Property of Dean's Office
(Do not take away)

History of the College of Engineering
University of Michigan
(Administration and Curriculum)

by

Mortimer E. Cooley

B. S. (Asst. Engr., USNA '78; degree conferred 1938);
M. E., Mich. 85; D. E., Mich. 29; DL.D., Nebraska, 11;
LL.D., Mich. Agr. Col. 07; Sc.D., Armour Inst., 23)

Professor of Mechanical Engineering, 1881-1928
Dean of the College of Engineering, 1904-1928
Dean of the Colleges of Engineering and Architecture, 1913-1928
Dean Emeritus, Colleges of Engineering and Architecture,
1928 to date.

September 1940

History of Engineering College

Scientific instruction was in its infancy in the United States at the beginning of the nineteenth century, and was available in only a few American colleges. Courses in astronomy, botany, physics, and chemistry had been taught in a few institutions; a department of mathematics and natural philosophy had been created in Harvard College in 1727; a professorship of botany in Columbia College in 1792; and a class in chemistry at Princeton in 1795. Physics and chemistry had been taught at the University of Pennsylvania and Dartmouth College; physics was taught in Union College. The usual method of instruction was by lectures, supplemented occasionally by experiments which the teachers performed. Ricketts, p.1

During the colonial period in America, industrial production was almost wholly confined to agriculture. After the Revolutionary War, the necessity for home industry became apparent and the beginning of American engineering and mechanical inventiveness were fostered. In 1790 Samuel Slater, a skilled English worker, established at Pawtucket the first successful mill driven by water power; in 1793 Eli Whitney invented the cotton gin which determined the industrial future of the South; Oliver Evans made the first machinery for flour mills in 1787, and in 1801 completed the first high pressure steam engine. Philadelphia equipped its waterworks with a double steam pump in 1801, built by Nicholas I. Rooseveldt. Six years later Robert Fulton made his celebrated trip up the

The collegiate plan of organization and most of the traditions of the professoriate can be traced back to classical colleges and the older universities of England; the interrogatory rather than expository form of teaching has its origin in the English grammar schools; the early engineering curricula were patterned after the French models, and the professional status of engineering schools is French, rather than similar to the British pupigate system; the early models of teaching manual arts were Russian; from Germany came the emphasis upon research and modern research methods. Out of American inventiveness developed the introduction of individual methods of laboratory instruction, unequalled anywhere in the world, and the provision of distinctive training in the economic and management phases of engineering. In no other country have engineering schools received so little outside domination as in America. The technical schools here have developed according to the ideas of the educators directly in charge of them; little is owed to statecraft except the means of extension and support; little to the organized engineering profession except occasional criticism of ways and methods of instruction; little to industries except needs for different training, employment for graduates, and gifts of equipment. SPEE, 822- 3

Had there been provision made in the "Catholepistemiad (or University of) Michigania" of 1817 for a course in engineering, the University of Michigan might have been the first to establish an engineering course in the United States. To consider the

descriptive geometry, with its application to shades, shadows, perspective and stone cutting, together with isometrical and spherical projections; drawing, in plan and elevation; topographical drawing; tinting in colors; Physics, including mechanics, acoustics, optics, heat, electricity and magnetism; Natural Science, including chemistry, mineralogy, geology, and meteorology; Astronomy; Language, including English language and literature, either French language and literature or German language and literature, and rhetoric; Philosophy, including logic, mental and moral science; Engineering, including plane, geodesic, railroad, and mining surveying, leveling, nature and strength of materials, theory of constructions, architecture, machines (particularly the Steam Engine and Locomotive), motors (particularly Steam and Water)." Catalog 1855-56 p. 34, & ff

Thus, from the very beginning, the degree in engineering at Michigan, first conferred in 1860 on Frank L. Krause and William Minto, has been based upon a complete four years of college work. As early as 1858 the University had an opportunity of becoming the first school to require a course of five years for engineering graduates. At a meeting of the Board of Regents held that year, Professor DeVolson Wood summarized the problem of getting the necessary engineering training as well as the classical requirements felt to be essential, into four years; he asked the Academidal Faculty to report their views on this matter. "Should the entire engineering course be included, in point of time, within the present undergraduate course of four years, or should a fifth be

added to complete the course?" This query, first formulated by a University of Michigan engineer in 1858, has not yet been answered in the affirmative; It was not settled at that time, but the problem was raised many times thereafter, and the five-year course advocated and recommended, by Mortimer E. Cooley, Dean of the College from 1904 to 1928.

Regents 1858 p.896

Another point of originality about the engineering course at the University is that it was the first in the country which was strictly a public institution; which was not the product of private beneficence, and which was recognized from the first on a footing of entire equality with the classical department of the University. It was started in such a manner that by mere expansion and growth, without radical change of any kind, it could and did expand into an engineering school of the first class.

The first member of the faculty to teach a class in engineering was Alexander Winchell (B.A., Wesleyan, 1847; and Hon. LL.D., Wesleyan, 1867) son of Horace Winchell, who was appointed Professor of Physics and Civil Engineering in 1853; in 1855 he was made Professor of Geology, Zoology, and Botany. During 1854 and part of 1855 he lectured in civil engineering. Professor Winchell died in 1890, having taught at the University for thirty-three years. He was away from the campus for four years, during his incumbency of the Presidency of Syracuse University and while he held a professorship in Vanderbilt University. Winchell was a man of large and varied learning, not only in the sciences which he taught,

but also in mathematics, physics, astronomy, ethnology, language, and philosophy. His work was widely known both in this country and in Europe, and his was a distinguished name to stand as the first professor in the engineering department at Michigan. Biog. data Hinsdale;

When Winchell was appointed to teach physics and civil engineering, he wrote in his diary Dec. 1, 1853, "as to civil engineering, I shall have little to do with it at present as the study has not yet been initiated." In February of 1854 he gave his first lecture on civil engineering; it lasted one-half-hour. By March he had started instruction in surveying and Parker's Aids. The first surveying instruments were bought that year, a Theodolite for $285 and a Level for $130, among other things. After this the class spent some time nearly every day outdoors with the instruments. Winchell reported that the students enjoyed this work nearly as much as he did. By 1855 he was considering elaborating his lectures into a book on civil engineering, feeling that a text was much needed as none was available which met the requirements here. Winchell undertook Winchell Papers, Vol. 78

Winchell Papers Vol. 78

to make a railroad survey in 1855, for which he was paid $5 a day. Thus the first professor of civil engineering was also engaged in a collateral practice, a policy which has continued to this day.

Among the papers which Winchell prepared relating to engineering were Civil Engineering; Wood as a Building Material; On Railroad Curves; To Find the Length of a Degree of Longitude in Any Latitude; Determination of Magnetic Meridian; On Dials and Dialing; Investigations, Formulae, Problems and Solutions in Mechanics.

Winchell was succeeded in 1855 by William Guy Peck (Brevet 2nd Lt. of Topographical Engineers, U.S.M.A., 1844), son of Alfred and Susan Baldwin Peck, who held the professorship of Physics and Civil Engineering, Peck stayed only two years, resigning in 1857 to go to Columbia where he was a professor of mathematics and astronomy. He was the author of many works in mathematics and astronomy, and died in New York City in 1892, aged 71.

M.E.Cooley file

Instruction in surveying and civil engineering lectures were continued under Professor Peck, who also acquired additional instruments, apparatus, and books, for the department of physics and civil engineering. Regents

The real founder of the engineering department was the next member of its faculty, De Volson Wood, who was made Assistant Professor of Civil Engineering in 1857, Professor of Physics and Civil Engineering in 1859 when he took his Master's degree here, and Professor of Civil Engineering in 1860. It is an interesting circumstance which in large measure determined the future of the Engineering College that its first permanent and continuous professorship was filled by an engineering graduate of Rensselaer, and shortly after President Tappan began his remarkable educational work here. Tappan was a man of broad and liberal views concerning educational affairs, and was one of the first to introduce in this country the Prussian ideas of the functions and administration of a University. While the University, when he came to it, was an

old-fashioned traditional college, Tappan believed an educational system of public instruction throughout the state, in which he so ardently believed, could be developed in Michigan, and hence he took an appointment to the Presidency here which otherwise would be difficult to understand in view of his standing, and the poor showing that Michigan had made so far. Tappan was one of the first educators to recognize the value of technological studies; and it was under his leadership that there was established as early as 1855-56 the four-year course in engineering at Michigan.

DeVolson Wood was the son of Julius and Amanda (Billings) Wood, and was born June 1, 1832, on a farm near Smyrna, New York. He was a teacher from the age of 17 until his death at 65 in 1897, teaching while he attended Albany Normal School (graduated (1853), and Rensselaer Polytechnic Institute (C. E., 1855). After he had completed his district school work, his father released him from farm work and he taught the district

Wood biog material From M.E.Cool file; magazine sketches, obituari and orig- inal reminisc ces by h daughter.

school, giving his father the money to pay for a hired man in his place. The next summer he walked across the state of New York to enter the Albany Normal, working on the way for his meals and bed. His extra clothing was a pair of jeans and two night shirts. He finished the course in one year. The next session he taught at the Normal School and took the train each afternoon to attend Rensselaer. In August of 1857 he started for Chicago where he had heard there was a teaching vacancy. He reached Detroit with no money to go further, and, leaving his baggage, walked to Ann Arbor. He thought if he only had ten cents, he would write his mother to tell her he was all right. In going up the steps to one of the campus buildings he found a dime. On later occasions in Ann Arbor, when he sought much needed funds for additional space and equipment for his engineers, Wood was not always so fortunate.

He introduced himself to President Tappan. Professor Beck had not returned, and Wood was asked to substitute for a

few days. He went out and found a boarding house, promising to pay as soon as he was paid. Since Peck did not return Wood was appointed Assistant Professor of Civil Engineering, and thus the first professor with a thorough training in engineering and in the teaching of engineering became a member of the faculty.

Even as a school boy, Wood had given evidence of his originality and scholarship. While he was in the Albany Normal School he developed and made practical a system of alligation taught in every school, although the author is known but to few. When he was 24, he had calculated and published material relating to an eclipse of the sun, telling weeks beforehand just when it would start and end. This calculation was used in a contemporary almanac. He had, throughout his life, an eager enthusiasm for and knowledge of astronomy.

n.b. Please do not change the spelling of alligation

DeVolson Wood was one of the best known professors in the United States. Beyond that reputation lay extraordinary ability as a mathematician and as an analyst, remarkable strength and simplicity of character, and a genius for teaching which made his reputation a good deal more than temporary or local. His powers as a mathematician have given him a permanent place in the literature of engineering, and no student of the higher mathematics of engineering can remain ignorant of the name of DeVolson Wood.

His real greatness was as a teacher. Perhaps that is misfortune; a teacher leaves no monument except in the hearts and in the minds of the men who actually come under his personal influence.

The peculiar merit of his teaching lay in his capacity to make men think for themselves, laboriously and enthusiastically. He was a man of untiring industry, full of suggestions and inquiries, animated always by a robust and transparent love of

truth; only the dullest students could fail to make creditable progress under his guidance. This genious for industry and this capacity for self-help are among the elements of character he succeeded in planting firmly in the long list of engineers who had the good fortune to come under his instruction both here and at Stevens Institute.

Sometimes, in educational circles, the accusationis made that engineering students do not receive much "cultural" background. Hotchkiss, of Rensselaer, once wrote: "Culture comes from many sources. It comes vastly more from the teacher than it does from what he teaches. I believe it is perfectly possible to take a course in Latin from a teacher who is possessed of little or no culture and go out of that course with no culture. I believe it is possible for a man to take a course in calculus under an inspiring, cultured teacher, and to go out of that course in calculus with a rare wealth of culture." Wood was the latter kind of teacher. In fact, the early days of engineering at Michigan, before the day of specialization, were remarkable because of the breadth of education and vision on the part of its small faculty.

In appearance, Wood was a striking figure. His solid and robust frame, his keen eye and square jaw, his frank and ready smile, his quick laughter - all these were part of his influence on young men. The youth who came in contact with him could not help feeling that he stood before a real man. He had a gift of personal interest in his students. It was not that he took any special trouble with any one man; but he was always able to carry a man's personality in his own mind, and he seemed always to be interested in knowing something about a man's career. And so it came about that his influence on the lives of his students did not cease when they left his classroom. In 1872 he reported on the graduates under him, saying "Of these, there are at present 62 civil engineers, 11 professor or teachers, 2 in business, 2 farmers, 1 editor, 1 assistant in an observatory, 1 director of the Cincinnati observatory, 1 whose business is unknown; one was killed at the Battle of Shiloh."

Regents 1872 (149-152)

When Wood came to Michigan, he prepared a syllabus of a proposed course in engineering, and the next year the Regents adopted the following resolutions:

Resolved, 1st that an Engineering Course be added to the present curriculum of the University

Resolved, 2nd, that the degree of Civil Engineer be conferred upon those who may pursue the engineering course and pass an approved examination.

Resolved, 3rd, that...Professor Wood's syllabus of that course be referred to the Academical Faculty.

Regents 1858 (896)

Under the course as it developed, instruction was begun in the sophomore class of the Scientific Section, when Land Surveying was started at the beginning of the year and continued for nine weeks. The classroom exercises consisted of recitations from Gillespie's Land Surveying, and lectures. The field exercises were not planned to make expert surveyors, but to teach the principles involved in surveying. Each student was required to do every part of the work for himself; he used the axe, chains, carried the flag, used the compass, the transit, and the theodolite, and computed his work from his field notes and made a plat of it. Neatness and accuracy in the reports were insisted upon. In 1872, a young lady took this course; "she was relieved from what might otherwise have been an embarrassment in the field work by the attendance of her brother who was in the same class." This young lady was Laura Rogers White, B.S., '74.

After Land Surveying, the class took up geometrical drawing, tinting and shading. The textbooks were by Warren, Drafting Instruments and Plane Projection Drawing. The students worked two hours a day on this subject in the drawing room under the supervision of an instructor. Besides the time spent in drawing, students were required to learn the theory, and to attend occasional recitations and reviews on the subject. This course extended over the second half of the first semester. Instruction in Descriptive Geometry was given the sophomore Scientific and Latin Scientific sections during the last half of the second semester.

Juniors in these sections took Shades and Shadows (Warren's) during the first semester. The recitation occuped one hour a week, the drawing exercises two hours each day for four days a week. Most of the drawing was done in the drawing room, though some was permitted in the students' rooms. In addition to the textbook figures, students constructed the perspective of objects from measurement. No one was allowed to pass who could not construct his thesis correctly and tint and shade it neatly.

During the second semester, juniors took Land Surveying, similar to but more complex than that given the sophomore class. Senior and junior classes in engineering lectures were given. The lectures extended over a portion of two years, alternating on successive years. The subjects covered the principles of steam engines of various kinds, principles of designing machinery, pattern making, moulding, and shop work. Part of this two-year lecture course consisted of exercises in machine drawing; Wood developed a novel method of instruction in this. He assigned a problem unfamiliar to the students, asked them to solve it, and to make a working drawing to represent their idea, accompanied by a specification and report. Solutions were reviewed and criticized before the class. As an example: Wood described the construction and operation of an ordinary D valve, showing particularly that in order to open a port so as to reverse the stroke of a piston, the valve, up to the point of opening the port, is moving in the opposite direction from the piston. The class was asked to invent such an arrangement of parts that the valve would open the port correctly if it moved the same way as the piston. From this

all the working parts of the steam engine were considered. The problems were simple, and were intended as a means of instruction, not as puzzles. In order to solve them,however, the students not only became familiar with what existed but also learned other possible ways of accomplishing the same end, and in connection with the criticisms learned why a particular combination was used. This class also read part of Warren's Machine Construction Drawing. After Class Day, the juniors took up railroad surveying.

The senior class in civil engineering began the theory and practice of the construction of roads and railroads, using Henck's Field Book forEngineers and Gillespie's Roads and Railroads. A course of lectures was given upon the construction of engineering instruments, modes of adjusting them and on various subjects having to do with railroads and roads. As early as 1860 the need for a course in road construction had been felt, and the Regents approved a study leading to answers for the following questions.

1. At what season of the year can our earthen roads be worked most advantageously?
2. Ought the same degree of dryness of the earth be required to work the roads as the farmer desires to make his fields mellow and pilourent?
3. When are covered or tiled drains preferable to open drains?
4. Would one tiled drain along the axis or center of a road ever þe preferable to two parallel ones on the outside?
5. When can the scraper be used economically in grading a road?
6. When the wheelbarrow?
7. When the cart?
8. In grading a hill, is it more economical to cut at once to the depth required and to fill at once to the heights or to do so by partial cuttings and fillings?

These questions were introduced with the statement that the subject of making earthen or common roads had received but little attention from the scientific world, and that the University's Scientific Department might attempt to consider the problem. Thus was the beginning laid for the Department of Engineering Research, established in 1920, sixty years after the first problem had been put to the staff and students of the College of Engineering for research on a matter of value to the State at large.

In the course on roads and railroads, the students were not only required to use the instruments in the field, but to adjust them. They did all the preliminary work of laying out a railroad

beginning with a reconnaissance, surveying the line, locating it, then re-surveying it. They took the levels, established a grade, set the side stakes, computed cuts and fills, made a finished map of the line including the profile.

Following roads and railroads was a course upon the resistance of materials, in which Wood used his own work as a textbook; and a course of lectures on the theory of bridge construction, the theory of hydraulic motors, the theory of the distribution of the water in cities, and other problems. Special attention was given to bridge construction.

Wood felt that the lecture system was a comparatively slow one and should be resorted to only when satisfactory textbooks were not available. He preferred the textbook method, with questions, criticisms and expansion of the contents. Because much of the information for the courses was scattered throughout many books, he was obliged to lecture in a systematic way and to assign outside reading. Books on engineering were housed in the library of the University, and much reading was done there. The engineering books were not collected in a separate library until the completion of the West Engineering Building

in 1904.

Military engineering and tactics were provided for in 1861, but because of the Civil War no available professor was found; Wood lectured on these subjects also.

In 1872 Wood gave a course of 30 lectures to one student in mining engineering; this course pertained to the engineering operations necessary in the process of mining.

Engineering classes in these days occupied three or four rooms in the South Wing of University Hall, rooms used for student dormitories in the early days (South College, built in 1849). They were heated by wood stoves stoked by the professor or an obliging student from immense woodboxes, daily filled by 'Jimmie' Otley - who was later promoted to an easier berth in the cloak-room of the Library. The water needed for the drawing room was supplied from a battered zinc pail, refilled from time to time as use demanded. It was a restricted environment, but a great deal of excellent work was done there, although under very disadvantageous conditions and heavily discounted by the lack of accommodations.

Demison
1902 (Technic)

Most of the teaching during the sixties was done by Wood alone, although at various times he had assistants and instructors to lessen the burden of his heavy schedule. Cleveland Abbe (A.B.) who later became a distinguished meteorologist, was an instructor in physics and civil engineering in 1859-60; Elmore Horton Wells (B.S,C.E.) was an instructor in engineering in 1864; Wm. Butler Morgan (C.E., A.M.) was an instructor in math and civil engineering in 1856-66. Assistants had been G. Y. Wisner in 1865, Stillman Williams Robinson (1866-67) who became an assistant professor of mining engineering and geodesy in 1867, and J. Burkitt Webb (1871). In 1872 Joseph Baker Davis (C.E., 1868) was appointed Assistant Professor of Civil Engineering, and, after Wood, was the second professor to be appointed to the engineering faculty who stayed for any length of time.

DeVolson Wood, the founder of the engineering department, was a true prophet. Not only could he calculate an eclipse of the sun when he was 24, but he was early convinced that the day was not far distant when we would see three things: a canal across the Isthmus of Panama, a horseless carriage, and flying

in the air. He experimented a good deal in attempting to develop flying, and in 1893 read a paper on balloons at the World's Fair in Chicago. But the broad vision he held in so many things was especially important to the future of the engineering college. In his 1871 report on the college, Wood summarized the engineering work and facilities thereof at Lehigh, Stevens, Illinois Industrial University, Yale, and Harvard, and first raised the question concerning the establishment of the engineering college as a separate unit from the literary college. Although this separation did not take place for nearly twenty-five years, its foundation was laid when DeVolson Wood wrote:

Regents - 1870-71

> I think we ought to seek for the establishment of a fourth department in the University, to be called the School of Technology, or Industrial School, or School of Arts and Trades, or some other suitable name, within which we should organize advanced courses in General Science, courses in Technical Chemistry, Courses in Engineering and Architecture. To accomplish this requires more means than the University has at its command, and hence an appeal should be made to the citizens of the State to endow such a school, or endow professorships, or erect a building, or to furnish apparatus; and if this does not succeed, an appeal should be made to the State for the same object, trusting that from one or both sources the necessary means might be secured to enable the University to develop such a department as to do credit to itself and meet the demands of the times.

Of Wood certainly it could be said by his successors, as Dr. Angell said of Dr. Tappan in 1887, "Not even yet have we filled in the sketch which he drew of the ideal University for

In connection with his ideas about the establishment of a a fourth department or college of engineering, stating how much money the establishment of a separate "Department" (i.e., College of Engineering) would require, Wood was asked to prepare a "memorial" concerning the funds required. He estimated a need of an endowment of $241,000 for a school of engineering, to provide for a new building, an apparatus fund, a library fund, equipment for shops, and professorships in civil, mechanical, and mining engineering, freehand drawing, geodesy and field operations. He estimated that if a complete technical school were to be developed, an additional endowment of $132,500 would be required, providing for professorships in metallurgy and assaying, architecture, chemistry, experimental physics, geology, zoology, taxidermy, modeling in plaster, clay, and waxite, and for models in architecture. The President, in his 1872 report asked for an endowment of from $373,500 to $500,000 for the purpose of a scientific school at Michigan which would embrace all the departments Wood had suggested. Unfortunately, no public-spirited Michigan citizen or citizens stepped forward to make this a possibility, as had been the case at Yale,

Harvard, and Stevens, among others; the separation did not take place until 1895, and then only the engineering courses were included in the new college.

In 1940 a means through which DeVolson Wood's dream of an endowed school providing multiply facilities for work and research was established. The officers of the University, after giving much thought to the problem created by the increasing inability of the State to provide moneyto keep the College of Engineering at its present status as one of the great engineering schools, reached the conclusion that state funds must be supplamented by ample funds from other sources. The Board of Regents therefore approved the creation of the Mortimer E. Cooley Foundation. Its objectives are to supplement the regular funds as required to insure the maintenance of a strong and adequate faculty for undergraduate teaching; to furnish facilities and laboratory equipment; to encourage and foster graduate work by providing funds which will secure and retain teachers of outstanding ability and provid them with physical equipment second to none; to encourage fundamental

research in pure and applied science by all faculty members; and to encourage making special grants to the College of Engineering for the establishment and support of libraries, laboratories, museums, and other instruments of teaching, and for the creation of scholarships and fellowships for advanced graduate work and research. The general plan is to create a Board composed of alumni and faculty members to secure endowments and to administer the funds acquired.

When Wood resigned in 1872 to go to the Stevens Institute of Technology, where he taught until his death, in 1897, returned him to Ann Arbor for burial, he left only one engineer who was already familiar with work at Michigan. This was Joseph Baker Davis, an alumnus of the engineering department in 1868, Assistant Professor of Civil Engineering from 1872 until 1891, when he became Professor of Geodesy and Surveying, a chair which he held until his retirement in 1910. In 1904 he became the first Associate Dean of the College of Engineering.

Upon Wood's resignation, Charles Ezra Greene (B.A., Harvard, 1862; B.S. in C.E., M.I.T., 1868; Hon C.E., Michigan, 1884) was appointed Professor of Civil Engineering in 1872, and in 1895

became the first Dean of the Engineering College. Charles Simeon Denison (B.S. Vermont, 1870); C.E. Vermont, 1871; M.S., Vermont, 1874) was also appointed to the faculty of the engineering department in the first of his several capacities during his forty-two years as one of the most beloved teachers at Michigan. He was Instructor in Engineering & Drawing, 1872-76; Instructor in Engineering and Drawing and Assistant in Architecture, 1876-1881; Acting Assistant Professor of Mechanical and Free Hand Drawing, 1881-82; Assistant Professor of Mechanical and Free Hand Drawing, 1882-85; Professor of Descriptive Geometry, Stereotomy, and Drawing, from 1885 until his death in 1913.

Thus, upon Wood's departure, engineering instruction was left in the hands of the triumvirate which guided its destiny for well over thirty years: Greene, Davis, and Denison, three names which loom exceedingly large in any consideration of the College of Engineering. Greene became the first Dean of the College (1895), Davis the first Associate Dean (1904), and Denison one of the most beloved professors ever to teach at Michigan. Denison's name is commemorated by the Denison

Arch of the West Engineering Building, in which tablets to his memory, and to that of Wood, Greene, and Davis, have been established by engineers in whose hearts and memory no bronze memorials were ever necessary.

Denison became a member of the faculty at the request of his friend, President Angell, who had come here the year before from Vermont, Denison's alma mater. Denison remained a member of the engineering faculty through more than ~~ten~~ generations of students - a total of 42 years. Probably no teacher in the history of the University was more beloved personally than Denison. A bachelor, the students were his whole life; even his profound knowledge of and interest in all things artistic was secondary to his affection for the engineering undergraduates, who early gave him the endearing name of Little Lord Chesterfield.

He was, in a real sense the founder of the present-day Department of Mechanism and Engineering Drawing, the career of which his own so closely parallels. But no story of the Engineering College could be told without the mention of the influence of his

sprightliness and wittiness, his unselfishness and sympathy, his justice and charm. He was the one about whom alumni always asked; when anyone from the University appeared, they would be greeted with, "Tell us of Little Lord Chesterfield." Denison, in his quiet, unobtrusive way stamped his character on everyone who came under his influence while in the University. Of him it could be truthfully said, "His life work was helping to build men."

Charles Ezra Greene, the first Dean of the College of Engineering (1895-1903) was the son of Rev. James Diman and Sarah Adeline (Durell) Greene. He was born at Cambridge, Mass., February 12, 1842. After fitting for college at the Cambridge high school and at Phillips-Exeter Academy, Greene entered Harvard, receiving the B.A. degree in 1862. He entered the business of breach-loading rifle manufacture in Massachusetts, and in February of 1864 became clerk of the Quartermaster's Dept. at Readville, Mass. He was commissioned 1st Lieut. in the U.S. Colored Troops, and served as regimental quartermaster before Richmond, Va., and in Texas, until 1866, when he resigned

and entered the Massachusetts Institute of Technology, graduating with the degree of B.S. in Civil Engineering in 1868.

After his graduation, he engaged in professional railroad and river and harbor improvement work in Maine and New Hampshire, and was city engineer of Bangor, Maine; he carried on a general practice until 1872, when he was appointed Professor of Civil Engineering at Michigan. He was given an honorary Civil Engineer degree here in 1884.

Greene, as a teacher and administrator in addition to an extensive consulting practice, was only one of many members of the engineering faculty who have added lustre to the reputation of the department by the manner in which they have acquitted themselves in professional practice. A theoretical or academic knowledge of engineering, no matter how thorough, has rarely been justification for adding an engineer to the staff here. It has been believed by those who have had in charge the forming of policy for the engineering college that the best teachers of engineering are those who are also the best engineers.

That this has been a wise policy is evidenced by the steady growth of the college from its inception, and by the esteem in which its graduates are held by employers throughout the country. No small part of the opinion of the engineering college is based upon the high regard felt for the members of its faculty as outstanding professional engineers.

Greene gave the appearance of being cold, even austere. He was a strict disciplinarian, perhaps as a result of his army experience during the Civil War. His classroom standards were high, his rigorous mental processes stimulating. To those who neglected their work, Greene seemed severe; to those who showed interest and ability he gave an approval which was highly valued because it was neither grudging nor effusive. The personality of the real man was not evident in the classroom. Outside it, he escaped from his apparent shell of austerity, and was genial, reminiscent, and cordial. He possessed a delightful sense of humor which he reserved for his more intimate friends.

Greene was much interested in his outstanding students, and in the future of engineering education. He directed several students, notably, R.L. Sackett (B.S.(C.E. 91), C.E. '96), Dean Emeritus of the Engineering School of Penna. State College, into the educational field. He was impatient with stupidity, and quick to appreciate exceptional ability of any kind.

Under Greene's leadership, the engineering college enrollment and faculty began the steady climb which has marked most of its history. When he came to the University in 1872 there were 62 students in engineering; in 1875 there were 69 students but due to general national conditions the enrollment began to drop, and in 1881 there were only 25 students; the climb started again in 1882. When the engineering college was separated from the literary college in 1895, and Greene became Dean, there were 319 engineering students; when he died in 1903, there were 828.

The causes of this growth of the engineering college are not difficult to understand. The year 1870 marked a boundary between two quite distinct periods of development in engineering

education. The earlier or formative stage had been led by the creation of new and distinctive schools and programs; its dominating personalities were more often scientists and publicists than engineers; its chief aim had been the training of civil engineers to meet the problems of an era of rapid geographical population and of growth in urban population. After 1870 came the period of expansion and ramification based on the established curricula. Engineers of distinction took an increasing leadership in education; an American literature of engineering began to develop through the authorship of leading professors; the engineering profession took on solidarity and began to influence the scheme of education; and the extraordinary expansion of industry created a wide field for mining, metallurgical and mechanical engineers. This period also saw the development of laboratory teaching, a field where American leadership has been especially marked. The early courses in mechanical engineering were concerned largely with the design of machinery and with the technology of the workship. The problem of power production and application on a large scale did not begin to assume a major

importance until the eighties. Shops rather than the laboratory were the seat of the early efforts at practical instruction. The early emphasis on shopwork was typical of the urge which the schools felt to make their training as practical as possible, as was the tendency of engineering teachers to demonstrate their competency by undertaking collateral practice. The opening up of the fields of electrical and chemical engineering led towards the development of engineering education into a scientific function, with emphasis upon the scientific spirit and original research which have marked the field in later years.

As early as 1864-65 a course in mining engineering leading to the degree of Mining Engineer was announced, and this degree was conferred from 1867 to 1870 although no legislative action providing for a school of mines was taken until 1875-76, when an appropriation was made for a professor of mining engineering, a professor of metallurgy, and a professor of architecture and design, with necessary assistant instructors. Unfortunately the legislature neglected to continue the appropriation at the expira-

tion of the biennial period, and the professors of mining engineering and architecture resigned or were given other appointments.

William Henry Pettee (B.A., Harvard, 1861) was appointed Professor of Mining Engineering; Silas Hamilton Douglas (Hon. M.A., Vermont, 1847), was Professor of Metallurgy and Chemical Technology(1875-77); and William LeBaron Jenney (C.E., Ecole Centrale des Arts et Manufactures, Paris, 1856), an architect in Chicago, was appointed Professor of Architecture and Design in 1876. In 1878, owing to the failure of the Legislature to renew the appropriation, the school of architecture and design came to an early death. Jenney asked for and received a leave of absence for two years, and returned to private practice as an architect in Chicago at the expiration of his leave. No degrees were given in Architecture until 1909, after the department was reestablished. Pettee resinged the chair of mining engineering and was appointed Professor of Mineralogy and Economic Geology, in charge of Mining Engineering. Douglas continued as Director

of the Chemical Laboratory until his retirement in 1877. In spite of the lack of funds, the University made every effort to keep the schools of mining and architecture going; professors in other departments volunteered to teach these subjects.

It seems unfortunate that the University was obliged eventually to drop its plans for a School of Mines. The establishment of one was called for in the Legislature by members from the Upper Peninsula, and a joint committee of the Senate and Legislature visited the University, reporting that we were already giving instruction in many branches pertinent to mining engineering, and that a School of Mines could be organized more economically here than elsewhere. When the professorship was established, purchase was made of furnaces, stamp mill, crusher, ores, furnace products, etc. One of the major gifts to be made to the University during its early years was the model of the stamp mill shown by the Calumet and Hecla Mining Company at the Centennial Exhibition at Philadelphia, and presented to the School of Mines at the conclusion of the Exhibition. The model cost at least twelve thousand dollars to build, and had the

largest value of any gift made up to that time by any individual or private corporation. Gifts of ores and other materials were made. Facilities were developed for instruction in assaying in the metallurgical laboratory. A study of the situation by Professor Pettee led him to recommend the establishmen of summer schools devoted to field instruction at such places as Marquette, Ishpeming, or Houghton - different places in different years - where time could be spent in visiting mines, mills, furnaces, and in securing and arranging specimens. It was felt this would more than offset the distance of the University from mining regions, and the plan would have developed in a fashion somewhat similar to the engineering camp in surveying.

Degrees in Mining Engineering were given from 1867 to 1870, from 1878 to 1880, and from 1886 to 1896. The latter years closely paralleled the development of the Michigan Mining School at Houghton, established by the Legislature May 1, 1885.

Surveying and Civil Engineering were, of course, the parents of the present Engineering College, and instruction has been given

in these departments continuously since 1853-54. The first degrees in Civil Engineering were conferred in 1860. The present-day Civil Engineering Department has several main divisions, including structural, hydraulic, transportation, sanitary, municipal, and public health engineering. There is a Highway Laboratory for the testing of highway materials, provided through a cooperative arrangement with the State Highway Department. The department also has a Transportation Library containing one of the most valuable collections of transportation literature in the country. The first degree in Transportation Engineering was given in 1932.

Surveying, which constituted a large part of the first engineering instruction at Michigan, has, like Civil Engineering, been taught continuously from the beginning. The Department of Geodesy and Surveying became a professional department offering a degree in 1921; the first degree was conferred in 1923. The department, like that of civl engineering, was underthe supervision of Winchell, Peck, Wood, and Greene; upon Greene's death, Joseph Baker Davis had charge.

Joseph Baker Davis was the first engineering graduate of the

University to return and to stay on its faculty. He was a student here from 1864 to 1868, when he was graduated as a Civil Engineer. During his undergraduate days he earned his way, and roomed with J. B. Steere, who afterwards became a celebrated naturalist and a great teacher in the University.

Davis' mother died when he was a few months old; he was raised by a maiden cousin of his grandfather. She was a member of the Society of Friends; her steadfast Quaker influence remained with Davis throughout his life. During his childhood and youth he endured many privations; in manhood he was possessed of great character, marked by strong common sense. He was unpretentious, strong, good-natured, hearty in his bearing, loyal to his University and to his friends.

Upon finishing college, Davis worked as an engineer for two years, spending the second semester of 1869-70 as Instructor under his beloved Professor, DeVolson Wood. In 1871 he went to Swarthmore, Pennsylvania, where he organized the Civil Engineering Department in Friends', now Swarthmore, College. He returned

to Michigan in the fall of 1872 after Wood had gone on to Stevens Institute, and began his long association with the engineering college as a member of its faculty for thirty-seven years. Davis, like Greene, maintained an enviable record as a successful consulting engineer as well as in the field of teaching. He was, among other things, City Engineer of Ann Arbor for sixteen years.

When Greene died in 1903, and Cooley was asked to serve as Dean, he agreed to do so only if he could have the advice and assistance of Davis as Associate Dean. This Davis agreed to, and he served as the first Associate Dean of the College until he retired in 1910. No better choice for Associate Dean could ever have been made. He was possessed of a great character, marked by strong common sense. He was unpretentious strong, good-natured, hearty in his bearing, loyal to his University and to his friends. His new duties brought him into direct contact with every student of the college. Every engineer who was at the University during the first decade of this century will remember the gruff but kindly voice of this

kindly advisor. His natural sympathy for students who suffered privations made it impossible for him to forget them or their hardships night or day. Because he gave of himself so unselfishly, and the demands made upon him were so great, he was unable to continue his work after 1910.

As early as 1874 Davis, at that time an instructor, organized a camp for field work in surveying. This was the pioneer surveying camp for field work in this country. It was first organized at Whitmore Lake, when it was a four weeks' course. The camp was moved from place to place each year, depending on arrangements which Prof. Davis was able to make for use of land, transportation, and housing facilities. In 1882 the camp was established at Old Mission; from that time until 1929 it was always located in the northern part of the Southern Peninsula of Michigan. It was a four weeks' course until 1902 when it was extended to six weeks; in 1909 it wa extended to eight weeks.

In the summer of 1908, through the efforts of Professor Davis and in part by gift from Colonel and Mrs. Charles Bogardus of Pellston, the University acquired 1500 acres of land on

Douglas Lake, thus giving the camp a permanent home. It was named Camp Davis, and has always been conducted in conformity with the rules and regulations that its founder developed and adopted after many years of experience. In February, 1929, the University acquired a new site located at Jackson's Hole, Wyoming, 75 miles south of Yellowstone Park. The camp has permanent buildings, including residences, dining room, kitchen, keeper's residence, instrument room, shop, and garage. The course is for eight weeks of five and one-half days each week, and provides eight hours of credit in surveying. The cost to each student is about $150 for the summer, including tuition, board, and transportation.

In 1868 a course was established leading to the degree of Mechanical Engineer, but the degree was abolished in 1870, and none was conferred until 1883, after the department was re-established in 1881. Stillman Williams Robinson (C.E., 1863) who was Assistant in Civil Engineering (1866-67) and Assistant Professor of Mining Engineering and Geodesy (1867-70), gave

the first instruction in mechanical engineering. He resigned in 1870 to accept the chair of Mechanical Engineering at Industrial University of Illinois and was later Professor of Mechanical Engineering at Ohio State University.

The Mechanical Engineering Department today provides instruction in steam-power; internal combustion; hydro-mechanical;heating, ventilating, and refrigerating; auto-mobile;.and industrial engineering, and in machine design. Under its supervision are the Mechanical Engineering and the Automotive and Internal Combustion Engine laboratories, which include all the equipment used for the illustration of the theory involved in mechanical engineering and for experimental work of both standard and research variety. As a result of the automotive industry's generosity, there is a permanent exhibit open to the public of typical examples of automotive equipment, from complete chassis down to the smallest parts.

When Mortimer E. Cooley (Assistant Engineer, U.S.N.A., 1878) reached the campus in 1881, he had been detailed by the U.S. Navy under the Act of Congress in 1879, "as Professor of Steam

Engineering and Iron Ship Building." While he lectured in naval architecture during the eighties, his real work proved to be in mechanical engineering, and he was designated Professor of Mechanical Engineering immediately on his arrival. The first engineering building was on the southeast corner of the campus. It was built from plans drawn up by Professor Davis, under Cooley's supervision. The structure cost $1500, with machinery and tools supplied for another $1000; it was frame, sheathed inside and out with brick on edge and nailed at the joints to the studs, and was 24 x 36 feet in size. The foundry, forge shop, and engine-room were on the ground floor; the pattern shop and machine shop were on the second floor. The building was opened for classes in February, 1882, and continued in use until 1887-88. In 1883 an abandoned carpenter shop was moved up to the west side of the original building and used for wood-working.

Regents 1881 (pp. 76, 137, 164)

Regents, 1883 (pp. 376, 453)

Cooley was one of five members of the engineering faculty, the others being Greene, Denison, Davis, and Pettee. Cooley was, at that time, the only Mechanical Engineer in the State of Michigan. He taught blacksmithing, machine shop, and pattern

and metal, not for the purpose of training him to become a mechanic, but so that he would understand the mechanical processes involved in executing his plans. The more recent development has tended to eliminate manual dexterity, and to substitute such activities as the compounding of alloys.

As soon as the first little Engineering Laboratory had been completed in 1881-82, it was overcrowded. This has been the fate of all buildings of the engineering college up to the present time. In 1882 it was reported to the Regents that "it was not possible for the Professor alone and in his narrow quarters to give instruction to all who desired it. The utility of actual work with tools and machines to engineers is now recognized in leading schools on both sides of the Atlantic. It is to be hoped that means may be placed at our disposal for enlarging the equipment of the laboratory and for providing a suitable assistant for the Professor." He got the assistant.

By 1885-86 a new Laboratory was called for. The first

unit of the permanent brick building which still stands, called the "Automotive Laboratory," was built on the east side of the original laboratory, and connected by a passageway at the second floor level. The new laboratory had three stories and an attic. Within two years it was necessary to enlarge it; the enlargement necessitated the removal of the first little laboratory built in 1881-82. The completed building consisted of the original east building, the central part and tower, and a west wing one-story foundry and forge shop: the building contained offices, class rooms, drawing rooms, and laboratories for testing machines, steam engines, watermotors, and strength of materials. The tower held a water tank of 100 barrels capacity for hydraulic work and a 30-ft. glass tube mercury column for standardizing gauges.

In 1890, the Dental College removed to the Old University Hospital, and the Dental Building which they had occupied was turned over to engineering classes. The oldest part of

this building had originally been a professor's residence, built in 1841; Professor Frieze had been its last occupant. It had been equipped for the Dental School in 1877, and an east wing was added the next year. In 1891 it was enlarged toward the north and a third story was added; the entrance was changed to the west side of the new part, and the word "Engineering" was placed over the doorway. There were 15 classrooms and several offices in this building, which continued in use until 1923, when it was removed to make room for the Clements Library. This New Engineering Building was called the Old Engineering Building after 1904.

Equipment for these various laboratories had been acquired by purchase whenever possible, but much of the equipment for these various laboratories came as gifts from tool and machine manufacturers, who furnished the laboratories with some of the finest products of their shops.

Because of the tremendous interest in the laboratories, the question arose during the eighties concerning the desira-

bility of establishing a manual-training school in which a young man could learn to be a skilled mechanic. It was decided that the wisest plan would be to limit the mechanical equipment and instruction to the needs of students in civil, mining and mechanical engineering; not only because the work at the University of Michigan was supposed to lead to an academic degree upon the conclusion of a professional training, but because funds for even the equipment necessary for this purpose were difficult to obtain.

Just before the New Engineering Building (old Dental Building) was acquired in 1891, the Department of Electrical Engineering came into being, in 1889. It was under the supervision of Henry S. Carhart, Professor of Physics, with George W. Patterson as Instructor in Electrical Engineering. The first degree was conferred in 1890. In May, 1905, George W. Patterson became the first Professor of Electrical Engineering, and was head of the Department from 1904 to 1914; he also served as Assistant Dean after 1922. The Department has grown with the development of public utilities and the

corresponding use of electricity until it now offers instruction in electrical power engineering, electrical communication, illumination engineering, electrical engineering design, electrical theory and laboratory technique, and industrial electrical engineering. The department maintains laboratories devoted to the study of dynamos, communication, photometrics, electronics and high voltage, electrical standards, and heat transfer. The steam-power plant of the University is used for instructional purposes, and the Detroit Edison Company has made available its hydraulic and steam-power plants for technical inspection trips and study.

By 1890, when the engineers moved into their own building, one hundred and sixty students were in the engineering department, taking civil mining, mechanical, electrical and sanitary engineering. That year twenty bachelor's degrees in engineering were granted, and two graduate degrees. In 1893 a return was made to French or German or Latin for the admission of engineering students and it became a requirement in 1895.

Thess had been eliminated early in the history of engineering at Michigan "because in our section of the country formany years a considerable number of men of mature years, who had grown up in offices of engineers without much opportunity for training in languages, came here to prepare themselves for engineering work." (Regents, 1893. Pp. 195-6) By 1893, "under the stimulus given in recent years to engineering study, especially to the preparation for mechanical and electrical engineering, by far the larger number of matriculants in these courses are young men prepared in our high schools where the languages are well taught. A good knowledge of French and German is so helpful to the accomplished engineer of our time that it is wise to encourage the students to get a good reading knowledge of these tongues early in his course." The requirement of a foreign language and special training in English led to the establishement of separate departments of English, and of Modern Languages for engineering students. Mathematics courses especially for engineers had been given from the beginning.

In 1895 there were 319 students enrolled in engineering. In April of that year it was "Resolved that a School of Technology be organized, comprising the Departments of Civil, Mechanical and Electrical Engineering, and that Professor Charles E. Greene be appointed Dean." A committee of Professo s Greene, Cooley, and Carhart was appointed to make, with the assistance of the President, a detailed plan for the organization of the new school. Strangely enough, two members of the committee, Greene and Cooley, were reluctant even to concur in the separation of the Department of Engineering from the Department of Literature, Science and the Arts, believing that the engineers' education should be as broad as possible, and that in separation the tendency would be to narrow it. Until later departments of engineering were added, there was room in the curricula of engineering for literary studies. These, both Professor Greene and Professor Cooley believed, were highly important in the training of the engineer in that they better fitted him to cope with the problems of life as a citizen as well as an engineer. While engineering studies alone sufficed for the

solution of problems based on the physical sciences, something more was needed to insure the best success of the engineer in his contact with his fellow man. Professor Greene's policy was the preparation of young men for the engineer's profession who would be not only a credit to the profession, but who would also play an important role as citizens.

However, rules for the government of the new Department of Engineering were formulated and adopted. The rules, in brief, were that the faculty would be composed of all above the grade of Assistant who taught engineering students; the government of the department would be invested in the faculty, which would hold general meetings as directed by itself, by the President, or the Dean, or called for by two Professors in the Department; the faculty would elect one of their own members as Secretary to keep the records of the proceedings; the recordsof studies elected and pursued by students, together with their grades, would be kept by the Registrar of the Literary Department; admission of students would be handled

by the Dean; candidates for graduation would be recommended by the faculty, and the requirements for graduation would be unchanged; students could take studies in departments other than the Literary Department only by permission of the Dean. The place of the Department of Engineering in the annual calendar and on public academic occasions was designated as immediately after the Department of Literature, Science, and the Arts. Dr. Angell said that for so many years the engineers had been so closely associated with the literaries, it should continue to be so.

And so the Department of Engineering became a separate college, with its own administration, in 1895. Concerning the desirability of this new school the President said in his report of that year, "Although we have taught engineering for more than forty years, many persons in Michigan have been unaware that we have engineering courses pursued by hundreds of students. This singular ignorance of what we are doing seems to be due in some degree to the fact that the engineering students have always been catalogued with the students of the

Literary Department. The establishment of a separate Department of Engineering.....should certainly attract the attention of our citizens, too many of whom have supposed that they must send their sons out of the state to be trained as Civil, Mechanical, or Electrical Engineers. (Regents, 1895. P. 506)

During the first years of its history as a separate school, the affairs of the College of Engineering were administered in much the same fashion as when it had been a part of the Literary College. For many years things having to do with engineering had been left up to the engineering faculty. The first meeting of the faculty of the new Department of Engineering was held October 3, 1895, with Dean Greene presiding. Faculty meetings were held each week during the school year for several years; a secretary was appointed for each meeting.

Framing and administering requirements for admission and graduation were relatively simple. Beginning with 1895 the admission of engineering students was handled by the Dean himself. Incoming students were given a serial number, which

appeared on all records. This number was placed on the record card, and a folder containing his credentials, correspondence, and other information collected during his residence in college was likewise so numbered. A card index, alphabetically arranged, contains this number. The serial numbers assigned to engineering students continue progressively every year thereafter; by 1940 the number 21,148 was reached. Information on any person who has been admitted to the College of Engineering since 1895 can be found at a glance.

As long as the department of engineering was a part of the literary college, the records were handled by facilities provided for by the literary college. After the separation, the same procedure was followed until 1901, when the first permanent secretary of the faculty, Herbert J. Goulding (B.S. '93), Instructor in Descriptive Geometry and Drawing, was appointed Secretary at an additional salary of $200 a year. Professor Goulding resigned in 1906, and was replaced

by James Pyper Bird (A.B. 1893), Instructor in French and Spanish to Engineering Students, who served until 1915. The records and office of the Secretary were established in 1903-03 in a suite of rooms on the first floor of the Engineering Building which had been the former Dental Building. On February 1, 1907, Camilla B. Green, now Assistant Secretary of the College of Engineering, started to work in the Secretary's Office, where she has been employed continuously since.

Because of the sequence of courses and prerequisites in programs of engineering students, the Faculty has always closely supervised the election of studies, and classification committees were established at an early date. A semester classification card was designed by Professor Goulding which showed the student's name, subjects, and credit hours, followed by hours of recitation, lectures or laboratory work for each day of the week, also the room where the classes were held, and the name of the instructor. This classification card proved so

satisfactory that only a few minor changes have been made in it since its inception in 1903, and the type of card has been adopted widely by other departments.

During Professor Greene's administration as Dean, not only was the office of the Secretary established, but two new engineering departments were added to the College, Marine Engineering and Naval Architecture, in 1900 and Chemical Engineering in 1901.

Some instruction in naval architecture had been given since 1881, but in 1898 an outline of a proposed course, patterned after the course given at the University of Glasgow, was presented to the Regents, and in 1899 an appropriation was requested and made for establishing such a course. In 1900 Herbert C. Sadler (B.S., Glasgow) was appointed Junior Professor of Naval Arthictecture, and in 1901 a curriculum was established leading to a degree in Marine Engineering. Professor Sadler became the third Dean of the College of Engineering (1928-37) and since 1939 has been Dean Emeritus of the College of Engineering and Professor Emeritus of Naval Architecture and

Marine Engineering. (From 1937 to 1939 he held the Alexander Ziwet Professorship.) The Department of Naval Architecture and Marine Engineering trains men in connection with the design and construction of ships and of machinery for ships, and also those who wish to enter the field of water transportation. The first degree was conferred in 1902. The Naval Tank, built in the West Engineering Building in 1904, was the first in this country, and provides for testing of models. Equipment is also available for studies relating to ship resistance, shallow-water effects, streamline flow, wave profiles, wake, and rolling, as well as a model room and workshop for making models of vessels.

The first degree in Chemical Engineering was conferred in 1901. In 1902 Edward D. Campbell was made Professor of Chemical Engineering and Analytical Chemistry, and in 1905 Director of the Chemical Laboratory. When the new Chemistry Building was completed in 1909, a large portion of it was devoted chemical engineering instruction. The present Department occupies 160,000 square feet of space in East Engineering Building,

and maintains five specialized laboratories. The General Chemical Engineering Laboratory provides facilities for unit operations in fluid flow, heat transfer, evaporation, distillation, absorption and extraction, humidifying, dehumidifying, water cooling, air conditioning, drying, refrigeration and evaporative cooling, filtration, and crystallization; the Metallurgical Engineering Laboratories, facilities for melting and heat-treating, metallographic projects, and physical properties, pyrometry, and X-ray. The Gas, Fuel, and Combustion Laboratories include equipment for research in gas and fuel, combustion, furnace materials, and gas engineering. The Petroleum Laboratories provide facilities for cracking-research, engine testing of motor fuels. The Technology Laboratories include facilities for study and research on ceramics, electrochemical work, precision tests of physiochemical properties, paint and varinsh problems, and pulp and paper problems. In addition to these special laboratories, two general laboratories are available for

ordinary chemical engineering projects, and graduate students are assigned individual laboratories in which to carry on their own experiments.

The Department of Chemical and Metallurgical Engineering has grown rapidly from its inception, and is now one of the outstanding departments in the country, with a reputation second to none in its field. Graduates of this department are in demand throughout the nation, and more graduate work is done by students in this department than in any other engineering department. The first degree in Metallurgical Engineering was conferred in 1936.

In 1902 there were 609 students in the engineering college. In October of that year the cornerstone of the New (now West) Engineering Building was laid. The four-storied fireproof steel and concrete building, with outside walls of vitrified paving brick and stone, and a red tile roof, was designed to fit the southeast corner of the campus, with an

arcade (The Denison Arch) for the passage of the diagonal walk. The building was equipped with a 300' naval tank - the first and enclosed tank and most complete of its kind in this country - and the first built by an educational institution - (The only other being at the Washington Navy Yard) - with mechanical and steam laboratories, hydraulic laboratory, electrical and physical testing laboratories and a mold loft, and was completed in 1904, and enlarged in 1910.

Before West Engineering Building was completed, Dean Greene died. He had been the dominating factor in the engineering college for more than thirty years, and his going left the college, its students and faculty, desolate. A true gentleman, Greene had seen to it that the destiny of the engineering college had been one of broad general training, fitting men for private as well as professional life.

Mortimer E. Cooley was appointed to succed him. Upon being given the aid and counsel of Professor Joseph Baker Davis as Associate Dean, he accepted the appointment. Thus the occupation of the first complete Engineering Building

coincided with a new administration of the college, one which, in its deanship, continued for twenty-four years.

Even the new building was full to overflowing(with 828 students)upon completion. It had been planned for 600 students. The building was enlarged in 1909-10. No new building was provided for until 1923, when East Engineering Building was completed; in 1922 the old Tappan School Building was acquired and renamed East Hall. This building is used for classes in non-technical subjects. East Engineering Building houses the Chemical and Metallurgical Department, the Department of Metal Processing (formerly Engineering Shops), the Department of Engineering Research, the Division of Transportation Engineering, the State Highway Laboratories, the Department of Aeronautical Engineering including the wind tunnels, the East Engineering Library for these departments, and the Transportation Library containing 100,000 items dealing with every phase of transportation.

In addition to East Hall and East Engineering Building, the College of Engineering is housed in West Engineering

Building and West Engineering Annex (old shop buildings), which provides additional space for Mechanical Engineering (automotive engineering), Engineering Mechanics, and Geodesy and Surveying. The West Engineering Building houses the departments of Civil, Mechanical, Electrical, and Marine Engineering, Geodesy and Surveying, Mechanism and Engineering Drawing, Engineering Mechanics, and Mathematics, as well as the administrative and secretarial offices and the general Engineering Library of 20,000 volumes dealing with engineering,

transferred from the general library to the new building in 1904.

The Department of Engineering Mechanics was established in 1911. Before that time, instruction in applied mechanics had been given by the Department of Civil Engineering. This department provides instruction in the subject which, perhaps more than any other, tests the student's ability to use the technical training given him in his other courses, at the same time preparing him for additional work. Work in this department is required of all engineering students, although a course has been established leading to a degree in Engineering Mechanics; the first degree was conferred in 1931. The Physical Testing Laboratory of this Department is equipped for the study of the action of forces on materials.

In 1916 the first aeronautical engineering course offered in the United States was established at the University of Michigan. The course had a forerunner in the University Aero Club, founded by Professor Herbert C. Sadler about 1910.

Professor Sadler constructed a wind tunnel for the club, and its members constructed a bi-plane glider during 1911-12. In 1913 Felix W. Pawlowski, of Warsaw, a practicing mechanical engineer in Chicago, trained in Germany (graduated 1896), was in this country. He had taken instruction at the first flying school in the world, that maintained by Prof. L. Marchis in Paris in 1909. Pawlowski, who was practicing as a mechanical engineer in Chicago, decided to write a number of universities and offered his services to a number of them in establishing a course in aeronautical engineering. Some of the schools never replied; only two took it seriously. One was the Massachusetts Institute of Technology, which indicated it might be interested in the future but not at the present; the other was the University of Michigan. The Dean of the Engineering College wired Pawlowski to come to Ann Arbor and talk it over. As a result of that interview, Pawlowski came to the University as instructor in mechanical engineering in February 1914; he lectured informally on aeronautical subjects until 1916, when the Department of Aeronautical Engineering was established. The first degree was granted in 1917. The Department maintains

two laboratories, one devoted to aerodynamics, the other to structures. The aerodynamic laboratory consists of two wind-tunnels, the larger an open-throat, double-return type with a wind velocity maximum of 100 miles per hour; the other a closed-throat, single-return type wind tunnel, with a maximum wind velocity of 60 miles per hour.

In 1920, the Department of Engineering Research was established. It affords an official channel through which the research facilities of the University in engineering and related fields of work are made available to the civic and industrial interests of the State and elsewhere. No work is offered students for credit, but many of the research projects which come to the Department afford an opportunity for students to work as assistants. The function of the department is largely administrative. The technical direction of researches sponsored through it is generally assigned to members of the faculty who give students opportunities to work as assistants and most of the work is done in the laboratories of the instructional departments with which they are associated. From its inception this Department has been under the direction of Professor Albert E. White;

including the director, the Department in 1940 maintains a full-time research staff of fourteen persons.

Mathematics courses designed especially for engineering students needs have been taught at Michigan almost from the begining. The required work is practically the same for all students of engineering, and extends throughout the first two years. The courses are designed not only to impart mathematical knowledge needed for the study of various branches of engineering, but also to train the mind in methods of precise reasoning, accustoming the student to the proper application of general principles to particular cases. A curriculum for a degree of Bachelor of Science in Engineering (Mathematics) has been established; the first degree was conferred in 1929. This course is not accredited with the Engineers' Council for Professional Development since it leads to fields other than engineering.

A curriculum in astronomy, with two years' work in any department of engineering, leading to the degree of Bachelor of Science in Engineering (Astronomy) is somewhat

similar in status to that for Mathematics; the first degree was conferred in 1939. A similar curriculum in physics was established at the same time as that for mathematics and astronomy, in 1928. The first degree in Physics was conferred in 1931, and a total of 55 degrees had been granted by 1940.

The idea of establishing engineering as a five-year professional course at Michigan was first bfoached by Wood in 1858. President Angell wrote, in his report of 1906, "The Engineering Department has been busily engaged in revising its course of study and getting fairly settled in its new building... The work laid out makes most strenuous demands upon the students, and calls for one period of six weeks in the summer vacation... The work of training a modern engineer is so heavy and so varied that if the principal schools will agree to adopt the plan of a five years' course that will probably be expedient." Six-year specialized courses were introduced in 1908, but nothing came of this. The course was increased from 125 to 140 credit hours for all students entering after the Fall of 1904.

Regents
1906
p.6

The idea of a longer training period has borne fruit

at Michigan in the establishment with several colleges of several combined curricula courses leading to fields other than engineering. One of the more important of these is the combined program with Albion College; under this a student who has been in residence for three years at Albion College and has completed with a good record a course of study including mathematics and sciences, is admitted to the College of Engineering. At the conclusion of his first year at Michigan, his records are transferred to Albion, wherehe receivem a Bachelor's Degree. After one additional year in the College of Engineering, Michigan confers on him the degree of Bachelor of Science in Engineering. The advantage of this five-year course lies in the broader general training afforded by the larger number of elective hours allowed the student, impossible in the four-year course.

Other combined curricula have been established through cooperation with other colleges on the campus, and with industry throughout the state. One is the Engineering-Business Administration course, under which a student enters the School of Business Administration after completing three years of undergraduate work in engineering. Upon completion of his first year in Business

Administration, he receives a Bachelor of Science in Engineering (Business Administration); upon completing his second year, he receives a Master of Business Administration. The first degree was conferred in 1936. A similar five-year program leads to the Bachelor of Science in Engineering (Forestry-Wood Technology), and, after five years, the last two in the School of Forestry, to the Master of Forestry (Wood Technology). No degrees have been conferred in this course. The Engineering-Law combined curriculum is a six-year course, especially designed for patent law, public service, manufacturing, and corporation business and operation; it includes three years in the Engineering College and three years in the Law School. At the end of the fourth year, the Engineering College confers a Bachelor of Science in Engineering (Law), and at the conclusion of the sixth year, the Law School confers a Bachelor of Law degree. The first degree was conferred in 1932.

Five-year cooperative programs with industry in electrical, mechanical, and chemical engineering, have been established. These courses are established only when cooperative relations with such industries as are able and willing to offer

a definite program of graded work of educational value can be secured. Students undertake cooperative work during periods of an entire summer or semester. In this cooperative program, the first degree in mechanical engineering was in 1926, in chemical in 1928, and in electrical in 1929.

Almost from the beginning there have been graduate students in the engineering college. In the early days these were usually graduates from the standard classical colleges who took engineering after receiving their literary degrees. It was not until well in the 20th century, however, that real progress was made in graduate work facilities; since these have been developed, the faculty of the engineering college devoted approximately 20% of its time to graduate instruction in the Horace H. Rackham School of Graduate Studies. Graduate degrees conferred by the College of Engineering include Master of Science in Engineering, Master of Science in Public Health Engineering, Doctor of Philosophy, Doctor of Science, Civil Engineer, Mechanical Engineer, Chemical Engineer, Metallurgical Engineer, Naval Architect, Marine Engineer, Aeronautical Engineer, Geodetic Engineer, and Public Health Engineer.

Bachelor degrees in engineering were, until 1881, designated as Civil Engineer, Mining Engineer, etc. After 1881 the degree became Bachelor of Science, with the diploma indicating the field in which the degree was taken; i.e., Bachelor of Science (Mechanical Engineering). After 1909 the degree became Bachelor of Mechanical Engineering, etc. Since 1916 the degree has been Bachelor of Science in Engineering (Mechanical Engineering), etc. From 1860 to 1940, 10,064 bachelor degrees in engineering had been conferred.

Just as the College of Engineering began as a department in the College of Literature, Science, and the Arts in 1853, not becoming a separate college until 1895, it, in turn, fathered an outstanding college of the present day University; this was the College of Architecture and Design.

A professorship of architecture was provided for in 1837, but no appropriation was made until 1875-76 for two years. Professor William LeBaron Jenney held this professorship for four years, two of which were on leave of absence. And so the real beginning of the department did not take place until 1903.

People throughout the state wrote the Regents requesting the establishment of a Chair of Architecture; in 1903 the matter was referred to the engineering committee. In 1905 it was voted to establish such a professorship. The Michigan Chapter of The American Institute of Architects wrote the Regents approving the action. In 1906 the engineering faculty submitted a schedule of work required for graduation in architecture and architectural engineering, which the Regents authorized to be published in the engineering announcement for 1906-07. The reasons for the inclusion of architecture in the engineering department were simple enough; as early as 1837 provision had been made for a joint professorship of "civil engineering and architecture," so the two were linked together from the beginning. In addition, the engineering college had recently moved into its new building; although overcrowded from the beginning, room was made for architecture. Drawing room facilities were available. Since only one professorship was established, other work was taught by the engineering faculty. Emil Lorch (A.M., Harvard, 1903) was appointed Professor of Architecture by state architects'

request, effective October 1st, 1906. A junior professorship went begging for lack of acceptance, and a professorship was established which was accepted in 1910 by Percy Ash, (C.E.) Professor and Dean of Architecture at George Washington University.

The course in architecture grew under the leadership of Professor Lorch, and in 1913 the following resolution of the faculty of the engineering department was presented to the Regents:

Regents 1913 p. 778

> Resolved, That the Department of Engineering and the Department of Architecture be hereinafter known as the Department of Engineering and Architecture with the present Dean and Secretary acting in a similar capacity for the new organization; and that the staff of the Department of Architecture shall hereinafter administer the admission and discipline of its students, with full control of the curricula in Architecture.

The official title of the College of Engineering was settled in 1915, when the Committee on Nomenclature established the distinctions in use today between department, course, school, and college.

Regents 1915 p. 195

In 1927 the College of Architecture removed to its own quarters in the new Architecture Building. Degrees were granted by the College of Engineering from 1909 to 1913, and after that by the Colleges of Engineering and Architecture until 1931, when the College of Architecture became completely separate,

with its own Dean, administration, student records, and organization. During the years between 1909 and 1931, a total of 480 degrees were conferred in Architecture.

A "foster" child of the College of Engineering was the School of Forestry. For over thirty years Volney Morgan Spalding (B.A. 1873) Professor of Botany, had advocated Forestry to the people of Michigan. In 1902 he was successful in providing instruction in Forestry in the Botanical Department; in April, 1903, the Board of Regents established the Department of Forestry. After 1904 instruction was given on the fourth floor of West Engineering Building. In 1909 a course of study was proposed by the engineering faculty, leading to the degree of Bachelor of Science in Preparation for Engineering in Forestry at the end of four years, and for a graduate forestry degree at the end of six years; this was a conservation engineering course. It was not, however, until 1913 that a course was adopted, and this led to the degree of Bachelor of Science in Forestry upon the completion of 120 hours. The Department of Forestry was never under the administration of the College of Engineering. In

1927 it became the School of Forestry and Conservation, with Professor Samuel T. Dana as Dean. Quarters for the new School were provided for in the Natural Science Building. A combined five-year course is given which leads to the degree of Bachelor of Science in Engineering (Forestry-Wood Technology) at the end of four years, and the degree of Master of Forestry (Wood Technology) at the end of five years.

The policy of the engineering college has always been to establish courses of instructions, or departments, as the need arose. Usually this need grew out of requirements of the industries of the state. Each of the departments which have been added to the curricula has filled a very definite lack; thus the College has been able to keep pace with the general advancement of specialized instruction.

There is a common first year for all engineering students. After the first year each student chooses the branch of engineering he expects to follow, and is then enrolled as a student in that branch. When the University Orientation Period for all new students ends, the Mentor System of the College of Engineering begins. The

Mentor System of the College of

Mentor System is a personalized form of solving the problem of a freshman's making a proper adjustment to his new environment; it is probably the oldest student personnel practice in continuous operation in this country, having been established in 1911. Just prior to that, the father of a prospective student visited the University among several other schools to examine personally the conditions surrounding students, particularly freshmen. Being requested to report the result of his findings when he returned home, he wrote quite freely saying he felt that freshmen, inexperienced as they were, suffered a severe handicap in the larger institutions. He had therefore selected for his son a small college in the East where students had more intimate contacts with their professors. Shortly afterwards our Mentor System was inaugurated, and has grown to be an integral part of the College of Engineering.

The Engineering College was the first one on the campus in which the Honor System was established; it has been effective since 1916. It was started as the result of a petition of the student body to the Faculty and has been in every way a product of the students themselves. The Faculty never asked for changes nor

in any way attempted to control or restrain the student committee. Under the Honor System is the cardinal principle that it is dishonorable for any man to receive credit which is not the result of his own efforts. This is a principle which members of the engineering profession must carry through life; it is part of the code of an engineer and of a gentleman. It has become a fine tradition of the students of the Engineering College.

As in the great majority of engineering schools, the control of the curricula, the regulations governing admission and graduation, the time schedule, and discipline are vested in the faculty of the college. All general educational policies, requirements, and rules for students are determined by a majority vote of the standing committees and of the faculty. Every voting member of the faculty is subject to serve on committees, many of which meet frequently and require much of their time.

Faculty control ends with the adoption of the curriculum and time schedule. Having determined the requirement in hours for each subject, the choice of subject matter, texts, and methods of instruction in each subject is left entirely to the department

concerned. Each department is treated as an expert in its own line, and this department autonomy is carefully preserved by common consent. Departments may vary in size, but not in self-sufficiencey. In faculty selections, a particular effort is made to see that the Chairman of each Department be a man of outstanding reputation in his professional field, and that each man in the department is assigned to work for which he is particularly fitted by temperament, ability, and training. Men must be qualified to advise the State as well as individuals on their respective fields.

Prior to 1906, an advisory committee of five was elected to undertake the care of the interests of the Department of Engineering in matters pertaining to appointments, buildings, rooms, stenographers, repairs to buildings, apparatus and equipment, etc. In 1906 the Standing Committee was established, consisting of the Dean as Chairman, the acting heads of the various departments, the Assistant Dean; this advisory committee continued until abolished and replaced with an elected Executive Committee to serve as an advisory committee to the Dean.

The Standing Committee, consisting of the Dean as Chairman, the Assistant Dean, and heads of the various departments, which was formally established in 1906 to act in an advisory capacity, had its beginnings in a committee of heads of departments called together to consider plans for West Engineering Building in 1901. In 1936 at the President's request and by his appointment, there was formed an Executive Committee for the College of Engineering, "charged with the duties of investigating and formulating educational research and instructional policies for consideration by the faculty and to act for the College in matters of budget, promotions, appointments, plant-extensions, and all other financial affairs". The Executive Committee is distinct from the Standing Committee, and both bodies serve to the present time.

In 1904 the administrative work of the College assumed a triparted nature; into that of Dean, Associate or Assistant Dean, and Secretary; this division has continued to the present. The Dean assumes the administrative duties having to do with faculty, curricula, policy, equipment, budget, and all similar matters going before the Regents. Alumni relations are largely left in

the hands of the Dean. The Associate or Assistant Dean attends to admission of students, and all matters of attendance and discipline. The Secretary has long handled all matters pertaining to student records once they are admitted, working in close cooperation with the Classification Committee on all details concerning schedule of courses and printed announcements concerning courses and curricula.

The office of Secretary has been held successively by Professors Goulding (1901-1906), Bird (1909-1915), Louis Allen Hopkins (1915-1933), and Alfred H. Lovell since 1933. Camilla B. Green has been Assistant Secretary since 1915, when she began to assume much of the responsibility for the management of the office.

The office of Associate Dean has been held by J. B. Davis, who resigned in 1910, when Assistant Professor William Henry Butts (A.B. '78, A.M. '78, Ph.D., Zurich) of the Mathematics Department was appointed Assistant Dean. Assistant Dean Butts had been principal of a military school for some years, and was well fitted for his work in admissions and the conduct of the students. His kind advice was often supplemented with more substantial assistance, since the Assistant Dean also had charge of student loans and

scholarships relating particularly to the Engineering College. Butts retired in 1922, and was succeeded by George W. Patterson, III (A.B. Yale, B.S., M.I.T., Ph.D. Munich), a member of the faculty since 1889, and Chairman of Electrical Engineering from 1904 to 1914, of Engineering Mechanics from 1915 to 1930. During the leave of absence of Dean Cooley in 1927-28, he served as Acting Dean of the Colleges of Engineering and Architecture, and in 1928 became Associate Dean of the College of Engineering. On May 22nd, 1930, his death ended more than 40 years of distinctive service rendered the University as teacher, scientist, and administrator. In addition to the academic degrees written after his name, the title of "Gentleman and Scholar" might well have been placed. He was succeeded by Alfred Henry Lovell (B.S. (E.E.) '99, M.S.E. '14), a member of the faculty of the Electrical Engineering Department since 1910. Professor Lovell has been assistant Dean of the College since 1930, and, since 1933, has also served as Secretary.

DeVolson Wood's preliminary administration before the College of Engineering was established had for its main objective to get things under way. He laid the foundation for his successors

to build on. His main contribution to the department was to develop the tradition which has held to this day: that engineering students must be thoroughly trained, must think for themselves, and must develop the personal integrity and high character which throughout the years have been a heritage of engineers. During the years before Greene became Dean (1872-1895) the department added mechanical and electrical engineering, tried to establish mining and metallurgy, and developed its physical equipment by the construction of laboratories and buildings. Since the College has been a separate school, there have been five deans. During these forty-five years as a college, four of these deans served whose total years as members of the engineering faculty is 154, an average length of teaching service of 38½ years.

The first was Charles Ezra Greene (1895-1903), a Civil Engineer; he was a member of the faculty for 31 years. Greene contributed the policy of a broad training for engineers; under him the College added the departments of marine engineering and naval architecture, and Chemical Engineering; West Engineering Building was built. The second was Mortimer E. Cooley, (1904-1928),

a member of the engineering faculty for 47 years, a Mechanical Engineer trained by the U. S. Naval Academy (1874-1878). Under him East Engineering Building was built, East Hall was acquired, the departments of Aeronautical Engineering and Engineering Research were started; the Mentor System was established, the Honor System was instituted. The policy of selecting outstanding professional men for departmental heads was given the stimulus of being made into a tradition; and Tappan's words guided faculty choices: "There is no safe guide in the appointment of professors save in the qualifications of the candidates." He resigned in 1928 and became Dean Emeritus of the Colleges of Engineering and Architecture.

The third Dean was Herbert Charles Sadler (1928-1937), internationally known in the field of naval architecture and marine engineering, and a member of the faculty for 37 years; he resigned in 1937 and became Dean Emeritus of the College of Engineering, and Professor Emeritus of Marine Engineering and Naval Architecture. Dean Sadler entered on an administration which was overshadowed by the unhappy period of national depression, with its years of curtailed University funds; his was a heavy load.

Until his administration the entire history of the College had been one of constant expansion; under him, while enrollment increased from 1600 to 1900, the departmental budgets had to be reduced. The fourth Dean was Henry Clay Anderson, (1937-39), B.S., U. of Kentucky) a mechanical engineer, who servked the University for 38 years, having been a teacher in the Mechanical Engineering Department since 1899 and Chairman of the Department since 1917. Anderson's death on October 14th, 1939, was felt as a personal loss by everyone connected with the college. His health was such that he should never have undertaken the heavy responsibilities which he shouldered for so brief a time, and which without doubt greatly hastened his death.

The fifth Dean, Ivan Charles Crawford (B.S. in C.E., U. of Colorado., '12; C.E. '15) came to the campus in July, 1940. He is the second Civil Engineer to be Dean of the College of Engineering. A graduate of the Army School of the Line, Langres, France, 1918, and of the G-1 course of the War College, Washington, D.C., in 1926, Dean Crawford brings to the college a background rich in service in the field of engineering education. Since 1912

he has been a teacher of civil engineering, and served 14 years as Dean of the College of Engineering at the University of Idaho, and 3 years as Dean of the School of Engineering and Architecture at the University of Kansas. During 1933-34 he served as State Engineer of the Federal Emergency Administration of Public Works for the State of Idaho, as did Dean Emeritus Mortimer E. Cooley for the State of Michigan (1933-1935).

Thus the fifth administration of the College of Engineering, with its 1940 enrollment of 2222 students, is back in the hands of the branch of the profession which introduced engineering instruction at Michigan in the 1850's, that of Civil Engineering.