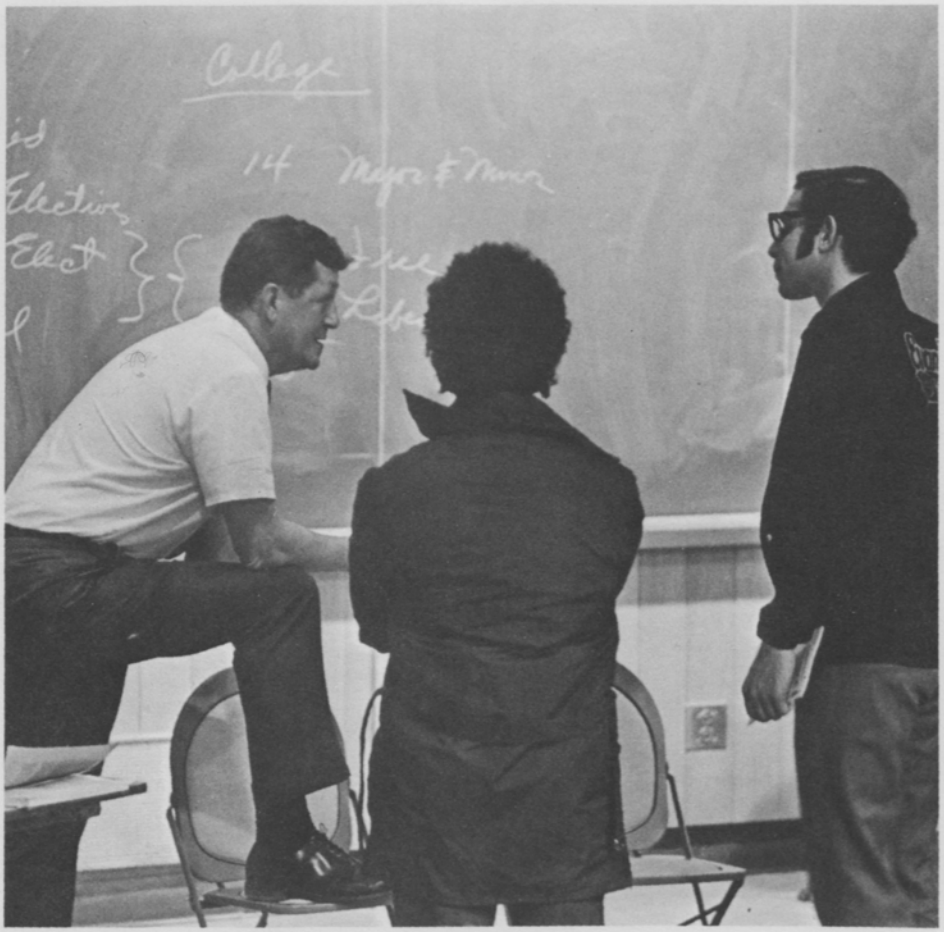
Dropkin

Above: Applied physics professor Henri S. Sack is the Walter S. Carpenter Jr. Professor of Engineering. Sack, who was educated as a mathematician and physicist in Switzerland, has been on the Cornell faculty since 1946. Among his research interests are studies of imperfections in solids.

Right: David Dropkin, the John Edson Sweet Professor of Mechanical Engineering, has been a member of the faculty since 1941. His specialties are heat transfer and thermal power. In 1969 he was awarded the Excellence in Teaching Award of the Cornell Society of Engineers.

Below left: William H. Erickson, professor of electrical engineering, has served the College as associate dean in charge of underclass affairs. He was responsible for the development of the first College-wide introductory engineering courses, and has supervised the development of individualized undergraduate curricula for upperclassmen since 1965.

Erickson



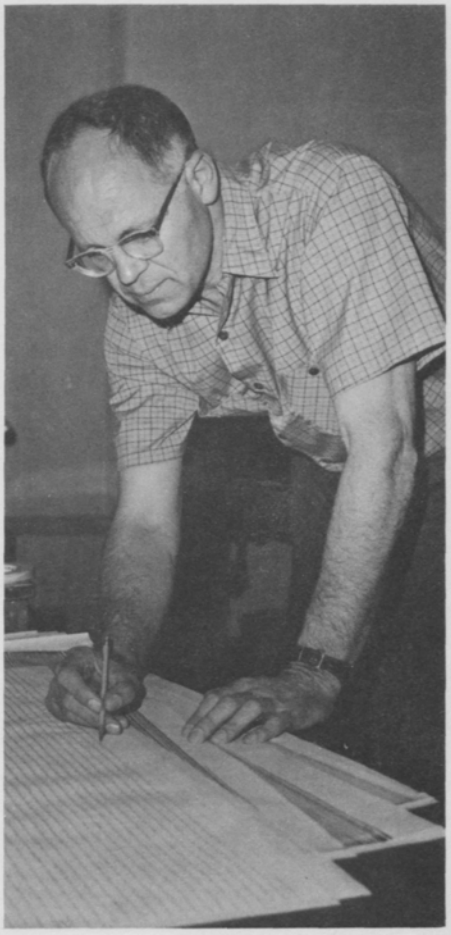
Below: Richard H. Gallagher is professor of structural engineering and chairman of the Department of Structural Engineering of the School of Civil and Environmental Engineering. He has considerable professional experience in civil and aerospace structural design and in the development of the finite element technique as applied to structural analysis.

Gallagher

Carlin

Rostoker

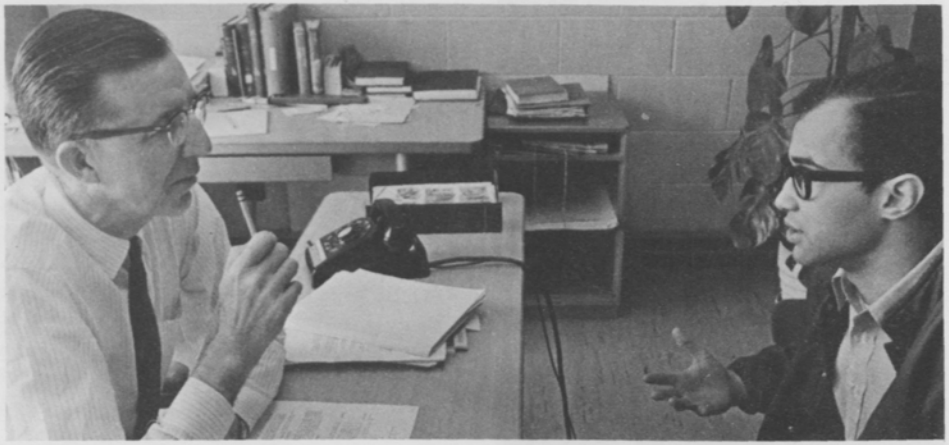
Oliver



Above: Director of the School of Electrical Engineering is Herbert J. Carlin, professor of electrical engineering who holds the J. Preston Levis Professorship of Engineering. The forty-member faculty which he serves as director is the largest group in the College. Carlin is a specialist in microwave circuits and network theory.

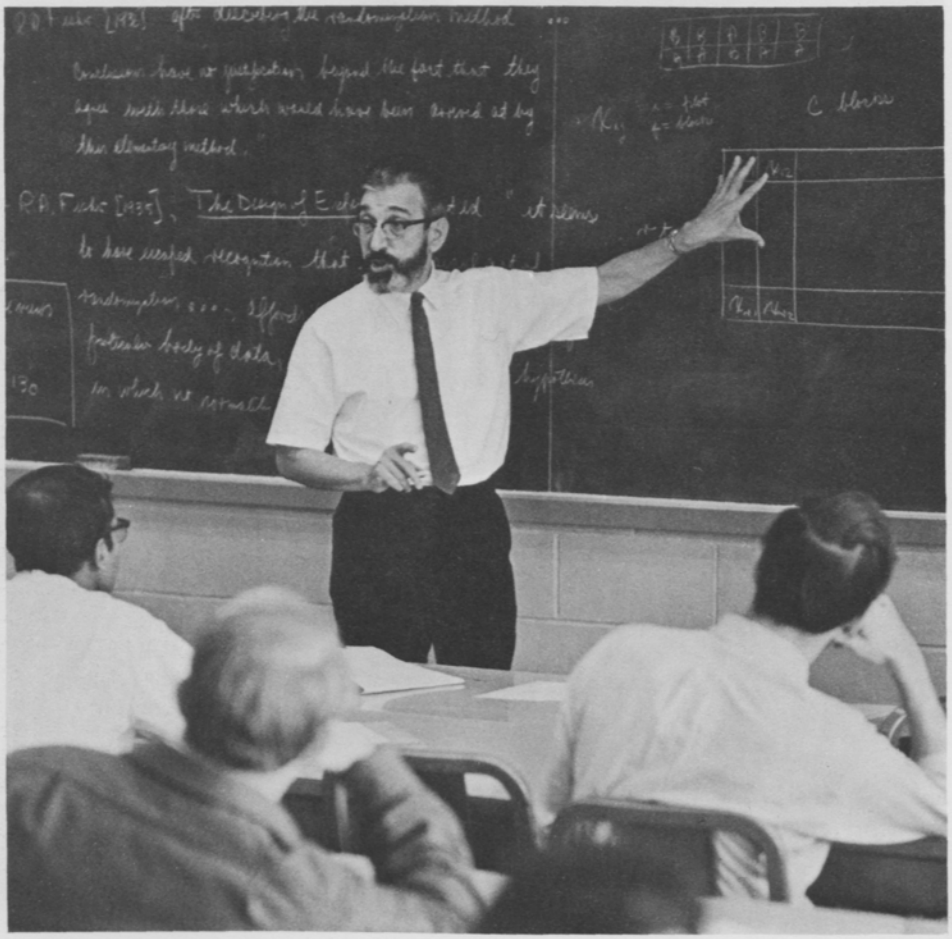
Center: Another distinguished chairholder in the College is Norman Rostoker, professor of applied physics, who is the IBM Professor of Engineering. Before coming to Cornell in 1967, he was manager of fusion and plasma physics projects at General Atomic in San Diego for eleven years.

Right: A recent addition to the College faculty is Jack E. Oliver, the Irving Porter Church Professor of Engineering, who is chairman of the newly reorganized University Department of Geological Sciences. Oliver is well known as a geophysicist specializing in seismology, and was associated with Columbia University's Lamont-Doherty Geological Observatory for many years before coming to Cornell. His main professional interest at the present time is in the area of plate tectonics.



Shepherd

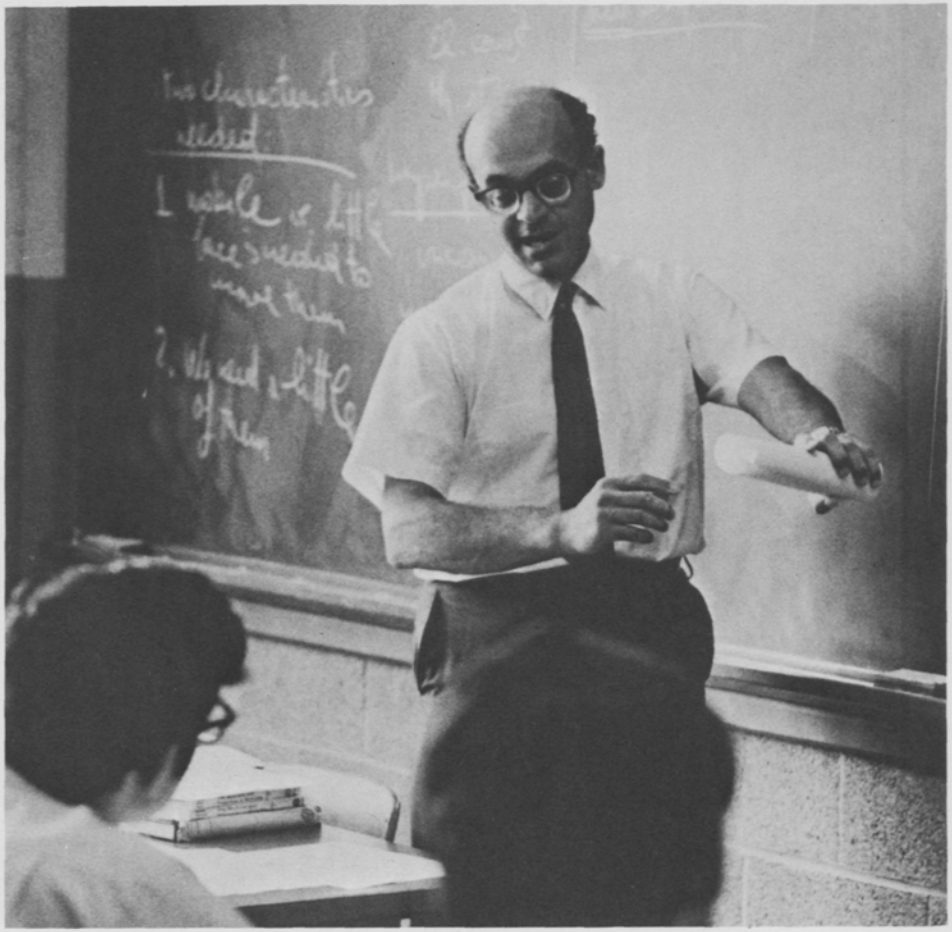
Bechhofer



In charge of the College's educational programs in one of its most established engineering fields and in one of its most recent are the two men pictured at right. Dennis G. Shepherd, above, is director of the Sibley School of Mechanical Engineering, whose roots go back to the beginnings of engineering education at Cornell. Robert E. Bechhofer, below, is chairman of the Department of Operations Research. Shepherd is a specialist in thermal power and Bechhofer, a mathematician, is primarily interested in the design of experiments and in ranking and selection procedures.

Below: Two distinguished members of the Department of Theoretical and Applied Mechanics are Bruno A. Boley, left, the Joseph P. Ripley Professor of Engineering and chairman of the Department, and Edmund T. Cranch, right, professor and associate dean of the College. Boley maintains research interest in space mechanics and in the areas of elasticity and inelasticity and thermal stress. Cranch, as associate dean, is concerned with the development of research programs. He has been at Cornell since his undergraduate years and is currently serving as an elected faculty member of the Cornell Board of Trustees.

Boley



Cranch

Below left: Franklin K. Moore, the Joseph C. Ford Professor of Mechanical Engineering, is chairman of the Department of Thermal Engineering. He is principally interested in fluid dynamics and in thermal pollution problems.
Below right: As an associate dean of the College, Malcolm S. Burton is responsible for the general direction of underclass affairs. He is also a professor of materials science and engineering.

Moore

Burton

THE CAMPUS TODAY

The Engineering Quadrangle on the south edge of the University campus is today an integrated, functional, and pleasant assembly of ten modern buildings, most of them constructed during the past two decades. This physical development of the College paralleled and facilitated a concurrent educational growth and expansion. And it was made possible almost entirely by the contributions of alumni benefactors.

The earliest building on the Quad, completed in 1942, is Olin Hall of Chemical Engineering. This was a gift of Franklin W. Olin, who graduated from the University in 1886 with a degree in civil engineering and went on to develop a group of enterprises which became consolidated as Olin Industries, Inc. The building was dedicated in memory of Franklin W. Olin, Jr., who was a 1912 Cornell graduate in mechanical engineering.

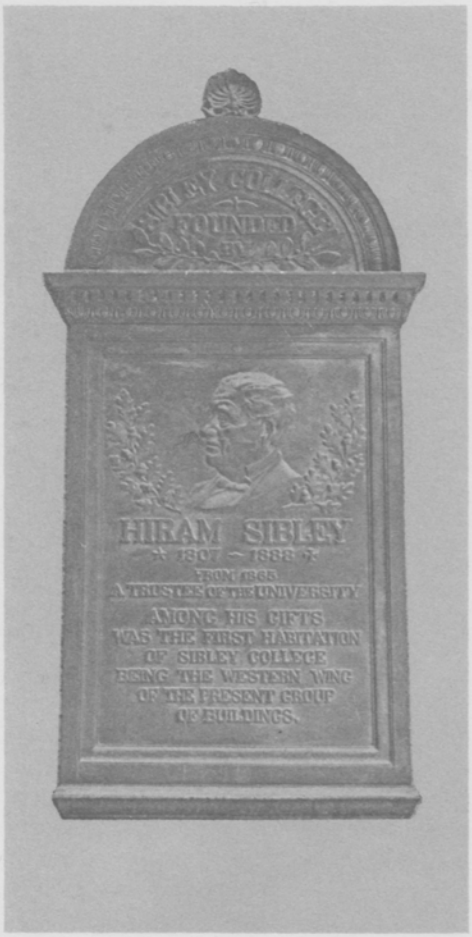
Next to be built, a decade later, were the adjoining Kimball and Thurston Halls, which were financed by a group of engineering alumni. These buildings were named in honor of Robert H. Thurston, director of the Sibley College of Mechanical Engineering and the Mechanic Arts from 1885 until his death in 1903, and Dexter S. Kimball, who served as the first dean of the College of Engineering from 1921 to 1936. These buildings house the Department of Theoretical and Applied Mechanics, the Department of Geological Sciences, and several testing laboratories of the Department of Structural Engineering.

Phillips Hall, center for the School of Electrical Engineering, was built in 1955 with funds provided by the Ellis L. Phillips Foundation. Phillips, founder and chief executive of the Long Island Lighting Company and a central figure in the development of the American electric utilities system, was an 1895 Sibley College engineering graduate.

Administrative offices and the Engineering Library were provided in Carpenter Hall, which opened in 1957. This building was a gift of Walter S. Carpenter, Jr., who has been associated with E. I. duPont de Nemours and Company since 1909 and was chairman of the Board until his retirement in 1962. Carpenter, a mechanical engineering graduate of the class of 1910, has also served Cornell as a member of the Board of Trustees.

The addition in 1958 of Upson Hall to the engineering complex of buildings was regarded as the shift in "center of gravity" of the College of Engineering to the new Quadrangle, for it served as a center for mechanical engineering, one of the two oldest branches of engineering at Cornell. Funds for the building were given by the late Maxwell M. Upson, an 1899 graduate in mechanical engineering who became chairman of the board of the construction firm Raymond International, Inc. Upson also served as a member of the University's Board of Trustees.

The following year saw the opening of two additional halls, Grumman and Hollister. Grumman Hall, housing the Graduate School of Aerospace Engineering, was a gift of Leroy R. Grumman, who was president of Grumman Aircraft Engineering Corporation and is now honorary chair-



man of the Board. Grumman is a 1916 graduate of Cornell with the degree of Mechanical Engineer.

Hollister Hall, the main facility of the School of Civil and Environmental Engineering, was funded by a gift from Spencer T. Olin in memory of his father, Franklin W. Olin (who had earlier provided the College with Olin Hall of Chemical Engineering.) Spencer T. Olin, a director of the Olin Mathieson Chemical Corporation, graduated from Cornell in 1921 as a Mechanical Engineer. The building was named in honor of S. C. Hollister, dean of the College of Engineering from 1937 to 1959.

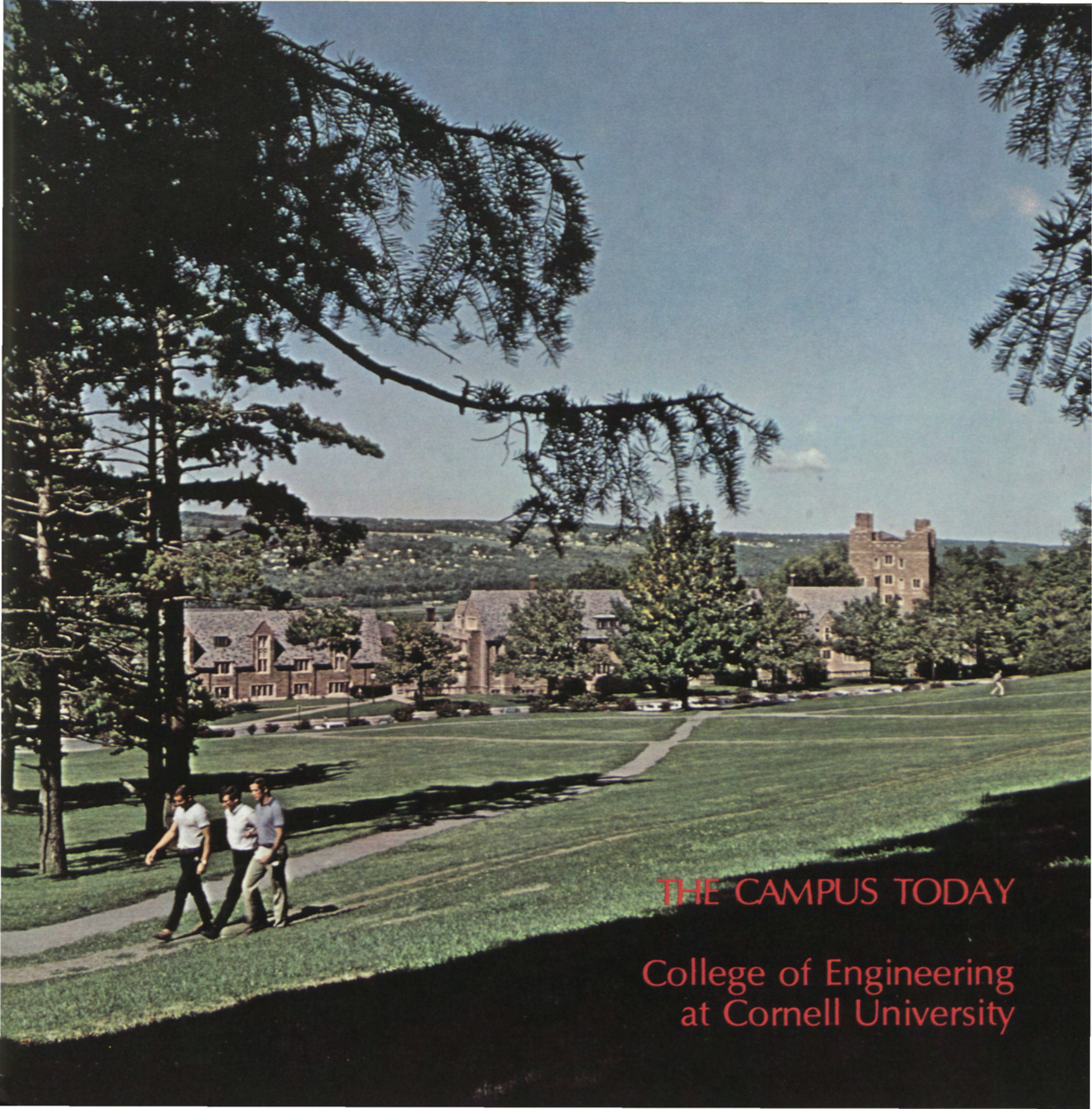
The Ward Laboratory of Nuclear Engineering was built in 1961 with financial assistance from the Atomic Energy Commission, the National Science Foundation, and the Cornell Aeronautical Laboratory. It is named in honor of J. Carlton Ward, Jr., a 1914 graduate in mechanical engineering, who served as chairman of the Engineering College Council for many years.

Bard Hall, a facility for teaching and research in metallurgy and materials, was provided in 1963 by the late Francis N. Bard, a Mechanical Engineer of the class of 1905. Bard was owner and president for more than fifty years of the Barco Manufacturing Company, makers of manufactured parts for the railroad and later the aircraft and missile industries.

Clark Hall of Science, which houses the School of Applied and Engineering Physics of the College of Engineering, was constructed in 1965 on the Arts and Sciences campus. It is named for Mr. and Mrs. W. Van Alan Clark, who provided substantial funding for its construction. Clark, chairman emeritus of the Board of Avon Products, Inc., is a 1909 mechanical engineering graduate.

The well landscaped Engineering Quadrangle has attained by now an established look. A collection of recent color photographs is presented on the following pages.

A link between the original campus and the new Quadrangle is this memento of the first engineering building, Sibley Hall, and its donor.

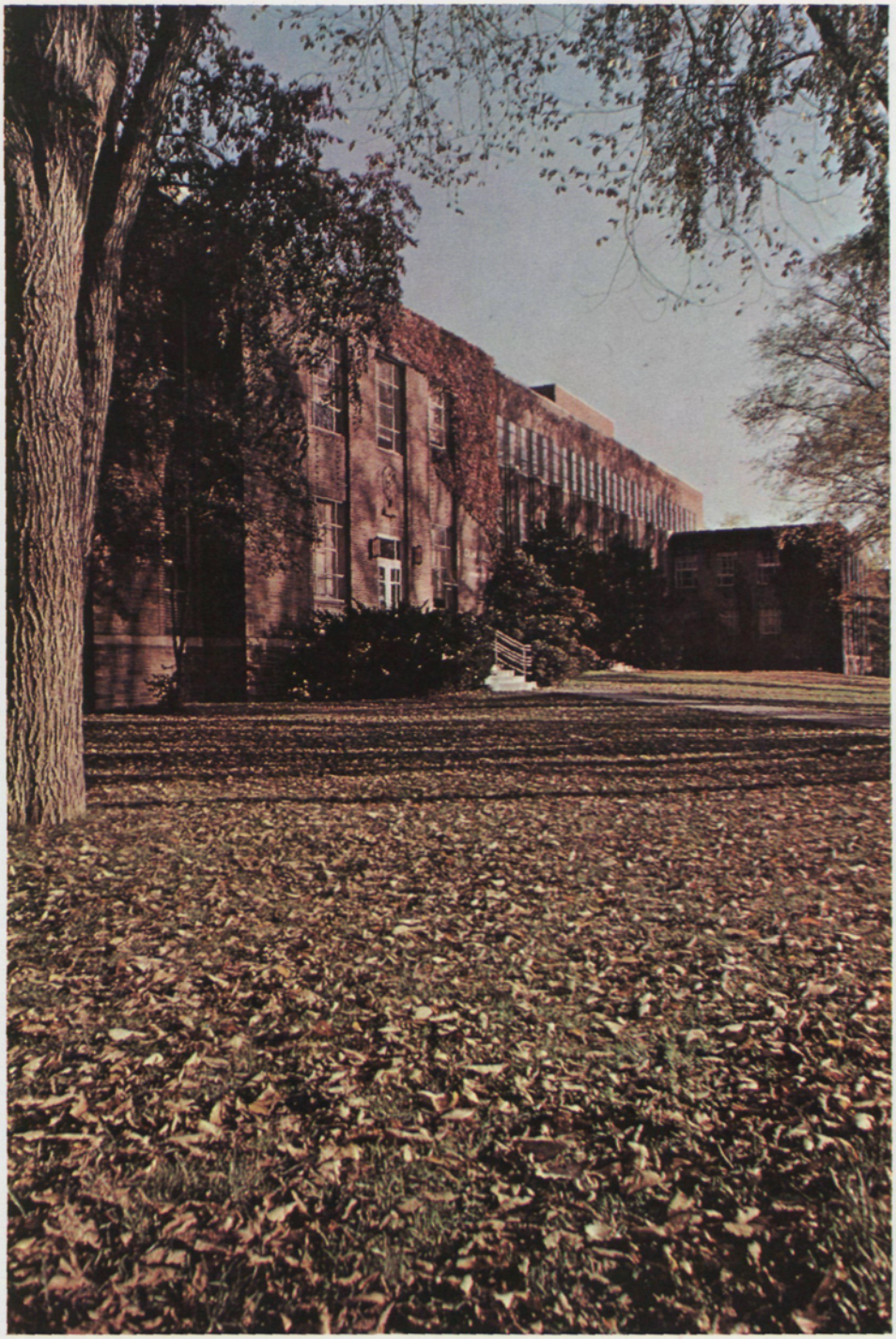


THE CAMPUS TODAY

College of Engineering at Cornell University

One of the ten modern buildings on the Engineering Quadrangle is Upson Hall, which houses the Sibley School of Mechanical Engineering, the School of Industrial Engineering and Operations Research, and the University's Department of Computer Science. Included are laboratories for thermal engineering and for mechanical systems and design. Upson also houses a facility that is important and convenient to many engineering departments and research groups: a remote terminal of Cornell's large-scale computer facility. Both digital and analog computer computing operations can be carried out here.

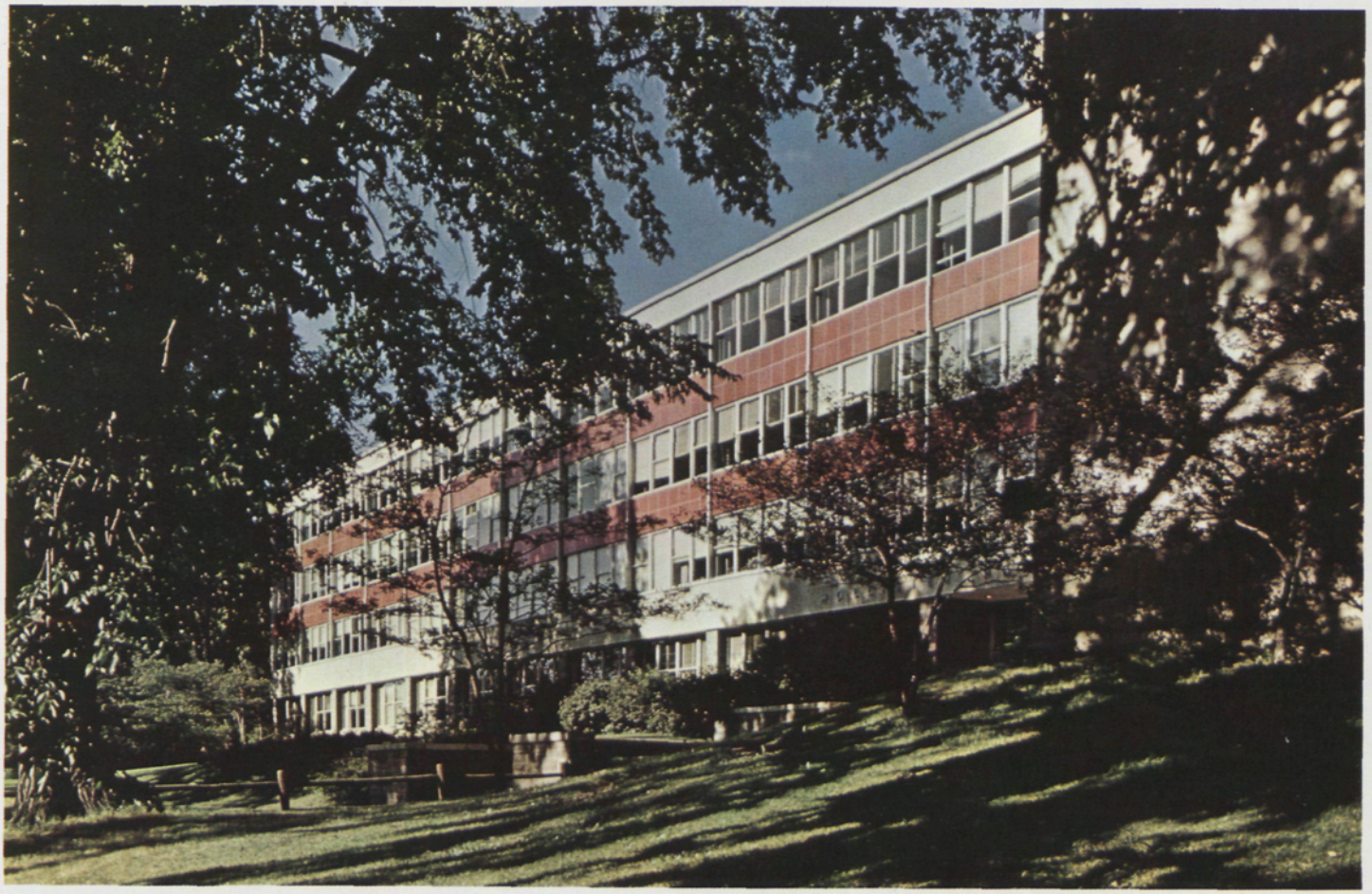
Phillips Hall is the teaching and research center of the School of Electrical Engineering. Located here are specialized laboratories to support work in plasma studies, quantum electronics, solid state electronics, optics and spectroscopy of solids, radio astronomy, and radio wave propagation. Cornell operates the internationally known Arecibo Observatory in Puerto Rico, which was designed by faculty members of the School.

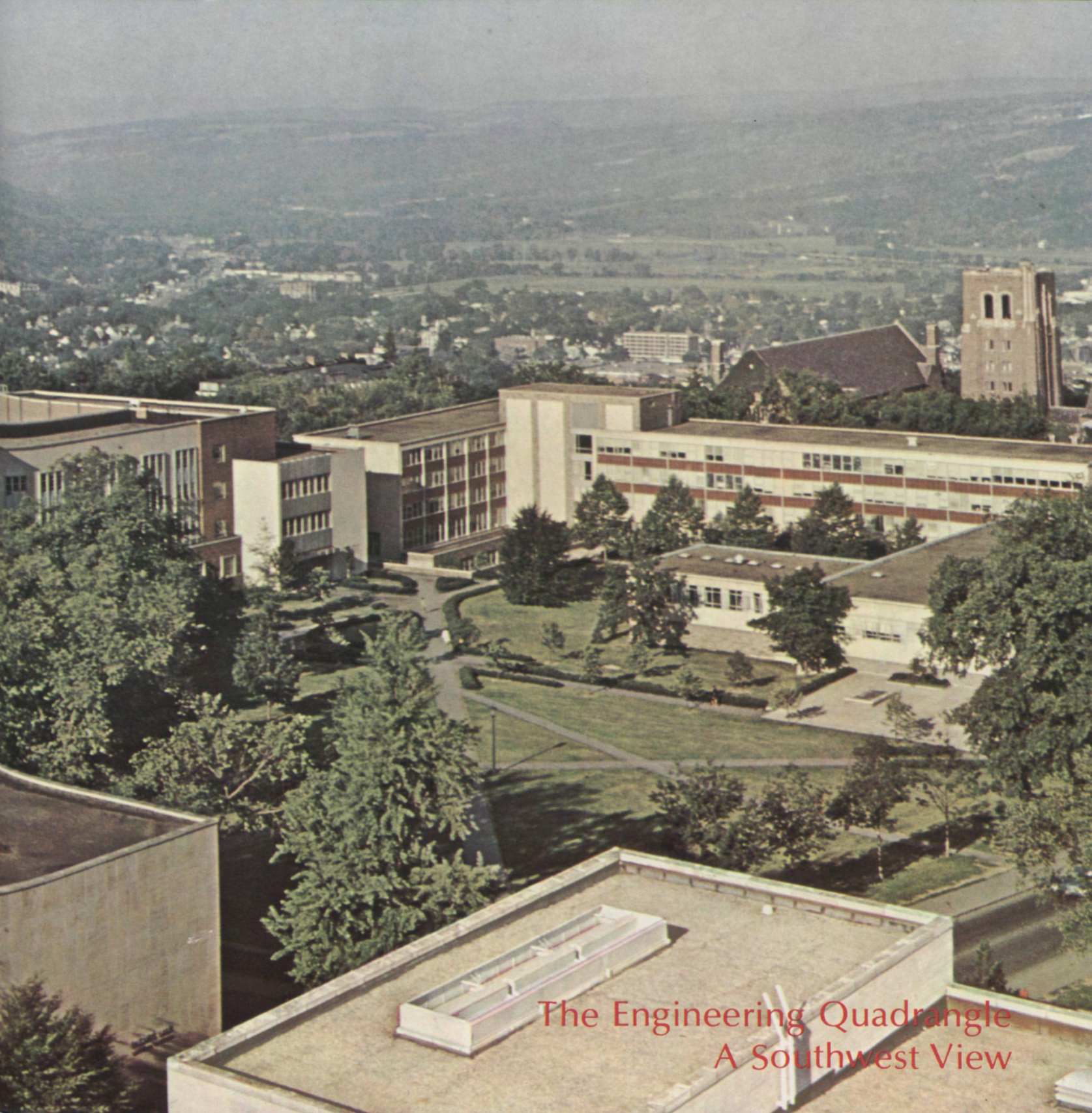


The School of Chemical Engineering is housed in Olin Hall, a modern building which initiated the College's move to the present campus area. Specialized laboratories in Olin include the Geer Laboratory for Rubber and Plastics, an extensive Unit Operations Laboratory, and others for biochemical engineering, microscopy, process control, and kinetics.

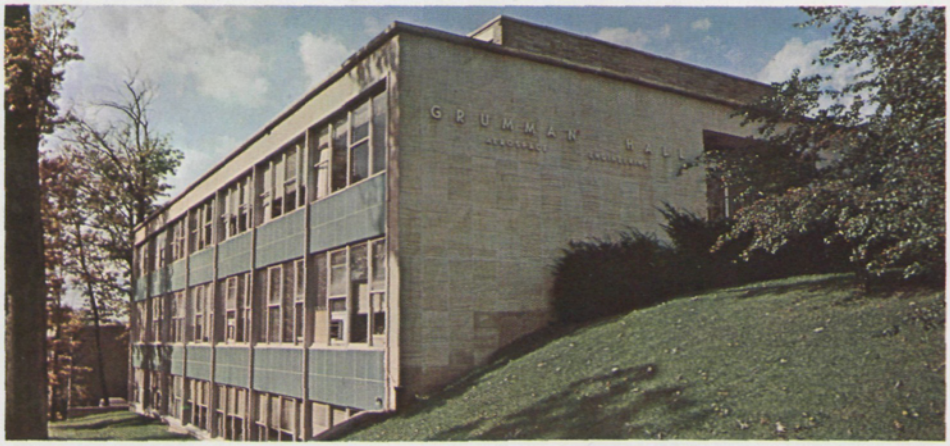
Opposite page, below: Hollister Hall, situated near the Cascadilla Gorge entrance to the University campus, is the main facility of the School of Civil and Environmental Engineering. Two University centers for interdisciplinary work related to this field are also housed here: the Center for Environmental Quality Management and the Water Resources and Marine Sciences Center. In addition, offices of the Division of Basic Studies, which administers the underclass program of the College, and of the Engineering Counseling Center are located in Hollister.

Opposite page, above: Many engineering undergraduates elect to live in the Baker complex of dormitories, down Library Slope from the Engineering Quad.





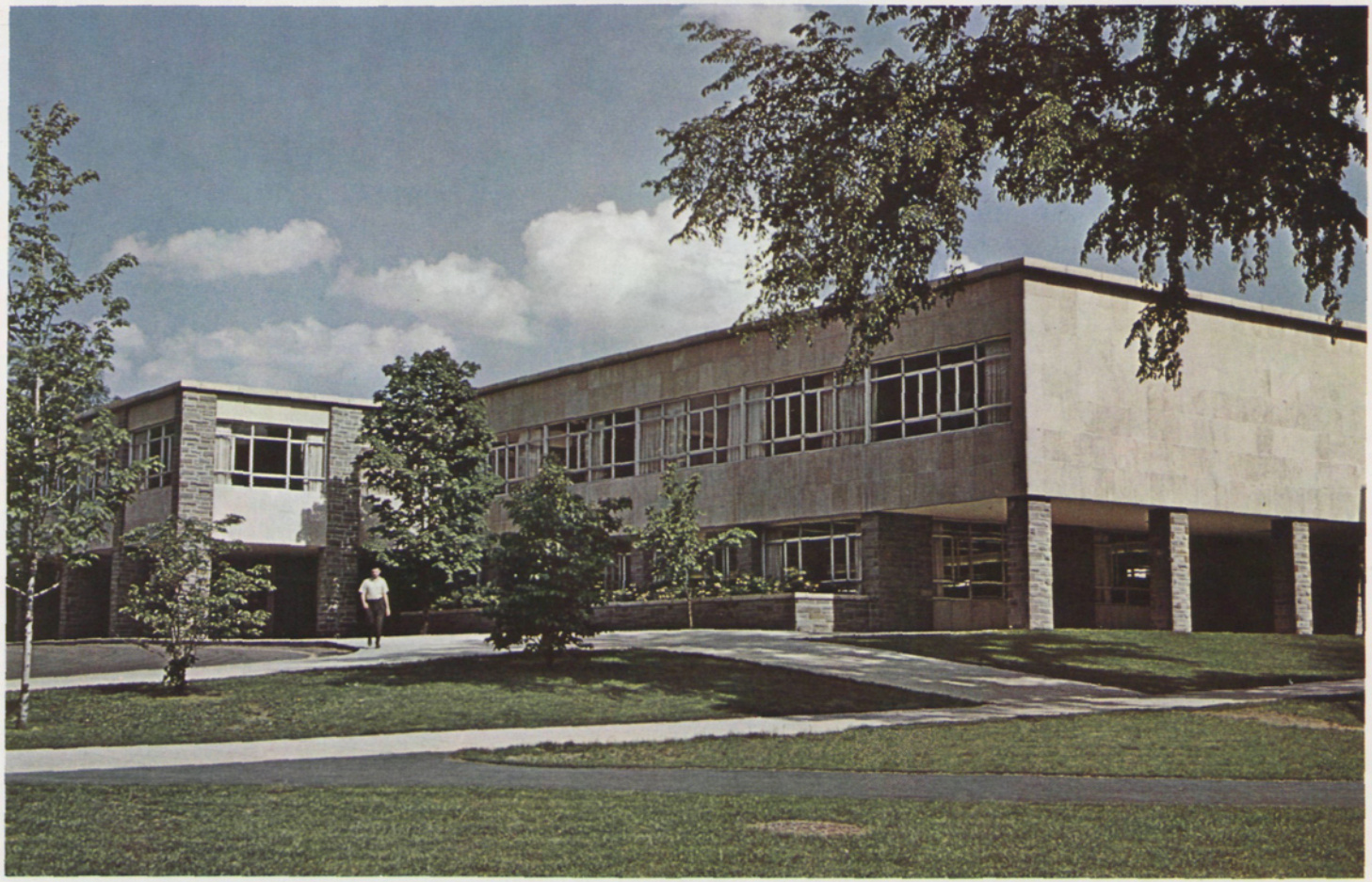
The Engineering Quadrangle
A Southwest View



Most of the facilities of the School of Applied and Engineering Physics are located in the Clark Hall of Science (right, below). This building serves the University's Department of Physics and is situated on the Arts and Sciences campus. It houses the Physical Sciences Library, research laboratories for solid state and surface physics, and the Materials Science Center. The Ward Laboratory of Nuclear Engineering (below) is on the Engineering Quadrangle. Its facilities include a TRIGA reactor, a "zero-power" reactor, a gamma radiation cell, and a low-energy ion accelerator.

Opposite page, top: Grumman Hall, home of the Graduate School of Aerospace Engineering, is primarily a research center. Facilities support study in such areas as aerodynamics, plasma physics, high-temperature chemical kinetics, laser chemistry, gas and fluid dynamics, magnetohydrodynamics, and ferro-fluid dynamics.

Below: The administrative offices of the College of Engineering and the Engineering Library are located in Carpenter Hall. Included are offices of the Dean and his staff, conference rooms, the College publications office, and a suite of offices for various student services, including admissions and placement. The Library's main reading room and the Albert W. Smith Browsing Library are on the ground floor. The Engineering Library's collection of approximately 125,000 books and periodicals is part of the University's total holdings of more than 3.6 million volumes.



Bard Hall is part of the Kimball-Thurston-Bard complex of connected buildings which provide a center for instruction and research in materials and structures, and for the testing of materials and structural elements. Most of the laboratories and classrooms of the Department of Materials Science and Engineering are housed in Bard. The building also functions as a facility of the University's interdisciplinary Materials Science Center. One of the special facilities is the Edward Bausch Laboratory of Metallurgy.

Kimball-Thurston Halls (opposite page) house the Department of Theoretical and Applied Mechanics, facilities of the Department of Structural Engineering, and the Department of Geological Sciences. Laboratories for undergraduate courses in mechanics and in strength of materials are located here. There are specialized laboratories for high-pressure studies, and three large structural engineering laboratories — for the full-scale testing of components, for model building and testing, and for cement and concrete studies.


THEORETICAL AND APPLIED MECHANICS
THURSTON HALL

College of Engineering
Cornell University

ENROLLMENT DATA: FALL TERM 1971

Undergraduates	2,117
Graduate Students	646
Underclass Enrollment	
Freshmen	664
Sophomores	529
Junior and Senior Enrollment	
Chemical Engineering	99
Civil and Environmental Engineering	162
College Program (interdisciplinary)	87
Electrical Engineering	239
Engineering Physics	89
Industrial Engineering and Operations Research	150
Materials Science and Engineering	8
Mechanical Engineering	90
Graduate Enrollment (including M.Eng., M.S., and Ph.D. degree candidates)	
Agricultural Engineering	20
Aerospace Engineering	23
Applied and Engineering Physics (including Nuclear Science and Engineering)	80
Chemical Engineering	48
Civil and Environmental Engineering	98
Computer Science	53
Electrical Engineering	104
Geological Sciences	7
Industrial Engineering and Operations Research	85
Materials Science and Engineering	45
Mechanical Engineering	57
Theoretical and Applied Mechanics	26

Some Faculty-Directed Projects

1970 – 1971

AEROSPACE ENGINEERING

Aerodynamics, Noise, and the Sonic Boom
Solitary Waves in a Magneto-plasma
Design and Building of a Prototype External-Combustion Nonpollution Engine
Spherical and Cylindrical Ion Probes in Flowing Continuum Plasmas

AGRICULTURAL ENGINEERING

Mechanical Harvesting of Fruits and Vegetables
Animal Waste Management
Irrigation System Requirements for Rice
Why Roads Break Up in Spring

APPLIED PHYSICS

Radio Observations of the Crab Nebula
Electron Microscope Observations of Molecular Structures of Biogenic Macromolecules
Slow Neutron Scattering and Thermalization
Lunar Electrical Conductivity

CHEMICAL ENGINEERING

Single Cell Protein from Chemical Wastes
The Transport of NaCl and Water Through Compressed Hydrophilic Films
A Model to Represent Bile Transport of Drugs
Phase Structure in Blends of Incompatible Polymers

COMPUTER SCIENCE

Automatic Information Organization and Retrieval
Formal Languages and Their Relation to Automata
Theory of Scheduling

ELECTRICAL ENGINEERING

The Outer Atmospheres of the Earth and Jupiter
Integrated Circuit Technology
Computer-Aided Circuit Design
Semiconductor Microwave Devices
The Design and Construction of an Electric Passenger Vehicle

ENVIRONMENTAL ENGINEERING

Land Use Classification with Simulated Satellite Photography
Currents and Circulation in Large Water Bodies
Applications of Economic Theory to Environmental Quality Management
Environmental Noise Management
Transportation Impact Analysis

GEOLOGICAL SCIENCES

Seismology and the New Global Tectonics
Mantle Earthquake Mechanisms
Recent Crustal Movements in New Guinea and in the Eastern United States

MATERIALS SCIENCE AND ENGINEERING

The Field Ion Microscopy of Gold
A Study of Void Formation in Fast Neutron-Irradiated Metals
Capillarity and Step Interactions on Solid Surfaces
Stress Aging in Anhydrous Nylon
Observation of Electromigration in Thin Films

MECHANICAL SYSTEMS AND DESIGN

The Behavior of the Lubricating Film Under Different Dynamic Loadings
Vibration, Noise, and Impact Control
Transient Temperature Distribution in Inertia Welding of Steels
The Design of Biomechanical (Prosthetic) Systems
An unmanned Martin Roving Vehicle

NUCLEAR SCIENCE AND ENGINEERING

Shape Isomerism and the Double-Humped Fission Barrier
Elemental Abundance of Apollo 12 Lunar Soil and Rocks
The Measurement of Neutron Importance Functions

OPERATIONS RESEARCH

Analytical Methodology and Optimal Control in Urban Traffic Networks
Multiple Decision Selection and Ranking Procedures
The Cooperative Theory of Behavior and its Applications

STRUCTURAL ENGINEERING

Model Analysis of Reinforced Concrete Structures
Interaction of Diaphragms and Multistory Building Frames
Application of Finite Element Analysis Techniques to Proposed Structural Designs
Optimum Design of Structures with a Minimum Cost Criterion

THEORETICAL AND APPLIED MECHANICS

The Psychology of Robots
Adhesion and Partial Slip Between Loaded Rough Surfaces
Portable Submersible Vehicles
The Free Dynamics of Pulsars
Wave Equations and Weak Damping

THERMAL ENGINEERING

External Natural Convection Flows
Design, Construction, and Operation of Purely Chemical Lasers
Bond Stresses in Composites with Overlapping Fibers

Donald F. Berth, chief editor of ENGINEERING: Cornell Quarterly, *has been at the College of Engineering since 1962. He has served as administrative assistant to former Dean Corson and as director of college relations, and since 1968 has been assistant dean with Dean Schultz.*

He founded the Quarterly, *a publication that has received a number of awards for excellence, in 1965. He also developed the College's informational and promotional publications program, which now produces more than one hundred items annually. Last year he initiated a new undergraduate advising and counselling program and served as its first director. His College activities have also included teaching, educational development and participation in the admissions program.*

For several years Berth was director of admissions and assistant to the president at Corning Community College in upstate New York. He developed a two-year transfer program in engineering science and the College's admissions program, and taught physics and chemistry.

A native of Massachusetts, he holds the BChE and MChE degrees from Worcester Polytechnic Institute; and he has also done graduate work in administration and social sciences at Cornell and at Harvard Universities.

Gladys J. McConkey became associate editor of the Quarterly *last fall and has served as editor for other College publications.*

She has been at Cornell since 1956, when she began a six-year assistantship in chemical physics research with the late Professor Peter J. W. Debye, a Nobel laureate. At Cornell she also worked for six years as an editor and writer of technical publications in biochemistry.

Mrs. McConkey, a native of Cleveland, Ohio, holds a B.S. degree in chemistry from Western Reserve University and an M.S. in biochemistry from the State University of Iowa, and has had additional graduate work in chemical physics. Her first research experience was with the Standard Oil Company of Ohio, and she later held a research assistantship in pathological chemistry at the School of Medicine at Iowa.

Her experience in publications includes a five-year period at Morehead (Kentucky) State University, where she taught journalism and was in charge of public relations and the news bureau.

She is a coauthor of Topics in Chemical Physics, *based on special lectures at Harvard University by Professor Debye (Elsevier Publishing Company, 1963) and of several scientific papers.*

Cover Illustrations

Outside front: Five men have served as dean of the College of Engineering since its consolidation in 1921. Top row, left to right: Dexter S. Kimball (1921–36), Herman Diederichs (1936–37), S. C. Hollister (1937–59). Bottom row, left to right: Dale R. Corson (1959–63), Andrew Schultz, Jr. 1963–).

Inside front: The machine shop of Sibley College of the Mechanic Arts was an innovation in engineering education in 1885 when this picture appeared with an article on the College in the October 17 issue of the Scientific American. *The shop was "fitted up with lathes and planers, milling machine and slotter, and with all the needed hand tools." The steam engine seen in the foreground was built by students under the direction of Professor John Edson Sweet, master mechanic and director of the machine shops from 1873, and had been exhibited at the Centennial Exhibition of 1876.*

Inside rear: The "dynamo room" in Sibley Hall provided machinery for instruction in the electrical engineering curriculum that had been introduced in 1883 by physics professor William A. Anthony. In this engraving, which was shown with the 1885 Scientific American *article, "a machine is seen supported upon the cradle of the Brackett dynamometer, and driven by a steam engine placed below." Also located in the room was the historic Gramme dynamo, the first in America, that had been built between 1872 and 1875 by Professor Anthony with the help of a mechanical engineering student, George S. Moler. The dynamo was powered by a five-horsepower gas engine, itself a marvel of the time, and delivered direct current through underground pipes to two open and sputtering arc lamps on the campus. This equipment represented the nation's first system for underground transmission of electricity, and its first outdoor electric lighting system.*

ENGINEERING: Cornell Quarterly
Editor: Donald F. Berth
Associate Editor: Gladys J. McConkey
General format and production assistance by the Office of University Publications

Lithographers: General Offset Printing Co., Springfield, Massachusetts

The press run of this special commemorative issue is 20,500. Additional copies may be purchased at $3.00 each. Body type is Times Roman and the heads are Optima. The cover is lithographed on Carnival Hopsack Embossed, the text on Mohawk Superfine and Mead Black and White Enamel Dull.

All correspondence, including notification of change of address, should be sent to ENGINEERING: Cornell Quarterly, Carpenter Hall, Ithaca, New York 14850.

Acknowledgments

The production of this special issue of the *Quarterly* was facilitated by outstanding technical assistance on the part of several individuals. The authors wish to express their appreciation to David Ruether, our staff photographer, who took the color pictures and the photographs of present faculty members; to Warren E. Rosati '45, of General Offset, who helped greatly with liaison between the authors and the printers, and design services; to Ronald E. Lohnes, also of General Offset, who was responsible for production coordination; and to Kelvin J. Arden, Director of Cornell University Publications, who served as a consultant in text and layout design.