

New Series, 1933
No. 10

Whole Number 453

THE
JOHNS HOPKINS
UNIVERSITY CIRCULAR

SCHOOL OF ENGINEERING

1934-35

BALTIMORE, MARYLAND
PUBLISHED BY THE UNIVERSITY
OCTOBER, 1933

CALENDAR

1934

March 25—April 1—Spring Vacation.

May 28—June 5, Monday—Tuesday—Undergraduate Examinations.

June 2, Saturday—Instruction ends in the College for Teachers.

June 12, Tuesday—Conferring of Degrees (4 p. m.).

June 25, Monday—Summer Courses begin.

August 4, Saturday—Summer Courses close.

September 17—20, Monday—Thursday—Entrance Examinations.

September 21, Friday—Competitive Examinations for Scholarships.

September 27, Thursday—Entering students enroll.

September 28—29, Friday and Saturday (forenoon)—Members of the upper classes enroll.

October 2, Tuesday—The University opens.

October 8, Monday—Instruction begins in the College for Teachers.

October 8, Monday—Night Courses for Technical Workers begin.

October 8, Monday—Evening Courses in Business Economics begin.

November 29, Thursday—Thanksgiving Recess begins (8.30 a. m.).

December 3, Monday—Instruction is resumed (8.30 a. m.).

December 20, Thursday—Christmas Recess begins (8.30 a. m.).

1935

January 3, Thursday—Instruction is resumed (8.30 a. m.).

January 28—February 5, Monday—Tuesday—Undergraduate Examinations.

February 6, Wednesday—Registration with Advisers for second term.

February 7, Thursday—Instruction is resumed.

February 22, Friday—Commemoration Day. Public exercises at 11 a. m.; all classes suspended.

March 24—31—Spring Vacation.

May 27—June 4, Monday—Tuesday—Undergraduate Examinations.

June 1, Saturday—Instruction ends in the College for Teachers.

June 11, Tuesday—Conferring of Degrees (4 p. m.).

ENTRANCE EXAMINATIONS, 1934

Remsen Hall, Room 101

Monday, September 17

9-11 a. m.—Algebra A (1 unit). 2-4 p. m.—English 1.

11 a. m.—12 m.—Algebra B ($\frac{1}{2}$ unit). 4-6 p. m.—English 2.

Tuesday, September 18

9-11 a. m.—Plane Geometry. 2-6 p. m.—History.

11.30 a. m.—1 p. m.—Plane Trigonometry.

Wednesday, September 19

9-11 a. m.—Latin (C. E. E. B. Cp. 2) 2-4 p. m.—Latin (Cicero, Virgil).

11 a. m.—1 p. m.—Biology, Botany, Chemistry.

Thursday, September 20

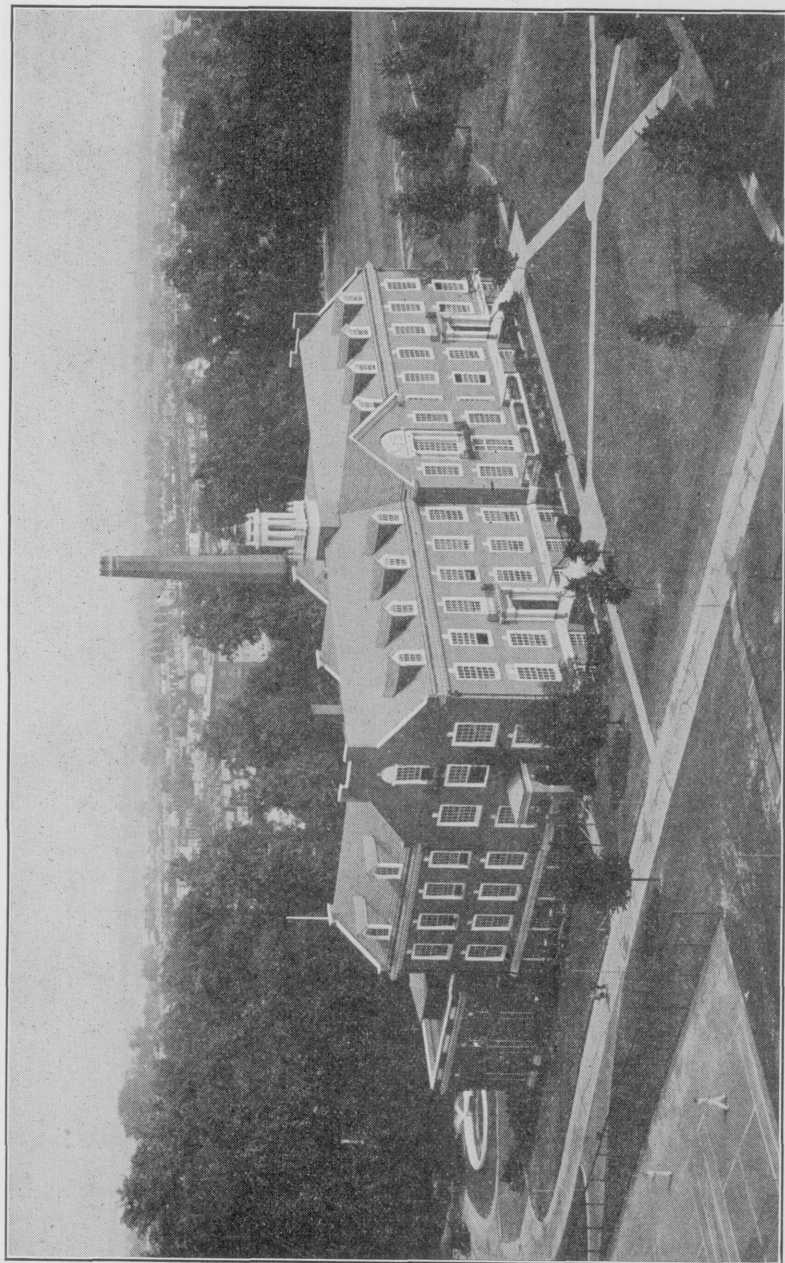
9-11 a. m.—Greek (Cp. 2), German, Spanish 2-4 p. m.—Greek (Cp. 3 or Cp. H.),

11 a. m.—1 p. m.—Physical Geography, French.
Physics, Zoology.

THE JOHNS HOPKINS UNIVERSITY CIRCULAR

ISSUED MONTHLY, JANUARY TO OCTOBER

Entered October 21, 1903, at Baltimore, Md., as second-class matter, under
Act of Congress of July 16, 1894



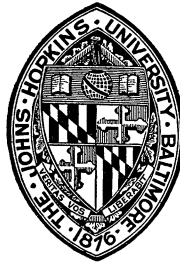
MARYLAND HALL

ELECTRICAL, GAS, AND MECHANICAL ENGINEERING

THE JOHNS HOPKINS UNIVERSITY

SCHOOL OF ENGINEERING

1934-1935



BALTIMORE
THE JOHNS HOPKINS PRESS

1933

TABLE OF CONTENTS

	PAGE
Board of Trustees.....	4
Officers of Administration.....	4
Faculty	5
Advisory Board of the School of Engineering.....	10
The Board of Engineering Studies.....	10
Standing Committees of the Board of Engineering Studies.....	10
Historical Statement of the University.....	11
School of Engineering.....	12
Requirements for Admission.....	16
Degrees	19
Tuition Fees and Expenses.....	23
Registration Directions and Information for Undergraduates.....	26
Living Accommodations.....	27
Bureau of Appointments.....	28
Civil Engineering.....	29
Electrical Engineering.....	36
Mechanical Engineering.....	43
Gas Engineering.....	49
General and Elective Courses.....	55
Physical Education.....	58
Military Science and Tactics.....	60
General Information and Regulations.....	64
Scholarships	69
Scholarship Holders.....	72
Appendix	75

BOARD OF TRUSTEES

Daniel Williard, <i>President</i>	Eli Frank
Theodore Marburg	Carlyle Barton
Blanchard Randall, <i>Vice-President</i>	Thomas R. Brown
Henry D. Harlan	Edwin G. Baetjer
Miles White, Jr.	Walter S. Gifford
B. Howell Griswold, Jr.	W. Graham Boyce
Frederick W. Wood	D. Luke Hopkins
Newton D. Baker	Joseph S. Ames, <i>ex officio</i>
J. Hall Pleasants	

S. Page Nelson, *Secretary*

OFFICERS OF ADMINISTRATION

President: Joseph Sweetman Ames
Dean of the Engineering Faculty: John Boswell Whitehead
Assistant Dean of the Engineering Faculty: William Bennett Kouwenhoven
Dean of the College of Arts and Sciences: Edward Wilber Berry
Librarian: John Calvin French
Assistant Librarian: Johannes Mattern
Registrar: Ryland Newman Dempster
Assistant Registrar: Irene M. Davis
Treasurer: S. Page Nelson
Assistant Treasurer: E. Maxwell Sauerwein
Auditor: Henry Iddins
Manager, Johns Hopkins Press: Christian W. Dittus

FACULTY FOR 1933-34

This list includes, besides the professors and instructors in Engineering, other members of the University faculty who are directly engaged in the instruction of Engineering students. The names are arranged in the several groups in alphabetical order. A date in brackets indicates the year of appointment to present rank; a second date means year of original appointment, if differing from the former.

PRESIDENT OF THE UNIVERSITY

JOSEPH SWEETMAN AMES, PH. D., LL. D.

[1929; 1890]

PROFESSORS

ALEXANDER GRAHAM CHRISTIE, M. E., *Professor of Mechanical Engineering*
[1920; 1914]

ABRAHAM COHEN, PH. D., *Collegiate Professor of Mathematics*
[1926; 1895]

JOSEPH CHRISTIE WHITNEY FRAZER, PH. D., SC. D., *B. N. Baker Professor of Chemistry*
[1916; 1901]

JOHN CALVIN FRENCH, PH. D., *Librarian of the University*
[1927; 1904]

NEIL E. GORDON, PH. D., *Francis P. Garvan Professor of Chemical Education and Chairman of Undergraduate Work in Chemistry*
[1928]

JOHN HERBERT GREGORY, S. B., *Professor of Civil and Sanitary Engineering*
[1920; 1918]

KARL FERDINAND HERZFELD, PH. D., SC. D., *Professor of Physics*
[1926]

JOHN CHARLES HUBBARD, PH. D., *Professor of Physics and Chairman of Undergraduate Work in Physics*
[1927]

WILBERT JAMES HUFF, PH. D., SC. D., *Professor of Gas Engineering*
[1924]

WILLIAM BENNETT KOUWENHOVEN, DIPL. ING., DR. ING., *Professor of Electrical Engineering and Assistant Dean of the Engineering Faculty*
[1930; 1914]

CARL F. MCKINNEY, MAJOR, INFANTRY, U. S. ARMY, *Professor of Military Science and Tactics*
[1928]

L. WARDLAW MILES, PH. D., *Collegiate Professor of English and Chairman of the Department of English in the College of Arts and Sciences*
[1927; 1926]

FRANCIS DOMINIC MURNAGHAN, PH. D., *Professor of Applied Mathematics*
[1928; 1918]

- WALTER A. PATRICK, PH. D., *Professor of Chemistry*
[1924; 1917]
- A. HERMAN PFUND, PH. D., *Professor of Physics*
[1926; 1906]
- E. EMMET REID, PH. D., LL. D., *Professor of Chemistry*
[1916; 1914]
- ROBERT BRUCE ROULSTON, PH. D., *Collegiate Professor of German and Director
of the Summer Courses*
[1928; 1908]
- JOSEPH TRUEMAN THOMPSON, B. S. IN ENG., *Professor of Civil Engineering*
[1930; 1919]
- JOHN BOSWELL WHITEHEAD, PH. D., *Professor of Electrical Engineering and
Dean of the Engineering Faculty*
[1910; 1898]
-

ASSOCIATE PROFESSORS

- LLOYD LOGAN, DR. ENG., *Associate Professor of Gas Engineering*
[1929; 1926]
- JOHANNES MATTERN, PH. D., *Assistant Librarian; Lecturer in Political Science*
[1911]
- BROADUS MITCHELL, PH. D., *Associate Professor of Political Economy*
[1927; 1919]
- FRANCIS OWEN RICE, D. SC., *Associate Professor of Chemistry*
[1926; 1924]
- JULIAN CHASE SMALLWOOD, M. E., *Associate Professor of Mechanical Engineering*
[1920; 1916]
- WILLIAM OSWALD WEYORTH, PH. D., *Associate Professor of Political Economy*
[1922; 1919]
- OSCAR ZARISKI, PH. D., *Associate Professor of Mathematics*
[1932; 1929] On leave 1934-35
-

ASSISTANT PROFESSORS

- FRANK P. COFFIN, CAPTAIN, INFANTRY (D. O. L.), *Assistant Professor of Military
Science and Tactics*
[1930]
- FRANK Z. PIRKEY, LIEUTENANT, CORPS OF ENGINEERS (D. O. L.), *Assistant Pro-
fessor of Military Science and Tactics*
[1930]
-

ASSOCIATES

- J. ELSTON AHLBERG, PH. D., *Associate in Chemistry*
[1932]
- ARTHUR O. BABENDREIER, *Associate in Drawing*
[1931; 1923]
- THOMAS F. COMBER, JR., S. B. IN C. E., *Associate in Civil Engineering*
[1926; 1920]

GEORGE HEBERTON EVANS, JR., PH. D., *Associate in Political Economy*
[1927; 1924]

THOMAS F. HUBBARD, B. E., *Associate in Civil Engineering*
[1927]

MAURICE LOYAL HUGGINS, PH. D., *Associate in Chemistry and Johnston Scholar
in Chemistry*
[1933; 1932]

SANFORD SWINDELL JENKINS, PH. D., *Associate in Chemistry*
[1932; 1931]

FRANK WOLFERT KOUWENHOVEN, M. E., *Associate in Mechanical Engineering*
[1928; 1920]

JOHN HAROLD LAMPE, DR. ENG., *Associate in Electrical Engineering*
[1928; 1920]

FREDERIC C. LANE, PH. D., *Associate in History*
[1931; 1928]

JOSEPH EDWARD MAYER, PH. D., *Associate in Chemistry*
[1930]

DAVID RICE MCKEE, PH. D., *Associate in French*
[1933; 1932]

FREDERICK WILBUR MEDAUGH, B. OF ENG., *Associate in Civil Engineering*
[1924; 1919]

MYRICK WHITING PULLEN, S. B., *Associate in Electrical Engineering*
[1918; 1912]

THOMAS F. SHEA, PH. D., *Associate in Chemistry*
[1932]

WILLIAM MYNN THORNTON, JR., PH. D., *Associate in Chemistry*
[1919]

EGBERTUS R. VAN KAMPEN, PH. D., *Associate in Mathematics*
[1931]

On leave 1933-34

GORDON THOMAS WHYBURN, PH. D., *Associate in Mathematics*
[1929]

JOHN WILLIAMSON, PH. D., *Associate in Mathematics*
[1928]

INSTRUCTORS

RONALD TAYLOR ABERCROMBIE, M. D., *Director of Physical Education*
[1905]

B. WILSON ALLAN, PH. D., *Instructor in Chemistry* (first term)
[1933]

LEWIS BALL, PH. D., *Instructor in English*
[1933]

THOMAS CROSS, JR., PH. D., *Instructor in Chemistry*
[1933]

JOE LEE DORROH, PH. D., *Instructor in Mathematics*
[1933]

MARTIN A. ELLIOTT, PH. D., *Instructor in Gas Engineering* (first term)
[1933]

- BERNARD L. EVERING, JR., PH. D., *Instructor in Chemistry* (second term)
[1934]
- SAMUEL BLAINE EWING, JR., A. M., *Instructor in English*
[1930]
- SAMUEL L. GOLDHEIM, PH. D., *Instructor in Chemistry* (first term)
[1933]
- FERDINAND HAMBURGER, JR., DR. ENG., *Instructor in Electrical Engineering*
[1931]
- KARL P. HANSON, B. S., *Instructor in Mechanical Engineering*
[1929]
- GORDON HUNTINGTON HARPER, PH. D., *Instructor in English*
[1932]
- CHARLES HENRY HARRY, PH. D., *Instructor in Mathematics*
[1932]
- FRANCIS MAHLON HASBROUCK, PH. D., *Instructor in Romance Languages*
[1933]
- LEWIS MILLER HEADLEY, B. M. E., *Instructor in Mechanical Engineering*
[1929]
- RICHARD HENRY LEE, PH. D., *Instructor in Physics*
[1933]
- ISADORE LEVIN, PH. D., *Instructor in Chemistry* (first term)
[1933]
- CLARENCE M. LOANE, PH. D., *Instructor in Chemistry* (first term)
[1933]
- RAYMOND N. LOVE, PH. D., *Instructor in Chemistry*
[1933]
- CLIFFORD PIERSON LYONS, PH. D., *Instructor in English*
[1932]
- WILLIAM KELSO MORRILL, PH. D., *Instructor in Mathematics*
[1930]
- JAMES W. MURRAY, PH. D., *Instructor in Chemistry* (first term)
[1933]
- EDWARD TAYLOR NORRIS, PH. D., *Instructor in English*
[1932]
- AUGUSTUS JOHN PRAHL, PH. D., *Instructor in German*
[1933]
- REUBEN ROSEMAN, PH. D., *Instructor in Chemistry* (first term)
[1933]
- JOHN ADOLPH SANDERSON, PH. D., *Instructor in Physics*
[1933]
- MARK HOWARD SECRIST, PH. D., *Instructor in Geology*
[1930]
- CHARLES H. SHAW, PH. D., *Instructor in Physics*
[1933]
- SHIRLEIGH SILVERMAN, PH. D., *Instructor in Physics*
[1933; 1930]
- FRED BARNES SLAGLE, PH. D., *Instructor in Chemistry* (second term)
[1934]

PAUL MOWBRAY WHEELER, PH. D., *Instructor in English*
[1929]

DONALD A. WILSON, PH. D., *Instructor in Chemistry*
[1933]

JACOB YERUSHALMY, PH. D., *Instructor in Mathematics*
[1933]

JUNIOR INSTRUCTORS

Chemistry

WILLIAM E. TROUT, JR., A. B.

English

HARRY ROBERT KILBOURNE

ALEXANDER M. SAUNDERS, A. M.

German

GURNEY W. CLEMENS, A. B.

Gas Engineering

DONALD T. BONNEY, B. E. (second term)

Mathematics

WILLIAM H. ERSKINE, A. B.

GEORGE RICHARD TROTT, A. M.

GEORGE EARL SCHWEIGERT, S. B.

WALTER STEVENS TURPIN, S. B.

JAMES FLETCHER WARDELL, A. B.

Physics

CARROLL WILLIAM BRYANT, A. B.

WILLIAM HUME, B. E.

Romance Languages

GEORGE D'ARCY HOCKING, A. B.

PAUL M. SPURLIN, PH. B.

EMANUEL VON DER MÜHL, A. M.

STUDENT ASSISTANTS

Chemistry

HILARY E. BACON, PH. D. (first term)

BERNARD L. EVERING, PH. D. (first term)

THEODORE L. BROWNYARD

THEODORE E. FIELD, S. B. (second term)

LAWTON ARTHUR BURROWS, S. B.

ARTHUR LAWRENCE GLASEBROOK

ROBERT E. BURNETT, S. B. IN CHEM.

CAREY B. JACKSON, S. M.

HENRY CADY CHITWOOD (first term)

WALTER OSCAR LUNDBERG

CLARENCE PATRICK ELY, S. B.

PAUL SUTTON (second term)

DONALD GUYER ZINK

Physics

WILLIAM RUDOLPH KANNE

MILTON LIPNICK, B. S. IN CHEM.

ALBERT SMITH, A. B.

ADVISORY BOARD OF THE SCHOOL OF ENGINEERING

The President of the University (*Chairman*)

J. B. Whitehead (<i>Secretary</i>)	J. H. Gregory	W. J. Huff
E. W. Berry	A. G. Christie	W. B. Kouwenhoven
E. B. Matthews	W. W. Ford	J. T. Thompson
J. C. W. Frazer		

This board was constituted by a resolution of the Trustees, May 9, 1913. It consists of the President of the University, certain members of the Faculty representing engineering and cognate sciences, and the Dean of the College of Arts and Sciences.

THE BOARD OF ENGINEERING STUDIES

The President of the University (*Chairman*)The Assistant Dean of the School of Engineering (*Vice-Chairman*)

J. H. Lampe (<i>Secretary</i>)	J. T. Thompson	A. O. Babendreier
J. B. Whitehead	J. C. Smallwood	T. F. Hubbard
J. H. Gregory	L. Logan	K. P. Hanson
A. G. Christie	M. W. Pullen	L. M. Headley
W. J. Huff	F. W. Medaugh	F. Hamburger, Jr.
J. C. Hubbard	T. F. Comber, Jr.	F. Z. Pirkey
J. C. W. Frazer	F. W. Kouwenhoven	T. F. Shea

This board, appointed annually, acts for the Advisory Board on all questions pertaining to undergraduate instruction.

STANDING COMMITTEES OF THE BOARD OF ENGINEERING STUDIES

Executive Committee

W. B. Kouwenhoven	A. G. Christie
(<i>Chairman</i>)	L. Logan
J. T. Thompson	
(<i>Secretary</i>)	

Curriculum Committee

W. B. Kouwenhoven	A. G. Christie
(<i>Chairman</i>)	W. J. Huff
J. T. Thompson	
(<i>Secretary</i>)	

HISTORICAL STATEMENT

THE UNIVERSITY

The Johns Hopkins University was founded by a merchant of Baltimore, Johns Hopkins (1795-1873) who bequeathed the greater part of his estate for the establishment of a university and a hospital. The University was incorporated in 1867, the Trustees organized in 1870 and the first courses of instruction were offered in October 1876. The work of the philosophical division of the University was begun in a small group of buildings on Howard Street where it continued until 1916 when the present site at Homewood was occupied. The Medical School was opened in 1893, in buildings adjacent to the Johns Hopkins Hospital. The School of Engineering, opened in 1914, forms part of the Homewood group. The School of Hygiene and Public Health was opened in 1918 in buildings on Howard Street but moved in 1925 to the present location near the Hospital.

The first President, inaugurated in February 1876, was Daniel Coit Gilman, who was followed upon his retirement in 1901 by Ira Remsen. Dr. Remsen resigned in 1912 and during a period of two years the duties of the presidential office were discharged by an Administrative Committee of the faculty, appointed by the Trustees. Dr. William H. Welch was the Chairman of the Committee. The third President was Frank Johnson Goodnow, who filled the office from 1914 until his resignation in 1929 when he was succeeded by Dr. Joseph S. Ames.

At the time of the organization of the Johns Hopkins University most of the institutions of higher education in this country were either colleges to which graduate schools had been added, or professional and technical schools. It was the declared intention of the trustees and president of the Johns Hopkins University to found an institution which would be characterized by academic freedom and mature scholarship, rather than by inflexible curricula designed to prepare students for a particular calling or to give them certain organized bodies of knowledge. While sharing with the traditional college the obligation of transmitting the intellectual heritage of the past, the University recognized the additional responsibility of expanding the bounds of knowledge through research.

The University community was to consist of a group of scholars, the professors being those of greater maturity whose presence would be both an inspiration and a practical help to the younger members composing the student body. In his inaugural address, Dr. Gilman declared ". . . while forms and methods vary, the freedom to investigate, the obligation to teach, and the careful bestowal of academic honors are always understood to be among the University functions. The pupils are supposed to be wise enough to select, and mature enough to follow the courses they pursue." Through the years, professional schools have been added, and since the beginning the undergraduate division of the Philosophical Faculty has functioned separately as a college. However, the general principles laid down at the founding have continued to be regarded as the essential characteristics of a University, and it has always been the endeavor of those to whom the academic affairs of the University were committed to render them effective in actual practice.

THE SCHOOL OF ENGINEERING

THE FOUNDATION

The establishment of the School of Engineering of the Johns Hopkins University was made possible by the passage of an Act of the General Assembly of the State of Maryland in its session of 1912. The preamble of the Act quotes the Declaration of Rights of the State as follows: "The Legislature ought to encourage the diffusion of knowledge and virtue, the extension of a judicious system of general education, the promotion of literature, the arts, sciences, agriculture, commerce and manufactures, and the general amelioration of the condition of the people." The Act further states that its purpose is the extension to the people of this State of opportunities, facilities, and advantages for education in applied science and advanced technology not hitherto available to them.

The Act provides a liberal appropriation for the erection of buildings and the purchase of equipment, and a continuing annual appropriation to the University. In conformity with the purpose and provisions of the Act the University offers each year a number of scholarships granting free tuition to residents of the State of Maryland. (See page 69).

Instruction was begun in the branches of Civil, Electrical, and Mechanical Engineering in the first of the new laboratories at Homewood, in October, 1914.

GENERAL PLAN OF INSTRUCTION

The School of Engineering offers graduate and undergraduate courses in the branches of Civil, Electrical, Mechanical, and Gas Engineering. Detailed statements as to the various courses are found in the following pages.

GRADUATE COURSES

The graduate courses offer advanced professional instruction. The plan of conducting the work of these courses is in general similar to that which governs the graduate work of other departments of the University.

The progress of the several branches of Engineering is followed in the current literature. Fitness for independent study and investigation is developed by seminary methods and in the laboratory. Special opportunities are offered for research and for experiment in the solution of engineering problems. Effort is made to maintain intimate contact with public corporations and municipal and State departments, and with others engaged in engineering enterprise, with the purpose of studying their problems and so aiding scientific progress in the methods of engineering.

The encouragement of individual initiative and independent study in the graduate courses constitutes especially valuable training for those who desire to become teachers of engineering subjects.

Detailed statements concerning the graduate instruction which is offered

in the several branches of Engineering are given below. Correspondence is invited as to the facilities which may be afforded for the investigation of special problems.

In addition to the professional courses enumerated below, attention is also drawn to a number of courses in allied subjects which are readily available. These courses present the most recent advances in the several sciences from the point of view of theory in its bearing on industrial applications and public needs. Among the more important are those in mathematics, physics, applied chemistry, economics, economic geology, and the courses in the School of Hygiene and Public Health. Further details as to these courses are given in special publications which will be sent on application. Through the close relationship between these courses and the graduate work in Engineering, exceptional opportunities are offered for specialized professional investigation.

Properly qualified students are admitted to any of the graduate courses. An academic or first degree in Engineering is not necessarily a prerequisite. Applicants for admission will confer with the heads of the respective departments of Engineering and will be admitted on the satisfactory exposition of their ability to pursue the advanced courses with profit.

Graduates of colleges of arts and sciences who have specialized in mathematics and physics or chemistry may, as graduate students, enter a two-year curriculum leading to the degree of Bachelor of Engineering.

The requirements for degrees, on completion of graduate study, are given on page 19.

COMBINED LIBERAL AND PROFESSIONAL COURSES

For those students who desire to follow courses in the liberal arts and sciences, and at the same time prepare themselves for the profession of Engineering, several special programs of study are offered in conjunction with the College of Arts and Sciences. Under these programs students may take the degree of Bachelor of Arts after four years and the degree of Bachelor of Engineering in two years thereafter. Exceptionally capable students may complete one of these programs in five years, and in all cases the period necessary for taking advanced degrees in Engineering is materially shortened. The University emphasizes particularly the opportunities offered in these courses for securing the combined liberal and professional education, which is essential for participation in the more important classes of modern engineering enterprise. For details of these courses see page 54.

UNDERGRADUATE COURSES

Undergraduate students who desire to prepare themselves for the profession of Engineering in four years will find opportunities in the several programs of courses described below. These undergraduate courses in Engineering aim to give students a thorough training in the principles of the several branches of Engineering and an introduction to the methods

of practice in general use. Emphasis is placed on fundamental and cultural studies in the first two years. In the later years these studies are combined with professional studies to an extent which should give the graduates a training and equipment enabling them to take an intelligent and increasingly responsible part in engineering undertakings. Particular effort is made to impart a thorough grounding in the general principles of the several branches of engineering, the greater portion of the time being devoted to this purpose. The further study of special applications is assigned to the graduate years.

The course of undergraduate instruction continues through four years. The program of studies for the first year is the same in all branches. Engineering studies begin in the second year, increasing in number and extent in the third and fourth years. Free-hand drawing is taught in the first year and mechanical and engineering drawing continue through all four years. The fundamental and general educational studies are conducted with the aid of the faculties of the College of Arts and Sciences, the College for Teachers and the School of Business Economics.

Students may choose at the beginning of the third year the branch of Engineering which they wish to follow. The fourth year is devoted mainly to professional studies of the principal subject. One of the earlier courses in each subject is arranged with special reference to the needs of students in other branches of Engineering.

In addition to recitations and personal conferences, practical work in the laboratory, demonstrations, and the study of existing engineering installations are prominent features of the methods of instruction.

Students are required to secure employment with engineering or other industrial organizations during the summer months. At least six months of such work is a prerequisite for graduation.

An important feature of the undergraduate instruction is a course of lectures on "Engineering Practice," given by practising and operating engineers. They are particularly designed to bring before the students the essential features of the planning, construction, and operation of modern engineering projects.

The University maintains Senior Division Units, Infantry and Engineering, of the Reserve Officers' Training Corps under the direction and control of the War Department. On entering the University a student may elect to enroll as a member of either of these units for a period of two years, and, if he should desire, for an additional period of two years.

Lists of courses offered for the year 1934-35 in the several professional subjects, to both graduate and undergraduate students, are given in succeeding pages.

NIGHT COURSES FOR TECHNICAL WORKERS

Special engineering courses are offered at night under the direction of the School of Engineering to those who are unable to attend day classes. The object is to provide special training to technical workers in their particular employment. These courses are not accepted for credit towards

the degree of Bachelor of Engineering, but under certain conditions, however, they may be counted as credit towards the degree of Bachelor of Science. Information concerning them may be secured from the Registrar.

BUILDINGS AND EQUIPMENT

The laboratories at Homewood, designed after careful study, provide every accommodation and facility for professional instruction. Besides the complete provision which has been made for undergraduate instruction, equipment has also been chosen with special reference to advanced study and experimental research.

The University operates its own steam and electric power plant, which furnishes heat and electric light and power to the various buildings of the University group at Homewood and heat to the New Municipal Art Museum. The types of the equipment in the power house, their arrangement, and the method of distributing heat and power through tunnels to the various buildings, have been chosen with particular reference to their use for the purposes of instruction.

Several photographs of the buildings of the engineering group are shown elsewhere in these pages. A more complete description of the buildings, with illustrations, has been published in the *Johns Hopkins University Circular* of December, 1916. The Alumni Memorial Hall provides living accommodations on the campus. A descriptive circular will be forwarded on request.

REQUIREMENTS FOR ADMISSION

Young men who wish to pursue undergraduate courses should apply to the Registrar of the University for a blank form of "Application for Admission," which must be filled out first by the applicant and then by the Principal of the high school who will forward it directly to the Registrar.

Students who are interested are invited to correspond with the Registrar during their high school years in order to receive advice in planning their programs. Applications should be filed as soon as possible after graduation, as in this case there is an opportunity to recommend additional work for the summer if it is necessary. The entrance examinations are held at the University in September of each year. [September 17-20, 1934.]

Applicants are received without examination upon certificates from the principals of schools approved by the various regional associations of colleges and secondary schools, provided that the certificates fully and satisfactorily cover the requirements for admission. The certificate must be incorporated in the form of application for admission. As soon as it is received, it is acted upon by the Registrar, and the applicant is notified at once in regard to the conditions of his admission. If a student's grade in any subject is less than the standard required by his school for certification, he is required to take the entrance examination in that subject.

To accommodate those who wish to take their examinations at other times and places, the University will accept certificates from the College Entrance Examination Board and the Board of Regents of the State of New York for subjects passed in accordance with their regulations.

ADVANCED STANDING

In general a student may be admitted to advanced standing only by passing the necessary examinations when he enters. Application must be made upon a blank form to be obtained from the Registrar. Students entering from other colleges, or from certain advanced schools recognized by the University, may be credited with work already done, provided that acceptable certificates are submitted.

A student who has completed two years in another college of approved standing may be admitted to the third year of the undergraduate curriculum on giving satisfactory evidence that he has completed courses equivalent to those required in the first two years in this University.

TABLE OF ADMISSION REQUIREMENTS

Those who wish to become candidates for the degree of Bachelor of Engineering must present evidence of a satisfactory knowledge of the following subjects:

1. Mathematics:
 - a. Algebra ($1\frac{1}{2}$ units). (C. E. E. B.,* Math. A † or Math A 1 and A 2).
 - b. Plane Geometry (1 unit). (C. E. E. B., Math. C).
2. English (3 units). (C. E. E. B., English 1 2, or Cp.).
3. Foreign Language (4 units required; not less than 2 units accepted in any one language):
 - a. Latin: Grammar, Composition, and *Caesar*, books I-IV (2 units). (C. E. E. B., Latin Cp. 2).
 - Cicero*, 6 orations (1 unit).
 - Virgil*, books I-VI (1 unit).
 - b. Greek } Elementary (C. E. E. B., Greek Cp. 2, French Cp. 2, German Cp. 2, Spanish Cp. 2, Italian Cp. 2).
 - c. French } (2 units).
 - d. German } Intermediate (C. E. E. B., Greek Cp. H, French B, German B, Spanish B, Italian B).
 - e. Spanish } (1 additional unit).
 - f. Italian }
4. History (1 unit). (C. E. E. B., History A, B, C, or D).
5. Electives, to make 15 units in all, from the following subjects:

Solid Geometry ($\frac{1}{2}$ unit).	(C. E. E. B., Math. D).
Plane Trigonometry ($\frac{1}{2}$ unit).	(C. E. E. B., Math. E).
Languages (1 to 5 units additional).	
History (2 units additional).	
Physical Geography (1 unit).	
Biology (1 unit).	
Botany (1 unit).	
Zoology (1 unit).	
Physics (1 unit).	
Chemistry (1 unit).	
Drawing (1 unit).	

(C. E. E. B. Equivalents).

A student must have satisfied the foregoing requirements before he may be fully matriculated.

COLLEGE ENTRANCE EXAMINATION BOARD

The College Entrance Examination Board holds examinations at numerous places in the country. The dates in 1934 are June 18-23 inclusive. At this University they will be held in Gilman Hall 112 and will be under the direction of the Registrar. These examinations, if passed with a mark of not less than 60 per cent., will be accepted for admission.

The application for examination must be addressed to the College Entrance Examination Board, 431 West 117th street, New York, and

* The abbreviation C. E. E. B. refers to the College Entrance Examination Board.

† Students who offer the equivalent of C. E. E. B. Math. A are allowed two units.

must be made upon a blank form to be obtained from the Secretary of the Board.

If the application is received sufficiently early, the examination fee will be \$10.00 for candidates examined in the United States, Canada and elsewhere. The fee, which must accompany the application, should be remitted by postal order, express order, or draft on New York to the order of the College Entrance Examination Board.

Detailed definitions of the requirements in all examination subjects are given in a circular of information published annually by the College Entrance Examination Board. Upon request a single copy of this document will be sent to any teacher without charge. In general a charge of twenty-five cents, which may be remitted in postage, will be made.

DEGREES

BACHELOR OF ENGINEERING

As evidence that the undergraduate curriculum in Engineering has been successfully completed, the degree of Bachelor of Engineering is conferred at its close. This degree is not intended to indicate completion of formal educational training in Engineering, but rather to mark a starting point from which students, who are for any reason not able or inclined to continue in the rigid discipline of advanced professional study, may nevertheless enter with credit into engineering work under the direction of others.

The student will normally follow one of the curricula outlined in the foregoing pages. Substitution of other studies in place of those prescribed may be made only by special arrangement.

Application for credit for work done elsewhere and for advanced standing should be made to the Registrar before the opening of the year. (See page 16.)

A prerequisite for the degree is that the student shall have spent at least six months in the employ of an approved engineering or other industrial organization. Failing this, the degree is withheld until this condition is fulfilled.

BACHELOR OF SCIENCE IN CHEMISTRY

The degree of Bachelor of Science in Chemistry is conferred on satisfactory completion of the 1931-32 undergraduate curriculum.

The curriculum leading to this degree will be discontinued after the candidates now in residence graduate.

BACHELOR OF SCIENCE

The degree of Bachelor of Science will be conferred upon students who have fulfilled certain requirements in the College for Teachers and the Night Courses for Technical Workers. These requirements are stated in the circular of the Night Courses for Technical Workers.

REQUIREMENTS FOR THE DEGREE OF MASTER OF CIVIL, ELECTRICAL, GAS AND MECHANICAL ENGINEERING

The degree of Master of Civil, Electrical, Gas or Mechanical Engineering is offered to students who have obtained the degree of Bachelor of Engineering or its equivalent from a college of good standing, who have then followed courses of university study under proper guidance for at least two years, and who have satisfied the requirements mentioned below.

The Advisory Board of the School of Engineering reserves the right to decide in each case whether the preliminary training has been satisfactory, and, if part of the time devoted to graduate work has been passed by the

candidate away from the University, whether this time may be considered as spent in accordance with these regulations.

The student must be in attendance at the University during the year immediately preceding the final examinations, unless for some extraordinary reason, special permission to the contrary is granted by the Advisory Board of the School of Engineering.

To be admitted as a candidate for this degree, the student must make application, according to a prescribed form, to the Advisory Board of the School of Engineering at least one academic year before he expects to present himself for the final examinations. The required work may be limited to one subject only, or it may embrace a principal subject and one or two allied subjects. The professor in charge of the principal subject must be consulted in the selection of the allied subjects.

In order to obtain the degree the candidate must satisfy two requirements:

He must carry out an original investigation and must pass examinations in his principal subject. The investigation may be either of the nature of experimental research, embodying new results, or a comprehensive written review of some important branch of the particular field of Engineering in which the candidate is working. The publication of this essay is not a requisite for the degree. The investigation must be upon a subject approved by the professor in charge of the principal subject and must be completed and a report submitted to the Advisory Board of the School of Engineering at least four weeks before the time of the final examinations. Two referees will then be appointed who will present a written report upon the investigation to the Advisory Board. The report should be prepared for presentation to the Committee in the manner prescribed for the dissertation submitted for the degree of Doctor of Philosophy.

If the report on the investigation is satisfactory, the candidate will be admitted to the examinations, and on satisfactory completion of these he will be recommended to the Board of Trustees and with their approbation the degree will be publicly conferred.

REQUIREMENTS FOR THE DEGREE OF DOCTOR OF ENGINEERING

The degree of Doctor of Engineering is offered to students who after obtaining the Bachelor of Engineering degree or equivalent from a college of good standing, have followed courses of university study under proper guidance and without serious distractions for at least three years, and have satisfied the requirements mentioned below.

The Advisory Board of the School of Engineering reserves the right to decide in each case whether the preliminary training has been satisfactory, and which, if any, years of graduate work not spent in this University are to be considered as spent in accordance with these regulations.

At least one academic year must be passed in this University, and, except in extraordinary cases, the one preceding the final examination.

Principal and Subordinate Subjects

To become a candidate for the degree the student must select a subject on which he intends to concentrate his efforts and must place himself under the guidance of the professor on this subject. This is called his "principal" subject. With the advice of the professor and subject to the approval of the Advisory Board of the School of Engineering, the student must choose two other studies, known as "subordinate" subjects, which he must follow. These are called the "first subordinate" and the "second subordinate," and the two should represent one year's work, two-thirds of this being devoted to the former.

Acceptance of the Candidate

A student who wishes to be considered a candidate for the degree must make written application to the Advisory Board of the School of Engineering upon a form provided for this purpose, at least one academic year before he expects to present himself for his final examinations. Before this application can be considered he must satisfy the Advisory Board that he is able to translate at sight French and German journals and monographs relating to his principal subject.

Requirements for the Degree

Certain requirements, as outlined above, must be met by a candidate in order to obtain the degree; but the distinctive requirement is the presentation of evidence that the candidate has carried to successful completion an original investigation in his principal subject upon a theme approved by his chief professor. The results of this investigation must be embodied in a dissertation, and submitted to the Advisory Board of the School of Engineering.

Regulations Concerning the Dissertation

(a) The dissertation must be prepared for presentation to the Advisory Board of the School of Engineering in accordance with instructions to be obtained from the Registrar, and to every such dissertation must be appended a brief biographical sketch of the author. It must be submitted to the Advisory Board at least four weeks before the examination in the principal subject.

(b) The Board shall designate two or more referees, who shall make a written report on the dissertation.

Regulations Concerning the Examinations

(a) The candidate shall be subjected to written examinations in his principal subject, and, whenever practicable, in both his subordinate subjects. The results of the examinations shall be reported in writing to the Advisory Board of the School of Engineering; and, if these reports and the reports on the dissertation are satisfactory, the candidate shall be

admitted to an oral examination in his principal and first subordinate subjects before the Board or a section of it.

(b) The written examinations in the subordinate subjects may be taken at any time during the candidate's residence at the University, subject to the judgment of the examiners.

(c) In the written examinations no session shall exceed five hours. In the oral examinations before the Board the time allotted shall be one hour, and three-quarters of this shall be devoted to the principal subject.

Other Regulations

Before the candidate is admitted to the oral examination he must signify his intention, in the event of his receiving the degree, to print his dissertation in full or in part, and to satisfy the requirements specified below.

If the dissertation is not printed in full, an abstract must be prepared or a portion selected, with the approval of the professor, which shall contain when printed not less than twenty-four octavo pages.

One hundred and fifty printed copies of the dissertation must be presented to the University within two years from the time when the degree is conferred. These must have the prescribed title-page and must contain the biographical sketch.

The candidate is advised to have these printed copies ready for presentation before the date for the conferring of the degree; otherwise a deposit of \$100.00 with the Treasurer of the University, must be made. This deposit is returned when the printed copies are presented to the University. If these have not been received within the years specified, the Advisory Board of the School of Engineering may declare the deposit forfeited and may apply the amount to printing the dissertation or a part of it.

Conferring of the Degree

The names of the candidates found worthy of the degree will be submitted to the Board of Trustees, and with their approbation the degree will be publicly conferred.

A more complete statement embodying less important details and regulations will be furnished on request.

DOCTOR OF PHILOSOPHY

The degree of Doctor of Philosophy is also open to graduate students in Engineering who comply with the requirements for that degree as set forth in the circular of the School of Higher Studies of the Faculty of Philosophy.

TUITION FEES AND EXPENSES

UNDERGRADUATE FEES

DEPOSIT

Upon entering the University, each student is required to deposit \$20.00, which is repaid at the end of the year if there are no charges against him.

TUITION FEE

The tuition fee for undergraduate students is \$450.00 per annum, payable in two installments (\$250.00 on Registration Day in September, \$200.00 on Registration Day in February). Students in residence during the second semester only will be charged \$250.00. No one is at liberty to attend classes until he has paid the tuition and deposit fee at the Treasurer's office. Previous to 1934-1935, students paid, in addition to the tuition fee, other fees for registration, the use of laboratories, athletic activities, and non-athletic activities. These fees have been abolished and the payment of the tuition fee entitles the students to all of the privileges heretofore charged as separate items. These include the following: registration in the University; the use of all laboratories; membership in the University Athletic Association which carries with it admission to all athletic contests at Homewood in which University students participate; use of Levering Hall; and subscription to all student activities subsidized by the University.

Students withdrawing from the University must at once notify the several instructors concerned, as well as the Registrar; otherwise they will be liable to the full charge for the term. No deduction in fees is made because of absence for a period of less than four months.

Students who need the elements of a language for matriculation and who are not holders of a State Scholarship are required to pay additional fees for the following courses in the College for Teachers: French, German, and Spanish Elements, and English Composition. There is no extra charge for other courses.

GRADUATION FEES

Before a degree is conferred all outstanding accounts at the Treasurer's office must be paid.

The fee for the diploma of Bachelor of Engineering or of Bachelor of Science in Chemistry is \$5.00.

The University will furnish academic costume for use at public exercises. The charge for this is \$3.00.

Holders of State Scholarships are exempt from all fees except the deposit of "caution money."

GRADUATE FEES

ENROLLMENT FEE

When a student applies for admission to graduate courses in the School of Engineering he receives a blank form which he must present, along with transcripts of his previous work, to the professor with whom he wishes to study. If the professor is satisfied that the student is prepared for work in his department, he will certify this on the blank. The student will then present this form, properly filled in, and the transcripts to the Registrar.

This procedure applies both to students who expect to be in full residence and also to those who wish to obtain permission to do a limited amount of work only.

The annual fee for registration is \$3.00. In case of registration after the specified period an additional fee of \$3.00 will be charged, unless, for exceptional reasons, contrary action be recommended by the department to which the student is admitted. The dates of enrollment will be October 1 to 6, 1934.

All students are required to make a deposit of \$20.00, which will be repaid them when they leave the University if there are no charges against them.

TUITION AND LABORATORY FEES

Students in Residence

The tuition fee for graduate students is \$300.00 per annum, payable in two installments (\$175.00 in October, \$125.00 in February). Students in residence during the second semester only will be charged \$175.00. The laboratory fee is \$36.00 payable in two equal installments in October and February.

Graduate students other than holders of State Scholarships are required to pay additional fees for the following courses in the College for Teachers: French, German, and Spanish Elements. There is no extra charge for other courses.

In all the laboratories there are charges made for breakage, for apparatus not returned in good condition, and for unusual supplies and special apparatus.

Students who have completed without serious interruptions* the third year of graduate work in the School of Engineering may apply to the President for a reduction of fees, provided that they have been in resi-

* Such as caused by illness, absence, or time spent in overcoming deficiencies in preparation or in earning an appreciable income.

dence in this University for at least two years and the department in which they are working certifies that the completion of the dissertation is the only requirement lacking for the degree. Such reduced fee shall be \$75.00, payable in one amount in advance, in addition to the customary charges for registration and caution money. In the case of students using laboratories the usual laboratory fee may be remitted on the recommendation of the Department concerned.

Students not in Residence

a. If a student is granted leave of absence by the Advisory Board of the School of Engineering with the privilege of completing his essay or dissertation while not in residence in the University, he will be charged a fee of \$40.00, payable October first, as well as a registration fee. He must also make the usual deposit of \$20.00.

b. If a student has passed the written examinations required for a degree and has had his essay or dissertation accepted by the Board, but is not prepared to present himself for his degree, he may be granted leave of absence by the Advisory Board, and will be charged only a registration fee.

c. The privilege is offered to those who are engaged in some occupation outside the University and who are accepted as graduate students in the School of Engineering to attend a limited number of lectures in the University, and/or to work in its laboratories.

The maximum number of hours of lectures or seminary work permitted is 6 per week, in case laboratory work is not done; and the maximum number of hours of laboratory work permitted is 10 per week if no lectures or seminaries are attended. If both lectures or seminary and laboratories are attended, the maximum number of hours permitted in the former is 3 and in the latter 6.

The fees charged for a year are \$40.00 per hour per week for lectures or seminaries and \$6.00 per hour per week for laboratory work, payable on entrance in October. The fees for one term only are \$25.00 per hour per week and \$3.00 per hour per week respectively, payable in advance.

Attendants on Single Courses

A student who has not been accepted as a candidate for a degree but who wishes to attend a single course may do so with the consent of the professor in charge of the course. No record is kept of the work of such a student and the fees are those charged students not in residence.

Summer Work

Graduate students in Engineering who are permitted to work in the libraries and laboratories during the summer are charged a fee of \$25.00 a month payable in advance.

GRADUATION FEES

Before a degree is conferred, all outstanding accounts at the Treasurer's Office must be paid; and, in the case of a student who has not been in regular residence, the minimum for his tuition fees as a member of the School of Engineering will be equivalent to the amount charged for the minimum period of regular residence. The minimum residence requirement for the Doctor's degree is three years, and for the Master's 2 years.

A deposit of \$100.00 must be made with the Treasurer by a candidate for the degree of Doctor of Philosophy in Engineering or Doctor of Engineering before the degree will be conferred unless he has satisfied the University requirements concerning the printing of his dissertation. (See page 22.)

The fees for diplomas are payable in advance and are as follows: for Master of Engineering, \$10.00, and for Doctor of Engineering, \$10.00, except in the case of a student who has received previously the degree of Master of Engineering in this University in which case the fee is \$5.00.

The University will furnish academic costume for use at public exercises. The charge for this is \$3.00.

EXEMPTIONS

Members of the full-time teaching staff may take courses in any school of the University without payment of fees other than laboratory fees, but they will be liable for extra fees to cover the cost of material used. (This does not include Summer Courses.)

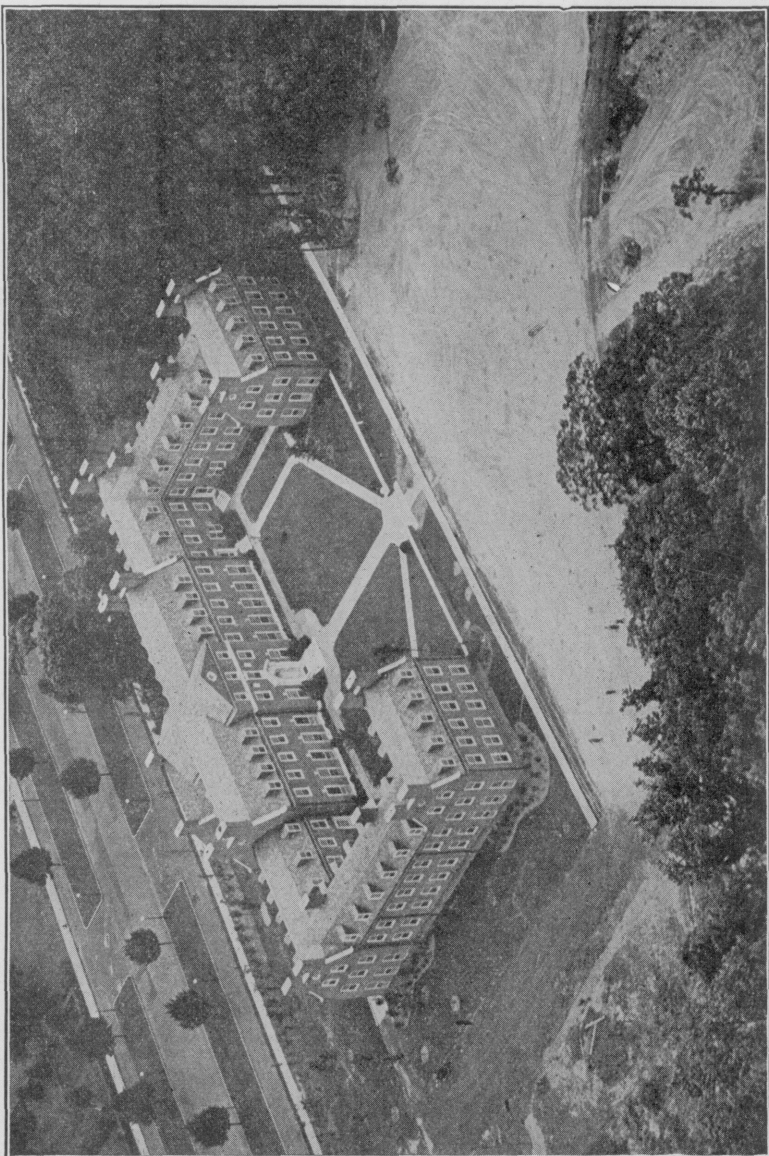
Fellows by Courtesy, and former students who have received the degree of Doctor of Philosophy or Doctor of Engineering in this University, are exempt from fees other than laboratory and registration fees, for courses in the School of Engineering and in the School of Higher Studies of the Faculty of Philosophy.

REGISTRATION DIRECTIONS AND INFORMATION FOR UNDERGRADUATES

Entering students must present their admission cards to the Treasurer on September 27, 1934, at 9 a. m., and pay the "caution money" deposit (\$20.00), and the tuition fee for the first term (\$250.00). Fees may be paid by mail in advance, in which case students should bring their receipts with them on the day of registration.

Members of the upper classes must follow the same procedure on September 28 or in the forenoon of September 29.

A fine of \$3.00 will be charged against those failing to enroll on the days named.



THE ALUMNI MEMORIAL HALL

All students will register for the second term on Wednesday, February 6.

No student will be enrolled until he presents a receipt from the Treasurer.

An examination in English Writing required of all entering students who have not received advanced standing in the course for work done in another college will be given on Tuesday and Wednesday, September 25 and 26, at 9 a. m., in Rooms 1 and 101 Remsen Hall. Residents of the city and nearby suburbs will take the examination on Tuesday; out-of-town students on Wednesday. Students who pass this examination will be given credit for the course and will take English 1 C. Those who fail will be required to take the course in English Writing.

All entering students intending to take Mathematics 1 C or 2 C will meet in Room 1 in Remsen Hall at 2 p. m., Wednesday, September 26, to take a placement examination. This will consist of simple questions in Algebra and Trigonometry, intended to test the student's ability to use these subjects in actual practice.

On the three enrollment days the Registrar's Office will be located in Remsen 101. All students must report to this office immediately after they have paid their fees and secured post office boxes. When they have registered they will be assigned to advisers to whom they must report at once.

On Monday, October 1, at 10 a. m., in Room 1, Remsen Hall the Deans of the College of Arts and Sciences and the School of Engineering will meet all entering students. On Tuesday, October 2, classes begin.

Every student should come to the Registrar's Office between October 8 and October 15 and enter his schedule of hours on a card which will be given him at that office.

LIVING ACCOMMODATIONS

The Alumni Memorial Hall provides accommodations for approximately one hundred and forty persons. A descriptive circular will be forwarded upon request.

A list of recommended boarding houses and rooms for rent with families is kept by the Secretary of the University branch of the Young Men's Christian Association.

BUREAU OF APPOINTMENTS

The University Bureau of Appointments, authorized by the Trustees, is under the supervision of the Registrar.

The Bureau maintains a file in which are registered all present and former students who care to avail themselves of its assistance in finding suitable employment. It is successful, year by year, in placing numbers of students in academic and business positions. The Bureau also records the names of resident students who desire to contribute to their own support by part-time and vacation work, and endeavors to secure for them employment as teachers, tutors, or salesmen in Baltimore. So far as its resources permit it gives vocational guidance to undergraduates, and keeps lists of books helpful to students who are selecting a vocation. The services of the Bureau are offered, without charge, to all students and former students of the University. There are no fees for its service to employers.

I—CIVIL ENGINEERING

The curriculum in Civil Engineering is planned to give four years of undergraduate college work along general lines, to fit a student for entrance into the civil engineering profession. Some work in the drafting-room is required in each of the four years, but, with the exception of the first year, this is all done in connection with other studies of a practical or theoretical nature. In the first two years the greater part of the work lies in the fields of mathematics, English, and the pure sciences; but in the last two years greater emphasis is put on strictly professional work.

In the courses in plane and advanced surveying, students are trained in the practical use of surveying instruments, the University having a full equipment of modern engineers' transits, levels and plane tables, together with level rods, stadia rods, etc. Surveys having a practical bearing are made, the notes taken in the field being later plotted in the drafting-room. Instruction is also given in the drafting-room in the preparation of topographical drawings. While in the field, the student is trained to take charge of survey work, and is thrown on his own responsibility to as great an extent as possible.

The hydraulics laboratory is well equipped with apparatus for making experiments on the flow of water. Facilities are afforded there for conducting experiments with orifices, rectangular and V-notch weirs, on flow in pipes and open channels, and with Pitot tubes, the Venturi meter, current meter, Pelton wheel, hydraulic ram and centrifugal pump; in the field measurements are made of steam flow and of discharge through fire hose and nozzles.

In the courses in theory of structures, structural engineering and reinforced concrete, students are required to analyse the stresses in various types of structures. In the drafting-room they design structures of different types and prepare general working drawings and shop detail drawings of the same in accordance with the best modern practice.

The Structural Research Laboratory is equipped with special apparatus for experimental stress analysis of models of structures.

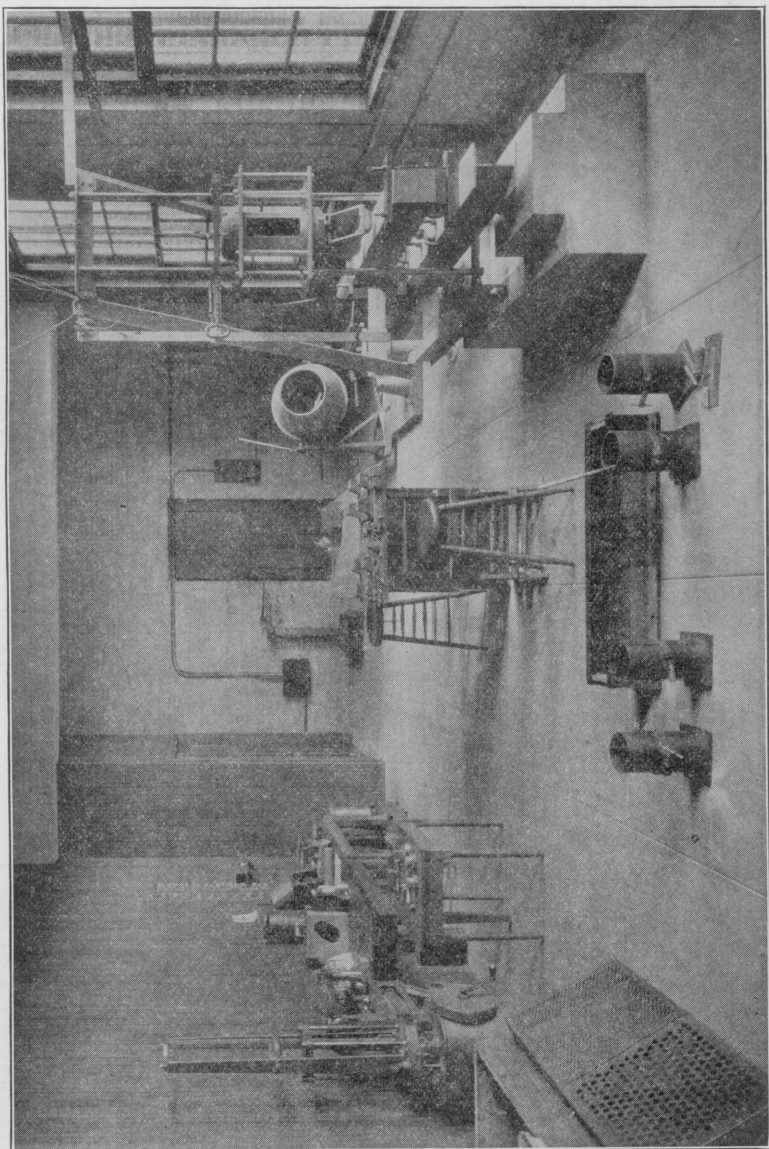
In the course in sanitary engineering, in that part dealing with water supply works, students are required to work up, in the drafting-room, the necessary data and diagrams for determining the relations between storage and runoff, to make layouts of piping, and to design various kinds of water works structures and details. In that part of the course dealing with sewerage works, each student makes a design of a sewerage system for a sewerage district, together with the working drawings and details therefor.

The Civil Engineering Department conducts a modern, well-organized laboratory used in connection with the courses in reinforced concrete and highway engineering, where standard tests and original investigations are conducted upon materials bearing upon these subjects.

In the drafting-room each student has assigned to him a modern drawing table, with locker and drawer, for his special use throughout the school year, so that full facilities for drafting-room work are available to him at all times.

Throughout the course in Civil Engineering inspection trips are made at intervals, so that students may have the opportunity of studying at first hand the application of the principles studied by them in the class and drafting-rooms, and after each inspection trip each student is required to turn in a written report of the structure or work inspected.

Graduate courses are provided for students who desire to work towards the master's or the doctor's degree, in such manner as to fit the needs and desires of properly qualified students who may apply for them. See page 12. The purpose and aim of these graduate courses is to permit the student, who upon the completion of a regular undergraduate course has been given a sound training in the fundamentals and general practice of Civil Engineering, to specialize more fully in some particular branch.



RESEARCH LABORATORY—REINFORCED CONCRETE

I—CIVIL ENGINEERING

FIRST YEAR

<i>1st Term</i>	Class	Lab.	<i>2nd Term</i>	Class	Lab.
Chemistry 1 C.....	3	6	Chemistry 1 C.....	3	6
*Mathematics 1 C or 2 C.....	4		*Mathematics 1 C or 2 C.....	4	
**English Writing or English 1 C.	3		**English Writing or English 1 C	3	
Engineering Drawing (111 E)....	1	6	Descriptive Geometry (111 E)....	1	6
General Engineering 1 E.....	1		General Engineering 1 E.....	1	
Modern Language and Physical Training	4		Modern Language and Physical Training	4	
or			or		
Military Science 1 C.....	2	2	Military Science 1 C.....	2	2

Engineering Work in the Summer

SECOND YEAR

<i>1st Term</i>	Class	Lab.	<i>2nd Term</i>	Class	Lab.
†Physics 1 C.....	4	6	†Physics 1 C.....	4	6
†Mathematics 3 C.....	4		†Mathematics 3 C.....	4	
Applied Mechanics (301 E)....	4		Strength of Materials (122 E)....	4	
Surveying (121 E).....	1	6	Civil Engineering Drawing (123 E)	1	6
**English Writing or English 1 C.	3		**English Writing or English 1 C	3	
and Physical Training	3		and Physical Training	3	
or			or		
Modern Language and Physical Training	3		Modern Language and Physical Training	3	
or			or		
Military Science 2 C.....	2	2	Military Science 2 C.....	2	2

Engineering Work in the Summer

THIRD YEAR

<i>1st Term</i>	Class	Lab.	<i>2nd Term</i>	Class	Lab.
Materials of Engineering (315 E).	3	3	Hydraulics (133 E).....	3	3
Theory of Structures (131 E)....	2	6	Theory of Structures (131 E)....	2	6
Elements of Electrical Engineering (201 E).....	3	6	Elements of Electrical Engineering (201 E).....	3	6
or			or		
Heat Engines (305 E).....	2	3	Heat Engines (305 E).....	2	3
Highway Engineering (132 E)....	2		Railroad Surveying (134 E)....	2	
Political Economy 1 C.....	3		Political Economy 1 C.....	3	
Mathematics 5 E.....	2				

Engineering Work in the Summer

FOURTH YEAR

<i>1st Term</i>	Class	Lab.	<i>2nd Term</i>	Class	Lab.
Geology 1 C.....	4	3	Geology 1 C.....	4	3
Structural Engineering (141 E)...	4	9	Reinforced Concrete (146 E)....	3	6
Sanitary Engineering (142 E)....	3	6	Sanitary Engineering (142 E)....	3	6
Railroad Engineering (143 E)....	2		Industrial Organization and Con- tracts (317 E).....	3	
Seminary (144 E).....	1		Seminary (144 E).....	1	
English 11 E.....	1		English 11 E.....	1	
			Advanced Surveying (145 E).....	1	3

† Mathematics 3 C and Physics 1 C are prerequisite to all third-year courses in Engineering.

* Students who have not had trigonometry must take Math. 1 C.

** See page 56.

I—CIVIL ENGINEERING

Professor GREGORY
Professor THOMPSON
Mr. BABENDREIER

Mr. COMBER
Mr. HUBBARD
Mr. MEDAUGH

UNDERGRADUATE COURSES

111 E. Engineering Drawing and Descriptive Geometry. Mr. BABENDREIER. One hour of class work and two drafting-room periods of three hours each, weekly, through the year.

Practice in the elements of mechanical drawing and freehand sketching, including the making of finished drawings in pencil, and tracings in ink. The elements of descriptive geometry, with problems covering intersections, projections, and developments.

121 E. Surveying. Mr. MEDAUGH and Mr. HUBBARD. One hour of lecture or recitation and two field or drafting-room periods of three hours each, weekly, first half-year.

Recitations and field work. The use of instruments is taught by having the students work out a number of simple practical problems in the field. The time in the drafting-room is devoted to plotting notes and making computations.

122 E. Strength of Materials. Mr. COMBER and Mr. HUBBARD. Four hours weekly, second half-year.

The elementary theory of the mechanics of materials, including stresses and strains, riveted joints, torsion, bending moments and shears, beams (stresses, deflections, beams with more than two supports, special beams), combined stresses and columns.

123 E. Civil Engineering Drawing. Mr. HUBBARD. One hour of lecture or recitation and two drafting-room periods of three hours each, weekly, second half-year.

This course includes the application of descriptive geometry to various structural problems. Emphasis is laid upon ordinary projections, lettering and proper drafting-room methods. The latter part of the course is devoted to the drawing of simple engineering structures, involving the principles of drafting and descriptive geometry.

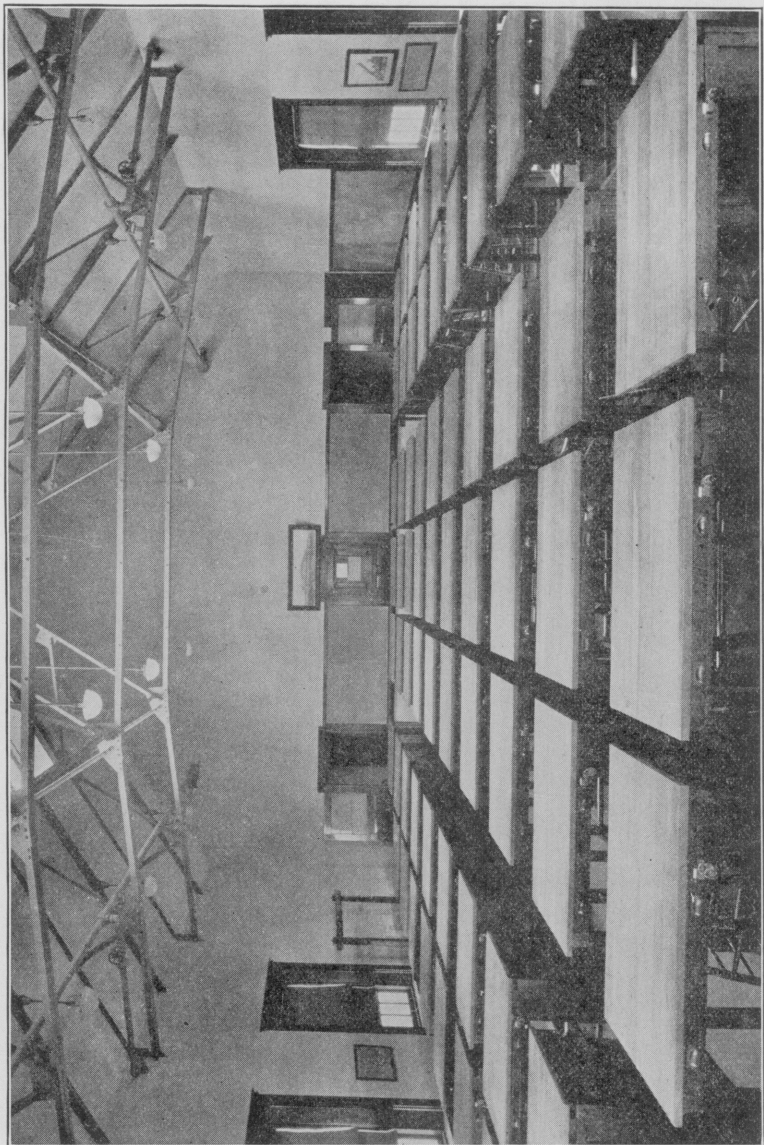
Prerequisite: Course 111 E—Engineering Drawing and Descriptive Geometry.

131 E. Theory of Structures. Professor THOMPSON. Two lecture or recitation hours and two three-hour periods in the drafting room, weekly, through the year.

Introduction to the theory and practice of structural design. The lecture and recitation periods are devoted to discussions of the following: analytical and graphical stress analysis of framed structures including roof and bridge trusses, lateral bracing systems, trestles, portals and mill building bents, influence lines and their applications to moving load stress phenomena; impact stresses, index stresses, counter stresses, etc. The theory of beam stress phenomena is also covered, including principal stresses.

The drafting-room periods are devoted to the applications of the foregoing in selected problems, including several designs.

Prerequisite: Course 122 E—Strength of Materials.



SOPHOMORE DRAFTING ROOM

132 E. Highway Engineering. Mr. COMBER. Two lecture or recitation hours and one three-hour period in the laboratory, weekly, first half-year.

The development of highway systems, and the design, construction and maintenance of roads and pavements, together with laboratory tests of bituminous and non-bituminous road and pavement materials.

133 E. Hydraulics. Mr. MEDAUGH. Three lecture or recitation hours and one laboratory period of three hours, weekly, second half-year.

The fundamental principles of hydrostatics and hydrodynamics, and the application of these principles to the solution of practical problems. Laboratory and field exercises include experiments with orifices, rectangular and V-notch weirs, Pitot tubes, nozzles, pipes, and open channels, the Venturi meter, current meter, Pelton wheel, hydraulic ram and centrifugal pump.

134 E. Railroad Surveying. Mr. MEDAUGH. Two lecture or recitation hours and one three-hour period in the field or drafting room, weekly, second half-year.

Simple and compound curves, easement curves, profiles, cross-sections, topography, paper location, slope stakes, and mass diagram.

Prerequisite: Course 121 E—Surveying.

141 E. Structural Engineering. Mr. COMBER. Four lecture or recitation hours and three periods of three hours each in the drafting room, weekly, first half-year.

This course is a continuation of course 131 E.

The recitation and lecture periods are devoted to the analysis of stresses, methods of design, and to the interpretation of specifications. The subjects include plate girders, subdivided trusses, cantilever bridges, three hinged arches, columns, earth pressure, masonry dams, and deflections.

The drafting periods are devoted to a complete design and general drawing of a plate girder railroad bridge; the complete design, stress sheet, and general drawing of a modern through riveted highway bridge; the graphical analysis of a high masonry dam; and the construction of Williot diagrams.

Prerequisite: Course 131 E—Theory of Structures.

142 E. Sanitary Engineering. Professor GREGORY. Three lecture or recitation hours and two drafting-room or field periods of three hours each, weekly, through the year.

The essential principles of design, construction and operation of sewerage and water supply works, and a comprehensive study of modern sanitary engineering practice. Laboratory exercises include inspection trips to typical water purification and sewage disposal works and other sanitary works.

Prerequisite: Course 133 E—Hydraulics.

143 E. Railroad Engineering. Mr. MEDAUGH. Two lecture or recitation hours, weekly, first half-year.

The roadbed: track and track accessories; turnouts and crossovers; yards and terminals; signalling; locomotive grade problems; string lining; reconnaissance, location and construction; valuation.

Prerequisite: Course 134 E—Railroad Surveying.

144 E. Seminary. Professor THOMPSON. One hour weekly, through the year.

The first term is devoted to the principles and practice of public speaking, with some attention to the methods of organizing and conducting meetings.

In the second term the meetings are conducted by the students under the supervision of

members of the faculty. Numerous reports on current scientific and engineering topics are prepared and submitted, the emphasis being placed on the proper preparation of the manuscript, the method of conducting the meeting and the manner of presenting the reports orally.

145 E. Advanced Surveying. Mr. HUBBARD. One hour of lecture or recitation and one three-hour period in the field or drafting room, weekly, second half-year.

Geodasy, practical astronomy; land surveying and recording; hydrographic surveying; mine surveying; theory and use of the sextant, plane table, and Beaman arc; city surveying; adjustment of instruments; and methods of map projection.

Prerequisite: Course 121 E—Surveying.

146 E. Reinforced Concrete. Professor THOMPSON. Three lecture or recitation hours and two drafting-room periods of three hours each, weekly, second half-year.

Materials, and fundamental principles of reinforced concrete design and construction. Concrete, steel; concrete and steel in combinations; the theory and design of slabs, beams, and columns; bending and direct stress.

Prerequisite: Course 131 E—Theory of Structures.

GRADUATE COURSES

151 E. Advanced Sanitary Engineering. Professor GREGORY. Three lecture or conference periods and two laboratory periods, weekly, through the year.

An advanced course in sanitary engineering, including lectures, reports, conferences, studies, and investigations, especially in the field of water supply and water purification, sewerage and sewage disposal.

152 E. Advanced Reinforced Concrete. Professor THOMPSON. Three lecture or conference hours and two laboratory periods, weekly, through the year.

The structural theory underlying the stress analyses and design of reinforced concrete continuous structures, rigid frames, arches, retaining walls, etc. The foregoing will be applied to the design of typical structures by both analytical and model analysis methods. A number of collateral subjects will be treated, such as roofs, foundations, contracts, specifications, etc. The theory and practice of concrete proportioning and its subsequent manipulation will be treated fully.

153 E. Advanced Structural Theory. Mr. COMBER. Three lecture or conference hours and two laboratory periods, weekly, through the year.

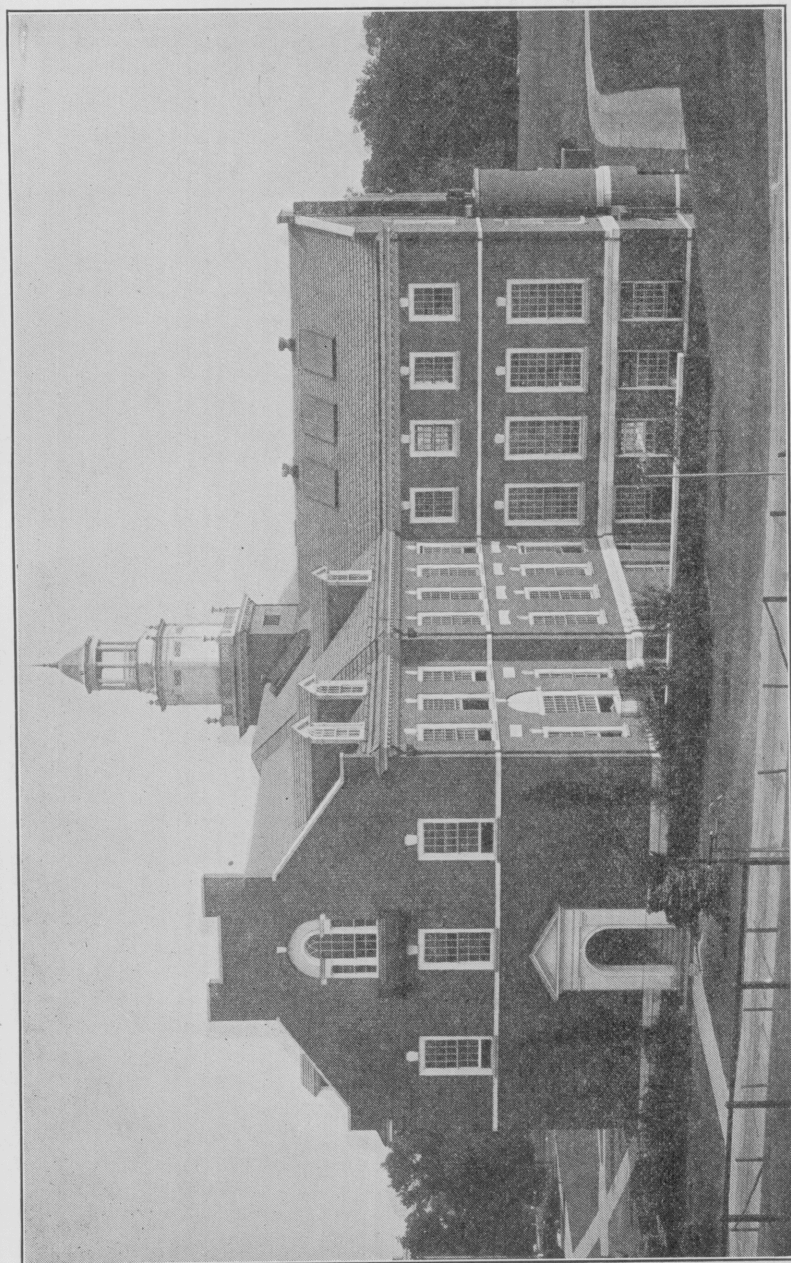
The study of various methods of attack on the deflections and stress analysis of statically indeterminate structures, such as area moments, conjugate beams, elastic weights, Williot diagrams, methods of work, slope deflections, etc. The subject of secondary and wind stresses will be covered.

In general, particular problems will be solved with complete presentation of fundamental theories and with discussions of current specifications.

Considerable attention will also be paid to mechanical methods of model analysis.

154 E. Advanced Hydraulics. Mr. MEDAUGH. Three lecture or conference hours and two laboratory periods, weekly, through the year.

A more detailed study will be made of problems which have only been fundamentally treated in the undergraduate hydraulics course. The following subjects will be taken up: The relationship between models and their originals, water-hammer, the hydraulic pump, turbines, pumps, penstocks, surge tanks, headgates, and the hydrograph.



LATROBE HALL
CIVIL ENGINEERING AND GEOLOGY

155 E. Advanced Highway Engineering. Professor THOMPSON. Three lecture or conference hours and two laboratory periods, weekly, through the year.

The organization and administration of Federal, State, Municipal and County highway affairs; design, construction, maintenance and materials; roadside control and beautification; labor and contractual relations.

161 E. Advanced Structural Design. Mr. COMBER. Three lecture or conference hours and two drafting-room periods, weekly, through the year.

The subjects to be studied include arches; rigid frame bridges; continuous and cantilever bridges; high buildings; and movable bridges.

162 E. Research. Two conference hours and laboratory through the year under the supervision of the Professor in charge of the preparation of the essay or dissertation.

163 E. Advanced Highway Engineering (Continuation of Course 155 E). Professor THOMPSON. Three lecture or conference hours and two laboratory periods, weekly, through the year.

A study of research problems and procedures; operation, including safety features and traffic control; the organization and use of traffic surveys; economics and finance; the interrelationship of various modes of transportation.

II—ELECTRICAL ENGINEERING

The curriculum in Electrical Engineering has been arranged with the aim to give a sound knowledge of underlying principles in the subjects of mathematics, physics, and chemistry, a constant contact with carefully chosen general educational topics, with special insistence on written and spoken English, and as wide a survey of the principles and practice of electrical engineering as may be safely attempted in a four years' undergraduate course.

The strictly electrical courses begin in the third year. In one course of this year the subject is approached through the problems of practice, and the underlying principles are derived as needed. More rigid courses in the mathematical theories of electricity, magnetism, and alternating currents are placed in the fourth year.

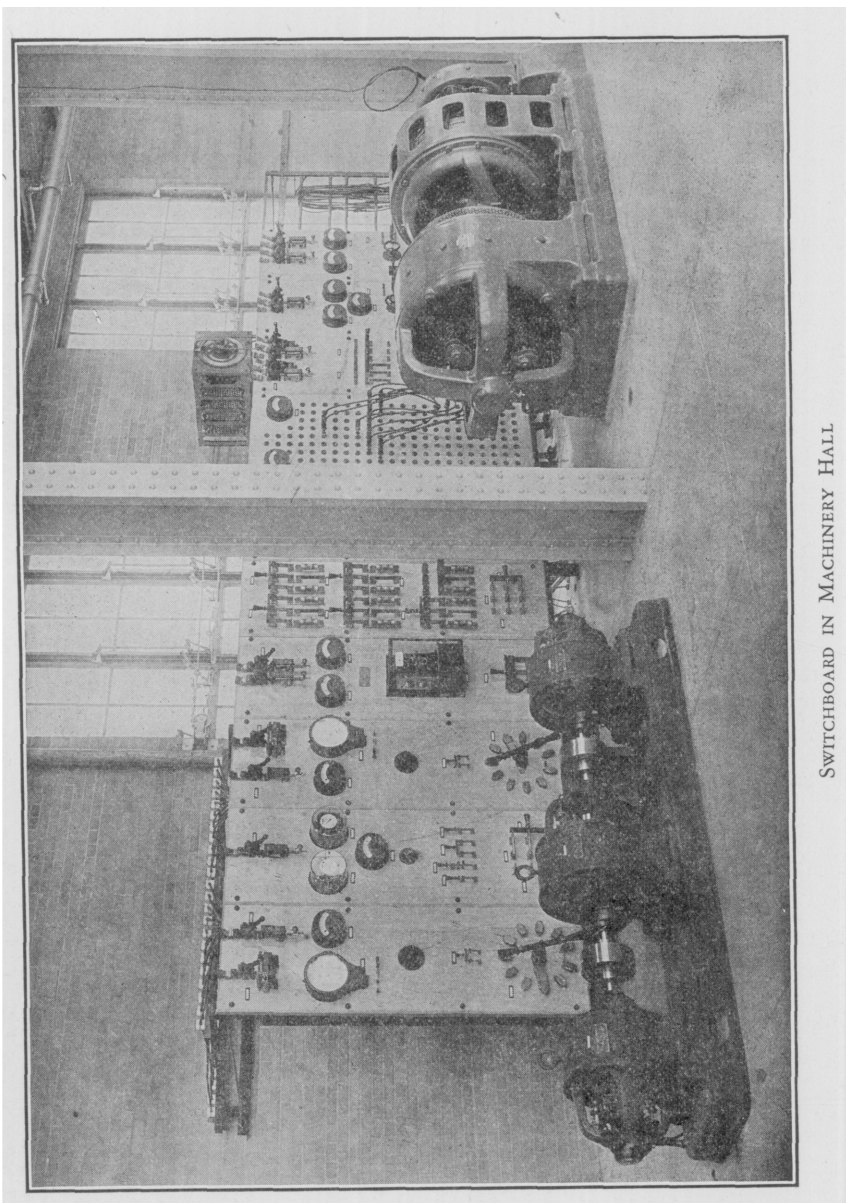
Laboratory work is an essential feature of the character of the instruction and is conducted in connection with all technical courses.

The undergraduate laboratories have been liberally designed and equipped. Constant attention is given to the content and organization of the laboratory courses. Ample resources are available for supplementing the equipment with new and important apparatus as indicated by current practice.

The dynamo laboratory is located in Machinery Hall. The various types of direct and alternating current generators are motor driven with fixed provision for speed control and circuit connections for each generator. Fixed stations are also provided for brake tests on all types of continuous and alternating current motors. Similar provision is made for singlephase and polyphase alternating current generator and motor tests. Also a wide variety of special tests are conducted on two similar 30 K. V. A., three-phase, six-terminal, motor-driven generators. Additional opportunities are afforded in a 50 K. V. A., motor-driven, single-phase, sine wave generator with direct-connected exciter and automatic voltage regulation.

Machinery Hall also contains the switchboard controlling the equipment necessary for the operation of a 240 volt, 450 ampere-hour, storage battery installed for experimental purposes, and also for carrying the night load of the University. This battery is operated in connection with the power station, and together with the switchboards in the two buildings affords exceptional opportunity for instruction and test.

The laboratories also contain ample provision for electrical measurements and tests of all descriptions, including especially those on transformers, methods of illumination, and others as described in connection with the various courses enumerated below. Of particular interest may be mentioned special generators for high frequency, for high continuous voltage, and the high tension laboratory for high alternating voltage.



SWITCHBOARD IN MACHINERY HALL

Particular attention may also be directed to the facilities for experimental investigation and research in the field of high frequency and high voltage and radio transmission. Transformers, generators and measuring equipment, especially selected for these fields, are provided and added as occasion demands.

In the graduate courses the student completes his formal study of the theory and practice of general electrical engineering. He may also by investigation and experimental research, under guidance, extend his knowledge in any chosen direction. The library, the graduate laboratories, and the shops have been equipped especially for independent research, and liberal provision is made for the support and encouragement of work of this character.

II—ELECTRICAL ENGINEERING

FIRST YEAR

<i>1st Term</i>	Class	Lab.	<i>2nd Term</i>	Class	Lab.
Chemistry 1 C.....	3	6	Chemistry 1 C.....	3	6
*Mathematics 1 C or 2 C.....	4		*Mathematics 1 C or 2 C.....	4	
**English Writing or English 1 C.	3		**English Writing or English 1 C.	3	
Engineering Drawing (111 E).....	1	6	Descriptive Geometry (111 E)....	1	6
General Engineering 1 E.....	1		General Engineering 1 E.....	1	
Modern Language and Physical Training	4		Modern Language and Physical Training	4	
or			or		
Military Science 1 C.....	2	2	Military Science 1 C.....	2	2

Industrial Work in the Summer

SECOND YEAR

<i>1st Term</i>		<i>2nd Term</i>	
†Mathematics 3 C.....	4	†Mathematics 3 C.....	4
†Physics 1 C.....	4	†Physics 1 C.....	4
Applied Mechanics (301 E).....	4	Strength of Materials (122 E)...	4
Surveying (121 E).....	1	Mechanism (303 E).....	1
**English Writing or English 1 C and Physical Training.....	3	**English Writing or English 1 C and Physical Training.....	3
or		or	
Modern Language and Physical Training	3	Modern Language and Physical Training	3
or		or	
Military Science 2 C.....	2	Military Science 2 C.....	2

Industrial Work in the Summer

THIRD YEAR

<i>1st Term</i>		<i>2nd Term</i>	
Elements of Electrical Engineering (201 E)	3	Elements of Electrical Engineering (203 E)	3
Electrical Measurements (207 E) ..	3	Design of Continuous Current Machinery (209 E).....	2
Heat Engines (305 E).....	3	Heat Engines (305 E).....	3
Political Economy 1 C.....	3	Political Economy 1 C.....	3
Mathematics 5 E.....	2	Hydraulics (132 E).....	3

Industrial Work in the Summer

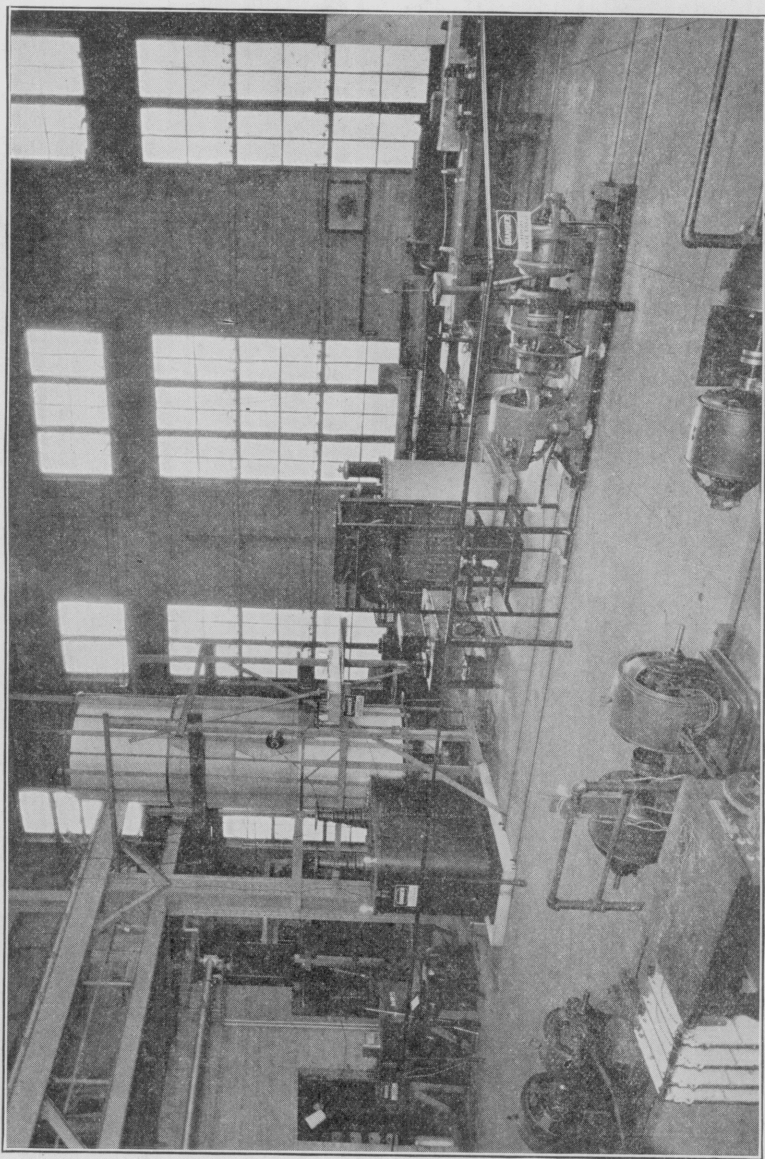
FOURTH YEAR

<i>1st Term</i>		<i>2nd Term</i>	
Advanced Electricity and Magnetism (221 E).....	3	Electric Transmission and Power Plant Machinery (223 E).....	3
Alternating Current Theory (211 E)	3	Alternating Current Machinery (213 E)	3
Electric Railways and Electric Illumination (215 E).....	3	Radio Theory (219 E).....	3
Power Plant Calculations (309 E)	3	Industrial Organization and Contracts (317 E).....	3
Materials of Engineering (205 E) ..	3	Elective	2
English 11 E.....	1	English 11 E.....	1

† Mathematics 3 C and Physics 1 C are prerequisite to all third-year courses in Engineering.

* Students who have not had trigonometry must take Math. 1 C.

** See page 56.



HIGH VOLTAGE RESEARCH LABORATORY

II—ELECTRICAL ENGINEERING

Professor WHITEHEAD
Professor KOUWENHOVEN
Dr. HAMBURGER

Dr. LAMPE
Mr. PULLEN

UNDERGRADUATE COURSES

201 E. Elements of Electrical Engineering. Mr. PULLEN, Dr. KOUWENHOVEN and Dr. LAMPE. Three hours weekly, first half-year.

This course deals with the principles and applications of continuous current circuits and machinery. The subjects are approached from the standpoint of concrete examples, the principles being derived as needed. In the laboratory special attention is given to the proper use of electrical measuring instruments and to the performance characteristics of generators and motors.

Prerequisites: Mathematics 2 C and 3 C, Physics 1 C.

203 E. Elements of Electrical Engineering. Mr. PULLEN, Dr. KOUWENHOVEN and Dr. LAMPE. Three hours weekly, second-half year.

This course, following 201 E, deals with the principles and applications of alternating current circuits and machinery. Elementary principles of Vector representation as applied to circuits with combinations of resistance, inductance and capacitance are emphasized. The elementary theory of the alternating current generator, transformer and simpler types of alternating current motors is studied. The laboratory work in this course parallels the classroom instruction.

Prerequisite: Course 201 E—Elements of Electrical Engineering.

207 E. Electrical Measurements. Professor KOUWENHOVEN and Mr. PULLEN. Three hours weekly, first half-year.

The course includes the theory and practice of the more important methods of precision measurement of current, electromotive force, resistance, capacitance, inductance, and the properties of magnetic circuits. The laboratory work accompanying this course also includes a thorough study of the latest types of commercial indicating and recording instruments for continuous current.

Prerequisites: Mathematics 2 C and 3 C and Physics 1 C.

209 E. Design of Continuous Current Machinery. Mr. PULLEN. Two hours weekly, second half year.

In this course the theory of direct current machinery begun in Course 201 E is continued, with special reference to the application of the underlying principles to the design of commercial generators and motors as determined by the available materials and methods of manufacture. The influence of the various factors on cost and methods of construction is discussed. The course also includes a discussion of the design and selection of the various types of continuous current motors, as related to the characteristics of their loads.

The solution of problems of design is carried out in the drafting-room.

211 E. Alternating Current Theory. Dr. LAMPE. Three hours weekly, first half-year.

The complete theory of circuits containing resistance, inductance and capacitance in the steady state. Vector and symbolic methods of solution. Cases occurring in practice. The solution of numerous problems is an important feature of the course and the classroom work is accompanied throughout by laboratory studies.

Prerequisites: Course 203 E—Elements of Electrical Engineering; Mathematics 5 E.

213. E. Alternating Current Machinery. Dr. LAMPE. Three hours weekly, second half-year.

The course is a continuation of Course 211 E. The theory of the more important types of alternating current machinery, including single-phase and polyphase generators and motors. The interconnection of polyphase circuits and parallel operation of polyphase systems. The laboratory exercises and equipment accompanying this course have been especially chosen with reference to the performance of polyphase generators in relation to their loads, and provide numerous problems in parallel operation, load and return power tests.

215 E. Electric Railways and Electric Illumination. Mr. PULLEN. Three hours weekly, first half-year.

A study of modern methods of electric operation of railways, starting from the mechanical problem of train movement, working back through the motor and transmission characteristics of the several available systems. The principles of electric illumination with studies and tests of present types of available lighting sources and methods of design. This course also includes a review of the commoner uses of large storage batteries for emergency peak load and other similar services.

Prerequisites: Courses 201 E and 203 E—Elements of Electrical Engineering.

219 E. Radio Theory. Dr. HAMBURGER. Three hours weekly, second half-year.

An introduction to the principles of radio transmission and reception including: general ideas of the propagation of electro-magnetic waves; resonance phenomena; coupled circuits; diodes, triodes, and tetrodes; hot cathode vacuum tubes as detectors; amplifiers and oscillators; modulation; types of oscillating circuits; and methods of design. This course also includes practice in radio transmission and reception.

Prerequisites: Courses 201 E and 203 E, Elements of Electrical Engineering, and Course 211 E—A. C. Theory.

221 E. Advanced Electricity and Magnetism. Professor WHITEHEAD and Dr. HAMBURGER. Three hours weekly, first half-year.

An introduction to the advanced mathematical theory of electricity and magnetism. The electric and magnetic fields, potential, specific inductive capacity, and its influence in the electric field. Theory of magnetism. The history and development of electromagnetic theory. Transient conditions in electric circuits.

Prerequisites: Courses 201 E and 203 E—Elements of Electrical Engineering.

223 E. Electric Transmission and Power Plant Machinery. Professor WHITEHEAD, Dr. LAMPE and Dr. HAMBURGER. Three hours weekly, second half-year.

The principles and design of transmission lines with reference, first, to the theory of their regulation and performance, and, second, to their design as determined by economic principles; the theories of the alternating current transformer and of the rotary converter. A review of the commoner types of high voltage protective apparatus; the selection of power plant machinery with a survey of modern types.

Prerequisite: Course 221 E, or Course 211 E—Alternating Current Theory.

225 E. Advanced Electrical Measurements. Professor KOUWENHOVEN. Two hours weekly, second half-year.

The theory, properties, and performance of all modern types of indicating, integrating, and recording instruments, with special reference to alternating current circuits.

Prerequisite: Course 211 E—Alternating Current Theory.

GRADUATE COURSES

251 E. Seminary. Professor WHITEHEAD. One hour weekly, through the year.

Advanced students meet with the faculty once each week for the review of contemporaneous research, both here and elsewhere, and for the presentation of papers summarizing present knowledge of electricity and its various applications.

252 E. Journal Meeting. Professor WHITEHEAD. One hour weekly, through the year.

Advanced students meet with the faculty once each week for the review and discussion of current periodicals and other literature.

253 E. Theory of Dielectrics. Professor WHITEHEAD. Three hours weekly, through the year.

A review and discussion of the several theories of dielectric phenomena, with special reference to dielectric absorption, energy loss, and phase difference, in their bearing on the performance of high voltage insulation, the theory of gaseous ionization and electric conduction in gases. This course alternates with Courses 255 E and 257 E.

255 E. Electrical Transmission of Energy. Professor WHITEHEAD. Three hours weekly, second half-year.

An advanced course in the theory of electrical transmission and allied topics, with special reference to long distance projects for large values of power. This course alternates with Courses 253 E and 257 E.

257 E. Advanced Alternating Current Theory. Professor WHITEHEAD. Three hours weekly, first half-year.

This course considers the extended application of the complex variable to electrical phenomena, with their practical applications, emphasizing transmission circuits, artificial circuits, filter circuits, field distributions, transients, and allied topics. This course alternates with Courses 253 E and 255 E.

259 E. Alternating Current Machinery. Professor KOUWENHOVEN. Three hours weekly, through the year.

A study of the general case of relative motion between electrical and magnetic circuits, both in the transient and steady state, with special reference to modern power machinery and the analysis of the newer types. This course alternates with Course 261 E.

261 E. The Theory of Electrical Measurements. Professor KOUWENHOVEN. Three hours weekly, through the year.

An advanced course in the theory of modern methods of precision measurement, and circuits of low current value, circuits of high frequency, and circuits of high voltage and power. This course alternates with Course 259 E.

263 E. Advanced Radio Theory. Dr. HAMBURGER. Two hours weekly, first half-year.

A consideration of special topics in the field of radio communication including the theory and practice of the measurement of frequency, antenna constants, electromagnetic waves and thermionic tube coefficients at radio frequencies.

This course alternates with Courses 267 E and 268 E.

265 E. Alternating Current Bridge Measurements. Professor KOUWENHOVEN. One hour class work, and two laboratory periods, weekly, throughout the year.

An advanced course in the theory and use of alternating current bridges, with special reference to the errors introduced by imperfect resistances, capacitances, and shielding.

266 E. Research Laboratory.

The laboratories offer exceptional facilities as to apparatus, space, different forms of electric power, and machine shops, for experimental investigation in any direction in the field of electrical engineering. The libraries of electrical engineering and allied subjects are also extensive and well maintained. Liberal provision is made for the purchase of special equipment necessary for investigation.

Research investigations are conducted under the general direction of Professor WHITEHEAD, with the assistance of other members of the faculty.

267 E. Electron Tubes. Dr. HAMBURGER. Two hours weekly, first half-year.

A study of diodes, triodes, tetrodes and pentodes, their characteristics and uses.

This course alternates with Courses 263 E and 268 E.

268 E. Electric Wave Filters. Dr. HAMBURGER. Two hours weekly, first half-year.

The theory and design of transmission networks and wave filters.

This course alternates with Courses 263 E and 267 E.

III—MECHANICAL ENGINEERING

The curriculum in Mechanical Engineering aims to give the student a thorough training in the principles that underlie the practice of the profession. The first two years are devoted largely to the fundamental sciences, to mathematics, and to general educational courses. Applied mechanics, strength of materials, mechanism, and surveying are taken in the second year. The technical work in the last two years is planned to give the student a thorough understanding of the general principles involved, rather than a specialized training in any one branch of mechanical engineering. The main courses deal with power engineering, machine design, materials of engineering, and industrial organization. These are supplemented by courses in electrical engineering, hydraulics, heat transfer and by general educational and elective studies.

Much attention is given to laboratory work, in which the principles developed in the classroom are applied. The laboratory and its machine equipment is of modern type. The University Power Plant, which is adjacent to Maryland Hall, was designed with particular reference to availability for laboratory work. Students thus become familiar with boilers, stokers, engines, turbines, pumps, heaters, condensers, etc., in actual commercial use. The 75-horsepower Buckeyemobile unit in the power plant is particularly suitable for testing work. The gas engine laboratory is located in an addition to the power house, and besides gas and gasoline engines Diesel engines have been installed. Fuel, gas, and oil laboratories and special research rooms are located in Maryland Hall. Machinery Hall contains a complete equipment of testing machines to determine the strength of materials and for testing cements and concrete, with an electric furnace and other apparatus for the heat treatment of steel, several steam engines, gas engines, a complete pump-testing plant, a complete refrigerating equipment, a large air compressor plant, apparatus for testing and calibrating instruments for measuring air, a Thomas electrical gas meter, a complete air washer equipment, and other miscellaneous apparatus. The power house is provided with an evaporator system for boiler make-up which is arranged for tests. A laboratory for the metallographic examination of metals is also provided.

Advanced courses are offered for graduate students who may wish to extend their training beyond the work covered in the four-year course. Such students are expected to conduct original research in the laboratories. Certain of the advanced courses are open to fourth-year students who are qualified to take them.

III—MECHANICAL ENGINEERING

FIRST YEAR

<i>1st Term</i>	Class	Lab.	<i>2nd Term</i>	Class	Lab.
Chemistry 1 C.....	3	6	Chemistry 1 C.....	3	6
*Mathematics 1 C or 2 C.....	4		*Mathematics 1 C or 2 C.....	4	
**English Writing or English 1 C.	3		**English Writing or English 1 C.	3	
Engineering Drawing (111 E)....	1	6	Descriptive Geometry (111 E)....	1	6
General Engineering 1 E.....	1		General Engineering 1 E.....	1	
Modern Language and Physical Training	4		Modern Language and Physical Training	4	
or			or		
Military Science 1 C.....	2	2	Military Science 1 C.....	2	2

Industrial Work in the Summer

SECOND YEAR

<i>1st Term</i>	Class	Lab.	<i>2nd Term</i>	Class	Lab.
†Mathematics 3 C.....	4		†Mathematics 3 C.....	4	
†Physics 1 C.....	4	6	†Physics 1 C.....	4	6
Applied Mechanics (301 E)....	4		Strength of Materials (122 E)...	4	
Surveying (121 E).....	1	6	Mechanism (303 E).....	1	6
**English Writing or English 1 C and Physical Training.....	3		**English Writing or English 1 C and Physical Training.....	3	
or			or		
Modern Language and Physical Training	3		Modern Language and Physical Training	3	
or			or		
Military Science 2 C.....	2	2	Military Science 2 C.....	2	2

Industrial Work in the Summer

THIRD YEAR

<i>1st Term</i>	Class	Lab.	<i>2nd Term</i>	Class	Lab.
Heat Engines (305 E).....	3	6	Heat Engines (305 E).....	3	6
Elements of Electrical Engineering (201 E)	3	6	Elements of Electrical Engineering (203 E)	3	6
Mathematics 5 E.....	2		Production Methods (325 E)....	2	3
Materials of Engineering (315 E).	3	6	Hydraulics (132 E).....	3	3
Political Economy 1 C.....	3		Political Economy 1 C.....	3	

Industrial Work in the Summer

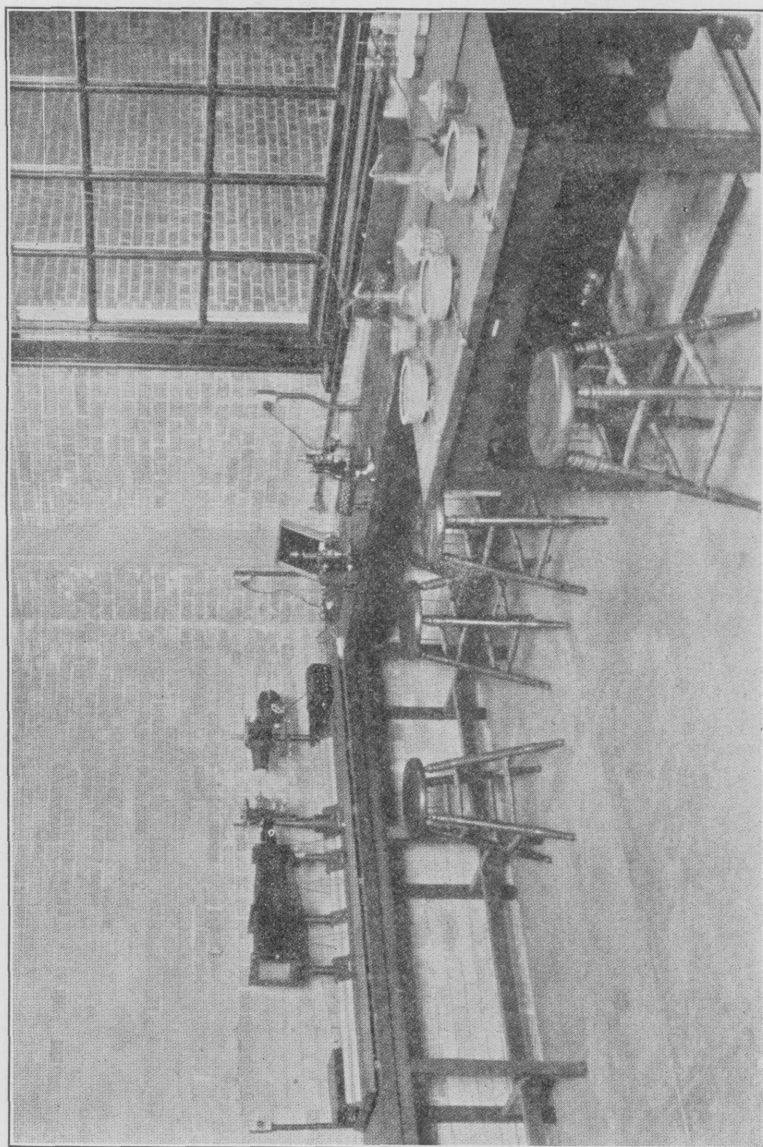
FOURTH YEAR

<i>1st Term</i>	Class	Lab.	<i>2nd Term</i>	Class	Lab.
Power Plant Calculations (309 E)	3		Steam Turbine Calculations (321 E)	3	
Machine Design (307 E).....	4	6	Internal Combustion Engines (323 E)	2	6
Alternating Current Theory (211 E)	3	6	Mechanical Laboratory (310 E)...		6
Mechanical Laboratory (310 E)...		6	Electrical Transmission and Power Plant Machinery (223 E).....	3	
Seminary and Journal (313 E)...	1		Seminary and Journal (313 E)...	1	
Heat Generation and Transmission (327 E).....	2		Industrial Organization and Contracts (317 E).....	3	
English 11 E.....	1		Machine Design (307 E).....	2	6
			English 11 E.....	1	

† Mathematics 3 C and Physics 1 C are prerequisite to all third-year courses in Engineering.

* Students who have not had trigonometry must take Math. 1 C.

** See page 56.



METALLOGRAPHIC LABORATORY

III—MECHANICAL ENGINEERING

Professor CHRISTIE

Associate Professor SMALLWOOD

Mr. HEADLEY

Mr. KOUWENHOVEN

Mr. HANSON

UNDERGRADUATE COURSES

301 E. Applied Mechanics. Mr. F. W. KOUWENHOVEN, Mr. HANSON and Mr. HEADLEY. Four hours weekly, first half-year.

This subject is taught by the extensive use of problems covering statics and kinetics. The sub-topics are: analysis of forces on simple structures and mechanisms by components, moments, and by the force triangle; center of gravity; friction; rectilinear motion; simple harmonic motion; analysis of inertia forces of reciprocating parts of engines; rotational motion, moment of inertia; inertia forces in rotation; centrifugal force; work, energy, and power; engine horse power and dynamometers; impulse and momentum.

The whole subject is treated with special reference to engineering problems, since it forms the basis of several of the more advanced engineering courses.

Prerequisites: Mathematics 1 C or 2 C, Course 111 E—Engineering Drawing and Descriptive Geometry, and registration in Mathematics 3 C.

303 E. Mechanism. Mr. HEADLEY. One hour of class work and six hours of drafting-room work, weekly, second half-year.

The lectures prepare for the drafting-room work, which consists of problems dealing with velocities and accelerations in systems of linkages and with the transmission of motion by means of belts and pulleys, cones and discs, gears, screws, links and cams.

Prerequisites: Mathematics 1 C or 2 C, and Course 111 E—Engineering Drawing and Descriptive Geometry.

305 E. Heat Engines. Associate Professor SMALLWOOD, Mr. F. W. KOUWENHOVEN and Mr. HANSON. Three hours weekly, through the third year.

The first term's work consists of fundamental thermodynamics with numerous problems. Sub-topics are: pressure-volume, and temperature entropy, energy and conditional relations of heat media, perfect gases and vapors being treated in parallel, the Carnot cycle, steady flow processes, the thermodynamic laws, available energy, etc. The second term topics are: gas-vapor mixtures, principles of combustion, and application of all previous study to actual heat-work conversions in engineering, covering the steam engine and turbine, the steam power plant, steam cycles, binary-vapor engines, internal combustion engines, air compressors, refrigerating machines, nozzles, and steam power auxiliaries. Laboratory work, in both terms, covers the testing of instruments, apparatus, and engines used in Power Plants.

Prerequisites: Course 111 E—Engineering Drawing and Descriptive Geometry, Chemistry 1 C, Mathematics 3 C, Physics 1 C and Course 301 E—Applied Mechanics.

307 E. Machine Design. Mr. HEADLEY. Four hours of class work first term, two hours second term, and six hours of designing, weekly, through the year.

The class work consists of lectures and recitations covering the fundamental, mechanical and dynamical principles involved in the design and operation of machinery. The drafting-room work consists of the solution of numerous problems involving the principles studied and discussed in class, and the complete design of one or more machines.

Prerequisites: Courses 111 E, 122 E—Strength of Materials, 301 E—Applied Mechanics, 303 E—Mechanism, 315 E—Materials of Engineering.

309 E. Power Plant Calculations. Professor CHRISTIE and Mr. HANSON. Three hours weekly, first half-year.

The calculations involved in the economic selection of such plant equipment as boilers, furnaces, chimneys, engines, turbines, condensers, pumps, and other auxiliaries. Also the cost considerations in the design of plants to suit given load conditions.

Prerequisites: Courses 305 E—Heat Engines, 201 E and 203 E—Elements of Electrical Engineering.

310 E. Mechanical Laboratory. Professor CHRISTIE and Mr. F. W. KOUWENHOVEN. Six hours of laboratory work, weekly, through the fourth year.

This course familiarizes the student with the commercial operation of power plant equipment and with the methods of analyzing its performance by studying the results of experiments. All work is in the nature of special problems to be solved experimentally with the power house and laboratory equipment.

Prerequisite: Course 305 E—Heat Engines.

313 E. Seminary and Journal Meeting. Mr. F. W. KOUWENHOVEN. One hour weekly, through the year.

Conducted by members of the faculty and participated in by fourth-year students. Attention is devoted principally to papers on engineering topics not covered in any other course. Papers on mechanical developments are also presented for discussion.

315 E. Materials of Engineering. Mr. F. W. KOUWENHOVEN. Three hours of class work and six hours of laboratory, weekly, first half-year.

A study of the manufacturing processes and physical properties of such engineering materials as cast iron, wrought iron, carbon and alloy steels, non-ferrous metals and alloys, woods, clay products, limes, cements and concretes. The theory of alloys is given much consideration.

The laboratory work consists of experimental studies on the testing machines of tensile, compressive and bending strengths of various materials used in engineering and the heat treatment of steels, also microphotographic and macrographic studies of metals.

Prerequisite: Course 301 E—Applied Mechanics.

317 E. Industrial Organization and Contracts. Professor CHRISTIE. Three hours weekly, second half-year.

The principles of industrial organization as applied to productive industries. Modern industrial tendencies, forms of ownership, types of organization, the functions of a conventional factory organization and its system for handling orders. Storekeeping methods. Planning, routing, and scheduling work. Shop records and costs; wage payment; betterment plans; safety-first organization; employment methods; burden and depreciation. Plant location and arrangement.

The second part of the course deals with engineering contracts and specifications and with some portions of commercial law.

Prerequisite: Political Economy 1 C.

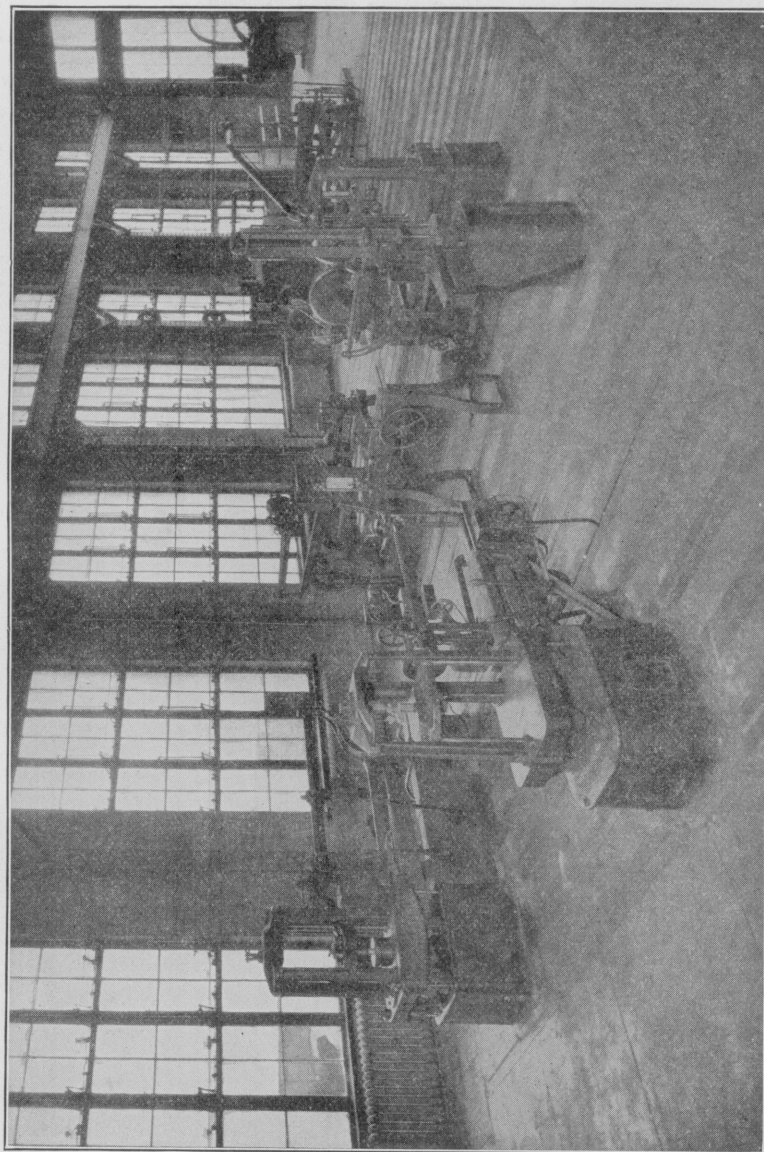
321 E. Steam Turbine Calculations. Mr. F. W. KOUWENHOVEN. Three hours weekly, second half-year.

The conversion of heat energy into velocity and kinetic energy and the application of the principles developed to the design of simple impulse, Rateau, Curtis, and Parsons types of turbines. The materials in use, and the proportioning of the turbines are discussed. Consideration is given to the commercial uses and performance of steam turbines and turbo-gears. Condition curves and bleeder calculations are discussed.

Prerequisites: Courses 305 E—Heat Engines and 309 E—Power Plant Calculations.

323 E. Internal Combustion Engines. Associate Professor SMALLWOOD and Mr. HANSON. Two hours of class work and six hours of laboratory, weekly, second half-year.

Principal cycles; fuels and fuel mixtures; effect of real mixture upon theoretical cycle;



MATERIALS TESTING LABORATORY

study of combustion in cylinders. Liquid fuel engines, carburetion, fuel injection, detonation. Thermodynamic analysis of engine performance. Economics of the internal combustion engine. Calculation of cylinder sizes. Modern developments in automotive, air-craft, and stationary engines.

The classroom work is accompanied by experimental work in the laboratory on gas, gasoline, and oil engines, and on a large Diesel engine.

Prerequisite: Course 305 E—Heat Engines.

325 E. Production Methods. Mr. F. W. KOUWENHOVEN. Two hours of class work and three hours laboratory, weekly, second half-year.

This course deals with a study of the machinery process and organization needed to manufacture a commercial article on a production basis. It involves a study of the design of the article, planning of processes, and selection of manufacturing machinery. Visits will be made to plants near Baltimore to study the processes followed.

327 E. Heat Generation and Transmission. Associate Professor SMALLWOOD. Two hours weekly, first half-year.

The principles of combustion applied to power and industrial furnaces operated on solid, liquid and gaseous fuels; the laws of heat transfer and heat transfer apparatus; evaporators; air conditioning, drying, and cooling processes; heating and ventilation of buildings; heat insulations. The course includes numerous problems.

GRADUATE COURSES

351 E. Advanced Power Plant Calculations. Professor CHRISTIE. Three hours weekly, through the year.

This course deals specifically with modern furnace, boiler and economizer problems, methods of feed heating by bleeding turbines and by other means, evaporator problems, and the heat balance of large modern stations.

353 E. Advanced Thermodynamics. Associate Professor SMALLWOOD. Three hours weekly, through the year.

The application of the laws of Thermodynamics to the solution of various problems arising in the engineering application of heat and general equations of thermodynamics. Many of these will arise in connection with advanced laboratory and research work.

355 E. Factory Organization and Management. Professor CHRISTIE. Three hours weekly, through the year.

The philosophy of management; the application of the methods developed to factory organization; labor relations and the human factor in engineering. A study will be made of actual plant problems.

357 E. Advanced Machine Design. Mr. HEADLEY. Three hours weekly, through the year.

Vibration problems in mechanical engineering, dynamics of machinery, photo-elastic methods as applied to machine design and the design of one or more complete machines.

359 E. Research Laboratory. Professor CHRISTIE.

The mechanical laboratories offer unusual opportunities to graduate students for original research along certain lines.

361 E. Steam Turbine Design. Professor CHRISTIE. Three hours weekly, through the year.

A critical study of steam turbine theory and the application of thermodynamics to steam turbine design and to problems of steam turbine performance.

363 E. Engineering Materials. Mr. F. W. KOUWENHOVEN. Three hours weekly, through the year.

A study of the *iron-carbon* series of metals, with particular reference to the structural arrangements of these metals and their modifications.

365 E. Seminary and Journal. Professors CHRISTIE and SMALLWOOD. One hour weekly, through the year.

A meeting for the presentation and discussion by graduate students and faculty of papers on research and developments of major importance in the field of Mechanical Engineering.

IV—GAS ENGINEERING

The curriculum in Gas Engineering has as its primary objects advanced instruction and research in the fundamental scientific and technical principles which underly the gas and fuel industries. However, the instruction is designed to equip a student for service not only in these industries, but also in the many other industries which require fundamental training of this character, with special emphasis on the mechanical and chemical phases of large scale operations.

Both undergraduate and graduate instruction is offered, the undergraduate curriculum consisting of four years, the first two of which are devoted chiefly to fundamental and cultural courses, such as English, mathematics, physics, and chemistry. In the third and fourth years these are combined with professional studies in gas engineering, fuel and gas analysis, and by-product recovery, together with related courses dealing with mechanical engineering and the elements of electrical engineering. Particular emphasis is given general principles, intensive study of special applications being assigned to the graduate years.

The courses in Gas and Fuel Technology offered the undergraduate deal with the fundamental mechanical and chemical principles involved in the manufacture of coal gas, water gas, oil gas, and producer gas, their purification, and distribution, and the commercial preparation and disposal of by-products. Special emphasis is placed upon those quantitative relations which determine design and economic operation. Through cooperative arrangements, students study the manufacture of water gas and coal gas in plants in and about Baltimore, carry out tests on large scale equipment such as automatic water gas machines, liquid and dry purification systems, and cooling and condensing apparatus, observe gas distribution practice in the field, and study typical problems in the utilization of gas in industrial plants. To minimize loss of time, a truck, equipped with seats, is provided for the transportation of students between the University and outside experimental work. During the Spring vacation students may arrange a trip covering several days under faculty supervision to plants of special interest at a considerable distance from Baltimore. The practical phases of manufacture and design are considered in special lectures given by men prominent in the gas and fuel industries. Students are given problems in plant layout and unit design, and collect construction and operation cost data. A room, equipped with drawing tables, is provided for the use of senior students in preparing reports and drawings. In the laboratory, students are required to examine coal, coke, gas, oil, tar, and ammonia products.

Where possible, the undergraduates are encouraged to continue their studies in the graduate courses. These courses are planned to develop

fitness for independent study and investigation and offer opportunities for research and experimentation in the solution of chemical and physical problems in Gas Engineering. An especial effort is made to maintain intimate contact with the various gas and fuel industries in and about Baltimore, which has long been a center for advanced developments in this field. Cooperative arrangements permit the use of the facilities of several of these industries for instruction and research. In the city and contiguous territory there are available installations dealing with natural gas, liquefied petroleum gases, gases from oil refining and cracking still operations, and producer gas, in addition to the usual coal and water gas. The very diversified industrial developments afford illustrations involving practically all the important fuel applications.

There is available for research work a complete small scale coal gas plant comprising a 400-pound retort and necessary auxiliary equipment. There is also available equipment for the study of gaseous reactions at elevated temperatures and at pressures up to 275 atmospheres, including two Rix compressors, autoclaves, high-pressure reservoir, electric furnaces, temperature regulators, purifiers, and auxiliary equipment. Meters, calorimeters, and complete equipment for the examination and analysis of fuel, gas, and by-products are available in the laboratories of the department.

Graduate students having the necessary training in mathematics, physics, chemistry, and mechanical engineering are offered advanced courses in Industrial Fuels, Gas Manufacture and Distribution, Solvent Recovery, and Refractories together with research work. Those desiring preparation for the executive branches in public utility work may pursue certain courses in corporation finance, corporation accounting, and related subjects offered by the Department of Political Economy. Students having the proper preparation should be able to complete the requirements for the master's degree in two years and the doctor's degree in three years. A number of special scholarships, donated by operating gas companies, are available for students of gas engineering who reside in certain localities. Inquiries concerning these scholarships should be addressed to the Assistant Dean of the School of Engineering, Johns Hopkins University.

IV—GAS ENGINEERING

FIRST YEAR

<i>1st Term</i>	Class	Lab.	<i>2nd Term</i>	Class	Lab.
Chemistry 2 C.....	3	6	Chemistry 2 C.....	3	6
*Mathematics 1 C or 2 C.....	4		*Mathematics 1 C or 2 C.....	4	
**English Writing or English 1 C.	3		**English Writing or English 1 C.	3	
Engineering Drawing (111 E)....	1	6	Descriptive Geometry (111 E)...	1	6
General Engineering 1 E.....	1		General Engineering 1 E.....	1	
***Modern Language and Physical Training	4		***Modern Language and Physical Training	4	
<i>or</i>			<i>or</i>		
Military Science 1 C.....	2	2	Military Science 1 C.....	2	2
Industrial Work in the Summer					

SECOND YEAR

<i>1st Term</i>	Class	Lab.	<i>2nd Term</i>	Class	Lab.
Mathematics 3 C.....	4		Mathematics 3 C.....	4	
Physics 1 C.....	4	6	Physics 1 C.....	4	6
Applied Mechanics (301 E)....	4		Strength of Materials (122 E)...	4	
†Surveying (121 E).....	1	6	†Mechanism (303 E).....	1	6
†Modern Language and Physical Training	3		†Modern Language and Physical Training	3	
<i>or</i>			<i>or</i>		
Military Science 2 C.....	2	2	Military Science 2 C.....	2	2
Industrial Work in the Summer					

THIRD YEAR

<i>1st Term</i>	Class	Lab.	<i>2nd Term</i>	Class	Lab.
Heat Engines (305 E).....	3	6	Heat Engines (305 E).....	3	6
Chemistry 3 C (Organic).....	3	6	Chemistry 3 C (Organic).....	3	6
Materials of Gas Manufacture (531 E)	2	6	Materials of Gas Manufacture (531 E)	2	6
Political Economy 1 C.....	3		Political Economy 1 C.....	3	
Materials of Engineering (315 E).	3		Hydraulics (132 E).....	3	
Industrial Work in the Summer					

FOURTH YEAR

<i>1st Term</i>	Class	Lab.	<i>2nd Term</i>	Class	Lab.
Unit Processes in Gas Engineering 542 E)	2	6	Unit Processes in Gas Engineering (542 E)	2	6
Elements of Electrical Engineer- ing (201 E).....	3	6	Elements of Electrical Engineer- ing (201 E).....	3	6
Gas Engineering (541 E).....	3	6	Gas Engineering (541 E).....	3	6
Heat Generation (327 E).....	2		Industrial Organization (317 E)..	3	
Power Plant Calculations (309 E)	3		Seminar, Gas Engineering (543 E)	1	
English 11 E.....	1		English 11 E.....	1	

* Students who have not had trigonometry must take Math. 1 C.

** See page 56.

*** German Elements may be offered for credit by students who have satisfied entrance requirements in Modern Language.

† Students entering the second year with advanced standing may satisfy the requirements in Chemistry by taking Chemistry 2 C, instead of Surveying, Mechanism and Modern Language.

‡ English Writing or English 1 C may be offered. See page 56.

IV—GAS ENGINEERING

Professor HUFF

Associate Professor LOGAN

Dr. ELLIOTT (first term)

UNDERGRADUATE COURSES

531 E. Materials of Gas Manufacture. Professor HUFF, Associate Professor LOGAN and an Assistant. Two hours class work and six hours laboratory, weekly, through the year.

This course is designed to acquaint the student with the more important methods for the laboratory examination of the materials encountered in gas manufacture. Particular emphasis is placed upon the chemical analysis of these materials, and the course illustrates approved quantitative procedures in gravimetric, volumetric, and gasometric analysis. Attention is also given to important thermal and physical properties which govern the efficient and economic use. Students familiarize themselves with the use of calorimeters, various types of gas analysis apparatus, the analysis of coal, typical water conditioning material, gas purifying material, and determine important oil properties.

541 E. Gas Engineering. Professor HUFF and Associate Professor LOGAN. Three hours class work and six hours laboratory, weekly, through the year.

The class work deals with the fundamental chemical and mechanical principles involved in the production of natural gas, coal gas, producer gas, water gas, liquefied petroleum gases, and oil gas, their purification, distribution, and efficient use, and the recovery of by-products. In the laboratory periods the class visits by-product coke, water gas, producer gas, oil refining and liquefied petroleum gas plants and the establishments of builders of gas equipment; prepares plant layouts; designs individual pieces of plant equipment; makes plant tests on commercial installations and carries on laboratory experiments designed to illustrate fundamental principles involved in plant processes. Special emphasis is placed upon the physical and organic chemistry involved in gas making and by-product recovery.

542 E. Unit Processes in Gas Engineering. Professor HUFF and Associate Professor LOGAN. Two hours lecture and six hours laboratory, weekly, through the year.

This course deals with certain fundamental unit processes which are encountered in Gas Engineering. In it will be discussed gas burner design including carbon monoxide hazards, the regeneration and recuperation of heat, the transfer of matter through fluid films, evaporation, distillation, design of fractionating units, condensation, absorption and extraction. The student visits and tests important typical unit installations in commercial operation.

543 E. Journal Meeting. Associate Professor LOGAN. One hour weekly, second half-year.

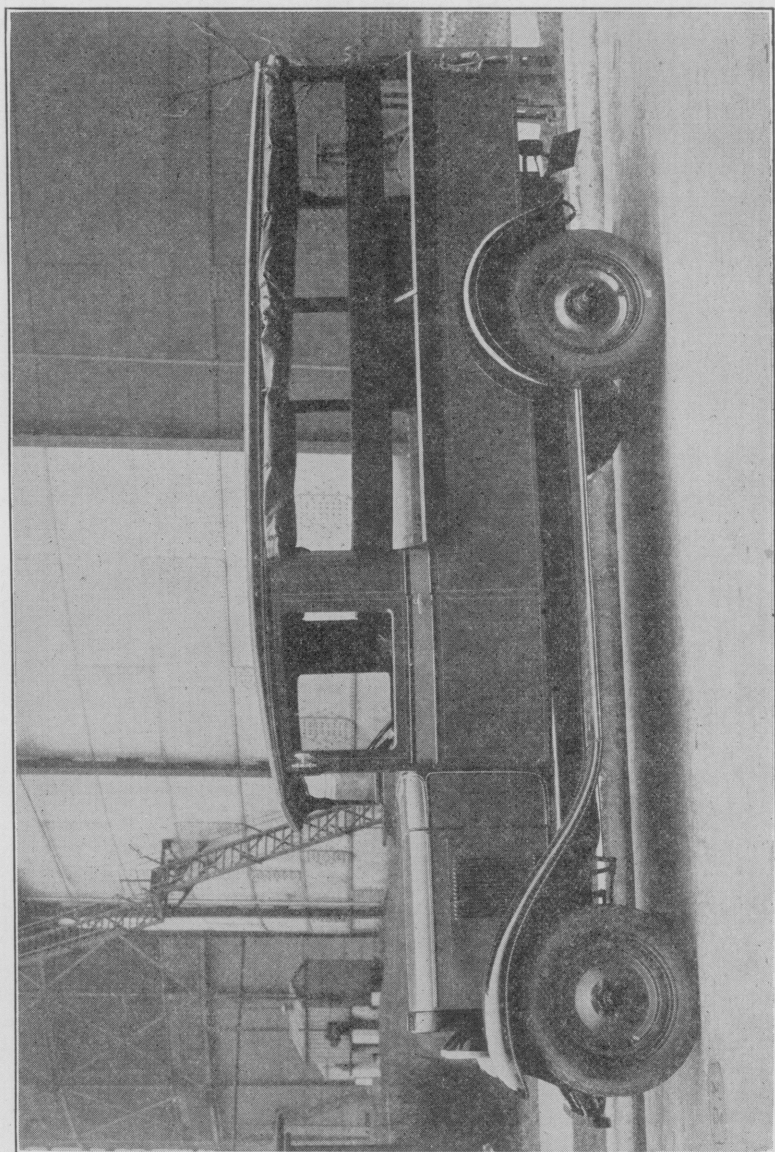
Attention is devoted principally to developments in gas engineering not covered in other courses. The students are assigned outstanding topics and are shown sources of information. They are obliged to prepare papers and participate in the discussion of theses.

GRADUATE COURSES *

551 E. Industrial Fuels. Professor HUFF. Three hours weekly, second half-year.

A study of the occurrence, distribution, and utilization of the common industrial fuels. Especial emphasis is placed upon the uses and limitations of industrial gas.

* While the department is prepared to offer any of the above graduate courses in any one year only those will be offered for which a demand exists and time permits.



TRUCK USED FOR TRANSPORTING GAS ENGINEERING STUDENTS AND INSTRUMENTS TO FIELD STUDIES

553 E. Solvent Recovery. Professor HUFF. Three hours weekly, first half-year.

A study of the physico-chemical principles involved in the absorption and distillation of important commercial solvents, particularly those recovered from manufactured and natural gas. The recovery and distillation of coal tar and water gas tar are considered.

555 E. Refractories. Professor HUFF. Three hours weekly, first half-year.

This course is devoted chiefly to a consideration of the physical and chemical properties of the more important refractories. Brief attention is paid to the process of manufacture, and the course includes the more important laboratory tests.

557 E. Gas Manufacture and Distribution. Professor HUFF.

An advanced course in gas manufacture and distribution. Students are required to do a large amount of collateral reading, and consider some aspects of the underlying thermodynamic theory.

558 E. Departmental Seminar. One hour weekly, through the year.

Advanced students and members of the staff meet for the discussion of publications relating to researches in gas engineering, and for the presentation of papers summarizing the present knowledge of various topics in this field.

559 E. Research. Professor HUFF and Associate Professor LOGAN.

Research problems upon the fundamental chemistry and physics of existing or proposed gas-making processes, the distribution and utilization of gas, and recovery and purification of by-products.

V—COMBINED COURSES IN THE LIBERAL ARTS AND IN ENGINEERING

These courses have been arranged with special reference to the increasing demand for engineers who, in addition to their professional training, shall also have some knowledge of literature, history, modern languages, economics, business, other sciences, and in general of those subjects usually understood as essential to a liberal education. It is now generally recognized that the larger undertakings of modern business and social enterprise require for their proper execution engineers who shall have as wide a knowledge as possible of social, political, and economic affairs. A broad education is essential for this knowledge and these courses are arranged with this purpose in view.

The student will find it possible to select a course leading to the degree of Bachelor of Arts, in which special emphasis may be placed on work in the departments of Mathematics, Physics, Chemistry or Geology, or a course leading to a degree in Business Economics. During these years the student who intends also to take the Engineering degree, should take those courses in the College of Arts and Sciences which are required of all Engineering students in their first two years, viz., Chemistry 1 C, Mathematics 1 C or 2 C and 3 C, English Writing or English 1 C and Physics 1 C. In the third and fourth years he will take as electives the technical courses in Drawing and Descriptive Geometry 111 E, Applied Mechanics 301 E and Strength of Materials 122 E, Mechanism 303 E or Civil Engineering Drawing 123 E, which are required for admission to the professional course of the third year of the normal undergraduate curriculum in Engineering. These elective courses count as credit towards the degree of Bachelor of Arts. Each degree is conferred at the time of the completion of the required course. Exceptional students following these combined courses may also shorten materially the time required for advanced degrees in Engineering. Students following these combined courses are eligible as applicants for State scholarships in Engineering only after the completion of the first two years of a combined course.

The courses leading to the degrees of Bachelor of Arts and Bachelor of Science in Economics are conducted by the College of Arts and Sciences and the School of Business Economics respectively. For further description of the courses and requirements for these degrees the separate circulars should be consulted.

GENERAL AND ELECTIVE COURSES

The following prescribed and elective courses appear in the curricula of the several branches of Engineering. Most of them are conducted by the College of Arts and Sciences, usually in separate sections in which special attention is given to the needs of students in Engineering.

General Engineering 1 E. Professor KOUWENHOVEN. One hour weekly, through the year.

Required of all first-year students in Engineering. Conducted in rotation by the several faculties. The course aims to stimulate the interest of the student by descriptions of the problems of engineering.

Chemistry 1 C. General Chemistry. Dr. SHEA and Assistants. Lectures and recitations three hours weekly and laboratory six hours weekly, through the year.

This course covers the field of general chemistry from the standpoint of modern theories and is offered to students who plan to take only one year of chemistry. It includes a description of the more important elements and inorganic compounds, and a brief period is devoted to certain fundamental phases of organic chemistry. The laboratory work includes a number of quantitative experiments and, during the larger part of the second term, the metals are studied from the standpoint of qualitative analysis.

Chemistry 2 C. Inorganic Chemistry and Qualitative Analysis.

Professor GORDON, Mr. TROUT and Assistants. Lectures and recitations three hours weekly, and laboratory six hours weekly, through the year.

This course is planned for students who intend to take more than one year of chemistry. No previous work in chemistry is required for admission. The entire year is devoted to inorganic chemistry, which is taught from the standpoint of modern atomic theory. The laboratory work of the first term includes a number of quantitative experiments; during the second term the laboratory work includes qualitative analysis. The course is organized so that a student may progress according to his ability and previous training, and the plan of instruction is intended to develop the students' initiative and independence of judgment.

Chemistry 3 C: Organic Chemistry. Dr. JENKINS and Assistants.

Lectures and recitations, three hours weekly, and laboratory, six hours weekly, through the year.

A systematic course in the general principles of organic chemistry intended for those who have had a thorough training in inorganic chemistry. The lectures and laboratory work are devoted to a study of the properties and reactions of the aliphatic and aromatic compounds.

Chemistry 4 C: Quantitative Physical Chemistry. Dr. HUGGINS and

Dr. AHLBERG. Lectures and recitations three hours weekly, and laboratory nine hours weekly, through the year.

An introductory course in physico-chemical principles and their application to quantitative measurement of the composition and properties of chemical substances.

Chemistry 4 E: Industrial Chemistry. Dr. SHEA. Lectures and recitations, two hours weekly, through the year.

Geology 1 C. Dr. SECRIST. Four lectures or recitations and three hours of laboratory work weekly, through the year.

This course is designed to give a general view of the subject of geology, and may profitably be pursued by those who wish to have some knowledge of the chief events of the earth's history. It includes an account of the origin of the features of the surface of the earth, a discussion of the phenomena of earthquakes, volcanoes, mountain-making, and an outline of the past history of the earth.

Materials illustrative of the lectures are studied in the laboratory. Emphasis is placed upon the observation of geological phenomena in nature, the State of Maryland presenting features of unusual interest for such study. Frequent excursions are made to neighboring points where the principles of the science are studied in the field, while a five-day trip is made in the Spring to places of special interest for geological study. This course is illustrated by maps, lantern views, and the rich collections of the University. A knowledge of elementary Physics is required for the pursuit of this course.

Mathematics 1 C. Professor COHEN and Associates. Four hours weekly, through the year.

Plane Trigonometry; Plane Analytic Geometry; Elements of the Calculus.

Mathematics 2 C. Professor COHEN and Associates. Four hours weekly, through the year.

Plane Analytic Geometry; Elements of the Calculus.

Mathematics 3 C. Professor COHEN and Associates. Four hours weekly, through the year.

Differential and Integral Calculus.

Mathematics 5 E. Professor COHEN and Associates. Two hours weekly, first half-year.

Differential Equations for Engineers.

Physics 1 C. Professor HUBBARD and Assistants. Four recitation hours, six laboratory hours, weekly, through the year.

An introductory course in general physics, including mechanics, heat, electricity, magnetism, sound and light. A working knowledge of trigonometry and analytic geometry is required.

English Writing. Dr. WHEELER and Assistants. Three hours weekly, through the year.

A course chiefly in expository and argumentative writing. The subjects are drawn from personal experience and the students' intellectual interests and reading.

(Required of all entering students who have not passed a satisfactory preliminary examination in prose composition, unless they have credit for an equivalent course from another college. If proficiency is demonstrated, a student may drop the course with credit November, January or March.

English 1 C: General Course in Literature. Professor MILES and Assistants. Three hours weekly, through the year.

Representative works by major authors in the various periods of English literary history are read. While some attention is given to the types of literature, the emphasis of the course is historical. Extra work may be assigned according to the demands of the instructor. Reports are made on reading.

English 11 E. Dr. WHEELER and Assistant. One hour weekly, through the year.

A course chiefly devoted to report and letter writing and to the oral presentation of engineering data and material.

Modern Languages. Four hours weekly, through the year.

Courses are offered in French, Italian, Spanish, and German. For further descriptions the Circular of the College of Arts and Sciences may be consulted.

Beginners' courses in French, German and Spanish are given in the College for Teachers. See page 23 for regulations in regard to fees.

Elements of Economics. Three hours weekly, through the year. Section 1: Dr. EVANS; Section 2: Associate Professor MITCHELL; Section 3: Associate Professor WEYFORTH.

This course teaches the elements of the science, aiming to show the principles upon which economic society is organized and operated. Particular attention is given to the theory of value and the theory of distribution together with their application to leading economic problems. Such subjects as Money and Banking, Rent, Wages, Interest, Profits, Industrial Combinations, International Trade, are treated in the course. It is part of the purpose of the course to indicate the application of scientific principles to current economic problems.

Required of all students before graduation.

Summer Work in Engineering Practice. At least six months in first, second and third summers.

All students are required to secure employment in some type of industrial work in the summer months. Six months of approved work of this character are required for the degree of Bachelor of Engineering.

PHYSICAL EDUCATION

Dr. ABERCROMBIE

The Department of Physical Education has under its direction all the activities in Physical Training and Athletics and instruction in Personal Hygiene. The courses and work are arranged to best meet the needs of the students and it is essential that students receive due credit for the same before graduating. The course in Physical Training is required of all undergraduate students during the first two years of residence unless they elect Military Training.

The authorities of the University, recognizing the importance of adequate supervision of the physical condition and welfare of students, have placed a Doctor of Medicine in charge as Director, and the students are brought under suitable and expert advice.

It is obligatory for each entering undergraduate student to present himself to the Director of this department and undergo a careful physical and medical examination.

The class in Physical Training is conducted by competent instructors, and the work is done for the most part out of doors, on the campus. During the months of January, February and March the course in personal hygiene is given. The courses are arranged to give a fairly comprehensive training in physical education.

The physical training course itself includes physical exercises, personal hygiene, and athletics, to which are devoted three required periods a week during the academic year. Individuals regularly exercising on official team squads are credited with an equivalent amount of work on account of physical training.

In order to prevent ill-advised participation in outdoor sports and to guard against over-indulgence in training, athletic teams of the University are under the control of the Director; no student is allowed to become a member of a team unless his physical condition is satisfactory and his strength up to the required standard; and no student is allowed to be a member of or a candidate for an athletic team who is seriously deficient in his studies. See p. 67. Students with Epidermophytosis (Athlete's Foot) are forbidden to use baths or showers in common on the University campus unless they are under acceptable treatment.

Should a student elect Military Science, he is required to follow the work prescribed by the War Department of the United States Government. This does not preclude his taking an active part in athletics, but on the contrary he should supplement his military training by other work in the line of physical training or sports.

Schedule 1934-35

Physical examinations for members of the football squad will be conducted previous to September 30; and for others, daily (except Friday and Saturday) at 3.00 o'clock, fourth floor, south wing, Gilman Hall,

October 2 to October 31. These examinations are required of all students in their first and second years of residence, those enrolled in Military Training, and those who intend to compete for any athletic team. Students will receive appointments for examinations the day of registration. Those students entering school late will receive their appointments for examination at 407 Gilman Hall.

The physical training class will meet on the campus November 1, at 4.10 p. m., and continue every Monday, Tuesday and Thursday until December 18, resuming January 3, and continuing through March.

Lectures in Hygiene will be given in Remsen Hall, Room 1, at 4.10 p. m. on dates announced for the Physical Training class.

Athletic teams meet according to schedules arranged by the team officials.

RESERVE OFFICERS' TRAINING CORPS DEPARTMENT OF MILITARY SCIENCE AND TACTICS

Major MCKINNEY

Captain COFFIN

Lieutenant PIRKEY

PURPOSE

The primary purpose of the Reserve Officers' Training Corps is to provide officers for the Reserve Corps. The Reserve Corps is the largest of the three component parts of the Army of the United States. This purpose is accomplished by providing for students a systematic course of military training at educational institutions. An effort is made to attain this object while students are pursuing their general or professional studies, with the least practicable interference with such work. The methods employed are designed to fit them physically, mentally, and morally, for pursuits of peace as well as of war.

TIME REQUIRED

Students devote four hours per week to this work. During the first and second years there are two one-hour periods per week spent in the classroom; one of these is a lecture period for which no preparation is required, and the other is a recitation period for which preparation is necessary. The remaining two hours are devoted to infantry drill and other practical work. During the third and fourth years two hours are spent in the classroom, one hour in outside work on special military engineering problems, and one hour is devoted to infantry drill.

CREDIT

In the first year, Military Science 1 can be taken in lieu of modern foreign language and Physical Training. In the second year, Military Science 2 may be taken in lieu of English and Physical Training or a modern foreign language and Physical Training. For the third and fourth year no credit is given.

AGREEMENT

Each student who desires to enroll in the Military Department must sign an agreement with the Government to continue the course for two academic years. At the end of this time, if he desires to continue his military work, he may sign another agreement for two more years, provided that he is selected by the President of the University and the Professor of Military Science and Tactics.

Students who elect to take the advanced course obligate themselves to attend one summer camp, usually at the end of the junior year. The Government bears the entire expense of these camps. In addition the students are paid a reasonable sum for each day spent in camp.

COMMUTATION OF SUBSISTENCE

Each student who elects to take the advanced course is paid commutation of subsistence during the entire two years.

UNIFORM

Members of the R. O. T. C. must appear in proper uniform at drill. A uniform is furnished free to each student by the government. The uniforms must be kept in good condition by the students and returned at the end of each academic year.

COMMISSION

The students completing the advanced course are eligible for selection by the President of the University and the Professor of Military Science and Tactics to receive commissions in the Officers' Reserve Corps and thereby become directly identified with the military establishment of the nation.

OUTLINE OF COURSES

First Year Basic. Two hours classroom and two hours practical work each week through the year.

Subjects

Infantry Drill Regulations: Instruction is given in the school of the soldier, squad and platoon, in close and extended order drill. The ceremonies of parade, guard mount, inspection and review are also practised.

The purpose of the training, besides teaching the mechanism of handling bodies of men in close and extended order, is to cultivate a spirit of team work and cooperation.

Infantry Weapons: A general course covering the characteristics of the rifle, automatic rifle, machine gun, one pounder and Stokes mortar.

Marksmanship, Rifle: The student is taught not only how to handle and shoot a rifle, but how to teach others to do so. An indoor gallery range for small-bore rifles makes gallery practice possible throughout the entire year.

Physical Training: This course is conducted in conjunction with the Department of Physical Education of the University. By calisthenics, athletics, and mass games, an effort is made to improve the physique of all students. Lectures on personal hygiene are given, with the object of improving the living conditions of all who pursue the course.

Military Courtesy: The course in military courtesy is in the form of lectures given throughout the year. It covers that form of courtesy that is peculiar to military life, and at the same time is useful to men in any walk of life.

Military Hygiene and First Aid: Instruction is given in personal hygiene, the care of men in groups, proper sanitary field measures, and the application of first aid for the injured or sick.

Military Bridges: A basic course in rigging, including knots and lashings.

The National Defense Act: To acquaint the student with the provisions of the National Defense Act and the mission of the R. O. T. C. in the military system.

Military History and Policy: A short lecture course covering the salient features of these subjects.

Second Year Basic. Two hours classroom and two hours practical work each week through the year.

Subjects

Military Field Engineering: This course covers the tactics of the squad, section, platoon and company in defense and the organization of defensive positions to include the combat group, strong point and center of resistance.

Infantry Drill: The objects and scope of the course are the same as for First Year Basic. Emphasis is placed on training in leadership, and, to that end, second year students are appointed to the grades of corporals and privates first class, according to proficiency shown during the first year.

Musketry: The purpose of this course is to give training in teamwork in the application of infantry fire. Students acting as leaders will apply, adjust and direct the fire of their squads against enemy targets. While most of this course is given theoretically, $1\frac{1}{2}$ hours practical work per week is devoted to the more important features. Some landscape target firing is conducted on the gallery range.

Military Explosives and Demolitions: A short course covering the characteristics, use and care of ordinary explosives and the computation and location of charges for demolition.

Combat Principles: The study of tactics is commenced during this year, embracing the tactical handling of small units to include the platoon in both offense and defense. The applicatory system of problems is largely used.

Map Reading: The instruction given is that necessary to enable the student to read maps with facility.

Physical Training: This is a continuation of the course outlined under First Year Basic.

Scouting and Patrolling: Theoretical and practical instruction in the duties of a member of a patrol and a scout in small tactical exercise.

First Year Advanced. Two hours classroom, one hour outside work on special military engineering problems, and one hour practical work each week through the year.

Subjects

Infantry Drill: The Rifle Platoon: During this year the student is appointed a sergeant, and is given further work to develop leadership. He is taught to train a platoon in close and extended order drill.

Military Field Engineering: An extension of the sophomore course embracing the organization of defensive positions, emplacements for artillery and automatic weapons, deep shelters, water supply, roads and railroads, camouflage, etc.

Military Bridges: This course covers briefly the characteristics and use of fixed and floating bridges, both improvised and standard types, and includes heavy, light and foot bridges. The general considerations governing the location of stream crossing are included in this course.

Military Roads: The types, location, construction and use of military roads are included and special attention is devoted to the subjects of traffic control and maintenance.

Aeroplane Mapping: The methods used in making military maps from aeroplane photographs.

Combat Principles: Continuation of the course to include the tactics of the section and platoon in offense and defense.

Military Sketching and Map Reading: The instruction given is that necessary to enable the student to read maps with facility, and to make road, outpost and area sketches.

Physical Training: This is a continuation of the courses outlined under First Year Basic.

Second Year Advanced. Two hours classroom, one hour outside work on special military engineering problems, and one hour practical work each week through the year.

Subjects

Infantry Drill: As a cadet officer the student is required during this year to assist in the instruction of the first three classes in the courses outlined above. He is afforded an opportunity to drill a company in close order, and to instruct and lead a platoon in extended order drill. Men in this class are employed as instructors of machine guns, howitzer and trench mortar squads.

Combat Principles: By practical work with small infantry units of underclassmen and by map or sand table problems to include the battalion, the principles of combat are demonstrated and taught in this course.

Military Law: This course embraces the general provisions of the Manual of Courts Martial, including the procedure of courts martial and the duties of members thereof, the means of disciplinary action and their application in a company. Detailed study is made of the Articles of War and their application to the most common offenses.

General Construction in War: Economic principles of construction in peace and war; plans and layouts for camps and cantonments, barracks, hospitals, warehouses, wharves, railway terminals, etc.

Military History of the United States: Through a series of lectures, the class is acquainted with the following phases of this subject; the sources of authority for our military establishment, the development of the military resources of the United States, the state of national preparedness for war at critical periods in the past, the cost of wars in relation to unpreparedness, and the need for national organization. The study of several important battles is taken up with some attention to detail.

Administration: A course of study and lectures on the duties of a company commander. The provisions of regulations and orders on the supply, mess, discipline and organization of a company. A survey of the records of the organization and the manner in which they are kept.

Organization and Duties of Engineers: (a) Organization of General and Special Engineer troops, and (b) The Corps of Engineers and its duties in peace and war. Operations of an Engineer unit in an Infantry Division in combat. Staff relations of Engineers with reference to military commanders and technical and supply services. River and harbor work, mapping, seacoast fortifications, etc.

Physical Training: This is a continuation of the work of preceding years, with the student acting as instructor.

Military Bridging: Practical problems in location and construction of military bridges.

Defense Against Chemical Warfare: To give an elementary knowledge of chemical material, and defense against chemical agents.

GENERAL INFORMATION AND REGULATIONS

1. *Committees.*

(a) The general control of the School of Engineering is vested in the Advisory Board, appointed by the Trustees, and consisting of the President of the University, the professors of Engineering, and certain professors of allied subjects. (See page 10.)

(b) The Board of Engineering Studies acts for the Advisory Board on all questions pertaining to undergraduate instruction.

(c) The Curriculum Committee, appointed by the President of the University from the members of the Board of Engineering Studies, has for its responsibility the discussion of the curriculum and the recommendations of this committee are submitted to the Board of Engineering Studies for its approval.

(d) The Executive Committee, appointed by the President of the University from the members of the Board of Engineering Studies, has authority in regard to all student matters such as marks, reinstatement, recommendations for graduation, recommendations concerning members of the teaching staff and any other matters referred to it by the Board.

2. *Advisers.*

(a) Each student upon admission is assigned to a member of the Faculty, who acts as his Adviser and endeavors to establish with him relations of friendliness and confidence.

(b) The Adviser of each student confers with him and enrolls him in the courses to be taken.

3. *Enrollment.*

(a) Enrollment of all students must be made on one of the three days specified on page 26.

(b) Students must report to their advisers immediately after enrollment and at the beginning of the second term.

(c) Every student must enter, not later than October 15th, his schedule of hours, on his enrollment card, at the Registrar's Office.

4. *Courses.*

(a) The regular courses of study required in each branch of Engineering are given on pages 29 to 53.

(b) A student who is permitted to change his schedule, must at once report such change to the Registrar on a form provided for this purpose, which must be signed by the Adviser, the Assistant Dean, and the Instructors of the courses involved. This form may be secured from the Adviser. Dropping a course without approval

and without notice to the Registrar will be counted as a failure. Dropping a course after an informal report indicating failure has been received is also counted as a failure.

5. *Limitations upon the Number of Courses.*

(a) A student whose work is seriously in arrears, or who has not fully completed the entrance requirements, may not, except by permission of the Board of Engineering Studies, take the full number of prescribed courses.

(b) A student taking the full number of prescribed courses for any term is not allowed to take any additional course, except by consent of his Adviser and subject to the approval of the Board of Engineering Studies.

6. *Prerequisite Courses.*

(a) Certain prerequisites are specified under the descriptions of the respective courses in Engineering. Failure in a prerequisite course, as signified by the grade 5 or F, debars a student from admission to courses requiring the prerequisite, except by special permission of the Board of Engineering Studies. The first half-year's work in a course continuing through the year is always prerequisite to the second half of the course.

(b) Mathematics 3C and Physics 1C are prerequisite to all third-year Engineering courses.

7. *Deficiencies.*

(a) If a student has not entirely satisfied the requirements of a course, he may be given a "Conditional Failure or Condition" as signified by the mark 5.5, accompanied by a statement as to how the condition is to be absolved, as, for example "5.5 Finish incomplete work", "5.5 Re-examination". In any case, a condition is to be absolved at the discretion of the instructor in charge. A condition in the first term must be absolved before March 1st following; in the second term, before November 1st following. In case of candidates for a degree a re-examination may be given before commencement. If a condition is not absolved before these time limits, it automatically becomes 5.

(b) A student may be deficient in a course from sickness causing absence from classes or final examination. He may then receive a report of "Ill". This report can be changed later to a definite mark for the term when the deficiency is removed. In case no mark is reported within 30 days after "Ill" is reported, a grade of 5.0 will replace the "Ill", except when a further delay is made necessary owing to prolonged sickness.

(c) A student must repeat a course in which he has failed, but he may not take, at the same time, any course to which the course

in question is a prerequisite, except by special permission of the Board of Engineering Studies.

(d) In case of absence from examination for any cause, the student must report immediately upon his return; if his excuse is accepted, he will receive a permit for an examination, which shall be presented to the instructor.

All first- and second-year students will report to the Dean of the College of Arts and Sciences; all third- and fourth-year students to the Assistant Dean of the School of Engineering.

(e) See Rule 5 (a).

(f) A fee of \$5.00 must be paid by the student for each re-examination or deferred examination. In case of absence from several examinations, due to the same cause, a single fee will cover all the examinations.

8. *Deficiencies resulting in exclusion from the University.*

(a) A candidate for the bachelor's degree who has not passed all the entrance examinations by the close of the September examination period at the beginning of his third year, ceases to be a member of the University.

(b) A student who at any time has accumulated in his record three failures, or three conditions, or any combination of these amounting to three, ceases to be a member of the University. A failure recorded on an earlier official report, which has not been absolved, counts as one of these three. In case the student desires to return to the University, he must make written application to the Board of Collegiate Studies, if he is in his first or second year, or to the Board of Engineering Studies, if in the third or fourth year, stating fully the grounds on which he asks reinstatement.

9. *Attendance.*

Punctual and regular attendance is required. Students who are unduly absent from any course are subject to a failing grade at any time before the end of the course, at the discretion of the instructor.

10. *Examinations.*

Examinations of all classes are held about the first of February and at the close of the academic year. These examinations are based upon the work of the preceding term, and the time allotted is as follows: in a three- or four-hour course, three hours; in a one- or two-hour course, two hours. Laboratory examinations may be conducted during the last laboratory period of each term.

11. *Reports.*

(a) Each instructor files with the Registrar at the close of each examination period official reports of the standing of his students.

These reports are based upon the regular exercises and the examinations, and are made in terms of the system described under Rule 12.

(b) In case of illness resulting in absence from classes or final examination, "Ill" is reported (see Rule 7 (b)).

(c) The grade 5.5 signifies a condition. (See Rule 7(a)).

(d) Informal reports on the standing of every student are made by the instructors to the Registrar about December 1 and March 15.

(e) Official reports of the standing of students in each course will be issued at the end of each term.

12. *Marks.*

(a) The scale of marks for official reports on third and fourth year courses is 10, 9, 8, etc. The highest mark is 10, which signifies "excellence". The lowest passing mark is 6.0. A "condition" is indicated by the mark 5.5, to be absolved at the discretion of the instructor. The mark 5.0 denotes "failure" to be absolved only by repeating the course. The word "Ill" is reported for a deficiency due to absence from illness. (See Rule 7(b)). Marks for first- and second-year courses are given in accordance with the regulations of the College of Arts and Sciences.

(b) The mark reported for an absolved failure or condition shall be entered on the student's record.

13. *Student Organizations.*

(a) No third- or fourth-year student is permitted to be a member of, or a candidate for, an athletic team, a musical or dramatic club, a debating team, or an editorial board during any term if he failed in any subject during the preceding term, unless his average standing for that term is at least "7." Students of the first and second years are subject to the regulations of the College of Arts and Sciences.

(b) No student transferring from another college shall represent this university on any athletic team or in any student activity during his first term.

(c) A student following less than three standard courses is not permitted to represent the University in any student activities.

14. *Notices.*

Students are apprised of classroom and laboratory assignments and other general information through notices on the bulletin boards.

15. *Advanced Standing.*

(a) Application for credit for engineering courses completed elsewhere should be made to the Registrar.

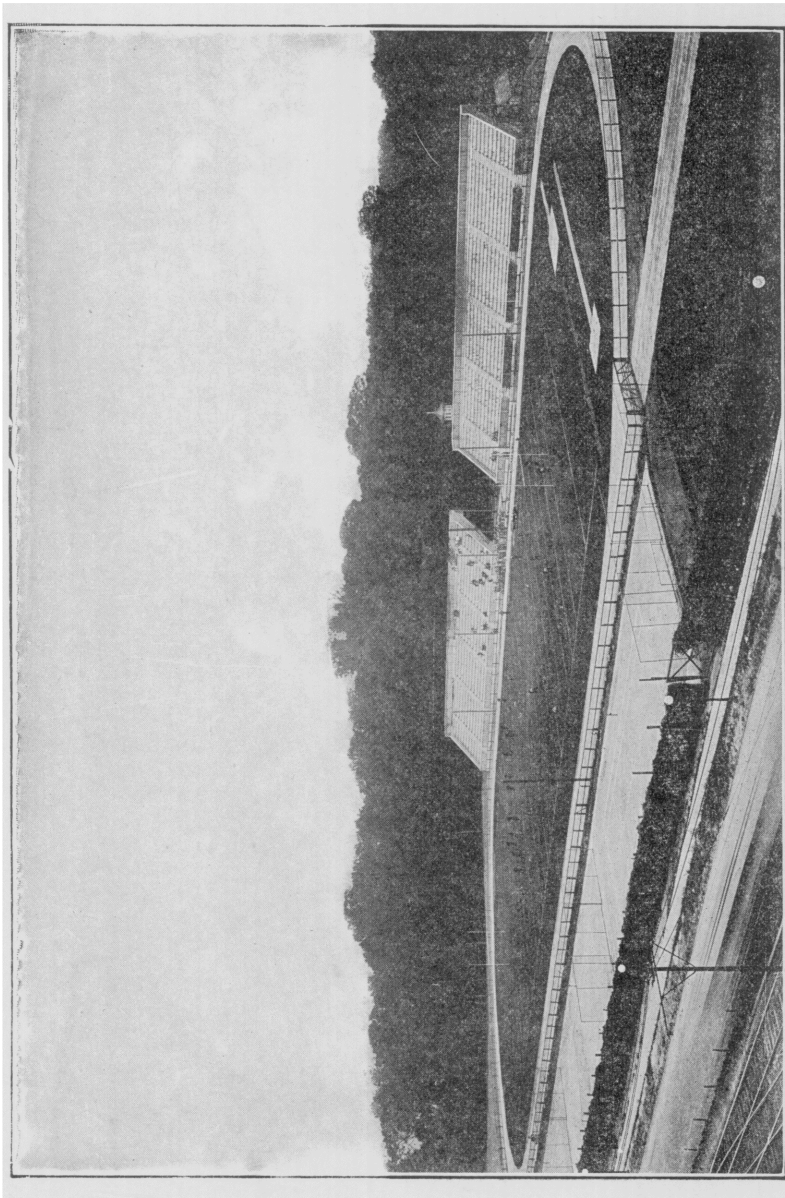
(b) See also page 16 under "Requirements for Admission to Undergraduate Courses."

16. *Transfer.*

A student wishing to transfer from one undergraduate school to another must make application upon a form obtainable from the Registrar with the approval of the Deans of the two schools and his Adviser, and must comply with such conditions as may be specified in granting the application and must make up any difference between the entrance requirements of the two schools. He may not count for graduation any course already taken which is not approved for graduation in the school he is entering.

17. *Other Regulations.*

Courses conducted by the College of Arts and Sciences are subject to the regulations of the College.



HOPKINS FIELD

SCHOLARSHIPS

SCHOLARSHIPS FOR GRADUATE STUDENTS

The University offers four scholarships to graduate students in Engineering entitling the holders to free tuition and laboratory fees. They are intended for students who have shown an interest in experimental research and who are in need of financial assistance to pursue advanced work. Applications for these scholarships should be made to the Dean of the School of Engineering before September 1.

SCHOLARSHIPS FOR FOREIGN STUDENTS

In order to encourage the international exchange of students, the Trustees have established twenty-five scholarships yielding free tuition for the benefit of foreign students. These scholarships are open to citizens of foreign countries who at the time of their application, are resident abroad. Applications must be in the hands of the President not later than March 15.

SCHOLARSHIPS IN GAS ENGINEERING

A number of gas companies throughout the United States offer special scholarships in the Department of Gas Engineering. The majority of these scholarships afford free tuition and text-books to the recipient. They are in general restricted to students residing in the territory supplied by the donating companies. Inquiries concerning these scholarships should be addressed to the Assistant Dean of the School of Engineering, Johns Hopkins University.

MARYLAND NATIONAL GUARD SCHOLARSHIPS

Two scholarships yielding free tuition are offered to undergraduate students in the College of Arts and Sciences, the School of Engineering, or the School of Business Economics, who are members of the Military Department of the State of Maryland. Applications must be in the hands of the President not later than September 15.

STATE SCHOLARSHIPS FOR UNDERGRADUATES

The legislative bill which established the School of Engineering makes liberal provision for scholarships granting free tuition to deserving students who reside in the State of Maryland.

One hundred and eight scholarships are awarded to young men from Baltimore City and the various counties of the State whose means are such that they are unable to procure a technical education unless free

tuition is granted them. In addition twenty-one scholarships are open to graduates of seven colleges of Maryland.

The scholarships are awarded so that as nearly as possible the same number of appointments in each county is made each year. For the year 1934-35 scholarships are vacant in the counties and in Baltimore City in accordance with the following list:

Allegany.....	1	Dorchester	1
Anne Arundel.....	1	Frederick	4
Baltimore	2	Garrett	0
Baltimore City:		Harford	0
First District.....	2	Howard	2
Second District.....	2	Kent	0
Third District.....	1	Montgomery	1
Fourth District.....	1	Prince George's.....	3
* Fifth District.....	1	Queen Anne's	1
* Sixth District.....	1	Somerset	2
Calvert	1	St. Mary's.....	0
Caroline	2	Talbot	0
Carroll	3	Washington	1
Cecil	1	Wicomico	1
Charles	2	Worcester	0

The total number of scholarships which may be held by the residents of the various counties and of Baltimore City, is given in the following list:

Allegany	6	Dorchester	4
Anne Arundel.....	4	Frederick	5
Baltimore County.....	6	Garrett	3
Baltimore City:		Harford	3
First District.....	6	Howard	2
Second District.....	6	Kent	2
Third District.....	6	Montgomery	4
Fourth District.....	6	Prince George's.....	4
Fifth District.....	6	Queen Anne's.....	2
Sixth District	6	Somerset	3
Calvert	2	St. Mary's.....	2
Caroline	3	Talbot	3
Carroll	4	Washington	5
Cecil	3	Wicomico	3
Charles	2	Worcester	3

COMPETITIVE EXAMINATION FOR SCHOLARSHIPS

In order to secure one of these scholarships, application must be made both for entrance¹ to the University and for scholarship² on blank forms which will be furnished by the Registrar of the University. Applications for the scholarships are considered only after the applicants have satis-

* The Legislative bill creating the scholarships limited the number to be awarded in the counties and legislative districts of Baltimore City to 108. No provision therefore was made for scholarships in the 5th and 6th legislative districts of Baltimore City, which have been created since the passage of the bill. The university will allot ordinary scholarships to residents of those two new districts up to the number of six in each, provided there are corresponding vacancies in the original number provided by the Legislative bill. No Senatorial scholarships are available in the 5th and 6th districts of Baltimore City.

¹ Application for admission should be made as soon as possible after the close of the school year. See page 16.

² Application for a scholarship must reach the Registrar not later than September 15.

fied the requirements for admission, examinations for which will be held September 17-20, 1934. Applications for scholarships must be filed prior to September 15.

When there is more than one applicant for a particular scholarship, a special competitive examination is held in Room 101, Remsen Hall, the day following the autumn entrance examinations (September 21, 1934). This examination is in Mathematics, English, and the elements of one of the four foreign languages—French, German, Spanish, Latin. The scope in each subject is that of the requirements for entrance. The examination in the three subjects covers one three-hour session.

Public announcement is made immediately of the relative standing of the applicants in the competitive examination. Each successful competitor then secures the certification of the Senator from his county or legislative district that the applicant resides in such county or district, and that his financial circumstances are such that he is unable to pursue a technical education unless free tuition be granted. The results of the competitive examination are sent to the respective Senators, together with the necessary blank forms of certification. No award of a scholarship is made until this certificate is received.

In addition to the scholarships in the above list six scholarships "At Large" are awarded to any otherwise properly qualified residents of the State of Maryland. One of these scholarships is open for 1934-35.

Three scholarships are also offered to Maryland graduates of each of the following Colleges: Loyola College, University of Maryland, Mt. St. Mary's College, St. John's College, Western Maryland College, and Washington College. The award of these scholarships is made without reference to the ability of the applicants to pay the fees, and is solely on the basis of merit as certified by the Presidents of the Colleges. Graduates of these institutions who have specialized in Mathematics and Physics or Chemistry may, as graduate students, enter a two-year curriculum leading to the degree of Bachelor of Engineering.

All the scholarships entitle the holders to free tuition, free text-books, and exemption from laboratory fees.

In each county and in the First, Second, Third and Fourth city legislative districts the Senator has the privilege of recommending one of the scholarship holders for the "Senatorial Emolument" of \$200, or other provision for defraying the cost of board and lodging. The recipient of the emolument is said to hold a "Senatorial Scholarship." Senatorial Scholarships may be awarded for 1934-35 in the Second District of Baltimore City and in Baltimore, Charles, Frederick, Howard, Queen Anne's, Washington and Wicomico Counties.

Appointments to scholarships are made for one year only. Renewals are conditional upon behavior, scholastic ability, industry, and upon the number of vacancies due to graduation or withdrawals at the end of each year.

One hundred and seven regular State scholarships, forty-seven special appointments to residents of Maryland, and five Gas Scholarships were awarded during the year 1933-34.

THE SCHOOL OF ENGINEERING *

SCHOLARSHIP HOLDERS

1933-1934

NAME	TYPE	RESIDENCE— DISTRICT OR COUNTY	YEAR
Ballard, L. W.	Ordinary	Baltimore County	Soph.
Baird, W. S.	St. John's		Grad. St.
Barker, H. H.	Ordinary	Allegany County	Fresh.
Beachley, R. W.	Wash. College		Grad. St.
Bittrick, W. E.	At Large		Soph.
Bottom, S. D., Jr.	Ordinary	Baltimore County	Fresh.
Brian, J. M.	Ordinary	Anne Arundel Co.	Senior
Brown, J. D.	Ordinary	Second District	Senior
Buck, G. S., Jr.	Ordinary	Baltimore County	Junior
Bullock, J. B.	Ordinary	Sixth District	Soph.
Caplan, L. R.	Senatorial	Prince George's Co.	Junior
Carroll, C. N.	Senatorial	First District	Soph.
Carter, G. M.	Gas		Junior
Church, G. B.	Ordinary	Kent County	Soph.
Claggett, T. J., Jr.	Senatorial	Talbot County	Soph.
Coan, J. M., Jr.	Senatorial	Second District	Junior
Cobb, R. B.	Ordinary	Wicomico County	Junior
Coleman, W. F.	Ordinary	Allegany County	Fresh.
Collins, O. L.	Senatorial	Dorchester County	Fresh.
Comella, W. O.	Senatorial	Kent County	Soph.
Curtis, J. R., Jr.	At Large		Junior
Donnelly, E. J.	Ordinary	Fifth District	Fresh.
Emmert, L. R.	Ordinary	Washington County	Soph.
Eppler, J. A.	Ordinary	Allegany County	Junior
Etchison, W. M.	Ordinary	Montgomery County	Fresh.
Evans, G. H.	Ordinary	Fifth District	Senior
Finkelstein, B.	Ordinary	Fifth District	Soph.
Friendlander, L.	Ordinary	Fourth District	Soph.
Friel, A. B.	Senatorial	Queen Anne's Co.	Senior
Frome, D. L.	At Large		Soph.
Gambrill, R. D.	Ordinary	Fifth District	Soph.
Gilbert, H. C.	Senatorial	Frederick County	Senior
Glasser, H. H.	Ordinary	Fourth District	Fresh.
Gresko, J. S.	Senatorial	St. Mary's County	Soph.
Grove, V. C., Jr.	Ordinary	Third District	Fresh.
Hager, P. B.	Ordinary	Washington County	Junior
Hall, F. B.	At Large		Soph.
Hatfield, E. J.	Ordinary	Anne Arundel Co.	Soph.
Hayden, J. G.	Senatorial	Allegany County	Junior
Henry, B. R.	Ordinary	Dorchester County	Fresh.
Hernick, P. W.	Senatorial	Cecil County	Junior
Hoffman, J.	Ordinary	Sixth District	Fresh.
Holtzman, P. T.	Ordinary	Second District	Junior
Hooke, A. C.	Ordinary	Second District	Fresh.
Houck, D. H.	Ordinary	Wicomico County	Junior
Jackson, J. M.	Ordinary	Cecil County	Junior
Jahns, F. W.	Senatorial	Second District	Senior
Jay, T.	Gas		Fresh.

* This list includes also awards of Gas Engineering Scholarships.

NAME	TYPE	RESIDENCE— DISTRICT OR COUNTY	YEAR
Johnson, G. D.	St. John's		Grad. St.
Kern, W. E.	Ordinary	Frederick County	Junior
King, J. M.	Ordinary	Garrett County	Soph.
Koenig, W. C.	Ordinary	Dorchester County	Fresh.
Kohlerman, F. L.	Ordinary	Fifth District	Junior
Kowalski, E. W.	Ordinary	First District	Soph.
Kramer, I. R.	Ordinary	First District	Junior
Lang, M. T.	Ordinary	Sixth District	Senior
Lee, H. B.	Senatorial	Baltimore County	Senior
Levin, P.	Ordinary	First District	Senior
Lotz, E. L.	St. John's		Grad. St.
Lusby, G. C., Jr.	Senatorial	Calvert County	Fresh.
McGuire, R. J.	Ordinary	Sixth District	Junior
MacClarence, J.	Ordinary	Third District	Soph.
MacMurray, L. C.	Senatorial	Garrett County	Junior
Markell, G. E.	Ordinary	Talbot County	Soph.
Marshall, T. H., Jr.	Senatorial	Harford County	Junior
Merrill, C. J.	Senatorial	Worcester County	Junior
Miller, E. C.	Senatorial	Carroll County	Junior
Mitchell, G.	Senatorial	Howard County	Senior
Mitchell, R. L.	Ordinary	Third District	Senior
Moravek, J. L.	Ordinary	Second District	Junior
Murray, A. H.	Ordinary	Baltimore County	Senior
Neu, W. H.	Ordinary	Harford County	Junior
Noweck, H. E.	Ordinary	Third District	Soph.
Nye, L. B., Jr.	Gas		Senior
Orem, S. R., Jr.	Ordinary	Talbot County	Fresh.
Pasarew, R.	Ordinary	Sixth District	Soph.
Payne, J. B.	Ordinary	St. Mary's County	Fresh.
Peale, W. O.	Ordinary	Fifth District	Fresh.
Ponkow, J. E.	Ordinary	Second District	Soph.
Powers, J. W.	Ordinary	Allegany County	Soph.
Regnier, R. C., Jr.	Senatorial	Fourth District	Junior
Reinoldi, C.	Ordinary	Third District	Fresh.
Reitze, W. J.	Ordinary	First District	Senior
Reynolds, P. W.	Ordinary	Sixth District	Soph.
Richardson, O. E.	Senatorial	Wicomico County	Senior
Riley, F. C.	Ordinary	Worcester County	Fresh.
Ryan, E. J.	At Large		Junior
Sachs, S. R.	Ordinary	Queen Anne's Co.	Fresh.
Schlotterbeck, R. S.	Ordinary	Washington County	Fresh.
Sholtes, C. E.	Ordinary	Montgomery County	Fresh.
Siverd, C. D.	At Large		Junior
Sklar, A. L.	Ordinary	Fourth District	Senior
Spang, J. B.	Ordinary	Harford County	Soph.
Steffey, J. G.	Senatorial	Washington County	Senior
Sterling, H. S.	Senatorial	Somerset County	Junior
Stevenson, J. H., Jr.	Ordinary	Garrett County	Fresh.
Stolberg, E. M.	Ordinary	First District	Fresh.
Strock, R. M.	Ordinary	Washington County	Fresh.
Tabler, M. C.	Ordinary	Prince George's Co.	Senior
Terry, J. N.	Gas		Senior
Thomas, D. W.	Ordinary	Anne Arundel Co.	Fresh.
Vincent, R. F.	Ordinary	Worcester County	Fresh.
Weiner, D. J.	Ordinary	Fourth District	Fresh.

NAME	TYPE	RESIDENCE— DISTRICT OR COUNTY	YEAR
Wells, H. S., Jr.	Ordinary	Fourth District	Fresh.
Whisler, F. D.	Senatorial	Caroline County	Junior
Williams, W. A.	Senatorial	Montgomery County	Soph.
Witte, W. J.	Ordinary	Baltimore County	Junior
Wobbeking, B. G.	Gas		Senior
Young, L. B.	Ordinary	Allegany County	Fresh.
Young, R. B.	Senatorial	Anne Arundel Co.	Soph.
Zepp, H. C.	Ordinary	Howard County	Senior

APPENDIX

The School of Engineering was established by the Board of Trustees of the University in the year 1912 as a result of a bill passed by the General Assembly of Maryland, January, 1912.

The bill, which follows, was approved by the Governor of the State on April 4, 1912.

THE TECHNICAL SCHOOL BILL

LAWS OF MARYLAND

January Session, 1912, Chapter 90

AN ACT providing for the establishment of scholarships in applied science or advanced technology available to the residents of this State; appropriating to The Johns Hopkins University for this purpose the sum of six hundred thousand dollars, and also the annual sum of fifty thousand dollars; and providing also a bond issue for said appropriation of six hundred thousand dollars.

Whereas, it is declared in Article 43 of the Declaration of Rights of this State, that "the Legislature ought to encourage the diffusion of knowledge and virtue, the extension of a judicious system of general education, the promotion of literature, the arts, sciences, agriculture, commerce and manufactures, and the general amelioration of the condition of the people"; and

Whereas, in furtherance of the principle so declared it is deemed advisable to extend to the people of this State the opportunities and facilities for education in applied sciences and advanced technology, and free tuition in said courses of study by adequate provision for scholarships for said purposes; and

Whereas, by resolution of the House of Delegates and the Senate, special committees were appointed to confer with the Trustees of the Johns Hopkins University for the purpose of determining the advisability of establishing at the University a school or department of applied science and advanced technology, and of providing for free scholarships in the course of study pursued therein; and said committees have favorably reported the plan therefor embodied in this Bill; Therefore,

SECTION 1. Be it enacted by the General Assembly of Maryland that the sum of six hundred thousand dollars is hereby appropriated to The Johns Hopkins University; to be paid to said University on the first day of November, 1912, or as soon thereafter as the proceeds from such sale of the bonds authorized by Section 6 of this Act shall have been received by the State.

SECTION 2. And be it further enacted, that there is hereby appropriated to The Johns Hopkins University the annual sum of fifty thousand dollars, and that the Treasurer of this State be and he is hereby authorized and directed, upon the Warrant of the Comptroller, to pay to The Johns Hopkins University the sum of fifty thousand dollars annually, accounting from January 1st, 1913.

SECTION 3. And be it further enacted, in order to better subserve the interests of this State, and to offer advantages to the young men of the counties and of Baltimore City not otherwise available to them at present, the said The Johns Hopkins University, in consideration of said appropriations made

by the foregoing Sections 1 and 2, shall establish one hundred and twenty-nine (129) scholarships entitling the holders to free tuition in said department of applied science or advanced technology, or in the courses preparatory thereto, which scholarships shall be open to the worthy young men of this State as hereafter set forth.

SECTION 4. And be it further enacted, that said scholarships shall be apportioned or allotted as follows:

First: There is hereby apportioned to the residents of each of the counties of this State and of each of the Legislative Districts of the City of Baltimore a number of said scholarships equal to the representation in or number of Delegates which such County or District may be entitled to elect to the House of Delegates at the time of the passage of this Act. Six scholarships, or scholarships at large, shall be open to the residents of this State, without reference to the County or Legislative District in which they may reside.

Only such deserving young men, whose residence in such County or District shall be bona fide, and whose means are such that they are unable to procure such technical education unless free tuition is granted them, shall be eligible for appointment to such scholarships. Whenever any vacancy shall occur in the scholarships allotted to the residents of any County or Legislative District, such fact shall be advertised by the University in a newspaper published in such County or City, and due notice given of the date, time and place of the examination for said scholarship. The list of candidates who pass the examination shall be prepared and published and their relative standing or order of merit given.

Notice of any vacancy in the scholarships at large shall be given by advertisement published in a newspaper published in the City of Baltimore, and the names of the qualified candidates and the order of their standing or merit shall be similarly published.

None of the scholarships provided for by this Section First shall, however, be awarded by the University to any candidate therefor, unless the Senator from the County or Legislative District in which such applicant resides certifies that his residence in such County or District is bona fide and that his financial circumstances are such that he is unable to procure such education without free tuition as above provided.

Whenever there are several applicants for the same scholarship all eligible under the foregoing requirements and all certified as eligible by the Senator from the County or District as above provided, that then the award of the scholarship by the University shall not be based on the standing or order of merit alone, but the merit and financial circumstances shall be considered together for the purpose of selecting the most deserving of said applicants.

Second: Three of said scholarships are apportioned or allotted to graduates of each of the following colleges: Loyola College, Maryland Agricultural College, Mount St. Mary's College, Rock Hill College, St. John's College, Washington College, Western Maryland College.

The award of scholarships to the graduates of said Colleges shall be made without regard to the ability of the applicants to pay tuition fees, and such award shall be determined solely by the scholastic standing and merit of the applicant as determined and certified by the president or other executive officer of the college of which he may be a graduate.

Third: The original and subsequent awards of scholarships shall be so arranged, so far as their number and the duration of the courses of study permit, that subsequently the same number of original awards as distinguished from renewals or reappointments shall be made each year, and so that such residents of said Counties or Legislative Districts and graduates of said Colleges may at all times hold the number of such scholarships to which they are entitled, and so that the total number of such scholarships

so held at one time may as nearly as possible be equal to, but shall not exceed, one hundred and twenty-nine scholarships.

Fourth: The holder of any scholarship hereby provided for shall be entitled to free tuition in any one of the courses in applied science or advanced technology, or the courses preparatory thereto, which may be from time to time established and defined by the University. Appointments to scholarships shall be made for one scholastic year, but the holder of any such scholarship who may in character, industry and ability conform to the standards and requirements of the University shall be entitled to reappointment or renewal of the award at the expiration of each year until the selected course of study shall have been completed; the holder of any scholarship hereby provided for shall be subject to no expense for laboratory fees, library dues, the purchase or use of books or supplies, matriculation and graduation fees, or any expense as a student at said institution.

Nothing herein contained shall in any way impair or affect the control by said University of its operation and of any of the studies pursued therein, or impair or in any way affect the power to fix the standards of scholarship required for admission to the University or for the continued prosecution of studies therein, or the examination or other methods of ascertaining or determining such fitness in scholarship or otherwise, or the power to maintain, prescribe and enforce the discipline, rules and regulations of the University.

Fifth: No distinction shall be made as to the rights and privileges or duties and obligations between the holders of said free scholarships and students who may pay the regular tuition. The holders of said scholarships shall have the same right in the selection of any of the established courses of study in applied science or advanced technology, or courses preparatory thereto, and the same privileges, facilities and service in the pursuit of said studies while in attendance at said University, and shall be equally subject to the same requirements as to scholarship, character and industry, and to the same rules and regulations now or hereafter established by the University both at the time of and in respect of the admission to such courses and during the course of study and the prosecution thereof, as the students who pay the regular tuition fee; provided that one of the scholarships herein provided for or allotted to each of the counties and each of the Legislative Districts of Baltimore City shall be known as a "Full Senatorial Scholarship" and the holder thereof shall be furnished or supplied by the said Johns Hopkins University with board, lodging, heat and light, free of expense, or in lieu thereof, at the election of the said University, be paid the sum of two hundred dollars (\$200) per school year in equal monthly installments, during the session of said University, in advance; and provided further that in awarding said "Full Senatorial Scholarships" the financial ability of the applicant, his parents, or those upon whom he depends for support shall be taken into consideration.

SECTION 5. And be it enacted, in order to provide for facilities especially adapted for the pursuit of said studies in applied science and advanced technology, said The Johns Hopkins University shall construct buildings and provide equipment necessary or appropriate for a department of applied science and advanced technology at a cost of not less than six hundred thousand dollars, said construction, equipment and expenditure shall be made from time to time as the needs of said department may require. It is the intention with reference to the scholarships awarded to the counties and the City of Baltimore, that the entrance requirements to the technical courses or courses preparatory thereto at The Johns Hopkins University shall begin where the graduating requirements of the approved high schools of this State leave off, or of the Baltimore Polytechnic Institute, and it is further provided that the officials of The Johns Hopkins University shall report to the Board of

Public Works in detail as to the expenditure of the appropriation of \$600,000 provided for in this Act.

SECTION 6. And be it enacted, for the purpose of providing funds for the payment of said sum of six hundred thousand dollars, a loan is hereby created, to be called the Technical School Loan of 1912, to the amount of six hundred thousand dollars. Said Loan shall bear date September 1st, 1912, and shall be payable as to principal fifteen years after said date, and shall bear interest at the rate of four per cent. per annum, payable on the first days of March and September in each year. Said loan and the bonds or certificates issued as evidence thereof shall be redeemable at par and accrued interest at any time after the expiration of ten years from the date thereof, and on the first day of March or September in such year. Notice of such intention to redeem shall be given by publication four times in some daily newspapers published in the City of Baltimore, the first publication to be made at least sixty days prior to the redemption date. Said loan and every part thereof and the interest payable thereon, and the certificates or evidences thereof shall be and remain exempt from State, County and municipal taxation.

The Governor, Comptroller of the Treasury, and Treasurer, or a majority of them are hereby authorized and directed to have prepared proper bonds or certificates of indebtedness of the State in good and sufficient form, to aggregate the amount of six hundred thousand dollars as evidence of such loans; such bonds or certificates of indebtedness shall bear date September 1st, 1912, and shall not be issued in less sums than one hundred dollars or some multiple thereof, each of said bonds or certificates of indebtedness shall be signed by the Treasurer of the State and countersigned by the Comptroller of the Treasury, and shall bear interest at the rate of four per cent. per annum, payable semi-annually on the first day of March and the first day of September in each year; such portion of said bonds or certificates shall be registered and such portion shall have interest coupons attached thereto, as the Governor, Comptroller of the Treasury and Treasurer, or a majority of them, shall determine.

In order to provide for the selling of the bonds or certificates of indebtedness aforesaid, to be issued under the provision of this Act, the Governor, Comptroller of the Treasury and the Treasurer of this State, or a majority of them, are hereby directed to advertise twice a week for four successive weeks between the first day of August and the fifteenth day of September, 1912, in two newspapers published in the City of Baltimore, that the Treasurer will be ready, at such date prior to September 20, 1912, and at such place or places as may be named in said advertisement, to receive bids for bonds or certificates of indebtedness issued under the provision of this Act, under such regulation as may be made in the discretion of the Governor, Comptroller of the Treasury and Treasurer, or a majority of them, and the accrued interest between the date of the bonds or certificates and the time of sale and delivery of any payment for said bonds or certificates shall be adjusted with the purchaser thereof under such regulations as may be made in the discretion of the Governor, Comptroller of the Treasury and Treasurer, or a majority of them; and upon the day mentioned in said advertisement as the day for opening the bids for the proposals thereby called for, they shall receive such sealed proposals for the purchase of the bonds or certificates of indebtedness designated in said advertisement; and on the opening of such sealed proposals, as many of said bonds or certificates of indebtedness as have been so bid for shall be awarded by the Governor, Comptroller of the Treasury and Treasurer, or a majority of them, to the highest responsible bidder or bidders therefor for cash if the prices are adequate, in the judgment of the Governor, Comptroller and Treasurer or a majority of them; and when two or more bidders have made the same bid, and such bid is the highest and the bonds or certificates so bid for by the highest responsible bidders are in excess of the whole amount of the bonds or certificates so

offered for sale, such bonds or certificates of indebtedness shall be awarded such highest responsible bidders bidding the same price in a ratable proportion. In case for any reason said advertisement for bids shall not be made at the time hereinbefore specifically provided, then the Governor, Comptroller of the Treasury and Treasurer, or a majority of them, shall as promptly as conveniently possible fix some other time for the publication of said advertisement and some other date for the receipt of bids, and shall give notice thereof by advertisement published twice a week for four successive weeks in two newspapers published in the City of Baltimore as above provided. In case any of said bonds or certificates so offered for sale are not bid for, or if any insufficient price be bid for them, they may be subsequently disposed of under the direction of the Governor, Comptroller of the Treasury and Treasurer, or a majority of them, at private sale upon the best terms they can obtain for the same; provided they shall not be sold at private sale for less than par and accrued interest.

The County Commissioners of this State and the Mayor and City Council of Baltimore are directed to levy the State taxes for the year 1913, and annually thereafter, at the rate of $\frac{3}{4}$ of one per cent. on each one hundred dollars of assessable property, until the principal and interest of said bonds or certificates shall have been paid, to be collected according to law, to meet the interest and create a sinking fund for the redemption of said loan.

SECTION 7. And be it further enacted that this Act shall take effect from date of passage.

Approved April 4, 1912.

P. L. GOLDSBOROUGH,
Governor.

JESSE D. PRICE,
President of the Senate.

[SEAL]

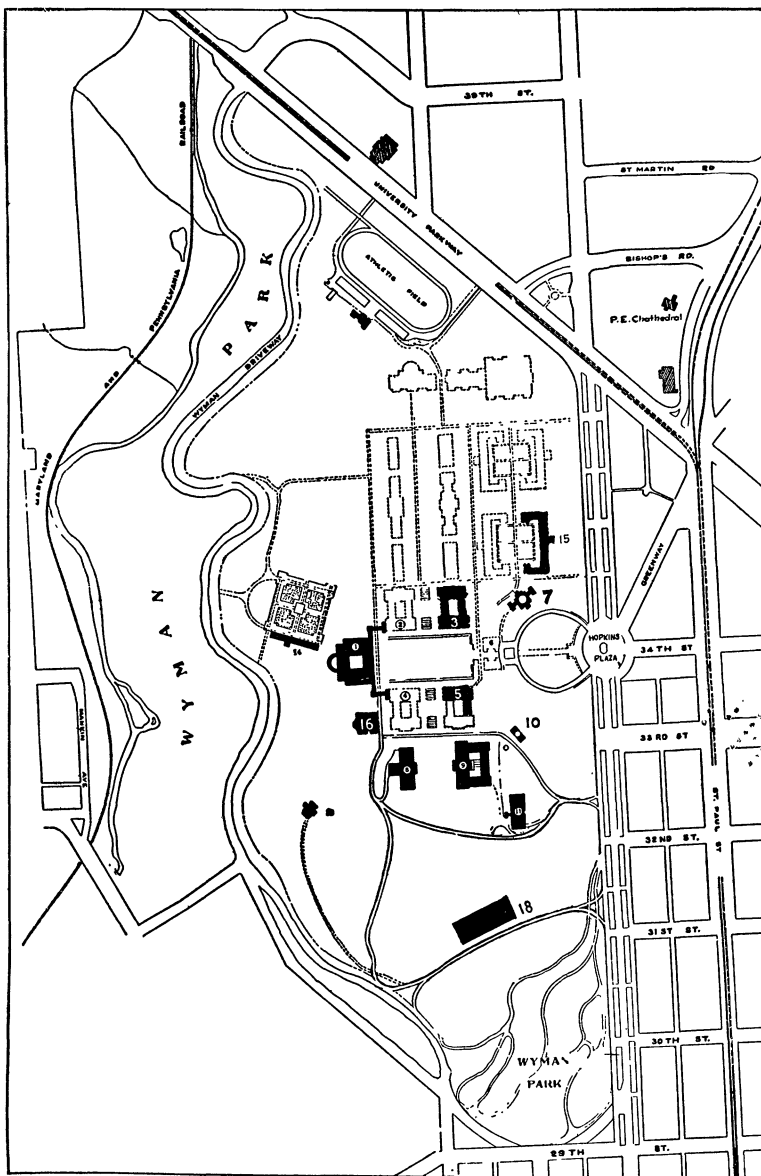
JAMES MCC. TRIPPE,
Speaker of the House of Delegates.

The Board of Trustees of the University, at their meeting on May 6, 1912, adopted the following resolutions and thereby established the School:

Resolved, That the Johns Hopkins University hereby accepts the offer of the State of Maryland to The Johns Hopkins University of six hundred thousand dollars and an annual sum of fifty thousand dollars, in consideration of the establishment of the scholarships provided in said Act, and agrees on its part to carry out the terms of said Act.

Resolved, That the Board of Trustees of the University record its appreciation of the action of the State of Maryland, in the passage of the legislation referred to, and the earnest desire and intent of the Board to cooperate with the State to secure the best results for the young men of the State, whose educational welfare will be committed to the University under the terms of the Act.

Resolved, That a copy of these Resolutions be forwarded to the Governor, the President of the Senate, and the Speaker of the House of Delegates.



PLAN OF GROUNDS AT HOMEWOOD

- | | | | |
|---|---------------------------|-------------------------|---------------------------|
| 1. Gilman Hall. | 3. Remsen Hall. | 5. Rowland Hall. | 7. Homewood House. |
| 8. Latrobe Hall. | 9. Maryland Hall. | 10. Barnstormers' Club. | 11. Power House. |
| 14. Botany and Plant Physiology Laboratory. | 15. Alumni Memorial Hall. | 16. Levering Hall. | 18. Baltimore Art Museum. |

THE JOHNS HOPKINS UNIVERSITY

BALTIMORE

FOUNDED 1876

Issues of the Johns Hopkins University Circular are published under the following titles:

SCHOOL OF HIGHER STUDIES
OF THE
FACULTY OF PHILOSOPHY
DEGREES A. M. AND PH. D.
(Open to Men and Women)

SCHOOL OF MEDICINE
DEGREE M. D.
(Open to Men and Women)

SCHOOL OF HYGIENE AND PUBLIC HEALTH
DEGREES DR. P. H., SC. D. IN HYG. AND S. M. IN HYG.
CERTIFICATES IN PUBLIC HEALTH
(Open to Men and Women)

SCHOOL OF ENGINEERING
DEGREES DR. ENG., M. ENG., B. E., AND S. B. IN CHEM.
(Open to Men)

SCHOOL OF HIGHER STUDIES IN EDUCATION
DEGREES ED. M. AND ED. D.
(Open to Men and Women)

SUMMER COURSES
TOWARDS A. M., A. B., AND S. B. DEGREES
(Open to Men and Women)

COLLEGE OF ARTS AND SCIENCES
DEGREE A. B.
(Open to Men)

SCHOOL OF BUSINESS ECONOMICS
DEGREE S. B. IN ECON.
(Open to Men)

COLLEGE FOR TEACHERS
DEGREE S. B.
(Open to Men and Women)

REPORT OF THE PRESIDENT